

COST STUDIES OF MULTIPURPOSE LARGE LAUNCH VEHICLES

VOLUME IV
BOOK A

BASELINE AMLLV COSTS
GET READY OR "A" COSTS



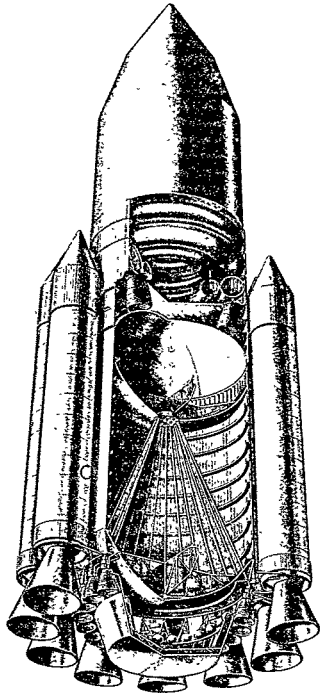
FINAL REPORT

SEPTEMBER 15, 1969

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FINAL REPORT
FOR
COST STUDIES OF MULTIPURPOSE
LARGE LAUNCH VEHICLES

BASELINE AMLLV COSTS

BOOK A OF VOLUME IV

PREPARED UNDER CONTRACT NAS2-5056
FOR
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
OFFICE OF ADVANCE RESEARCH AND TECHNOLOGY
MISSION ANALYSIS DIVISION
SEPTEMBER 15, 1969

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ABSTRACT

Nine volumes including this volume present the final report documentation outlining the accomplishments for the "Cost Studies of the Multipurpose Large Launch Vehicles" (MLLV), NASA/OART Contract NAS2-5056. This AMLLV cost volume presents the detailed costs for implementation and operation of the elements of the Advanced Multipurpose Large Launch Vehicle family (as previously defined by NASA/OART Contract NAS2-4079).

The AMLLV family will consist of a single-stage-to-orbit configuration plus other configurations consisting of a main stage (as used for the single-stage-to-orbit configuration) with various quantities of 260 inch diameter solid rocket motor (SRM) strap-on stages and/or injection stage modules. The main stage will employ LOX/LH₂ propellant with either a multichamber/plug or toroidal/aerospike engine system. The single-stage-to-orbit configuration will have a payload capability of approximately 1,000,000 pounds to a 100 nautical mile earth orbit. With the addition of the strap-on SRM stages and/or LOX/LH₂ injection stage modules, this payload capability can be increased incrementally to as much as 3,740,000 pounds.

The contract consisted of four study phases. The Phase I activity was a detailed cost analysis of an Advanced Multipurpose Large Launch Vehicle (AMLLV) family as previously defined in NASA/OART Contract NAS2-4079. Costs for vehicle design, test, transportation, manufacture and launch were defined. Resource implications for the AMLLV configurations were determined to support the cost analysis.

The Phase II study activity consisted of the conceptual design and resource analysis of a smaller or half size Multipurpose Large Launch Vehicle (MLLV) family.

The Phase III activity consisted of a detailed cost analysis of the smaller Multipurpose Large Launch Vehicle configurations as defined in Phase II. Costs for vehicle design, test, transportation, manufacture and launch were determined.

The Phase IV activity assessed the results of the study including the implications on performance, resources and cost of vehicle size, program options, and vehicle configuration options. The study results provided data in sufficient depth to permit analysis of the cost/performance potential of the various options and/or advanced technologies.

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ABSTRACT (Continued)

KEY WORDS

Advanced Multipurpose Large Launch Vehicles (AMLLV)

Half Size Multipurpose Large Launch Vehicles (MLLV)

Single-Stage-to-Orbit

Multichamber/Plug Engine System

Toroidal/Aerospike Engine System

260 Inch Solid Propellant Rocket Motor (SRM)

Orbital Injection Stage

Contract NAS2-4079

Contract NAS2-5056

Payload to 100 NM Orbit

Cost

Resources

Zero Stage Vehicles

Parallel Stage Vehicles

Main Stage Throttling

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FOREWORD

This volume, Baseline AMLLV cost, is one of nine volumes documenting the results of a twelve month study program "Cost Studies of Multipurpose Large Launch Vehicles," NASA/OART Contract NAS2-5056. The objective of this study was to define cost, cost sensitivities, and cost/size sensitivities of potential future launch vehicles to aid in the guidance of current and future technology programs. The baseline vehicles utilized to make this assessment were:

- a. The Advanced Multipurpose Large Launch Vehicles (AMLLV) as defined under NASA/OART Contract NASA/OART Contract NAS2-4079.
- b. The Multipurpose Large Launch Vehicles (MLLV) as defined under this contract and described in Volume II of this report, "Half Size Vehicle (MLLV) Conceptual Design."

The program documentation includes this "Baseline AMLLV Cost Volume," Volume IV plus a Summary Volume, a Design Volume, a Resources Volume, Cost Volumes, Cost Implications Volume, Advanced Technology Implications Volume, and Appendices Volumes. Individual designations for these volumes are as follows:

Volume I	Summary
Volume II	Half Size Vehicle (MLLV) Conceptual Design
Volume III	Resource Implications
Volume IV	Baseline AMLLV Costs
Volume V	Baseline MLLV Costs
Volume VI	Cost Implications of Vehicle Size, Technology Configurations, and Program Options
Volume VII	Advanced Technology Implications
Volume VIII	Flight Control and Separation, and Stress Analysis (Unclassified Appendices)
Volume IX	Propulsion Data and Trajectories (Classified Appendices)

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FOREWORD (Continued)

Data on the 260 inch diameter solid propellant rocket motor were obtained from the Aerojet Genral Corporation. Data on the multichamber/plug propulsion system were obtained from the Pratt and Whitney Division of the United Aircraft Corporation and the Rocketdyne Division of the North American Rockwell Corporation. Data on the toroidal/aerospike propulsion system were obtained from the Rocketdyne Division of the North American Rockwell Corporation.

These propulsion data were obtained from the propulsion contractors at no cost to the contract. The material received encompassed not only the technical data, but resources, schedules and advanced technology information. This support materially aided The Boeing Company in the preparation of a complete and meaningful study and is gratefully acknowledged.

This study was administered under the direction of NASA/OART Mission Analysis Division, Ames Research Center, Moffett Field, California under the direction of the technical monitor, Mr. Edward W. Gomersall.

This Volume IV, Baseline AMLLV costs, is the fourth of nine volumes reporting the results of the Contract "Cost Studies of Multipurpose Large Launch Vehicles." Contained in this volume are the results of the detailed cost analysis of the Advanced Multipurpose Large Launch Vehicle (AMLLV) baseline vehicle family. This cost analysis constitutes Phase I, Task 1 of the study program. Included in this task, are the non-recurring and recurring costs for implementation and launch of the baseline (AMLLV) vehicle family.

Figure 1.0.0.0-1 displays the manner in which the costs are categorized. The non-recurring costs are divided into two classifications; (1) "Get Ready Costs" or A costs, which are identified as the costs associated with getting ready to produce and operate the first production article (e.g., basic design, brick and mortar facilities, tooling, fabrication and erection, etc.) and (2) "R&D Costs" or B costs which are defined as all costs associated with the developmental testing of hardware items (e.g., static test, dynamic test, flight test, etc.). The recurring costs are identified as the "first unit" or C costs, which are defined as all the costs associated with the production and launch of the first flight vehicle.

The resource data were received from the effected working organizations in terms of required manhours, materials, tooling, equipment and facilities. Figure 1.0.0.0-2 displays these working organizations, their location relationships and the type of input data submitted. This data was developed into cost information by the addition of direct and overhead labor rates and factored items. Direct cost increments were sequentially totaled with factored indirect supporting costs. (Indirect and supporting costs include costs for quality control, program management, planning, training, structures and other program associated elements overhead and/or burdened costs and G&A). This data was then subjected to a thorough review prior to inclusion in this document to insure completeness, clarity and accuracy.

The depth of the cost reporting levels and supporting information necessitated that this cost volume be divided into three books. This book (Book A) contains the (Section 1.0) Introduction and Summary, (Section 2.0) Ground Rules and Assumptions, and (Section 3.0) Get Ready or A costs. The second book (Book B) contains the (Section 4.0) Development Testing or B costs. The remaining book (Book C) contains the (Section 5.0) First Unit or C costs. Figure 1.0.0.0-3 shows the relationship of the three books described above to their proper section of the Volume IV documentation. Further, each of the sections is subdivided into the areas of index, introduction, single stage vehicle costs, etc., as shown in the right hand portion on this figure. Each of the Book A through C costs are subdivided in the same manner to facilitate understanding of the method of reporting the cost data and to provide comparable cost elements.

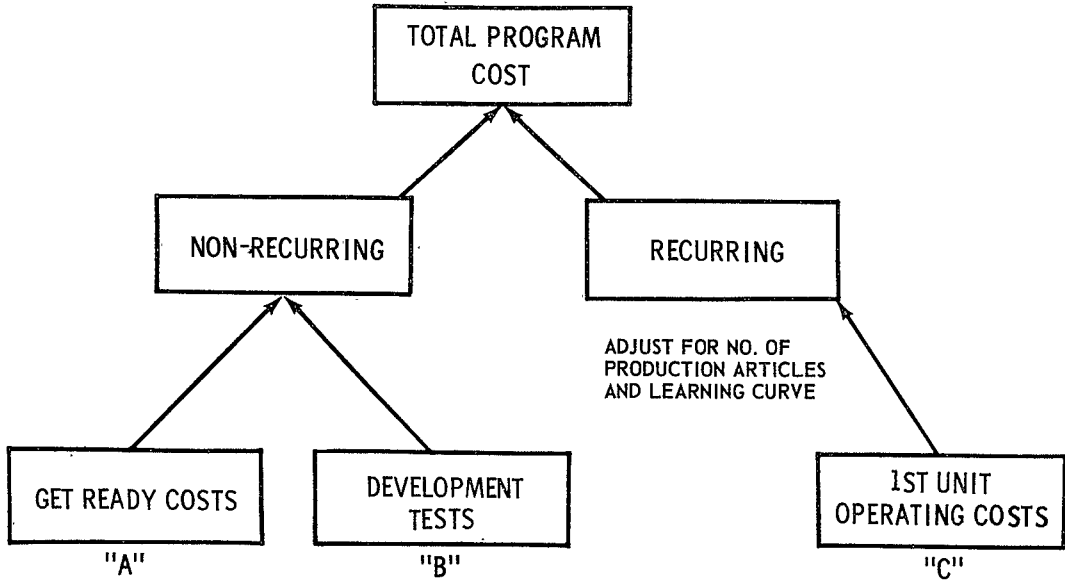


FIGURE 1.0.0.0-1 METHOD OF COST CATEGORIZATION

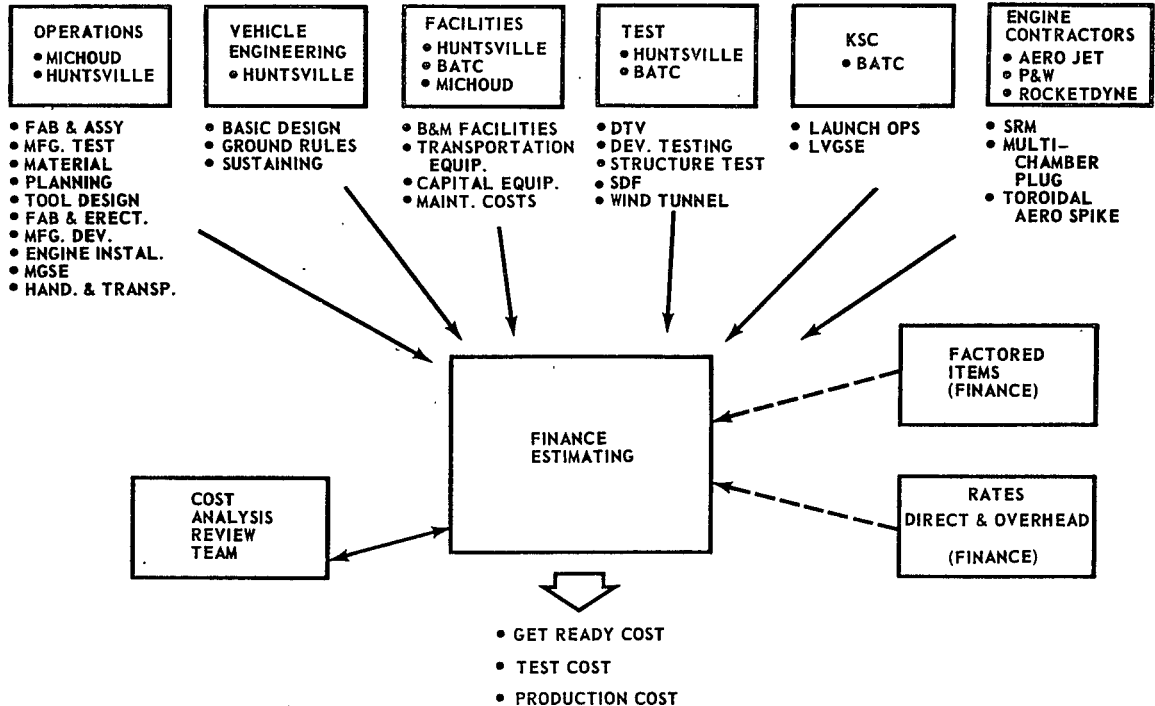
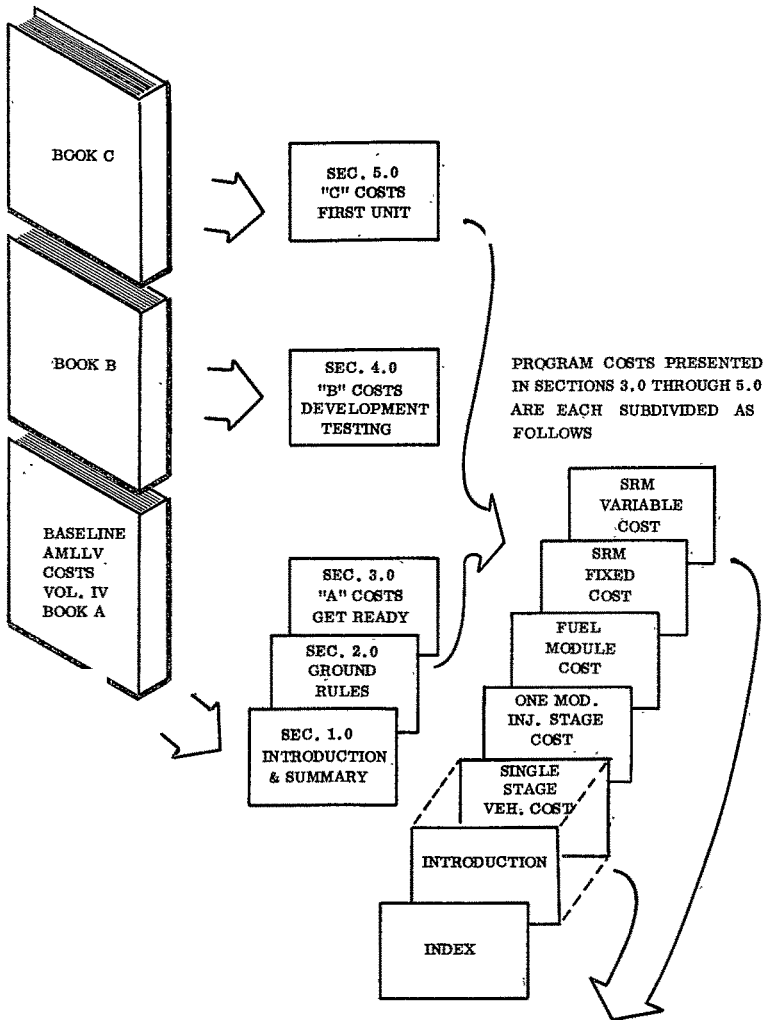


FIGURE 1.0.0.0-2 COST COLLECTION, TABULATION, AND ESTIMATING FLOW DIAGRAM



NOTE:

THE SECTION FOR EACH VEHICLE COMPONENT HAS A FLOW DIAGRAM THAT DISPLAYS THE DEPTH, COST AND LOCATION OF ALL APPROPRIATE DETAILS

FIGURE 1.0.0.0-3 REPORTING OUTLINE FOR VOLUME IV, BASELINE AMLLV COSTS

With the A, B, and C costs shown in these three books of Volume IV, the total program costs for the selected baseline AMLLV family are presented in a modular form which permit the determination of the cost of any desired phase, element or category of the baseline AMLLV family cost. This is illustrated in Figure 1.0.0.0-4. With this detailed breakdown of costs, it is possible to determine what impact these costs have on total program costs or it is possible, through substitution, to insert revised or amended cost data in place of the existing data.

An example of how the cost data can be used is illustrated by the "PIE" charts contained on Figures 1.0.0.0-5 through 1.0.0.0-7 which display the "A", "B" and "C" costs by program element, for the AMLLV single-stage-to-orbit vehicle. These charts give a clear graphic picture of each major element cost impact on the total program cost. For example, in Figure 1.0.0.0-7, the AMLLV single-stage-to-orbit first unit cost by element is shown. The systems cost is 18.2 percent of the total vehicle cost. Further analysis of the systems cost is shown in the lower left hand pie chart. The propellant/mechanical systems are 64.2 percent of the systems cost. Examining this cost in more detail shows that its major cost element is the contract end-item, which is 94.5 percent of the total cost. The contract end-item is then divided into its cost by component as shown in the lower right hand pie chart. The major cost element is the material cost, 52.2 percent. The material cost of the vehicle system is, therefore, $52.2 \times 94.5 \times 64.2 = 31.7$ percent of the systems cost or 5.7 percent of the total vehicle cost. Similar comparisons of other elements will permit identification of their costs as a percentage of the total costs. With this data available, the desirability of a change (based on cost only) can be readily analyzed. High cost elements can be identified and emphasis can be placed upon these areas for further study.

Figure 1.0.0.0-8 through 1.0.0.0-10 display the "A", "B" and "C" costs by cost categories for the AMLLV single-stage-to-orbit vehicle. These charts display the costs by categories such as tooling, engineering, quality control, etc., rather than by elements. These charts can be used to determine where cost driving categories are and indicated areas where further study should be undertaken to reduce costs.

Figures 1.0.0.0-11 through 1.0.0.0-13 summarize the complete "A", "B" and "C" costs. These cost flow diagrams indicate the costs of components and/or operations related to the various vehicle stages and identify the applicable sections of this volume in which the detailed costs can be found. The "B" cost flow diagram is repeated in Book "B" and the "C" cost flow diagram is repeated in Book "C" to facilitate understanding of the method of presenting the cost data.

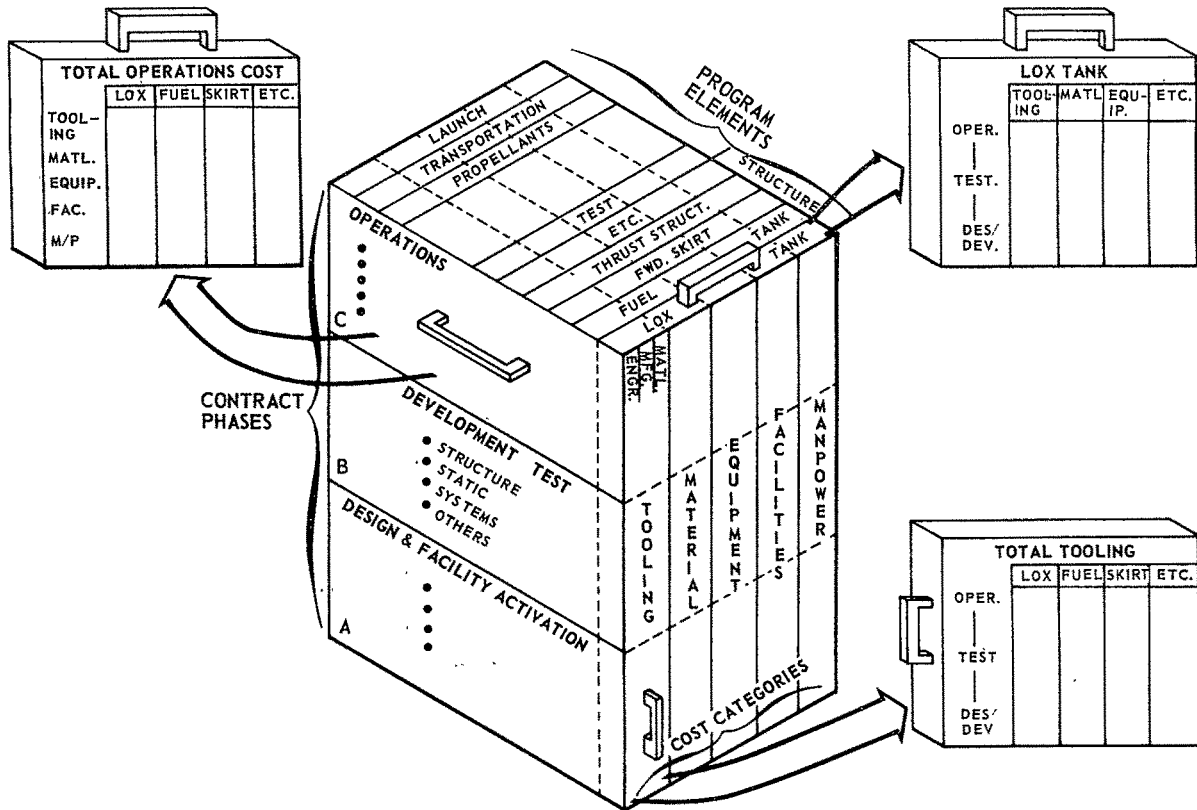


FIGURE 1.0.0.0-4 SCHEMATIC OF MODULAR COST DATA DEVELOPED FOR COST REPORTING

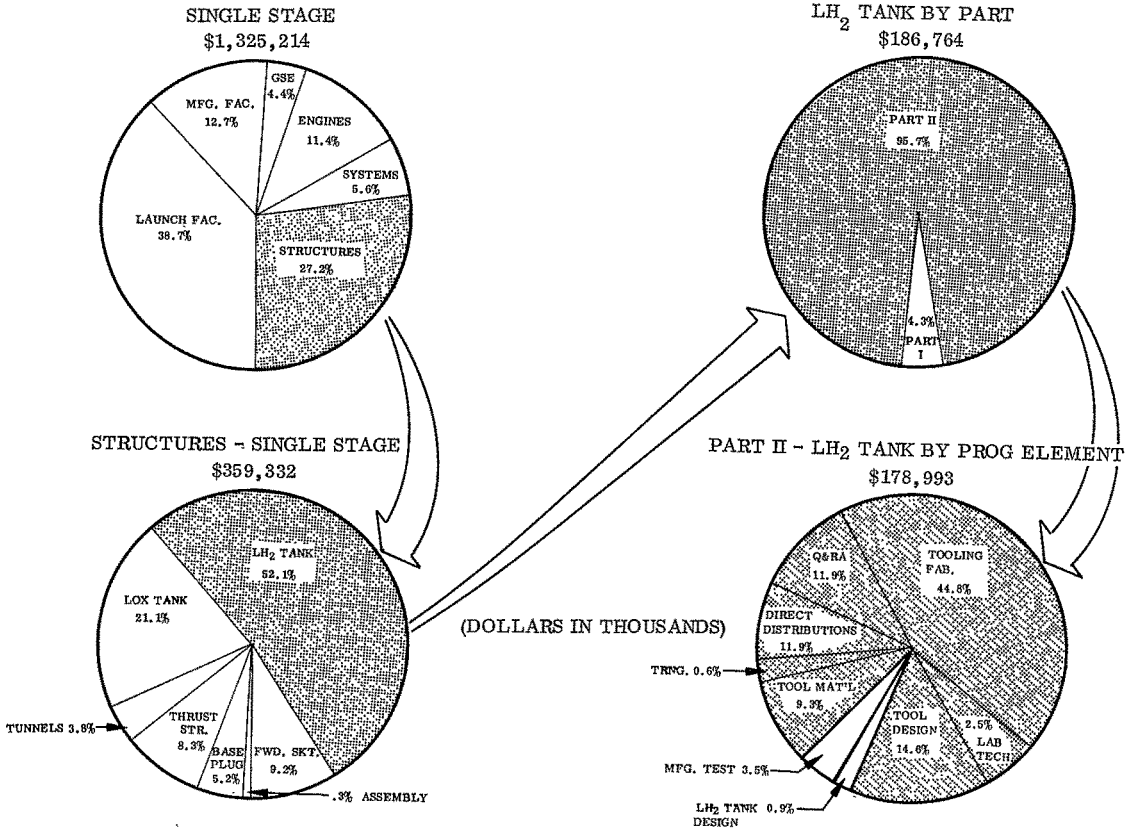
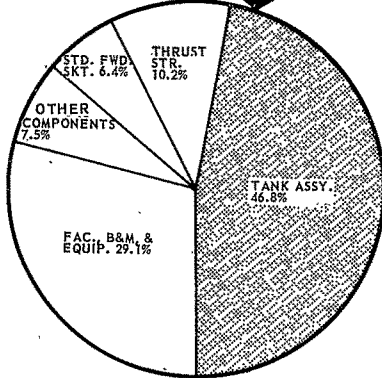
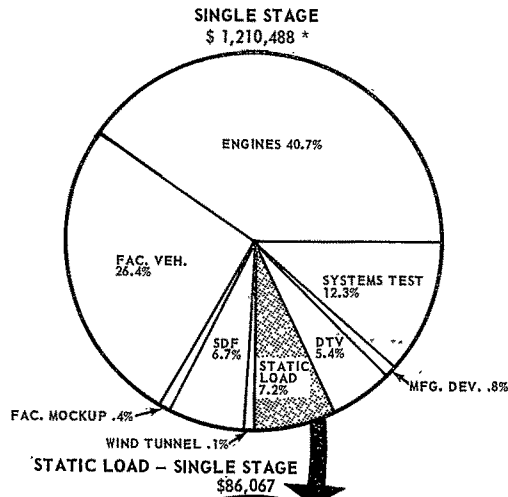
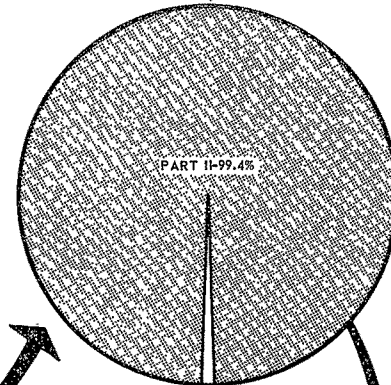


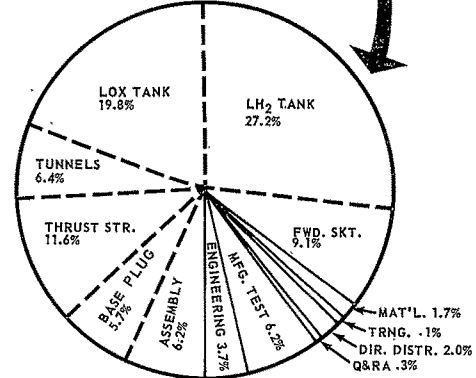
FIGURE 1.0.0.0-5 AMLLV SINGLE STAGE VEHICLE GET READY OR "A" COST BY PROGRAM ELEMENT



TANK ASSY. - STATIC LOAD BY PART
\$40,206



PART II - TANK ASSY. BY ELEMENT
\$39,985



(DOLLARS IN THOUSANDS)

EXCLUDES R & D FLIGHTS
FROM " B " COST

FIGURE 1.0.0.0-6 AMLLV SINGLE STAGE VEHICLE DEVELOPMENT TEST OR "B" COST BY PROGRAM ELEMENT

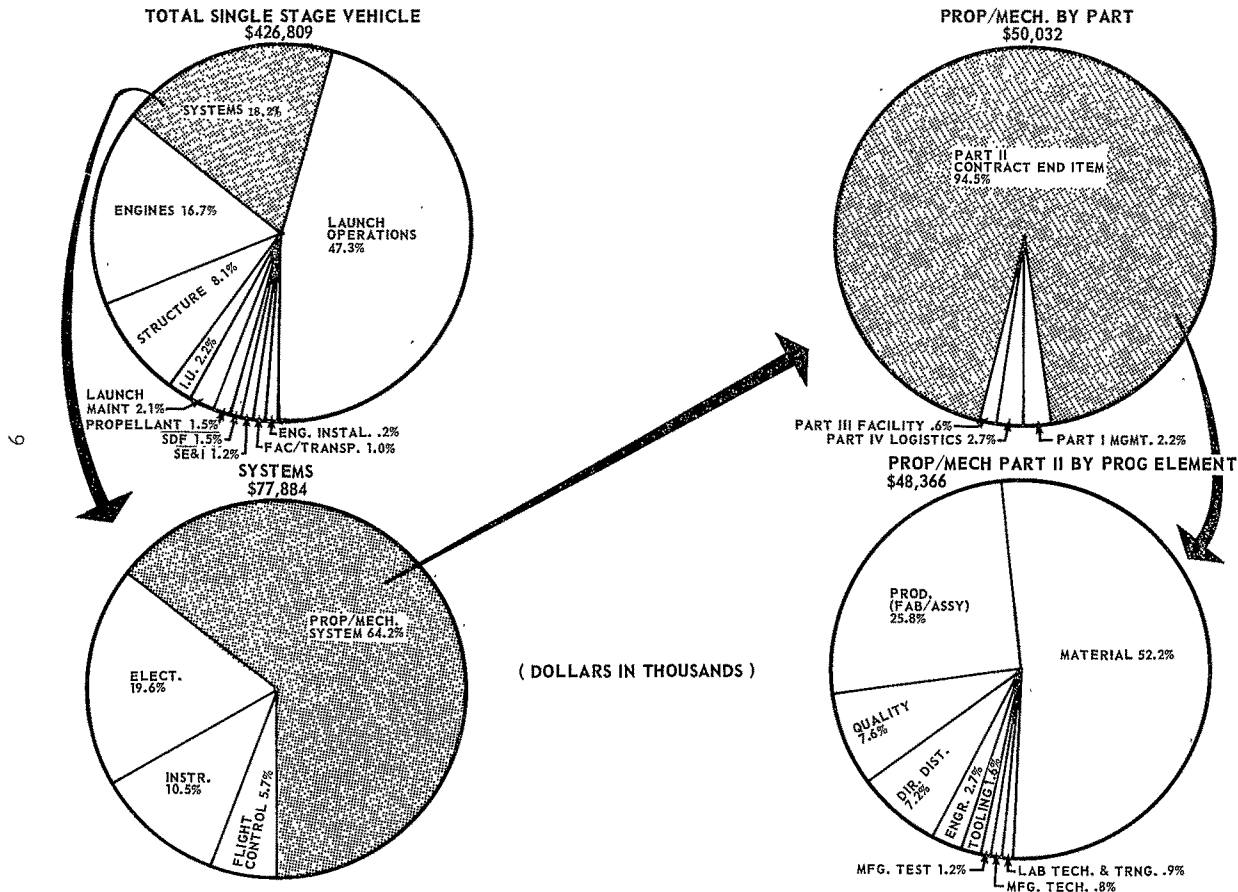
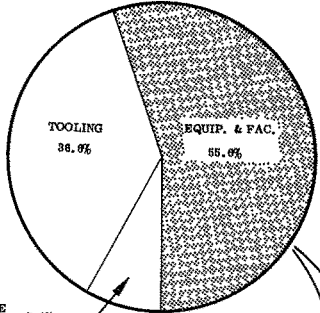
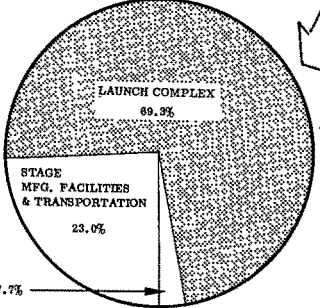


FIGURE 1.0.0.0-7 AMLLV SINGLE STAGE VEHICLE FIRST UNIT (1ST R&D FLIGHT TEST) COST OR "C" BY PROGRAM ELEMENT

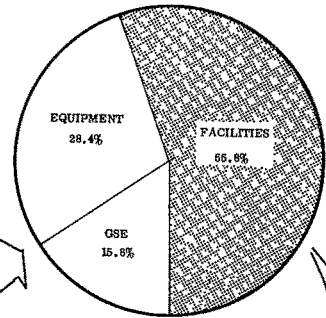
TOTAL SINGLE STAGE VEHICLE
\$1,325,214



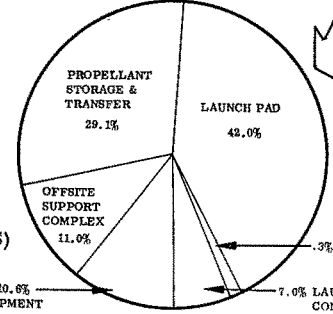
EQUIPMENT AND FACILITIES
\$739,887



LAUNCH COMPLEX
\$512,047



LAUNCH COMPLEX FACILITIES
\$285,683



(DOLLARS IN THOUSANDS)

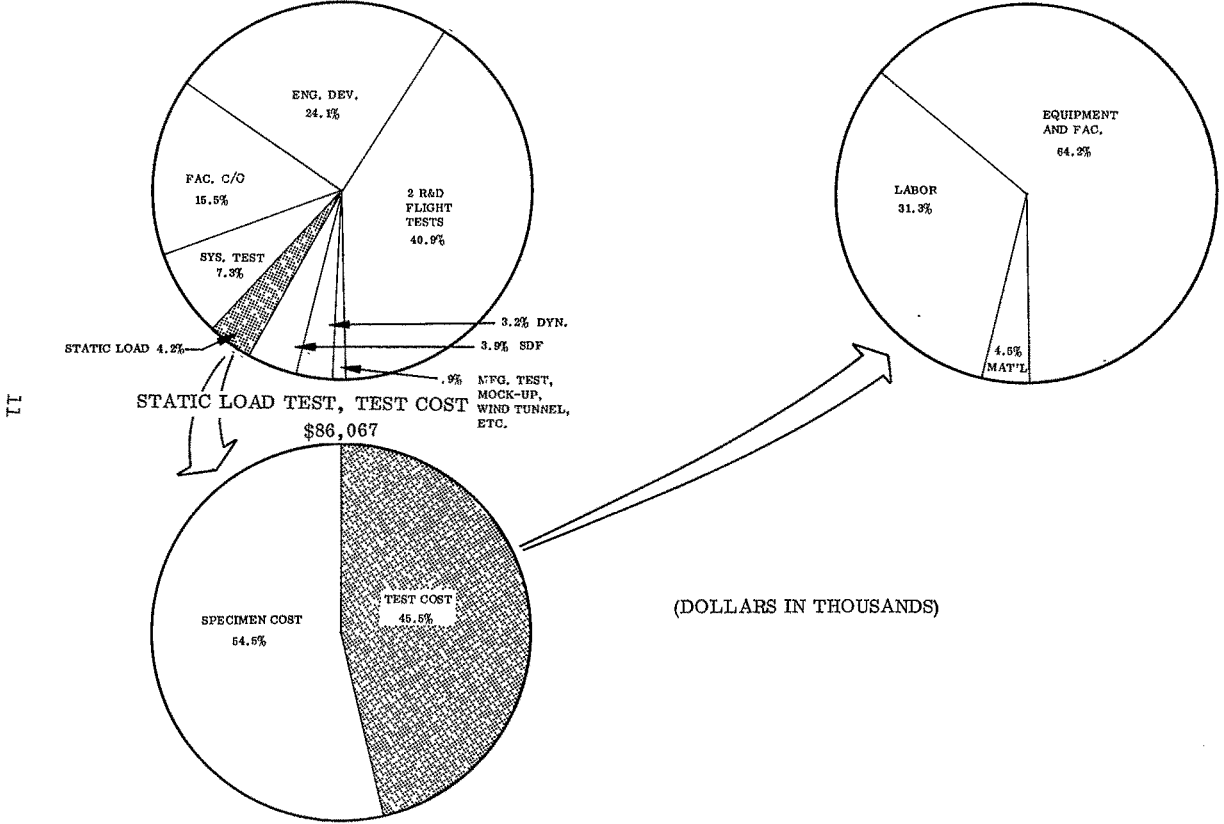
-.3% STAGE STORAGE TEST & C/O FACILITY

10

FIGURE 1.0.0.0-8 AMLLV SINGLE STAGE VEHICLE GET READY COST BY COST CATEGORIES

TOTAL COST TOTAL SINGLE STAGE VEHICLE
\$2,047,223

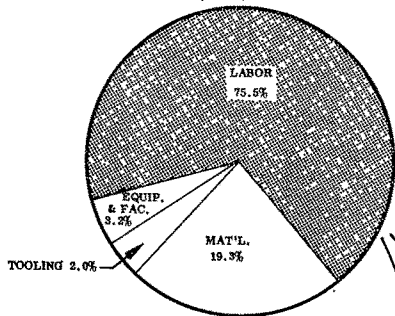
STATIC LOAD TESTS
\$39,133



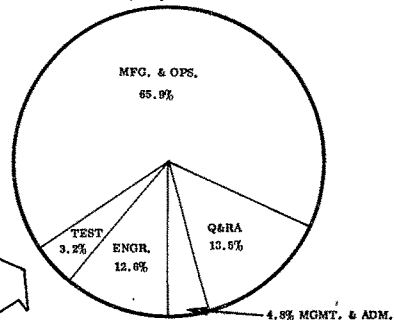
(DOLLARS IN THOUSANDS)

FIGURE 1.0.0.0-9 AMLLV SINGLE-STAGE-TO-ORBIT DEVELOPMENT TEST COST BY COST CATEGORIES

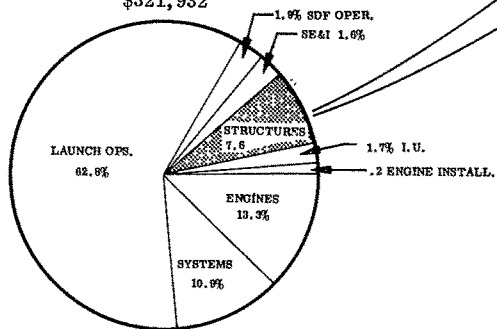
TOTAL SINGLE STAGE VEHICLE
\$426,809



STRUCTURES LABOR
\$24,283

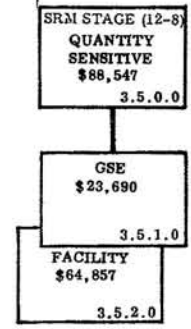
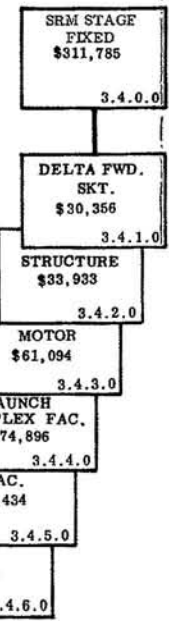
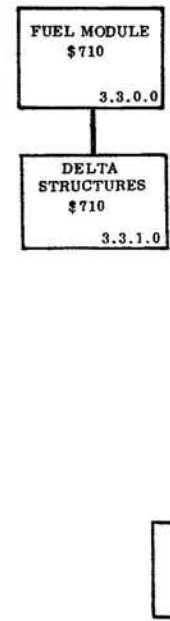
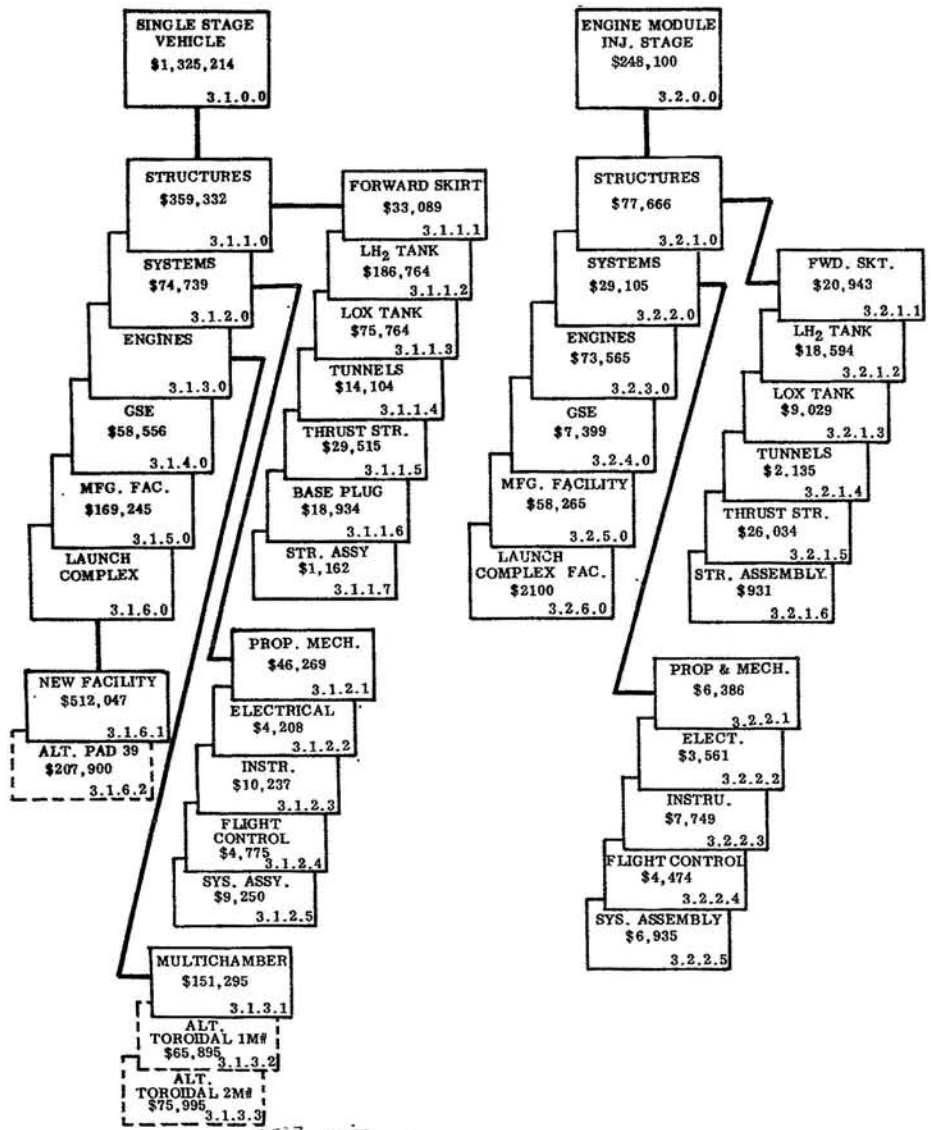


LABOR
\$321,932



(DOLLARS IN THOUSANDS)

FIGURE 1.0.0.0-10 AMLLV SINGLE STAGE TO ORBIT VEHICLE FIRST UNIT (1ST R&D FLIGHT TEST) COST BY COST CATEGORIES



NOTE: --- ALTERNATE SYSTEMS
DOLLARS ARE IN THOUSANDS.
NUMBERS IN LOWER RIGHT CORNER
DESIGNATE APPLICABLE SECTION
NUMBER FOR COST DETAILS.

FIGURE 1.0.0.0-11 AMLLV GET READY OR "A" COST FLOW DIAGRAM

13/14 A

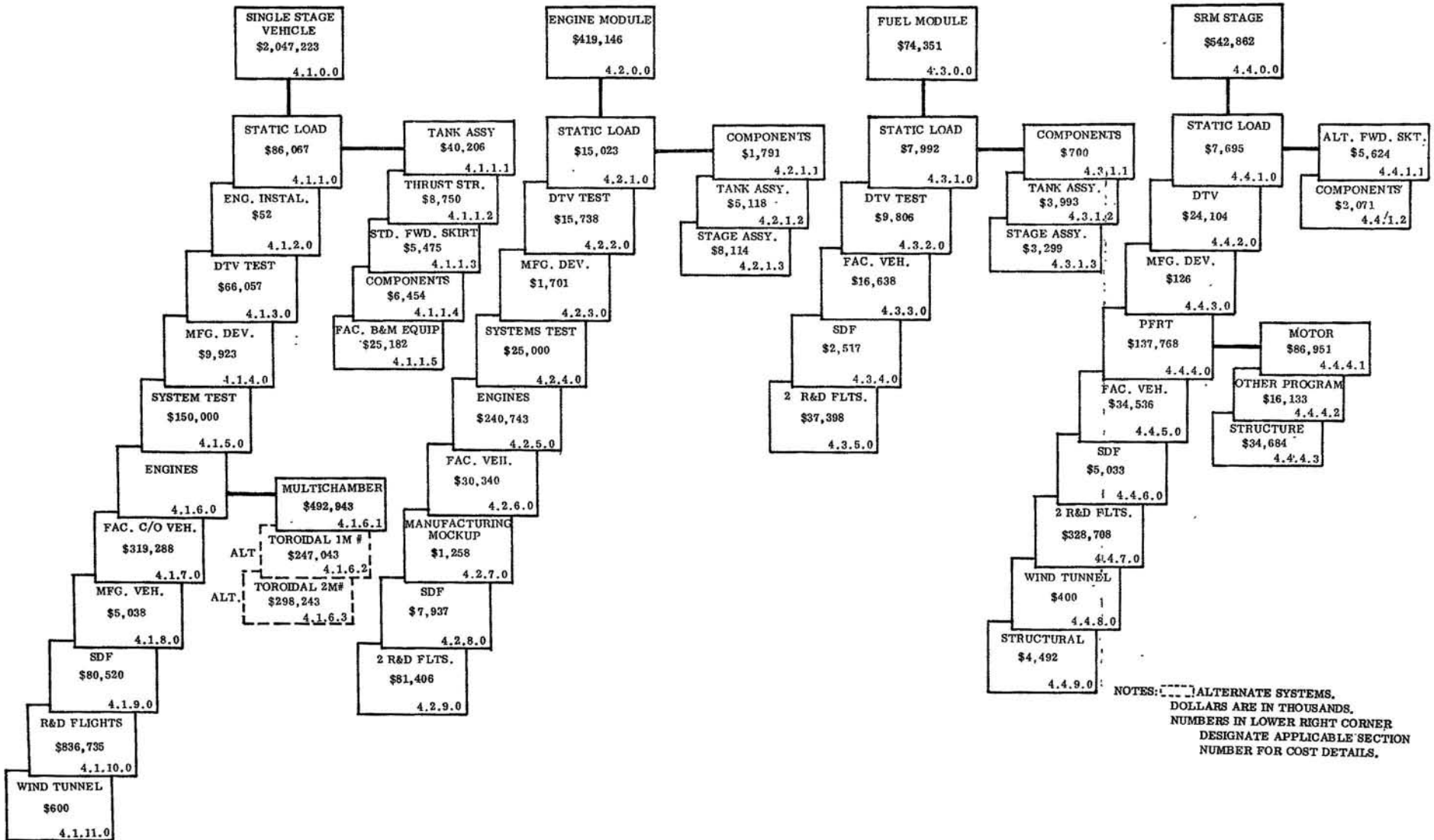


FIGURE 1.0.0.0-12 AMLLV DEVELOPMENTAL OR "B" COST FLOW DIAGRAM

15/16-A
 11.

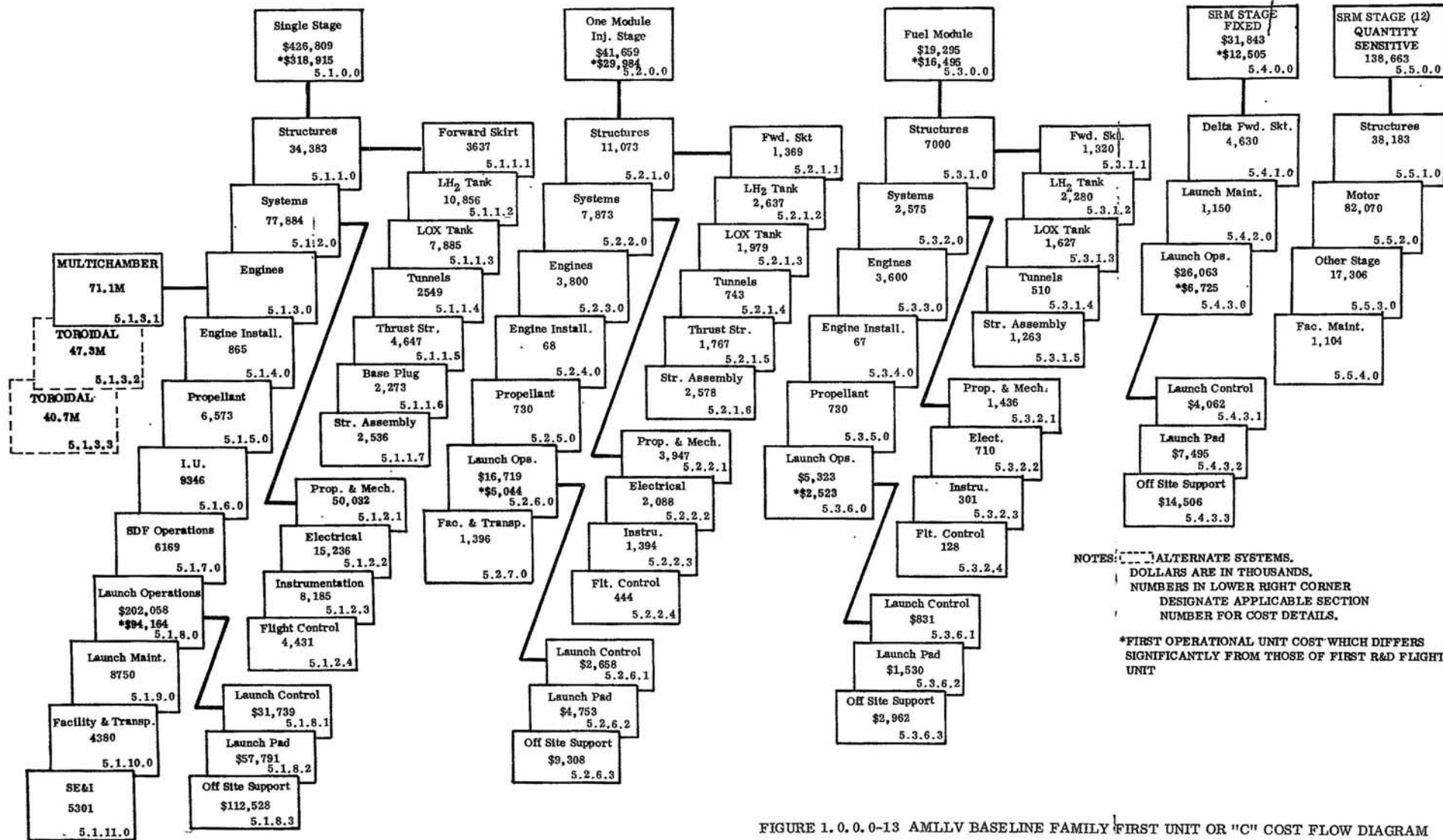


FIGURE 1.0.0.0-13 AMLLV BASELINE FAMILY FIRST UNIT OR "C" COST FLOW DIAGRAM

17/18-A

17/18-B

1.0 (Continued)

In addition to the cost distributions shown by program and/or stage elements, costs can be distributed by cost categories, i.e.: labor, material, tooling facilities and equipment. Tables 1.0.0.0-I through 1.0.0.0-IX show such distributions as the main stage vehicle, three module injection stage and twelve SRM strap-on stages respectively for each of the three program phases. (A, B and C cost categories.)

The distribution of costs to the cost categories was accomplished by reviewing each individual entry in the back-up detailed cost sheets. Assignment of a specific cost entry to a given cost category was based on an individual judgement of each entry. Some of these assignments required arbitrary assumptions which would effect the total distributions shown. For example, manpower and vehicle material as shown, relate only to that manpower and vehicle material to be expended to design, test, build and operate the vehicle. Manpower required in support of the other categories, i.e., tooling, material, facilities and equipment is included in the cost of those items as applicable. For example, manpower for tool design is shown as a tooling cost. Similarly, material required for tooling is shown as a tooling cost. Material costs as assigned to the vehicle material category reflect all costs for purchases material (inclusive of purchased assemblies and subsystems) to be used to design, test, manufacture and operate the vehicle. SRM and liquid engines for this distribution were not considered purchased assemblies (vehicle material) but were further broken down into the manpower, material, tooling, fabrication and equipment by categories. All systems and subsystems, on the other hand, were classified as vehicle material exclusively.

The distribution of Phase A costs by cost category indicates that a significant portion of the "Get Ready" costs will be attributable to Facilities and Equipment. The next largest cost category will be tooling.

The costs for vehicle material will be negligible. Program management and vehicle engineering design costs will represent approximately only 1.5 percent and 6.0 percent respectively of the total Phase A costs.

The distribution of costs by categories for Phase B include not only the costs for conducting the test, but also the costs required to provide the test specimens. The manpower costs will represent the major portion (66%) of the liquid stage B costs. As most of the SRM stage test components will be purchased, material costs for the SRM will exceed the manpower costs.

The distribution of costs by category for the first operational unit (C cost) shows that the costs for manpower will represent by far the majority of the liquid stage production and launch costs. Manpower costs will be a smaller percentage

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TABLE 1.0.0.0-I

AMLLV - MAIN STAGE

(DOLLARS IN THOUSANDS)

COST ELEMENTS	LABOR		MAT'L Misc.	TOOLING				FAC. & EQUIP.	TOTAL
	Mgm't & Adm.	Vehicle Engr.		Tooling Design	Tooling Mat'l	Mfg. & Set-Up	Tooling Q&RA		
STRUCTURES									
Fwd. Skirt	\$ 1,132	\$ 1,699	\$ 70	\$ 5,227	\$ 2,810	\$ 18,528	\$ 3,723	\$ -	\$ 33,089
LH ₂ Tank	7,771	1,483	60	30,752	16,514	108,894	27,290	-	186,764
LOX Tank	3,157	3,319	137	11,978	6,433	42,443	8,297	-	75,764
Tunnels	603	1,277	52	2,108	1,134	7,470	1,460	-	14,104
Thrust Structure	1,175	3,250	134	4,320	2,322	15,328	2,991	-	29,515
Base Plug	799	5,520	226	2,143	1,152	7,604	1,490	-	18,934
Assembly	57	1,061	44	-	-	-	-	-	1,162
Structures Total	14,694	17,609	723	56,528	30,365	200,262	39,151	-	359,332
SYSTEMS									
Prop./Mech.	1,953	5,304	218	6,728	3,609	23,803	4,654	-	46,269
Electrical	184	3,181	131	125	64	441	82	-	4,208
Instrumentation	450	8,485	347	161	88	594	112	-	10,237
Flight Control	196	1,699	70	481	261	1,731	337	-	4,775
Assembly	418	8,485	347	-	-	-	-	-	9,250
Systems Total	3,201	27,154	1,113	7,495	4,022	26,569	5,185	-	74,739
ENGINES	-	37,500	-	-	46,100	11,100	-	56,595	151,295
GSE	2,131	-	6	-	11,457	37,604	7,358	-	58,556
MFG. FACILITY	-	-	-	-	-	-	-	169,245	169,245
LAUNCH COMPLEX	-	-	-	-	-	-	-	512,047	512,047*
MAIN STAGE TOTALS.	\$20,026	\$82,263	\$1,842	\$64,023	\$91,944	\$275,535	\$51,694	\$739,887	\$1,325,214

*ALTERNATE PAD 39 - \$207,900

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"A" COST CATEGORIES

21-22-A

21-22-B

TABLE 1.0.0.0-II

AMLLV - MAIN STAGE

(DOLLARS IN THOUSANDS)

TYPE OF TEST	LABOR				MAT'L	TOOLING	EQUIP. & FAC.	SUB-TOTAL	TOTALS
	Mgmt. & Adm.	Engr.	Mfg. & Ops.	Q&RA					
STATIC LOAD TEST Specimens	\$ 532 1,616	\$ 3,543 4,187	\$ 6,376 22,873	\$ 1,918 4,472	\$ 1,582 11,630	\$ - 1,769	\$ 25,182 387	\$ 39,133 46,934	\$ - 86,067
ENG. INSTALLATION TEST Specimens	2 -	- -	35 -	7 -	8 -	- -	- -	52 -	- 52
DYNAMIC TEST Specimens	549 1,184	3,700 3,067	7,128 16,756	1,135 3,276	2,026 8,519	- 1,296	17,137 284	31,675 34,382	- 66,057
MANUFACTURING DEV. Specimens	357 -	- -	6,571 -	1,314 -	1,681 -	- -	- -	9,923 -	- 9,923
SUBSYSTEM & SYSTEM TEST Specimens	- -	- -	- -	- -	150,000 -	- -	- -	150,000 -	- 150,000
ENGINE DEVELOPMENT (1) Specimens	- -	143,200 7,407	54,000 85,707	- -	114,143 50,457	11,500 11,329	15,200 -	338,043 154,900	- 492,943
FACILITY CHECKOUT Specimens	- 1,899	- 4,918	240,077 26,871	- 5,254	6,573 13,663	- 2,078	17,500 455	264,150 55,138	- 319,288
MANUFACTURING MOCK-UP Specimens	194 -	- -	3,462 -	692 -	690 -	- -	- -	5,038 -	- 5,038
SYSTEMS BREADBOARD Specimens	- -	- -	18,920 -	- -	- -	- -	61,600 -	80,520 -	- 80,520
WIND TUNNEL Specimens	- -	- -	600 -	- -	- -	- -	- -	600 -	- 600
TWO R&D FLIGHTS Specimens	17,376 12,409	29,500 32,143	299,248 175,606	57,788 34,333	44,380 89,291	- 13,582	28,102 2,977	476,394 360,341	- 836,735
"B" SUBTOTALS	19,010 17,108	179,943 51,722	636,417 327,813	62,854 47,335	321,083 173,560	11,500 30,054	164,721 4,103	1,395,528 651,695	- 2,047,223
"B" TOTAL	\$36,118	\$231,665	\$964,230	\$110,189	\$494,643	\$41,554	\$168,824	\$2,047,223	\$2,047,223

23/24-A

"B" COST CATEGORIES

23-24-B

TABLE 1.0.0.0-III

AMLLV - MAIN STAGE

(DOLLARS IN THOUSANDS)

COST ELEMENTS	LABOR					MATERIAL			TOOLING		FAC. & EQUIP.	TOTAL
	Mgmt. & Adm.	Engr.	Mfg. & Ops.	Test	Q&RA	Mfg.	Logistics	Q&RA	Labor	Mtl.		
STRUCTURES												
Fwd. Skirt	\$ 146	\$ 22	\$ 2,252	\$ 111	\$ 462	\$ 367	\$ 23	\$ 15	\$ 172	\$ 27	\$ 40	\$ 3,637
LH ₂ Tank	313	320	4,602	227	944	3,663	269	29	351	56	82	10,856
LOX Tank	273	576	3,809	187	782	1,364	512	24	246	44	68	7,885
Tunnels	79	230	1,043	51	214	610	205	6	80	12	19	2,549
Thrust Str.	188	217	2,740	136	562	311	193	18	205	32	45	4,647
Base Plug	71	384	790	39	162	395	341	6	61	10	14	2,273
Assembly	114	1,318	732	37	150	5	160	4	-	-	16	2,536
Structure Totals	1,184	3,067	15,968	788	3,276	6,715	1,703	102	1,115	181	284	34,383
SYSTEMS												
Prop./Mech.	682	1,124	9,647	686	2,019	33,958	808	62	752	118	176	50,032
Electrical	640	376	9,600	474	1,969	672	424	61	733	115	172	15,236
Instrumentation	305	1,009	3,904	192	801	795	740	24	298	47	70	8,185
Flt. Control	81	179	1,108	54	228	2,496	159	8	85	13	20	4,431
Systems Totals	1,708	2,688	24,259	1,406	5,017	37,921	2,131	155	1,868	293	438	77,884
ENGINES*	-	3,400	34,740	4,600	-	23,160	-	-	-	5,200	-	71,100
ENGINE INSTL.	39	-	577	57	124	4	-	4	44	7	9	865
PROPELLANT	-	-	-	-	-	6,573	-	-	-	-	-	6,573
I. U.*	-	-	5,608	-	-	3,738	-	-	-	-	-	9,346
SDF OPS.	-	1,727	4,442	-	-	-	-	-	-	-	-	6,169
LAUNCH OPS.	8,688	14,750	149,624	-	28,894	-	-	167	-	-	-	202,058
LAUNCH MAINT.	-	-	-	-	-	-	-	-	-	-	8,750	8,750
FAC. MAINT. & TRANSP.	-	-	-	-	-	-	-	-	-	-	4,380	4,380
SE&I	-	5,301	-	-	-	-	-	-	-	-	-	5,301
MAIN STAGE TOTAL	\$11,619	\$30,933	\$235,218	\$6,851	\$37,311	\$78,111	\$3,834	\$363	\$3,027	\$5,681	\$13,861	\$426,809

*MANUFACTURING COST FACTORED 60/40% INTO LABOR AND MATERIAL

"C" COST CATEGORIES

25-26-A

25-26-B

TABLE 1.0.0.0-IV

AMLLV - ENGINE MODULE + TWO FUEL MODULES

(DOLLARS IN THOUSANDS)

COST ELEMENT	LABOR		MAT'L	TOOLING				EQUIP. & FAC.	TOTALS
	Mgmt. & Adm.	Vehicle Eng.	Misc.	Tooling Design	Tooling Mat'l.	Mfg. & Set-Up	Tooling Q&RA		
STRUCTURES - ENG. MOD.									
Fwd. Skirt	\$ 879	\$ 1,061	\$ 43	\$ 3,285	\$ 1,774	\$11,627	\$2,274	\$ -	\$ 20,943
LH ₂ Tank	776	2,121	87	2,694	1,447	9,594	1,875	-	18,594
LOX Tank	380	2,121	87	1,116	600	3,952	773	-	9,029
Tunnels	89	849	43	200	107	709	138	-	2,135
Thrust Structure	1,085	1,061	43	4,132	2,218	14,634	2,861	-	26,034
Assembly	39	849	43	-	-	-	-	-	931
Structures Total	3,248	8,062	346	11,427	6,146	40,516	7,921	-	77,666
STRUCTURES - FUEL MOD.	29	655	26	-	-	-	-	-	710
SYSTEMS									
Prop. & Mech.	279	4,243	174	293	157	1,037	203	-	6,386
Electrical	155	2,546	104	132	70	464	90	-	3,561
Instrumentation	345	6,364	261	124	67	492	96	-	7,749
Flight Control	190	1,697	70	448	239	1,531	299	-	4,474
Assembly	310	6,364	261	-	-	-	-	-	6,935
Systems Total	1,279	21,214	870	997	533	3,524	688	-	29,105
ENGINES	-	20,400	-	-	24,900	6,000	-	22,265	73,565
GSE	270	-	-	-	1,403	4,788	938	-	7,399
MANUFACTURING FACILITY	-	-	-	-	-	-	-	58,265	58,265
LAUNCH COMPLEX	-	-	-	-	-	-	-	2,100	2,100
INJECTION STG. TOTALS	\$4,826	\$50,331	\$1,242	\$12,424	\$32,982	\$54,828	\$9,547	\$82,630	\$248,810

"A" COST CATEGORIES

27-28-A
JT

27-28-B

TABLE 1.0.0.0-V

AMLLV - ENGINE MODULE + FUEL MODULE

(DOLLARS IN THOUSANDS)

TYPE OF TESTS	LABOR				MTL.	TOOLING	EQUIP. & FAC.	SUB- TOTALS	TOTALS
	Mgmt. & Adm.	Engr.	Mfg. & Ops.	Q&RA					
STATIC LOAD TEST - E/M Specimens	\$ 115 452	\$ 771 1,115	\$ 1,684 6,388	\$ 84 1,248	\$ 189 2,330	\$ - 538	\$ - 109	\$ 2,843 12,180	\$ - 15,023
STATIC LOAD TEST - F/M Specimens	20 572	176 1,410	338 8,078	30 1,578	78 2,946	- 680	- 138	582 15,402	- 15,984
DTV TEST - E/M Specimens	137 411	920 1,014	1,969 5,807	134 1,135	505 2,118	- 489	1,000 99	4,665 11,073	- 15,738
DTV TEST - F/M Specimens	- 691	- 1,704	- 9,761	- 1,908	- 3,560	- 822	1,000 166	1,000 18,612	- 19,612
MANUFACTURING DEVELOPMENT Specimens	75 -	1,015 -	340 -	271 -	- -	- -	- -	1,701 -	- 1,701
SYSTEMS TEST Specimens	- -	- -	- -	- -	25,000 -	- -	- -	25,000 -	- 25,000
ENGINEERING DEVELOPMENT Specimens	- -	77,600 -	112,800 -	- -	35,943 -	6,200 -	8,200 -	240,743 -	- 240,743
FACILITY VEHICLE - E/M Specimens	- 411	- 1,014	18,537 5,807	- 1,135	730 2,118	- 489	- 99	19,267 11,073	- 30,340
FACILITY VEHICLE - F/M Specimens	- 567	- 1,400	16,528 8,017	- 1,567	1,460 2,924	- 675	- 138	17,988 15,288	- 33,276
MANUFACTURING MOCK-UP Specimens	47 -	- -	866 -	173 -	172 -	- -	- -	1,258 -	- 1,258
SYSTEM BREADBOARD - E/M Specimens	- -	- -	1,237 -	- -	- -	- -	6,700 -	7,937 -	- 7,937
SYSTEM BREADBOARD - F/M Specimens	- -	- -	- -	- -	- -	- -	5,034 -	5,034 -	- 5,034
TWO R&D FLIGHTS (2) - E/M Specimens	1,438 1,726	2,441 4,259	24,761 24,390	4,782 4,767	1,476 8,896	- 2,054	- 416	34,898 46,508	- 81,406
(4) FM Specimen	674 1,781	1,145 4,396	11,611 25,172	2,242 4,920	2,928 9,181	- 2,120	- 430	18,600 48,000	- 66,600
"B" SUBTOTAL: TEST SPECIMEN	2,506 6,611	84,068 16,312	190,671 93,420	7,716 18,258	68,421 34,073	6,200 7,867	21,934 1,595	381,516 178,136	- -
"B" GRAND TOTALS	\$9,117	\$100,380	\$284,091	\$25,974	\$102,494	\$14,067	\$23,529	-	\$559,652

"B" COST CATEGORIES

29-30-A

29-30-B

TABLE 1.0.0.0-VI

AMLLV - ENGINE MODULE + FUEL MODULE

(DOLLARS IN THOUSANDS)

COST ELEMENTS	LABOR					MATERIAL			TOOLING		FAC. & EQUIP.	TOTAL
	Mgmt. & Adm.	Engr.	Mfg. & Ops.	Test	Q&RA	Mfg.	Logistics	Q&RA	Labor	Mtl.		
STRUCTURES												
For. Skirt	\$ 132	\$ 35	\$ 2,004	\$ 97	\$ 411	\$ 963	\$ 24	\$ 12	\$ 154	\$ 23	\$ 35	\$ 3,890
LH ₂ Tank	272	183	4,066	201	833	808	171	24	311	49	73	6,991
LOX Tank	205	183	3,058	151	629	345	171	18	233	38	55	5,086
Tunnels	70	128	982	49	201	64	115	6	74	12	17	1,718
Thrust Structure	55	154	735	37	151	415	137	5	56	9	13	1,767
Assembly	210	362	2,977	147	610	25	327	15	227	36	55	4,991
Structure Totals	944	1,045	13,822	682	2,835	2,620	945	80	1,055	167	248	24,443
SYSTEMS												
Prop. & Mech.	157	333	2,259	105	464	2,837	296	15	163	25	36	6,690
Electrical	142	128	2,205	102	450	66	114	15	159	25	36	3,442
Instrumentation	72	321	897	40	184	75	284	5	64	12	15	1,969
Flight Control	20	64	256	13	46	206	57	1	19	3	5	690
System Totals	391	846	5,617	260	1,144	3,184	751	36	405	65	92	12,791
ENGINES	512	-	8,814	727	-	-	-	-	767	-	-	10,820
ENGINE INSTL.	7	-	138	6	29	2	2	-	10	1	1	196
PROPELLANT	-	-	-	-	-	2,190	-	-	-	-	-	2,190
LAUNCH OPERATIONS	1,177	1,998	20,264	-	3,913	-	-	13	-	-	-	27,365
FACILITY & TRANSPORTATION	-	-	-	-	-	-	-	-	-	-	1,396	1,396
I/S TOTALS (E/M)	\$3,031	\$3,889	\$48,655	\$1,675	\$7,921	\$7,996	\$1,698	\$129	\$2,237	\$233	\$1,737	\$79,201

31-32-A
A

"C" COST CATEGORIES

31-32-B
A

TABLE 1.0.0.0-VII

AMLLV - SRM STAGES

(DOLLARS IN THOUSANDS)

COST ELEMENT	LABOR		MAT'L Misc.	TOOLING				FAC. & EQUIP.	TOTAL
	Mgm't & Adm.	Vehicle Engr.		Tooling Design	Tooling Mat'l.	Mfg. & Set-Up	Tooling Q&RA		
DELTA FWD SKIRT	\$1,548	\$1,482	\$61	\$ 4,732	\$ 2,536	\$16,731	\$3,266	\$ -	\$ 30,356
STRUCTURE									
Aft Skirt	154	123	5	616	329	2,078	406	-	3,711
SRM Fittings	52	74	3	204	108	685	134	-	1,260
Attach Structure	815	435	18	3,294	1,764	13,297	-	-	19,623
Nose Cone	387	188	8	1,573	841	5,305	1,037	-	9,339
Total Structures	1,408	820	34	5,687	3,042	21,365	1,577	-	33,933
SRM MOTOR	395	1,898	-	858	57,943	-	-	-	61,094
LAUNCH COMPLEX FACILITIES	-	-	-	-	-	-	-	174,896	174,896
MFG. FACILITY (FIXED)	-	-	-	-	-	-	-	8,434	8,434
SRM GSE (FIXED)	-	-	-	-	3,072	-	-	-	3,072
SRM TOTAL (FIXED)	395	1,898	-	858	61,015	-	-	183,330	311,785
SRM QUANTITATIVE SENSITIVE									
GSE Facility	-	-	-	-	23,690	-	-	64,857	23,690 64,857
TOTAL	-	-	-	-	23,690	-	-	64,857	88,547
SRM GRAND TOTAL	\$3,351	\$4,200	\$95	\$11,277	\$90,283	\$38,096	\$4,843	\$248,187	\$400,332

33/34-A

"A" COST CATEGORIES

33/34-B

TABLE 1.0.0.0-VIII

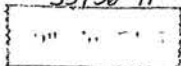
AMLLV - SRM

(DOLLARS IN THOUSANDS)

TYPE OF TESTS	LABOR					MTL.	TOOLING	EQUIP. & FAC.	SUB- TOTALS	TOTALS
	Mgmt. & Adm.	Engr.	Mfg. & Ops.	Q&RA						
STATIC LOAD Specimen	\$ 55 255	\$ 343 38	\$ 727 4,129	\$ 71 807	\$ 144 708	\$ - 348	\$ - 70	\$ 1,340 6,355	\$ - 7,695	
DYNAMIC TEST Specimen	35 234	227 35	450 3,788	67 740	495 650	- 319	17,000 64	18,274 5,830	- 24,104	
MANUFACTURING DEV. Specimen	14 -	78 -	- -	15 -	19 -	- -	- -	126 -	- 126	
PFRT Specimen	1,578 -	7,830 -	11,049 8,001	1,779 2,350	1,743 95,301	- -	8,137 -	32,116 105,652	- 137,768	
"F" VEHICLE Specimen	- -	- -	24,321 774	- 227	- 9,214	- -	- -	24,321 10,215	- 34,536	
SYSTEMS BREADBOARD Specimen	- -	- -	1,183 -	- -	- -	- -	3,850 -	5,033 -	- 5,033	
WIND TUNNEL Specimen	- -	- -	- -	- -	400 -	- -	- -	400 -	- 400	
STRUCTURAL Specimen	- 134	- 284	408 2,034	- 423	227 592	- 92	263 35	-895 3,594	- 4,492	
TWO R&D FLIGHTS Specimen	2,621 2,721	3,921 6,437	44,814 53,382	8,746 12,081	897 185,811	278 1,868	2,404 2,822	63,686 265,022	- 328,708	
SUBTOTALS	4,303 3,344	12,399 6,794	82,957 72,108	10,678 16,628	3,925 292,176	278 2,627	31,654 2,991	- -	- -	
"B" GRAND TOTAL	\$7,647	\$19,193	\$155,065	\$27,306	\$296,101	\$2,905	\$34,645	\$477,993	\$542,862	

"B" COST CATEGORIES

35/36-A



H

35/36-B



TABLE 1.0.0.0-IX

AMLLV - SRM

(DOLLARS IN THOUSANDS)

COST ELEMENTS	LABOR					MATERIAL			TOOLING		FAC & EQUIP.	SUB- TOTAL	TOTAL
	Mgmt. & Adm.:	Engr.	Mfg. & Ops.	Test	Q&RA	Mfg.	Logistics	Q&RA	Labor	Mtl.			
SRM - FIXED													
Delta Fwd. Skirt	\$ 191	\$ 65	\$ 2,919	\$144	\$ 598	\$ 337	\$ 46	\$ 20	\$ 223	\$ 35	\$ 52	\$ -	\$ 4,630
Launch Main.	-	-	-	-	-	-	-	-	-	-	1,150	-	1,150
Launch Ops.													
Launch Control	175	297	3,008	-	580	-	-	2	-	-	-	4,062	-
Launch Pad	322	547	5,550	-	1,072	-	-	4	-	-	-	7,495	-
Off Site Support	624	1,059	10,742	-	2,074	-	-	7	-	-	-	14,506	-
Launch Ops. Sub-Total	1,121	1,903	19,300	-	3,726	-	-	13	-	-	-	26,063	26,063
SRM FIXED TOTAL	1,312	1,968	22,219	144	4,324	337	46	33	223	35	1,202	-	31,843
SRM QUANTITY SENSITIVITY												1ST UNIT	12 UNITS
STRUCTURES	1,424	2,858	20,568	701	4,165	4,823	1,328	127	1,583	234	372	3,594	38,183
Attach. Structure	68	90	1,030	27	206	265	42	6	79	12	19	1,844	
Nose Cone	31	64	444	13	90	70	30	3	34	5	8	792	
Aft Skirt	20	51	284	13	59	73	24	2	22	3	5	556	
Fittings	15	64	178	13	37	46	29	1	14	2	3	402	
MOTOR	-	-	9,912	-	-	72,158	-	-	-	-	-	7,725	82,070
OTHER STAGE	-	-	-	-	-	17,306	-	-	-	-	-	1,629	17,306
FACILITY MAINT.	-	-	-	-	-	-	-	-	-	-	1,105	104	1,104
SRM QTY. SENSTV. TOTAL	1,424	2,858	30,480	701	4,165	94,287	1,328	127	1,583	234	1,477	13,052	138,663
SRM GRAND TOTAL	\$2,736	\$4,826	\$52,699	\$845	\$8,489	\$94,624	\$1,374	\$160	\$1,806	\$269	\$2,678		\$170,506

37/38-A

"C" COST CATEGORIES

37/38-B

1.0 (Continued)

of SRM stage costs because of the high percentage of purchased propellant, materials and stage components.

With the details provided in the three Cost Books comprising Volume IV, several program options exist such as the types of engines, launch facilities, program size, etc. Figure 1.0.0.0-14 illustrates how costs can be identified from the detail data to evaluate one of these options. Options one, two, three and four show the costs of the AMLLV multichamber/plug propulsion system, the 2000 psia toroidal/aerospike with the one million pounds thrust/module (16 modules) and the 2000 psia toroidal/aerospike with the two million pounds thrust/module (8 modules), respectively. The "A", "B" and "C" costs are shown for the AMLLV with the propulsion costs deleted. The total program costs incorporating each propulsion option are also shown. Similar comparisons can be made for other program options. These will be discussed in Volume VI of this final report.

This Volume IV, Baseline AMLLV Costs primarily presents only the cost data. Applications for these costs, for cost effectiveness analyses and cost sensitivity studies, can be found in Volume VI (Cost Implications of Vehicle Size, Technology, Configurations and Program Options).

DOLLARS IN THOUSANDS

PROPULSION SYSTEM OPTIONS	GET READY "A" COST	DEVELOPMENT TEST "B" COST	PRODUCTION "C" COST
<u>Engine Option Number One</u> Multichamber/Plug Propulsion System	\$151,295	\$492,943	\$71,000
<u>Engine Option Number Two</u> Toroidal/Aerospike Propulsion System One Million Lbs. Thrust/Module - 16 Modules 2000 PSIA Chamber Pressure	65,895	247,043	47,300
<u>Engine Option Number Three</u> Toroidal/Aerospike Propulsion System Two Million Lbs. Thrust/Module - 8 Modules 2000 PSIA Chamber Pressure	75,995	298,243	40,660
Single Stage to Orbit Vehicle Cost (Less Propulsion System)	\$1,173,919	\$1,554,730*	\$355,809
Single Stage to Orbit Vehicle with Multi- chamber/Plug	\$1,325,214	\$2,047,223*	\$426,809
Single Stage to Orbit Vehicle with Toroidal/ Aerospike - One Million Lbs. Thrust/Module 16 Modules - 2000 PSIA	\$1,239,814	\$1,801,773*	\$403,109
Single Stage to Orbit Vehicle with Toroidal/ Aerospike - Two Million Lbs. Thrust/Module 8 Modules - 2000 PSIA	\$1,249,914	\$1,852,973*	\$396,469

* 2 R&D Flight Test = \$836,735. Costs are included in "B" costs

FIGURE 1.0.0.0-14 PROPULSION SYSTEM OPTIONS FOR THE AMLLV SINGLE STAGE VEHICLE

2.0 STUDY OBJECTIVES, GROUND RULES AND ASSUMPTIONS, PRICING FACTORS AND LABOR RATES

2.1 STUDY OBJECTIVES

This study, "Cost Studies of Multipurpose Large Launch Vehicles," was directed to define the economical aspects of future launch vehicle systems. To accomplish this objective, the previously completed study, "Advanced Multipurpose Large Launch Vehicles," Contract NAS2-4079 (Baseline AMLLV) was subjected to a detailed cost analysis. This cost analysis included the determination of the non-recurring and recurring costs for implementation and operation of the baseline AMLLV vehicle family. This volume IV reports the results of this cost analysis. A similar cost analysis was conducted on the half size vehicle (MLLV) family as defined by the Volume II half size vehicle design concept and the Volume III, resources implications. The half size vehicle cost analysis is reported in Volume V.

2.2 GROUND RULES AND ASSUMPTIONS

The following ground rules, guidelines, and assumptions were utilized in the cost analysis of the baseline AMLLV vehicle family:

- a. Production and launch rates are based on two vehicles per year.
- b. Cost estimates were based on 1968 dollars without inflationary factors.
- c. All cost values in this report are contractors cost values only and do not include profit or fee with the exception of the Solid Rocket Motors and liquid engines.
- d. The first unit has been defined as the first flight vehicle, effects of learning curve(s) enter after that unit.
- e. Where possible, the cost estimates were based on direct costs with burdens added as a separate item.
- f. The R&D flight vehicles consist of two vehicles.
- g. The facility checkout vehicle includes structural hardware, transportation and the complete launch cycle cost.
- h. Static firing of the vehicles will occur at the launch pad.

2.2 (Continued)

i. Resource Inputs

Resource inputs for recurring and non-recurring items were received from functional organizations within The Boeing Company and from propulsion contractors (Aerojet General, Pratt and Whitney, and Rocketdyne). Most of the direct inputs were in terms of manhours; however, total dollar costs were also received for several items, i. e., material, equipment, engines, etc.

The Manufacturing Department at the Michoud Assembly Facility and the Huntsville Operations Department provided manhours and material estimates for the following items: 1) Fabrication, Major and Minor Assembly of the Sub-System Components, 2) Manufacturing Test manhours, 3) Raw and Production Material, 4) Planning manhours, 5) Tool Design manhours, 6) Tool Fab. and Erection hours, 7) Manufacturing Development hours, and 8) MGSE and Handling/Transportation Equipment hours and dollars.

The Huntsville Engineering Department provided basic engineering design and sustaining engineering manhours. The Facilities Department at Huntsville, BATC and Michoud provided costs of the brick and mortar facilities for production, test and launch; transportation and handling equipment; capital equipment and maintenance costs. The Test Organization at Huntsville provided manhours and costs for conducting Developmental Testing, Structural Tests, Systems Development (SDF), Systems Tests, Dynamic Tests, Manufacturing Development and Wind Tunnel Tests.

The Engineering Department at BATC provided costs for Launch Operations and Launch Vehicle Ground Support Equipment (LVGSE) and Test Equipment.

The propulsion contractors provided costs for the solid rocket motors, toroidal/aerospike engine and the multichamber/plug engines. The liquid engine data was supplemented with data received from the Propulsion Office at NASA/MSFC.

The details associated with these direct inputs are displayed and summarized in the "Resources Implications" Volume III of this report.

2.3 PRICING FACTORS

Once the data was received by the Cost Estimating Organization, elemental and overall costs were developed; the direct cost elements were totaled with the associated indirect and supporting costs. These direct and supporting costs include but are not necessarily limited to: Quality Control, Program Management,

2.3 (Continued)

Planning, Training, etc. These will be discussed, in detail, in the paragraphs that follow.

The cost collection summary form is divided into four basic parts:

- Part I Program Management,
- Part II The Contract End Item (CEI),
- Part III Facilities,
- Part IV Logistics.

Throughout this cost analysis, this format has been used to maintain consistency. On occasion, the category of "other" is included as a cost element to collect those elements which do not necessarily fit the established format. In those instances, a footnote has been provided to explain what items are included in the category of "other."

Part I Program Management, Program Planning and Reporting and Industrial Relations

These elements were applied by the costing organization: The weighing of such elements were based on historical Saturn V experience.

Part II Engineering, Production, Tooling and Manufacturing Test

Included in the Engineering costs, either basic or sustaining, are laboratory technicians support and the associated operating material costs. Included in production costs are direct factory labor for fabrication and assembly of the system or subsystem components, miscellaneous charges, tool and production planning, direct distributable labor, training, quality inspection, manufacturing technicians, raw material, and standards. Tooling cost, either basic or sustaining, include direct factory labor, direct distributables, training, quality and tooling material. Manufacturing test costs include the labor costs for component testing, training, technicians, and quality assurance.

Part III Facilities

Included are the costs for the brick and mortar buildings, stands, pads, etc., craft labor maintenance, transportation and handling labor, plant engineering support, and facilities maintenance costs.

2.3 (Continued)

Part IV Logistics

Included are the logistics support and the cost of spares, maintenance analysis and field support engineering labor costs.

The following in-depth explanation covers each major cost element as to their function and use:

Part I

- a. Program Executive - Function: Program office and equipment management; program assessment, problem identification, customer liaison; change board, change status, follow-up and commitment.

This element is a level of effort; however, for this study, a factor was developed from Saturn historical data. It was determined that this function was 1.2% of the direct labor manhours in Parts II through IV with the exception of launch operations which is .95%.

- b. Program Planning and Reporting (PP&R) - Function: Determination and development of product activities for planning purposes. Monitors performance and the processes of the management of the business.

PP&R is a pricing factor, developed from historical actuals. That is submitted (usually on an annual basis) to the NASA, negotiated, and used for forward pricing purposes. PP&R labor hours are developed by applying 3% to the total direct labor manhours in Parts II through IV below with the exception of launch operations which is 2.4%.

Material (consisting of graphics and aids) is required to support this function. A rate of 2¢ per PP&R manhour was used.

- c. Industrial Relations - Function: Health, safety and training operations. Industrial Relations is a pricing factor, developed from historical data. That is submitted (usually on an annual basis) to the NASA, negotiated, and used for forward pricing purposes. Industrial Relations labor hours are developed by applying 65% to the total direct manhour base in Parts II through IV below with the exception of launch operations which is .54%. For training aids and supplies, a rate of .10¢ per industrial relations manhour was used.

Part II

- a. Engineering

1. Design Activity Functions

2.3

(Continued)

- a. Changes to the initial release of Class I documentation applicable to the procurement, fabrication, assembly and test of the stage.
 - b. Liaison - Liaison with manufacturing, quality control, procurement, vendors and testing functions are required to resolve discrepancies.
 - c. Failure Analysis - Investigations, analyses and studies of anomalies and failures.
 - d. Flight Test Evaluation - Provide data for flight performance predictions, measurement and data acquisition requirements, statistical analysis and flight performance evaluation.
 - e. Design Change Implementation of in-scope design changes resulting from remedial engineering and cost and producibility activities.
2. Test Functions:
- a. Maintenance of test procedures
 - b. Test planning
 - c. Fixture and instrumentation
 - d. Conduct tests
 - e. Data reduction and evaluation
 - f. Preparation of test reports
3. Configuration Management Functions:
- a. Preparation and maintenance contract specification addendas
 - b. Interface control
 - c. Delivery support of the end item acceptance data package
4. Reliability Engineering Functions :
- a. Continuing technical management and surveillance of the reliability program

2.3 (Continued)

- b. Reliability design analyses of design changes
- c. Reliability surveillance for design reviews
- d. Failure analyses
- e. Reliability testing
- f. Flight test evaluation

The engineering manhours for "a" through "d" above, both recurring and non-recurring functions, were received as a direct input to the study.

- b. Laboratory Technicians - Function: Shop support to engineering, qualification and reliability testing in the form of test set-up, test specimens, special or peculiar test equipment. These laboratory technicians support engineering, and are a function thereof.

A review of the historical Saturn data indicated, that on a composite basis, this effort was approximately 20% of the direct engineering manhours (Part II, paragraph "a" above). Therefore, for the purpose of this study, the factor of 20% was applied to the AMLLV engineering manhours to estimate laboratory technician manhours.

The materials required to support these technicians were priced at \$2.10 per laboratory technician manhour.

- c. Fabrication and Assembly - Function:

- 1. Fabrication - direct labor necessary to manufacture the individual detail parts
- 2. Minor Assembly - direct labor necessary to join together the major sections, installation of equipment and systems and assembly of major sub-assemblies.

The direct manhours to accomplish fabrication, minor and major assembly were a direct input to the study by the Boeing/Michoud Manufacturing Department.

- d. Miscellaneous Charges - Functions:

- 1. Process control
- 2. Part numbering and stamping

2.3 (Continued)

3. Certification of welding and plating process
4. Cutter grinding
5. Other items not readily identifiable to hardware

It is reasonable to assume that in a normal production program, similar or related functions of this nature would be required. Therefore, a review of Saturn history indicated that this type of effort was approximately 7.8% of the fabrication and assembly manhours. This factor was applied to the AMLLV fabrication and assembly manhours.

- e. Maintenance and Incorporation of In-Scope Changes - Function: Maintenance and incorporation of in-scope changes to component and sub-system test requirements for fabrication and/or rework of parts, drawers, etched cards, etc.

This effort was determined to be 1.1% of fabrication and assembly manhours on the Saturn V program and, therefore, that factor was applied to the AMLLV fabrication and assembly manhours.

- f. Tool and Production Planning - Function:

1. Sustaining planning for; Procurement; Fabrication; Assembly and Installation.
2. Translation of engineering designs and specifications into work plans and task descriptions.
3. PERT support: By maintaining PERT networks; update to PERT documentation and PERT status of the manufacturing operations.

It was determined, from historical Saturn data, that tool and production planning was approximately 28% of the production and tool sustaining manhours. This percentage was applied to the AMLLV production (Part II, Paragraphs 3 through 5) and tool sustaining manhours (Part II, Paragraph 12) to determine the tool and production planning manhours.

- g. Direct Distributable - Function: Production order control - dispatch clerks, parts control clerks, production order control clerks, production controllers, factory clerks, production control records (PCR), design accounting, PCR clerks, parts listers, tool room attendants, tool procurement, coordinators, blueprint control clerks, shipping, craters, and packaging engineers; chemical and LOX cleaning.

2.3 (Continued)

Direct distributable was estimated on the basis of historical Saturn data at approximately 32% of total production manhours. The AMLLV direct distributed manhours may be determined by applying 32% of the production manhours (Part II, Paragraphs 3 through 5).

- h. Training - Function: Train and orient new and/or existing personnel. Based on historical experience, it was determined that training manhours were a function of the manhours shown in Part II, Paragraphs 3, 4, 5, 6, 7 and 12. By applying a factor of 1.1% to the AMLLV manufacturing base training manhours may be estimated.
- i. Quality - Function:
 - 1. Source control
 - 2. Reliability data collection and analysis
 - 3. Quality program documentation
 - 4. Inspection stamp control
 - 5. Reliability audits
 - 6. Design review
 - 7. Quality audits
 - 8. Fabrication and assembly inspection
 - 9. Functional test and stage test inspection
 - 10. Configuration accountability and product delivery
 - 11. Procurement planning
 - 12. Laboratory material analysis
 - 13. Process control
 - 14. Contamination control
 - 15. Non-destructive testing
 - 16. Equipment quality analysis

2.3 (Continued)

17. Discrepancy control area

18. Measurement control

Normally, quality support is a direct input; however, for the purpose of this study quality was factored onto the total manhours (Part II, Paragraphs 2 through 7 and 12) associated with the contract end item (CEI) hardware. A factor of 20% was applied to the AMLLV CEI hardware manhours to develop the quality support. In addition, \$.30 per quality manhour was used to estimate the material required to support this function.

- j. Manufacturing Technology - Function: Conduct process development programs to assure reliable manufacture of stage hardware and mechanical support equipment.

Manufacturing technology is a pricing factor, developed from historical data, that is submitted, (usually on an annual basis) to the NASA, negotiated, and used for forward pricing purposes. The current factor is 1.9%. The AMLLV manufacturing technician manhour may be determined by applying this factor to all direct manhours (Part II, Paragraphs 3 through 8). Material costs, to support this function, were based on \$1.75 per manufacturing technology manhour.

- k. Raw Material and Standards - Includes the raw material, standards, purchased parts, equipment, major sub-systems, technical services and maintenance repair and operating (MRO) supplies and services associated with the production of the Contract End Item (CEI).

Estimates for material costs were received from the Boeing/Michoud Operations Department in terms of dollar estimates.

- l. Tool Sustaining - Function:

- 1. Support previously fabricated basic tooling
- 2. Repair and maintenance of major tools
- 3. Manufacturing changes
- 4. Vendor deficiencies
- 5. Lost and worn tools

2.3 (Continued)

Tool sustaining is a pricing factor, developed from historical data. That is submitted (usually on an annual basis) to the NASA, negotiated, and used for formal pricing purposes. Tool sustaining manhour for the AMLLV are determined by applying 8% to Part II, Paragraphs 3, 4, and 5 above.

m. Manufacturing Test - Function :

1. Maintain test procedures
2. Planning the testing of stage components
3. Testing stage and mechanical support equipment systems, sub-systems and components

The manufacturing test manhours were received from the Boeing/Michoud Operations Department as a direct input to the study.

Part III

Facilities Labor - Function:

- a. Equipment management
- b. General Installation Subcontractors equipment management
- c. Engineering support

For this study, it was estimated that this type of facilities labor would be 3% of direct fabrication and assembly manhours (Part II, Paragraph 3)

Part IV

Logistics - Function:

- a. Logistics engineering for maintenance analysis
- b. Technical manuals
- c. Field support engineering

The logistics manhours were a direct input from Boeing/Michoud Engineering Department Logistics hardware or spares were estimated at \$56 per engineering hour.

2.4 LABOR RATES

The labor rates used for this cost analyses are intended to be typical of the Aerospace industry. The development of these rates were based on a composite of the skill mixes (i.e., various levels and grades of supervision, engineers, technician, hourly and general salary type individuals). The rates are based on 1968 dollars without inflationary factors. The rates for program effort (exclusive of launch operations) were submitted to the Program Office at NASA-MSFC and verbal concurrence was received that they were within the industry average. (The launch operations rates were a Boeing best estimate based on 1968 actuals.)

Two types of labor rates were developed: (1) engineering, and (2) manufacturing. The various cost elements used in this study were classified into either of these two categories as follows:

- a. The engineering rates are applicable to:
 1. Engineering
 2. Logistics
 3. Program Management
 4. Program Planning and Reporting
 5. Manufacturing Technicians
- b. The manufacturing rates are applicable to:
 1. Laboratory Technicians
 2. Quality
 3. Direct Distributable
 4. Tool Sustaining
 5. Production
 6. Industrial Relations
 7. Training
 8. Facilities

2.4 (Continued)

In actual practice, each of the above cost elements would have a separate composite labor rate; however, for the purpose of this study and to keep the number of rates and/or calculations to a minimum, the above grouping was effected.

As a relatively significant difference in rates was found between those of the launch complex and those of other sites, a separate set of labor rates were developed and applied to activities conducted at the launch complex.

The resulting rates used for the cost analyses including applicable fringe benefits, other burdens and G&A are as follows:

<u>Program Exclusive of Launch Operations</u>	<u>Engineering</u>	<u>Manufacturing</u>
Base Labor Rate	\$ 6.43	\$4.26
Fringe Benefits	<u>1.51</u>	<u>1.00</u>
Subtotal	\$ 7.94	\$5.26
Other Burden & G&A	<u>3.87</u>	<u>4.46</u>
Total	<u>\$11.81</u>	<u>\$9.72</u>
 <u>Launch Operations</u>	 <u>Engineering</u>	 <u>Manufacturing</u>
Base Labor Rate	\$6.00	\$4.92
Fringe Benefits	<u>1.38</u>	<u>1.13</u>
Subtotal	7.38	6.05
Other Burden & G&A	<u>2.20</u>	<u>1.78</u>
Total	<u>\$9.58</u>	<u>\$7.83</u>

NOTE: This is the first book (Book A) of the three books which comprise Volume IV, Baseline AMLLV Cost, of the final documentation for "Cost Studies of Multipurpose Large Launch Vehicles". This Book A contains Section 3.0, AMLLV Get Ready "A" Cost. Book B contains Section 4.0, AMLLV Development Test "B" Costs. Book C contains Section 5.0, AMLLV First Unit "C" Cost. The pages in this volume are numbered sequentially in Book A through Book C.

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3.0 GET READY OR "A" COSTS

This section contains a detailed breakdown of the non-recurring - get ready or A costs. These are all of the costs associated with "Getting Ready" to produce and operate the first production article (e.g., basic design, Brick and Mortar Facilities, Tooling, Fabrication and Erection, etc.). The Resource Data was received from the affected working organizations in terms of the required manhours, materials, tooling, equipment and facilities. On this basic, elemental and overall costs were developed. The direct cost increments were sequentially totaled with factored indirect and supporting costs based on current and historical data. These indirect and supporting costs include the costs for quality control, program management, planning, training, structures, other program associated elements, overhead and/or burden costs and G&A. These costs are also expressed in terms of manhours and material dollars to the component level for each of the selected vehicles.

The preceding Figure 1.0.0.0-11 illustrates the Get Ready Cost flow diagram. Costs shown for the single stage vehicle include all of the costs as necessary to get ready to build the vehicle, GSE, manufacturing facility and launch complex. The costs shown for the injection stage single module (engine module) includes similar costs. Where the same manufacturing facility and launch facility will be used by both the main (single stage) and the injection stage modules, costs were apportioned between the stage components. Similarly, costs of the injection stage fuel module, solid motor fixed cost and the solid motor quality sensitive costs are subdivided and contain proportional costs for launch facility, manufacturing, facility, etc.

Each of these major headings are then further subdivided into its major cost items. The costs are included in the same box. The applicable paragraph number where back-up data has been presented is also shown in the box.

The lower level stage and system costs were developed, priced and summarized into the four major parts and their sub-division as defined in the previous Section 2.3.

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3.1 SINGLE STAGE VEHICLE

The total Get Ready or "A" costs for the Single Stage AMLLV vehicle are displayed in Table 3.1.0.0-I. These costs include the costs associated with designing the hardware structures, systems, liquid engines, Ground Support Equipment (GSE), the production facility and the Launch Complex facility. Figure 3.1.0.0-1 displays these costs and the appropriate sub-paragraph number for each item included in the Single Stage Vehicle.

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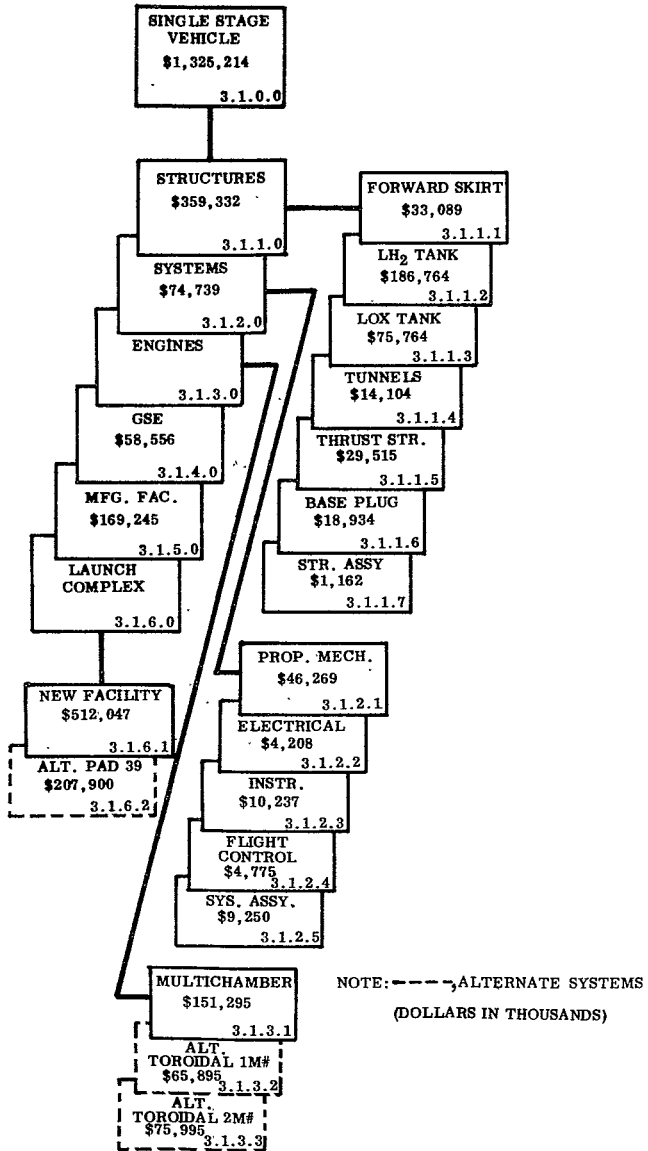


FIGURE 3.1.0.0-1 AMLLV SINGLE STAGE TO ORBIT VEHICLE GET READY, "A" COSTS

TABLE 3.1.0.0-I
 AMLLV COST SUMMARY

SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	829	5,056								829	5,056
PROGRAM PLAN. & REPT.	1,072	12,663								1,072	12,663
INDUSTRIAL RELATIONS	849	2,258								849	2,258
ENGINEERING			7,820	129,853						7,820	129,853
LAB TECHNICIANS			1,564	15,199						1,564	15,199
TOOLING			20,040	240,899						20,040	240,889
PRODUCTION			0	11,100						0	11,100
MANUFACTURING TEST			949	9,221						949	9,221
MANUFACTURING TECH.			505	5,968						505	5,968
Q & R A			5,438	52,841						5,438	52,841
FACILITIES											
DIRECT DIST			5,322	51,722						5,322	51,722
TRAINING			289	2,819						289	2,819
TOTAL DIRECT LABOR	2,750	19,977	41,927	519,612						44,677	539,589
MATERIAL		40		35,583							35,623
LOGISTIC HARDWARE											
BURDEN		15		12,100							12,115
TOTAL MATERIAL		55		47,683							47,738
TOTAL OTHER						721,387			*16,500		737,887
TOTAL COST		20,032		567,295		721,387			16,500		1,325,214

* See Engines

NOTE: "OTHER" INCLUDES MANUFACTURING FACILITY, LAUNCH FACILITY, AND GSE.

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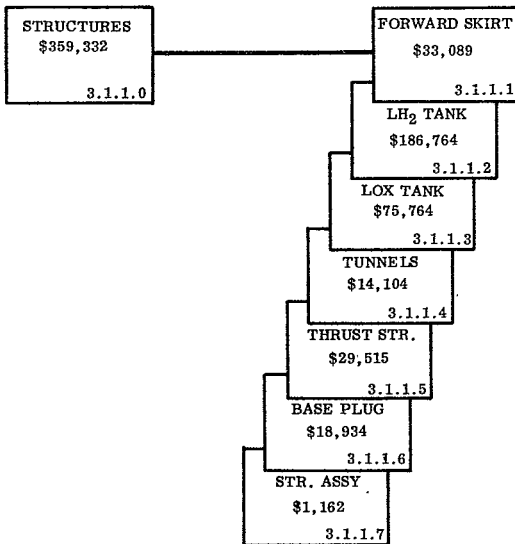
3.1.1 Structures

The Get Ready cost for the structural components of the single stage vehicle are displayed in Figure 3.1.1.0-1. The cost details of the structural components are contained in appropriate subparagraphs, as indicated.

Table 3.1.1.0-I is a total cost summary of these structures.

These costs are comprised of Basic (or Non-Recurring) Engineering Costs which are required to produce the basic tooling, fabrication and assembly of tooling, and basic article design, including all engineering such as manufacturing liaison and coordination required to produce the first article. These costs are non-recurring in that they are experienced once during the production cycle.

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(DOLLARS IN THOUSANDS)

FIGURE 3.1.1.0-1 AMLLV MAIN STAGE STRUCTURES COSTS GET READY, "A" COSTS

TABLE 3.1.1.0-I
 AMLLV COST SUMMARY

Single Stage - Structures

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	314	3,702								314	3,702
PROGRAM PLAN. & REPT.	787	9,293								787	9,293
INDUSTRIAL RELATIONS	170	1,658								170	1,658
ENGINEERING			5,355	63,242						5,355	63,242
LAB TECHNICIANS			1,071	10,409						1,071	10,409
TOOLING			15,177	147,522						15,177	147,522
PRODUCTION											
MANUFACTURING TEST			718	6,984						718	6,984
MANUFACTURING TECH.			384	4,525						384	4,525
Q & R A			4,069	39,550						4,069	39,550
FACILITIES											
DIRECT DIST			4,033	39,191						4,033	39,191
TRAINING			218	2,124						218	2,124
TOTAL DIRECT LABOR	1,271	14,653	31,025	313,547						32,296	328,200
MATERIAL		30		23,200							23,230
LOGISTIC HARDWARE											
BURDEN		11		7,891							7,902
TOTAL MATERIAL		41		31,091							31,132
TOTAL OTHER											
TOTAL COST		14,694		344,638							359,332

3.1.1.1 Forward Skirt - Standard (Lightweight Skirt)

TABLE 3.1.1.1-I

Forward Skirt - Single Stage

AMLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	24	283								24	283
PROGRAM PLAN. & REPT.	61	720								61	720
INDUSTRIAL RELATIONS	13	126								13	126
ENGINEERING			500	5,905						500	5,905
LAB TECHNICIANS			100	972						100	972
TOOLING			1,404	13,647						1,404	13,647
PRODUCTION											
MANUFACTURING TEST			66	646						66	646
MANUFACTURING TECH.			36	422						36	422
Q & R A			378	3,672						378	3,672
FACILITIES											
DIRECT DIST			372	3,619						372	3,619
TRAINING			20	194						20	194
TOTAL DIRECT LABOR	98	1,129	2,876	29,077						2,974	30,206
MATERIAL		2		2,149							2,151
LOGISTIC HARDWARE											
BURDEN		1		731							732
TOTAL MATERIAL		3		2,880							2,883
TOTAL OTHER											
TOTAL COST		1,132		31,957							33,089

AMLLV

PART I

Forward Skirt - Single Stage
ASSEMBLY OR SYSTEM

TABLE 3.1.1.1-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	(In Thousands) <u>Dollars</u>
<u>Direct Labor</u>			
Engineering	120		
Logistics			
Laboratory Technician	24		
Production			
Tooling	1,404		
Manufacturing Test	66		
Q&RA	378		
Facilities			
Manufacturing Technician	<u>36</u>		
Total Direct Labor	<u>2,028</u>		
Program Executive		24	283
Program Planning & Reporting		61	720
Industrial Relations		<u>13</u>	<u>126</u>
Total Labor - Part I		<u>98</u>	<u>1,129</u>
<u>Material</u>			
Program Planning & Reporting			1
Industrial Relations			<u>1</u>
Material Subtotal			<u>2</u>
Material & Administrative Burden			<u>1</u>
Total Material			<u>3</u>
TOTAL COST - PART I			<u>1,132</u>

TABLE 3.1.1.1-III

Forward Skirt - Single Stage

AMLLV PART II COST SUMMARY

A B C (IN THOUSANDS)

ELEMENT OF COST	DESIGN ENGINEERING		PRODUCTION		DESIGN & FAB. TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	120	1,417			380	4,488			500	5,905
LAB TECHNICIANS	24	233			76	739			100	972
TOOLING					1,404	13,647			1,404	13,647
PRODUCTION										
MANUFACTURING TEST							66	646	66	646
MANUFACTURING TECH.					32	402	2	20	36	422
Q&RA	5	49			355	3,451	18	172	378	3,672
DIRECT DIST					351	3,421	21	207	372	3,619
TRAINING					19	185	1	10	20	194
TOTAL DIRECT LABOR	149	1,699			2,619	26,324	108	1,054	2,876	29,077
MATERIAL										
LAB. TECHNICIANS		50				160				210
TOOLING						1,762				1,762
PRODUCTION										
MFG. TECHNICIANS						60	3			63
Q&RA		2				107	5			114
SUBTOTAL		52				2,089	8			2,149
MAT. & ADM. BURDEN		18				710	3			731
TOTAL MATERIAL		70				2,799	11			2,880
TOTAL PART II COST		1,769				29,123	1,065			31,957

AMLLV
 NON-RECURRING COSTS
 PART II-A FORWARD SKIRT - Single Stage
 ASSEMBLY OR SYSTEM (IN THOUSANDS)
 DESIGN ENGINEERING

<u>ELEMENT OF COST</u>	TABLE 3.1.1.1-IV	<u>MANHOURS</u>	<u>DOLLARS</u>
BASIC DESIGN		120	\$1,417
1. Laboratory Technicians		<u>24</u>	<u>233</u>
Subtotal		144	\$1,650
2. Q&RA		<u>5</u>	<u>49</u>
TOTAL ENGINEERING LABOR		<u>149</u>	<u>\$1,699</u>
MATERIAL			
3. Laboratory Technicians			\$ 50
4. Q&RA			<u>2</u>
Subtotal			\$ 52
5. Material and Adm. Burden			<u>18</u>
TOTAL MATERIAL			<u>\$ 70</u>
TOTAL ENGINEERING COST			<u>\$1,769</u>

AMLLV
NON-RECURRING COSTS

FORWARD SKIRT - Single Stage
PART IIB ASSEMBLY OR SYSTEM
TOOLING

(IN THOUSANDS)

TABLE 3.1.1.1-V

<u>ELEMENT OF COST</u>	<u>COLUMN I MANHOURS</u>	<u>COLUMN II MANHOURS</u>	<u>COLUMN III DOLLARS</u>
TOOL DESIGN		380	\$ 4,488
1. Lab. Tech.		<u>76</u>	<u>739</u>
TOTAL ENGR.		<u>456</u>	<u>\$ 5,227</u>
Fabrication and Erection			
Fab. & Assembly	1,007		\$ 9,788
Misc. Charges	79		768
Maintain & Add In Scope Changes	<u>11</u>		<u>107</u>
SUBTOTAL (A)	1,097		\$10,663
2. Tool and Production Planning	<u>307</u>		<u>2,984</u>
SUBTOTAL (B)	1,404		\$13,647
3. Direct Distributable	<u>351</u>		<u>3,412</u>
SUBTOTAL (C)	1,755		\$17,059
4. Training	<u>19</u>		<u>185</u>
SUBTOTAL (D)	1,774		\$17,244
5. Q&RA	355		3,451
6. Manufacturing Tech.	<u>34</u>		<u>402</u>
TOTAL PRODUCTION LABOR	<u>2,163</u>		<u>\$21,097</u>
MATERIAL			
7. Tooling			\$ 1,762
8. Lab. Tech.			160
9. Q&RA			107
10. Manufacturing Tech.			<u>60</u>
MATERIAL SUBTOTAL (E)			\$ 2,089
11. Material & Adm. Burden			<u>710</u>
TOTAL MATERIAL			<u>\$ 2,799</u>
TOTAL TOOLING COST			<u>\$29,123</u>

AMLLV
PART IIB
MANUFACTURING
MANUFACTURING TEST

Forward Skirt - Tooling - Single Stage

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 3.1.1.1-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	50,349	489,392
Component Test Planning	<u>16,112</u>	<u>156,605</u>
(1) Subtotal (A)	66,461	645,997
(2) Direct Distributable	<u>21,267</u>	<u>206,718</u>
Subtotal (B)	87,728	852,715
(3) Training	<u>965</u>	<u>9,380</u>
Subtotal (C)	88,693	862,095
(4) Mfg. Tech.	<u>1,685</u>	<u>19,901</u>
Subtotal (D)	90,378	881,996
(5) Q&RA	<u>17,739</u>	<u>172,418</u>
Total Mfg. Test Labor	<u>108,117</u>	<u>1,054,414</u>
 Material		
(6) Q&RA		5,322
(7) Mfg. Tech.		<u>2,949</u>
Subtotal (E)		8,271
(8) Material & Adm. Burden		<u>2,812</u>
Total Material		<u>11,083</u>
Total Mfg. Test Cost		<u>\$1,065,497</u>

3.1.1.2 LH₂ Tank

TABLE 3.1.1.2-I

AMLV COST SUMMARY LH₂ Tank - Single StageA B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
	PROGRAM EXECUTIVE	166	1,960								
PROGRAM PLAN. & REPT.	416	4,913								416	4,913
INDUSTRIAL RELATIONS	90	875								90	875
ENGINEERING			2,341	27,647						2,341	27,647
LAB TECHNICIANS			468	4,549						468	4,549
TOOLING			8,253	80,220						8,253	80,220
PRODUCTION											
MANUFACTURING TEST			391	3,799						391	3,799
MANUFACTURING TECH.			208	2,455						208	2,455
Q & R A			2,194	21,329						2,194	21,329
FACILITIES											
DIRECT DIST			2,188	21,267						2,188	21,267
TRAINING			119	1,153						119	1,153
TOTAL DIRECT LABOR	672	7,748	16,162	162,419						16,834	170,167
MATERIAL		17		12,368							12,385
LOGISTIC HARDWARE											
BURDEN		6		4,206							4,212
TOTAL MATERIAL		23		16,574							16,597
TOTAL OTHER											
TOTAL COST		7,771		178,993							\$186,764

AMLLV

PART I

LH₂ Tank - Single Stage
ASSEMBLY OR SYSTEM

TABLE 3.1.1.2-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>(In Thousands) Dollars</u>
<u>Direct Labor</u>			
Engineering	2,341		
Logistics			
Laboratory Technician	468		
Production			
Tooling	8,253		
Manufacturing Test	391		
Q&RA	2,194		
Facilities			
Manufacturing Technician	<u>208</u>		
Total Direct Labor	<u>13,855</u>		
Program Executive		166	1,960
Program Planning & Reporting		416	4,913
Industrial Relations		<u>90</u>	<u>875</u>
Total Labor - Part I		<u>672</u>	<u>7,748</u>
<u>Material</u>			
Program Planning & Reporting			8
Industrial Relations			<u>9</u>
Material Subtotal			17
Material & Administrative Burden			<u>6</u>
Total Material			<u>23</u>
TOTAL COST - PART I			<u>7,771</u>

TABLE 3.1.1.2-III

AMLLV PART II COST SUMMARY LH₂ Tank - Single StageA B C (IN THOUSANDS)

ELEMENT OF COST	DESIGN ENGINEERING		PRODUCTION		DESIGN & FAB. TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	105	1,240			2,236	26,407			2,341	27,647
LAB TECHNICIANS	21	204			447	4,345			468	4,549
TOOLING					8,253	80,220			8,253	80,220
PRODUCTION										
MANUFACTURING TEST							391	3,799	391	3,799
MANUFACTURING TECH.					198	2,338	10	117	208	2,455
Q&RA	4	39			2,086	20,276	104	1,014	2,194	21,329
DIRECT DIST					2,063	20,052	125	1,215	2,188	21,267
TRAINING					113	1,098	6	55	119	1,153
TOTAL DIRECT LABOR	130	1,483			15,396	154,736	636	6,200	16,162	162,419
MATERIAL										
LAB. TECHNICIANS		44				939				983
TOOLING						10,363				10,363
PRODUCTION										
MFG. TECHNICIANS						347		17		364
Q&RA		1				626		31		658
SUBTOTAL		45				12,275		48		12,368
MAT. & ADM. BURDEN		15				4,174		17		4,206
TOTAL MATERIAL		60				16,449		65		16,574
TOTAL PART II COST		1,543				171,185		6,265		178,993

AMLLV
 NON-RECURRING COSTS
 PART II-A LH₂ TANK - Single Stage
 ASSEMBLY OR SYSTEM
 DESIGN ENGINEERING
 TABLE 3.1.1.2-IV

<u>ELEMENT OF COST</u>	<u>MANHOURS</u>	<u>DOLLARS</u>
		(In Thousands)
BASIC DESIGN	105	\$1,240
1. Laboratory Technicians	<u>21</u>	<u>204</u>
Subtotal	126	1,444
2. Q&RA	<u>4</u>	<u>39</u>
TOTAL ENGINEERING LABOR	<u>130</u>	<u>\$1,483</u>
MATERIAL		
3. Laboratory Technicians		\$.44
4. Q&RA		<u>1</u>
Subtotal		45
5. Material and Adm. Burden		<u>15</u>
TOTAL MATERIAL		<u>60</u>
TOTAL ENGINEERING COST		<u>\$1,543</u>

AMLLV
NON-RECURRING COSTS

LH₂ TANK - Single Stage
PART IIB ASSEMBLY OR SYSTEM
TOOLING

TABLE 3.1.1.2-V

(In Thousands)

<u>ELEMENT OF COST</u>	<u>COLUMN I MANHOURS</u>	<u>COLUMN II MANHOURS</u>	<u>COLUMN III DOLLARS</u>
TOOL DESIGN		2,236	26,407
1. Lab. Tech.		<u>447</u>	<u>4,345</u>
TOTAL ENGR.		<u>2,683</u>	<u>\$ 30,752</u>
Fabrication and Erection			
Fab. & Assembly	5,921		57,552
Misc. Charges	462		4,491
Maintain & Add In Scope Changes	<u>65</u>		<u>632</u>
SUBTOTAL (A)	6,448		62,675
2. Tool and Production Planning	<u>1,805</u>		<u>17,545</u>
SUBTOTAL (B)	8,253		80,220
3. Direct Distributable	<u>2,063</u>		<u>20,052</u>
SUBTOTAL (C)	10,316		100,272
4. Training	<u>113</u>		<u>1,098</u>
SUBTOTAL (D)	10,429		101,370
5. Q&RA	2,086		20,276
6. Manufacturing Tech.	<u>198</u>		<u>2,338</u>
TOTAL PRODUCTION LABOR	<u>12,713</u>		<u>\$123,984</u>
MATERIAL			
7. Tooling			10,363
8. Lab. Tech.			939
9. Q&RA			626
10. Manufacturing Tech.			<u>347</u>
MATERIAL SUBTOTAL (E)			<u>12,275</u>
11. Material & Adm. Burden			<u>4,174</u>
TOTAL MATERIAL			<u>16,449</u>
TOTAL TOOLING COST			<u>\$171,185</u>

AMLLV
PART IIB
MANUFACTURING
MANUFACTURING TEST

LH₂ Tank - Tooling - Single Stage

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 3.1.1.2-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	296,072	2,877,820
Component Test Planning	94,743	920,902
(1) Subtotal (A)	390,815	3,798,722
(2) Direct Distributable	<u>125,061</u>	<u>1,215,591</u>
Subtotal (B)	515,876	5,014,313
(3) Training	<u>5,675</u>	<u>55,157</u>
Subtotal (C)	521,551	5,069,470
(4) Mfg. Tech.	<u>9,909</u>	<u>117,030</u>
Subtotal (D)	531,460	5,186,500
(5) Q&RA	<u>104,310</u>	<u>1,013,893</u>
Total Mfg. Test Labor	<u><u>635,770</u></u>	<u><u>6,200,393</u></u>
Material		
(6) Q&RA		31,293
(7) Mfg. Tech.		<u>17,341</u>
Subtotal (E)		48,634
(8) Material & Adm. Burden		<u>16,536</u>
Total Material		<u><u>65,170</u></u>
Total Mfg. Test Cost		<u><u>6,265,563</u></u>

TABLE 3.1.1.3-I

LOX TANK - SINGLE STAGE

AMLLV COST SUMMARY

ASSEMBLY OR SYSTEM

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	68	797								68	797
PROGRAM PLAN. & REPT.	169	1,995								169	1,995
INDUSTRIAL RELATIONS	36	356								36	356
ENGINEERING			1,106	13,062						1,106	13,062
LAB TECHNICIANS			221	2,148						221	2,148
TOOLING			3,217	31,270						3,217	31,270
PRODUCTION											
MANUFACTURING TEST			152	1,480						152	1,480
MANUFACTURING TECH.			81	955						81	955
Q & RA			854	8,297						854	8,297
FACILITIES											
DIRECT DIST			862								
TRAINING											
TOTAL DIRECT LABOR	273	3,148	6,539	66,037						6,812	69,185
MATERIAL		7		4,903							4,910
LOGISTIC HARDWARE											
BURDEN		2		1,667							1,669
TOTAL MATERIAL		9		6,570							6,579
TOTAL OTHER											
TOTAL COST		3,157		72,607							\$75,764

A MLLV

PART I

LOX Tank - Single Stage

ASSEMBLY OR SYSTEM

TABLE 3.1.1.3-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	(In Thousands) <u>Dollars</u>
<u>Direct Labor</u>			
Engineering	1,106		
Logistics			
Laboratory Technician	221		
Production			
Tooling	3,217		
Manufacturing Test	152		
Q&RA	854		
Facilities			
Manufacturing Technician	<u>81</u>		
Total Direct Labor	<u><u>5,631</u></u>		
Program Executive		68	797
Program Planning & Reporting		169	1,995
Industrial Relations		<u>36</u>	<u>356</u>
Total Labor - Part I		<u><u>273</u></u>	<u><u>3,148</u></u>
<u>Material</u>			
Program Planning & Reporting			3
Industrial Relations			<u>4</u>
Material Subtotal			7
Material & Administrative Burden			<u>2</u>
Total Material			<u><u>9</u></u>
TOTAL COST - PART I			<u><u>\$3,157</u></u>

TABLE 3.1.1.3-III

AMLLV PART II COST SUMMARY LOX Tank - Single Stage

A B C (IN THOUSANDS)

ELEMENT OF COST	DESIGN ENGINEERING		PRODUCTION		DESIGN & FAB. TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	235	2,775			871	10,287			1,106	13,062
LAB TECHNICIANS	47	457			174	1,691			221	2,148
TOOLING					3,217	31,270			3,217	31,270
PRODUCTION										
MANUFACTURING TEST							152	1,480	152	1,480
MANUFACTURING TECH.					77	909	4	46	81	955
Q&RA					813	7,902	41	395	854	8,297
DIRECT DIST	9	87			804	7,815	49	474	862	8,376
TRAINING					44	428	2	21	46	1,449
TOTAL DIRECT LABOR	291	3,319			6,000	60,302	248	2,416	6,539	66,037
MATERIAL										
LAB. TECHNICIANS		99				365				464
TOOLING						4,038				4,038
PRODUCTION										
MFG. TECHNICIANS						135		7		142
Q&RA		3				244		12		259
SUBTOTAL		102				4,782		19		4,903
MAT. & ADM. BURDEN		35				1,626		6		1,667
TOTAL MATERIAL		137				6,408		25		6,570
TOTAL PART II COST		3,456				66,710		2,441		72,607

AMLLV
 NON-RECURRING COSTS
 PART II-A LOX TANK - Single Stage

ASSEMBLY OR SYSTEM
 DESIGN ENGINEERING
 TABLE 3.1.1.3-IV

<u>ELEMENT OF COST</u>	(IN THOUSANDS)	
	<u>MANHOURS</u>	<u>DOLLARS</u>
BASIC DESIGN	235	\$2,775
1. Laboratory Technicians	47	457
Subtotal	282	\$3,232
2. Q&RA	9	87
TOTAL ENGINEERING LABOR	291	\$3,319
MATERIAL		
3. Laboratory Technicians		\$ 99
4. Q&RA		3
Subtotal		\$ 102
5. Material and Adm. Burden		35
TOTAL MATERIAL		\$ 137
TOTAL ENGINEERING COST		\$3,456

AMLLV
NON-RECURRING COSTS

LOX TANK - Single Stage
PART IIB ASSEMBLY OR SYSTEM
TOOLING

TABLE 3.1.1.3-V

(IN THOUSANDS)

<u>ELEMENT OF COST</u>	<u>COLUMN I MANHOURS</u>	<u>COLUMN II MANHOURS</u>	<u>COLUMN III DOLLARS</u>
TOOL DESIGN		871	\$10,287
1. Lab. Tech.		<u>174</u>	<u>1,691</u>
TOTAL ENGR.		<u>1,045</u>	<u>\$11,978</u>
Fabrication and Erection			
Fab. & Assembly	2,308		\$22,434
Misc. Charges	180		1,750
Maintain & Add In Scope Changes	<u>25</u>		<u>243</u>
SUBTOTAL (A)	2,513		\$24,427
2. Tool and Production Planning	<u>704</u>		<u>6,843</u>
SUBTOTAL (B)	3,217		\$31,270
3. Direct Distributable	<u>804</u>		<u>7,815</u>
SUBTOTAL (C)	4,021		\$39,085
4. Training	<u>44</u>		<u>428</u>
SUBTOTAL (D)	4,065		\$39,513
5. Q&RA	813		7,902
6. Manufacturing Tech.	<u>77</u>		<u>909</u>
TOTAL PRODUCTION LABOR	<u>4,955</u>		<u>\$48,324</u>
MATERIAL			
7. Tooling			\$ 4,038
8. Lab. Tech.			365
9. Q&RA			244
10. Manufacturing Tech.			<u>135</u>
MATERIAL SUBTOTAL (E)			4,782
11. Material & Adm. Burden			<u>1,626</u>
TOTAL MATERIAL			<u>6,408</u>
TOTAL TOOLING COST			<u>\$66,710</u>

AMLLV
 PART IIB
 MANUFACTURING
 MANUFACTURING TEST

LOX Tank - Tooling - Single Stage

ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 3.1.1.3-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	115,379	1,121,484
Component Test Planning	<u>36,921</u>	<u>358,874</u>
(1) Subtotal (A)	152,300	1,480,358
(2) Direct Distributable	<u>48,736</u>	<u>473,714</u>
Subtotal (B)	201,036	1,954,072
(3) Training	<u>2,211</u>	<u>21,494</u>
Subtotal (C)	203,247	1,975,566
(4) Mfg. Tech.	<u>3,862</u>	<u>45,607</u>
Subtotal (D)	207,109	2,021,173
(5) Q&RA	<u>40,650</u>	<u>395,114</u>
Total Mfg. Test Labor	<u><u>247,759</u></u>	<u><u>2,416,287</u></u>
Material		
(6) Q&RA		12,195
(7) Mfg. Tech.		<u>6,758</u>
Subtotal (E)		18,953
(8) Material & Adm. Burden		<u>6,444</u>
Total Material		<u><u>25,397</u></u>
Total Mfg. Test Cost		<u><u>\$2,441,684</u></u>

3.1.1.4 Tunnels

TABLE 3.1.1.4-I

Tunnels - Single Stage

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	13	154								13	154
PROGRAM PLAN. & REPT.	32	378								32	378
INDUSTRIAL RELATIONS	7	68								7	68
ENGINEERING			243	2,870						243	2,870
LAB TECHNICIANS			49	476						49	476
TOOLING			566	5,501						566	5,501
PRODUCTION											
MANUFACTURING TEST			27	260						27	260
MANUFACTURING TECH. Q & R A			154	1,499						154	1,499
FACILITIES											
DIRECT DIST			150	1,454						150	1,454
TRAINING			8	82						8	82
TOTAL DIRECT LABOR	52	600	1,212	12,315						1,264	12,915
MATERIAL											
LOGISTIC HARDWARE		2		885							887
BURDEN											
TOTAL MATERIAL		3		1,186							1,189
TOTAL OTHER											
TOTAL COST		603		13,501							14,104

AMLLV

PART I

Tunnels - Single Stage
ASSEMBLY OR SYSTEM

TABLE 3.1.1.4-II

(In Thousands)

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	243		
Logistics			
Laboratory Technician	49		
Production			
Tooling	566		
Manufacturing Test	27		
Q&RA	154		
Facilities			
Manufacturing Technician	<u>15</u>		
Total Direct Labor	<u>1,054</u>		
Program Executive		13	154
Program Planning & Reporting		32	378
Industrial Relations		<u>7</u>	<u>68</u>
Total Labor - Part I		<u>52</u>	<u>600</u>
<u>Material</u>			
Program Planning & Reporting			1
Industrial Relations			<u>1</u>
Material Subtotal			2
Material & Administrative Burden			<u>1</u>
Total Material			<u>3</u>
TOTAL COST - PART I			<u>\$603</u>

TABLE 3.1.1.4-III

Tunnels - Single Stage

AMLLV PART II COST SUMMARY

A B C (IN THOUSANDS)

ELEMENT OF COST	DESIGN ENGINEERING		PRODUCTION		DESIGN & FAB. TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	90	1,063			153	1,807			243	2,870
LAB TECHNICIANS	18	175			31	301			49	476
TOOLING					566	5,501			566	5,501
PRODUCTION										
MANUFACTURING TEST							27	260	27	260
MANUFACTURING TECH.					14	165	1	8	15	173
Q&RA	4	39			143	1,390	7	70	154	1,499
DIRECT DIST					141	1,371	9	83	150	1,454
TRAINING					8	78		4	8	82
TOTAL DIRECT LABOR	112	1,277			1,056	10,613	44	425	1,212	12,315
MATERIAL										
LAB. TECHNICIANS		38				65				103
TOOLING						710				710
PRODUCTION										
MFG. TECHNICIANS						25		1		26
Q&RA		1				43		2		46
SUBTOTAL		39				843		3		885
MAT. & ADM. BURDEN		13				287		1		301
TOTAL MATERIAL		52				1,130		4		1,186
TOTAL PART II COST		1,329				11,743		429		13,501

AMLLV
 NON-RECURRING COSTS
 PART II-A TUNNELS - Single Stage

<u>ELEMENT OF COST</u>	TABLE 3.1.1.4-IV	(IN THOUSANDS)
	<u>MANHOURS</u>	<u>DOLLARS</u>
BASIC DESIGN	90	\$1,063
1. Laboratory Technicians	<u>18</u>	<u>175</u>
Subtotal	108	\$1,238
2. Q&RA	<u>4</u>	<u>39</u>
TOTAL ENGINEERING LABOR	<u>112</u>	<u>\$1,277</u>
MATERIAL		
3. Laboratory Technicians		\$ 38
4. Q&RA		<u>1</u>
Subtotal		\$ 39
5. Material and Adm. Burden		<u>13</u>
TOTAL MATERIAL		<u>\$ 52</u>
TOTAL ENGINEERING COST		<u>\$1,329</u>

AMLLV
NON-RECURRING COSTS

TUNNELS - Single Stage
PART IIB ASSEMBLY OR SYSTEM
TOOLING

(IN THOUSANDS)

<u>ELEMENT OF COST</u>	<u>TABLE 3.1.1.4-V</u> <u>COLUMN I</u> <u>MANHOURS</u>	<u>COLUMN II</u> <u>MANHOURS</u>	<u>COLUMN III</u> <u>DOLLARS</u>
TOOL DESIGN		153	\$ 1,807
1. Lab. Tech.		<u>31</u>	<u>301</u>
TOTAL ENGR.		<u>184</u>	<u>\$ 2,108</u>
Fabrication and Erection			
Fab. & Assembly	406		\$ 3,946
Misc. Charges	32		311
Maintain & Add In Scope Changes	<u>4</u>		<u>39</u>
SUBTOTAL (A)	442		\$ 4,296
2. Tool and Production Planning	<u>124</u>		<u>1,205</u>
SUBTOTAL (B)	566		\$ 5,501
3. Direct Distributable	<u>141</u>		<u>1,321</u>
SUBTOTAL (C)	707		\$ 6,872
4. Training	<u>8</u>		<u>78</u>
SUBTOTAL (D)	715		\$ 6,950
5. Q&RA	143		1,390
6. Manufacturing Tech.	<u>14</u>		<u>165</u>
TOTAL PRODUCTION LABOR	<u>872</u>		<u>\$ 8,505</u>
MATERIAL			
7. Tooling			710
8. Lab. Tech.			65
9. Q&RA			43
10. Manufacturing Tech.			<u>25</u>
MATERIAL SUBTOTAL (E)			\$ 843
11. Material & Adm. Burden			<u>287</u>
TOTAL MATERIAL			<u>\$ 1,130</u>
TOTAL TOOLING COST			<u>\$11,743</u>

AMLLV
PART IIB
MANUFACTURING
MANUFACTURING TEST

Tunnels - Tooling - Single Stage

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 3.1.1.4-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	20,280	197,122
Component Test Planning	<u>6,490</u>	<u>63,079</u>
(1) Subtotal (A)	26,770	260,201
(2) Direct Distributable	<u>8,566</u>	<u>83,263</u>
Subtotal (B)	35,336	343,464
(3) Training	<u>389</u>	<u>3,777</u>
Subtotal (C)	35,725	347,241
(4) Mfg. Tech.	<u>679</u>	<u>8,015</u>
Subtotal (D)	36,404	355,256
(5) Q&RA	<u>7,145</u>	<u>69,447</u>
Total Mfg. Test Labor	<u><u>43,548</u></u>	<u><u>424,703</u></u>
Material		
(6) Q&RA		2,143
(7) Mfg. Tech.		<u>1,188</u>
Subtotal (E)		3,331
(8) Material & Adm. Burden		<u>1,133</u>
Total Material		<u><u>4,464</u></u>
Total Mfg. Test Cost		<u><u>429,167</u></u>

3.1.1.5 Thrust Structure

TABLE 3.1.1.5-I

AMLLV COST SUMMARY

Thrust Structure - Single Stage

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	25	295								25	295
PROGRAM PLAN. & REPT.	63	744								63	744
INDUSTRIAL RELATIONS	14	136								14	136
ENGINEERING			544	6,424						544	6,424
LAB TECHNICIANS			109	1,059						109	1,059
TOOLING			1,161	11,285						1,161	11,285
PRODUCTION											
MANUFACTURING TEST			55	534						55	534
MANUFACTURING TECH.			29	347						29	347
Q & R A			317	3,078						317	3,078
FACILITIES											
DIRECT DIST			308	2,990						308	2,990
TRAINING			17	164						17	164
TOTAL DIRECT LABOR	102	1,175	2,540	25,881						2,642	27,056
MATERIAL		2		1,833							1,833
LOGISTIC HARDWARE											
BURDEN		1		623							626
TOTAL MATERIAL		3		2,456							2,459
TOTAL OTHER											
TOTAL COST		1,178		28,337							\$29,515

AMLLV

PART I

Thrust Structure - Single Stage
ASSEMBLY OR SYSTEM

TABLE 3.1.1.5-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	(In Thousands) <u>Dollars</u>
<u>Direct Labor</u>			
Engineering	544		
Logistics			
Laboratory Technician	109		
Production			
Tooling	1,161		
Manufacturing Test	55		
Q&RA	317		
Facilities			
Manufacturing Technician	<u>29</u>		
Total Direct Labor	<u>2,215</u>		
Program Executive		25	295
Program Planning & Reporting		63	744
Industrial Relations		<u>14</u>	<u>136</u>
Total Labor - Part I		<u>102</u>	<u>\$1,175</u>
<u>Material</u>			
Program Planning & Reporting			1
Industrial Relations			<u>1</u>
Material Subtotal			2
Material & Administrative Burden			<u>1</u>
Total Material			<u>3</u>
TOTAL COST - PART I			<u>\$1,178</u>

TABLE 3.1.1.5-III

AMLV PART II COST SUMMARY Thrust Structure - Single Stage

A B C (IN THOUSANDS)

ELEMENT OF COST	DESIGN ENGINEERING		PRODUCTION		DESIGN & FAB. TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	230	2,716			314	3,708			544	6,424
LAB TECHNICIANS	46	447			63	612			109	1,059
TOOLING					1,161	11,285			1,161	11,285
PRODUCTION										
MANUFACTURING TEST							55	534	55	534
MANUFACTURING TECH.					28	331	1	16	29	347
Q&RA	9	87			293	2,848	15	143	317	3,078
DIRECT DIST					290	2,819	18	171	308	2,990
TRAINING					16	156	1	8	17	164
TOTAL DIRECT LABOR	285	3,250			2,165	21,759	89	872	2,539	25,881
MATERIAL										
LAB. TECHNICIANS		97				132				229
TOOLING						1,457				1,457
PRODUCTION										
MFG. TECHNICIANS						49	3			52
Q&RA		3				88	4			95
SUBTOTAL		100				1,726	7			1,833
MAT. & ADM. BURDEN		34				587	2			623
TOTAL MATERIAL		134				2,313	9			2,456
TOTAL PART II COST		3,384				24,072	881			28,337

AMLLV
 NON-RECURRING COSTS
 PART II-A THRUST STRUCTURE - Single Stage

ASSEMBLY OR SYSTEM

DESIGN ENGINEERING

(In Thousands)

<u>ELEMENT OF COST</u>	TABLE 3.1.1.5-IV	<u>MANHOURS</u>	<u>DOLLARS</u>
BASIC DESIGN		230	\$ 2,716
1. Laboratory Technicians		<u>46</u>	<u>447</u>
Subtotal		276	3,163
2. Q&RA		<u>9</u>	<u>87</u>
TOTAL ENGINEERING LABOR		<u><u>285</u></u>	<u><u>\$ 3,250</u></u>
MATERIAL			
3. Laboratory Technicians			\$ 97
4. Q&RA			<u>3</u>
Subtotal			100
5. Material and Adm. Burden			<u>34</u>
TOTAL MATERIAL			<u><u>134</u></u>
TOTAL ENGINEERING COST			<u><u>\$ 3,384</u></u>

AMLLV
NON-RECURRING COSTS

THRUST STRUCTURE - Single Stage
PART IIB ASSEMBLY OR SYSTEM
TOOLING

TABLE 3.1.1.5-V

(In Thousands)

<u>ELEMENT OF COST</u>	<u>COLUMN I MANHOURS</u>	<u>COLUMN II MANHOURS</u>	<u>COLUMN III DOLLARS</u>
TOOL DESIGN		314	3,708
1. Lab. Tech.		<u>63</u>	<u>612</u>
TOTAL ENGR.		<u>377</u>	<u>\$ 4,320</u>
Fabrication and Erection			
Fab. & Assembly	833		8,097
Misc. Charges	65		632
Maintain & Add In Scope Changes	<u>9</u>		<u>87</u>
SUBTOTAL (A)	907		8,816
2. Tool and Production Planning	<u>254</u>		<u>2,469</u>
SUBTOTAL (B)	1,161		11,285
3. Direct Distributable	<u>290</u>		<u>2,819</u>
SUBTOTAL (C)	1,451		14,104
4. Training	<u>16</u>		<u>156</u>
SUBTOTAL (D)	1,467		14,260
5. Q&RA	293		2,848
6. Manufacturing Tech.	<u>28</u>		<u>331</u>
TOTAL PRODUCTION LABOR	<u>1,788</u>		<u>\$ 17,439</u>
MATERIAL			
7. Tooling			1,457
8. Lab. Tech.			132
9. Q&RA			88
10. Manufacturing Tech.			<u>49</u>
MATERIAL SUBTOTAL (E)			1,726
11. Material & Adm. Burden			587
TOTAL MATERIAL			<u>2,313</u>
TOTAL TOOLING COST			<u>\$ 24,072</u>

AMLLV
PART IIB
MANUFACTURING
MANUFACTURING TEST

Thrust Structure - Tooling Single Stage

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 3.1.1.5-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	41,639	404,731
Component Test Planning	13,324	129,513
(1) Subtotal (A)	54,963	534,244
(2) Direct Distributable	<u>17,588</u>	<u>170,957</u>
Subtotal (B)	72,551	705,201
(3) Training	<u>798</u>	<u>7,757</u>
Subtotal (C)	73,350	712,958
(4) Mfg. Tech.	<u>1,394</u>	<u>16,458</u>
Subtotal (D)	74,744	729,416
(5) Q&RA	<u>14,670</u>	<u>142,591</u>
Total Mfg.. Test Labor	<u>89,414</u>	<u>872,007</u>
Material		
(6) Q&RA		4,401
(7) Mfg. Tech.		<u>2,439</u>
Subtotal (E)		6,840
(8) Material & Adm. Burden		<u>2,325</u>
Total Material		<u>9,165</u>
Total Mfg. Test Cost		<u>\$881,172</u>

3.1.1.6 Base Plug

TABLE 3.1.1.6-I

Base Plug - Single Stage

AMLEV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	17	201								17	201
PROGRAM PLAN. & REPT.	43	508								43	508
INDUSTRIAL RELATIONS	9	87								9	87
ENGINEERING			546	6,448						546	6,448
LAB TECHNICIANS			109	1,059						109	1,059
TOOLING			576	5,599						576	5,599
PRODUCTION											
MANUFACTURING TEST			27	265						27	265
MANUFACTURING TECH.			15	173						15	173
Q & RA			169	1,646						169	1,646
FACILITIES											
DIRECT DIST			153	1,485						153	1,485
TRAINING			8	82						8	82
TOTAL DIRECT LABOR	69	796	1,603	16,757						1,672	17,553
MATERIAL		2		1,029							1,031
LOGISTIC HARDWARE BURDEN		1		349							350
TOTAL MATERIAL		3		1,378							1,381
TOTAL OTHER											
TOTAL COST		799		18,135							\$18,934

AMLLV

PART I

Base Plug - Single Stage
ASSEMBLY OR SYSTEM

TABLE 3.1.1.6-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	(In Thousands) <u>Dollars</u>
<u>Direct Labor</u>			
Engineering	546		
Logistics			
Laboratory Technician	109		
Production			
Tooling	576		
Manufacturing Test	27		
Q&RA	169		
Facilities			
Manufacturing Technician	<u>15</u>		
Total Direct Labor	<u>1,442</u>		
Program Executive		17	201
Program Planning & Reporting		43	508
Industrial Relations		<u>9</u>	<u>87</u>
Total Labor - Part I		<u>69</u>	<u>\$796</u>
<u>Material</u>			
Program Planning & Reporting			1
Industrial Relations			<u>1</u>
Material Subtotal			2
Material & Administrative Burden			<u>1</u>
Total Material			<u>3</u>
TOTAL COST - PART I			<u>\$799</u>

TABLE 3.1.1.6-III

Base Plug - Single Stage

AMLLV PART II COST SUMMARY

A B C (IN THOUSANDS)

ELEMENT OF COST	DESIGN ENGINEERING		PRODUCTION		DESIGN & FAB. TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	390	4,606			156	1,842			546	6,448
LAB TECHNICIANS	78	758			31	301			109	1,059
TOOLING					576	5,599			576	5,599
PRODUCTION										
MANUFACTURING TEST							27	265	27	265
MANUFACTURING TECH.					14	165	1	8	15	173
Q&RA	16	156			146	1,419	7	71	169	1,646
DIRECT DIST					144	1,400	9	85	153	1,485
TRAINING					8	78		4	8	82
TOTAL DIRECT LABOR	484	5,520			1,075	10,804	44	433	1,603	16,757
MATERIAL										
LAB. TECHNICIANS		164				65				229
TOOLING						723				723
PRODUCTION										
MFG. TECHNICIANS						25		1		26
Q&RA		5				44		2		51
SUBTOTAL		169				857		3		1,029
MAT. & ADM. BURDEN		57				291		1		349
TOTAL MATERIAL		226				1,148		4		1,378
TOTAL PART II COST		\$5,746				\$11,952		\$437		\$18,135

AMLLV
 NON-RECURRING COSTS
 PART II-A BASE PLUG - Single Stage

ASSEMBLY OR SYSTEM
 DESIGN ENGINEERING

(IN THOUSANDS)

<u>ELEMENT OF COST</u>	TABLE 3.1.1.6-IV	<u>MANHOURS</u>	<u>DOLLARS</u>
BASIC DESIGN		390	\$4,606
1. Laboratory Technicians		<u>78</u>	<u>758</u>
Subtotal		468	\$5,364
2. Q&RA		<u>16</u>	<u>156</u>
TOTAL ENGINEERING LABOR		<u>484</u>	<u>\$5,520</u>
MATERIAL			
3. Laboratory Technicians			\$ 164
4. Q&RA			<u>5</u>
Subtotal			\$ 169
5. Material and Adm. Burden			<u>57</u>
TOTAL MATERIAL			<u>\$ 226</u>
TOTAL ENGINEERING COST			<u>\$5,746</u>

AMLLV
NON-RECURRING COSTS

BASE PLUG - Single Stage
PART IIB ASSEMBLY OR SYSTEM
TOOLING

(IN THOUSANDS)

TABLE 3.1.1.6-V

ELEMENT OF COST	COLUMN I MANHOURS	COLUMN II MANHOURS	COLUMN III DOLLARS
TOOL DESIGN		156	\$ 1,842
1. Lab. Tech.		31	301
TOTAL ENGR.		187	\$ 2,143
Fabrication and Erection			
Fab. & Assembly	413		\$ 4,014
Misc. Charges	32		311
Maintain & Add In Scope Changes	5		49
SUBTOTAL (A)	450		\$ 4,374
2. Tool and Production Planning	126		1,225
SUBTOTAL (B)	576		\$ 5,599
3. Direct Distributable	144		1,400
SUBTOTAL (C)	720		\$ 6,999
4. Training	8		78
SUBTOTAL (D)	728		\$ 7,077
5. Q&RA	146		1,419
6. Manufacturing Tech.	14		165
TOTAL PRODUCTION LABOR	888		\$ 8,661
MATERIAL			
7. Tooling			\$ 723
8. Lab. Tech.			65
9. Q&RA			44
10. Manufacturing Tech.			25
MATERIAL SUBTOTAL (E)			\$ 857
11. Material & Adm. Burden			291
TOTAL MATERIAL			\$ 1,148
TOTAL TOOLING COST			\$11,952

AMLLV
PART IIB
MANUFACTURING
MANUFACTURING TEST

Base Plug-Tooling - Single Stage

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 3.1.1.6-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	20,670	\$200,912
Component Test Planning	<u>6,614</u>	<u>64,292</u>
(1) Subtotal (A)	27,284	\$265,204
(2) Direct Distributable	<u>8,731</u>	<u>84,865</u>
Subtotal (B)	36,015	\$350,069
(3) Training	<u>395</u>	<u>3,850</u>
Subtotal (C)	36,411	\$353,919
(4) Mfg. Tech.	<u>692</u>	<u>8,170</u>
Subtotal (D)	37,103	\$362,089
(5) Q&RA	<u>7,282</u>	<u>70,784</u>
Total Mfg. Test Labor	<u><u>44,385</u></u>	<u><u>\$432,873</u></u>
Material		
(6) Q&RA		2,185
(7) Mfg. Tech.		<u>1,211</u>
Subtotal (E)		3,396
(8) Material & Adm. Burden		<u>1,154</u>
Total Material		<u><u>4,550</u></u>
Total Mfg. Test Cost		<u><u>\$437,423</u></u>

3.1.1.7 Structure Assembly

TABLE 3.1.1.7-I

Structure Assembly - Single Stage

AMLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	1	12								1	12
PROGRAM PLAN. & REPT.	3	35								3	35
INDUSTRIAL RELATIONS	1	10								1	10
ENGINEERING			75	846						75	886
LAB TECHNICIANS			15	146						15	146
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A			3	29						3	29
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR	5	57	93	1,061						98	1,118
MATERIAL				33							33
LOGISTIC HARDWARE											
BURDEN				11							11
TOTAL MATERIAL				44							44
TOTAL OTHER											
TOTAL COST		57		1,105							1,162

AMLLV

PART I

Structure Assembly - Single Stage
ASSEMBLY OR SYSTEM

TABLE 3.1.1.7-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	(In Thousands) <u>Dollars</u>
<u>Direct Labor</u>			
Engineering	75		
Logistics			
Laboratory Technician	15		
Production			
Tooling			
Manufacturing Test			
Q&RA	3		
Facilities			
Manufacturing Technician			
Total Direct Labor	<u>93</u>		
Program Executive		1	12
Program Planning & Reporting		3	35
Industrial Relations		<u>1</u>	<u>10</u>
Total Labor - Part I		<u>5</u>	<u>57</u>
<u>Material</u>			
Program Planning & Reporting			
Industrial Relations			
Material Subtotal			
Material & Administrative Burden			
Total Material			<u> </u>
TOTAL COST - PART I			<u>57</u>

TABLE 3.1.1.7-III

Structure Assembly - Single Stage

AMLLV PART II COST SUMMARY

A B C (IN THOUSANDS)

ELEMENT OF COST	DESIGN ENGINEERING		PRODUCTION		DESIGN & FAB. TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	75	886							75	886
LAB TECHNICIANS	15	146							15	146
TOOLING										
PRODUCTION										
MANUFACTURING TEST										
MANUFACTURING TECH.										
Q & RA	3	29							3	29
DIRECT DIST										
TRAINING										
TOTAL DIRECT LABOR	93	1,061							93	1,061
MATERIAL										
LAB. TECHNICIANS		32								32
TOOLING										
PRODUCTION										
MFG. TECHNICIANS										
Q&RA		1								1
SUBTOTAL		33								33
MAT. & ADM. BURDEN		11								11
TOTAL MATERIAL		44								44
TOTAL PART II COST		1,105								1,105

AMLLV
 NON-RECURRING COSTS
 PART II-A STRUCTURES ASSEMBLY - Single Stage

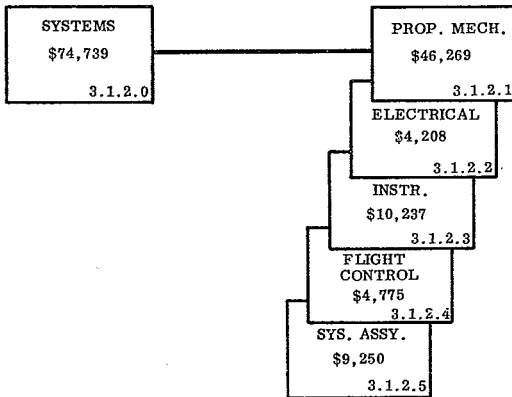
<u>ELEMENT OF COST</u>	TABLE 3.1.1.7-IV	(In Thousands)	
		<u>MANHOURS</u>	<u>DOLLARS</u>
BASIC DESIGN		75	\$ 886
1. Laboratory Technicians		<u>15</u>	<u>146</u>
Subtotal		90	\$1,032
2. Q&RA		<u>3</u>	<u>29</u>
TOTAL ENGINEERING LABOR		<u>93</u>	<u>\$1,061</u>
MATERIAL			
3. Laboratory Technicians			\$ 32
4. Q&RA			<u>1</u>
Subtotal			\$ 33
5. Material and Adm. Burden			<u>11</u>
TOTAL MATERIAL			<u>\$ 44</u>
TOTAL ENGINEERING COST			<u>\$1,105</u>

3.1.2 Systems

The Get Ready costs for the system components of the single stage vehicle are displayed in Figure 3.1.2.0-1. The details for each individual system component are contained in the appropriate subparagraph, as indicated in the figure.

Table 3.1.2.0-I is a total Get Ready cost of all of the systems.

These costs consist of basic (or non-recurring) engineering required to produce the basic tooling, fabrication and assembly of tooling, and basic article design including all engineering, such as, Manufacturing liaison and coordination required to produce the first article. These costs are non-recurring in that they are experienced once during the production cycle.



(DOLLARS IN THOUSANDS)

FIGURE 3.1.2.0-1 AMLLV MAIN STAGE SYSTEMS COSTS GET READY, "A" COSTS

TABLE 3.1.2.0-I
 AMLIV COST SUMMARY

SINGLE STAGE - SYSTEMS

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	69	814								69	814
PROGRAM PLAN. & REPT.	171	2,019								171	2,019
INDUSTRIAL RELATIONS	37	360								37	360
ENGINEERING			2,465	29,111						2,465	29,111
LAB TECHNICIANS			493	4,790						493	4,790
TOOLING			2,013	19,567						2,013	19,567
PRODUCTION											
MANUFACTURING TEST			96	925						96	925
MANUFACTURING TECH.			50	595						50	595
Q & RA			611	5,933						611	5,933
FACILITIES											
DIRECT DIST			534	5,187						534	5,187
TRAINING			30	295						30	295
TOTAL DIRECT LABOR	277	3,193	6,292	66,403						6,569	69,596
MATERIAL		6		3,833							3,839
LOGISTIC HARDWARE											
BURDEN		2		1,302							1,304
TOTAL MATERIAL		8		5,135							5,143
TOTAL OTHER											
TOTAL COST		3,201		71,538							74,739

3.1.2.1 Propulsion/Mechanical System

TABLE 3.1.2.1-I

AMLLV COST SUMMARY

PROP. & MECH. - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	42	496								42	496
PROGRAM PLAN. & REPT.	104	1,228								104	1,228
INDUSTRIAL RELATIONS	23	224								23	224
ENGINEERING			864	10,204						864	10,204
LAB TECHNICIANS			173	1,682						173	1,682
TOOLING			1,804	17,535						1,804	17,535
PRODUCTION											
MANUFACTURING TEST			86	830						86	830
MANUFACTURING TECH.			45	533						45	533
Q & R A			494	4,800						494	4,800
FACILITIES											
DIRECT DIST			478	4,650						478	4,650
TRAINING			26	255						26	255
TOTAL DIRECT LABOR	169	1,948	3,970	40,489						4,139	42,437
MATERIAL		4		2,856							2,860
LOGISTIC HARDWARE BURDEN		1		971							972
TOTAL MATERIAL		5		3,827							3,832
TOTAL OTHER											
TOTAL COST		1,953		44,316							46,269

AMLLV

PART I

PROP. & MECH. - S/S
ASSEMBLY OR SYSTEM

TABLE 3.1.2.1-II

(In Thousands)

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	864		
Logistics			
Laboratory Technician	173		
Production			
Tooling	1,804		
Manufacturing Test	85		
Q&RA	494		
Facilities			
Manufacturing Technician	45		
Total Direct Labor	<u>3,465</u>		
Program Executive		42	496
Program Planning & Reporting		104	1,228
Industrial Relations		<u>23</u>	<u>224</u>
Total Labor - Part I		<u>169</u>	<u>1,948</u>
<u>Material</u>			
Program Planning & Reporting			2
Industrial Relations			<u>2</u>
Material Subtotal			4
Material & Administrative Burden			<u>1</u>
Total Material			<u>5</u>
TOTAL COST - PART I			<u>1,953</u>

TABLE 3.1.2.1-III

AMLLV PART II COST SUMMARY

PROP. & MECH. - SINGLE STAGE

A B C (IN THOUSANDS)

ELEMENT OF COST	DESIGN ENGINEERING		PRODUCTION		DESIGN & FAB. TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	375	4,429			489	5,775			864	10,204
LAB TECHNICIANS	75	729			98	953			173	1,682
TOOLING					1,804	17,535			1,804	17,535
PRODUCTION										
MANUFACTURING TEST							86	830	86	830
MANUFACTURING TECH.					43	508	2	25	45	533
Q & RA	15	146			456	4,432	23	222	494	4,800
DIRECT DIST					451	4,384	27	266	478	4,650
TRAINING					25	243	1	12	26	255
TOTAL DIRECT LABOR	465	5,304			3,366	33,830	139	1,355	3,970	40,489
MATERIAL										
LAB. TECHNICIANS		158				206				364
TOOLING						2,265				2,265
PRODUCTION										
MFG. TECHNICIANS						75		3		78
Q&RA						137		7		149
SUBTOTAL		163				2,683		10		2,856
MAT. & ADM. BURDEN		55				912		4		971
TOTAL MATERIAL		218				3,595		14		3,827
TOTAL PART II COST		5,522				37,425		1,369		44,316

AMLLV
 NON-RECURRING COSTS
 PART II-A PROPULSION & MECHANICAL SYSTEM - S/S
 ASSEMBLY OR SYSTEM
 DESIGN ENGINEERING

<u>ELEMENT OF COST</u>	TABLE 3.1.2.1-IV	(In Thousands) <u>MANHOURS</u>	<u>DOLLARS</u>
BASIC DESIGN		375	\$4,429
1. Laboratory Technicians		<u>75</u>	<u>729</u>
Subtotal		450	\$5,158
2. Q&RA		<u>15</u>	<u>146</u>
TOTAL ENGINEERING LABOR		<u>465</u>	<u>\$5,304</u>
MATERIAL			
3. Laboratory Technicians			\$ 158
4. Q&RA			<u>5</u>
Subtotal			\$ 163
5. Material and Adm. Burden			<u>55</u>
TOTAL MATERIAL			<u>\$ 218</u>
TOTAL ENGINEERING COST			<u>\$5,522</u>

AMLLV
NON-RECURRING COST

PROPULSION & MECHANICAL SYSTEM - S/S
PART IIB ASSEMBLY OR SYSTEM
TOOLING

TABLE 3.1.2.1-V

(In Thousands)

<u>ELEMENT OF COST</u>	<u>COLUMN I MANHOURS</u>	<u>COLUMN II MANHOURS</u>	<u>COLUMN III DOLLARS</u>
TOOL DESIGN		489	\$ 5,775
1. Lab. Tech.		<u>98</u>	<u>953</u>
TOTAL ENGR.		<u>587</u>	<u>\$ 6,728</u>
Fabrication and Erection			
Fab. & Assembly	1,294		\$12,578
Misc. Charges	101		982
Maintain & Add In Scope Changes	<u>14</u>		<u>136</u>
SUBTOTAL (A)	1,409		\$13,696
2. Tool and Production Planning	<u>395</u>		<u>3,839</u>
SUBTOTAL (B)	1,804		\$17,535
3. Direct Distributable	<u>451</u>		<u>4,384</u>
SUBTOTAL (C)	2,255		\$21,919
4. Training	<u>25</u>		<u>243</u>
SUBTOTAL (D)	2,280		\$22,162
5. Q&RA	456		4,432
6. Manufacturing Tech.	<u>43</u>		<u>508</u>
TOTAL PRODUCTION LABOR	<u>2,779</u>		<u>\$27,102</u>
MATERIAL			
7. Tooling			\$ 2,265
8. Lab. Tech.			206
9. Q&RA			137
10. Manufacturing Tech.			<u>75</u>
MATERIAL SUBTOTAL (E)			\$ 2,683
11. Material & Adm. Burden			<u>912</u>
TOTAL MATERIAL			<u>\$ 3,595</u>
TOTAL TOOLING COST			<u>\$37,425</u>

AMLIV
 PART IIB
 MANUFACTURING
 MANUFACTURING TEST

PROP. & MECHANICAL SYSTEM - TOOLING - S/S

ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 3.1.2.1-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	64,718	629,059
Component Test Planning	<u>20,710</u>	<u>201,298</u>
(1) Subtotal (A)	85,428	830,357
(2) Direct Distributable	<u>27,337</u>	<u>265,714</u>
Subtotal (B)	112,765	1,096,071
(3) Training	<u>1,240</u>	<u>12,057</u>
Subtotal (C)	114,005	1,108,128
(4) Mfg. Tech.	<u>2,166</u>	<u>25,580</u>
Subtotal (D)	116,171	1,133,708
(5) Q&RA	<u>22,801</u>	<u>221,625</u>
Total Mfg. Test Labor	<u><u>138,972</u></u>	<u><u>1,355,333</u></u>
Material		
(6) Q&RA		6,840
(7) Mfg. Tech.		<u>3,791</u>
Subtotal (E)		10,631
(8) Material & Adm. Burden		<u>3,614</u>
Total Material		<u><u>14,245</u></u>
Total Mfg. Test Cost		<u><u>1,369,578</u></u>

3.1.2.2 Electrical System

TABLE 3.1.2.2-1

AMLLV COST SUMMARY

ELECTRICAL - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	4	47								4	47
PROGRAM PLAN. & REPT.	10	118								10	118
INDUSTRIAL RELATIONS	2	19								2	19
ENGINEERING			234	2,763						234	2,763
LAB TECHNICIANS			47	456						47	456
TOOLING			33	321						33	321
PRODUCTION											
MANUFACTURING TEST			2	15						2	15
MANUFACTURING TECH.			1	12						1	12
Q & R A			17	169						17	169
FACILITIES											
DIRECT DIST			9	83						9	83
TRAINING			1	10						1	10
TOTAL DIRECT LABOR	16	184	344	3,829						360	4,013
MATERIAL				146							146
LOGISTIC HARDWARE BURDEN				49							49
TOTAL MATERIAL				195							195
TOTAL OTHER											
TOTAL COST		184		4,024							4,208

AMLLV

PART I

ELECTRICAL - S/S
ASSEMBLY OR SYSTEM

TABLE 3.1.2.2-II

<u>Element of Cost</u>	<u>Manhours</u>	(In Thousands)	
		<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	234		
Logistics			
Laboratory Technician	47		
Production			
Tooling	33		
Manufacturing Test	2		
Q&RA	17		
Facilities			
Manufacturing Technician	1		
	<u>334</u>		
Program Executive		4	47
Program Planning & Reporting		10	118
Industrial Relations		2	19
		<u>16</u>	<u>184</u>
Total Labor - Part I			
<u>Material</u>			
Program Planning & Reporting			
Industrial Relations			
Material Subtotal			
Material & Administrative Burden			
Total Material			
TOTAL COST - PART I			
			<u>184</u>

TABLE 3.1.2.2-III

AMLV PART II COST SUMMARY

ELECTRICAL - SINGLE STAGE.

A B C (IN THOUSANDS)

ELEMENT OF COST	DESIGN ENGINEERING.		PRODUCTION		DESIGN & FAB. TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	225	2,657			9	106			234	2,763
LAB TECHNICIANS	45	437			2	19			47	456
TOOLING					33	321			33	321
PRODUCTION										
MANUFACTURING TEST							2	15	2	15
MANUFACTURING TECH.					1	12			1	12
Q&RA	9	87			8	78		4	17	169
DIRECT DIST					8	78	1	5	9	83
TRAINING					1	10			1	10
TOTAL DIRECT LABOR	279	3,181			62	624	3	24	344	3,829
MATERIAL										
LAB. TECHNICIANS		95				4				99
TOOLING						40				40
PRODUCTION										
MFG. TECHNICIANS						2				2
Q&RA		3				2				5
SUBTOTAL		98				48				146
MAT. & ADM. BURDEN		33				16				49
TOTAL MATERIAL		131				64				195
TOTAL PART II COST		3,312				688		24		4,024

AMLLV
 NON-RECURRING COSTS
 PART II-A ELECTRICAL SYSTEM -S/S

ASSEMBLY OR SYSTEM
 DESIGN ENGINEERING

(IN THOUSANDS)

<u>ELEMENT OF COST</u>	TABLE 3.1.2.2-IV	<u>MANHOURS</u>	<u>DOLLARS</u>
BASIC DESIGN		225	\$2,657
1. Laboratory Technicians		<u>45</u>	<u>437</u>
Subtotal		270	\$3,094
2. Q&RA		<u>9</u>	<u>87</u>
TOTAL ENGINEERING LABOR		<u>279</u>	<u>\$3,181</u>
MATERIAL			
3. Laboratory Technicians			\$ 95
4. Q&RA			<u>3</u>
Subtotal			\$ 98
5. Material and Adm. Burden			<u>33</u>
TOTAL MATERIAL			<u>\$ 131</u>
TOTAL ENGINEERING COST			<u>\$3,312</u>

AMLLV
NON-RECURRING COSTS
ELECTRICAL SYSTEM - S/S
PART IIB ASSEMBLY OR SYSTEM
TOOLING

TABLE 3.1.2.2-V

(IN THOUSANDS)

<u>ELEMENT OF COST</u>	<u>COLUMN I MANHOURS</u>	<u>COLUMN II MANHOURS</u>	<u>COLUMN III DOLLARS</u>
TOOL DESIGN		9	\$106
1. Lab. Tech.		<u>2</u>	<u>19</u>
TOTAL ENGR.		<u>11</u>	<u>\$125</u>
Fabrication and Erection			
Fab. & Assembly	23		\$224
Misc. Charges	2		19
Maintain & Add In Scope Changes	<u>1</u>		<u>10</u>
SUBTOTAL (A)	26		\$253
2. Tool and Production Planning	<u>7</u>		<u>68</u>
SUBTOTAL (B)	33		\$321
3. Direct Distributable	<u>8</u>		<u>78</u>
SUBTOTAL (C)	41		\$399
4. Training	<u>1</u>		<u>10</u>
SUBTOTAL (D)	42		\$409
5. Q&RA	8		78
6. Manufacturing Tech.	<u>1</u>		<u>12</u>
TOTAL PRODUCTION LABOR	<u>51</u>		<u>\$499</u>
MATERIAL			
7. Tooling			\$ 40
8. Lab. Tech.			4
9. Q&RA			2
10. Manufacturing Tech.			<u>2</u>
MATERIAL SUBTOTAL (E)			\$ 48
11. Material & Adm. Burden			<u>16</u>
TOTAL MATERIAL			<u>\$ 64</u>
TOTAL TOOLING COST			<u>\$688</u>

AMLLV
PART IIB
MANUFACTURING
MANUFACTURING TEST

ELECTRICAL SYSTEM - TOOLING - S/S

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 3.1.2.2-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	1,154	11,217
Component Test Planning	<u>369</u>	<u>3,589</u>
(1) Subtotal (A)	1,523	14,806
(2) Direct Distributable	<u>487</u>	<u>4,738</u>
Subtotal (B)	2,010	19,544
(3) Training	<u>22</u>	<u>215</u>
Subtotal (C)	2,032	19,759
(4) Mfg. Tech.	<u>39</u>	<u>456</u>
Subtotal (D)	2,071	20,215
(5) Q&RA	<u>407</u>	<u>3,951</u>
Total Mfg. Test Labor	<u><u>2,478</u></u>	<u><u>24,166</u></u>
Material		
(6) Q&RA		122
(7) Mfg. Tech.		<u>68</u>
Subtotal (E)		190
(8) Material & Adm. Burden		<u>64</u>
Total Material		<u><u>254</u></u>
Total Mfg. Test Cost		<u><u>24,420</u></u>

3.1.2.3 Instrumentation System

TABLE 3.1.2.3-I

- AMLLV COST SUMMARY

INSTRUMENTATION - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	10	118								10	118
PROGRAM PLAN. & REPT.	24	283								24	283
INDUSTRIAL RELATIONS	5	49								5	49
ENGINEERING			612	7,228						612	7,228
LAB TECHNICIANS			122	1,185						122	1,185
TOOLING			45	437						45	437
PRODUCTION											
MANUFACTURING TEST			2	20						2	20
MANUFACTURING TECH.			1	13						1	13
Q & R A			36	345						36	345
FACILITIES											
DIRECT DIST			12	114						12	114
TRAINING			1	10						1	10
TOTAL DIRECT LABOR	39	450	831	9,352						870	9,802
MATERIAL				325							325
LOGISTIC HARDWARE											
BURDEN				110							110
TOTAL MATERIAL				435							435
TOTAL OTHER											
TOTAL COST		450		9,787							10,237

AMLLV

PART I
INSTRUMENTATION - S/S
ASSEMBLY OR SYSTEM

TABLE 3.1.2.3-II

<u>Element of Cost</u>	<u>Manhours</u>	(In Thousands)	
		<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	612		
Logistics			
Laboratory Technician	122		
Production			
Tooling	45		
Manufacturing Test	2		
Q&RA	36		
Facilities			
Manufacturing Technician	1		
Total Direct Labor	<u>818</u>		
Program Executive		10	118
Program Planning & Reporting		24	283
Industrial Relations		<u>5</u>	<u>49</u>
Total Labor - Part I		<u>39</u>	<u>450</u>
<u>Material</u>			
Program Planning & Reporting			
Industrial Relations			
Material Subtotal			
Material & Administrative Burden			
Total Material			<u> </u>
TOTAL COST - PART I			<u>450</u>

TABLE 3.1.2.3-III

AMLLV PART II COST SUMMARY

INSTRUMENTATION - S/S

A B C (IN THOUSANDS)

ELEMENT OF COST	DESIGN ENGINEERING		PRODUCTION		DESIGN & FAB. TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	600	7,086			12	142			612	7,228
LAB TECHNICIANS	120	1,166			2	19			122	1,185
TOOLING					45	437			45	437
PRODUCTION										
MANUFACTURING TEST							2	20	2	20
MANUFACTURING TECH.					1	12		1	1	13
Q & RA	24	233			11	107	1	5	36	345
DIRECT DIST					11	107	1	7	12	114
TRAINING					1	10			1	10
TOTAL DIRECT LABOR	744	8,485			83	834	4	33	831	9,352
MATERIAL										
LAB. TECHNICIANS		252				4				256
TOOLING						56				56
PRODUCTION										
MFG. TECHNICIANS						2				2
Q&RA		7				3		1		11
SUBTOTAL		259				65		1		325
MAT. & ADM. BURDEN		88				22				110
TOTAL MATERIAL		347				87		1		435
TOTAL PART II COST		8,832				921		34		9,787

AMLLV
 NON-RECURRING COSTS
 PART II-A INSTRUMENTATION SYSTEM - S/S

ASSEMBLY OR SYSTEM

DESIGN ENGINEERING

(IN THOUSANDS)

<u>ELEMENT OF COST</u>	TABLE 3.1.2.3-IV	<u>MANHOURS</u>	<u>DOLLARS</u>
BASIC DESIGN		600	\$7,086
1. Laboratory Technicians		<u>120</u>	<u>1,166</u>
Subtotal		720	\$8,252
2. Q&RA		<u>24</u>	<u>233</u>
TOTAL ENGINEERING LABOR		<u>744</u>	<u>\$8,485</u>
MATERIAL			
3. Laboratory Technicians			\$ 252
4. Q&RA			<u>7</u>
Subtotal			\$ 259
5. Material and Adm. Burden			<u>88</u>
TOTAL MATERIAL			<u>\$ 347</u>
TOTAL ENGINEERING COST			<u>\$8,832</u>

AMLLV
 NON-RECURRING COSTS
INSTRUMENTATION SYSTEM - S/S
 PART IIB ASSEMBLY OR SYSTEM
 TOOLING
 (IN THOUSANDS)

TABLE 3.1.2.3-V

<u>ELEMENT OF COST</u>	<u>COLUMN I MANHOURS</u>	<u>COLUMN II MANHOURS</u>	<u>COLUMN III DOLLARS</u>
TOOL DESIGN		12	\$142
1. Lab. Tech.		<u>2</u>	<u>19</u>
TOTAL ENGR.		<u>14</u>	<u>\$161</u>
Fabrication and Erection			
Fab. & Assembly	32		\$311
Misc. Charges	2		19
Maintain & Add In Scope Changes	<u>1</u>		<u>10</u>
SUBTOTAL (A)	35		\$340
2. Tool and Production Planning	<u>10</u>		<u>97</u>
SUBTOTAL (B)	45		\$437
3. Direct Distributable	<u>11</u>		<u>107</u>
SUBTOTAL (C)	56		\$544
4. Training	<u>1</u>		<u>10</u>
SUBTOTAL (D)	57		\$554
5. Q&RA	11		107
6. Manufacturing Tech.	<u>1</u>		<u>12</u>
TOTAL PRODUCTION LABOR	<u>69</u>		<u>\$673</u>
MATERIAL			
7. Tooling			\$ 56
8. Lab. Tech.			4
9. Q&RA			3
10. Manufacturing Tech.			<u>2</u>
MATERIAL SUBTOTAL (E)			\$ 65
11. Material & Adm. Burden			<u>22</u>
TOTAL MATERIAL			<u>\$ 87</u>
TOTAL TOOLING COST			<u>\$921</u>

AMLLV
 PART IIB
 MANUFACTURING
 MANUFACTURING TEST
 INSTRUMENTATION SYSTEM - TOOLING - S/S

ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 3.1.2.3-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	1,587	15,426
Component Test Planning	<u>508</u>	<u>4,936</u>
(1) Subtotal (A)	2,095	20,362
(2) Direct Distributable	<u>670</u>	<u>6,515</u>
Subtotal (B)	2,765	26,877
(3) Training	<u>30</u>	<u>295</u>
Subtotal (C)	2,795	27,172
(4) Mfg. Tech.	<u>53</u>	<u>627</u>
Subtotal (D)	2,848	27,799
(5) Q&RA	<u>559</u>	<u>5,434</u>
Total Mfg. Test Labor	<u><u>3,407</u></u>	<u><u>33,233</u></u>
Material		
(6) Q&RA		168
(7) Mfg. Tech.		<u>93</u>
Subtotal (E)		261
(8) Material & Adm. Burden		<u>89</u>
Total Material		<u><u>350</u></u>
Total Mfg. Test Cost		<u><u>33,583</u></u>

3.1.2.4 Flight Control System

TABLE 3.1.2.4-I

AMLLV COST SUMMARY

FLIGHT CONTROL - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT.		CONT. END ITEM		FACILITIES		LOGISTICS		OTHER	TOTAL	
	PART I		PART II		PART III		PART IV			M/H	\$
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	4	47								4	47
PROGRAM PLAN. & REPT.	11	130								11	130
INDUSTRIAL RELATIONS	2	19								2	19
ENGINEERING			155	1,830						155	1,830
LAB TECHNICIANS			31	301						31	301
TOOLING			131	1,274						131	1,274
PRODUCTION											
MANUFACTURING TEST			6	60						6	60
MANUFACTURING TECH.			3	37						3	37
Q & R A			40	386						40	386
FACILITIES											
DIRECT DIST			35	340						35	340
TRAINING			2	20						2	20
TOTAL DIRECT LABOR	17	196	403	4,248						420	4,444
MATERIAL				247							247
LOGISTIC HARDWARE											
BURDEN				84							84
TOTAL MATERIAL				331							331
TOTAL OTHER											
TOTAL COST		196		4,579							4,775

AMLLV

PART I

FLIGHT CONTROL - S/S

ASSEMBLY OR SYSTEM

TABLE 3.1.2.4-II

<u>Element of Cost</u>	(EN THOUSANDS)		
	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	155		
Logistics			
Laboratory Technician	31		
Production			
Tooling	131		
Manufacturing Test	6		
Q&RA	40		
Facilities			
Manufacturing Technician	<u>3</u>		
Total Direct Labor	<u>366</u>		
Program Executive		4	47
Program Planning & Reporting		11	130
Industrial Relations		<u>2</u>	<u>19</u>
Total Labor - Part I		<u>17</u>	<u>196</u>
<u>Material</u>			
Program Planning & Reporting			
Industrial Relations			
Material Subtotal			
Material & Administrative Burden			
Total Material			<u> </u>
TOTAL COST - PART I			<u>196</u>

TABLE 3.1.2.4-III

AMLV PART II COST SUMMARY FLIGHT CONTROL - S/S

A B C (IN THOUSANDS)

ELEMENT OF COST	DESIGN ENGINEERING		PRODUCTION		DESIGN & FAB. TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	120	1,417			35	413			155	1,830
LAB TECHNICIANS	24	233			7	68			31	301
TOOLING					131	1,274			131	1,274
PRODUCTION										
MANUFACTURING TEST							6	60	6	60
MANUFACTURING TECH.					3	35		2	3	37
Q&RA	5	49			33	321	2	16	40	386
DIRECT DIST					33	321	2	19	35	340
TRAINING					2	19		1	2	20
TOTAL DIRECT LABOR	149	1,699			244	2,451	10	98	403	4,248
MATERIAL										
LAB. TECHNICIANS		50				15				65
TOOLING						164				164
PRODUCTION										
MFG. TECHNICIANS						5				5
Q&RA		2				10	1			13
SUBTOTAL		52				194	1			247
MAT. & ADM. BURDEN		18				66				84
TOTAL MATERIAL		70				260	1			331
TOTAL PART II COST		1,769				2,711	99			4,579

AMLLV
 NON-RECURRING COSTS
 PART II - FLIGHT CONTROL SYSTEM - S/S

ASSEMBLY OR SYSTEM
 DESIGN ENGINEERING

<u>ELEMENT OF COST</u>	TABLE 3.1.2.4-IV	(In Thousands) <u>MANHOURS</u>	<u>DOLLARS</u>
BASIC DESIGN		120	\$1,417
1. Laboratory Technicians		<u>24</u>	<u>233</u>
Subtotal		144	\$1,650
2. Q&RA		<u>5</u>	<u>49</u>
TOTAL ENGINEERING LABOR		<u>149</u>	<u>\$1,699</u>
MATERIAL			
3. Laboratory Technicians			\$ 50
4. Q&RA			<u>2</u>
Subtotal			\$ 52
5. Material and Adm. Burden			<u>18</u>
TOTAL MATERIAL			<u>\$ 70</u>
TOTAL ENGINEERING COST			<u>\$1,769</u>

AMLLV
NON-RECURRING COSTS
FLIGHT CONTROL SYSTEM - S/S
PART IIB ASSEMBLY OR SYSTEM
TOOLING

(IN THOUSANDS)

<u>ELEMENT OF COST</u>	<u>COLUMN I MANHOURS</u>	<u>COLUMN II MANHOURS</u>	<u>COLUMN III DOLLARS</u>
TOOL DESIGN		35	\$ 413
1. Lab. Tech.		<u>7</u>	<u>68</u>
TOTAL ENGR.		<u>42</u>	<u>\$ 481</u>
Fabrication and Erection			
Fab. & Assembly	94		\$ 914
Misc. Charges	7		68
Maintain & Add In Scope Changes	<u>1</u>		<u>10</u>
SUBTOTAL (A)	102		\$ 992
2. Tool and Production Planning	<u>29</u>		<u>282</u>
SUBTOTAL (B)	131		\$1,274
3. Direct Distributable	<u>33</u>		<u>321</u>
SUBTOTAL (C)	164		\$1,595
4. Training	<u>2</u>		<u>19</u>
SUBTOTAL (D)	166		\$1,614
5. Q&RA	33		321
6. Manufacturing Tech.	<u>3</u>		<u>35</u>
TOTAL PRODUCTION LABOR	<u>202</u>		<u>\$1,970</u>
MATERIAL			
7. Tooling			\$ 164
8. Lab. Tech.			15
9. Q&RA			10
10. Manufacturing Tech.			<u>5</u>
MATERIAL SUBTOTAL (E)			\$ 194
11. Material & Adm. Burden			<u>66</u>
TOTAL MATERIAL			<u>\$ 260</u>
TOTAL TOOLING COST			<u>\$2,711</u>

AMLLV
PART IIB
MANUFACTURING
MANUFACTURING TEST

FLIGHT CONTROL SYSTEM - TOOLING - S/S

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 3.1.2.4-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	4,690	45,587
Component Test Planning	1,501	14,588
(1) Subtotal (A)	<u>6,191</u>	<u>60,175</u>
(2) Direct Distributable	1,981	19,255
Subtotal (B)	8,172	79,430
(3) Training	90	873
Subtotal (C)	8,262	80,303
(4) Mfg. Tech.	157	1,853
Subtotal (D)	8,419	82,156
(5) Q&RA	1,652	16,060
Total Mfg. Test Labor	<u>10,071</u>	<u>98,216</u>
Material		
(6) Q&RA		496
(7) Mfg. Tech.		275
Subtotal (E)		<u>771</u>
(8) Material & Adm. Burden		262
Total Material		<u>1,033</u>
Total Mfg. Test Cost		<u>99,249</u>

3.1.2.5 System Assembly

TABLE 3.1.2.5-I

AMLLV COST SUMMARY

SYSTEMS ASSEMBLY - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	9	106								9	106
PROGRAM PLAN. & REPT.	22	260								22	260
INDUSTRIAL RELATIONS	5	49								5	49
ENGINEERING			600	7,086						600	7,086
LAB TECHNICIANS			120	1,166						120	1,166
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A			24	233						24	233
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR	36	415	744	8,485						780	8,900
MATERIAL		2		259							261
LOGISTIC HARDWARE BURDEN		1		88							89
TOTAL MATERIAL		3		347							350
TOTAL OTHER											
TOTAL COST		418		8,832							9,250

AMLLV

PART I
 SYSTEMS ASSEMBLY - S/S
ASSEMBLY OR SYSTEM

TABLE 3.1.2.5-II

<u>Element of Cost</u>	<u>Manhours</u>	(In Thousands)	
		<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	600		
Logistics			
Laboratory Technician	120		
Production			
Tooling			
Manufacturing Test			
Q&RA	24		
Facilities			
Manufacturing Technician			
	<hr/>		
Total Direct Labor	<u>744</u>		
Program Executive		9	106
Program Planning & Reporting		22	260
Industrial Relations		<u>5</u>	<u>49</u>
Total Labor - Part I		<u>36</u>	<u>415</u>
<u>Material</u>			
Program Planning & Reporting			1
Industrial Relations			<u>1</u>
Material Subtotal			2
Material & Administrative Burden			<u>1</u>
Total Material			<u>3</u>
TOTAL COST - PART I			<u>418</u>

TABLE 3.1.2.5-III

AMLLV PART II COST SUMMARY SYSTEMS ASSEMBLY - SINGLE STAGE

A B C (IN THOUSANDS)

ELEMENT OF COST	DESIGN ENGINEERING		PRODUCTION		DESIGN & FAB. TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	600	7,086							600	7,086
LAB TECHNICIANS	120	1,166							120	1,166
TOOLING										
PRODUCTION										
MANUFACTURING TEST										
MANUFACTURING TECH.										
Q&RA	24	233							23	233
DIRECT DIST										
TRAINING										
TOTAL DIRECT LABOR	744	8,485							744	8,485
MATERIAL										
LAB. TECHNICIANS		252								252
TOOLING										
PRODUCTION										
MFG. TECHNICIANS										
Q&RA		7								7
SUBTOTAL		259								259
MAT. & ADM. BURDEN		88								88
TOTAL MATERIAL		347								347
TOTAL PART II COST		8,832								8,832

AMLLV
 NON-RECURRING COSTS
 PART II-A SYSTEMS ASSEMBLY - S/S
 ASSEMBLY OR SYSTEM
 DESIGN ENGINEERING

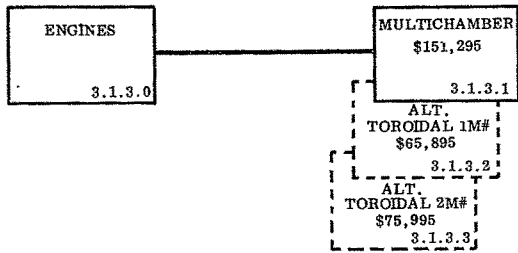
<u>ELEMENT OF COST</u>	TABLE 3.1.2.5-IV	(In Thousands)	
		<u>MANHOURS</u>	<u>DOLLARS</u>
BASIC DESIGN		600	\$7,086
1. Laboratory Technicians		<u>120</u>	<u>1,166</u>
Subtotal		720	\$8,252
2. Q&RA		<u>24</u>	<u>233</u>
TOTAL ENGINEERING LABOR		<u><u>744</u></u>	<u><u>\$8,485</u></u>
MATERIAL			
3. Laboratory Technicians			\$ 252
4. Q&RA			<u>7</u>
Subtotal			\$ 259
5. Material and Adm. Burden			<u>88</u>
TOTAL MATERIAL			<u><u>\$ 347</u></u>
TOTAL ENGINEERING COST			<u><u>\$8,832</u></u>

3.1.3 Liquid Engine Costs

This section shows the Get Ready costs for the following types of propulsion systems:

- 3.1.3.1 Multichamber/Plug (with 24 modules having fixed nozzles and a vacuum thrust per module of 793,000 pounds)
- 3.1.3.2 Toroidal/aerospike (2000 psia with 16 modules, each producing one million pound thrust at sea level)
- 3.1.3.3 Toroidal/aerospike (2000 psia with 8 modules, each producing two million pound thrust at sea level)

Figure 3.1.3.0-1 shows the AMLLV get ready, "A" costs for the multichamber/plug engine system. Alternative toroidal/aerospike engine systems costs are also shown.



NOTE:----- ALTERNATE SYSTEMS

(DOLLARS IN THOUSANDS)

FIGURE 3.1.3.0-1 AMLLV MAIN STAGE ENGINE OPTIONS COSTS GET READY, "A" COSTS

3.1.3.1 Multichamber/Plug Engine

Parametric cost data was received from Pratt and Whitney for the multichamber/plug propulsion system. This data covered a range of propulsion system sizes, i.e., from above the requirements for a full size AMLLV engine to below that of a half size (MLLV) engine (Figure 3.1.3.1-1). The data received included the total cost for engine development, PFRT and Qualifications Testing as a function of Module Vacuum Thrust.

As stated in Section 1.0, of this book, the program development costs (for the purpose of this study) were sub-divided into two categories: (1) Get Ready or "A" costs, and (2) Development Testing or "B" costs. Since the parametric data (Figure 3.1.3.1-1) included costs associated with both categories, it was necessary to establish the appropriate costs associated for each of the categories. The allocation pertaining to Get Ready costs will be discussed herein (The Development Test costs will be discussed in Book B).

The only cost data received, that reflected program costs for engine development (by "A" and "B" cost categories), was that submitted by Rocketdyne on the 1200 psia toroidal/aerospike engine system. Figure 3.1.3.1-2 displays, in terms of percentages, the elements of cost developed from this data.

The percentages developed were then applied to the multichamber/plug propulsion system total development costs to divide it into get ready and development test costs. The example below illustrates how these costs were divided.

Example: Pratt and Whitney total cost \$490 million X 22.7% (from Figure 3.1.3.1-2) = \$111,200 M Get Ready Cost, (the remainder being used in the Development Test or "B" costs.)

Table 3.1.3.1-I displays the results of this exercise. These costs were also supplemented by other costs for facilities and capital equipment.

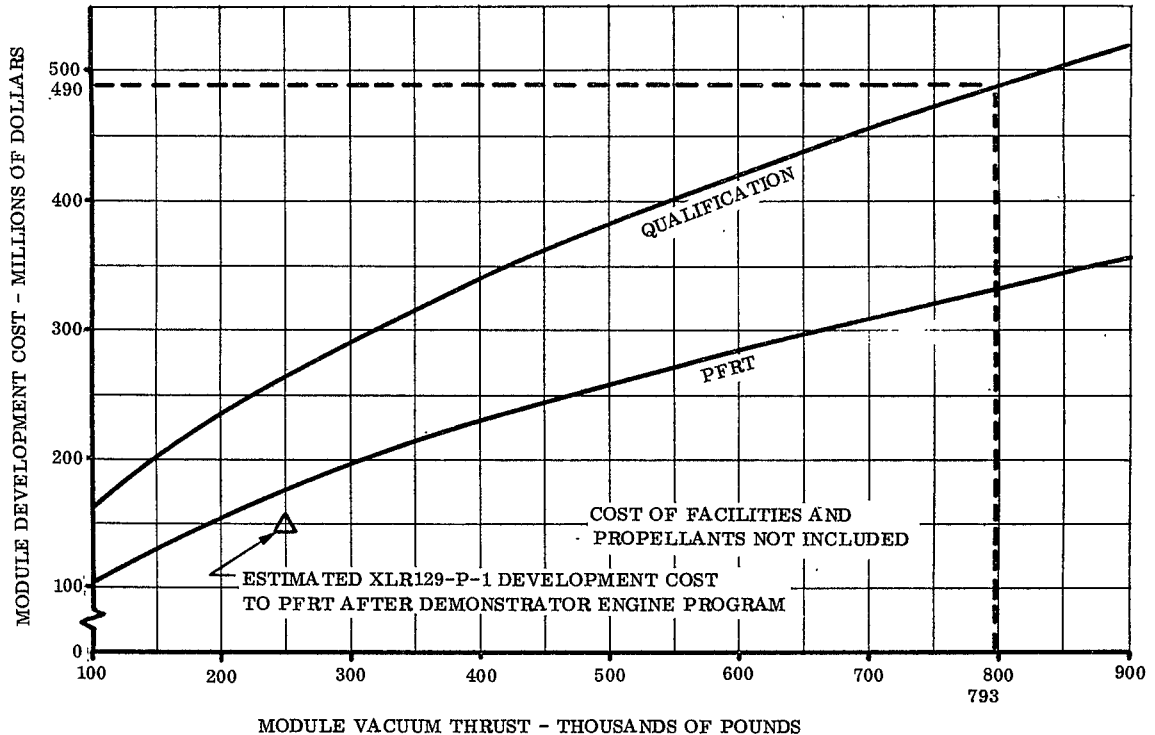


FIGURE 3.1.3.1-1 AMLLV ENGINE SYSTEM - ESTIMATED MODULE DEVELOPMENT COST OXYGEN/HYDROGEN MULTICHAMBER/PLUG PROPULSION SYSTEM (PRATT & WHITNEY DATA)

	GET READY OR "A" PERCENTAGES	DEVELOPMENT TEST OR "B" PERCENTAGES			
		COMPONENT	ENGINE	PFRT	QUAL.
Design and Development					
Engineering	72.2%	46.8%	34.7%	35.1%	35.1%
Test	-0-	22.6	12.7	8.8	8.8
Equipment	2.5	4.0	5.8	-0-	-0-
Tooling (Basic)	25.3	4.0	3.9	-0-	-0-
Fabrication	-0-	22.6	42.9	56.1	56.1
	<u>100.0%</u>	<u>100.0%</u>	<u>100.0%</u>	<u>100.0%</u>	<u>100.0%</u>
Subtotal	46.8%	24.9%	52.1%	11.5%	11.5%
Production (Non-Recurring)					
Tooling (Basic)	55.5%				
Equipment	16.7				
GSE	27.8				
	<u>100.0%</u>				
Subtotal	53.2%				
TOTAL	22.7%	77.3%			
		100.0%			

NOTE: Percentages based on 1200 psia 286K pound thrust module, as submitted by Rocketdyne in memo No. 68RC-16347 dated 20 December 1968.

These percentages were:

- (1) Used as is for the 1200 psia, 286 K thrust engine
- (2) Used to allocate the amounts applicable to "A" and "B" cost categories on the Multichamber/Plug engine.

FIGURE 3.1.3.1-2 DEVELOPMENT COST FOR 1200 PSIA TOROIDAL/AEROSPIKE PROPULSION SYSTEM DIVIDED INTO PERCENTAGES OF GET READY AND DEVELOPMENT TEST COST - BASED ON 1200 PSIA - 286,000 POUND THRUST MODULE

TABLE 3.1.3.1-I

AMLV COST SUMMARY

SINGLE STAGE - ENGINES - (MULTICHAMBER)

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING				37,500							37,500
LAB TECHNICIANS											
TOOLING				46,100							46,100
PRODUCTION				11,100							11,100
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR				94,700							94,700
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER						40,095			*16,500		56,595
TOTAL COST				94,700		40,095			16,500		151,295

* GSE

AMLLV MULTICHAMBER/PLUG ENGINE
(793 K LB THRUST)

TABLE 3.1.3.1-II

<u>Get Ready or "A" Cost</u>	<u>(Dollars In Thousands)</u>
Engineering	\$ 37,500
Tooling	46,100
Equipment	11,100
GSE	<u>16,500</u>
*Subtotal	\$111,200
**Facility and Capital Equipment	<u>40,095</u>
	<u><u>\$151,295</u></u>

TABLE 3.1.3.1-II

- * Developed from parametric data supplied by Pratt and Whitney and supplemented by percentages developed from Rocketdyne data.
- ** Cost estimate supplied by direct input from the Boeing/Huntsville Facilities Department.

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3.1.3.2 Toroidal/Aerospike Engine Cost (One Million Pound Thrust)

This paragraph presents the Get Ready cost for a toroidal/aerospike engine system consisting of sixteen 2000 psia modules, each of which will produce one million pounds of sea level thrust. Costs for this alternative engine system were supplied by Rocketdyne. However, the costs for the "A" and "B" categories were combined together.

In order to determine that amount which applied to "A" costs only, the same percentage apportionment between "A" and "B" costs used for the 1200 psia modules was applied to the 2000 psia propulsion system. Figure 3.1.3.2-1 displays, in terms of percentages, this breakdown of the categories. These percentages were then applied to the 2000 psia module data and the results are displayed in Table 3.1.3.2-I.

NOTE: The costs for this engine configuration are not added in the cost summary for the single stage vehicle shown in Table 3.1.3.1-I above. The toroidal/aerospike engine costs must substitute in lieu of those for the multichamber/plug engine to define the cost of the single stage vehicle with the toroidal/aerospike engine system.

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	GET READY OR "A" PERCENTAGES	DEVELOPMENT TEST OR "B" PERCENTAGES			
		COMPONENT	ENGINE	PFRT	QUAL.
Design and Development					
Engineering	68.2%	28.8%	26.7%	25.5%	25.5%
Test	-0-	13.9	6.7	6.4	6.4
Equipment	4.5	12.6	20.3	-0-	-0-
Tooling (Basic)	27.3	5.2	1.8	-0-	-0-
Fabrication	-0-	39.5	44.5	68.1	68.1
	100.0%	100.0%	100.0%	100.0%	100.0%
Subtotal	51.1%	34.5%	48.5%	8.5%	8.5%
Production (Non-Recurring)					
Tooling (Basic)	38.1%				
Equipment	23.8				
GSE	38.1				
	100.0%				
Subtotal	48.9%				
TOTAL	16.3%	83.7%			
		100%			

Percentages based on 1200 psia one million pound thrust module, as submitted by Rocketdyne, in memo No. 68RC-16347 dated 20 December 1968.

These percentages were:

- (1) Used as is for the 1200 psia, one million pound module.
- (2) Used to allocate the amount of cost applicable to on the "A" and "B" cost categories for the one and two million pound thrust modules.

FIGURE 3.1.3.2-1 DEVELOPMENT COSTS FOR THE 1200 PSIA TOROIDAL/AEROSPIKE PROPULSION SYSTEM DIVIDED INTO PERCENTAGES OF GET READY AND DEVELOPMENT TEST COSTS - BASED ON 1200 PSIA - 1 MILLION POUND THRUST MODULE

TABLE 3.1.3.2-I

SINGLE STAGE - ENGINES - (TOROIDAL) - 2000 PSI - 16 MODULE

AMLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN.& REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING				8,900							8,900
LAB TECHNICIANS											
TOOLING				7,600							7,600
PRODUCTION				3,600							3,600
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & RA											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR				20,100							20,100
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER						40,095			*	5,700	45,795
TOTAL COST				20,100		40,095				5,700	65,895

* GSE and Fee

AMLLV
SINGLE STAGE - ENGINE
*TOROIDAL

TABLE 3.1.3.2-II

"A" Costs

Engineering	\$ 8.9 \bar{m}
Test	
Equipment	.6 \bar{m}
Tooling (Basic)	3.6 \bar{m}
Fabrication	<u> </u>

Subtotal	\$13.1 \bar{m}
(Incl. Fee)	

Tooling (Basic)	\$ 4.0 \bar{m}
Equipment	3.0 \bar{m}
GSE	<u>4.5\bar{m}</u>

Subtotal	\$11.5 \bar{m}
(Incl. Fee)	<u>12.7\bar{m}</u>

(A and B = \$158.7 \bar{m})	Total	<u><u>\25.8\bar{m}$</u></u>
--------------------------------	-------	--

* 1.0 \bar{m} thrust per module, 2,000 PSI

Facilities - See Multichamber Plug Engine

3.1.3.3 Toroidal/Aerospike Engine Cost (Two Million Pound Thrust)

This paragraph presents the Get Ready cost for a toroidal/aerospike engine system consisting of eight 2000 psia modules, each of which will produce two million pounds of sea level thrust. Costs for this alternative engine system were supplied by Rocketdyne. However, the costs for the "A" and "B" categories were combined together.

In order to determine that amount which applied to "A" costs only, the same percentage apportionment between "A" and "B" costs used for the 1200 psia modules was applied to the 2000 psia propulsion system. Figure 3.1.3.2-1 displays, in terms of percentage, this breakdown of the categories. These percentages were then applied to the 2000 psia module data and the results are displayed in Table 3.1.3.3-I.

NOTE: The costs for this engine configuration are not added in the cost summary for the single stage vehicle as shown in Table 3.1.3.1-I above. The toroidal/aerospike cost must be substituted in lieu of those for the multichamber/plug engine to define the cost of the single stage vehicle with the toroidal/aerospike engine system.

TABLE 3.1.3.3-I

SINGLE STAGE - ENGINES - (TOROIDAL) - 2000 PSI - 8 MODULES

AMLIV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING				12,400							12,400
LAB TECHNICIANS											
TOOLING				10,500							10,500
PRODUCTION				5,100							5,100
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR				28,000							28,000
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER						40,095			*7,900		47,995
TOTAL COST				28,000		40,095			7,900		75,995

* GSE & FEE

AMLLV
 SINGLE STAGE ENGINE
 *TOROIDAL
 TABLE 3.1.3.3-II

"A" Costs

Engineering	\$12.4	
Test		
Equipment	.9	
Tooling (Basic)	4.9	
Fabrication		
Subtotal	\$18.2	\$18.2
Tooling (Basic)	5.6	
Equipment	4.2	
GSE	6.3	
Subtotal	\$16.1	\$16.1
(Incl. Fee)		\$17.7
(A and B = \$220.0m)	Total	\$35.9

* 2.0m 2000 PSI - Lbs Thrust - 8 Modules
 Facilities - See Multichamber

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3.1.4 Ground Support Equipment (GSE)

The Get Ready costs of the Ground Support Equipment (GSE) required for the single stage vehicle include such items as:

Test and Checkout Equipment:

- Electrical test station
- Mechanical test station
- Data system test station
- Interconnection equipment
- Checkout auxiliary equipment
- Test, checkout, calibration and maintenance equipment
- Sub-systems test equipment
- Sub-assemblies and parts test
- Data processing station

Handling and Transportation Equipment:

- General equipment
- Stage handling equipment
- Component handling equipment
- Stage transportation equipment

The Get Ready costs associated with this equipment is displayed in Table 3.1.4.0-I.

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TABLE 3.1.4.0-I
 AMLLV COST SUMMARY

GSE - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	46	540								46	540
PROGRAM PLAN. & REPT.	114	1,351								114	1,351
INDUSTRIAL RELATONS ENGINEERING	25	240								25	240
LAB TECHNICIANS											
TOOLING			2,850	27,700						2,850	27,700
PRODUCTION											
MANUFACTURING TEST			135	1,312						135	1,312
MANUFACTURING TECH. Q & R A			71	848						71	848
FACILITIES			758	7,358						758	7,358
DIRECT DIST TRAINING			755	7,344						755	7,344
			41	400						41	400
TOTAL DIRECT LABOR	185	2,131	4,610	44,962						4,795	47,093
MATERIAL		4		8,550							8,554
LOGISTIC HARDWARE BURDEN				2,907							2,909
TOTAL MATERIAL		6		11,457							11,463
TOTAL OTHER											
TOTAL COST		2,137		56,419							58,556

AMLLV

PART I

GSE - S/S
ASSEMBLY OR SYSTEM

TABLE 3.1.4.0-II

<u>Element of Cost</u>	<u>Manhours</u>	(In Thousands)	
		<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering			
Logistics			
Laboratory Technician			
Production			
Tooling	2,850		
Manufacturing Test	135		
Q&RA	758		
Facilities			
Manufacturing Technician	71		
	<u>3,814</u>		
Program Executive		46	540
Program Planning & Reporting		114	1,351
Industrial Relations		<u>25</u>	<u>240</u>
		<u>185</u>	<u>2,131</u>
<u>Material</u>			
Program Planning & Reporting			2
Industrial Relations			<u>2</u>
Material Subtotal			4
Material & Administrative Burden			<u>2</u>
Total Material			<u>6</u>
TOTAL COST - PART I			<u>2,137</u>

TABLE 3.1.4.0-III

AMLIV PART II COST SUMMARY

GSE - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING										
LAB TECHNICIANS										
TOOLING					2,850	27,700			2,850	27,700
PRODUCTION										
MANUFACTURING TEST							135	1,312	135	1,312
MANUFACTURING TECH.					68	808	3	40	71	848
Q & R A					721	7,001	37	357	758	7,358
DIRECT DIST					712	6,925	43	420	755	7,345
TRAINING					39	381	2	19	41	400
TOTAL DIRECT LABOR					4,390	42,815	220	2,147	4,610	44,962
MATERIAL										
LAB. TECHNICIANS										
TOOLING						8,362				8,362
PRODUCTION										
MFG. TECHNICIANS						120		6		126
Q & R A						51		11		62
SUBTOTAL						8,533		17		8,550
MAT. & ADM. BURDEN						2,901		6		2,907
TOTAL MATERIAL						11,434		23		11,457
TOTAL PART II COST						54,249		2,170		56,419

AMLLV
 NON-RECURRING COSTS
 GSE - S/S
 PART IIB ASSEMBLY OR SYSTEM
 TOOLING

TABLE 3.1.4.0-IV

ELEMENT OF COST	COLUMN I MANHOURS	COLUMN II MANHOURS	COLUMN III DOLLARS
TOOL DESIGN			
1. Lab. Tech.			
TOTAL ENGR.			
Fabrication and Erection			(In Thousands)
Fab. & Assembly	2,044,425		19,872
Misc. Charges	159,465		1,550
Maintain & Add In Scope Changes	22,489		218
SUBTOTAL (A)	2,226,379		21,640
2. Tool and Production Planning	623,386		6,060
SUBTOTAL (B)	2,849,765		27,700
3. Direct Distributable	712,441		6,925
SUBTOTAL (C)	3,562,206		34,625
4. Training	39,184		381
SUBTOTAL (D)	3,601,390		35,006
5. Q&RA	720,278		7,001
6. Manufacturing Tech.	68,426		808
TOTAL PRODUCTION LABOR	4,390,094		42,815
MATERIAL			
7. Tooling			8,362
8. Lab. Tech.			51
9. Q&RA			120
10. Manufacturing Tech.			8,533
MATERIAL SUBTOTAL (E)			8,533
11. Material & Adm. Burden			2,901
TOTAL MATERIAL			11,434
TOTAL TOOLING COST			54,249

* INCLUDED IN FAB & ASSEMBLY

AMLIV
 PART IIB
 MANUFACTURING
 MANUFACTURING TEST
 GSE - S/S

ASSEMBLY OR SYSTEM
 NON-RECURRING

TABLE 3.1.4.0-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	102,221	993,588
Component Test Planning	<u>32,711</u>	<u>317,951</u>
(1) Subtotal (A)	134,932	1,311,539
(2) Direct Distributable	<u>43,178</u>	<u>419,690</u>
Subtotal (B)	178,110	1,731,229
(3) Training	<u>1,959</u>	<u>19,042</u>
Subtotal (C)	180,069	1,750,271
(4) Mfg. Tech.	<u>3,421</u>	<u>40,402</u>
Subtotal (D)	183,490	1,790,673
(5) Q&RA	36,698	356,705
Total Mfg. Test Labor	<u><u>220,188</u></u>	<u><u>2,147,378</u></u>
Material		
(6) Q&RA		11,009
(7) Mfg. Tech.		<u>5,987</u>
Subtotal (E)		16,996
(8) Material & Adm. Burden		<u>5,779</u>
Total Material		<u><u>22,775</u></u>
Total Mfg. Test Cost		<u><u>2,170,153</u></u>

AMLLV
 PART II
 NON-RECURRING COST
 GSE - S/S

 ASSEMBLY OR SYSTEM

TABLE 3.1.4.0-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Material (\$)</u>
Test & C/O Equipment:		
General Equipment	70,225	\$ 287,220
Elec. Test Station	2,240	9,160
Mech. Test Station	4,663	19,072
Data Systems Test Station	10,480	42,863
Interconnect Equipment	72,360	295,952
C/O Aux. Equipment	111,650	456,649
Test C/O Calib. & Maint. Equip.	2,385	9,755
Sub Systems Test Equip.	360,485	1,474,384
Sub Assemblies & Parts Test	407,065	1,664,896
Data Processing Station	568	2,323
Engine Test & C/O equip.	51,805	211,882
Handling & Transportation Equip.		
General equip.	33,438	136,761
Stage Handling equip.	788,003	3,222,932
Component Handling equip.	106,433	435,311
Stage transportation equip.	20,195	82,598
Engine Handling equip.	2,430	9,939
TOTAL MGSE	<u>2,044,425</u>	<u>\$ 8,361,697</u>

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3.1.5 Manufacturing Facility

The Get Ready costs include costs for construction of the manufacturing building, the vertical assembly building, post manufacturing and stage test building, the office building, and the capital equipment. For a detailed description of the manufacturing facility refer to the Volume III of this report.

Transportation costs are also included for such items as the barges (for stage transportation), the tow vehicle, the land transporter, and the cost for the barge trip from the manufacturing facility to the launch site.

The total cost of these activities for the Single Stage Vehicle is displayed in Table 3.1.5.0-I.

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TABLE 3.1.5.0-I

AMLLV COST SUMMARY MANUFACTURING FACILITIES & TRANSPORTATION - S/S A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER						169,245					169,245
TOTAL COST						169,245					169,245

AMLLV
NON-RECURRING COST SUMMARY

SINGLE STAGE
FACILITIES & TRANSPORTATION
(DOLLARS IN THOUSANDS)

TABLE 3.1.5.0-II

<u>Element of Cost.</u>	<u>Facilities</u>	<u>Equipment</u>	<u>Transportation</u>
Manufacturing Bldg.	\$80,985	\$42,342	
Vertical Assy. Bldg.	14,437	4,594	
Post Mfg. & Stage Test Bldg.	4,500	300	
Liquid Engine Mfg. Bldg.			
Office	<u>13,406</u>	<u>1,586</u>	
Subtotal	\$113,328	\$48,822	
<u>Transportation</u>			
Barge			\$ 4,619
Tow Vehicle			82
Land Transporter			<u>2,394</u>
Subtotal			7,095
Transportation			7,095
Equipment			48,822
Facilities			<u>113,328</u>
MANUFACTURING FACILITIES COST			<u>\$169,245</u>

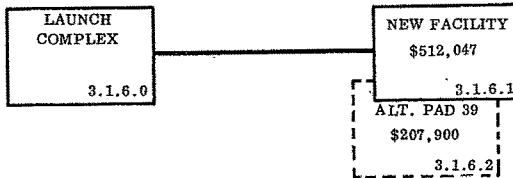
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3.1.6 Launch Complex Facility

The Launch Complex Facility for the Single Stage Vehicle consists of land, buildings, utility systems, machinery, laboratory equipment, electronic equipment, furniture, office equipment, vehicles and other equipment used in launching operations. For a further discussion of this facility refer to Volume III of this report.

Launch facility costs are provided for (1) a new facility, refer to Paragraph 3.1.6.1, and (2) an alternate launch facility, refer to Paragraph 3.1.6.2. Figure 3.1.6.0-1 shows the cost of a new facility and offers as an alternative launch facility the use of Launch Complex 39.

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NOTE: - - - ALTERNATE SYSTEMS

(DOLLARS IN THOUSANDS)

FIGURE 3.1.6.0-1 AMLLV SINGLE STAGE TO ORBIT VEHICLE LAUNCH COMPLEX FACILITY GET READY, "A" COSTS

3.1.6.1 Launch Complex Facility - New Facility

The Get Ready Cost for the Launch Complex facility for the Single Stage Vehicle includes such items as:

- Site development canal, hydraulic, fill, etc.
- Gantry crane
- Unloading crane
- Service structures
- Umbilical tower
- Core support and holddown boom
- Propellant storage and transfer and disposal system
- Stage storage acceptance test and checkout
- Launch and test control center
- Off site support complex

Total cost for this facility is displayed in Table 3.1.6.1-I.

TABLE 3.1.6.1-I

AMLLV COST SUMMARY LAUNCH COMPLEX FACILITIES - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER						512,047					512,047
TOTAL COST						512,047					512,047

AMLLV
 LAUNCH COMPLEX FACILITIES
 NON-RECURRING
 (DOLLARS IN THOUSANDS)

TABLE 3.1.6.1-II

<u>BRICK AND MORTAR</u>	(DOLLARS IN THOUSANDS)
1. Site Development Canal, Hyd. Fill, etc.	\$30,000
2. Reinforce Concrete Launch Pad (Flame Deflect)	120,000
3. Propellant Storage and Transfer and Disposal Systems	83,250
4. Launch and Test Control Center	20,000
5. Off-Site Support Complex	31,613
6. Stage Storage Acceptance Test & Checkout	<u>1,000</u>
	\$285,863
<u>GROUND SUPPORT EQUIPMENT</u>	
1. Gantry Equipment	\$12,000
2. Service Structure	45,000
3. Umbilical Tower	11,000
4. SRM Aft Support Structure	3,000
5. Core Support and Hold Down Boom	<u>10,000</u>
	81,000
<u>EQUIPMENT (GENERAL)</u>	
1. Test	125,000
2. Off Site Support	<u>20,184</u>
	<u>145,184</u>
 TOTAL	 <u><u>\$512,047</u></u>

3.1.6.2 Launch Complex Facility - Launch Complex 39

The Get Ready Cost for the Single Stage Vehicle from the existing Launch Complex 39 would require the following new items:

- Mobile Launcher
- Mobile Service Structure
- Firing Room

The launch pad, vertical assembly building and hydrogen facility would require modification only. The total cost of this effort is displayed in Table 3.1.6.2-I.

TABLE 3.1.6.2-1

AMLLV COST SUMMARY LAUNCH COMPLEX FACILITIES-PAD 39- S/S

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER						207,900					207,900
TOTAL COST						207,900					207,900

AMLLV
NON-RECURRING

* LAUNCH COMPLEX FACILITIES & EQUIPMENT

(DOLLARS IN THOUSANDS)

TABLE 3.1.6.2-II

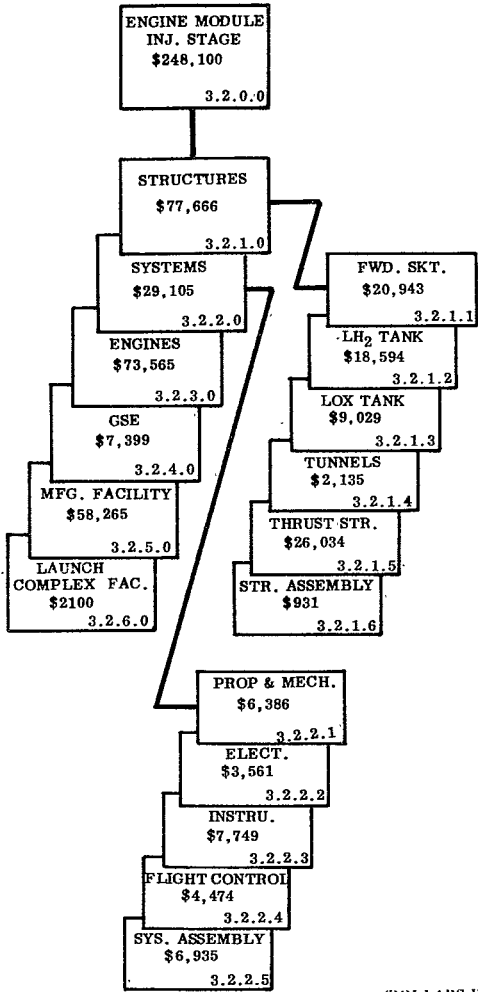
<u>Item</u>	<u>Dollars</u>
Launch Pad	56,000
Roadbed (Crawlway)	19,000
Ramp for Crawler	9,000
Mobil Launcher	51,000
Mobil Service Structure	19,000
Vehicle Assembly Bldg. Mod.	400
Firing Room	52,000
Hydrogen Facility	<u>1,500</u>
TOTAL	<u>207,900</u>

* Required for Launching the Single-Stage AMLLV from Launch Complex 39.

3.2 ENGINE MODULE - INJECTION STAGE

The Get Ready summary costs for the injection stage - engine module are displayed in Figure 3.2.0.0-1. Table 3.2.0.0-I displays the total cost for the injection stage-engine module by Part and by Element of Cost.

These costs include the cost associated with designing the hardware structures, systems, the liquid engines, the Ground Support Equipment (GSE), the production facility and the Launch Complex facility.



(DOLLARS IN THOUSANDS)

FIGURE 3.2.0.0-1 AMLLV INJECTION STAGE ENGINE MODULE GET READY, "A" COSTS

TABLE 3.2.0.0-I
 AMLLV COST SUMMARY

ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	103	1,213								103	1,213
PROGRAM PLAN. & REPT.	258	3,040								258	3,040
INDUSTRIAL RELATIONS	56	537								56	537
ENGINEERING			4,429	55,514						4,429	55,514
LAB TECHNICIANS			594	5,782						594	5,782
TOOLING			3,697	60,836						3,697	60,836
PRODUCTION				6,000							6,000
MANUFACTURING TEST			179	1,739						179	1,739
MANUFACTURING TECH.			92	1,102						92	1,102
Q & R A			1,064	10,351						1,064	10,351
FACILITIES											
DIRECT DIST			982	9,542						982	9,542
TRAINING			54	519						54	519
TOTAL DIRECT LABOR	417	4,790	11,091	151,385						11,508	156,175
MATERIAL		5		6,932	13,365						20,302
LOGISTIC HARDWARE											
BURDEN		2		2,356							2,356
TOTAL MATERIAL		7		9,288	13,365						22,660
TOTAL OTHER					**60,365			**8,900			69,265
TOTAL COST		4,790		160,673	73,730			8,900			248,100

* SEE TABLE 3.2.3.0-III

** SEE TABLES 3.2.5.0-II and 3.2.6.0-II

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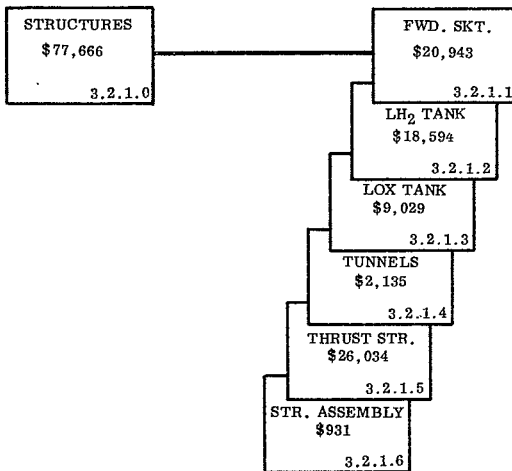
3.2.1 Structures

The Get Ready cost for the structural components of the injection stage - engine module are displayed in Figure 3.2.1.0-1. The cost details of these structural components are contained in the appropriate subparagraphs, as indicated.

Table 3.2.1.0-I is a total Get Ready cost of these structures.

These costs are comprised of basic (or non-recurring) engineering costs required to produce the basic tooling, fabrication and assembly of tooling, and basic article design including all engineering such as manufacturing liaison and coordination required to produce the first article. These costs are non-recurring in that they are experienced once during the production life of a model.

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(DOLLARS IN THOUSANDS)

FIGURE 3.2.1.0-1 AMLLV INJECTION STAGE - ENGINE MODULE STRUCTURES COSTS
GET READY, "A" COSTS

TABLE 3.2.1.0-I

AMLLV COST SUMMARY STRUCTURES - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	70	822								70	822
PROGRAM PLAN. & REPT.	174	2,057								174	2,057
INDUSTRIAL RELATIONS	38	363								38	363
ENGINEERING			2,856	16,544						2,856	16,544
LAB TECHNICIANS			280	2,725						280	2,725
TOOLING			3,067	29,813						3,067	29,813
PRODUCTION											
MANUFACTURING TEST			149	1,450						149	1,450
MANUFACTURING TECH.			76	914						76	914
Q & R A			837	8,141						837	8,141
FACILITIES											
DIRECT DIST			814	7,918						814	7,918
TRAINING			45	431						45	431
TOTAL DIRECT LABOR	282	3,242	8,124	67,936						8,406	71,178
MATERIAL		4		4,837							4,841
LOGISTIC HARDWARE											
BURDEN		2		1,645							1,647
TOTAL MATERIAL		6		6,482							6,488
TOTAL OTHER											
TOTAL COST		3,248		74,418							77,666

3.2.1.1 Forward Skirt

TABLE 3.2.1.1-I
 AMLLV COST SUMMARY

FORWARD SKIRT - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	19	224								19	224
PROGRAM PLAN. & REPT.	47	555								47	555
INDUSTRIAL RELATIONS	10	97								10	97
ENGINEERING			314	3,707						314	3,707
LAB TECHNICIANS			63	610						63	610
TOOLING			882	8,571						882	8,571
PRODUCTION											
MANUFACTURING TEST			42	406						42	406
MANUFACTURING TECH.			22	263						22	263
Q & R A			237	2,303						237	2,303
FACILITIES											
DIRECT DIST			233	2,273						233	2,273
TRAINING			13	124						13	124
TOTAL DIRECT LABOR	76	876	1,806	18,257						1,882	19,133
MATERIAL		2		1,348							1,350
LOGISTIC HARDWARE											
BURDEN		1		459							460
TOTAL MATERIAL		3		1,807							1,810
TOTAL OTHER											
TOTAL COST		879		20,064							20,943

AMLLV

PART I
 FORWARD SKIRT - E/M
ASSEMBLY OR SYSTEM

TABLE 3.2.1.1-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	(In Thousands) <u>Dollars</u>
<u>Direct Labor</u>			
Engineering	314		
Logistics			
Laboratory Technician	63		
Production			
Tooling	882		
Manufacturing Test	42		
Q&RA	237		
Facilities			
Manufacturing Technician	<u>22</u>		
Total Direct Labor	<u>1,560</u>		
Program Executive		19	224
Program Planning & Reporting		47	555
Industrial Relations		<u>10</u>	<u>97</u>
Total Labor - Part I		<u>76</u>	<u>876</u>
<u>Material</u>			
Program Planning & Reporting			1
Industrial Relations			<u>1</u>
Material Subtotal			2
Material & Administrative Burden			<u>1</u>
Total Material			<u>3</u>
TOTAL COST - PART I			<u>879</u>

TABLE 3.2.1.1-III

AMLLV PART II COST SUMMARY

FORWARD SKIRT - E/M

A B C (IN THOUSANDS)

ELEMENT OF COST	DESIGN ENGINEERING		PRODUCTION		DESIGN & FAB. TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	75	886			239	2,821			314	3,707
LAB TECHNICIANS	15	146			48	464			63	610
TOOLING					882	8,571			882	8,571
PRODUCTION										
MANUFACTURING TEST							42	406	42	406
MANUFACTURING TECH.					21	250	1	13	22	263
Q & RA	3	29			223	2,166	11	108	237	2,303
DIRECT DIST					220	2,143	13	130	233	2,273
TRAINING					12	118	1	6	13	124
TOTAL DIRECT LABOR	93	1,061			1,645	16,533	68	663	1,806	14,972
MATERIAL										
LAB. TECHNICIANS		31				100				131
TOOLING						1,107				1,107
PRODUCTION										
MFG. TECHNICIANS						37		2		39
Q&RA		1				67		3		71
SUBTOTAL		32				1,311		5		1,348
MAT. & ADM. BURDEN		11				446		2		459
TOTAL MATERIAL		43				1,757		17		1,807
TOTAL PART II COST		1,104				18,290		670		20,064

AMLLV
 NON-RECURRING COSTS
 PART II-A FORWARD SKIRT - E/M

ASSEMBLY OR SYSTEM
 DESIGN ENGINEERING

<u>ELEMENT OF COST</u>	TABLE 3.2.1.1-IV	<u>MANHOURS</u>	<u>DOLLARS</u>
BASIC DESIGN		75,000	\$ 885,750
1. Laboratory Technicians		<u>15,000</u>	<u>145,800</u>
Subtotal		90,000	\$1,031,550
2. Q&RA		<u>3,000</u>	<u>29,160</u>
TOTAL ENGINEERING LABOR		<u>93,000</u>	<u>\$1,060,710</u>
 MATERIAL			
3. Laboratory Technicians			\$ 31,500
4. Q&RA			<u>900</u>
Subtotal			\$ 32,400
5. Material and Adm. Burden			<u>11,016</u>
TOTAL MATERIAL			\$ <u>43,416</u>
TOTAL ENGINEERING COST			<u>\$1,104,126</u>

AMLLV
 NON-RECURRING COSTS
 FORWARD SKIRT - E/M
 PART IIB ASSEMBLY OR SYSTEM
 TOOLING

TABLE 3.2.1.1-V

<u>ELEMENT OF COST</u>	<u>COLUMN I MANHOURS</u>	<u>COLUMN II MANHOURS</u>	<u>COLUMN III DOLLARS</u>
TOOL DESIGN		238,862	\$ 2,820,960
1. Lab. Tech.		<u>47,772</u>	<u>464,344</u>
TOTAL ENGR.		<u>286,634</u>	<u>\$ 3,285,304</u>
Fabrication and Erection			
Fab. & Assembly	632,580		\$ 6,148,677
Misc. Charges	49,341		479,594
Maintain & Add In Scope Changes	<u>6,958</u>		<u>67,632</u>
SUBTOTAL (A)	688,879		\$ 6,695,903
2. Tool and Production Planning	<u>192,886</u>		<u>1,874,852</u>
SUBTOTAL (B)	881,765		\$ 8,570,755
3. Direct Distributable	<u>220,441</u>		<u>2,142,687</u>
SUBTOTAL (C)	1,102,206		\$10,713,442
4. Training	<u>12,124</u>		<u>117,845</u>
SUBTOTAL (D)	1,114,330		\$10,831,287
5. Q&RA	222,866		2,166,257
6. Manufacturing Tech.	<u>21,172</u>		<u>250,041</u>
TOTAL PRODUCTION LABOR	<u>1,358,368</u>		<u>\$13,247,585</u>
MATERIAL			
7. Tooling			\$ 1,107,015
8. Lab. Tech.			100,321
9. Q&RA			66,860
10. Manufacturing Tech.			<u>37,051</u>
MATERIAL SUBTOTAL (E)			\$ 1,311,247
11. Material & Adm. Burden			<u>445,824</u>
TOTAL MATERIAL			<u>\$ 1,757,071</u>
TOTAL TOOLING COST			<u>\$18,289,960</u>

AMLLV
 PART IIB
 MANUFACTURING
 MANUFACTURING TEST
FORWARD SKIRT - TOOLING - E/M
 ASSEMBLY OR SYSTEM
 NON-RECURRING

TABLE 3.2.1.1-1-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	31,629	307,434
Component Test Planning	<u>10,121</u>	<u>98,378</u>
(1) Subtotal (A)	41,750	405,812
(2) Direct Distributable	<u>13,360</u>	<u>129,859</u>
Subtotal (B)	55,110	535,671
(3) Training	<u>606</u>	<u>5,892</u>
Subtotal (C)	55,716	541,563
(4) Mfg. Tech.	<u>1,069</u>	<u>12,502</u>
Subtotal (D)	56,775	554,065
(5) Q&RA	<u>11,143</u>	<u>108,312</u>
Total Mfg. Test Labor	<u>67,918</u>	<u>662,377</u>
Material		
(6) Q&RA		3,343
(7) Mfg. Tech.		<u>1,853</u>
Subtotal (E)		5,196
(8) Material & Adm. Burden		<u>1,766</u>
Total Material		<u>6,962</u>
Total Mfg. Test Cost		<u>669,339</u>

3.2.1.2 LH₂ Tank

TABLE 3.2.1.2-I

AMLLV COST SUMMARY

LH₂ TANK - ENGINE MODULEA B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	17	197								17	197
PROGRAM PLAN. & REPT.	42	492								42	492
INDUSTRIAL RELATIONS	9	87								9	87
ENGINEERING			346	4,084						346	4,084
LAB TECHNICIANS			69	673						69	673
TOOLING			723	7,028						723	7,028
PRODUCTION											
MANUFACTURING TEST			38	371						38	371
MANUFACTURING TECH.			18	217						18	217
Q & R A			199	1,933						199	1,933
FACILITIES											
DIRECT DIST			193	1,876						193	1,876
TRAINING			11	102						11	102
TOTAL DIRECT LABOR	68	776	1,597	16,284						1,665	17,060
MATERIAL				1,145							1,145
LOGISTIC HARDWARE											
BURDEN				389							389
TOTAL MATERIAL				1,534							1,534
TOTAL OTHER											
TOTAL COST		776		17,818							18,594

AMLLV

PART I
LH₂ TANK - E/M

ASSEMBLY OR SYSTEM

TABLE 3.2.1.2-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	(in Thousands) <u>Dollars</u>
<u>Direct Labor</u>			
Engineering	346		
Logistics			
Laboratory Technician	69		
Production			
Tooling	723		
Manufacturing Test	38		
Q&RA	199		
Facilities			
Manufacturing Technician	<u>18</u>		
Total Direct Labor	<u>1,393</u>		
Program Executive		17	197
Program Planning & Reporting		42	49
Industrial Relations		<u>9</u>	<u>87</u>
Total Labor - Part I		<u>68</u>	<u>776</u>
<u>Material</u>			
Program Planning & Reporting			
Industrial Relations			
Material Subtotal			
Material & Administrative Burden			_____
Total Material			_____
TOTAL COST - PART I			<u>776</u>

TABLE 3.2.1.2-III

AMLV PART II COST SUMMARY LH₂ TANK - ENGINE MODULIA B C (IN THOUSANDS)

ELEMENT OF COST	DESIGN ENGINEERING		PRODUCTION		DESIGN & FAB. TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	150	1,771			196	2,313			346	4,084
LAB TECHNICIANS	30	292			39	381			69	673
TOOLING					723	7,028			723	7,028
PRODUCTION										
MANUFACTURING TEST							38	371	38	371
MANUFACTURING TECH.					17	205	1	12	18	217
Q&RA	6	58			183	1,776	10	99	199	1,933
DIRECT DIST					181	1,757	12	119	193	1,876
TRAINING					10	97	1	5	11	102
TOTAL DIRECT LABOR	186	2,121			1,349	13,557	62	606	1,597	16,284
MATERIAL										
LAB. TECHNICIANS		63				82				145
TOOLING						908				908
PRODUCTION										
MFG. TECHNICIANS						30	2			32
Q&RA		2				55	3			60
SUBTOTAL		65				1,075	5			1,145
MAT. & ADM. BURDEN		22				366	1			389
TOTAL MATERIAL		87				1,441	6			1,534
TOTAL PART II COST		2,208				14,998	612			17,818

AMLLV
 NON-RECURRING COSTS
 PART II-A LH₂ TANK - E/M
 ASSEMBLY OR SYSTEM
 DESIGN ENGINEERING

<u>ELEMENT OF COST</u>	TABLE 3.2.1.2-IV	<u>MANHOURS</u>	<u>DOLLARS</u>
BASIC DESIGN		150,000	\$1,771,500
1. Laboratory Technicians		<u>30,000</u>	<u>291,600</u>
Subtotal		180,000	\$2,063,100
2. Q&RA		<u>6,000</u>	<u>58,320</u>
TOTAL ENGINEERING LABOR		<u>186,000</u>	<u>\$2,121,420</u>
MATERIAL			
3. Laboratory Technicians			\$ 63,000
4. Q&RA			<u>1,800</u>
Subtotal			\$ 64,800
5. Material and Adm. Burden			<u>22,032</u>
TOTAL MATERIAL			<u>\$ 86,832</u>
TOTAL ENGINEERING COST			<u>\$2,208,252</u>

AMLLV
NON-RECURRING COSTS

LH₂ TANK - E/M
PART IIB ASSEMBLY OR SYSTEM
TOOLING

TABLE 3.2.1.2-V

<u>ELEMENT OF COST</u>	<u>COLUMN I MANHOURS</u>	<u>COLUMN II MANHOURS</u>	<u>COLUMN III DOLLARS</u>
TOOL DESIGN		195,861	\$2,313,118
1. Lab. Tech.		<u>39,172</u>	<u>380,752</u>
TOTAL ENGR.		<u>235,033</u>	<u>\$2,693,870</u>
Fabrication and Erection			
Fab. & Assembly	518,700		\$5,041,764
Misc. Charges	40,459		393,261
Maintain & Add In Scope Changes	<u>5,706</u>		<u>55,462</u>
SUBTOTAL (A)	564,865		\$5,490,487
2. Tool and Production Planning	<u>158,162</u>		<u>1,537,335</u>
SUBTOTAL (B)	723,027		\$7,027,822
3. Direct Distributable	<u>180,757</u>		<u>\$1,756,958</u>
SUBTOTAL (C)	3,784		\$8,784,780
4. Training	<u>1,942</u>		<u>96,636</u>
SUBTOTAL (D)	3,726		\$8,881,416
5. Q&RA	182,745		1,776,281
6. Manufacturing Tech.	<u>17,361</u>		<u>205,033</u>
TOTAL PRODUCTION LABOR	<u>1,113,832</u>		<u>\$10,862,730</u>
MATERIAL			
7. Tooling			907,725
8. Lab. Tech.			82,261
9. Q&RA			54,824
10. Manufacturing Tech.			30,382
MATERIAL SUBTOTAL (E)			<u>1,075,192</u>
11. Material & Adm. Burden			365,565
TOTAL MATERIAL			<u>\$1,440,757</u>
TOTAL TOOLING COST			<u>\$14,997,357</u>

AMLLV
 PART IIB
 MANUFACTURING
 MANUFACTURING TEST
LH₂ TANK - TOOLING - E/M
 ASSEMBLY OR SYSTEM
 NON-RECURRING
 TABLE 3.2.1.2-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	28,935	281,248
Component Test Planning	<u>9,259</u>	<u>89,999</u>
(1) Subtotal (A)	38,194	371,247
(2) Direct Distributable	<u>12,222</u>	<u>118,799</u>
Subtotal (B)	50,416	490,046
(3) Training	<u>555</u>	<u>5,390</u>
Subtotal (C)	50,971	495,436
(4) Mfg. Tech.	<u>968</u>	<u>11,437</u>
Subtotal (D)	51,939	506,873
(5) Q&RA	<u>10,194</u>	<u>99,087</u>
Total Mfg. Test Labor	<u><u>62,133</u></u>	<u><u>605,960</u></u>
Material		
(6) Q&RA		3,058
(7) Mfg. Tech.		<u>1,695</u>
Subtotal (E)		4,753
(8) Material & Adm. Burden		<u>1,616</u>
Total Material		<u><u>6,369</u></u>
Total Mfg. Test Cost		<u><u>612,329</u></u>

3.2.1.3 LOX Tank

TABLE 3.2.1.3-I

ANLLV COST SUMMARY

LOX TANK - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	8	96								8	96
PROGRAM PLAN. & REPT.	20	241								20	241
INDUSTRIAL RELATIONS	4	43								4	43
ENGINEERING			231	2,729						231	2,729
LAB TECHNICIANS			46	450						46	450
TOOLING			299	2,911						299	2,911
PRODUCTION											
MANUFACTURING TEST			14	138						14	138
MANUFACTURING TECH.			7	89						7	89
Q & R A			86	831						86	831
FACILITIES											
DIRECT DIST			80	772						80	772
TRAINING			4	42						4	42
TOTAL DIRECT LABOR	32	380	767	7,962						799	8,342
MATERIAL				513							513
LOGISTIC HARDWARE											
BURDEN				174							174
TOTAL MATERIAL				687							687
TOTAL OTHER											
TOTAL COST		380		8,649							9,029

AMLLV

PART I

LOX TANK - E/M

ASSEMBLY OR SYSTEM

TABLE 3.2.1.3-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	(In Thousands) <u>Dollars</u>
<u>Direct Labor</u>			
Engineering	231		
Logistics			
Laboratory Technician	46		
Production			
Tooling	299		
Manufacturing Test	14		
Q&RA	86		
Facilities	.		
Manufacturing Technician	<u>7</u>		
Total Direct Labor	<u>683</u>		
Program Executive		8	96
Program Planning & Reporting		20	241
Industrial Relations		<u>4</u>	<u>43</u>
Total Labor - Part I		<u>32</u>	<u>380</u>
<u>Material</u>			
Program Planning & Reporting			
Industrial Relations			
Material Subtotal			
Material & Administrative Burden			_____
Total Material			_____
TOTAL COST - PART I			<u>380</u>

TABLE 3.2.1.3-III

AMLLV PART II COST SUMMARY LOX TANK - E/M

A B C (IN THOUSANDS)

ELEMENT OF COST	DESIGN ENGINEERING		PRODUCTION		DESIGN & FAB. TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	150	1,771			81	958			231	2,729
LAB TECHNICIANS	30	292			16	158			46	450
TOOLING					299	2,912			299	2,912
PRODUCTION										
MANUFACTURING TEST							14	138	14	138
MANUFACTURING TECH.					7	85		4	7	89
Q&RA	6	58			76	736	4	37	86	831
DIRECT DIST					75	728	5	44	80	772
TRAINING					4	40		2	4	42
TOTAL DIRECT LABOR	186	2,121			558	5,616	23	225	767	7,962
MATERIAL										
LAB. TECHNICIANS		63				34				97
TOOLING						376				376
PRODUCTION										
MFG. TECHNICIANS						13		1		14
Q&RA		2				23		1		26
SUBTOTAL		65				446		2		513
MAT. & ADM. BURDEN		22				151		1		174
TOTAL MATERIAL		87				597		3		687
TOTAL PART II COST		2,208				6,213		228		8,649

AMLLV
 NON-RECURRING COSTS
 PART II-A LOX TANK - E/M

ASSEMBLY OR SYSTEM
 DESIGN ENGINEERING.

<u>ELEMENT OF COST</u>	<u>TABLE 3.2.1.3-IV</u>	<u>MANHOURS</u>	<u>DOLLARS</u>
BASIC DESIGN		150,000	\$ 1,771,500
1. Laboratory Technicians		<u>30,000</u>	<u>291,600</u>
Subtotal		180,000	2,063,100
2. Q&RA		<u>6,000</u>	<u>58,320</u>
TOTAL ENGINEERING LABOR		<u>186,000</u>	<u>\$ 2,121,420</u>
MATERIAL			
3. Laboratory Technicians			63,000
4. Q&RA			<u>1,800</u>
Subtotal			64,800
5. Material and Adm. Burden			<u>22,032</u>
TOTAL MATERIAL			\$ <u>86,832</u>
TOTAL ENGINEERING COST			\$ <u>2,208,252</u>

AMLLV
NON-RECURRING COSTS

LOX TANK - E/M
PART IIB ASSEMBLY OR SYSTEM
TOOLING
TABLE 3.2.1.3-V

<u>ELEMENT OF COST</u>	<u>COLUMN I MANHOURS</u>	<u>COLUMN II MANHOURS</u>	<u>COLUMN III DOLLARS</u>
TOOL DESIGN		81,142	958,287
1. Lab. Tech.		<u>16,228</u>	<u>157,736</u>
TOTAL ENGR.		<u>97,370</u>	<u>1,116,023</u>
Fabrication and Erection			
Fab. & Assembly	214,890		2,088,730
Misc. Charges	16,761		162,917
Maintain & Add In Scope Chang	<u>2,364</u>		<u>22,978</u>
SUBTOTAL (A)	234,015		2,274,625
2. Tool and Production Planning	<u>65,524</u>		<u>636,893</u>
SUBTOTAL (B)	299,539		2,911,518
3. Direct Distributable	<u>74,885</u>		<u>727,883</u>
SUBTOTAL (C)	374,424		3,639,401
4. Training	<u>4,119</u>		<u>40,037</u>
SUBTOTAL (D)	378,543		3,679,438
5. Q&RA	75,709		735,891
6. Manufacturing Tech.	<u>7,192</u>		<u>84,938</u>
TOTAL PRODUCTION LABOR	<u>461,444</u>		<u>\$ 4,500,267</u>
MATERIAL			
7. Tooling			376,058
8. Lab. Tech.			34,079
9. Q&RA			22,713
10. Manufacturing Tech.			<u>12,586</u>
MATERIAL SUBTOTAL (E)			<u>445,436</u>
11. Material & Adm. Burden			<u>151,448</u>
TOTAL MATERIAL			<u>\$ 597,886</u>
TOTAL TOOLING COST			<u>\$ 6,213,176</u>

MLLV
PART IIB
MANUFACTURING
MANUFACTURING TEST

LOX TANK - TOOLING - E/M

ASSEMBLY OR SYSTEM

NON-RECURRING

TABLE 3.2.1.3-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	10,745	104,441
Component Test Planning	<u>3,438</u>	<u>33,421</u>
(1) Subtotal (A)	14,183	137,862
(2) Direct Distributable	<u>4,539</u>	<u>44,115</u>
Subtotal (B)	18,722	181,977
(3) Training	<u>206</u>	<u>2,001</u>
Subtotal (C)	18,928	183,978
(4) Mfg. Tech.	<u>360</u>	<u>4,247</u>
Subtotal (D)	19,288	188,225
(5) Q&RA	<u>3,786</u>	<u>36,795</u>
Total Mfg. Test Labor	<u><u>23,074</u></u>	<u><u>225,020</u></u>
 Material		
(6) Q&RA		1,136
(7) Mfg. Tech.		<u>629</u>
Subtotal (E)		1,765
(8) Material & Adm. Burden		<u>600</u>
Total Material		<u><u>2,365</u></u>
Total Mfg. Test Cost		<u><u>227,385</u></u>

3.2.1.4 Tunnels

TABLE 3.2.1.4-I

AMLLV COST SUMMARY

TUNNELS - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	2	22								2	22
PROGRAM PLAN. & REPT.	5	57								5	57
INDUSTRIAL RELATIONS	1	10								1	10
ENGINEERING			75	881						75	881
LAB TECHNICIANS			15	145						15	145
TOOLING			54	523						54	523
PRODUCTION											
MANUFACTURING TEST			3	25						3	25
MANUFACTURING TECH.			1	15						1	15
Q & RA			15	161						15	161
FACILITIES											
DIRECT DIST			14	139						14	139
TRAINING			1	7						1	7
TOTAL DIRECT LABOR	8	89	178	1,896						186	1,985
MATERIAL				112							112
LOGISTIC HARDWARE BURDEN				38							38
TOTAL MATERIAL				150							150
TOTAL OTHER											
TOTAL COST		89		2,046							2,135

AMLLV

PART I

TUNNELS - E/M
ASSEMBLY OR SYSTEM

TABLE 3.2.1.4-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>(In Thousands)</u> <u>Dollars</u>
<u>Direct Labor</u>			
Engineering	75		
Logistics			
Laboratory Technician	15		
Production			
Tooling	54		
Manufacturing Test	3		
Q&RA	15		
Facilities			
Manufacturing Technician	1		
	<hr/>		
Total Direct Labor	163		
	<hr/> <hr/>		
Program Executive		2	22
Program Planning & Reporting		5	57
Industrial Relations		1	10
		<hr/>	<hr/>
Total Labor - Part I		8	89
		<hr/> <hr/>	<hr/> <hr/>
<u>Material</u>			
Program Planning & Reporting			
Industrial Relations			
Material Subtotal			
Material & Administrative Burden			
			<hr/>
Total Material			<hr/> <hr/>
			<hr/> <hr/>
TOTAL COST - PART I			89
			<hr/> <hr/>

TABLE 3.2.1.4-III

AMLLV PART II COST SUMMARY

TUNNELS - E/M

A B C (IN THOUSANDS)

ELEMENT OF COST	DESIGN ENGINEERING		PRODUCTION		DESIGN & FAB. TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	60	709			15	172			75	881
LAB TECHNICIANS	12	117			3	28			15	145
TOOLING					54	523			54	523
PRODUCTION										
MANUFACTURING TEST							3	25	3	25
MANUFACTURING TECH.					1	15			1	15
Q&RA	2	23			13	131		7	15	161
DIRECT DIST					13	131	1	8	14	139
TRAINING					1	7			1	7
TOTAL DIRECT LABOR	74	849			100	1,007	4	40	178	1,896
MATERIAL										
LAB. TECHNICIANS		25				6				31
TOOLING						68				68
PRODUCTION										
MFG. TECHNICIANS						2				2
Q&RA		7				4				11
SUBTOTAL		32				80				112
MAT. & ADM. BURDEN		11				27				38
TOTAL MATERIAL		43				107				150
TOTAL PART II COST		892				1,114		40		2,046

AMLLV
 NON-RECURRING COSTS
 PART II-A TUNNELS - E/M'
 ASSEMBLY OR SYSTEM
 DESIGN ENGINEERING

<u>ELEMENT OF COST</u>	TABLE 3.2.1.4-IV	<u>MANHOURS</u>	<u>DOLLARS</u>
BASIC DESIGN		60,000	\$708,600
1. Laboratory Technicians		<u>12,000</u>	<u>116,640</u>
Subtotal		72,000	\$825,240
2. Q&RA		<u>2,400</u>	<u>23,328</u>
TOTAL ENGINEERING LABOR		<u>74,400</u>	<u>\$848,568</u>
MATERIAL			
3. Laboratory Technicians			\$ 25,200
4. Q&RA			<u>7,200</u>
Subtotal			\$ 32,400
5. Material and Adm. Burden			<u>11,016</u>
TOTAL MATERIAL			<u>\$ 43,416</u>
TOTAL ENGINEERING COST			<u>\$891,984</u>

AMLLV
NON-RECURRING COSTS

TUNNELS - E/M
PART IIB ASSEMBLY OR SYSTEM
TOOLING

TABLE 3.2.1.4-V

<u>ELEMENT OF COST</u>	<u>COLUMN I MANHOURS</u>	<u>COLUMN II MANHOURS</u>	<u>COLUMN III DOLLARS</u>
TOOL DESIGN		14,579	\$172,178
1. Lab. Tech.		<u>2,916</u>	<u>28,344</u>
TOTAL ENGR.		<u>17,495</u>	<u>\$200,522</u>
Fabrication and Erection			
Fab. & Assembly	38,610		\$375,289
Misc. Charges	3,012		29,276
Maintain & Add In Scope Changes	<u>425</u>		<u>4,131</u>
SUBTOTAL (A)	42,047		\$408,696
2. Tool and Production Planning	<u>11,733</u>		<u>114,045</u>
SUBTOTAL (B)	53,780		\$522,741
3. Direct Distributable	<u>13,455</u>		<u>130,783</u>
SUBTOTAL (C)	67,235		\$653,524
4. Training	<u>740</u>		<u>7,193</u>
SUBTOTAL (D)	67,975		\$660,717
5. Q&RA	13,447		130,705
6. Manufacturing Tech.	<u>1,291</u>		<u>15,247</u>
TOTAL PRODUCTION LABOR	<u>82,713</u>		<u>\$806,669</u>
MATERIAL			
7. Tooling			\$ 67,568
8. Lab. Tech.			6,124
9. Q&RA			4,034
10. Manufacturing Tech.			<u>2,259</u>
MATERIAL SUBTOTAL (E)			\$ 79,985
11. Material & Adm. Burden			<u>27,195</u>
TOTAL MATERIAL			<u>\$107,180</u>
TOTAL TOOLING COST			<u>\$1,114,371</u>

AMLLV
 PART IIB
 MANUFACTURING
 MANUFACTURING TEST
TUNNELS - TOOLING - E/M
 ASSEMBLY OR SYSTEM
 NON-RECURRING

TABLE 3.2.1.4-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	1,931	18,769
Component Test Planning	<u>618</u>	<u>6,006</u>
(1) Subtotal (A)	2,549	24,775
(2) Direct Distributable	<u>816</u>	<u>7,928</u>
Subtotal (B)	3,365	32,703
(3) Training	<u>37</u>	<u>360</u>
Subtotal (C)	3,402	33,063
(4) Mfg. Tech.	<u>65</u>	<u>763</u>
Subtotal (D)	3,467	33,826
(5) Q&RA	<u>680</u>	<u>6,613</u>
Total Mfg. Test Labor	<u><u>4,147</u></u>	<u><u>40,439</u></u>
Material		
(6) Q&RA		204
(7) Mfg. Tech.		<u>113</u>
Subtotal (E)		317
(8) Material & Adm. Burden		108
Total Material		<u><u>425</u></u>
Total Mfg. Test Cost		<u><u>40,864</u></u>

3.2.1.5 · Thrust Structure

TABLE 3.2.1.5-I
 AMLLV COST SUMMARY

THRUST STRUCTURE - F/M

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	23	274								23	274
PROGRAM PLAN. & REPT.	58	686								58	686
INDUSTRIAL RELATIONS	13	122								13	122
ENGINEERING			375	4,434						375	4,434
LAB TECHNICIANS			75	730						75	730
TOOLING			1,109	10,780						1,109	10,780
PRODUCTION											
MANUFACTURING TEST			52	510						52	510
MANUFACTURING TECH.			28	330						28	330
Q & R A			298	2,890						298	2,890
FACILITIES											
DIRECT DIST			294	2,858						294	2,858
TRAINING			16	156						16	156
TOTAL DIRECT LABOR	94	1,082	2,247	22,688						2,341	23,770
MATERIAL		2		1,687							1,689
LOGISTIC HARDWARE BURDEN		1		574							575
TOTAL MATERIAL		3		2,261							2,264
TOTAL OTHER											
TOTAL COST		1,085		24,949							26,034

AMLLV

PART I

THRUST STRUCTURE - E/M

ASSEMBLY OR SYSTEM

TABLE 3.2.1.5-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	(In Thousands) <u>Dollars</u>
<u>Direct Labor</u>			
Engineering	375		
Logistics			
Laboratory Technician	75		
Production			
Tooling	1,109		
Manufacturing Test	53		
Q&RA	297		
Facilities			
Manufacturing Technician	<u>28</u>		
Total Direct Labor	<u>1,937</u>		
Program Executive		23	274
Program Planning & Reporting		58	686
Industrial Relations		<u>13</u>	<u>122</u>
Total Labor - Part		<u>94</u>	<u>1,082</u>
<u>Material</u>			
Program Planning & Reporting			1
Industrial Relations			<u>1</u>
Material Subtotal			2
Material & Administrative Burden			<u>1</u>
Total Material			<u>3</u>
TOTAL COST - PART I			<u>1,085</u>

TABLE 3.2.1.5-III

AMLLV PART II COST SUMMARY THRUST STRUCTURE - E/M

A B C (IN THOUSANDS)

ELEMENT OF COST	DESIGN ENGINEERING		PRODUCTION		DESIGN & FAB. TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	75	886			300	3,548			375	4,343
LAB TECHNICIANS	15	146			60	584			75	730
TOOLING					1,109	10,780			1,109	10,780
PRODUCTION										
MANUFACTURING TEST							52	510	52	510
MANUFACTURING TECH.					27	314	1	16	28	300
Q&RA	3	29			281	2,725	14	136	298	2,890
DIRECT DIST					277	2,695	17	163	294	2,858
TRAINING					15	148	1	8	16	156
TOTAL DIRECT LABOR	93	1,061			2,069	20,794	85	833	2,247	22,688
MATERIAL										
LAB. TECHNICIANS		31				126				157
TOOLING						1,392				1,392
PRODUCTION										
MFG. TECHNICIANS						47	2			49
Q&RA		1				84	4			89
SUBTOTAL		32				1,649	6			1,687
MAT. & ADM. BURDEN		11				561	2			574
TOTAL MATERIAL		43				2,210	8			2,261
TOTAL PART II COST		1,104				23,004		841		24,949

AMLLV
 NON-RECURRING COSTS
 PART II-A THRUST STRUCTURE -E/M
 ASSEMBLY OR SYSTEM
 DESIGN ENGINEERING

<u>ELEMENT OF COST</u>	<u>TABLE 3.2.1.5-IV</u>	<u>MANHOURS</u>	<u>DOLLARS</u>
BASIC DESIGN		75,000	\$ 885,750
1. Laboratory Technicians		<u>15,000</u>	<u>145,800</u>
Subtotal		90,000	\$1,031,550
2. Q&RA		<u>3,000</u>	<u>29,160</u>
TOTAL ENGINEERING LABOR		<u>93,000</u>	<u>\$1,060,710</u>
 MATERIAL			
3. Laboratory Technicians			\$ 31,500
4. Q&RA			<u>900</u>
Subtotal			\$ 32,400
5. Material and Adm. Burden			<u>11,016</u>
TOTAL MATERIAL			<u>\$ 43,416</u>
TOTAL ENGINEERING COST			<u>\$1,104,126</u>

AMLLV
NON-RECURRING COSTS

THRUST STRUCTURE - E/M
PART IIB ASSEMBLY OR SYSTEM
TOOLING

TABLE 3.2.1.5-V

<u>ELEMENT OF COST</u>	<u>COLUMN I MANHOURS</u>	<u>COLUMN II MANHOURS</u>	<u>COLUMN III DOLLARS</u>
TOOL DESIGN		300,419	\$3,547,948
1. Lab. Tech.		<u>60,084</u>	<u>584,016</u>
TOTAL ENGR.		<u>360,503</u>	<u>\$4,131,964</u>
Fabrication and Erection			
Fab. & Assembly	795,600		\$7,733,232
Misc. Charges	62,057		603,194
Maintain & Add In Scope Changes	<u>8,752</u>		<u>85,069</u>
SUBTOTAL (A)	866,409		8,421,495
2. Tool and Production Planning	<u>242,595</u>		<u>2,358,023</u>
SUBTOTAL (B)	1,109,004		10,779,518
3. Direct Distributable	<u>277,251</u>		<u>2,694,880</u>
SUBTOTAL (C)	1,386,255		13,474,398
4. Training	<u>15,249</u>		<u>148,220</u>
SUBTOTAL (D)	1,401,504		13,622,618
5. Q&RA	280,301		2,724,526
6. Manufacturing Tech.	<u>26,629</u>		<u>314,488</u>
TOTAL PRODUCTION LABOR	<u>1,708,434</u>		<u>\$16,661,632</u>
MATERIAL			
7. Tooling			\$ 1,392,300
8. Lab. Tech.			126,176
9. Q&RA			84,090
10. Manufacturing Tech.			46,601
MATERIAL SUBTOTAL (E)			<u>1,649,167</u>
11. Material & Adm. Burden			560,717
TOTAL MATERIAL			<u>2,209,884</u>
TOTAL TOOLING COST			<u>\$23,003,480</u>

AMLLV
 PART IIB
 MANUFACTURING
 MANUFACTURING TEST
THRUST STRUCTURE - TOOLING - E/M
 ASSEMBLY OR SYSTEM

TABLE 3.2.1.5-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	39,780	386,662
Component Test Planning	<u>12,730</u>	<u>123,732</u>
(1) Subtotal (A)	52,510	510,394
(2) Direct Distributable	<u>16,803</u>	<u>163,325</u>
Subtotal (B)	69,313	673,719
(3) Training	<u>762</u>	<u>7,411</u>
Subtotal (C)	70,075	681,130
(4) Mfg. Tech.	<u>1,331</u>	<u>15,724</u>
Subtotal (D)	71,406	696,854
(5) Q&RA	<u>14,015</u>	<u>136,226</u>
Total Mfg. Test Labor	<u><u>85,421</u></u>	<u><u>833,080</u></u>
Material		
(6) Q&RA		4,205
(7) Mfg. Tech.		<u>2,330</u>
Subtotal (E)		6,535
(8) Material & Adm. Burden		<u>2,222</u>
Total Material		<u><u>8,757</u></u>
Total Mfg. Test Cost		<u><u>841,837</u></u>

3.2.1.6 Structure Assembly

TABLE 3.2.1.6-1

AMLLV COST SUMMARY STRUCTURE ASSEMBLY - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	1	9								1	9
PROGRAM PLAN. & REPT.	2	26								2	26
INDUSTRIAL RELATIONS	1	4								1	4
ENGINEERING			60	709						60	709
LAB TECHNICIANS			12	117						12	117
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A			2	23						2	23
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR	4	39	74	849						78	888
MATERIAL				32							32
LOGISTIC HARDWARE BURDEN				11							11
TOTAL MATERIAL				43							43
TOTAL OTHER											
TOTAL COST		39		892							931

AMLLV

PART I
 STRUCTURE ASSEMBLY - E/M
 ASSEMBLY OR SYSTEM

TABLE 3.2.1.6-II

(In Thousands)

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	60		
Logistics			
Laboratory Technician	12		
Production			
Tooling			
Manufacturing Test			
Q&RA	2		
Facilities			
Manufacturing Technician			
Total Direct Labor	<u>74</u>		
Program Executive		1	9
Program Planning & Reporting		2	26
Industrial Relations		1	4
Total Labor - Part I		<u>4</u>	<u>39</u>
<u>Material</u>			
Program Planning & Reporting			
Industrial Relations			
Material Subtotal			
Material & Administrative Burden			
Total Material			
TOTAL COST - PART I			<u>39</u>

TABLE 3.2.1.6-III

AMLLV PART II COST SUMMARY STRUCTURE ASSEMBLY - E/M

A B C (IN THOUSANDS)

ELEMENT OF COST	DESIGN ENGINEERING		PRODUCTION		DESIGN & FAB. TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	60	709							60	709
LAB TECHNICIANS	12	117							12	117
TOOLING										
PRODUCTION										
MANUFACTURING TEST										
MANUFACTURING TECH.										
Q & RA	2	23							2	23
DIRECT DIST										
TRAINING										
TOTAL DIRECT LABOR	74	849							74	849
MATERIAL		25								25
LAB. TECHNICIANS										
TOOLING										
PRODUCTION										
MFG. TECHNICIANS										
Q&RA		7								7
SUBTOTAL		32								32
MAT. & ADM. BURDEN		11								11
TOTAL MATERIAL		43								43
TOTAL PART II COST		892								892

AMLLV
 NON-RECURRING COSTS
 PART II-A STRUCTURES ASSEMBLY - E/M
 ASSEMBLY OR SYSTEM
 DESIGN ENGINEERING

<u>ELEMENT OF COST</u>	<u>TABLE 3.2.1.6-IV</u>	<u>MANHOURS</u>	<u>DOLLARS</u>
BASIC DESIGN		60,000	\$708,600
1. Laboratory Technicians		<u>12,000</u>	<u>116,640</u>
Subtotal		72,000	\$825,240
2. Q&RA		<u>2,400</u>	<u>23,328</u>
TOTAL ENGINEERING LABOR		<u>74,400</u>	<u>\$848,568</u>
MATERIAL			
3. Laboratory Technicians			\$ 25,200
4. Q&RA			<u>7,200</u>
Subtotal			\$ 32,400
5. Material and Adm. Burden			<u>11,016</u>
TOTAL MATERIAL			<u>\$ 43,416</u>
TOTAL ENGINEERING COST			<u>\$891,984</u>

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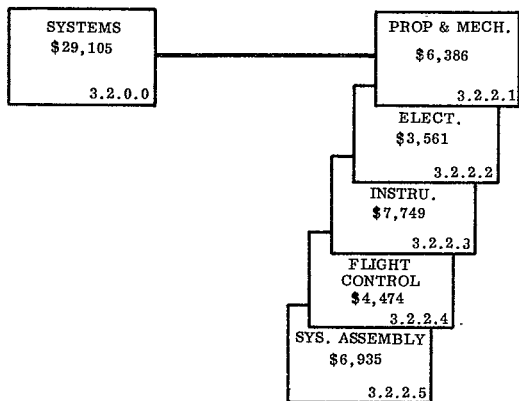
3.2.2 Systems

The Get Ready cost for the system components of the Injection Stage - Engine Module are displayed in Figure 3.2.2.0-1. The cost details of the system components are contained in the appropriate subparagraphs, as indicated.

Table 3.2.2.0-I is a total Get Ready cost of these systems.

These costs are comprised of basic (or non-recurring) engineering costs required to produce the basic tooling, fabrication and assembly of tooling, and basic article design including all engineering such as manufacturing liaison and coordination required to produce the first article. These costs are non-recurring in that they are experienced once during the production life of a model.

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(DOLLARS IN THOUSANDS)

FIGURE 3.2.2.0-1 AMLLV INJECTION STAGE ENGINE MODULE SYSTEMS COSTS GET READY, "A" COSTS

TABLE 3.2.2.0-I
 AMLLV COST SUMMARY

SYSTEMS - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	27	323								27	323
PROGRAM PLAN.& REPT.	69	812								69	812
INDUSTRIAL RELATIONS	15	144								15	144
ENGINEERING			1,573	18,570						1,573	18,570
LAB TECHNICIANS			314	3,057						314	3,057
TOOLING			267	2,596						267	2,596
PRODUCTION											
MANUFACTURING TEST			13	122						13	122
MANUFACTURING TECH.			7	80						7	80
Q & R A			130	1,272						130	1,272
FACILITIES											
DIRECT DIST			72	689						72	689
TRAINING			4	37						4	37
TOTAL DIRECT LABOR	111	1,279	2,380	26,423						2,491	27,702
MATERIAL				1,048							1,048
LOGISTIC HARDWARE											
BURDEN				355							355
TOTAL MATERIAL				1,403							1,403
TOTAL OTHER											
TOTAL COST		1,279		27,826							29,105

3.2.2.1 Propulsion/Mechanical System

TABLE 3.2.2.1-I

PROPULSION AND MECHANICAL - ENGINE MODULE

A MLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	6	71								6	71
PROGRAM PLAN. & REPT.	15	177								15	177
INDUSTRIAL RELATIONS	3	31								3	31
ENGINEERING			321	3,795						321	3,795
LAB TECHNICIANS			64	624						64	624
TOOLING			79	764						79	764
PRODUCTION											
MANUFACTURING TEST			4	36						4	36
MANUFACTURING TECH.			2	22						2	22
Q & R A			33	320						33	320
FACILITIES											
DIRECT DIST			21	203						21	203
TRAINING			1	12						1	12
TOTAL DIRECT LABOR	24	279	525	5,776						549	6,055
MATERIAL				247							247
LOGISTIC HARDWARE											
BURDEN				84							84
TOTAL MATERIAL				331							331
TOTAL OTHER											
TOTAL COST		279		6,107							6,386

AMLLV
NON-RECURRING

PART I

PROPULSION AND MECHANICAL - E/M
ASSEMBLY OR SYSTEM

TABLE 3.2.2.1-II

(In Thousands)

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	321		
Logistics			
Laboratory Technician	64		
Production			
Tooling	79		
Manufacturing Test	4		
Q&RA	33		
Facilities			
Manufacturing Technician	<u>2</u>		
Total Direct Labor	<u>503</u>		
Program Executive		6	71
Program Planning & Reporting ,		15	177
Industrial Relations		<u>3</u>	<u>31</u>
Total Labor - Part I		<u>24</u>	<u>279</u>
<u>Material</u>			
Program Planning & Reporting			
Industrial Relations			
Material Subtotal			
Material & Administrative Burden			<u> </u>
Total Material			<u> </u>
TOTAL COST - PART I			<u>279</u>

TABLE 3.2.2.1-III

PROPULSION AND MECHANICAL - ENGINE MODULE

AMLLV PART II COST SUMMARY

A B C (IN THOUSANDS)

ELEMENT OF COST	DESIGN ENGINEERING		PRODUCTION		DESIGN & FAB. TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	300	3,543			21	252			321	3,795
LAB TECHNICIANS	60	583			4	41			64	624
TOOLING					79	764			79	764
PRODUCTION										
MANUFACTURING TEST							4	36	4	36
MANUFACTURING TECH.					2	22			2	22
Q&RA	12	117			20	193	1	10	33	320
DIRECT DIST					20	191	1	12	21	203
TRAINING					1	11		1	1	12
TOTAL DIRECT LABOR	372	4,243			147	1,474	6	59	525	5,776
MATERIAL										
LAB. TECHNICIANS		126				9				135
TOOLING						99				99
PRODUCTION										
MFG. TECHNICIANS						3				3
Q&RA		4				6				10
SUBTOTAL		130				117				247
MAT. & ADM. BURDEN		44				40				84
TOTAL MATERIAL		174				157				331
TOTAL PART II COST		4,417				1,631		59		6,107

AMLLV
 NON-RECURRING COSTS
 PART II-A PROPULSION & MECHANICAL SYSTEM - E/M

ASSEMBLY OR SYSTEM

DESIGN ENGINEERING

TABLE 3.2.2.1-IV

<u>ELEMENT OF COST</u>	<u>MANHOURS</u>	<u>DOLLARS</u>
BASIC DESIGN	300,000	\$3,543,000
1. Laboratory Technicians	60,000	583,200
Subtotal	<u>360,000</u>	<u>4,126,200</u>
2. Q&RA	<u>12,000</u>	<u>116,640</u>
TOTAL ENGINEERING LABOR	<u>372,000</u>	\$ <u>4,242,840</u>
MATERIAL		
3. Laboratory Technicians		126,000
4. Q&RA		<u>3,600</u>
Subtotal		129,600
5. Material and Adm. Burden		44,064
TOTAL MATERIAL		\$ <u>173,664</u>
TOTAL ENGINEERING COST		\$ <u>4,416,504</u>

AMLLV
NON-RECURRING COSTS

PROPULSION & MECHANICAL SYSTEM - E/M
PART IIB ASSEMBLY OR SYSTEM
TOOLING

TABLE 3.2.2.1-V

<u>ELEMENT OF COST</u>	<u>COLUMN I MANHOURS</u>	<u>COLUMN II MANHOURS</u>	<u>COLUMN III DOLLARS</u>
TOOL DESIGN		21,304	\$ 251,600
1. Lab. Tech.		<u>4,261</u>	<u>41,417</u>
TOTAL ENGR.		<u>25,565</u>	<u>\$ 293,017</u>
Fabrication and Erection			
Fab. & Assembly	56,420		548,402
Misc. Charges	4,401		42,778
Maintain & Add In Scope Changes	<u>621</u>		<u>6,036</u>
SUBTOTAL (A)	61,442		597,216
2. Tool and Production Planning	<u>17,203</u>		<u>167,213</u>
SUBTOTAL (B)	78,645		764,429
3. Direct Distributable	<u>19,661</u>		<u>191,105</u>
SUBTOTAL (C)	98,306		955,534
4. Training	<u>1,081</u>		<u>10,507</u>
SUBTOTAL (D)	99,387		966,041
5. Q&RA	19,877		193,204
6. Manufacturing Tech.	<u>1,888</u>		<u>22,297</u>
TOTAL PRODUCTION LABOR	<u>121,152</u>		<u>\$ 1,181,542</u>
MATERIAL			
7. Tooling			98,735
8. Lab. Tech.			8,948
9. Q&RA			5,963
10. Manufacturing Tech.			<u>3,304</u>
MATERIAL SUBTOTAL (E)			\$ 116,950
11. Material & Adm. Burden			<u>39,763</u>
TOTAL MATERIAL			<u>156,713</u>
TOTAL TOOLING COST			<u>\$ 1,631,272</u>

AMLLV
PART IIB
MANUFACTURING
MANUFACTURING TEST

PROP & MECH. SYSTEM - TOOLING - E/M

ASSEMBLY OR SYSTEM
NON-RECURRING

TABLE 3.2.2.1-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	2,821	27,420
Component Test Planning	<u>903</u>	<u>8,774</u>
(1) Subtotal (A)	3,724	36,194
(2) Direct Distributable	<u>1,192</u>	<u>11,581</u>
Subtotal (B)	4,916	47,775
(3) Training	<u>54</u>	<u>525</u>
Subtotal (C)	4,970	48,300
(4) Mfg. Tech.	<u>94</u>	<u>1,115</u>
Subtotal (D)	5,064	49,415
(5) Q&RA	<u>994</u>	<u>9,660</u>
Total Mfg. Test Labor	<u><u>6,058</u></u>	<u><u>59,075</u></u>
 Material		
(6) Q&RA		298
(7) Mfg. Tech.		<u>165</u>
Subtotal (E)		463
(8) Material & Adm. Burden		<u>158</u>
Total Material		<u><u>621</u></u>
Total Mfg. Test Cost		<u><u>59,696</u></u>

3.2.2.2 Electrical System

TABLE 3.2.2.2-I

AMLLV COST SUMMARY

ELECTRICAL - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	3	39								3	39
PROGRAM PLAN. & REPT.	8	99								8	99
INDUSTRIAL RELATIONS	2	17								2	17
ENGINEERING			190	2,239						190	2,239
LAB TECHNICIANS			38	369						38	369
TOOLING			35	342						35	342
PRODUCTION											
MANUFACTURING TEST			2	16						2	16
MANUFACTURING TECH.			1	11						1	11
Q & R A			16	160						16	160
FACILITIES											
DIRECT DIST			10	90						10	90
TRAINING				5							5
TOTAL DIRECT LABOR	13	155	292	3,232						305	3,387
MATERIAL				130							130
LOGISTIC HARDWARE BURDEN				44							44
TOTAL MATERIAL				174							174
TOTAL OTHER											
TOTAL COST		155		3,406							3,561

MLLV

PART I

ELECTRICAL - E/M
ASSEMBLY OR SYSTEM

TABLE 3.2.2.2-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	(In Thousands) <u>Dollars</u>
<u>Direct Labor</u>			
Engineering	190		
Logistics			
Laboratory Technician	38		
Production			
Tooling	35		
Manufacturing Test	2		
Q&RA	16		
Facilities			
Manufacturing Technician	1		
Total Direct Labor	<u>282</u>		
Program Executive		3	39
Program Planning & Reporting		8	99
Industrial Relations		2	17
Total Labor - Part I		<u>13</u>	<u>155</u>
<u>Material</u>			
Program Planning & Reporting			
Industrial Relations			
Material Subtotal			
Material & Administrative Burden			
Total Material			
TOTAL COST - PART I			<u>155</u>

TABLE 3.2.2-III

AMLLV PART II COST SUMMARY ELECTRICAL SYSTEM - ENGINE MODULE

A B C (IN THOUSANDS)

ELEMENT OF COST	DESIGN ENGINEERING		PRODUCTION		DESIGN & FAB. TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	180	2,126			10	113			190	2,239
LAB TECHNICIANS	36	350			2	19			38	369
TOOLING					35	342			35	342
PRODUCTION										
MANUFACTURING TEST							2	16	2	16
MANUFACTURING TECH.					1	10		1	1	11
Q&RA	7	70			9	86		4	16	160
DIRECT DIST					9	85	1	5	10	90
TRAINING						5				5
TOTAL DIRECT LABOR	223	2,546			66	660	3	26	292	3,232
MATERIAL										
LAB. TECHNICIANS		76				4				80
TOOLING						44				44
PRODUCTION										
MFG. TECHNICIANS						1				1
Q&RA		2				3				5
SUBTOTAL		78				52				130
MAT. & ADM. BURDEN		26				18				44
TOTAL MATERIAL		104				70				174
TOTAL PART II COST		2,650				730		26		3,406

AMLLV
 NON-RECURRING COSTS
 PART II-A ELECTRICAL SYSTEM - E/M
 ASSEMBLY OR SYSTEM
 DESIGN ENGINEERING

<u>ELEMENT OF COST</u>	TABLE 3.2.2.2-IV	<u>MANHOURS</u>	<u>DOLLARS</u>
BASIC DESIGN		180,000	\$2,125,800
1. Laboratory Technicians		<u>36,000</u>	<u>349,920</u>
Subtotal		216,000	\$2,475,720
2. Q&RA		<u>7,200</u>	<u>69,984</u>
TOTAL ENGINEERING LABOR		<u>223,200</u>	<u>\$2,545,704</u>
MATERIAL			
3. Laboratory Technicians			\$ 75,600
4. Q&RA			<u>2,160</u>
Subtotal			\$ 77,760
5. Material and Adm. Burden			<u>26,438</u>
TOTAL MATERIAL			\$ <u>104,198</u>
TOTAL ENGINEERING COST			\$2, <u>649,902</u>

AMLIV
 NON-RECURRING COSTS
 ELECTRICAL SYSTEM - E/M
 PART IIB ASSEMBLY OR SYSTEM
 TOOLING

TABLE 3.2.2.2-V

ELEMENT OF COST	COLUMN I MANHOURS	COLUMN II MANHOURS	COLUMN III DOLLARS
TOOL DESIGN		9,523	\$112,467
1. Lab. Tech.		1,905	18,517
TOTAL ENGR.		11,428	\$130,984
Fabrication and Erection			
Fab. & Assembly	25,220		\$245,138
Misc. Charges	1,991		19,353
Maintain & Add In Scope Changes	277		2,692
SUBTOTAL (A)	27,488		\$267,183
2. Tool and Production Planning	7,697		74,815
SUBTOTAL (B)	35,185		\$341,998
3. Direct Distributable	8,796		85,497
SUBTOTAL (C)	43,981		\$427,495
4. Training	484		4,704
SUBTOTAL (D)	44,465		\$432,199
5. Q&RA	8,893		86,440
6. Manufacturing Tech.	845		9,979
TOTAL PRODUCTION LABOR	54,203		\$528,618
MATERIAL			
7. Tooling			\$ 44,135
8. Lab. Tech.			4,001
9. Q&RA			2,668
10. Manufacturing Tech.			1,479
MATERIAL SUBTOTAL (E)			\$ 52,283
11. Material & Adm. Burden			17,776
TOTAL MATERIAL			\$ 70,059
TOTAL TOOLING COST			\$729,661

MLLV
PART IIB
MANUFACTURING
MANUFACTURING TEST

ELECTRICAL SYSTEM - TOOLING - E/M

ASSEMBLY OR SYSTEM
NON-RECURRING

TABLE 3.2.2.2-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	1,261	12,257
Component Test Planning	404	3,922
(1) Subtotal (A)	1,665	16,170
(2) Direct Distributable	533	5,177
Subtotal (B)	2,198	21,356
(3) Training	24	234
Subtotal (C)	2,222	21,590
(4) Mfg. Tech.	42	498
Subtotal (D)	2,264	22,088
(5) Q&RA	444	4,318
Total Mfg. Test Labor	<u>2,708</u>	<u>26,406</u>
 Material		
(6) Q&RA		133
(7) Mfg. Tech.		74
Subtotal (E)		207
(8) Material & Adm. Burden		70
Total Material		<u>277</u>
Total Mfg. Test Cost		<u>26,683</u>

3.2.2.3 Instrumentation System

TABLE 3.2.2.3-I

AMLLV COST SUMMARY

INSTRUMENTATION - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	7	87								7	87
PROGRAM PLAN. & REPT.	19	219								19	219
INDUSTRIAL RELATIONS	4	39								4	39
ENGINEERING			459	5,420						459	5,420
LAB TECHNICIANS			92	893						92	893
TOOLING			33	322						33	322
PRODUCTION											
MANUFACTURING TEST			5	55						5	55
MANUFACTURING TECH.			1	12						1	12
Q & R A			28	271						28	271
FACILITIES											
DIRECT DIST			10	99						10	99
TRAINING			1	4						1	4
TOTAL DIRECT LABOR	30	345	629	7,076						659	7,421
MATERIAL				245							245
LOGISTIC HARDWARE BURDEN				83							83
TOTAL MATERIAL				328							328
TOTAL OTHER											
TOTAL COST		345		7,404							7,749

AMLLV

PART I

INSTRUMENTATION - E/M

ASSEMBLY OR SYSTEM

TABLE 3.2.2.3-II

(In Thousands)

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	459		
Logistics			
Laboratory Technician	92		
Production			
Tooling	33		
Manufacturing Test	5		
Q&RA	28		
Facilities			
Manufacturing Technician	1		
	<u>618</u>		
Program Executive		7	87
Program Planning & Reporting		19	219
Industrial Relations		<u>4</u>	<u>39</u>
Total Labor - Part I		<u>30</u>	<u>345</u>
<u>Material</u>			
Program Planning & Reporting			
Industrial Relations			
Material Subtotal			
Material & Administrative Burden			<u> </u>
Total Material			<u> </u>
TOTAL COST - PART I			<u>345</u>

TABLE 3.2.2.3-III

AMLLV PART II COST SUMMARY INSTRUMENTATION - E/M

A B C (IN THOUSANDS)

ELEMENT OF COST	DESIGN ENGINEERING		PRODUCTION		DESIGN & FAB. TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	450	5,314			9	106			459	5,420
LAB TECHNICIANS	90	875			2	18			92	893
TOOLING					33	322			33	322
PRODUCTION										
MANUFACTURING TEST							5	55	5	55
MANUFACTURING TECH.					1	10		2	1	12
Q & RA	18	175			8	81	2	15	28	271
DIRECT DIST					8	81	2	18	10	99
TRAINING					1	4			1	4
TOTAL DIRECT LABOR	558	6,364			62	622	9	90	629	7,076
MATERIAL										
LAB. TECHNICIANS		189				4				193
TOOLING						42				42
PRODUCTION										
MFG. TECHNICIANS						1				1
Q&RA		6				2	1			9
SUBTOTAL		195				49	1			245
MAT. & ADM. BURDEN		66				17				83
TOTAL MATERIAL		261				66	1			328
TOTAL PART II COST		6,625				688	91			7,404

AMLLV
 NON-RECURRING COSTS
 PART II-A INSTRUMENTATION SYSTEM - E/M
 ASSEMBLY OR SYSTEM
 DESIGN ENGINEERING

<u>ELEMENT OF COST</u>	TABLE 3.2.2.3-IV	<u>MANHOURS</u>	<u>DOLLARS</u>
BASIC DESIGN		450,000	\$5,314,500
1. Laboratory Technicians		<u>90,000</u>	<u>874,800</u>
Subtotal		540,000	\$6,189,300
2. Q&RA		<u>18,000</u>	<u>174,960</u>
TOTAL ENGINEERING LABOR		<u>558,000</u>	\$ <u>6,364,260</u>
MATERIAL			
3. Laboratory Technicians			\$ 189,000
4. Q&RA			<u>5,400</u>
Subtotal			\$ 194,400
5. Material and Adm. Burden			<u>66,096</u>
TOTAL MATERIAL			\$ <u>260,496</u>
TOTAL ENGINEERING COST			\$ <u>6,624,756</u>

AMLLV
NON-RECURRING COSTS

INSTRUMENTATION SYSTEM - E/M
PART IIB ASSEMBLY OR SYSTEM
TOOLING

TABLE 3.2.2.3-V

<u>ELEMENT OF COST</u>	<u>COLUMN I MANHOURS</u>	<u>COLUMN II MANHOURS</u>	<u>COLU DOLL</u>
TOOL DESIGN		8,983	\$106,
1. Lab. Tech.		<u>1,797</u>	<u>17,</u>
TOTAL ENGR.		<u>10,780</u>	<u>\$123,</u>
Fabrication and Erection			
Fab. & Assembly	23,790		\$231,
Misc. Charges	1,856		18,
Maintain & Add In Scope Changes	<u>262</u>		<u>2,</u>
SUBTOTAL (A)	25,908		\$251,
2. Tool and Production Planning	<u>7,254</u>		<u>70,</u>
SUBTOTAL (B)	33,162		\$322,
3. Direct Distributable	<u>8,291</u>		<u>80,</u>
SUBTOTAL (C)	41,453		\$402,
4. Training	<u>456</u>		<u>4,</u>
SUBTOTAL (D)	41,909		\$407,
5. Q&RA	8,382		81,
6. Manufacturing Tech.	<u>796</u>		<u>9,</u>
TOTAL PRODUCTION LABOR	<u>51,087</u>		<u>\$498,</u>
MATERIAL			
7. Tooling			\$ 41,
8. Lab. Tech.			3,
9. Q&RA			2,
10. Manufacturing Tech.			<u>1,</u>
MATERIAL SUBTOTAL (E)			\$ 49,
11. Material & Adm. Burden			<u>16,</u>
TOTAL MATERIAL			<u>\$ 66,</u>
TOTAL TOOLING COST.			<u>\$687,</u>

AMLLV
 PART IIB
 MANUFACTURING
 MANUFACTURING TEST
 INSTRUMENTATION SYSTEM - TOOLING - E/M

ASSEMBLY OR SYSTEM
 NON-RECURRING

TABLE 3.2.2.3-VI

<u>Element of Cost</u>	<u>hours</u>	<u>Dollars</u>
Component Test	1,190	11,567
Component Test Planning	381	3,701
(1) Subtotal (A)	1,571	15,268
(2) Direct Distributable	503	4,885
Subtotal (B)	2,073	20,153
(3) Training	23	222
Subtotal (C)	2,096	20,375
(4) Mfg. Tech.	40	470
Subtotal (D)	2,136	20,845
(5) Q&RA	419	4,075
Total Mfg. Test Labor	<u>2,555</u>	<u>24,920</u>
Material		
(6) Q&RA		126
(7) Mfg. Tech.		70
Subtotal (E)		196
(8) Material & Adm. Burden		66
Total Material		<u>262</u>
Total Mfg. Test Cost		<u>25,182</u>

3.2.2.4 Flight Control System

TABLE 3.2.2.4-I

AMLLV COST SUMMARY

FLIGHT CONTROL - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	4	48								4	48
PROGRAM PLAN. & REPT.	10	120								10	120
INDUSTRIAL RELATIONS	2	22								2	22
ENGINEERING			153	1,802						153	1,802
LAB TECHNICIANS			30	296						30	296
TOOLING			120	1,168						120	1,168
PRODUCTION											
MANUFACTURING TEST			2	15						2	15
MANUFACTURING TECH.			3	35						3	35
Q & R A			35	346						35	346
FACILITIES											
DIRECT DIST			31	297						31	297
TRAINING			2	16						2	16
TOTAL DIRECT LABOR	16	190	376	3,975						392	4,165
MATERIAL				231							231
LOGISTIC HARDWARE BURDEN				78							78
TOTAL MATERIAL				309							309
TOTAL OTHER											
TOTAL COST		190		4,284							4,474

AMLLV

PART I

FLIGHT CONTROL - E/M
ASSEMBLY OR SYSTEM

TABLE 3.2.2.4-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	(In Thousands) <u>Dollars</u>
<u>Direct Labor</u>			
Engineering	153		
Logistics			
Laboratory Technician	30		
Production			
Tooling	120		
Manufacturing Test	2		
Q&RA	35		
Facilities			
Manufacturing Technician	3		
	<u>343</u>		
Program Executive		4	48
Program Planning & Reporting		10	120
Industrial Relations		<u>2</u>	<u>22</u>
Total Labor - Part I		<u>16</u>	<u>190</u>
<u>Material</u>			
Program Planning & Reporting			
Industrial Relations			
Material Subtotal			
Material & Administrative Burden			
Total Material			<u> </u>
TOTAL COST - PART I			<u>190</u>

TABLE 3-2.2.4-III

AMLLV PART II COST SUMMARY FLIGHT CONTROL - E/M

A B C (IN THOUSANDS)

ELEMENT OF COST	DESIGN ENGINEERING		PRODUCTION		DESIGN & FAB. TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	120	1,417			33	385			153	1,802
LAB TECHNICIANS	24	233			6	63			30	296
TOOLING					120	1,168			120	1,168
PRODUCTION										
MANUFACTURING TEST							2	15	2	15
MANUFACTURING TECH.					3	34		1	3	35
Q&RA	5	47			30	295		4	35	346
DIRECT DIST					30	292	1	5	31	297
TRAINING					2	16			2	16
TOTAL DIRECT LABOR	149	1,697			224	2,253	3	25	376	3,975
MATERIAL										
LAB. TECHNICIANS		51				14				65
TOOLING						151				151
PRODUCTION										
MFG. TECHNICIANS						5				5
Q&RA		1				9				10
SUBTOTAL		52				179				231
MAT. & ADM. BURDEN		18				60				78
TOTAL MATERIAL		70				239				309
TOTAL PART II COST		1,767				2,492		25		4,284

AMLLV
NON-RECURRING COSTS
PART II-A FLIGHT CONTROL SYSTEM - E/M

ASSEMBLY OR SYSTEM
DESIGN ENGINEERING

<u>ELEMENT OF COST</u>	TABLE 3.2.2.4-IV	<u>MANHOUR</u>	<u>DOLLARS</u>
BASIC DESIGN		120,000	\$1,417,200
1. Laboratory Technicians		<u>24,000</u>	<u>233,280</u>
Subtotal		144,000	\$1,650,480
2. Q&RA		<u>4,800</u>	<u>46,656</u>
TOTAL ENGINEERING LABOR		<u>148,800</u>	<u>\$1,697,136</u>
MATERIAL			
3. Laboratory Technicians			\$ 50,400
4. Q&RA			<u>1,440</u>
Subtotal			\$ 51,840
5. Material and Adm. Burden			<u>17,626</u>
TOTAL MATERIAL			<u>\$ 69,466</u>
TOTAL ENGINEERING COST			<u>\$1,766,602</u>

AMLLV
NON-RECURRING COSTS

FLIGHT CONTROL SYSTEM - E/M
PART IIB ASSEMBLY OR SYSTEM
TOOLING
TABLE 3.2.2.4-V

<u>ELEMENT OF COST</u>	<u>COLUMN I MANHOURS</u>	<u>COLUMN II MANHOURS</u>	<u>COLUMN III DOLLARS</u>
TOOL DESIGN		32,545	\$384,356
1. Lab. Tech.		<u>6,509</u>	<u>63,267</u>
TOTAL ENGR.		<u>39,054</u>	<u>\$447,623</u>
Fabrication and Erection			
Fab. & Assembly	86,190		\$837,766
Misc. Charges	6,723		65,348
Maintain & Add In Scope Changes	<u>948</u>		<u>9,215</u>
SUBTOTAL (A)	93,861		\$912,329
2. Tool and Production Planning	<u>26,281</u>		<u>255,451</u>
SUBTOTAL (B)	120,142		\$1,167,780
3. Direct Distributable	<u>30,036</u>		<u>291,950</u>
SUBTOTAL (C)	150,178		\$1,459,730
4. Training	<u>1,652</u>		<u>16,057</u>
SUBTOTAL (D)	151,830		\$1,475,787
5. Q&RA	30,366		295,158
6. Manufacturing Tech.	<u>2,885</u>		<u>34,072</u>
TOTAL PRODUCTION LABOR	<u>185,081</u>		<u>\$1,805,017</u>
MATERIAL			
7. Tooling			\$ 150,832
8. Lab. Tech.			13,669
9. Q&RA			9,110
10. Manufacturing Tech.			<u>5,049</u>
MATERIAL SUBTOTAL (E)			\$ 178,660
11. Material & Adm. Burden			<u>60,755</u>
TOTAL MATERIAL			<u>\$ 239,415</u>
TOTAL TOOLING COST			<u>\$2,492,055</u>

AMLIV
 PART IIB
 MANUFACTURING
 MANUFACTURING TEST
FLIGHT CONTROL SYSTEM - TOOLING - E/M
 ASSEMBLY OR SYSTEM
 NON-RECURRING

TABLE 3.2.2.4-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	4,310	41,893
Component Test Planning	<u>1,379</u>	<u>13,406</u>
(1) Subtotal (A)	5,689	55,299
(2) Direct Distributable	<u>1,821</u>	<u>17,695</u>
Subtotal (B)	7,510	72,994
(3) Training	<u>83</u>	<u>803</u>
Subtotal (C)	7,593	73,797
(4) Mfg. Tech.	<u>144</u>	<u>1,703</u>
Subtotal (D)	7,737	75,500
(5) Q&RA	<u>1,518</u>	<u>14,759</u>
Total Mfg. Test Labor	<u><u>9,255</u></u>	<u><u>90,259</u></u>
Material		
(6) Q&RA		456
(7) Mfg. Tech.		<u>252</u>
Subtotal (E)		708
(8) Material & Adm. Burden		<u>241</u>
Total Material		<u><u>949</u></u>
Total Mfg. Test Cost		<u><u>91,208</u></u>

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3.2.2.5 System Assembly

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TABLE 3.2.2.5-1

AMLLV COST SUMMARY

SYSTEMS ASSEMBLY - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	7	78								7	78
PROGRAM PLAN. & REPT.	17	197								17	197
INDUSTRIAL RELATIONS	4	35								4	35
ENGINEERING			450	5,314						450	5,314
LAB TECHNICIANS.			90	875						90	875
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q. & R A			18	175						18	175
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR	28	310	558	6,364						586	6,674
MATERIAL				195							195
LOGISTIC HARDWARE BURDEN				66							66
TOTAL MATERIAL				261							261
TOTAL OTHER											
TOTAL COST		310		6,625							6,935

ANLLV

PART I
 SYSTEMS ASSEMBLY - E/M
ASSEMBLY OR SYSTEM

TABLE 3.2.2.5-II

(In Thousands)

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	450		
Logistics			
Laboratory Technician	90		
Production			
Tooling			
Manufacturing Test			
Q&RA	18		
Facilities			
Manufacturing Technician			
	<hr/>		
Total Direct Labor	<u>558</u>		
Program Executive		7	78
Program Planning & Reporting		17	197
Industrial Relations		<u>4</u>	<u>35</u>
		28	310
Total Labor - Part I		<hr/> <u>28</u>	<hr/> <u>310</u>
<u>Material</u>			
Program Planning & Reporting			
Industrial Relations			
Material Subtotal			
Material & Administrative Burden			<hr/>
Total Material			<hr/> <hr/>
TOTAL COST - PART I			<hr/> <u>310</u>

TABLE 3.2.2.5-III

AMLLV PART II COST SUMMARY SYSTEMS ASSEMBLY - E/M

A B C (IN THOUSANDS)

ELEMENT OF COST	DESIGN ENGINEERING		PRODUCTION		DESIGN & FAB. TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	450	5,314							450	5,314
LAB TECHNICIANS	90	875							90	875
TOOLING										
PRODUCTION										
MANUFACTURING TEST										
MANUFACTURING TECH.										
Q & RA	18	175							18	175
DIRECT DIST										
TRAINING										
TOTAL DIRECT LABOR	558	6,364							558	6,364
MATERIAL										
LAB. TECHNICIANS		189								189
TOOLING										
PRODUCTION										
MFG. TECHNICIANS										
Q&RA		6								6
SUBTOTAL		195								195
MAT. & ADM. BURDEN		66								66
TOTAL MATERIAL		261								261
TOTAL PART II COST		6,625								6,625

AMLLV
 NON-RECURRING COSTS
 PART II-A SYSTEMS FINAL ASSEMBLY - E/M
 ASSEMBLY OR SYSTEM
 DESIGN ENGINEERING

<u>ELEMENT OF COST</u>	TABLE 3.2.2.5-IV	<u>MANHOURS</u>	<u>DOLLARS</u>
BASIC DESIGN		450,000	\$5,314,500
1. Laboratory Technicians		<u>90,000</u>	<u>874,800</u>
Subtotal		540,000	\$6,189,300
2. Q&RA		<u>18,000</u>	<u>174,960</u>
TOTAL ENGINEERING LABOR		<u>558,000</u>	<u>\$6,364,260</u>
MATERIAL			
3. Laboratory Technicians			\$ 189,000
4. Q&RA			<u>5,400</u>
Subtotal			\$ 194,400
5. Material and Adm. Burden			\$ <u>66,096</u>
TOTAL MATERIAL			\$ <u>260,496</u>
TOTAL ENGINEERING COST			<u>\$6,624,756</u>

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3.2.3 Injection Stage Liquid Engines

The Get Ready costs for the 250K thrust engine were developed from the parametric cost data supplied by Pratt and Whitney, and are displayed in Table 3.2.3.0-I.

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TABLE 3.2.3.0-I
 AMLLV COST SUMMARY

ENGINES - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING				20,400							20,400
LAB TECHNICIANS											
TOOLING				24,900							24,900
PRODUCTION				6,000							6,000
MANUFACTURING TEST											
MANUFACTURING TECH. Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR				51,300							51,300
MATERIAL						13,365					13,365
LOGISTIC HARDWARE BURDEN											
TOTAL MATERIAL						13,365					13,365
TOTAL OTHER								*8,900			8,900
TOTAL COST				51,300		13,365			8,900		73,565

* GSE

AMLLV
 ONE MODULE INJECTION STAGE
 ENGINE

TABLE 3.2.3.0-II

"A" COSTS

Engineering	\$20.4M	
Test		
Equipment	.7M	
Tooling	7.1M	
Fabrication		_____
Subtotal		\$28.2M
<u>Production</u>		
Tooling	\$17.8M	
Equipment	5.3M	
GSE	8.9M	_____
Subtotal		\$32.0M
<u>Facilities</u>	\$13.4M	_____
		\$13.4M
Total		<u><u>\$73.6M</u></u>

AMLLV
LIQUID ENGINE FACILITIES AND EQUIPMENT

TABLE 3.2.3.0-III Facilities

Equipment

Non-Recurring

Injection Stage

\$ 6,962,000

\$ 6,403,000

3.2.4 Ground Support Equipment (GSE)

The Get Ready cost for the engine module GSE includes:

Test and Checkout Equipment:

- Electrical test station
- Mechanical test station
- Data system test station
- Interconnection equipment
- Checkout auxiliary equipment
- Test, checkout, calibration and maintenance equipment
- Subsystems, test equipment
- Subassemblies and parts test
- Data processing station

Handling and Transportation Equipment:

- Stage handling equipment
- Component handling equipment
- Stage transportation equipment

The Get Ready costs associated with this equipment is displayed in Table 3.2.4.0-I .

TABLE 3.2.4.0-I
 AMLLV COST SUMMARY

GSE - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	6	68								6	68
PROGRAM PLAN. & REPT.	15	171								15	171
INDUSTRIAL RELATIONS	3	30								3	30
ENGINEERING											
LAB TECHNICIANS											
TOOLING			363	3,527						363	3,527
PRODUCTION											
MANUFACTURING TEST			17	167						17	167
MANUFACTURING TECH.			9	108						9	108
Q & R A			97	938						97	938
FACILITIES											
DIRECT DIST			96	935						96	935
TRAINING			5	51						5	51
TOTAL DIRECT LABOR	24	269	587	5,726						611	5,995
MATERIAL		1		1,047							1,047
LOGISTIC HARDWARE											
BURDEN				356							356
TOTAL MATERIAL		1		1,403							1,404
TOTAL OTHER											
TOTAL COST		270		7,129							7,399

AMLLV
NON-RECURRING

PART I
GSE - E/M

ASSEMBLY OR SYSTEM

TABLE 3.2.4.0-II

(In Thousands)

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering			
Logistics			
Laboratory Technician			
Production			
Tooling	363		
Manufacturing Test	17		
Q&RA	97		
Facilities			
Manufacturing Technician	7		
Total Direct Labor	<u>484</u>		
Program Executive		6	68
Program Planning & Reporting		15	171
Industrial Relations		<u>3</u>	<u>30</u>
Total Labor - Part I		<u>24</u>	<u>269</u>
<u>Material</u>			
Program Planning & Reporting			1
Industrial Relations			1
Material Subtotal			<u>1</u>
Material & Administrative Burden			<u>1</u>
Total Material			<u>1</u>
TOTAL COST - PART I			<u>270</u>

TABLE 3.2.4.0-III

GSE - E/M

AMLLV PART II COST SUMMARY

A B C (IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING										
LAB TECHNICIANS										
TOOLING					363	3,527			363	3,527
PRODUCTION										
MANUFACTURING TEST							17	167	17	167
MANUFACTURING TECH.					8	103	1	5	9	108
Q&RA					92	892	5	46	97	938
DIRECT DIST					91	882	5	53	96	935
TRAINING					5	49		2	5	51
TOTAL DIRECT LABOR					559	5,453	28	273	587	5,726
MATERIAL										
LAB. TECHNICIANS										
TOOLING						1,002				1,002
PRODUCTION										
MFG. TECHNICIANS						15		1		16
Q&RA						28		1		29
SUBTOTAL						1,045		2		1,047
MAT. & ADM. BURDEN						355		1		356
TOTAL MATERIAL						1,400		3		1,403
TOTAL PART II COST						6,853		276		7,129

AMLIV
NON-RECURRING COSTS

GSE E/M
PART II ASSEMBLY OR SYSTEM
TOOLING

TABLE 3.2.4.0-IV

<u>ELEMENT OF COST</u>	<u>COLUMN I MANHOURS</u>	<u>COLUMN II MANHOURS</u>	<u>COLUMN III DOLLARS</u>
TOOL DESIGN			
1. Lab. Tech.		-----	-----
TOTAL ENGR.		=====	=====
Fabrication and Erection			(In Thousand)
Fab. & Assembly	260,344		2,531
Misc. Charges	20,307		197
Maintain & Add In Scope Changes	<u>2,864</u>		<u>28</u>
SUBTOTAL	283,515		2,756
2. Tool and Production Planning	<u>79,384</u>		<u>771</u>
SUBTOTAL	362,899		3,527
3. Direct Distributable	<u>90,725</u>		<u>882</u>
SUBTOTAL	453,624		4,409
4. Training	<u>4,990</u>		<u>49</u>
SUBTOTAL	458,614		4,458
5. Q&RA	91,723		892
6. Manufacturing Tech.	<u>8,714</u>		<u>103</u>
TOTAL PRODUCTION LABOR	<u>559,051</u>		<u>5,453</u>
MATERIAL			
7. Tooling			1,002
8. Lab. Tech.			28
9. Q&RA			15
10. Manufacturing Tech.			1,045
MATERIAL SUBTOTAL			<u>1,045</u>
11. Material & Adm. Burden			355
TOTAL MATERIAL			<u>1,400</u>
TOTAL TOOLING COST			<u>6,853</u>

AMLLV
PART IIB
MANUFACTURING
MANUFACTURING TEST

GSE - E/M

ASSEMBLY OR SYSTEM
NON-RECURRING

TABLE 3.2.4.0-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	13,017	126,525
Component Test Planning	<u>4,165</u>	<u>40,484</u>
(1) Subtotal (A)	17,182	167,009
(2) Direct Distributable	<u>5,498</u>	<u>53,441</u>
Subtotal (B)	22,680	220,450
(3) Training	<u>249</u>	<u>2,420</u>
Subtotal (C)	22,929	222,870
(4) Mfg. Tech.	<u>436</u>	<u>5,149</u>
Subtotal (D)	23,365	228,019
(5) Q&RA	<u>4,673</u>	<u>45,422</u>
Total Mfg. Test Labor	<u>28,038</u>	<u>273,441</u>
Material		
(6) Q&RA		1,402
(7) Mfg. Tech.		<u>763</u>
Subtotal (E)		2,165
(8) Material & Adm. Burden		<u>736</u>
Total Material		<u>2,901</u>
Total Mfg. Test Cost		<u>276,342</u>

AMLLV
 PART II
 NON-RECURRING COST
 GSE - E/M
 ASSEMBLY OR SYSTEM

<u>Element of Cost</u>	TABLE 3.2.4.0-VI	<u>Manhours</u>	<u>Material</u> (\$)
Test and Checkout Equipment:			
General Equipment		8,247	\$ 31,751
Electrical Test Station		269	1,036
Mechanical Test Station		559	2,152
Data Systems Test Station		1,258	4,843
Interconnect Equipment		8,683	33,430
C/O Auxilliary Equipment		13,398	51,582
Test, Checkout, Calibration, and Maintenance Equipment		286	1,101
Subsystems Test Equipment		43,258	166,543
Subassemblies and Parts Test		48,858	188,103
Data Processing Station		68	262
Engine Test and Checkout Equipment		20,722	79,780
Handling and Transportation Equipment:			
General Equipment		4,012	15,446
Stage Handling Equipment		94,560	364,056
Component Handling Equipment		12,771	49,168
Stage Transportation Equipment		2,423	9,329
Engine Handling Equipment		972	3,742
 Total MGSE		 <u>260,344</u>	 <u>\$1,002,324</u>

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3.2.5 Manufacturing Facility - Injection Stage Engine Module

Get Ready Costs associated with the Engine Module for additions to the Main Stage manufacturing building, post manufacturing, and stage test building and the office building plus the additional capital equipment are displayed in Table 3.2.5.0-I.

Transportation costs are also included for such items as barges, the tow vehicle, the land transporter, and the cost for the barge trip from the manufacturing facility to the launch site.

For a detailed description of the manufacturing facility refer to Volume III of this report.

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TABLE 3.2.5.0-I
 AMLIV COST SUMMARY

MANUFACTURING FACILITY - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH. Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE BURDEN											
TOTAL MATERIAL											
TOTAL OTHER						58,265					58,265
TOTAL COST						58,265					58,265

AMLLV
 RECURRING COST SUMMARY
 ANNUAL
 ENGINE MODULE

 FACILITIES & TRANSPORTATION
 (DOLLARS IN THOUSANDS)

TABLE 3.2.5.0-II

<u>Element of Cost</u>	<u>Facilities</u>	<u>Equipment</u>	<u>Transportation</u>
Manufacturing Bldg.	26,995	14,113	
Vertical Assy. Bldg.	4,813	1,531	
Post Mfg. & Stage Test Bldg	1,500	100	
Liquid Engine Mfg. Bldg.			
Office	<u>4,469</u>	<u>529</u>	
Subtotal	37,777	16,273	
<u>Transportation</u>			
Barge			1,592
Tow Vehicle			82
Land Transporter			<u>1,541</u>
Subtotal			4,215
<u>Totals</u>			
Transportation			4,215
Equipment			16,273
Facilities			37,777
(1) Barge Trips			-----
TOTAL MANUFACTURING FACILITIES ANNUAL RECURRING COST			58,265

3.2.6 Launch Complex Facility

That share of the Launch Complex Facility for the injection stage - engine module consists of an appropriate allocation of land, buildings, utility systems, machinery, laboratory equipment, electronic equipment, furniture, office equipment, vehicles and other equipment used in launching operations.

The costs of this facility associated with the engine module are displayed in Table 3.2.6.0-I.

TABLE 3.2.6.0-I
 AMLV COST SUMMARY

ENGINE MODULE - LAUNCH COMPLEX FACILITY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER						2,100					2,100
TOTAL COST						2,100					2,100

AMLLV
LAUNCH COMPLEX FACILITIES
NON-RECURRING
(DOLLARS IN THOUSANDS)

TABLE 3.2.6.0-II

BRICK AND MORTAR

1.	Site Development Canal, Hyd. Fill, etc.	\$ 46,000
2.	Reinforce Concrete Launch Pad (Flame Deflect)	209,440
3.	Propellant Storage and Transfer and Disposal Systems	83,250
4.	Launch and Test Control Center	23,800
5.	Off-Site Support Complex	31,613
6.	Stage Storage Acceptance Test & Checkout	<u>5,000</u>

\$339,103

GROUND SUPPORT EQUIPMENT

1.	Gantry Equipment	\$ 22,610
2.	Unloading Crane	6,545
3.	Service Structure	58,671
4.	Umbilical Tower	14,092
5.	SRM Aft Support Structure	12,896
6.	SRM Fwd. Attach.	8,680
7.	Core Support and Hold Down Boom	<u>17,112</u>

\$140,606

EQUIPMENT (GENERAL)

1.	Test	129,150
2.	Off Site Support	<u>20,184</u>

\$149,334

TOTAL LAUNCH FACILITIES

\$689,043

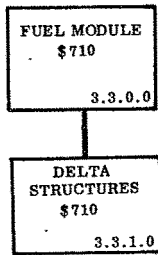
NOTE: Estimated 512,047 - Single Stage
 Estimated 2,100 - Engine Module*
 Estimated 174,896 - Solid Rocket Motor

689,043

* The cost associated with the Engine Module was allocated from the total Launch Complex cost.

3.3 INJECTION STAGE - FUEL MODULE

The Get Ready costs for the injection stage - fuel module are displayed in Figure 3.3.0.0-1. Basically, this cost consists of only the additional cost associated with designing the structure for the fuel module. Engine, systems, GSE, manufacturing and launch facilities costs, shown in 3.2.2 through 3.2.6, are adequate to support the fuel module requirements.



(DOLLARS IN THOUSANDS)

FIGURE 3.3.0.0-1 AMLLV INJECTION STAGE FUEL MODULE GET READY, "A" COSTS

TABLE 3.3.0.0-I

AMLLV COST SUMMARY

FUEL MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	1	7								1	7
PROGRAM PLAN. & REPT.	2	19								2	19
INDUSTRIAL RELATIONS		3									3
ENGINEERING			45	532						45	532
LAB TECHNICIANS			9	106						9	106
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A			2	17						2	17
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR	3	29	56	655						59	684
MATERIAL				19							19
LOGISTIC HARDWARE											
BURDEN				7							7
TOTAL MATERIAL				26							26
TOTAL OTHER											
TOTAL COST		29		681							710

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3.3.1 Structures

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TABLE 3.3.1.0-I

AMLLV COST SUMMARY

STRUCTURES - FUEL MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	1	7								1	7
PROGRAM PLAN. & REPT.	2	19								2	19
INDUSTRIAL RELATIONS		3									3
ENGINEERING			45	532						45	532
LAB TECHNICIANS			9	106						9	106
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & RA			2	17						2	17
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR	3	29	56	655						59	684
MATERIAL				19							19
LOGISTIC HARDWARE BURDEN				7							7
TOTAL MATERIAL				26							26
TOTAL OTHER											
TOTAL COST		29		681							710

MLLV

PART I

DESIGN - F/M
ASSEMBLY OR SYSTEM

TABLE 3.3.1.0-III

(In Thousands)

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	45		
Logistics	.		
Laboratory Technician	9		
Production			
Tooling			
Manufacturing Test			
Q&RA	2		
Facilities			
Manufacturing Technician			
Total Direct Labor	<u>56</u>		
Program Executive		1	7
Program Planning & Reporting		2	19
Industrial Relations			
Total Labor - Part I		<u>3</u>	<u>29</u>
<u>Material</u>			
Program Planning & Reporting			
Industrial Relations			
Material Subtotal			
Material & Administrative Burden			
Total Material			
TOTAL COST - PART I			<u>29</u>

TABLE 3.3.1.0-IV

AMLLV PART II COST SUMMARY

DESIGN - FUEL MODULE

A B C (IN THOUSANDS)

ELEMENT OF COST	DESIGN ENGINEERING		PRODUCTION		DESIGN & FAB. TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	45	532							45	532
LAB TECHNICIANS	9	106							9	106
TOOLING										
PRODUCTION										
MANUFACTURING TEST										
MANUFACTURING TECH.										
Q&RA	2	17							2	17
DIRECT DIST										
TRAINING										
TOTAL DIRECT LABOR	56	655							56	655
MATERIAL										
LAB. TECHNICIANS										
TOOLING										
PRODUCTION										
MFG. TECHNICIANS		18								18
Q&RA		1								1
SUBTOTAL		19								19
MAT. & ADM. BURDEN		7								7
TOTAL MATERIAL		26								26
TOTAL PART II COST		681								681

AMLLV
 NON-RECURRING COSTS
 PART II-A DESIGN - F/M

ASSEMBLY OR SYSTEM
 DESIGN ENGINEERING

<u>ELEMENT OF COST</u>	<u>TABLE 3.3.1.0-V</u>	<u>MANHOURS</u>	<u>DOLLARS</u>
BASIC DESIGN		45,000	\$531,450
1. Laboratory Technicians		<u>9,000</u>	<u>106,290</u>
Subtotal		54,000	\$637,740
2. Q&RA		<u>1,800</u>	<u>17,496</u>
TOTAL ENGINEERING LABOR		<u>55,800</u>	<u>\$655,236</u>
MATERIAL			
3. Laboratory Technicians			\$ 18,900
4. Q&RA			<u>540</u>
Subtotal			\$ 19,440
5. Material and Adm. Burden			<u>6,610</u>
TOTAL MATERIAL			<u>\$ 26,050</u>
TOTAL ENGINEERING COST			<u>\$681,286</u>

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3.4 SRM STAGE FIXED COST

The Get Ready Costs associated with the SRM's were classified into two categories, i.e.: (1) SRM fixed costs, and (2) SRM quantity sensitive costs. This was necessary in order to compensate for the various combinations of SRM's that can be used within the baseline AMLLV vehicle family i.e., 2 to 12 SRM's per vehicle.

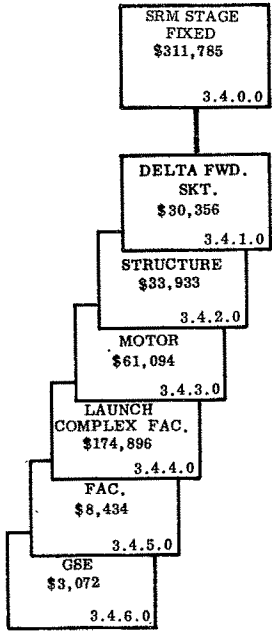
The Get Ready Costs in this paragraph are for those items which are not considered quantity sensitive to the number of SRM's per vehicle, i.e.:

- a. The delta cost associated with designing the alternate (heavy weight) forward skirt.
- b. The design of the other structures.
- c. The design of the SRM motor.
- d. The Launch Complex Facility.

The costs shown for the GSE and production facility are based on providing for a production rate of 24 SRM's per year

The total "FIXED" Get Ready Costs are shown in Figure 3.4.0.0-1.

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(DOLLARS IN THOUSANDS)

FIGURE 3.4.0.0-1 AMLLV SRM STAGE FIXED COST GET READY, "A" COSTS

TABLE 3.4.0.0-I

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
	PROGRAM EXECUTIVE	70	844								
PROGRAM PLAN.& REPT.	178	2,094								178	2,094
INDUSTRIAL RELATIONS	40	405								40	405
ENGINEERING			1,155	13,626						1,155	13,626
LAB TECHNICIANS			185	1,791						185	1,791
TOOLING			2,792	27,148						2,792	27,148
PRODUCTION											
MANUFACTURING TEST			60	583						60	583
MANUFACTURING TECH.			68	825						68	825
Q & R A			729	7,077						729	7,077
FACILITIES											
DIRECT DIST			718	6,980						718	6,980
TRAINING			40	386						40	386
TOTAL DIRECT LABOR	288	3,343	5,747	58,416						6,035	61,759
MATERIAL		7		62,177							62,184
LOGISTIC HARDWARE											
BURDEN		1		1,439							1,440
TOTAL MATERIAL		8		63,616							63,624
TOTAL OTHER					183,330				*3,072		186,402
TOTAL COST		3,351		122,032	183,330				3,072		311,785

* See Table 3.4.6.0-II

3.4.1 Delta Costs for the Alternate (Heavy Weight) Forward Skirt

The Get Ready costs shown in this section are those associated with designing the heavy weight forward skirt. This cost is a delta which is over and above the cost of the standard (lightweight) forward skirt.

TABLE 3.4.1.0-I
 AMLIV COST SUMMARY

ALTERNATE FORWARD SKIRT

A B C

(IN THOUSAN

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
	PROGRAM EXECUTIVE	33	390								
PROGRAM PLAN. & REPT.	81	957								81	957
INDUSTRIAL RELATIONS	18	196								18	196
ENGINEERING			449	5,302						449	5,302
LAB TECHNICIANS			90	874						90	874
TOOLING			1,266	12,035						1,266	12,305
PRODUCTION											
MANUFACTURING TEST			60	583						60	583
MANUFACTURING TECH.			32	392						32	392
Q & R A			340	3,304						304	3,304
FACILITIES											
DIRECT DIST			336	3,268						336	3,268
TRAINING			19	183						19	183
TOTAL DIRECT LABOR	132	1,543	2,592	26,211						2,724	27,754
MATERIAL		4		1,939							1,943
LOGISTIC HARDWARE											
BURDEN		1		658							659
TOTAL MATERIAL		5		2,597							2,602
TOTAL OTHER											
TOTAL COST		1,548		28,808							30,356

AMLLV
 NON-RECURRING
 PART I
 ALTERNATE FORWARD SKIRT
 ASSEMBLY OR SYSTEM

TABLE 3.4.1.0-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	829		
Logistics			
Laboratory Technician	166		
Production			
Tooling	1,266		
Manufacturing Test	60		
Q&RA	340		
Facilities			
Manufacturing Technician	<u>31</u>		
Total Direct Labor	<u>2,692</u>		
Program Executive		33	390
Program Planning & Reporting		81	957
Industrial Relations		<u>18</u>	<u>196</u>
Total Labor - Part I		<u>132</u>	<u>1,543</u>
<u>Material</u>			
Program Planning & Reporting			2
Industrial Relations			<u>2</u>
Material Subtotal			4
Material & Administrative Burden			1
Total Material			<u>5</u>
TOTAL COST - PART I			<u>1,548</u>

TABLE 3.4.1.0-III

AMLLV PART II COST SUMMARY

ALTERNATE FORWARD SKIRT

A B C (IN THOUSANDS)

ELEMENT OF COST	DESIGN ENGINEERING		PRODUCTION		DESIGN & FAB. TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	105	1,240			344	4,062			449	5,302
LAB TECHNICIANS	21	204			69	670			90	874
TOOLING					1,266	12,305			1,266	12,305
PRODUCTION										
MANUFACTURING TEST							60	583	60	583
MANUFACTURING TECH.					30	374	2	18	32	392
Q&RA	4	38			320	3,110	16	156	340	3,304
DIRECT DIST					317	3,081	19	187	336	3,268
TRAINING					18	175	1	8	19	183
TOTAL DIRECT LABOR	130	1,482			2,364	23,777	98	952	2,592	26,211
MATERIAL										
LAB. TECHNICIANS		45				145				190
TOOLING						1,592				1,592
PRODUCTION										
MFG. TECHNICIANS						52		3		55
Q&RA		1				96		5		102
SUBTOTAL		46				1,885		8		1,939
MAT. & ADM. BURDEN		15				641		2		658
TOTAL MATERIAL		61				2,526		10		2,597
TOTAL PART II COST		1,543				26,303		962		28,808

AMLLV
PART IIB
MANUFACTURING
MANUFACTURING TEST

ALTERNATE FORWARD SKIRT - TOOLING

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 3.4.1.0-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	45,474	442,008
Component Test Planning	<u>14,551</u>	<u>141,442</u>
(1) Subtotal (A)	60,025	583,450
(2) Direct Distributable	<u>19,209</u>	<u>186,705</u>
Subtotal (B)	79,234	770,155
(3) Training	<u>872</u>	<u>8,471</u>
Subtotal (C)	80,106	778,626
(4) Mfg. Tech.	<u>1,522</u>	<u>17,975</u>
Subtotal (D)	81,628	796,601
(5) Q&RA	<u>16,021</u>	<u>155,725</u>
Total Mfg. Test Labor	<u><u>97,649</u></u>	<u><u>952,326</u></u>
 Material		
(6) Q&RA		4,806
(7) Mfg. Tech.		<u>2,663</u>
Subtotal (E)		7,469
(8) Material & Adm. Burden		<u>2,540</u>
Total Material		<u><u>10,009</u></u>
Total Mfg. Test Cost		<u><u>962,335</u></u>

AMLLV
 NON-RECURRING COSTS
 PART II ALTERNATE FORWARD SKIRT

ASSEMBLY OR SYSTEM

DESIGN ENGINEERING

<u>ELEMENT OF COST</u>	<u>TABLE 3.4.1.0-V</u>	<u>MANHOURS</u>	<u>DOLLARS</u>
BASIC DESIGN		105	1,240
1. Laboratory Technicians		<u>21</u>	<u>204</u>
Subtotal		126	1,444
2. Q&RA		<u>4</u>	<u>38</u>
TOTAL ENGINEERING LABOR		<u><u>130</u></u>	<u><u>1,482</u></u>
MATERIAL			
3. Laboratory Technicians			45
4. Q&RA		<u> </u>	<u>1</u>
Subtotal			46
5. Material and Adm. Burden			<u>15</u>
TOTAL MATERIAL			<u><u>61</u></u>
TOTAL ENGINEERING COST			<u><u>1,543</u></u>

AMLLV
 NON-RECURRING COSTS
 ALTERNATE FORWARD SKIRT
 PART IIB ASSEMBLY OR SYSTEM
 TOOLING

TABLE 3.4.1.0-VI

<u>ELEMENT OF COST</u>	<u>COLUMN I MANHOURS</u>	<u>COLUMN II MANHOURS</u>	<u>COLUMN III DOLLARS</u>
TOOL DESIGN		344	\$ 4,062
1. Lab. Tech.		<u>69</u>	<u>670</u>
TOTAL ENGR.		<u>413</u>	<u>4,732</u>
Fabrication and Erection			
Fab. & Assembly	909	909	8,836
Misc. Charges	70		680
Maintain & Add In Scope Changes	<u>10</u>		<u>97</u>
SUBTOTAL (A)	989		9,613
2. Tool and Production Planning	<u>277</u>		<u>2,692</u>
SUBTOTAL (B)	1,266		12,305
3. Direct Distributable	<u>317</u>		<u>3,081</u>
SUBTOTAL (C)	1,583		15,386
4. Training	<u>18</u>		<u>175</u>
SUBTOTAL (D)	1,601		15,561
5. Q&RA	320		3,110
6. Manufacturing Tech.	<u>30</u>		<u>374</u>
TOTAL PRODUCTION LABOR	<u>1,951</u>		<u>19,045</u>
MATERIAL			
7. Tooling			1,592
8. Lab. Tech.			145
9. Q&RA			96
10. Manufacturing Tech.			<u>52</u>
MATERIAL SUBTOTAL (E)			1,885
11. Material & Adm. Burden			<u>641</u>
TOTAL MATERIAL			<u>2,526</u>
TOTAL TOOLING COST			<u>26,303</u>

3.4.2 Stage Structures for SRM

The Get Ready costs shown in Table 3.4.2.0-I are for the design, fabrication and assembly, and tool setup for other structures such as: Aft skirt fittings, nose cone and forward skirt of the SRM.

TABLE 3.4.2.0-1

AMLLV COST SUMMARY

SRM - STRUCTURE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
	PROGRAM EXECUTIVE	29	356								
PROGRAM PLAN. & REPT.	76	892								76	892
INDUSTRIAL RELATIONS	17	157								17	157
ENGINEERING			472	5,568						472	5,568
LAB TECHNICIANS			95	917						95	917
TOOLING			1,526	14,843						1,526	14,843
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.			36	433						36	433
Q & R A			389	3,773						389	3,773
FACILITIES											
DIRECT DIST			382	3,712						382	3,712
TRAINING			21	203						21	203
TOTAL DIRECT LABOR	122	1,405	2,921	29,449						3,043	30,854
MATERIAL		3		2,295							2,298
LOGISTIC HARDWARE BURDEN				781							781
TOTAL MATERIAL		3		3,076							3,079
TOTAL OTHER											
TOTAL COST		1,408		32,525							33,933

TABLE 3.4.2.1-1
 AMLLV COST SUMMARY

SRM - AFT SKIRT

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	3	39								3	39
PROGRAM PLAN. & REPT.	8	98								8	98
INDUSTRIAL RELATIONS	2	17								2	17
ENGINEERING			54	632						54	532
LAB TECHNECIANS			11	104						11	104
TOOLING			165	1,607						165	1,607
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.			4	47						4	47
Q & R A			42	409						42	409
FACILITIES											
DIRECT DIST			41	402						41	402
TRAINING			2	22						2	22
TOTAL DIRECT LABOR	13	154	319	3,223						332	3,377
MATERIAL				250							250
LOGISTIC HARDWARE BURDEN				84							84
TOTAL MATERIAL				334							334
TOTAL OTHER											
TOTAL COST		154		3,557							3,711

AMLLV
NON-RECURRING
PART I

SRM AFT SKILL
ASSEMBLY OR SYSTEM
TABLE 3.4.2.1-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	53,486		
Logistics			
Laboratory Technician	10,697		
Production			
Tooling	165,327		
Manufacturing Test			
Q&RA	42,134		
Facilities			
Manufacturing Technician	<u>3,970</u>		
Total Direct Labor	<u>275,614</u>		
Program Executive		3,307	39,056
Program Planning & Reporting		8,268	97,645
Industrial Relations		<u>1,766</u>	<u>17,166</u>
Total Labor - Part I		<u>13,341</u>	<u>153,867</u>
<u>Material</u>			
Program Planning & Reporting			165
Industrial Relations			<u>177</u>
Material Subtotal			342
Material & Administrative Burden			<u>116</u>
Total Material			<u>458</u>
TOTAL COST - PART I			<u>154,325</u>

TABLE 3.4.2.1-III

AMLLV PART II COST SUMMARY

SRM AFT SKIRT

A B C (IN THOUSANDS)

ELEMENT OF COST	DESIGN ENGINEERING		PRODUCTION		DESIGN & FAB. TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	9	103			45	529			54	632
LAB TECHNICIANS	2	17			9	87			11	104
TOOLING					165	1,607			165	1,607
PRODUCTION										
MANUFACTURING TEST										
MANUFACTURING TECH.					4	47			4	47
Q & RA		3			42	406			42	409
DIRECT DIST					41	402			41	402
TRAINING					2	22			2	22
TOTAL DIRECT LABOR	11	123			308	3,100			319	3,223
MATERIAL										
LAB. TECHNICIANS		4				19				23
TOOLING						208				208
PRODUCTION										
MFG. TECHNICIANS						7				7
Q&RA						12				12
SUBTOTAL		4				246				250
MAT. & ADM. BURDEN		1				83				84
TOTAL MATERIAL		5				329				334
TOTAL PART II COST		125				3,429				3,557

AMLLV
 NON-RECURRING COSTS
 PART II-A ^{SEP} AFT SKIRT
 ASSEMBLY OR SYSTEM
 DESIGN ENGINEERING

<u>ELEMENT OF COST</u>	TABLE 3.4.2.1-IV	<u>MANHOURS</u>	<u>DOLLARS</u>
BASIC DESIGN		5,100	102,747
1. Laboratory Technicians		<u>1,740</u>	<u>16,915</u>
Subtotal		<u>10,440</u>	<u>119,660</u>
2. Q&RA		<u>348</u>	<u>3,385</u>
TOTAL ENGINEERING LABOR		<u>10,788</u>	<u>\$123,045</u>
MATERIAL			
3. Laboratory Technicians			3,654
4. Q&RA			<u>104</u>
Subtotal			<u>3,758</u>
5. Material and Adm. Burden			<u>1,278</u>
TOTAL MATERIAL			<u>\$ 5,036</u>
TOTAL ENGINEERING COST			<u>\$128,079</u>

AMLLV
 NON-RECURRING COSTS
 SRK
AFT SKIRT
 PART IIB ASSEMBLY OR SYSTEM
 TOOLING

TABLE 3.4.2.1-V

<u>ELEMENT OF COST</u>	<u>COLUMN I MANHOURS</u>	<u>COLUMN II MANHOURS</u>	<u>COLUMN III DOLLARS</u>
TOOL DESIGN		44,786	526,923
1. Lab. Tech.		<u>8,957</u>	<u>87,062</u>
TOTAL ENGR.		<u>53,743</u>	<u>565,985</u>
Fabrication and Erection			
Fab. & Assembly	<u>118,606</u>		1,152,850
Misc. Charges	<u>9,251</u>		89,920
Maintain & Add In Scope Changes	<u>1,305</u>		<u>12,685</u>
SUBTOTAL (A)	<u>129,162</u>		<u>1,255,455</u>
2. Tool and Production Planning	<u>36,165</u>		<u>351,524</u>
SUBTOTAL (B)	<u>165,327</u>		<u>1,606,979</u>
3. Direct Distributable	<u>41,332</u>		<u>401,747</u>
SUBTOTAL (C)	<u>206,659</u>		<u>2,008,726</u>
4. Training	<u>2,273</u>		<u>22,094</u>
SUBTOTAL (D)	<u>208,932</u>		<u>2,030,820</u>
5. Q&RA	<u>41,786</u>		<u>406,160</u>
6. Manufacturing Tech.	<u>3,970</u>		<u>46,886</u>
TOTAL PRODUCTION LABOR	<u>254,688</u>		<u>\$2,483,866</u>
MATERIAL			
7. Tooling			207,561
8. Lab. Tech.			18,810
9. Q&RA			12,536
10. Manufacturing Tech.			<u>6,948</u>
MATERIAL SUBTOTAL (E)			<u>245,855</u>
11. Material & Adm. Burden			<u>83,591</u>
TOTAL MATERIAL			<u>\$ 329,446</u>
TOTAL TOOLING COST			<u>\$3,429,297</u>

TABLE 3.4.2.2-I

AMLLV COST SUMMARY

SRM FITTINGS

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	1	13								1	13
PROGRAM PLAN. & REPT.	3	33								3	33
INDUSTRIAL RELATIONS	1	6								1	6
ENGINEERING			20	237						20	237
LAB TECHNICIANS			4	39						4	39
TOOLING			54	530						54	530
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.			1	15						1	15
Q & RA			14	136						14	136
FACILITIES											
DIRECT DIST			14	133						14	133
TRAINING			1	7						1	7
TOTAL DIRECT LABOR	5	52	108	1,097						113	1,149
MATERIAL				82							82
LOGISTIC HARDWARE BURDEN				29							29
TOTAL MATERIAL				111							111
TOTAL OTHER											
TOTAL COST		52		1,208							1,260

AMLLV
 NON-RECURRING
 PART I
 SRM FITTINGS
ASSEMBLY OR SYSTEM

TABLE 3.4.2.2-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	19,995		
Logistics			
Laboratory Technician	3,999		
Production			
Tooling	54,542		
Manufacturing Test			
Q&RA	13,995		
Facilities			
Manufacturing Technician	<u>1,310</u>		
Total Direct Labor	<u>99,841</u>		
Program Executive		1,126	13,298
Program Planning & Reporting		2,815	33,245
Industrial Relations		<u>601</u>	<u>5,842</u>
Total Labor - Part I		<u>4,542</u>	<u>52,385</u>
<u>Material</u>			
Program Planning & Reporting			56
Industrial Relations			<u>60</u>
Material Subtotal			116
Material & Administrative Burden			<u>39</u>
Total Material			<u>155</u>
TOTAL COST - PART I			<u>52,540</u>

TABLE 3.4.2.2-III

AMLLV PART II COST SUMMARY

SRM FITTINGS

A B C (IN THOUSANDS)

ELEMENT OF COST	DESIGN ENGINEERING		PRODUCTION		DESIGN & FAB. TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	5	62			15	175			20	237
LAB TECHNICIANS	1	10			3	29			4	39
TOOLING					54	530			54	530
PRODUCTION										
MANUFACTURING TEST										
MANUFACTURING TECH.					1	15			1	15
Q&RA		2			14	134			14	136
DIRECT DIST					14	133			14	133
TRAINING					1	7			1	7
TOTAL DIRECT LABOR	6	74			102	1,023			108	1,097
MATERIAL										
LAB. TECHNICIANS		2				6				8
TOOLING						68				68
PRODUCTION										
MFG. TECHNICIANS						2				2
Q&RA						4				4
SUBTOTAL		2				80				82
MAT. & ADM. BURDEN		1				28				29
TOTAL MATERIAL		3				108				111
TOTAL PART II COST		77				1,131				1,208

AMLLV
NON-RECURRING COSTS
SRM
FITTINGS

PART IIB ASSEMBLY OR SYSTEM
TOOLING

<u>ELEMENT OF COST</u>	TABLE 3.4.2.2-IV <u>COLUMN I MANHOURS</u>	<u>COLUMN I MANHOURS</u>	<u>COLUMN III DOLLARS</u>
TOOL DESIGN		14,775	\$174,493
1. Lab. Tech.		<u>2,955</u>	<u>28,723</u>
TOTAL ENGR.		<u>17,730</u>	<u>\$203,216</u>
Fabrication and Erection			
Fab. & Assembly	39,129		380,334
Misc. Charges	3,052		29,665
Maintain & Add In Scope Changes	<u>430</u>		<u>4,180</u>
SUBTOTAL (A)	42,611		\$414,179
2. Tool and Production Planning	<u>11,931</u>		<u>115,969</u>
SUBTOTAL (B)	54,542		\$530,148
3. Direct Distributable	<u>13,636</u>		<u>132,542</u>
SUBTOTAL (C)	68,178		662,690
4. Training	<u>750</u>		<u>7,290</u>
SUBTOTAL (D)	68,928		669,980
5. Q&RA	13,786		134,000
6. Manufacturing Tech.	<u>1,310</u>		<u>15,471</u>
TOTAL PRODUCTION LABOR	<u>84,024</u>		<u>\$819,451</u>
MATERIAL			
7. Tooling			\$ 68,476
8. Lab. Tech.			6,206
9. Q&RA			2,136
10. Manufacturing Tech.			<u>2,293</u>
MATERIAL SUBTOTAL (E)			\$ 81,111
11. Material & Adm. Burden			<u>27,578</u>
TOTAL MATERIAL			<u>\$108,689</u>
TOTAL TOOLING COST			<u>\$1,131,356</u>

AMLLV
 NON-RECURRING COSTS
 PART II-A SRM FITTINGS

ASSEMBLY OR SYSTEM
 DESIGN ENGINEERING

<u>ELEMENT OF COST</u>	<u>TABLE 3.4.2.2-V</u>	<u>MANHOURS</u>	<u>DOLLARS</u>
BASIC DESIGN		5,220	\$61,648
1. Laboratory Technicians		<u>1,044</u>	<u>10,148</u>
Subtotal		6,264	\$71,796
2. Q&RA		<u>209</u>	<u>2,051</u>
TOTAL ENGINEERING LABOR		<u><u>6,473</u></u>	<u><u>\$73,827</u></u>
MATERIAL			
3. Laboratory Technicians			2,192
4. Q&RA			<u>63</u>
Subtotal			\$ 2,255
5. Material and Adm. Burden			<u>767</u>
TOTAL MATERIAL			<u><u>\$ 3,022</u></u>
TOTAL ENGINEERING COST			<u><u>\$76,849</u></u>

TABLE 3.4.2.3-1
 AMLLV COST SUMMARY

SRM ATTACH STRUCTURE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	17	206								17	206
PROGRAM PLAN. & REPT.	44	516								44	516
INDUSTRIAL RELATIONS	9	91								9	91
ENGINEERING			271	3,191						271	3,191
LAB TECHNICIANS			54	526						54	526
TOOLING			885	8,603						885	8,604
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.			21	251						21	251
Q & R A			225	2,186						225	2,186
FACILITIES											
DIRECT DIST			221	2,151						221	2,151
TRAINING			12	118						12	118
TOTAL DIRECT LABOR	70	813	1,689	17,026						1,759	17,839
MATERIAL		2		1,329							1,331
LOGISTIC HARDWARE											
BURDEN				453							453
TOTAL MATERIAL		2		1,782							1,784
TOTAL OTHER											
TOTAL COST		815		18,808							19,623

AMLLV
NON-RECURRING

PART I

SRM ATTACH STRUCTURE
ASSEMBLY OR SYSTEM

TABLE 3.4.2.3-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	270,496		
Logistics	54,099		
Laboratory Technician			
Production			
Tooling	885,065		
Manufacturing Test			
Q&RA	224,930		
Facilities			
Manufacturing Technician	<u>21,252</u>		
Total Direct Labor	<u>1,455,842</u>		
Program Executive		17,470	206,321
Program Planning & Reporting		43,675	515,802
Industrial Relations		<u>9,325</u>	<u>90,639</u>
Total Labor - Part I		<u>70,470</u>	<u>812,762</u>
<u>Material</u>			
Program Planning & Reporting			874
Industrial Relations			<u>933</u>
Material Subtotal			1,807
Material & Administrative Burden			<u>614</u>
Total Material			<u>2,421</u>
TOTAL COST - PART I			<u>815,183</u>

TABLE 3.4.2.3-III

AMLLV PART II COST SUMMARY

SRM ATTACH STRUCTURE

A B C (IN THOUSANDS)

ELEMENT OF COST	DESIGN ENGINEERING		PRODUCTION		DESIGN & FAB. TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	31	363			240	2,828			271	3,191
LAB TECHNICIANS	6	60			48	466			54	526
TOOLING					885	8,603			885	8,603
PRODUCTION										
MANUFACTURING TEST										
MANUFACTURING TECH. Q&RA	1	12			21	251			21	251
DIRECT DIST					224	2,174			225	2,186
TRAINING					221	2,151			221	2,151
TOTAL DIRECT LABOR	38	435			1,651	16,591			1,689	17,026
MATERIAL										
LAB. TECHNICIANS		13				101				114
TOOLING						1,111				1,111
PRODUCTION										
MFG. TECHNICIANS						37				37
Q&RA						67				67
SUBTOTAL		13				1,316				1,329
MAT. & ADM. BURDEN		5				448				453
TOTAL MATERIAL		18				1,764				1,782
TOTAL PART II COST		453				18,355				18,808

AMLLV
 NON-RECURRING COSTS
 PART II-A ATTACH STRUCTURE
 ASSEMBLY OR SYSTEM
 DESIGN ENGINEERING

<u>ELEMENT OF COST</u>	TABLE 3.4.2.3-V	<u>MANHOURS</u>	<u>DOLLARS</u>
BASIC DESIGN		50,740	343,059
1. Laboratory Technicians		<u>6,148</u>	<u>59,759</u>
Subtotal		<u>36,886</u>	<u>\$422,798</u>
2. Q&RA		<u>1,230</u>	<u>11,956</u>
TOTAL ENGINEERING LABOR		<u>38,118</u>	<u>\$434,754</u>
 MATERIAL			
3. Laboratory Technicians			12.911
4. Q&RA			<u>369</u>
Subtotal			<u>\$ 13,280</u>
5. Material and Adm. Burden			<u>4,515</u>
TOTAL MATERIAL			<u>\$ 17,795</u>
TOTAL ENGINEERING COST			<u>\$452,549</u>

AMLLV
NON-RECURRING COSTS
S.M.
ATTACH STRUCTURE
PART IIB ASSEMBLY OR SYSTEM
TOOLING

TABLE 3.4.2.3-IV

<u>ELEMENT OF COST</u>	<u>COLUMN I MANHOURS</u>	<u>COLUMN II MANHOURS</u>	<u>COLUMN III DOLLARS</u>
TOOL DESIGN		239,756	2,827,975
1. Lab. Tech.		<u>47,951</u>	<u>466,081</u>
TOTAL ENGR.		<u>287,407</u>	<u>\$3,294,059</u>
Fabrication and Erection			
Fab. & Assembly	<u>634,947</u>		6,171,685
Misc. Charges	<u>49,526</u>		481,393
Maintain & Add In Scope Changes	<u>6,984</u>		<u>67,884</u>
SUBTOTAL (A)	<u>691,457</u>		<u>\$6,720,962</u>
2. Tool and Production Planning	<u>193,608</u>		1,881,869
SUBTOTAL (B)	<u>885,065</u>		<u>\$8,602,831</u>
3. Direct Distributable	<u>221,266</u>		2,150,706
SUBTOTAL (C)	<u>1,106,331</u>		<u>\$10,753,537</u>
4. Training	<u>12,170</u>		<u>118,292</u>
SUBTOTAL (D)	<u>1,118,501</u>		<u>\$10,871,829</u>
5. Q&RA	<u>223,700</u>		<u>2,174,364</u>
6. Manufacturing Tech.	<u>21,252</u>		<u>250,986</u>
TOTAL PRODUCTION LABOR	<u>1,363,453</u>		<u>\$13,297,179</u>
MATERIAL			
7. Tooling			1,111,157
8. Lab. Tech.			100,697
9. Q&RA			67,110
10. Manufacturing Tech.			<u>37,191</u>
MATERIAL SUBTOTAL (E)			<u>\$1,316,155</u>
11. Material & Adm. Burden			<u>447,493</u>
TOTAL MATERIAL			<u>1,763,648</u>
TOTAL TOOLING COST			<u>\$18,354,886</u>

TABLE 3.4.2.4-I

AMLLV COST SUMMARY

SRM NOSE CONE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
	PROGRAM EXECUTIVE	8	98								
PROGRAM PLAN. & REPT.	21	245								21	245
INDUSTRIAL RELATIONS	5	43								5	43
ENGINEERING			127	1,508						127	1,508
LAB TECHNICIANS			26	248						26	248
TOOLING			411	4,103						422	4,103
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.			10	120						10	120
Q & R A			108	1,042						108	1,042
FACILITIES											
DIRECT DIST			106	1,026						106	1,026
TRAINING			6	56						6	56
TOTAL DIRECT LABOR	34	386	805	8,103						839	8,489
MATERIAL		1		634							635
LOGISTIC HARDWARE											
BURDEN				215							215
TOTAL MATERIAL		1		849							850
TOTAL OTHER											
TOTAL COST		387		8,952							9,339

AMLLV
 NON-RECURRING
 PART I
 SRM NOSE CONE
ASSEMBLY OR SYSTEM

TABLE 3.4.2.4-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	127,686		
Logistics			
Laboratory Technician	25,537		
Production			
Tooling	422,109		
Manufacturing Test			
Q&RA	107,222		
Facilities			
Manufacturing Technician	<u>10,135</u>		
Total Direct Labor	<u>692,689</u>		
Program Executive		8,312	98,165
Program Planning & Reporting		20,781	245,424
Industrial Relations		<u>4,437</u>	<u>43,128</u>
Total Labor - Part I		<u>33,530</u>	<u>386,717</u>
<u>Material</u>			
Program Planning & Reporting			416
Industrial Relations			<u>444</u>
Material Subtotal			860
Material & Administrative Burden			<u>292</u>
Total Material			<u>1,152</u>
TOTAL COST - PART I			<u>387,869</u>

TABLE 3.4.2.4-III

AMLLV PART II COST SUMMARY SRM NOSE CONE

A B C (IN THOUSANDS)

ELEMENT OF COST	DESIGN ENGINEERING		PRODUCTION		DESIGN & FAB. TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	13	157			114	1,351			127	1,508
LAB TECHNICIANS	3	26			23	222			26	248
TOOLING					422	4,103			422	4,103
PRODUCTION										
MANUFACTURING TEST										
MANUFACTURING TECH.					10	120			10	120
Q&RA	1	5			107	1,037			108	1,042
DIRECT DIST					106	1,026			106	1,026
TRAINING					6	56			6	56
TOTAL DIRECT LABOR	17	188			788	7,915			805	8,103
MATERIAL										
LAB. TECHNICIANS		6				48				54
TOOLING						530				530
PRODUCTION										
MFG. TECHNICIANS						18				18
Q&RA						32				32
SUBTOTAL		6				628				634
MAT. & ADM. BURDEN		2				213				215
TOTAL MATERIAL		8				841				849
TOTAL PART II COST		196				8,756				8,952

AMLLV
 NON-RECURRING COSTS
 SRM
 PART II-A NOSE CONE

<u>ELEMENT OF COST</u>	<u>TABLE 3.4.2.4-IV</u>	<u>MANHOURS</u>	<u>DOLLARS</u>
BASIC DESIGN		13,340	\$157,545
1. Laboratory Technicians		<u>2,668</u>	<u>25,933</u>
Subtotal		<u>16,008</u>	<u>183,478</u>
2. Q&RA		<u>534</u>	<u>5,190</u>
TOTAL ENGINEERING LABOR		<u>16,542</u>	<u>\$188,668</u>
MATERIAL			
3. Laboratory Technicians			\$ <u>5,603</u>
4. Q&RA			<u>160</u>
Subtotal			<u>\$ 5,763</u>
5. Material and Adm. Burden			<u>1,959</u>
TOTAL MATERIAL			<u>\$ 7,722</u>
TOTAL ENGINEERING COST			<u>\$196,390</u>

AMLIV
 NON-RECURRING COSTS
 SRM
 NGSE CONE
 PART IIB ASSEMBLY OR SYSTEM
 TOOLING

TABLE 3.4.2.4-V

ELEMENT OF COST	COLUMN I MANHOURS	COLUMN II MANHOURS	COLUMN III DOLLARS
TOOL DESIGN		114,346	\$1,350,426
1. Lab. Tech.		<u>22,869</u>	<u>222,287</u>
TOTAL ENGR.		<u>137,215</u>	<u>\$1,572,713</u>
Fabrication and Erection			
Fab. & Assembly	<u>302,822</u>		2,943,430
Misc. Charges	<u>23,620</u>		229,586
Maintain & Add In Scope Changes	<u>3,331</u>		<u>32,377</u>
SUBTOTAL (A)	<u>329,773</u>		<u>3,205,393</u>
2. Tool and Production Planning	<u>92,336</u>		897,506
SUBTOTAL (B)	<u>422,109</u>		<u>4,102,897</u>
3. Direct Distributable	<u>105,527</u>		<u>1,025,722</u>
SUBTOTAL (C)	<u>527,636</u>		<u>5,128,621</u>
4. Training	<u>5,804</u>		<u>56,415</u>
SUBTOTAL (D)	<u>533,440</u>		<u>5,185,036</u>
5. Q&RA	<u>106,688</u>		<u>1,037,007</u>
6. Manufacturing Tech.	<u>10,135</u>		<u>119,694</u>
TOTAL PRODUCTION LABOR	<u>650,263</u>		<u>\$6,341,737</u>
MATERIAL			
7. Tooling			\$ 529,939
8. Lab. Tech.			48,025
9. Q&RA			32,006
10. Manufacturing Tech.			<u>17,736</u>
MATERIAL SUBTOTAL (E)			<u>627,706</u>
11. Material & Adm. Burden			<u>213,420</u>
TOTAL MATERIAL			<u>\$ 841,126</u>
TOTAL TOOLING COST			<u>\$8,755,576</u>

3.4.3 The SRM Motor

The Get Ready costs shown in this section are those costs directly related to the Engineering design of the SRM motor and tooling design. Also, the Get Ready cost of the actual tooling is included. This tooling includes:

Development Tooling

- Process tooling
- Tooling maintenance and modification
- Chamber tooling
- Nozzle shell tooling
- Ablative and exit cone tooling
- Auxiliary power unit tooling
- Igniter tooling
- Inspection tooling

Production Tooling

- Process tooling
- Chamber tooling
- Nozzle shell tooling
- Ablatives and exit cone tooling
- Inspection tooling

The total costs for this item are displayed in Table 3.4.3.0-I.

TABLE 3.4.3.0-I

AMLLV COST SUMMARY

SOLID ROCKET MOTOR

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	8	98								8	98
PROGRAM PLAN. & REPT.	21	245								21	245
INDUSTRIAL RELATIONS	5	52								5	52
ENGINEERING			234	2,756						234	2,756
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR	34	395	234	2,756						268	3,151
MATERIAL				57,943							57,943
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL				57,943							57,943
TOTAL OTHER											
TOTAL COST		395		60,699							61,094

AMLLV
 NON-RECURRING
 PART I
SOLID ROCKET MOTOR
ASSEMBLY OR SYSTEM

TABLE 3.4.3.0-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering			
Logistics			
Laboratory Technician			
Production			
Tooling			
Manufacturing Test			
Q&RA			
Facilities			
Manufacturing Technician	_____		
Total Direct Labor	=====		
Program Executive		8,295	97,960
Program Planning & Reporting		20,737	244,900
Industrial Relations		5,364	52,140
Total Labor - Part I		34,396	395,000
<u>Material</u>			
Program Planning & Reporting			
Industrial Relations			
Material Subtotal			
Material & Administrative Burden			_____
Total Material			=====
TOTAL COST - PART I			395,000

TABLE 3.4.3.0-III

AMLV PART II COST SUMMARY

SOLID ROCKET MOTORS

A B C (IN THOUSANDS)

ELEMENT OF COST	DESIGN ENGINEERING		PRODUCTION		DESIGN & FAB. TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	161	1,898			73	858			234	2,756
LAB TECHNICIANS										
TOOLING										
PRODUCTION										
MANUFACTURING TEST										
MANUFACTURING TECH.										
Q & RA										
DIRECT DIST										
TRAINING										
TOTAL DIRECT LABOR	161	1,898			73	858			234	2,756
MATERIAL										
LAB. TECHNICIANS						57,943				57,943
TOOLING										
PRODUCTION										
MFG. TECHNICIANS										
Q&RA										
SUBTOTAL						57,943				57,943
MAT. & ADM. BURDEN										
TOTAL MATERIAL						57,943				57,943
TOTAL PART II COST		1,898				58,801				60,699

AMLLV
 NON-RECURRING COSTS
 PART II SOLID ROCKET MOTOR

ASSEMBLY OR SYSTEM
 DESIGN ENGINEERING

<u>ELEMENT OF COST</u>	TABLE 3.4.3.0-IV	<u>MANHOURS</u>	(In Thousands) <u>DOLLARS</u>
BASIC DESIGN		160,711	1,898
1. Laboratory Technicians		_____	_____
Subtotal			
2. Q&RA			
TOTAL ENGINEERING LABOR		<u>160,711</u>	<u>1,898</u>
MATERIAL			
3. Laboratory Technicians			
4. Q&RA		_____	_____
Subtotal			
5. Material and Adm. Burden			_____
TOTAL MATERIAL			<u>_____</u>
TOTAL ENGINEERING COST			<u>1,898</u>

NOTE: Based on Aerojet General input.

AMLIV
 NON-RECURRING COSTS
 SOLID ROCKET MOTOR
 PART IIB ASSEMBLY OR SYSTEM
 TOOLING

TABLE 3.4.3.0-V

(In Thousands)
 COLUMN III
 DOLLARS

<u>ELEMENT OF COST</u>	<u>COLUMN I MANHOURS</u>	<u>COLUMN II MANHOURS</u>	<u>COLUMN III DOLLARS</u>
TOOL DESIGN		72,650	858
1. Lab. Tech.		_____	_____
TOTAL ENGR.		<u>72,650</u>	<u>858</u>
Fabrication and Erection			
Fab. & Assembly			
Misc. Charges			
Maintain & Add			
In Scope Changes	_____		_____
SUBTOTAL (A)			_____
2. Tool and Production Planning	_____		_____
SUBTOTAL (B)			_____
3. Direct Distributable	_____		_____
SUBTOTAL (C)			_____
4. Training	_____		_____
SUBTOTAL (D)			_____
5. Q&RA			
6. Manufacturing Tech.	_____		_____
TOTAL PRODUCTION LABOR	<u>_____</u>		<u>_____</u>
MATERIAL			
7. Tooling *			57,943
8. Lab. Tech.			
9. Q&RA			
10. Manufacturing Tech.			
MATERIAL SUBTOTAL (E)			_____
11. Material & Adm. Burden			
TOTAL MATERIAL			<u>_____</u>
TOTAL TOOLING COST			<u>58,801</u>

* Includes both manhour and material. No further breakout was given by Aerojet.

3.4.4 Launch Complex Facility - SRM Stage

The Get Ready Cost for that portion of the Launch Complex Facility associated with SRM stages are:

- Site development canal, hydraulic, fill, etc.
- Gantry crane
- Unloading hoist
- SRM rotating fixture
- Service structure
- Umbilical tower
- SRM aft support structure
- SRM forward attachment and alignment boom mechanism
- Launch and test control center
- Off site support complex

This cost is based on the provision of a facility capable of a launch rate of two vehicles per year with each vehicle consisting of a main stage and twelve SRM strap-on stages. The total cost is displayed in Table 3.4.4.0-1.

TABLE 3.4.4.0-I

AMLLV COST SUMMARY

SRM LAUNCH COMPLEX FACILITY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
	PROGRAM EXECUTIVE										
PROGRAM PLAN.& REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & RA											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER							174,896				174,896
TOTAL COST							174,896				174,896

AMLLV
 LAUNCH COMPLEX FACILITIES
 NON-RECURRING
 (DOLLARS IN THOUSANDS)

TABLE 3.4.4.0-II

BRICK AND MORTAR

1. Site Development Canal, Hyd. Fill, etc.	46,000	
2. Reinforce Concrete Launch Pad (Flame Deflect)	209,440	
3. Propellant Storage and Transfer and Disposal Systems	83,250	
4. Launch and Test Control Center	23,800	
5. Off-Site Support Complex	31,613	
6. Stage Storage Acceptance Test & Checkout	<u>5,000</u>	
		399,103

GROUND SUPPORT EQUIPMENT

1. Gantry Equipment	22,610	
2. Unloading Crane	6,545	
3. Service Structure	58,671	
4. Umbilical Tower	14,092	
5. SRM Aft Support Structure	12,896	
6. SRM Fwd. Attach.	8,680	
7. Core Support and Hold Down Boom	<u>17,112</u>	
		140,606

EQUIPMENT (GENERAL)

1. Test	129,150	
2. Off Site Support	<u>20,184</u>	<u>149,334</u>

TOTAL LAUNCH FACILITIES

689,043

NOTE:

Estimated	512,047	-	Single Stage
Estimated	2,000	-	Engine Module
Estimated	<u>174,896</u>	-	Solid Rocket Motor*
	<u>689,043</u>		

* The cost associated with the solid rocket motor was allocated from the total launch complex cost.

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3.4.5 SRM Manufacturing Facility - Fixed Costs

The fixed Get Ready costs for the SRM manufacturing facility were defined design costs necessary to establish the minimum requirements for the production of 260" SRM motors regardless of the quantity of SRM's to be built. Table 3.4.5.0-I displays these costs.

NOTE: Refer to Paragraph 3.5.2 for the additional facility costs associated with the actual production of the SRM's which are quantity sensitive.

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TABLE 3.4.5.0-I

AMLLV COST SUMMARY

SRM MANUFACTURING FACILITIES (FIXED)

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER						8,434					8,434
TOTAL COST						8,434					8,434

AMLLV
 NON-RECURRING
 MANUFACTURING FACILITIES
 SRM
 DOLLARS IN THOUSANDS
 TABLE 3.4.5.0-II

AEROJET

Production	<u>67,667</u>	<u>67,667</u>
<u>* OTHER CONTRACTOR</u>		
Brick & Mortar	3,230	
Handling Equipment	457	
Capital Equipment	<u>1,937</u>	<u>5,624</u>
Total Manufacturing Facilities		** <u><u>73,291</u></u>

* Facilities required to build attach structure, nose cone, aft skirt, and fittings for SRM at Michoud. These are required in addition to the facilities required for the core stage vehicle.

** 11% Fixed 8,434 Attributable to SRM fixed costs.
 89% Variable 64,857

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3.4.6 Ground Support Equipment (GSE)

The Get Ready cost for SRM GSE includes the following items:

- Electronic checkout van
- Hydraulic power servicing unit
- Motor leakage pressurization unit
- Leak detection unit, helium type
- Pneumatic power supply cart
- Nozzle/TVC alignment kit
- Maintenance stands
- Environmental monitoring equipment
- Handling equipment
- Barges (12)

The costs associated with this equipment is displayed in Table 3.4.6.0-I. These costs are fixed in nature and are additive to the Quantity Sensitive costs reflected in sub-paragraph 3.5.1.

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TABLE 3.4.6.0-I

AMLLV COST SUMMARY

SRM GROUND SUPPORT EQUIP (FIXED)

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER									3,072		3,072
TOTAL COST									3,072		3,072

AMLLV

SRM

*GROUND SUPPORT EQUIPMENT
DOLLARS IN THOUSANDS

TABLE 3.4.6.0-II

1. Electronic Checkout Van	\$ 437
2. Hydraulic Power Servicing Unit	51
3. Motor Backage Pressurization Unit	32
4. Leak Detection Unit, Helium Type	19
5. Pneumatic Power Supply Cart	36
6. Nozzle/TVC Alignment Kit	20
7. Maintenance Stands	123
8. Environmental Monitoring Equipment	14
9. Handling Equipment	30
10. Barges (13)	<u>\$ 26,000</u>
TOTAL GSE	** <u>\$26,762</u>

*Based on Aerojet input for Sat V/4-260 Study

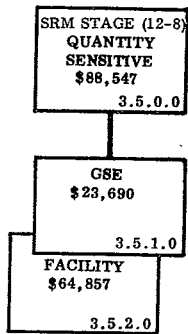
** 11.0% For Fixed 3,072 Attributable to SRM fixed costs.
89.0% For Fixed Variable 23,690

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3.5 SRM QUANTITY SENSITIVE COST

The Get Ready cost details for the 260" SRM's shown in Figure 3.5.0.0-I, are those costs directly related to the actual number of SRM's to be produced. The maximum units per year, for purposes of this study, was assumed to be twenty-four per year. The costs in this paragraph are those costs required to increase the SRM production from four to twenty-four units per year. They are additive to those costs shown in subsections 3.4.5 and 3.4.6 for the Manufacturing Facility and GSE.

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(DOLLARS IN THOUSANDS)

FIGURE 3.5.0.0-1. AMLLV SOLID MOTOR STAGE QUANTITY SENSITIVE COSTS
GET READY, "A" COSTS

TABLE 3.5.0.0-I

AMLLV COST SUMMARY

TOTAL SRM STAGE (VARIABLE)

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER						64,857			*23,690		88,547
TOTAL COST						64,857			23,690		88,547

* See Table 3.5.1.0-II

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3.5.1 Ground Support Equipment (GSE)

The SRM quantity sensitive GSE requirements are those costs associated with the production of 24 vehicles per year. These costs are displayed in Table 3.5.1.0-I, and are in addition to those costs reflected in sub-paragraph 3.4.6.

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TABLE 3.5.1.0-I

AMLLV COST SUMMARY

SRM GROUND SUPPORT EQUIPMENT (VARIABLE)

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
	PROGRAM EXECUTIVE										
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER									23,690		23,690
TOTAL COST									23,690		23,690

AMLLV

SRM

*GROUND SUPPORT EQUIPMENT

(DOLLARS IN THOUSANDS)

1.	Electronic Checkout Van	TABLE 3.5.1.0-II	432
2.	Hydraulic Power Servicing Unit		51
3.	Motor Package Pressurization Unit		32
4.	Leak Detection Unit, Helium Type		19
5.	Pneumatic Power Supply Cart		36
6.	Nozzle/TVC Alignment Kit		20
7.	Maintenance Stands		123
8.	Environmental Monitoring Equipment		14
9.	Handling Equipment		30
10.	Barges (13)		<u>26,000</u>
		TOTAL GSE	** <u>26,762</u>

* Based on Aerojet input for Sat V/4-260 Study

**	11% For Fixed	3,072	Attributable to SRM quantity sensitive costs.
	89% For Variable	23,690	

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3.5.2 Manufacturing Facility

The SRM motor quantity sensitive manufacturing facility costs are those costs associated with the actual number of vehicle to be produced per year. These costs are reflected in Table 3.5.2.0-1, and are in addition to the fixed facility costs in subparagraph 3.4.5.

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TABLE 3.5.2.0-I

AMLLV COST SUMMARY SRM MANUFACTURING FACILITIES (VARIABLE)

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
	PROGRAM EXECUTIVE										
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER						64,857					64,857
TOTAL COST						64,857					64,857

AMLLV
 NON-RECURRING
 MANUFACTURING FACILITIES
SRM
 (DOLLARS IN THOUSANDS)
 TABLE 3.5.2.0-II

AEROJET

Production		67,667
------------	--	--------

* OTHER CONTRACTOR

Brick & Mortar	3,230	
Handling Equipment	457	
Capital Equipment	<u>1,937</u>	<u>5,624</u>

Total Manufacturing Facilities		** <u>73,291</u>
--------------------------------	--	------------------

* Facilities required to build attach structure, nose cone, aft skirt, and fittings for SRM at Michoud. These are required in addition to the facilities required for the core stage vehicle.

11% For Fixed 8,434

** 89% For Variable 64,857 Attributable to SRM quantity sensitive costs.

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FINAL REPORT
FOR
COST STUDIES OF MULTIPURPOSE
LARGE LAUNCH VEHICLES

BASELINE AMLLV COSTS

BOOK B OF VOLUME IV

PREPARED UNDER CONTRACT NAS2-5056
FOR
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MISSION ANALYSIS DIVISION
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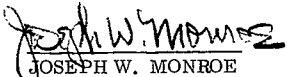
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NOTE: This is the second book (Book B) of the three books which comprise Volume IV of the final documentation for "Cost Studies of Multipurpose Large Launch Vehicles." This book contains Section 4.0, AMLLV Development Test or "B" Costs. Sections 1.0 through 3.0 are in Book A, AMLLV Get Ready or "A" Costs, and Section 5.0, AMLLV First Unit or "C" Costs is in Book C.

The pages in this volume are numbered sequentially in Book A through Book C.

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4.0 DEVELOPMENT TEST OR "B" COSTS

This section contains a detailed breakdown of the total non-recurring development testing costs for the various configuration elements of the Advanced Multipurpose Large Launch Vehicle (AMLLV) baseline family i. e. : The detailed costs are in most instances displayed to the subsystem level by element of cost.

The non-recurring costs have been categorized into the following sub-paragraphs:

- a. Single Stage to Orbit Vehicle (Section 4. 1)
- b. Injection Stage - Engine Module (Section 4. 2)
- c. Injection Stage - Fuel Module (Section 4. 3)
- d. Solid Rocket Motor Stage (Section 4. 4)

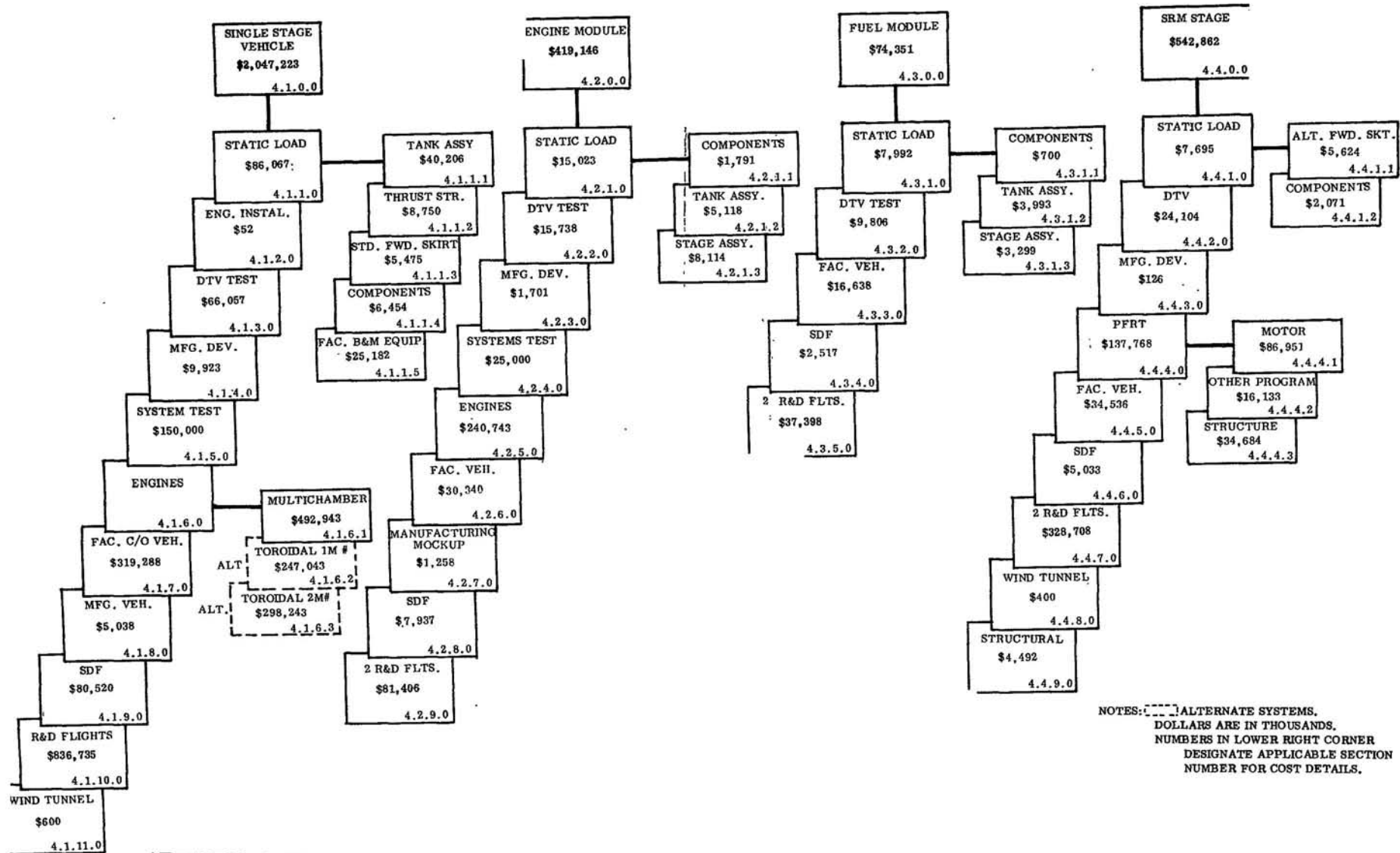
Costs for each of the configuration elements are categorized by the various types of testing required.

- a. Static Load Test
- b. Engine Installation - Manufacturing Development
- c. Manufacturing Development Test
- d. System Test
- e. Engine PFRT and Qualification Test
- f. Facility Checkout
- g. Manufacturing Mockup
- h. Systems Development Facility
- i. R&D Flight Vehicles
- j. Wind Tunnel Testing

For convenience and easy reference, the costs associated with the above items are displayed in Figure 4.0.0.0-1. Sub-paragraph numbers are also referenced to assist in locating the desired item(s).



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NOTES: [---] ALTERNATE SYSTEMS.
 DOLLARS ARE IN THOUSANDS.
 NUMBERS IN LOWER RIGHT CORNER
 DESIGNATE APPLICABLE SECTION
 NUMBER FOR COST DETAILS.

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FIGURE 4.0.0.0-1 AMLLV DEVELOPMENTAL OR "B" COST FLOW DIAGRAM

361/362-B

4.0 (Continued)

As stated in Section 1.0 of this volume (see Book A, Volume IV), the output of Phase I, Task 1 was to produce "Modularized" cost data. The "modularized" data presented in this section provide an understanding of the costs associated with all the development testing of the hardware items and will permit the evaluation of the relative impact of specific tests and/or elements on overall program costs. The development testing costs were developed in such a manner that the major vehicle options stand on their own, i.e., the costs for the single stage vehicle are the total costs for testing the single-stage-to-orbit vehicle. The costs for the injection stage - engine module, the injection stage - fuel module and the SRM's are the additional costs for testing each of these configuration elements.

Volume III - Resource Implications of this final report provides the basic overall general philosophy, ground rules and assumptions and the basic resource inputs for the development test programs. Resource and cost requirements for each of the specific tests or test categories are provided for each vehicle configuration option, in terms of (1) the facility equipment and tools required for the testing activity, and (2) the manpower, material and test specimens required to conduct each of the tests.

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4.1 SINGLE STAGE VEHICLE

The summary costs for testing the single stage AMLLV vehicle are displayed in Table 4.1.0.0-I. These costs include not only the cost associated with conducting the test but all the costs of the test specimens as well. Specimen costs were developed from the recurring costs contained in Book C of this volume. Figure 4.1.0.0-1 displays the total cost of the single stage vehicle by type of test and the appropriate sub-paragraph where the cost information is located.

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TOTAL SINGLE STAGE

TABLE 4.1.0.0-I
AMLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	35	407								35	407
PROGRAM PLAN. & REPT.	86	1032								86	1,032
INDUSTRIAL RELATIONS	18	189								18	189
ENGINEERING INPUT			614	150443						614	150,443
LAB TECHNICIANS			510	4951						510	4,951
TOOLING INPUT				11500							11,500
PRODUCTION INPUT			1434	184030						1,434	184,030
MANUFACTURING TEST ENGINES INPUT				54000							54,000
MANUFACTURING TECH. Q & R A			353	3433						353	3,443
FACILITIES											
DIRECT DIST			621	6040						621	6,040
TRAINING			28	274						28	274
TOTAL DIRECT LABOR	139	1628	3560	414681						3,699	416,309
MATERIAL		6		4619					114143		118,768
LOGISTIC HARDWARE BURDEN				*46934							46,934
				1368							1,368
TOTAL MATERIAL		6		52921					114143		167,070
TOTAL OTHER				34382	42319				1387143		1,463,844
TOTAL COST		1634		501984	42319				1501286		2,047,223

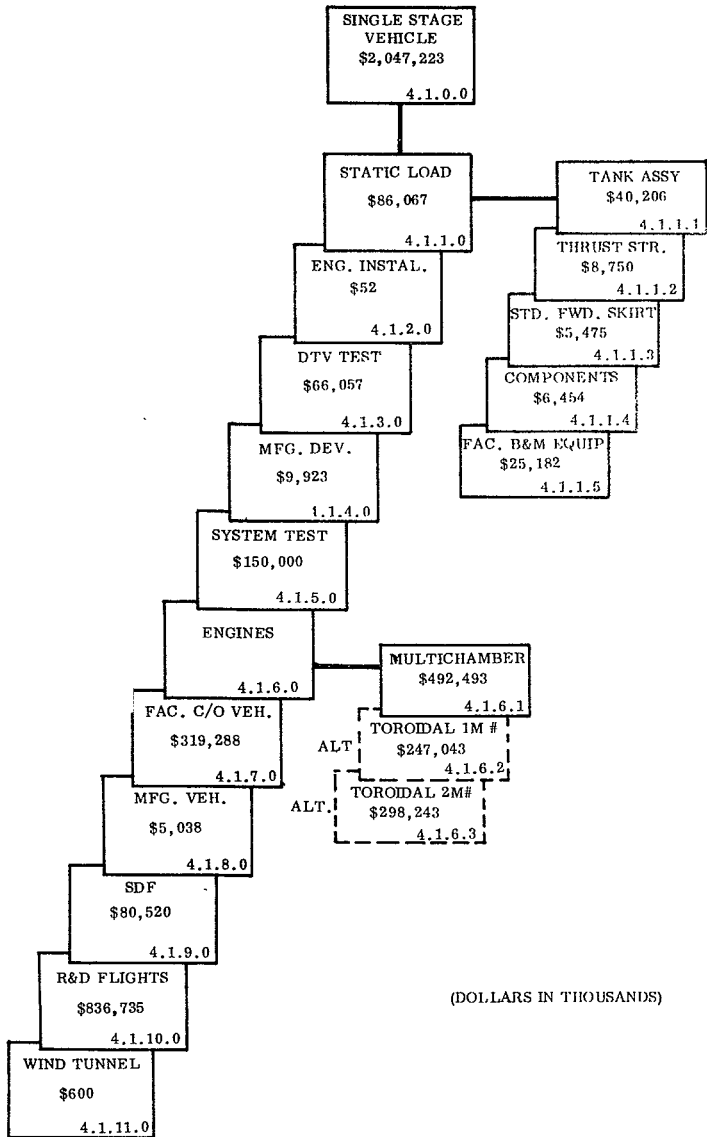


FIGURE 4.1.0.0-1 AMLLV SINGLE STAGE TO ORBIT VEHICLE COSTS DEVELOPMENT TEST, "B" COSTS



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4.1.1 Static Load Test - Single Stage Vehicle

The total costs of conducting all of the static load tests for the single stage vehicle are displayed in Table 4.1.1.0-I. In addition, Figure 4.1.1.0-1 displays the overall tests cost and appropriate sub-section number for the various components that require static testing.

Sections 4.1.1.1 through 4.1.1.4, which reflect the test costs for the tank assembly, thrust structure, standard forward skirt and the other components, include the costs of the labor, material, and tooling for the following:

a. Engineering

1. Mechanical and Electrical design
2. Drafting and support
3. Liaison
4. Conduct the test
5. Test reports

b. Manufacturing

1. Facility checkout and preparation
2. Specimen installation
3. Load fixture fabrication
4. Load fixture installation
5. Plumbing installation
6. Instrumentation installation
7. Mechanical checkout
8. Electrical checkout
9. Conduct the test
10. Teardown effort

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TABLE 4.1.1.0-I
AMLLV COST SUMMARY

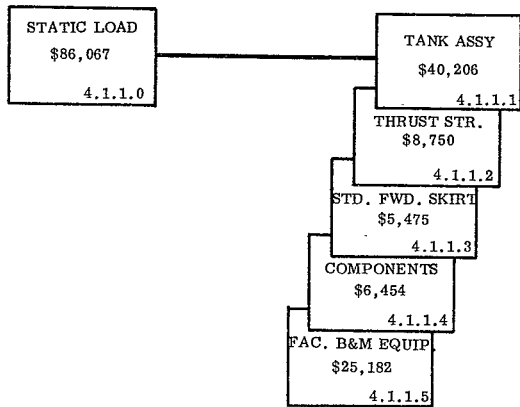
TOTAL STATIC LOAD TEST - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	12	134								12	134
PROGRAM PLAN. & REPT.	28	335								28	335
INDUSTRIAL RELATIONS	5	59								5	59
ENGINEERING			301	3,543						301	3,543
LAB TECHNICIANS											
TOOLING											
PRODUCTION			617	5,995						617	5,995
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A			31	295						31	295
FACILITIES											
DIRECT DIST			197	1,918						197	1,918
TRAINING			9	86						9	86
TOTAL DIRECT LABOR	45	528	1,155	11,837						1,200	12,365
MATERIAL		4		1,332							1,336
LOGISTIC HARDWARE				*46,934							46,934
BURDEN				250							250
TOTAL MATERIAL		4		48,516							48,520
TOTAL OTHER				25,182							25,182
TOTAL COST		\$532		\$60,353	\$25,182						\$86,067

*Specimen



(DOLLARS IN THOUSANDS)

FIGURE 4.1.1.0-1 AMLLV MAIN STAGE STATIC LOAD TEST COSTS DEVELOPMENT TEST, "B" COSTS

4.1.1 (Continued)

c. Material and Parts

1. Raw material
2. Mechanical components
3. Electrical transducers
4. Electrical components and equipment
5. Test specimen (from "C" cost)

d. Retest Allowance

Parts, materials and labor costs

Section 4.1.1.5 reflects the cost of the static load test facilities and the capital equipment for conducting the tests. In addition, the maintenance costs for the facilities and capital equipment are also included.

4.1.1.1 Tank Assembly - Static Load Test

TABLE 4.1.1.1-I

STATIC LOAD TEST - TANK ASSEMBLY SINGLE STAGE

A MLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	5	56								5	56
PROGRAM PLAN. & REPT.	12	139								12	139
INDUSTRIAL RELATIONS	2	25								2	25
ENGINEERING			125	1,472						125	1,472
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST			256	2,490						256	2,490
MANUFACTURING TECH.											
Q & R A			13	125						13	125
FACILITIES											
DIRECT DIST			82	796						82	796
TRAINING			4	36						4	36
TOTAL DIRECT LABOR	19	220	480	4,919						499	5,139
MATERIAL		1		661							662
LOGISTIC HARDWARE				34,383							34,383
BURDEN				22							22
TOTAL MATERIAL		1		35,066							35,067
TOTAL OTHER											
TOTAL COST		\$221		\$39,985							\$40,206

AMLLV
DEVELOPMENT COST
NON-RECURRING

PART I

TANK ASSY. (SINGLE STAGE)

CONDUCT STATUS LOAD TEST

TABLE 4.1.1.1-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollar:</u>
<u>Direct Labor</u>			
Engineering	124,709		
Logistics			
Laboratory Technician			
Production			
Tooling			
Manufacturing Test	256,128		
Q&RA	12,807		
Facilities			
Manufacturing Technician			
	<hr/>		
Total Direct Labor		<u>393,644</u>	
Program Executive		4,723	\$ 55,786
Program Planning & Reporting		11,809	139,468
Industrial Relations		<u>2,558</u>	<u>24,869</u>
Total Labor - Part I		<u>19,091</u>	<u>\$220,124</u>
<u>Material</u>			
Program Planning & Reporting			236
Industrial Relations			256
Material Subtotal			<hr/> 492
Material & Administrative Burden			<hr/> 167
Total Material			<hr/> \$ 659
			<hr/> <hr/>
TOTAL COST - PART I			<u>\$220,783</u>

TABLE 4.1.1.1-III

STATIC LOAD TEST - TANK ASSEMBLY - SINGLE STAGE

AMLLV PART II COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	125	1,472							125	1,472
LAB TECHNICIANS										
TOOLING										
PRODUCTION										
MANUFACTURING TEST							256	2,490	256	2,490
MANUFACTURING TECH.										
Q & R A							13	125	13	125
DIRECT DIST							82	796	82	796
TRAINING							4	36	4	36
TOTAL DIRECT LABOR	125	1,472					355	3,447	480	4,919
MATERIAL				*34,383						34,383
LAB. TECHNICIANS										
TOOLING										
PRODUCTION								657		657
MFG. TECHNICIANS										
Q & R A								4		4
SUBTOTAL				34,383				661		35,044
MAT. & ADM. BURDEN								22		22
TOTAL MATERIAL				34,383				724		35,066
TOTAL PART II COST		1,472		34,383				4,130		39,985

* Specimen - Inc. - LH₂ Tank, LOX Tank, Forward Skirt, Tunnels, Thrust Structure, Base Plug, and Assembly.

AMLLV
R&D TEST COST
NON-RECURRING

TANK ASSEMBLY (SINGLE STAGE)
CONDUCT STATIC LOAD TEST

(IN THOUSANDS)

TABLE 4.1.1.1-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Engineering	108,933	\$1,286
Retest Allowance	<u>15,776</u>	<u>186</u>
TOTAL COST	<u>124,709</u>	<u>\$1,472</u>

AMLLV
R & D TEST COST
NON-RECURRING

TANK ASSEMBLY (SINGLE STAGE)
CONDUCT STATIC LOAD TEST

TABLE 4.1.1.1-V

(IN THOUSANDS)

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Manufacturing	210,193	\$2,043
(2) Retest Allowance	45,935	447
Subtotal	<u>256,128</u>	<u>\$2,490</u>
(3) Direct Distributable	81,961	796
Subtotal	<u>338,089</u>	<u>\$3,286</u>
(4) Training	3,719	36
Subtotal	<u>341,808</u>	<u>\$3,322</u>
(5) Q&RA	12,807	125
TOTAL LABOR	<u><u>354,615</u></u>	<u><u>\$3,447</u></u>
 <u>Material</u>		
(6) Raw Material & Parts		\$ 657
(7) Q&RA		<u>4</u>
Material Subtotal		\$ 661
(8) Material & Admin. Burden		<u>22</u>
TOTAL MATERIAL		<u>\$ 683</u>
TOTAL COST		<u><u>\$4,130</u></u>

4. 1. 1. 2 Thrust Structure - Static Load Test

TABLE 4.1.1.2-I

STATIC LOAD TEST - THRUST STRUCTURE

SINGLE STAGE

AMLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	3	38								3	38
PROGRAM PLAN. & REPT.	8	96								8	96
INDUSTRIAL RELATIONS	2	17								2	17
ENGINEERING			83	981						83	981
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST			179	1,742						179	1,742
MANUFACTURING TECH.											
Q & R A			9	81						9	81
FACILITIES											
DIRECT DIST			57	558						57	558
TRAINING			3	25						3	25
TOTAL DIRECT LABOR	13	151	331	3,387						344	3,538
MATERIAL		1		421							422
LOGISTIC HARDWARE				4,647							4,647
BURDEN				143							143
TOTAL MATERIAL		1		5,211							5,212
TOTAL OTHER											
TOTAL COST		\$152		\$8,598							\$8,750

AMLLV
 DEVELOPMENT COST
 NON-RECURRING
 PART I

THRUST STRUCTURE (SINGLE STAGE)
 CONDUCT STATIC LOAD TEST
 TABLE +.1.1.2-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	83,094		
Logistics			
Laboratory Technician			
Production			
Tooling			
Manufacturing Test	179,258		
Q&RA	8,356		
Facilities			
Manufacturing Technician	_____		
Total Direct Labor	<u>270,708</u>		
Program Executive		3,248	\$ 38,363
Program Planning & Reporting		8,121	95,911
Industrial Relations		<u>1,759</u>	<u>17,103</u>
Total Labor - Part I		<u>13,129</u>	<u>\$151,378</u>
<u>Material</u>			
Program Planning & Reporting			\$ 162
Industrial Relations			<u>175</u>
Material Subtotal			\$ 337
Material & Administrative Burden			<u>115</u>
Total Material			<u>\$ 453</u>
TOTAL COST - PART I			<u>\$151,831</u>

TABLE 4.1.1.2-III

STATIC LOAD TEST - THRUST STRUCTURE (SINGLE STAGE)

AMLLV PART II COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	83	981							83	981
LAB TECHNICIANS										
TOOLING										
PRODUCTION										
MANUFACTURING TEST							179	1,742	179	1,742
MANUFACTURING TECH.										
Q & R A							9	81	9	81
DIRECT DIST							57	558	57	558
TRAINING							3	25	3	25
TOTAL DIRECT LABOR	83	981					248	2,406	331	3,387
MATERIAL				*4,647						4,647
LAB. TECHNICIANS										
TOOLING										
PRODUCTION								418		418
MFG. TECHNICIANS										
Q & R A								3		3
SUBTOTAL				4,647				421		5,068
MAT. & ADM. BURDEN								143		143
TOTAL MATERIAL				4,647				564		5,211
TOTAL PART II COST		\$981		\$4,647				\$2,970		\$8,598

* Specimen

AMLLV
R&D TEST COST
NON-RECURRING

THRUST STRUCTURE (SINGLE STAGE)

CONDUCT STATIC LOAD TEST

TABLE 4.1.1.2-IV

(IN THOUSANDS)

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Engineering	72,600	\$857
Retest Allowance	<u>10,494</u>	<u>124</u>
TOTAL COST	<u>83,094</u>	<u>\$981</u>

AMLLV
R & D TEST COST
NON-RECURRING

THRUST STRUCTURE (SINGLE STAGE)
CONDUCT STATIC LOAD TEST

TABLE 4.1.1.2-V

(In Thousands)

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Manufacturing	148,700	\$1,445
(2) Retest Allowance	<u>30,558</u>	<u>297</u>
Subtotal	179,258	\$1,742
(3) Direct Distributable	<u>57,363</u>	<u>558</u>
Subtotal	236,621	\$2,300
(4) Training	<u>2,603</u>	<u>25</u>
Subtotal	239,224	\$2,325
(5) Q&RA	<u>8,356</u>	<u>81</u>
Total Labor	<u>247,580</u>	<u>\$2,406</u>
<u>Material</u>		
(6) Raw Material & Parts		418
(7) Q&RA		<u>3</u>
Material Subtotal		\$ 421
(8) Material & Administrative Burden		<u>143</u>
Total Material		<u>\$ 564</u>
Total Cost		<u>\$2,970</u>

4.1.1.3 Standard Forward Skirt (Lightweight Skirt) - Static Load Test

TABLE 4.1.1.3-I

STATIC LOAD TEST - FORWARD SKIRT

SINGLE STAGE

AMLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	2	19								2	19
PROGRAM PLAN. & REPT.	4	46								4	46
INDUSTRIAL RELATIONS		8									8
ENGINEERING			42	492						42	492
LAB TECHNICIANS											
TOOLING											
PRODUCTION			86	830						86	830
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A			4	42						4	42
FACILITIES											
DIRECT DIST			27	265						27	265
TRAINING			1	12						1	12
TOTAL DIRECT LABOR	6	73	160	1,641						166	1,714
MATERIAL		1		92							91
LOGISTIC HARDWARE				3,637							3,637
BURDEN				31							31
TOTAL MATERIAL		1		3,760							3,761
TOTAL OTHER											
TOTAL COST		74		5,401							5,475

AMLLV
DEVELOPMENT COST
NON-RECURRING
PART I

FORWARD SKIRT (SINGLE STAGE)
ASSEMBLY OR SYSTEM
CONDUCT STATIC LOAD TEST

TABLE 4.1.1.3-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	41,629		
Logistics			
Laboratory Technician			
Production			
Tooling			
Manufacturing Test	85,345		
Q&RA	4,267		
Facilities			
Manufacturing Technician	_____		
Total Direct Labor	131,241		
Program Executive		1,574	18,598
Program Planning & Reporting		3,937	46,498
Industrial Relations		853	8,291
Total Labor - Part I		6,365	73,387
<u>Material</u>			
Program Planning & Reporting			78
Industrial Relations			85
Material Subtotal			163
Material & Administrative Burden			56
Total Material			219
TOTAL COST - PART I			73,607

TABLE 4.1.1.3-III

STATIC LOAD TEST - FORWARD SKIRT - SINGLE STAGE

AMLLV PART II COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	42	492							42	492
LAB TECHNICIANS										
TOOLING										
PRODUCTION										
MANUFACTURING TEST							86	830	86	830
MANUFACTURING TECH.										
Q & R A							4	42	4	42
DIRECT DIST							27	265	27	265
TRAINING							1	12	1	12
TOTAL DIRECT LABOR	42	492					118	1,149	160	1,641
MATERIAL				*3,637						3,637
LAB. TECHNICIANS										
TOOLING										
PRODUCTION								91		91
MFG. TECHNICIANS										
Q & R A								1		1
SUBTOTAL				3,637				92		3,729
MAT. & ADM. BURDEN								31		31
TOTAL MATERIAL				3,637				123		3,760
TOTAL PART II COST		492		3,637				1,272		5,401

* Specimen

AMLLV
R&D TEST COST
NON-RECURRING

FORWARD SKIRT (SINGLE STAGE)

CONDUCT STATIC LOAD TEST

TABLE 4.1.1.3-IV

(IN THOUSANDS)

<u>Element of Cost</u>	<u>Mannours</u>	<u>Dollars</u>
Engineering	36,400	\$430
Retest Allowance	<u>5,229</u>	<u>62</u>
TOTAL COST	<u><u>41,629</u></u>	<u><u>\$492</u></u>

AMLLW
R & D TEST COST
NON-RECURRING

FORWARD SKIRT (SINGLE STAGE)

CONDUCT STATIC LOAD TEST

TABLE 4.1.1.3-V

(IN THOUSANDS)

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Manufacturing	74,300	722
(2) Retest Allowance	11,045	108
Subtotal	85,345	839
(3) Direct Distributable	27,310	265
Subtotal	112,655	1,095
(4) Training	1,239	12
Subtotal	113,894	1,107
(5) Q&R ^A	4,267	42
TOTAL LABOR	118,161	1,149
 <u>Material</u>		
(6) Raw Material & Parts		91
(7) Q&RA		1
Material Subtotal		92
(8) Material & Admin. Burden		31
TOTAL MATERIAL		123
TOTAL COST		1,272

4.1.1.4 Component Testing - Static Load Test

TABLE 4.1.1.4-I

STATIC LOAD TEST - COMPONENTS - S/S

ANLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	2	21								2	21
PROGRAM PLAN. & REPT.	4	54								4	54
INDUSTRIAL RELATIONS	1	9								1	9
ENGINEERING			51	598							
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST			96	933						96	933
MANUFACTURING TECH.											
Q & R A			5	47						5	47
FACILITIES											
DIRECT DIST			31	299						31	299
TRAINING			1	13						1	13
TOTAL DIRECT LABOR	7	84	184	1,890						191	1,974
MATERIAL		1		158							159
LOGISTIC HARDWARE				*4,267							4,267
BURDEN				54							54
TOTAL MATERIAL	1			4,479							4,480
TOTAL OTHER											
TOTAL COST		85		6,369							6,454

*Specimen

A MLLV
 DEVELOPMENT COST
 NON-RECURRING
 PART I
 COMPONENTS (SINGLE STAGE)
ASSEMBLY OR SYSTEM

TABLE 4.1.1.4-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	50,610		
Logistics			
Laboratory Technician	95,986		
Production			
Tooling			
Manufacturing Test			
Q&RA	4,800		
Facilities			
Manufacturing Technician			
Total Direct Labor	<u>151,396</u>		
Program Executive		1,816	21,455
Program Planning & Reporting		4,541	53,638
Industrial Relations		<u>984</u>	<u>9,564</u>
Total Labor - part 1		<u>7,342</u>	<u>84,658</u>
<u>Material</u>			
Program Planning & Reporting			90
Industrial Relations			98
Material Subtotal			<u>188</u>
Material & Administrative Burden			<u>64</u>
Total Material			<u>254</u>
TOTAL COST - PART I			<u>84,911</u>

TABLE 4.1.1.4-III

STATIC LOAD TEST - COMPONENTS - S/S

AMLLV PART II COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	51	598							51	598
LAB TECHNICIANS										
TOOLING										
PRODUCTION							96	933	96	933
MANUFACTURING TEST										
MANUFACTURING TECH.										
Q & R A							5	47	5	47
DIRECT DIST							31	299	31	299
TRAINING							1	13	1	13
TOTAL DIRECT LABOR	51	598					133	1,292	184	1,890
MATERIAL				* 4,267						4,267
LAB. TECHNICIANS										
TOOLING										
PRODUCTION								157		157
MFG. TECHNICIANS										
Q & R A								1		1
SUBTOTAL				4,267				158		4,425
MAT. & ADM. BURDEN								54		54
TOTAL MATERIAL				4,267				212		4,479
TOTAL PART II COST		598		4,267				1,504		6,369

*Specimen

AMLIIV
R&D TEST COST
NON-RECURRING

COMPONENTS (SINGLE STAGE)

CONDUCT STATIC LOAD TEST

TABLE 4.1.1.4-IV

<u>Element of Cost</u>	<u>Manhours</u>	(IN THOUSANDS) <u>Dollars</u>
Engineering	44,467	\$525
Retest Allowance	<u>6,143</u>	<u>73</u>
TOTAL COST	<u>50,610</u>	<u>\$598</u>

AMLLV
R & D TEST COST
NON-RECURRING

COMPONENTS (SINGLE STAGE)

CONDUCT STATIC LOAD TEST

TABLE 4.1.1.4-V

(IN THOUSANDS)

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Manufacturing	78,100	759
(2) Retest Allowance	17,886	174
Subtotal	95,986	933
(3) Direct Distributable	30,716	299
Subtotal	126,702	1,232
(4) Training	1,394	13
Subtotal	128,096	1,245
(5) Q&RA	4,800	47
TOTAL LABOR	132,896	1,292
 <u>Material</u>		
(6) Raw Material & Parts		157
(7) Q&RA		1
Material Subtotal		158
(8) Material & Admin. Burden		54
TOTAL MATERIAL		212
TOTAL COST		1,504

4. 1. 1.5 Static Test Facility, Capital Equipment and Maintenance

TABLE 4.1.1.5-I

AMLLV COST SUMMARY

STATIC LOAD TEST B&M, EQUIP.MAINT. - S/S

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES						1,008					1,008
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR						1,008					1,008
MATERIAL						24,174					24,174
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL						24,174					24,174
TOTAL OTHER											
TOTAL COST						25,182					25,182

AMLLV
R & D TEST FACILITIES

STATIC LOAD TEST - SINGLE STAGE

TABLE 4.1.1.5-II

(In Thousands)

Dollars

Brick & Mortar & Equipment	\$ 24,174
Maintenance (One Year)	<u>1,008</u>
Total Cost	<u><u>\$ 25,182</u></u>

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4.1.2 Engine Installation - Manufacturing Development

This cost covers the effort that is required to develop the processes that are necessary to assure reliable installation of the engines on the single stage. Table 4.1.2.0-I reflects the cost of this function.

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TABLE 4.1.2.0-1

 AMLLV COST SUMMARY MANUFACTURING DEVELOPMENT ENGINE INSTALLATION-S/S A B C (IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE		2									2
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS ENGINEERING											
LAB TECHNICIANS			3	27						3	27
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH. Q & R A				7							7
FACILITIES											
DIRECT DIST			1	8						1	8
TRAINING											
TOTAL DIRECT LABOR		2	4	42						4	44
MATERIAL				6							6
LOGISTIC HARDWARE BURDEN				2							2
TOTAL MATERIAL				8							8
TOTAL OTHER											
TOTAL COST		2		50							52

AMLLV

PART I

MANUFACTURING DEVELOPMENT - S/S
ASSEMBLY OR SYSTEM

TABLE 4.1.2.0-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering			
Logistics			
Laboratory Technician	. 2,731		
Production			
Tooling			
Manufacturing Test			
Q&RA	710		
Facilities			
Manufacturing Technician			
Total Direct Labor	<u>3,441</u>		
Program Executive		41	484
Program Planning & Reporting		104	1,228
Industrial Relations		<u>23</u>	<u>224</u>
Total Labor - Part I		<u>168</u>	<u>1,936</u>
<u>Material</u>			
Program Planning & Reporting			2
Industrial Relations			<u>2</u>
Material Subtotal			4
Material & Administrative Burden			<u>1</u>
Total Material			<u>5</u>
TOTAL COST - PART I			<u>1,941</u>

TABLE 4.1.2.0-III

AMLLV PART II COST SUMMARY

ENGINE INSTALLATION

A B C

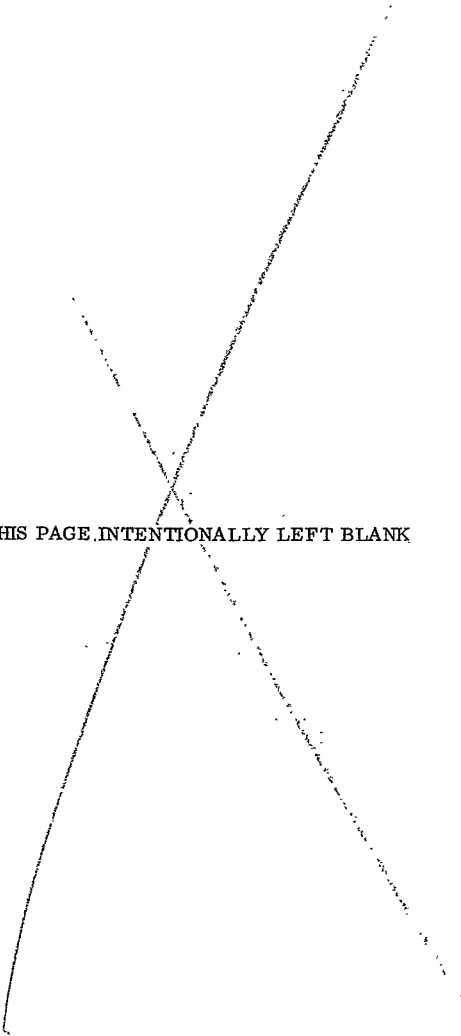
(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING										
LAB TECHNICIANS			3	27					3	27
TOOLING										
PRODUCTION										
MANUFACTURING TEST										
MANUFACTURING TECH.										
Q & R A				7						7
DIRECT DIST			1	8					1	8
TRAINING										
TOTAL DIRECT LABOR			4	42					4	42
MATERIAL				6						6
LAB. TECHNICIANS										
TOOLING										
PRODUCTION										
MFG. TECHNICIANS										
Q & R A										
SUBTOTAL				6						6
MAT. & ADM. EXPEN				2						2
TOTAL MATERIAL				8						8
TOTAL PART II COST				50						50

AMLLV
 DEVELOPMENTAL COST
 NON-RECURRING
MANUFACTURING DEVELOPMENT
 ENGINE INSTALLATION - S/S

TABLE 4.1.2.0-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Laboratory Technician	2,731	26,545
Direct Distributable	<u>874</u>	<u>8,495</u>
Subtotal	3,605	35,040
Training	<u>40</u>	<u>388</u>
Subtotal	3,645	35,428
Quality and Reliability Assurance	<u>729</u>	<u>7,085</u>
TOTAL LABOR	<u><u>4,374</u></u>	<u><u>42,513</u></u>
 <u>Material</u>		
Laboratory Technician		6,000
Material and Administrative Burden		<u>2,040</u>
TOTAL MATERIAL		<u><u>8,040</u></u>
TOTAL COST		<u><u>50,553</u></u>



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4.1.3 Dynamic Testing - Single Stage Vehicle

The total cost for performing the dynamic tests on the single stage vehicle are displayed in Table 4.1.3.0-I. This includes the labor, material, tooling, facilities and equipment to accomplish the following functions:

a. Engineering

1. Mechanical and Electrical design
2. Drafting and support
3. Liaison
4. Conduct the test
5. Test reports

b. Manufacturing

1. Facility checkout and preparation
2. Specimen installation
3. Load fixture - fabrication and installation
4. Plumbing installation
5. Instrumentation installation
6. Mechanical checkout
7. Electrical checkout
8. Conduct the test
9. Teardown effort

c. Material and Parts

1. Raw materials
2. Mechanical components

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4.1.3 (Continued)

3. Electrical transducers
 4. Electrical components and equipment
 5. Test specimen (from "C" costs)
- d. Retest Allowance

Parts, materials and labor costs

The cost of maintaining the facilities and capital equipment are also included. The maintenance cost covers the time period of the test cycle - 9 months.

TABLE 4.1.3.0-I
 AMLLV COST SUMMARY

DYNAMIC TEST - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	12	139								12	139
PROGRAM PLAN. & REPT.	29	347								29	347
INDUSTRIAL RELATIONS	7	62								7	62
ENGINEERING			313	3,700						313	3,700
LAB TECHNICIANS											
TOOLING											
PRODUCTION			550	5,341						550	5,341
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & RA			116	1,135						116	1,135
FACILITIES											
DIRECT DIST			176	1,709						176	1,709
TRAINING			8	78						8	78
TOTAL DIRECT LABOR	48	548	1,163	11,963						1,211	12,511
MATERIAL		1		1,512							1,513
LOGISTIC HARDWARE				34,382							34,382
BURDEN				514							514
TOTAL MATERIAL		1		36,408							36,409
TOTAL OTHER						17,137					17,137
TOTAL COST		\$549		\$48,371		17,137					\$66,057

AMLLV

NON-RECURRING

PART I

DYNAMIC TEST
ASSEMBLY OR SYSTEM

SINGLE STAGE

TABLE 4.1.3.0-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	313,314		
Logistics			
Laboratory Technician			
Production	549,508		
Tooling			
Manufacturing Test			
Q&RA	116,770		
Facilities			
Manufacturing Technician			
Total Direct Labor	<u>979,592</u>		
Program Executive		11,755	\$ 138,827
Program Planning & Reporting		29,387	\$ 347,068
Industrial Relations		<u>6,367</u>	<u>\$ 61,890</u>
Total Labor - Part I		<u>47,510</u>	<u>\$ 547,786</u>
<u>Material</u>			
Program Planning & Reporting			\$ 587
Industrial Relations			<u>636</u>
Material Subtotal			\$ 1,223
Material & Administrative Burden			<u>416</u>
Total Material			<u>\$ 1,640</u>
TOTAL COST - PART I			<u>\$ 549,427</u>

TABLE 4.1.3.0-III
 AMLLV PART II COST SUMMARY

DYNAMIC TEST - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	313	3,700							313	3,700
LAB TECHNICIANS										
TOOLING										
PRODUCTION							550	5,341	550	5,341
MANUFACTURING TEST										
MANUFACTURING TECH.										
Q & R A							116	1,135	116	1,135
DIRECT DIST							176	1,709	176	1,709
TRAINING							8	78	8	78
TOTAL DIRECT LABOR	313	3,700					850	8,263	1,163	11,963
MATERIAL SPECIMEN				* 34,382				1,477		35,859
LAB. TECHNICIANS										
TOOLING										
PRODUCTION										
MFG. TECHNICIANS										
Q & R A								35		35
SUBTOTAL				34,382				1,512		35,894
MAT. & ADM. BURDEN								514		514
TOTAL MATERIAL				34,382				2,026		36,408
TOTAL PART II COST		3,700		34,382				10,289		\$48,371

* Specimen

A MLLV
R & D TEST COST
NON-RECURRING

SINGLE STAGE

CONDUCT DYNAMIC TEST

TABLE 4.1.3.0-IV

<u>Element of Cost</u>	<u>Manhours</u>	(In Thousands) <u>Dollars</u>
Engineering	274,033	\$ 3,236
Retest Allowance	<u>39,281</u>	<u>\$ 464</u>
TOTAL COST	<u>313,314</u>	<u>\$ 3,700</u>

AMLLV
R & D TEST COST
NON-RECURRING

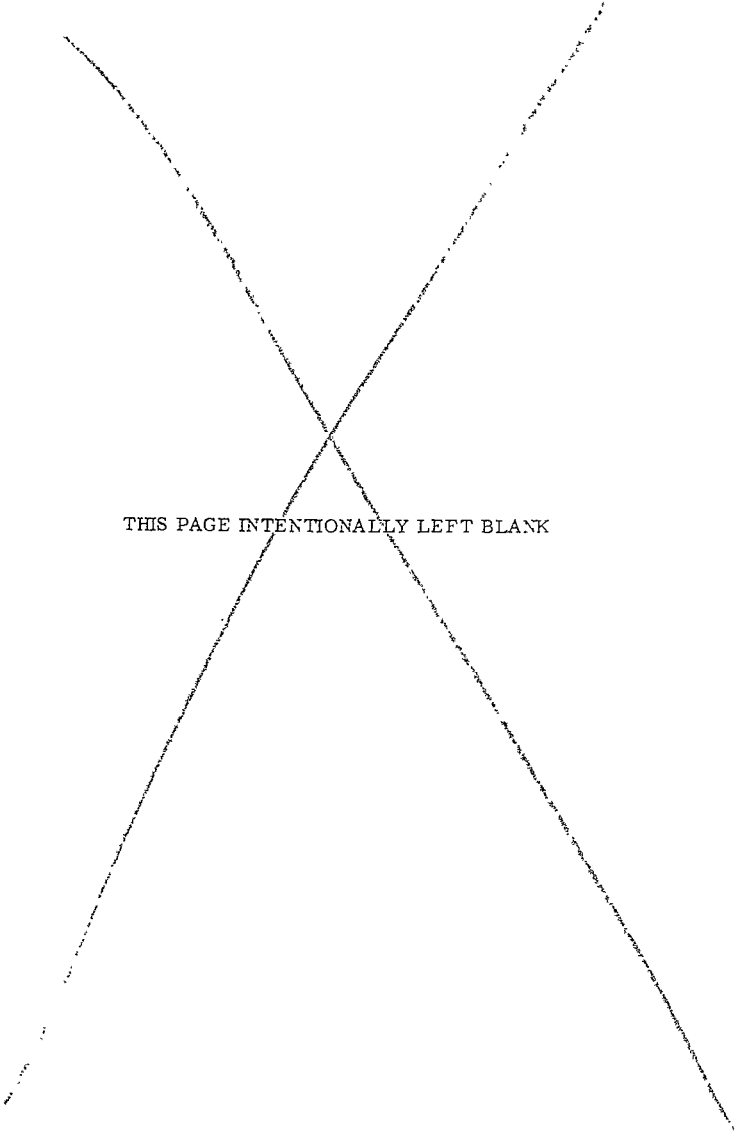
SINGLE STAGE

CONDUCT DYNAMIC TEST

TABLE 4.1.3.0-V

(IN THOUSANDS)

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Manufacturing	435,130	\$ 4,229
(2) Retest Allowance	114,378	1,112
Subtotal	<u>549,508</u>	<u>\$ 5,341</u>
(3) Direct Distributable	175,843	1,709
Subtotal	<u>725,321</u>	<u>\$ 7,050</u>
(4) Training	7,979	78
Subtotal	<u>733,330</u>	<u>\$ 7,128</u>
(5) Q&RA	116,770	1,135
TOTAL LABOR	<u><u>850,100</u></u>	<u><u>\$ 8,263</u></u>
 <u>Material</u>		
(6) Raw Material & Parts		\$ 1,477
(7) Q&RA		<u>35</u>
Material Subtotal		<u>\$ 1,512</u>
(8) Material & Admin. Burden		<u>514</u>
TOTAL MATERIAL		<u><u>\$ 2,026</u></u>
TOTAL COST		<u><u>\$10,289</u></u>



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4.1.4 Manufacturing Development Test - Single Stage Vehicle

The manufacturing development task is directed toward the development and implementation of fabrication and assembly processes to produce the single stage vehicles.

Defined in broad terms, the procedure is as follows:

- a. Determine manufacturing development requirements through coordination and review of engineering drawings and specifications, present methods and existing manufacturing capabilities.
- b. Establish suitable manufacturing methods. Document and coordinate these methods with applicable organizations.
- c. Define equipment requirements, tooling criteria, training requirements, and establish step-by-step procedures for critical manufacturing.
- d. Coordinate with factory, manufacturing engineering, facilities training, etc., to assist them in the implementation and proper application of newly developed methods.

Table 4.1.4.0-I displays the cost associated with this function for the single stage vehicle.

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TABLE 4.1.4.0-1
 AMLLV COST SUMMARY

MANUFACTURING DEVELOPMENT - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	7	84								7	84
PROGRAM PLAN. & REPT.	19	230								19	230
INDUSTRIAL RELATIONS	4	42								4	42
ENGINEERING											
LAB TECHNICIANS			507	4,924						507	4,924
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A			135	1,314						135	1,314
FACILITIES											
DIRECT DIST			162	1,575						162	1,575
TRAINING			7	72						7	72
TOTAL DIRECT LABOR	30	356	811	7,885						841	8,241
MATERIAL		1		1,254							1,255
LOGISTIC HARDWARE											
BURDEN				427							427
TOTAL MATERIAL		1		1,681							1,682
TOTAL OTHER											
TOTAL COST		357		9,566							9,923

AMLLV
 NON-RECURRING
 PART I
 MANUFACTURING DEVELOPMENT
 ASSEMBLY OR SYSTEM
 SINGLE STAGE
 TABLE 4.1.4.0-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering			
Logistics			
Laboratory Technician	506,559		
Production			
Tooling			
Manufacturing Test			
Q&RA	135,203		
Facilities			
Manufacturing Technician			
Total Direct Labor	<u>641,762</u>		
Program Executive		7,071	83,509
Program Planning & Reporting		19,484	230,106
Industrial Relations		<u>4,348</u>	<u>42,263</u>
Total Labor - Part I		<u>30,903</u>	<u>355,878</u>
<u>Material</u>			
Program Planning & Reporting			390
Industrial Relations			<u>434</u>
Material Subtotal			824
Material & Administrative Burden			<u>280</u>
Total Material			<u>1,104</u>
TOTAL COST - PART I			<u>356,982</u>

TABLE 4.1.4.0-III

MANUFACTURING DEVELOPMENT - SINGLE STAGE

AMLLV PART II COST SUMMARY

A B C

(IN THOUSANDS)

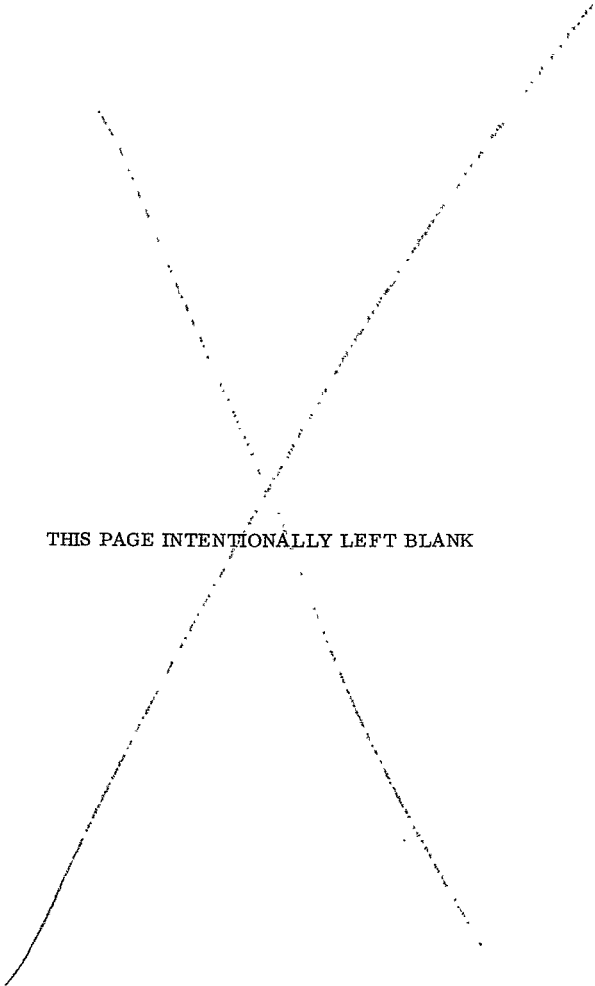
ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING										
LAB TECHNICIANS			507	4,924					507	4,924
TOOLING										
PRODUCTION										
MANUFACTURING TEST										
MANUFACTURING TECH.										
Q & R A			135	1,314					135	1,314
DIRECT DIST			162	1,575					162	1,575
TRAINING			7	72					7	72
TOTAL DIRECT LABOR			811	7,885					811	\$ 7,885
MATERIAL										
LAB. TECHNICIANS				1,213						1,213
TOOLING										
PRODUCTION										
MFG. TECHNICIANS										
Q & R A				41						41
SUBTOTAL				1,254						1,254
MAT. & ADM. BURDEN				427						427
TOTAL MATERIAL				1,681						1,681
TOTAL PART II COST				\$9,566						\$9,566

AMLLV

MANUFACTURING DEVELOPMENT
CORE STAGE

TABLE 4.1.4.0-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u> (In Thousands)
Lab. Technician	506,559	\$4,924
Direct Distributable	<u>162,099</u>	<u>1,575</u>
Subtotal "A"	668,658	\$6,499
Training	<u>7,355</u>	<u>72</u>
Subtotal "B"	676,013	\$6,571
Q&RA	<u>135,203</u>	<u>1,314</u>
Total Labor	<u>811,216</u>	<u>\$7,885</u>
Material		
Lab. Technician		\$1,213
Q&RA		<u>41</u>
Material Subtotal		\$1,254
Material & Admin. Burden		<u>427</u>
Total Material		<u>\$1,681</u>
TOTAL COST		<u>\$9,566</u>



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4.1.5 Systems Test - Single Stage Vehicle

Systems tests are identified as those tests that are required in addition to the major testing (dynamic static load, flight, etc. that are displayed elsewhere in Section 4.0). It was not possible to define all of the specific tests that fall within this category; however, the requirements for this general category were estimated in terms of overall program costs by applying historical data to the overall cost of producing the first flight vehicle.

Historical data relative to research and development testing of components and subsystems for other programs, prior to and inclusive of the S-IC program, were used as a basis for cost estimates for the single stage.

Table 4.1.5.0-I shows the resulting cost estimates for component and subsystem testing of the single stage.

Systems test include (but are not limited to):

- a. On-board test and checkout
- b. Qualification testing
- c. Acoustics testing, etc.

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TABLE 4.1.5.0-I
 AMLLV COST SUMMARY

SYSTEMS TEST - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABCR											
MATERIAL											
LOGISTIC HARDWARE											
EURDEN											
TOTAL MATERIAL											
TOTAL OTHER									150,000		150,000
TOTAL COST									150,000		150,000

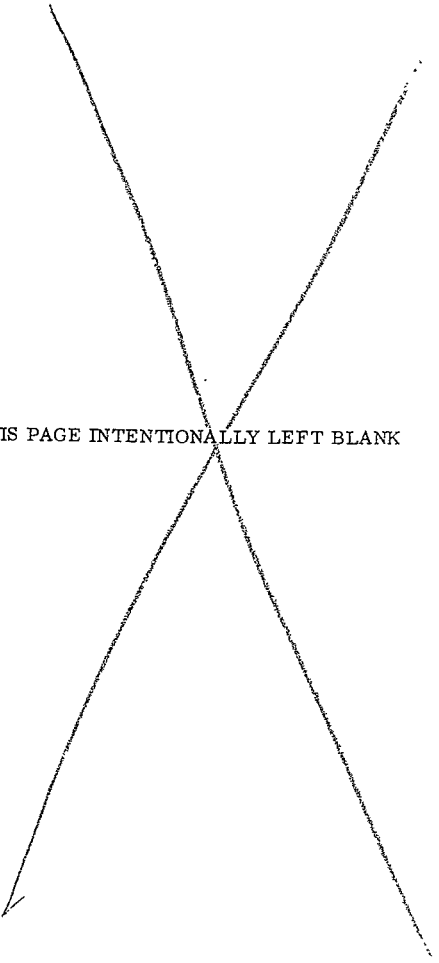
* SEE BACK-UP

AMLLV
DEVELOPMENTAL TESTING COST
NON-RECURRING
SYSTEMS TEST

TABLE 4.1.5.0-II

<u>Element of Cost</u>	<u>Dollars</u> (In Thousands)
Miscellaneous Test Include:	
On board test & C/O System development.	
Qualification Testing	
Acoustics Testing, etc.	
Single Stage Cost (1)	<u>150,000</u>

(1) Cost based on Engineering Estimate.



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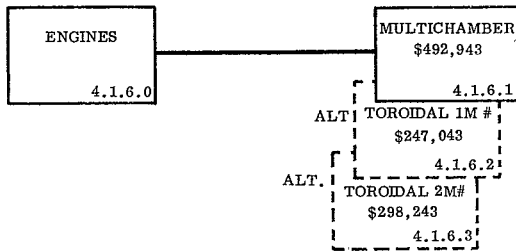
4.1.6 Engine PFRT and Qualification Testing - Main Stage

This section shows the development test costs for the following types of engines:

- 4.1.6.1 Multichamber/Plug (with 24 modules having fixed nozzles and a vacuum thrust of 793,000 pounds)
- 4.1.6.2 Toroidal/aerospike (2000 psia with 16 modules, each producing one million pound thrust at sea level)
- 4.1.6.3 Toroidal/aerospike (2000 psia with 8 modules, each producing two million pound thrust at sea level)

Figure 4.1.6.0-1 shows the AMLLV main stage liquid engine propulsion system costs. The multichamber/plug propulsion system is shown as the engine system on the main stage with the two toroidal/aerospike systems as alternative propulsion systems.

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(DOLLARS IN THOUSANDS)

FIGURE 4.1.6.0-1 AMLLV MAIN STAGE ENGINE OPTIONS COST DEVELOPMENT TEST, "B" COSTS

4.1.6.1 Multichamber/Plug Engine - Main Stage

Parametric cost data was received from Pratt and Whitney for the multichamber/plug propulsion system. This data covered a range of propulsion system sizes from above the requirements for a full size AMLLV engine to below that of a half size (MLLV) engine (Figure 4.1.6.1-1). The data received included the total cost for engine development, PFRT and qualifications testing as a function of module vacuum thrust.

As stated in Section 1.0, of Book A, the program development costs (for the purpose of this study) were sub-divided into two categories: (1) Get Ready or "A" costs and (2) Developmental Testing or "B" costs. Since the parametric data (Figure 4.1.6.1-1) included costs associated with both categories, it was necessary to establish the appropriate costs associated for each of the categories. The allocation pertaining to development test costs will be discussed herein (the get ready costs were discussed in Book A). The only cost data received, that reflected program costs for engine development, (by "A" and "B" cost categories) was that submitted by Rocketdyne on the 1200 psia toroidal/aerospike engine system. Figure 4.1.6.1-2 displays, in terms of percentages, the elements of cost developed from this data.

The percentages developed were then applied to the multichamber/plug propulsion system total development costs to divide it into get ready and development test costs. The example below illustrates how these costs were divided.

Example: Pratt and Whitney total cost \$490 million X 77.3% (from Figure 4.1.6.1-2)
= \$378,800 development test cost (the remainder being used in the
get ready or "A" cost).

Table 4.1.6.1-I displays the results of this compilation. These costs were also supplemented by other costs for facilities and capital equipment.

Figure 4.1.6.1-3 reflects the parametric data received from Pratt and Whitney for propellant consumption during the engine development program. The propellant data was provided in millions of pounds of propellant as a function of module vacuum thrust/thousands of pounds. This data was then converted to total dollars and was used on all three engine systems.

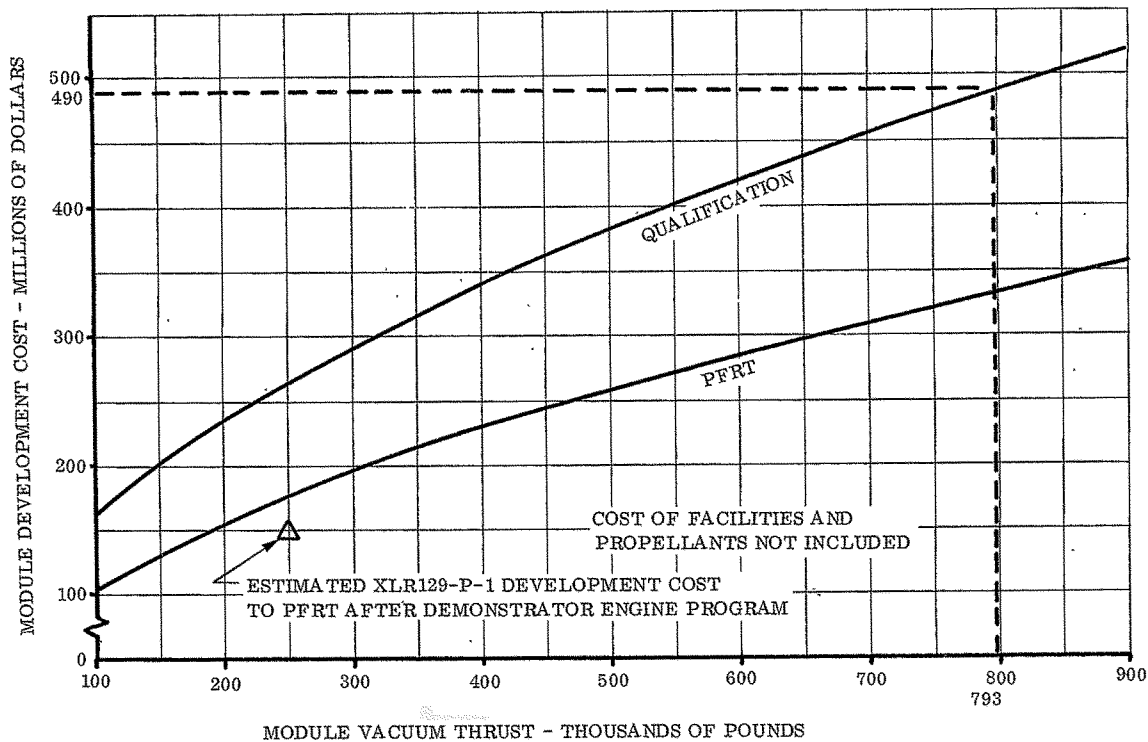


FIGURE 4.1.6.1-1 AMLLV MAIN STAGE PROPULSION SYSTEM - ESTIMATED MODULE DEVELOPMENT COSTS OXYGEN/HYDROGEN MULTICHAMBER/PLUG PROPULSION SYSTEM (PRATT & WHITNEY DATA)

	Get Ready or "A" Percentages		Development Test or "B" Percentages							
			Component		Engine		PFRT		Qual.	
Design and Development										
Engineering	72.2%		46.8%		34.7%		35.1%		35.1%	
Test	-0-		22.6		12.7		8.8		8.8	
Equipment	2.5%		4.0		5.8		-0-		-0-	
Tooling (Basic)	25.3		4.0		3.9		-0-		-0-	
Fabrication	-0-		22.6		42.9		56.1		56.1	
Subtotal	100%	46.8%	100%	24.9%	100%	52.1%	100%	11.5%	100%	11.5%
Production (Non-Recurring)										
Tooling (Basic)	55.5%									
Equipment	16.7									
GSE	27.8									
Subtotal	100%	53.2%								
TOTAL		22.7%				77.3%				
			100%							

NOTE: Percentages based on 1200 psia 286K pound thrust module, as submitted by Rocketdyne, in memo No. 68 RC-16347 dated December 20, 1968.

These percentages were:

- Used as is for the 1200 psia, 286K thrust engine
 - Used to allocate the amounts applicable to "A" and "B" cost categories on the multichamber/plug engine

FIGURE 4.1.6.1-2 DEVELOPMENT COST FOR 1200 PSIA TOROIDAL/AEROSPIKE PROPULSION SYSTEM DIVIDED INTO PERCENTAGES OF GET READY AND DEVELOPMENT TEST COST-BASED ON 1200 PSIA - 286,000 POUND THRUST MODULE

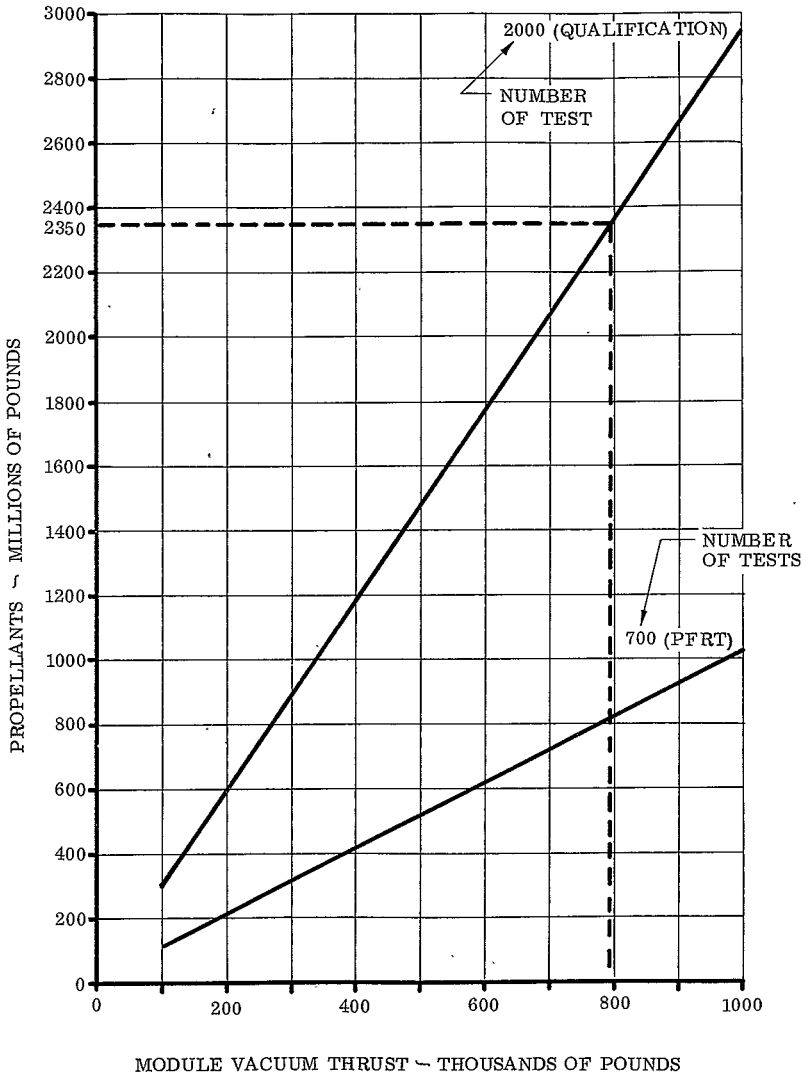


FIGURE 4.1.6.1-3 AMLLV MAIN STAGE PROPULSION SYSTEM - ESTIMATED PROPELLANT CONSUMPTION DURING ENGINE DEVELOPMENT INCLUDING ANCLLIARY FLUIDS OXYGEN/HYDROGEN MIXTURE RATIO, 6:1 (PRATT & WHITNEY DATA)

TABLE 4.1.6.1-I SINGLE STAGE - ENGINES
 AMLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING				143,200							143,200
LAB TECHNICIANS											
TOOLING				11,500							11,500
PRODUCTION				170,100							170,100
MANUFACTURING TEST				54,000							54,000
MANUFACTURING TECH. Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR				378,800							378,800
MATERIAL									114,143		114,143
LOGISTIC HARDWARE BURDEN											
TOTAL MATERIAL									114,143		114,143
TOTAL OTHER											
TOTAL COST				378,800					114,143		492,943

*Propellant

AMLLV
 SINGLE STAGE ENGINE
 *MULTI-CHAMBER
 PLUG ENGINE

TABLE 4.1.6.1-II

<u>"B" Costs</u>	<u>Component</u>	<u>Engine</u>	<u>PFRP</u>	<u>Qual.</u>	<u>Total</u>
Engineering	\$44.1M	\$ 68.5M	\$15.3M	\$15.3M	\$143.2M
Test	21.3M	25.1M	3.8M	3.8M	54.0M
Equipment	3.8M	11.4M			15.2M
Tooling (Basic)	3.8M	7.7M			11.5M
Fabrication	<u>21.3M</u>	<u>84.6M</u>	<u>24.5M</u>	<u>24.5M</u>	<u>154.9M</u>
Subtotal	\$94.3M	\$197.3M	\$43.6M	\$43.6M	\$378.8M

AMLLV

PROPELLANT CONSUMPTION

INC. ANCILLARY FLUIDS

OXYGEN/HYDROGEN

MIX RATIO = 6.0

2,000 QUALIFICATION TESTS

SINGLE STAGE ENGINE PROGRAM

MULTI-CHAMBER

PLUG ENGINE

TABLE 4.1.6.1-III

<u>TOTAL CONSUMPTION</u>		2,350,000,000 lbs.
OXYGEN		2,014,285,715 lbs.
HYDROGEN		335,714,285 lbs.
 <u>COST</u>		
OXYGEN	$\$.015 \times 2,014,285,715 \text{ lbs.}$	$= \$ 30,214,286$
HYDROGEN	$\$.25 \times 335,714,285 \text{ lbs.}$	$= \underline{83,928,571}$
TOTAL		$\cdot \underline{\underline{\$114,142,857}}$

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4.1.6.2 Toroidal/Aerospike Engine Cost (One Million Pound Thrust) - Main Stage

This paragraph presents the get ready cost for a toroidal/aerospike engine system consisting of sixteen 2000 psia modules, each of which will produce one million pounds of sea level thrust. Costs for this alternative engine system were supplied by Rocketdyne. However, the costs for the "A" and "B" categories were combined together.

In order to determine that amount which applied to "B" costs only, the same percentage apportionment between A and B costs used for the 1200 psia modules was applied to the 2000 psia propulsion system. Figure 4.1.6.2-1 displays, in terms of percentages, this breakdown of the categories. These percentages were then applied to the 2000 psia module data and the results are displayed in Table 4.1.6.2-1. Propellant costs are also included.

NOTE: The costs for this engine configuration are not added in the cost summary for the single stage vehicle shown in Table 4.1.6.1-I above. The toroidal/aerospike engine costs must be substituted in lieu of those for the multichamber/plug engine to define the cost of the single stage vehicle with the toroidal/aerospike engine system.

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	Get Ready or "A" Percentages		Development or "B" Percentages							
			Component	Engine	PFRT	Qual.				
Design and Development										
Engineering	68.2%		28.3%	26.7%	25.5%	25.5%				
Test	-0-		11.4	6.7	6.4	6.4				
Equipment	4.5		12.5	20.3	-0-	-0-				
Tooling (Basic)	27.3		5.2	1.8	-0-	-0-				
Fabrication	-0-		39.5	44.5	68.1	68.1				
Subtotal	100%	51.1%	100%	34.5%	100%	48.5%	100%	8.5%	100%	8.5%
Production (Non-Recurring)										
Tooling (Basic)	38.1%									
Equipment	23.8									
GSE	38.1									
Subtotal	100%	48.9%								
TOTAL		16.3%				83.7%				
			100%							

NOTE: Percentages based on 1200 psia, one million pound thrust module, as submitted by Rocketdyne, in memo No. 68RC-16347 dated December 20, 1968.

These percentages were:

- (1) Used as is for the 1200 psia, one million pound module.
- (2) Used to allocate the amount of cost applicable to on the "A" and "B" cost categories for the one and two million pound thrust modules.

FIGURE 4.1.6.2-1 DEVELOPMENT COSTS FOR 1200 PSIA TOROIDAL/AEROSPIKE PROPULSION SYSTEM DIVIDED INTO PERCENTAGES OF GET READY AND DEVELOPMENT TEST COSTS - BASED ON 1200 PSIA - ONE MILLION POUND THRUST MODULE

TABLE 4.1.6.2-I
 AMLLV COST SUMMARY

SINGLE STAGE ENGINES
 (TOROIDAL)

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING				36,300							36,300
LAB TECHNICIANS											
TOOLING				3,900							3,900
PRODUCTION				81,500							81,500
MANUFACTURING TEST				11,200							11,200
MANUFACTURING TECH. Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR				132,900							132,900
MATERIAL									*114,143		114,143
LOGISTIC HARDWARE BURDEN											
TOTAL MATERIAL									114,143		114,143
TOTAL OTHER											
TOTAL COST				132,900					114,143		247,043

* Propellant

AMLLV
 TOROIDAL ENGINE PROGRAM
 1.0M THRUST PER MODULE -16 MODULES
 2000 PSI

TABLE 4.1.6.2-II

<u>"B" Costs</u>	<u>Component</u>	<u>Engine</u>	<u>PFRT</u>	<u>Qual.</u>	<u>Total</u>
Engineering	\$13.3M	\$17.2M	\$2.9M	\$2.9M	\$36.3M
Test	5.5M	4.3M	.7M	.7M	11.2M
Equipment	6.0M	13.1M			19.1M
Tooling (Basic)	2.7M	1.2M			3.9M
Fabrication	18.4M	28.6M	7.7M	7.7M	62.4M
Subtotal (Incl. Fee)	\$45.9M	\$64.4M	\$11.3M	\$11.3M	\$132.9M

4.1.6.3 Toroidal/Aerospike Engine Cost (Two Million Pound Thrust) - Main Stage

This paragraph presents the get ready cost for a toroidal/aerospike engine system consisting of eight 2000 psia modules, each of which will produce two million pounds of sea level thrust. Costs for this alternative engine system were supplied by Rocketdyne. However, the costs for the "A" and "B" categories were combined together.

In order to determine that amount which applied to "B" costs only, the same percentage apportionment between A and B costs used for the 1200 psia modules was applied to the 2000 psia propulsion system. Figure 4.1.6.2-1 displays, in terms of percentages, this breakdown of the categories. These percentages were then applied to the 2000 psia module data and the results are displayed in Table 4.1.6.3-1. Propellant costs are also included.

NOTE: The costs for this engine configuration are not added in the cost summary for the single stage vehicle as shown in Table 4.1.6.1-I above. The toroidal/aerospike cost must be substituted in lieu of those for the multichamber/plug engine to define the cost of the single stage vehicle with the toroidal/aerospike engine system.

TABLE 4.1.6.3-I
 AMLLV COST SUMMARY

SINGLE STAGE ENGINES - (TOROIDAL)
 (TWO MILLION POUNDS THRUST)

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING				59,200							59,200
LAB TECHNICIANS											
TOOLING				5,300							5,300
PRODUCTION				112,900							112,900
MANUFACTURING TEST				15,700							15,700
MANUFACTURING TECH.											
Q & RA											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR				184,100							184,100
MATERIAL									*114,143		114,143
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL									114,143		114,143
TOTAL OTHER											
TOTAL COST				184,100					114,143		298,243

* PROPELLANT

440

AMLLV
SINGLE STAGE ENGINE
*TOROIDAL

TABLE 4.1.6.3-II

"B" Costs

(In Millions)

	<u>Comp.</u>	<u>Engine</u>	<u>PFRT</u>	<u>Qual.</u>	<u>Total</u>
Engineering	18.4	23.8	4.0	4.0	50.2
Test	7.7	6.0	1.0	1.0	15.7
Equipment	8.4	18.1			26.5
Tooling (Basic)	3.7	1.6			5.3
Fabrication	<u>25.4</u>	<u>39.8</u>	<u>10.6</u>	<u>10.6</u>	<u>86.4</u>
Subtotal (Incl. Fee)	63.6	89.3	15.6	15.6	184.1

* 2.0m 2000 Pounds - Thrust - 8 Modules

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4.1.7 Facility Checkout Vehicle - Single Stage Vehicle

The facility vehicle is defined as the test article that will be used to checkout the following:

- a. The manufacturing tools, facilities and equipment
- b. All R&D test facilities and equipment
- c. Handling and transportation equipment
- d. Launch complex facilities and support areas
- e. All GSE (manufacturing facility and launch facility)
- f. All processes and procedures

The primary objective of the facility vehicle is to achieve a state of operational readiness prior to processing of the flight vehicles. The costs associated with this facility vehicle are displayed in Table 4.1.7.0-I. The facility vehicle consists of the following types of cost elements:

- a. Single stage structure
- b. Systems
- c. Transportation from the manufacturing plant to the launch site
- d. The cost of a dummy payload and instrument unit
- e. Launch cycle cost (based on one years cost to checkout the facility)
- f. Propellant cost
- g. Launch site maintenance cost

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TABLE 4.1.7.0-I

AMLLV COST SUMMARY

FACILITY VEHICLE - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER									*319,288		319,288
TOTAL COST									319,288		319,288

* See Backup

AMLLV
NON-RECURRING
R&D COST

FACILITY VEHICLE - S/S

TABLE 4.1.7.0-II

<u>Element of Cost</u>	<u>Dollars</u> (In <u>Thousands</u>)
Structures	34,383
Systems	19,471
Transportation	84
Dummy Payload & IU	1,200
Launch Operations	240,077
Propellant	6,573
Launch Maintenance (1 Yr)	<u>17,500</u>
TOTAL COST	<u><u>319,288</u></u>

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4.1.8 Manufacturing Mockup Vehicle - Single Stage Vehicle

The manufacturing mockup will be used extensively to aid and assist in the development of the production tooling and the manufacturing techniques.

This mockup is not a complete vehicle, but is limited to full size sub-assemblies and sub-systems. The costs for developing the mockup for the single stage vehicle are reflected in Table 4.1.8.0-I.

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TABLE 4.1.8.0-I

FACILITY MOCK-UP

A MLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	4	48								4	48
PROGRAM PLAN. & REPT.	10	120								10	120
INDUSTRIAL RELATIONS	2	26								2	26
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION			267	2,594						267	2,594
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & RA			71	692						71	692
FACILITIES											
DIRECT DIST			85	830						85	830
TRAINING			4	38						4	38
TOTAL DIRECT LAECR	16	194	427	4,154						443	4,348
MATERIAL				515							515
LOGISTIC HARDWARE											
BURDEN				175							175
TOTAL MATERIAL				690							690
TOTAL OTHER											
TOTAL COST		\$194		\$4,844							\$5,038

AMLLV
PART I
FACILITY MOCK-UP
ASSEMBLY OR SYSTEM
TABLE 4.1.8.0-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering			
Logistics			
Laboratory Technician			
Production	266,900		
Tooling			
Manufacturing Test			
Q&RA	71,237		
Facilities			
Manufacturing Technician			
Total Direct Labor		<u>338,137</u>	
Program Executive		4,058	\$ 47,925
Program Planning & Reporting		10,144	119,801
Industrial Relations		<u>2,198</u>	<u>25,958</u>
Total Labor - Part I		<u>16,400</u>	<u>\$193,684</u>
<u>Material</u>			
Program Planning & Reporting			\$ 203
Industrial Relations			220
Material Subtotal			<u>\$ 423</u>
Material & Administrative Burden			<u>144</u>
Total Material			<u>\$ 567</u>
TOTAL COST - PART I			<u>\$194,251</u>

TABLE 4.1.8.0-III

FACILITY MOCK-UP

AMLLV PART II COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	S	M/H	\$	M/H	\$
ENGINEERING										
LAB TECHNICIANS										
TOOLING										
PRODUCTION										
MANUFACTURING TEST			267	2,594					267	2,594
MANUFACTURING TECH.										
Q & R A			71	692					71	692
DIRECT DIST			85	830					85	830
TRAINING			4	38					4	38
TOTAL DIRECT LABOR			427	4,154					427	4,154
MATERIAL				494						494
LAB. TECHNICIANS										
TOOLING										
PRODUCTION										
MFG. TECHNICIANS										
Q & R A				21						21
SUBTOTAL				515						515
MAT. & ADM. EXPEN.				175						175
TOTAL MATERIAL				690						690
TOTAL PART II COST				\$4,844						\$4,844

AMLLV

FACILITY MOCK-UP

SINGLE STAGE

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 4.1.8.0-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u> (In Thousand)
Fab. & Assy.	266,900	\$ 2,594
Direct Distributable	<u>85,408</u>	<u>830</u>
Subtotal (A)	352,308	\$ 3,424
Training	<u>3,875</u>	<u>38</u>
Subtotal (B)	356,183	\$ 3,462
Q&RA	<u>71,237</u>	<u>692</u>
Total Labor	<u>427,420</u>	<u>\$ 4,154</u>
Material		
Raw Material		\$ 494
Q&RA		<u>\$ 21</u>
Subtotal (C)		\$ 515
Material & Adm. Burden		<u>\$ 175</u>
Total Material		<u>\$ 690</u>
Total Tooling Cost		<u>\$ 4,844</u>



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4.1.9 Systems Development Facility (Breadboard) - Single Stage Vehicle

The Systems Development Breadboard Facility will provide for extensive testing, evaluation, and verification of components, subsystems, and systems under controlled conditions that approximate those at the launch site.

Existing facilities at Michoud will be used to house the breadboard. (A new facility for this activity would cost approximately \$750,000.) The equipment for these tests will primarily consist of the elements of vehicle and GSE hardware and/or simulators that make up the breadboard plus the computer complex.

The costs associated with the SDF for the single stage vehicle are displayed in Table 4.1.9.0-I.

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TABLE 4.1.9.0-I

AMLLV COST SUMMARY

SDF - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
	PROGRAM EXECUTIVE										
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER									*80,520		80,520
TOTAL COST									80,520		80,520

*SEE BACK-UP

AMLLV
NON-RECURRING COST
R & D TEST FACILITIES

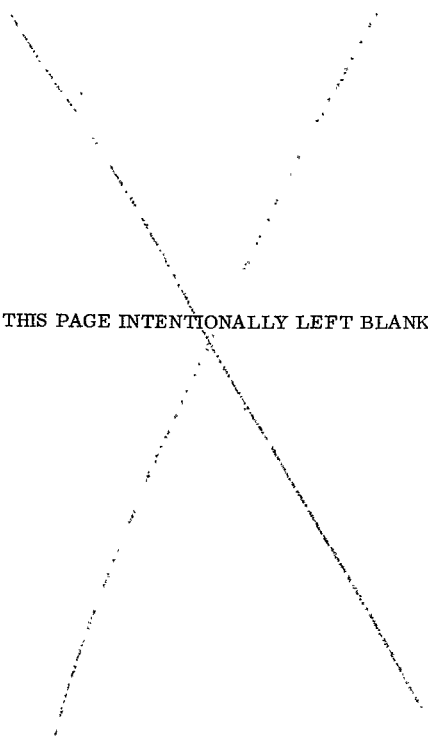
SYSTEMS DEVELOPMENT FACILITY - SINGLE STAGE

TABLE 4.1.9.0-II

(In Thousands)

<u>Element of Cost</u>	<u>Dollars</u>
Equipment	\$ 61,600
Operation (1)	<u>18,920</u>
Total SDF	<u><u>\$ 80,520</u></u>

(1) Operation Cost is estimated for a five year period.



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4.1.10 R&D Flight Vehicles - Single Stage Vehicle

The two R&D flight vehicles are the final qualification testing that must precede the manned flights in order to qualify the system.

The prime objectives of flight tests are:

- a. Evaluation of hardware characteristics and operational procedures which cannot be adequately evaluated by ground testing.
- b. Acquisition of flight data and correlation of these data with the results of ground tests.
- c. Flight verification of the launch vehicle and ground support equipment prior to manned flight.
- d. Flight verification of stage subsystems affecting crew safety prior to manned flight.
- e. Ground crew training.

Each flight space vehicle will be as complete as practicable; i.e., no dummy stage, modules or subsystems, with the exception of a simulated payload.

Individual stage (specimen) costs were obtained from the "C" category estimates with allowances for the additional R&D instrumentation.

The costs for two single stage vehicles are shown in Table 4.1.0.0-I. This cost includes all the cost of stage hardware, R&D instrumentation, instrument unit, SE&I and launch cycle costs (these launch costs for each R&D flight are based on a nine month cycle; the normal launch cycle, will however, be based on six months). In addition, these costs include all transportation, facility and equipment maintenance.

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TABLE 4.1.10.0-I
 AMLLV COST SUMMARY

TWO R&D FLIGHTS - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER									836,735		836,735
TOTAL COST									836,735		836,735

* See Back-up

TABLE 4.1.10.0-II
 AMLLV
 NON-RECURRING
TWO R&D FLIGHTS - SINGLE STAGE
 (DOLLARS IN THOUSANDS)

<u>Element of Cost</u>	<u>No. 1</u>	<u>No. 2</u>
Stage Hardware (1)	\$188,611	\$171,730
Propellants	6,573	6,573
Instrument Unit	9,346	9,346
SDF Operations	174,324	174,324
Launch Maintenance	8,750	8,750
SE&I	8,480	8,480
Instrumentation	<u>24,555</u>	<u>24,555</u>
	\$426,808	\$409,927
 Total Costs of Two R&D Flights		 \$836,735

(1) Includes Transportation and Facility and Equipment Maintenance Costs

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4.1.11 Wind Tunnel (Model Tests) - Single Stage Vehicle

Models will be used in wind tunnel tests to investigate the aerodynamic characteristics and dynamic behavior of the AMLLV single stage under laboratory conditions.

Test Description

Force Model Tests - The purpose of these tests will be to ascertain range safety aerodynamics after inflight destruct, by checking the aerodynamic characteristics of models of selected fragments of the single stage.

AMLLV Single Stage Base Heating Model Tests - Supersonic and transonic tests will be conducted. The tests will include heating and pressure measurements in the base region for the range of possible configurations and anticipated flight environments.

Performance Characteristics of Various Vehicle Combinations - Model tests will determine aerodynamic performance characteristics of possible vehicle configurations within the vehicle family.

Resource Requirements

The assumption is that adequate facilities already exist for the conduct of the model tests to develop the required information for the AMLLV program. It is anticipated, therefore, that costs for these tests will be based on procurement of the models and occupancy time at the test facility.

Based on prior test experience, the following estimates were made as shown in Table 4.1.11.0-I.

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TABLE 4.1.11.0-I
AMLLV COST SUMMARY

WIND TUNNEL

SINGLE STAGE
(IN THOUSANDS)

A B C

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER									*600		600
TOTAL COST									600		600

* See back-up

AMLLV
DEVELOPMENTAL TESTING COSTS
NON-RECURRING

<u>Element of Cost</u>	<u>WIND TUNNEL TEST</u> TABLE 4.1.1.1.0-II	<u>Dollars</u> (In Thousands)
Single Stage		\$600

(1) These costs based on Engineering estimate.

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4.2 INJECTION STAGE - ENGINE MODULE

The summary costs for testing of the injection stage - engine module are displayed in Table 4.2.0.0-I. The costs include not only the cost associated with conducting the tests but also the costs of the test specimens. Specimen costs were developed from the recurring costs contained in Book C of this volume. Figure 4.2.0.0-I displays the total costs associated with the injection stage - engine module and the appropriate subparagraph where the cost information is located.

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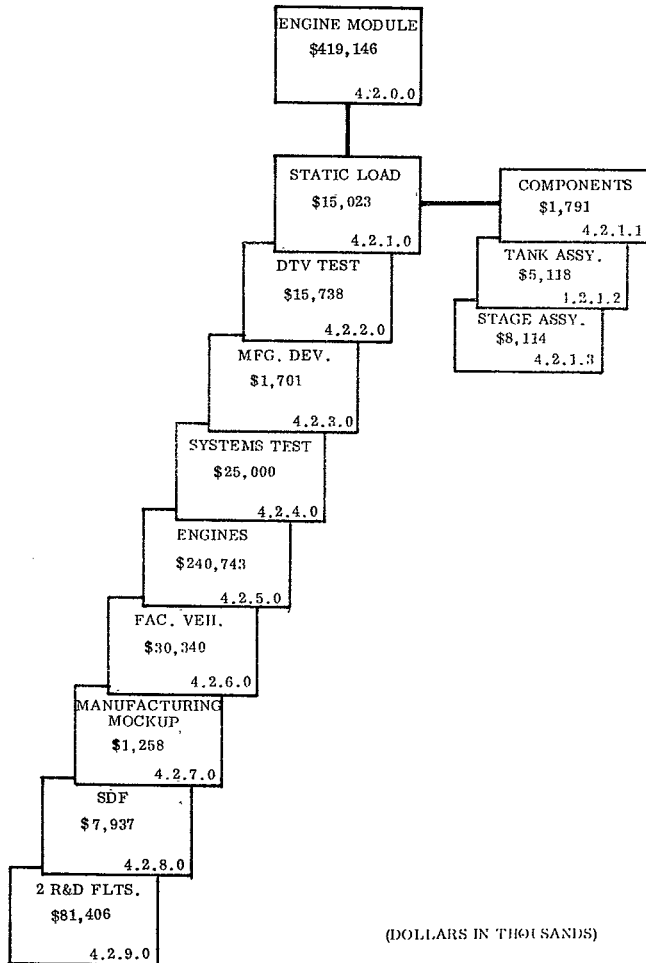
TABLE 4.2.0.0-I
TOTAL
AMLLV COST SUMMARY

ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	9	95								8	95
PROGRAM PLAN. & REPT.	20	239								20	239
INDUSTRIAL RELATIONS	4	39								4	39
ENGINEERING			143	79,291						143	79,291
LAB TECHNICIANS			104	1,015						104	1,015
TOOLING				6,200							6,200
PRODUCTION			67	92,449						67	92,449
MANUFACTURING TEST			282	31,942						282	31,942
MANUFACTURING TECH.											
Q & RA			68	662						68	662
FACILITIES					1,000						1,000
DIRECT DIST			144	1,404						144	1,404
TRAINING			7	64						7	64
TOTAL DIRECT LABOR	33	373	815	213,027	1,000					848	214,400
MATERIAL		1		505					35,943		36,449
LOGISTIC HARDWARE				12,320							12,320
BURDEN				221							221
TOTAL MATERIAL		1		13,046					35,943		48,990
TOTAL OTHER				11,073					144,683		155,756
TOTAL COST		374		237,146	1,000				194,168		419,146



(DOLLARS IN THOUSANDS)

FIGURE 4.2.0.0-1 AMLLV INJECTION STAGE ENGINE MODULE COSTS DEVELOPMENT TEST, "B" COSTS

4.2.1 Static Load Test - Injection Stage, Engine Module

The total cost of conducting all of the static load tests for the injection stage-engine module are displayed in Table 4.2.1.0-I. In addition, Figure 4.2.1.0-1 displays the cost and subparagraph number at the various components that require static testing. Paragraph 4.2.1.1 through 4.2.1.3 reflect the cost for the tank assembly, stage assembly and other components; which include the necessary material and labor to accomplish the following functions:

a. Engineering

1. Mechanical and Electrical Design
2. Drafting and Support
3. Liaison
4. Conduct the test
5. Test Reports

b. Manufacturing

1. Facility checkout and preparation
2. Specimen installation
3. Load fixture fabrication
4. Load fixture installation
5. Plumbing installation
6. Instrumentation installation
7. Mechanical checkout
8. Electrical checkout
9. Conduct the test
10. Teardown effort

4.2.1 (Continued)

c. Material and Parts

1. Raw material
2. Mechanical components
3. Electrical transducers
4. Electrical components and equipment
5. Test specimen (from "C" cost)

d. Retest Costs

Parts, materials and labor costs.

The test facilities that are to be utilized for the single stage vehicle were considered adequate to accommodate the engine module; therefore, no additional facility or equipment costs were added for testing of the engine module.

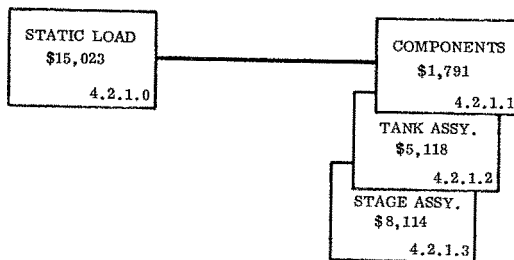
TABLE 4.2.1.0-I
 AMLLV COST SUMMARY

STATIC LOAD TEST - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	3	29								3	29
PROGRAM PLAN. & REPT.	6	72								6	72
INDUSTRIAL RELATIONS	1	14								1	14
ENGINEERING			65	771						65	771
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST			130	1,266						130	1,266
MANUFACTURING TECH.											
Q & R A			9	84						9	84
FACILITIES											
DIRECT DIST			41	400						41	400
TRAINING			2	18						2	18
TOTAL DIRECT LAEOR	10	115	247	2,539						257	2,654
MATERIAL				140							140
LOGISTIC HARDWARE				12,180							12,180
BURDEN				49							49
TOTAL MATERIAL				12,369							12,369
TOTAL OTHER											
TOTAL COST		115		14,908							15,023



(DOLLARS IN THOUSANDS)

FIGURE 4.2.1.0-1 AMLLV INJECTION STAGE ENGINE MODULE STATIC LOAD COSTS DEVELOPMENT TEST, "B" COSTS

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4.2.1.1 Component Testing - Static Load Test

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TABLE 4.2.1.1-1
 AMLLV COST SUMMARY

AMLLV
 TOTAL COST SUMMARY
 STATIC LOAD TEST (COMPONENTS)

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	1	7								1	6
PROGRAM PLAN. & REPT.	1	18								1	18
INDUSTRIAL RELATIONS		3									3
ENGINEERING			16	186						16	186
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST			31	306						31	306
MANUFACTURING TECH.											
Q & R A			2	20						2	20
FACILITIES											
DIRECT DIST			10	94						10	94
TRAINING			1	4						1	4
TOTAL DIRECT LABOR	2	28	60	610						62	638
MATERIAL				34							34
LOGISTIC HARDWARE				1,107							1107
BURDEN				12							12
TOTAL MATERIAL				1,153							1,153
TOTAL OTHER											
TOTAL COST		28		1,763							1,791

AMLLV
DEVELOPMENT COST
NON-RECURRING
PART I

COMPONENTS - E/M
ASSEMBLY OR SYSTEM

TABLE 4.2.1.1-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollar::</u>
<u>Direct Labor</u>			
Engineering	15,776		
Logistics			
Laboratory Technician			
Production			
Tooling			
Manufacturing Test	31,441		
Q&RA	2,097		
Facilities			
Manufacturing Technician			
	<hr/>		
Total Direct Labor	49,314		
	<hr/> <hr/>		
Program Executive		592	6,992
Program Planning & Reporting		1,479	17,467
Industrial Relations		321	3,120
		<hr/>	<hr/>
Total Labor - Part I		2,392	27,579
		<hr/> <hr/>	<hr/> <hr/>
<u>Material</u>			
Program Planning & Reporting			29
Industrial Relations			32
Material Subtotal			<hr/> 61
Material & Administrative Burden			21
Total Material			<hr/> 82
			<hr/> <hr/>
TOTAL COST - PART I			<hr/> <hr/> 27,661

AMLLV
 PART II COST SUMMARY
 NON-RECURRING
 STATIC LOAD TEST (COMPONENTS) A B C
 E/M

TABLE 4.2.1.1-III
 AMLLV PART II COST SUMMARY

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	16	186							16	186
LAB TECHNICIANS										
TOOLING										
PRODUCTION										
MANUFACTURING TEST							31	306	31	306
MANUFACTURING TECH.										
Q & R A							2	20	2	20
DIRECT DIST							10	94	10	94
TRAINING							1	4	1	4
TOTAL DIRECT LABOR	16	186					44	424	60	610
MATERIAL				*1,107						1,107
LAB. TECHNICIANS										
TOOLING										
PRODUCTION								33		33
MFG. TECHNICIANS										
Q & R A								1		1
SUBTOTAL				1,107				34		1,107
MAT. & ADM. BURDEN								12		12
TOTAL MATERIAL				1,107				46		1,153
TOTAL PART II COST		186		1,107				470		1,763

*Specimen

AMLLV
R & D TEST COST
NON-RECURRING

COMPONENTS - E/M

CONDUCT STATIC LOAD TEST

TABLE 4.2.1.1-IV

<u>Element of Cost</u>	<u>Manhours</u>	(In Thousands) <u>Dollars</u>
Engineering	13,870	164
Retest Allowance	<u>1,906</u>	<u>22</u>
TOTAL COST	<u><u>15,776</u></u>	<u><u>186</u></u>

AMLLV
R & D TEST COST
NON-RECURRING

COMPONENTS - E/M
CONDUCT STATIC LOAD TEST

TABLE 4.2.1.1-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(IN THOUSANDS)		
(1) Manufacturing	25,864	251
(2) Retest Allowance	5,777	55
Subtotal	31,441	306
(3) Direct Distributable	10,052	94
Subtotal	41,493	400
(4) Training	456	4
Subtotal	41,949	404
(5) Q&RA	2,097	20
TOTAL LABOR	44,046	424
 <u>Material</u>		
(6) Raw Material & Parts		33
(7) Q&RA		1
Material Subtotal		34
(8) Material & Admin. Burden		12
TOTAL MATERIAL		46
TOTAL COST		470

4.2.1.2 Tank Assembly - Static Load Test

AMLLV
TOTAL COST SUMMARY
STATIC LOAD TEST (TANK ASSEMBLY)

TABLE 4.2.1.2-I
AMLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	1	5								1	5
PROGRAM PLAN. & REPT.	1	12								1	12
INDUSTRIAL RELATIONS		3									3
ENGINEERING			11	134						11	134
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST			23	222						23	222
MANUFACTURING TECH.											
Q & R A			2	15						2	15
FACILITIES											
DIRECT DIST			7	70						7	70
TRAINING				3							
TOTAL DIRECT LABOR	2	20	43	444						45	464
MATERIAL				28							28
LOGISTIC HARDWARE				4,616							4,616
BURDEN				10							10
TOTAL MATERIAL				4,654							4,654
TOTAL OTHER											
TOTAL COST		20		5,098							5,118

AMLLV
 DEVELOPMENT COST
 NON-RECURRING
 PART I

TANK ASSEMBLY - E/M
ASSEMBLY OR SYSTEM

TABLE 4.2.1.2-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	11,319		
Logistics			
Laboratory Technician			
Production			
Tooling			
Manufacturing Test	22,656		
Q&RA	1,512		
Facilities			
Manufacturing Technician			
Total Direct Labor	35,487		
Program Executive		426	5,031
Program Planning & Reporting		1,065	12,578
Industrial Relations		250	2,430
Total Labor - Part I		1,741	20,039
<u>Material</u>			
Program Planning & Reporting			21
Industrial Relations			25
Material Subtotal			46
Material & Administrative Burden			16
Total Material			62
TOTAL COST - PART I			20,101

AMLLV
PART II COST SUMMARY
NON-RECURRING
STATIC LOAD TEST (TANK ASSY.)

TABLE 4.2.1.2-III

AMLLV PART II COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	11	134							11	134
LAB TECHNICIANS										
TOOLING										
PRODUCTION										
MANUFACTURING TEST							23	222	23	222
MANUFACTURING TECH.										
Q & R A							2	15	2	15
DIRECT DIST							7	70	7	70
TRAINING								3		3
TOTAL DIRECT LABOR	11	134					32	310	43	444
MATERIAL				*4,616						4,616
LAB. TECHNICIANS										
TOOLING										
PRODUCTION								27		27
MFG. TECHNICIANS										
Q & R A								1		1
SUBTOTAL				4,616				28		4,644
MAT. & ADM. BURDEN								10		10
TOTAL MATERIAL				4,616				38		4,654
TOTAL PART II COST		134		4,616				348		5,098

*Specimen

AMLLV
R & D TEST COST
NON-RECURRING

TANK ASSEMBLY - E/M
CONDUCT STATIC LOAD TEST

TABLE 4.2.1.2-IV

<u>Element of Cost</u>	<u>Manhours</u>	(In Thousands)
		<u>Dollars</u>
Engineering	9,939	118
Retest Allowance	<u>1,380</u>	<u>16</u>
TOTAL COST	<u>11,319</u>	<u>134</u>

AMLLV
R & D TEST COST
NON-RECURRING

TANK ASSEMBLY - E/M
CONDUCT STATIC LOAD TEST

TABLE 4.2.1.2-V

(IN THOUSANDS)

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Manufacturing	18,636	181
(2) Retest Allowance	4,020	41
Subtotal	<u>22,656</u>	<u>222</u>
(3) Direct Distributable	7,250	70
Subtotal	<u>29,906</u>	<u>292</u>
(4) Training	329	3
Subtotal	<u>30,235</u>	<u>295</u>
(5) Q&RA	<u>1,512</u>	<u>15</u>
TOTAL LABOR	<u><u>31,747</u></u>	<u><u>310</u></u>
 <u>Material</u>		
(6) Raw Material & Parts		27
(7) Q&RA		1
Material Subtotal		<u>28</u>
(8) Material & Admin. Burden		10
TOTAL MATERIAL		<u>38</u>
TOTAL COST		<u><u>348</u></u>

4.2.1.3 Stage Assembly - Static Load Test

TABLE 4.2.1.3-I
 AMLLV COST SUMMARY

AMLLV
 TOTAL COST SUMMARY
 STATIC LOAD TEST (STAGE ASSEMBLY)

A B C ENGINE MODULE
 (IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	1	17								1	17
PROGRAM PLAN. & REPT.	4	42								4	42
INDUSTRIAL RELATIONS	1	8								1	8
ENGINEERING			38	451						38	451
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST			76	738						76	738
MANUFACTURING TECH.											
Q & R A			5	49						5	49
FACILITIES											
DIRECT DIST			24	236						24	236
TRAINING			1	11						1	11
TOTAL DIRECT LABOR	6	67	144	1,485						150	1,552
MATERIAL				78							78
LOGISTIC HARDWARE				6,457							6,457
BURDEN				27							27
TOTAL MATERIAL				6,562							6,562
TOTAL OTHER											
TOTAL COST		67		8,047							8,114

A MLLV
DEVELOPMENT COST
NON-RECURRING
PART I

STAGE ASSEMBLY - E/M
ASSEMBLY OR SYSTEM

TABLE 4.2.1.3-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	38,170		
Logistics			
Laboratory Technician			
Production			
Tooling			
Manufacturing Test	75,925		
Q&RA	5,066		
Facilities			
Manufacturing Technician	_____		
Total Direct Labor	119,161		

Program Executive		1,430	16,888
Program Planning & Reporting		3,575	42,221
Industrial Relations		775	7,533
		_____	_____
Total Labor - Part I		5,870	66,642
		_____	_____
<u>Material</u>			
Program Planning & Reporting			72
Industrial Relations			78

Material Subtotal			150
Material & Administrative Burden			51

Total Material			201

TOTAL COST - PART I			66,843

AMLLV
PART II COST SUMMARY
NON-RECURRING

STATIC LOAD TEST STAGE ASSEMBLY - E/M

TABLE 4.2.1.3-III
AMLLV PART II COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	38	451							38	451
LAB TECHNICIANS										
TOOLING										
PRODUCTION										
MANUFACTURING TEST							76	738	76	738
MANUFACTURING TECH.										
Q & R A							5	49	5	49
DIRECT DIST							24	236	24	236
TRAINING							1	11	1	11
TOTAL DIRECT LABOR	38	451					106	1,034	144	1,485
MATERIAL				*6,457						6,457
LAB. TECHNICIANS										
TOOLING										
PRODUCTION							76		76	
MFG. TECHNICIANS										
Q & R A							2		2	
SUBTOTAL				6,457			78		6,535	
MAT. & ADM. BURDEN							27		27	
TOTAL MATERIAL				6,457			105		6,562	
TOTAL PART II COST		451		6,457			1,139		8,047	

* Specimen

AMLLV
R & D TEST COST
NON-RECURRING

STAGE ASSEMBLY - E/M
CONDUCT STATIC LOAD TEST

TABLE 4.2.1.1, 3-IV

<u>Element of Cost</u>	<u>Manhours</u>	(In Thousands) <u>Dollars</u>
Engineering	33,575	\$397
Retest Allowance	<u>4,595</u>	<u>54</u>
TOTAL COST	<u><u>38,170</u></u>	<u><u>\$451</u></u>

AMLLV
R & D TEST COST
NON-RECURRING

STAGE ASSEMBLY - E/M
CONDUCT STATIC LOAD TEST

TABLE 4.2.1.3-V

(IN THOUSANDS)

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Manufacturing	62,545	\$608
(2) Retest Allowance	13,380	130
Subtotal "A"	<u>75,925</u>	<u>\$738</u>
(3) Direct Distributable	24,296	236
Subtotal "B"	<u>100,221</u>	<u>\$974</u>
(4) Training	1,102	11
Subtotal "C"	<u>101,323</u>	<u>\$985</u>
(5) Q&RA	5,066	49
TOTAL LABOR	<u><u>106,389</u></u>	<u><u>\$1,034</u></u>
 <u>Material</u>		
(6) Raw Material & Parts		\$ 76
(7) Q&RA		2
Material Subtotal		<u>\$ 78</u>
(8) Material & Admin. Burden		27
TOTAL MATERIAL		<u>\$105</u>
TOTAL COST		<u><u>\$1,139</u></u>

4.2.2 Dynamic Testing - Injection Stage - Engine Module

The total cost for performing the dynamic tests on the injection stage - engine module are displayed in Table 4.2.2.0-I, these costs include the labor and material to accomplish the following functions:

a. Engineering

1. Mechanical and Electrical Design
2. Drafting and support
3. Liaison
4. Conduct the test
5. Test reports

b. Manufacturing

1. Facility C/O and preparation
2. Specimen installation
3. Load fixture - fabrication and installation
4. Plumbing installation
5. Instrumentation installation
6. Mechanical checkout
7. Electrical checkout
8. Conduct the test
9. Teardown effort

c. Material and Parts

1. Raw materials
2. Mechanical components
3. Electrical transducers

4.2.2 (Continued)

4. Electrical components and equipment

5. Test specimen (from "C" costs)

d. Retest

Parts, materials and labor costs

The test facilities and necessary equipment to conduct dynamic testing of the injection stage - engine module also are displayed in Table 4.2.2.0-I. These costs are additive to the dynamic test facility cost of the single stage vehicle as that vehicle carries the majority of the costs associated with dynamic testing.

TABLE 4.2.2.0-1
 AMLLV COST SUMMARY

DYNAMIC TEST - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	.3	35								3	35
PROGRAM PLAN. & REPT.	7	90								7	90
INDUSTRIAL RELATIONS	2	11								2	11
ENGINEERING			78	920						78	920
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST			152	1,476						152	1,476
MANUFACTURING TECH.											
Q & R A			13	134						13	134
FACILITIES						1,000					1,000
DIRECT DIST			49	472						49	472
TRAINING			2	21						2	21
TOTAL DIRECT LABOR	12	136	294	3,023	1,000					306	4,159
MATERIAL		1		377							378
LOGISTIC HARDWARE				11,073							11,073
BURDEN				128							128
TOTAL MATERIAL		1		11,578							11,579
TOTAL OTHER											
TOTAL COST		137		14,601	1,000						15,738

AMLLV
 NON-RECURRING
 PART I
 DYNAMIC TEST - E/M
ASSEMBLY OR SYSTEM

TABLE 4.2.2.0-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	77,929		
Logistics			
Laboratory Technician			
Production	151,807		
Tooling			
Manufacturing Test			
Q&RA	13,801		
Facilities			
Manufacturing Technician	_____		
Total Direct Labor	<u>243,537</u>		
Program Executive		2,922	34,513
Program Planning & Reporting		7,654	90,400
Industrial Relations		<u>1,582</u>	<u>11,811</u>
Total Labor - Part I		<u>12,228</u>	<u>136,742</u>
<u>Material</u>			
Program Planning & Reporting			152
Industrial Relations			<u>158</u>
Material Subtotal			310
Material & Administrative Burden			<u>106</u>
Total Material			<u>416</u>
TOTAL COST - PART I			<u>137,140</u>

TABLE 4.2.2.0-III

DYNAMIC TEST - E/M

A MLLV PART II COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	78	920							78	920
LAB TECHNICIANS										
TOOLING										
PRODUCTION							152	1,476	152	1,476
MANUFACTURING TEST										
MANUFACTURING TECH.										
Q & R A							13	134	13	134
DIRECT DIST							49	472	49	472
TRAINING							2	21	2	21
TOTAL DIRECT LABOR	78	920					216	2,103	294	3,023
MATERIAL				*11,073						11,073
LAB. TECHNICIANS										
TOOLING										
PRODUCTION								373		373
MFG. TECHNICIANS										
Q & R A								4		4
SUBTOTAL				11,073				377		11,450
MAT. & ADM. BURDEN								128		128
TOTAL MATERIAL				11,073				505		11,578
TOTAL PART II COST		920		11,073				2,608		14,601

*Specimen

AMLLV
R & D TEST COST
NON-RECURRING

INJECTION STAGE - E/M
CONDUCT STATIC LOAD TEST

TABLE 4.2.2.0-IV

<u>Element of Cost</u>	<u>Manhours</u>	(In Thousands) <u>Dollars</u>
Engineering	67,798	801
Retest Allowance	<u>10,131</u>	<u>119</u>
TOTAL COST	<u><u>77,929</u></u>	<u><u>920</u></u>

AMLLV
R & D TEST COST
NON-RECURRING

INJECTION STAGE - E/M
CONDUCT DYNAMIC TEST

TABLE 4.2.2.0-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Manufacturing	130,278	1,266
(2) Retest Allowance	21,529	210
Subtotal	151,807	1,476
(3) Direct Distributable	48,578	472
Subtotal	200,385	1,948
(4) Training	2,204	21
Subtotal	202,589	1,969
(5) Q&RA	13,801	134
TOTAL LABOR	216,390	2,103
 <u>Material</u>		
(6) Raw Material & Parts		373
(7) Q&RA		4
Material Subtotal		377
(8) Material & Admin. Burden		128
TOTAL MATERIAL		505
TOTAL COST		2,608

AMLLV
R&D TEST SPECIMEN COST
NON-RECURRING

DYNAMIC TEST - E/M

TABLE 4.2.2.0-VI

<u>Element of Cost</u>	<u>Dollars</u> <u>(In Thousands)</u>
Stage Assembly	
Forward Skirt	1,369
Thrust Structure	1,767
Tunnels	743
Structure Assembly	2,578
LH ₂ Tank	2,637
LOX Tank	<u>1,979</u>
Total Specimen Cost	11,073
Facility Cost	1,000

4.2.3 Manufacturing Development Test - Injection Stage - Engine Module

The manufacturing development task is directed toward the development and implementation of fabrication and assembly processes to produce the injection stage - engine module.

Defined in broad terms, the procedure is as follows:

- a. Determine manufacturing development requirements through coordination and review of engineering drawings and specifications, present methods and existing manufacturing capabilities.
- b. Establish suitable manufacturing methods. Document and coordinate these methods with applicable organizations.
- c. Define equipment requirements, tooling criteria, training requirements, and establish step-by-step procedures for critical manufacturing.
- d. Coordinate with factory, manufacturing engineering, facilities, training, etc., to assist them in the implementation and proper application of newly developed methods.

Table 4.2.3.0-I displays the cost associated with this function for the injection stage - engine module vehicle.

TABLE 4.2.3.0-I
 AMLLV COST SUMMARY

MANUFACTURING DEVELOPMENT - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	2	19								2	19
PROGRAM PLAN. & REPT.	4	47								4	47
INDUSTRIAL RELATIONS	1	9								1	9
ENGINEERING											
LAB TECHNICIANS			104	1,015						104	1,015
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A			28	271						28	271
FACILITIES											
DIRECT DIST			33	325						33	325
TRAINING			2	15						2	15
TOTAL DIRECT LABOR	7	75	167	1,626						174	1,701
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER											
TOTAL COST		75		1,626							1,701

AMLLV
 NON-RECURRING
 PART I
 MANUFACTURING DEVELOPMENT
 ASSEMBLY OR SYSTEM

TABLE 4.2.3.0-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering			
Logistics			
Laboratory Technician	104,439		
Production			
Tooling			
Manufacturing Test			
Q&RA	27,875		
Facilities			
Manufacturing Technician			
Total Direct Labor	<u>132 314</u>		
Program Executive		1,588	18,754
Program Planning & Reporting		4,017	47,441
Industrial Relations		<u>896</u>	<u>8,709</u>
Total Labor - Part I		<u>6,501</u>	<u>74,904</u>
<u>Material</u>			
Program Planning & Reporting			80
Industrial Relations			<u>90</u>
Material Subtotal			170
Material & Administrative Burden			<u>58</u>
Total Material			<u>228</u>
TOTAL COST - PART I			<u>75,132</u>

TABLE 4.2.3.0-III

MANUFACTURING DEVELOPMENT - ENGINE MODULE

AMLLV PART II COST SUMMARY

A B C (IN THOUSANDS)

ELEMENT OF COST	DESIGN ENGINEERING		PRODUCTION		DESIGN & FAB. TOOLING		MANUFACTURING TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING							104	1,015	104	1,015
LAB TECHNICIANS										
TOOLING										
PRODUCTION										
MANUFACTURING TEST										
MANUFACTURING TECH.										
Q & RA							28	271	28	271
DIRECT DIST							33	325	33	325
TRAINING							2	15	2	15
TOTAL DIRECT LABOR							167	1,626	167	1,626
MATERIAL										
LAB. TECHNICIANS										
TOOLING										
PRODUCTION										
MFG. TECHNICIANS										
Q&RA										
SUBTOTAL										
MAT. & ADM. BURDEN										
TOTAL MATERIAL										
TOTAL PART II COST								1,626		1,626

A MLLV
PART IIB
NON-RECURRING

MANUFACTURING DEVELOPMENT - E/M

ASSEMBLY OR SYSTEM
LST UNIT COST

TABLE 4.2.3.0-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Lab Technician	104,439	1,015
(2) Direct Distributable	<u>33,420</u>	<u>325</u>
Subtotal (A)	137,859	1,340
(3) Training	<u>1,516</u>	<u>15</u>
Subtotal (B)	139,375	1,355
(4) Q&RA	<u>27,875</u>	<u>271</u>
Total Tooling Labor	<u><u>167,250</u></u>	<u><u>1,626</u></u>
 Material		
(5) Lab Technician		
(6) Q&RA		_____
Subtotal (C)		_____
(7) Material & Adm. Burden		_____
Total Material		_____
Total Tooling Cost		<u><u>1,626</u></u>

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4.2.4 Systems Test - Injection Stage - Engine Module

Injection stage systems tests are identified as those tests that are required in addition to the major testing (dynamic, static load, flight, etc.) that are displayed elsewhere in this section. It was not possible to define all of the specific tests that fall within this category; however, the requirements for this general category were estimated in terms of overall program costs by applying estimated data to the overall cost of producing the injection stage - engine module flight vehicle. Historical data, relative to research and development testing, of components and sub-systems, for other programs, prior to and inclusive of the S-IC program, were used as a basis for cost estimates for the engine module. Table 4.2.4.0-I shows the resulting cost estimates for component and sub-system testing of this module.

Systems test include: (but are not limited to)

- a. Onboard test and checkout
- b. Qualification testing
- c. Acoustics testing, etc.

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TABLE 4.2.4.0-I

SYSTEMS TEST - ENGINE MODULE

AMLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABCR											
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER									25,000		25,000
TOTAL COST									25,000		25,000

AMLLV
DEVELOPMENTAL TESTING COST
NON-RECURRING

MISCELLANEOUS TESTING

TABLE 4.2.4.0-II

<u>Element of Cost</u>	<u>Dollars</u> <u>(In Thousands)</u>
Miscellaneous Tests Include:	
On Board Test and Checkout System Development	
Qualification Testing	
Acoustics Testing, etc.	
Engine Module	\$25,000

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4.2.5 Injection Stage Liquid Engine PFRT and Qualification Testing

This section shows the development costs (including propellant) for the 250,000 pound thrust engine.

This engine cost was extracted from Figure 4.1.6.1-I, provided by Pratt and Whitney, in the same method as used for the main stage engine.

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TABLE 4.2.5.0-I

ENGINE MODULE - ENGINES

A MLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING				77,600							77,600
LAB TECHNICIANS											
TOOLING				6,200							6,200
PRODUCTION				91,800							91,800
MANUFACTURING TEST				29,200							29,200
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABCR				204,800							204,800
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER									*35,943		35,943
TOTAL COST				204,800					35,943		240,743

* Propellant

AMLV
 ONE MODULE INJECTION STAGE
 ENGINE

TABLE 4.2.5.0-II

"B" COSTS

	<u>Component</u>	<u>Engine</u>	<u>PFRT</u>	<u>Qual.</u>	<u>Total</u>
Engineering	\$24.0M	\$ 37.0M	\$ 8.3M	\$ 8.3M	\$ 77.6M
Test	11.5M	13.5M	2.1M	2.1M	29.2M
Equipment	2.0M	6.2M			8.2M
Tooling	2.0M	4.2M			6.2M
Fabrication	<u>11.5M</u>	<u>45.7M</u>	<u>13.2M</u>	<u>13.2M</u>	<u>83.6M</u>
Subtotal	\$51.0M	\$106.6M	\$23.6M	\$23.6M	\$204.8M

"A" + "B" = \$265.0M

AMLLV

PROPELLANT CONSUMPTION

INC. ANCILLARY FLUIDS

OXYGEN/HYDROGEN

MEX RATIO = 6.0

2,000 QUALIFICATION TESTS

ONE MODULE INJECTION STAGE ENGINE PROGRAM

ENGINE

250K THRUST

TABLE 4.2.5.0-III

<u>TOTAL CONSUMPTION</u>	740,000,000 lbs.
OXYGEN	634,285,715 lbs.
HYDROGEN	105,714,285 lbs.

COST

OXYGEN	\$.015 X 634,285,715 lbs.	= \$ 9,514,286
HYDROGEN	\$.25 X 105,714,285 lbs.	= <u>26,428,571</u>
TOTAL		<u><u>\$35,942,857</u></u>

4.2.6 Facility Checkout Module - Injection Stage - Engine Module

The injection stage facility checkout module is defined as the test article that will be used to check out the following:

- a. The manufacturing tools, facilities and equipment.
- b. All R&D test facilities and equipment.
- c. Handling and transportation equipment.
- d. Launch complex facilities and support area.
- e. All GSE (manufacturing facility and launch facility)
- f. All processes and procedures.

The primary objective of the facility vehicle is to achieve a state of operational readiness prior to processing of the flight modules. The costs associated with this facility checkout module are displayed in Table 4.2.6.0-1. The facility module consists of the following:

- a. Engine module structure .
- b. Systems .
- c. Transportation from the manufacturing plant to the launch site.
- d. Launch cycle cost (based on one year cost to checkout the facility).
- e. Propellant cost

TABLE 4.2.6.0-I
AMLLV COST SUMMARY

FACILITY VEHICLE - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER									30,340		30,340
TOTAL COST									30,340		30,340

514

AMLLV
NON-RECURRING
R&D COST

FACILITY VEHICLE

<u>Element of Cost</u>	TABLE 4.2.6.0-II	Dollars <u>(In Thousands)</u>
Structures		\$11,073
Systems		1,968
Transportation		39
Launch Operations		16,530
Propellant		<u>730</u>
Total Cost		<u>\$30,340</u>

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4.2.7 Manufacturing Mockup Module - Injection Stage - Engine Module

The injection stage - engine module manufacturing mockup will be used extensively to aid and assist in the development of the production tooling and the manufacturing techniques.

This mockup is not a complete vehicle, and is limited to full size sub-assemblies and sub-systems. The costs for developing the mockup for the engine module are reflected in Table 4.2.7.0-I.

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TABLE 4.2.7.0-I
 AMLLV COST SUMMARY

FACILITY MOCK-UP - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	1	12								1	12
PROGRAM PLAN. & REPT.	3	30								3	30
INDUSTRIAL RELATIONS		5									5
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION			67	649						67	649
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A			18	173						18	173
FACILITIES											
DIRECT DIST			21	207						21	207
TRAINING			1	10						1	10
TOTAL DIRECT LABOR	4	47	107	1,039						111	1,086
MATERIAL				128							128
LOGISTIC HARDWARE											
BURDEN				44							44
TOTAL MATERIAL				172							172
TOTAL OTHER											
TOTAL COST		47		1,211							1,258

AMLLV

PART I

FACILITY MOCK-UP - E/M
ASSEMBLY OR SYSTEM

TABLE 4.2.7.0-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering			
Logistics			
Laboratory Technician			
Production	66,725		
Tooling			
Manufacturing Test			
Q&RA			
Facilities	17,809		
Manufacturing Technician			
Total Direct Labor	<u>84,534</u>		
Program Executive		1,014	11975
Program Planning & Reporting		2,536	29,950
Industrial Relations		<u>549</u>	<u>5,356</u>
Total Labor - Part I		<u>4,099</u>	<u>47,281</u>
<u>Material</u>			
Program Planning & Reporting			51
Industrial Relations			55
			<u>106</u>
Material Subtotal			
			36
Material & Administrative Burden			<u>36</u>
Total Material			<u>142</u>
TOTAL COST - PART I			<u>47,423</u>

TABLE 4.2.7.0-III

FACILITY MOCK-UP - E/M

AMLLV PART II COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING										
LAB TECHNICIANS										
TOOLING										
PRODUCTION			67	649					67	649
MANUFACTURING TEST										
MANUFACTURING TECH.										
Q & R A			18	173					18	173
DIRECT DIST			21	207					21	207
TRAINING			1	10					1	10
TOTAL DIRECT LABOR			107	1,039					107	1,039
MATERIAL				123						123
LAB. TECHNICIANS										
TOOLING										
PRODUCTION										
MFG. TECHNICIANS										
Q & R A				5						5
SUBTOTAL				128						128
MAT. & ADM. BURDEN				44						44
TOTAL MATERIAL				172						172
TOTAL PART II COST				1,211						1,211

AMLLV
 NON-RECURRING
 FACILITY MOCK-UP - E/M

ASSEMBLY OR SYSTEM
 TABLE 4.2.7.0-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>(In Thousands Dollars)</u>
(1) Fabrication and Assembly	66,725	649
(2) Direct Distributable	<u>21,352</u>	<u>207</u>
Subtotal (A)	88,077	856
(3) Training	<u>969</u>	<u>10</u>
Subtotal (B)	89,046	866
(4) Q&RA	<u>17,809</u>	<u>173</u>
Total Tooling Labor	<u>106,855</u>	<u>1,039</u>
 Material		
(5) Raw Material		123
(6) Q&RA		<u>5</u>
Subtotal (C)		128
(7) Material & Adm. Burden		<u>44</u>
Total Material		<u>172</u>
Total Tooling Cost		<u>1,211</u>

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4.2.8 Systems Development Facility (Breadboard) - Injection Stage - Engine Module

The injection stage engine module Systems Development Breadboard Facility will provide for extensive testing, evaluation, and verification of components, sub-systems and systems under controlled conditions that approximate those at the launch site.

Existing facilities at Michoud will be used to house the breadboard. (A new facility for this activity would cost approximately \$750,000). The equipment for these tests will primarily consist of the elements of vehicle and GSE hardware and/or simulators that make up the breadboard plus the computer complex.

The costs associated with the SDF for the engine module are displayed in Table 4.2.8.0-I.

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TABLE 4.2.8.0-I
ANLLV COST SUMMARY

SDF - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER									7,937		7,937
TOTAL COST									7,937		7,937

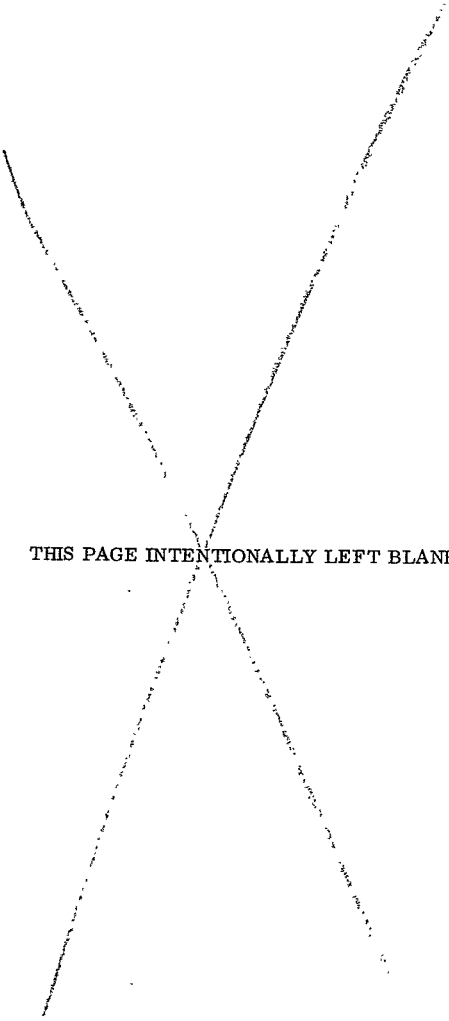
AMLLV
NON-RECURRING COST
R&D TEST FACILITIES

SYSTEMS DEVELOPMENT FACILITY - ENGINE MODULE

TABLE 4.2.8.0-II

<u>Element of Cost</u>	Dollars <u>(In Thousands)</u>
Equipment	\$7,700
Operation (1)	<u>237</u>
Total SDF	<u><u>\$7,937</u></u>

(1) Operations cost is estimated for a five year period.



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4.2.9 R&D Flight Modules - Injection Stage - Engine Module

The R&D injection stage - engine module flight modules are the final qualification testing that must precede the manned flights in order to qualify the system.

The prime objectives of flight tests are:

- a. Evaluation of hardware characteristics and operational procedures which cannot be adequately evaluated by ground testing.
- b. Acquisition of flight data and correlation of these data with the results of ground tests.
- c. Flight certification of the launch vehicle and ground support equipment prior to manned flight.
- d. Flight verification of stage subsystems affecting crew safety prior to manned flight.
- e. Ground crew training.

Individual module (specimen) costs were obtained from the "C" category of estimates with allowances for the additional R&D instrumentation. The costs for the two R&D engine modules are shown in Table 4.2.9.0-1. These costs include all of the costs associated with the engine module hardware, additional R&D instrumentation, SE&I and Launch Cycle Costs (the launch costs for each R&D flight are based on a nine month cycle), in addition, these costs include all appropriate transportation cost, facility and equipment maintenance cost.

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TABLE 4.2.9.0-I
 AMLLV COST SUMMARY

TWO R&D FLIGHTS - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER									81,406		81,406
TOTAL COST									81,406		81,406

TABLE 4.2.9.0-II
 AMLLV
 DEVELOPMENTAL COSTS
 NON-RECURRING
TWO R&D FLIGHTS - ENGINE MODULE
 (DOLLARS IN THOUSANDS)

<u>Element of Cost</u>	<u>No. 1</u>	<u>No. 2</u>
Stage Hardware (1)	\$24,210	\$22,298
Propellants	730	730
Launch Operations	10,731	10,731
Instrumentation	<u>5,988</u>	<u>5,988</u>
	\$41,658	\$39,747
Total Costs of Two R&D Flights	\$81,406	

- (1) Includes Transportation and Facility and Equipment Maintenance Costs

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4.3 INJECTION STAGE - FUEL MODULE

The summary costs for testing of the injection stage - fuel module are displayed in Table 4.3.0.0-I. The costs include not only the cost associated with conducting the tests, but also the costs of the required test specimens. Specimen costs were developed from the recurring costs contained in Book C of this volume. Figure 4.3.0.0-1 displays the total costs associated with the injection stage - fuel module and the appropriate sub-paragraphs where the cost information is located.

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TOTAL FUEL MODULE

TABLE 4.3.0.0-I
MLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN.& REPT.	1	10								1	10
INDUSTRIAL RELATIONS											
ENGINEERING			7	88						7	88
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST			12	115						12	115
MANUFACTURING TECH.											
Q & R A			2	15						2	15
FACILITIES						500					500
DIRECT DIST			4	37						4	37
TRAINING			1	17						1	17
TOTAL DIRECT LABCR	1	10	26	272		500				27	782
MATERIAL				7							7
LOGISTIC HARDWARE				17007							17,007
BURDEN				2							2
TOTAL MATERIAL				17016							17,016
TOTAL OTHER									56553		56,553
TOTAL COST		10		17288		500			56553		74,351

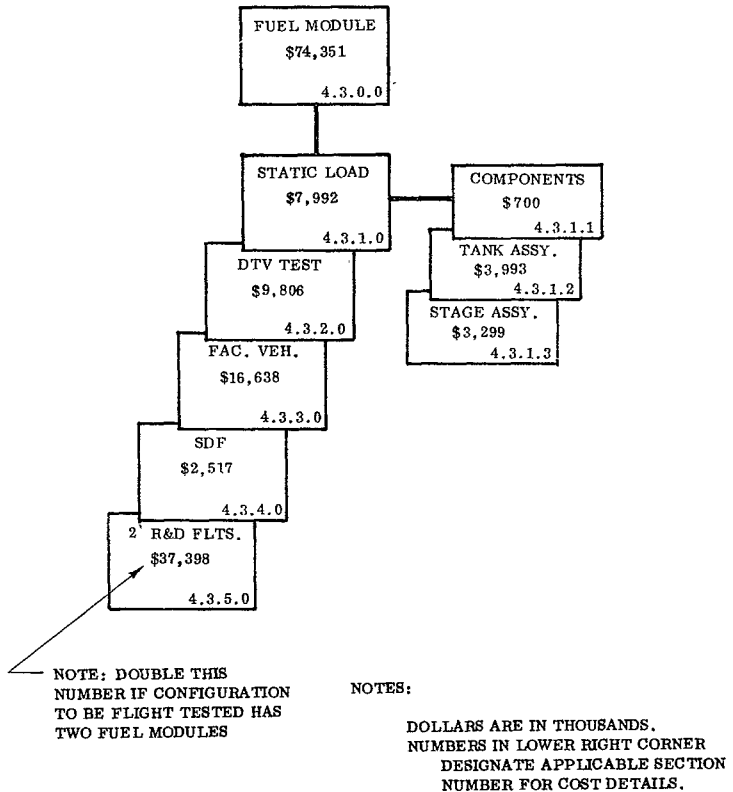


FIGURE 4.3.0.0-1 AMLLV INJECTION STAGE FUEL MODULE COST DEVELOPMENT TEST, "B" COSTS

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4.3.1 Static Load Test - Injection Stage - Fuel Module

The total cost of conducting all of the static load test for the injection stage fuel module is displayed in Table 4.3.1.0-I. In addition, Figure 4.3.1.0-1 displays the cost and sub-paragraph number of the various components that require static testing. Sections 4.3.1.1 through 4.3.1.3 reflects the cost for the tank assembly, stage, assembly and other components, which include the necessary material and labor to accomplish the following functions:

a. Engineering

- (1) Mechanical and electrical design
- (2) Drafting and support
- (3) Liaison
- (4) Conduct the test
- (5) Test reports

b. Manufacturing

- (1) Facility checkout and preparation
- (2) Specimen installation
- (3) Load fixture fabrication
- (4) Load fixture installation
- (5) Plumbing installation
- (6) Instrumentation installation
- (7) Mechanical checkout
- (8) Electrical checkout
- (9) Conduct the test
- (10) Teardown effort

c. Material and Parts

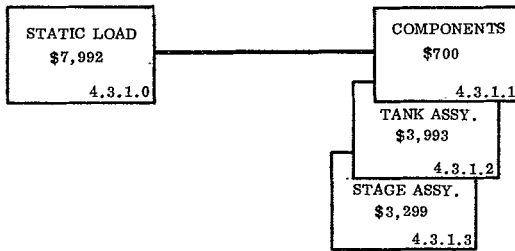
- (1) Raw material
- (2) Mechanical components
- (3) Electrical transducers
- (4) Electrical components and equipment
- (5) Test specimen (from "C" cost)

d. Retest Costs

- (1) Parts, materials and labor costs

The test facilities that are to be utilized for the single stage vehicle are considered adequate to accommodate the fuel module; therefore, no additional facility or equipment costs were added for static testing of the fuel module.

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(DOLLARS IN THOUSANDS)

FIGURE 4.3.1.0-1 AMLLV INJECTION STAGE FUEL MODULE STATIC LOAD COST DEVELOPMENT TEST, "B" COSTS

STATIC LOAD TEST - FUEL MODULE

TABLE 4.3.1.0-I
MLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.	1	10								1	10
INDUSTRIAL RELATIONS											
ENGINEERING			7	88						7	88
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST			12	115						12	115
MANUFACTURING TECH.											
Q & R A			2	15						2	15
FACILITIES											
DIRECT DIST			4	37						4	37
TRAINING			1	17						1	17
TOTAL DIRECT LABOR	1	10	26	272						27	282
MATERIAL				7							7
LOGISTIC HARDWARE BURDEN				7701							7,710
TOTAL MATERIAL				7710							7,710
TOTAL OTHER											
TOTAL COST		10		7982							7,992

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4.3.1.1 Component Testing - Static Load Test

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TABLE 4.3.1.1-I
 AMLLV COST SUMMARY

STATIC LOAD TEST - COMPONENTS
 INJ. STAGE FUEL MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	1	7								1	7
PROGRAM PLAN. & REPT.	1	18								1	18
INDUSTRIAL RELATIONS		3									3
ENGINEERING			16	186						16	186
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST			31	306						31	306
MANUFACTURING TECH.											
Q & R A			2	20						2	20
FACILITIES											
DIRECT DIST			10	94						10	94
TRAINING			1	4						1	4
TOTAL DIRECT LABOR	2	28	60	610						62	638
MATERIAL				34							34
LOGISTIC HARDWARE											
BURDEN				12							12
TOTAL MATERIAL				46							46
TOTAL OTHER				16							16
TOTAL COST		28		672							700

AMLLV

PART I

COMPONENTS - F/M
ASSEMBLY OR SYSTEM

TABLE 4.3.1.1-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	15,776		
Logistics			
Laboratory Technician			
Production			
Tooling			
Manufacturing Test	31,441		
Q&RA	2,097		
Facilities			
Manufacturing Technician			
Total Direct Labor	<u>49,314</u>		
Program Executive		592	6,992
Program Planning & Reporting		1,479	17,467
Industrial Relations		<u>321</u>	<u>3,120</u>
Total Labor - Part I		<u>2,392</u>	<u>27,579</u>
<u>Material</u>			
Program Planning & Reporting			29
Industrial Relations			32
Material Subtotal			<u>61</u>
Material & Administrative Burden			<u>21</u>
Total Material			<u>82</u>
TOTAL COST - PART I			<u>27,661</u>

TABLE 4.3.1.1-III
 AMLLV PART II COST SUMMARY

STATIC LOAD TEST - COMPONENT - F/M

B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	16	186							16	186
LAB TECHNICIANS										
TOOLING										
PRODUCTION							31	306	31	306
MANUFACTURING TEST										
MANUFACTURING TECH.										
Q & R A							2	20	2	20
DIRECT DIST							10	94	10	94
TRAINING							1	4	1	4
TOTAL DIRECT LABOR	16	186					44	424	60	610
MATERIAL								33		33
LAB. TECHNICIANS				16						16
TOOLING										
PRODUCTION										
MFG. TECHNICIANS										
Q & R A								1		1
SUBTOTAL				16				34		50
MAT. & ADM. BURDEN								12		12
TOTAL MATERIAL				16				46		62
TOTAL PART II COST		186		16				470		672

AMLLV
 R & D TEST COST
 NON-RECURRING

COMPONENTS - F/M
CONDUCT STATIC LOAD TEST

TABLE 4.3.1.1-IV

<u>Element of Cost</u>	<u>Manhours</u>	(In Thousands) <u>Dollars</u>
Engineering	13,870	164
Retest Allowance	<u>1,906</u>	<u>22</u>
TOTAL COST	<u><u>15,776</u></u>	<u><u>186</u></u>

AMLLV
R & D TEST COST
NON-RECURRING

COMPONENTS - F/M
CONDUCT STATIC LOAD TEST

TABLE 4.3.1.1.1-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
		(IN THOUSANDS)
(1) Manufacturing	25,864	251
(2) Retest Allowance	<u>5,577</u>	<u>55</u>
Subtotal	31,441	306
(3) Direct Distributable	<u>10,052</u>	<u>94</u>
Subtotal	41,493	400
(4) Training	<u>456</u>	<u>4</u>
Subtotal	41,949	404
(5) Q&RA	<u>2,097</u>	<u>20</u>
TOTAL LABOR	<u><u>44,046</u></u>	<u><u>424</u></u>
 <u>Material</u>		
(6) Raw Material & Parts		33
(7) Q&RA		<u>1</u>
Material Subtotal		34
(8) Material & Admin. Burden		12
TOTAL MATERIAL		<u>46</u>
TOTAL COST		<u><u>470</u></u>

4.3.1.2 Tank Assembly - Static Load Test

TABLE 4.3.1.2-I
 AMLLV COST SUMMARY

STATIC LOAD TEST - TANK ASSY.
 FUEL MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.		2									2
INDUSTRIAL RELATIONS											
ENGINEERING			1	15						1	15
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST			4	34						4	34
MANUFACTURING TECH.											
Q & R A			1	10						1	10
FACILITIES											
DIRECT DIST			1	11						1	11
TRAINING				5							5
TOTAL DIRECT LABOR		2	7	75						7	77
MATERIAL				7							7
LOGISTIC HARDWARE				3,907							3,907
BURDEN				2							2
TOTAL MATERIAL				3,916							3,916
TOTAL OTHER											
TOTAL COST		2		3,991							3,993

AMLLV

PART I

TANK ASSEMBLY - F/M
ASSEMBLY OR SYSTEM
CONDUCT STATIC LOAD TEST

TABLE 4.3.1.2-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering			
Logistics	1,256		
Laboratory Technician			
Production	3,542		
Tooling			
Manufacturing Test			
Q&RA	169		
Facilities			
Manufacturing Technician			
Total Direct Labor	<u>4,967</u>		
Program Executive		54	637
Program Planning & Reporting		149	1,759
Industrial Relations		32	311
Total Labor - Part I		<u>235</u>	<u>2,707</u>
<u>Material</u>			
Program Planning & Reporting			11
Industrial Relations			15
Material Subtotal			26
Material & Administrative Burden			9
Total Material			<u>35</u>
TOTAL COST - PART I			<u>2,742</u>

TABLE 4.3.1.2-III

AMLLV PART II COST SUMMARY STATIC LOAD TEST - TANK ASSY - F/M

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	1	15							1	15
LAB TECHNICIANS										
TOOLING										
PRODUCTION										
MANUFACTURING TEST							4	34	4	34
MANUFACTURING TECH.										
Q & R A							1	10	1	10
DIRECT DIST							1	11	1	11
TRAINING								5		5
TOTAL DIRECT LABOR	1	15					6	60	7	75
MATERIAL				*3,907				7		3,914
LAB. TECHNICIANS										
TOOLING										
PRODUCTION										
MFG. TECHNICIANS										
Q & R A										
SUBTOTAL				3,907				7		3,914
MAT. & ADM. BURDEN								2		2
TOTAL MATERIAL				3,907				9		3,916
TOTAL PART II COST		15		3,907				69		3,991

*Specimen

AMLLV
R & D TEST COST
NON-RECURRING

TANK ASSEMBLY - F/M
CONDUCT STATIC LOAD TEST

TABLE 4.3.1.2¹-IV

<u>Element of Cost</u>	<u>Manhours</u>	(In Thousands)
		<u>Dollars</u>
Engineering	1,127	13
Retest Allowance	<u>129</u>	<u>2</u>
TOTAL COST	<u><u>1,256</u></u>	<u><u>15</u></u>

AMLLV
R & D TEST COST
NON-RECURRING

TANK ASSEMBLY - F/M
CONDUCT STATIC LOAD TEST

TABLE 4.3.1.2-V

(IN THOUSANDS)

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Manufacturing	2,842	27
(2) Retest Allowance	700	7
Subtotal	<u>3,542</u>	<u>34</u>
(3) Direct Distributable	1,133	11
Subtotal	<u>4,675</u>	<u>45</u>
(4) Training	468	5
Subtotal	<u>5,143</u>	<u>50</u>
(5) Q&RA	1,029	10
TOTAL LABOR	<u><u>6,172</u></u>	<u><u>60</u></u>
 <u>Material</u>		
(6) Raw Material & Parts		7
(7) Q&RA		7
Material Subtotal		<u>7</u>
(8) Material & Admin. Burden		2
TOTAL MATERIAL		<u><u>9</u></u>
TOTAL COST		<u><u>69</u></u>

4.3.1.3 Stage Assembly - Static Load Test

TABLE 4.3.1.3-I
 AMLLV COST SUMMARY

STATIC LOAD TEST - STAGE ASSY.
 FUEL MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.	1	8								1	8
INDUSTRIAL RELATIONS											
ENGINEERING			6	73						6	73
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST			8	81						8	81
MANUFACTURING TECH.											
Q & R A			1	5						1	5
FACILITIES											
DIRECT DIST			3	26						3	26
TRAINING			1	12						1	12
TOTAL DIRECT LABOR	1	8	19	197						20	205
MATERIAL				1							1
LOGISTIC HARDWARE				3,093							3,093
BURDEN											
TOTAL MATERIAL				3,094							3,094
TOTAL OTHER											
TOTAL COST		8		3,291							3,299

AMLLV

PART I

STAGE ASSEMBLY - INJ. STAGE - F/M
ASSEMBLY OR SYSTEM

TABLE 4.3.1.3-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	6,237		
Logistics			
Laboratory Technician			
Production	8,352		
Tooling			
Manufacturing Test			
Q&RA	557		
Facilities			
Manufacturing Technician			
Total Direct Labor	<u>15,146</u>		
Program Executive		167	1,972
Program Planning & Reporting		454	5,362
Industrial Relations		<u>98</u>	<u>953</u>
Total Labor - Part I		<u>719</u>	<u>8,287</u>
<u>Material</u>			
Program Planning & Reporting			9
Industrial Relations			<u>10</u>
Material Subtotal			19
Material & Administrative Burden			<u>6</u>
Total Material			<u>25</u>
TOTAL COST - PART			<u>8,312</u>

TABLE 4.3.1.3-III

STATIC LOAD TEST - STAGE ASSY

AMLLV PART II COST SUMMARY

F/M

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	6	73							6	73
LAB TECHNICIANS										
TOOLING										
PRODUCTION										
MANUFACTURING TEST							8	81	8	81
MANUFACTURING TECH.										
Q & R A							1	5	1	5
DIRECT DIST							3	26	3	26
TRAINING							1	12	1	12
TOTAL DIRECT LABOR	6	73					13	124	19	197
MATERIAL				* 3,093						3,094
LAB. TECHNICIANS										
TOOLING										
PRODUCTION										
MFG. TECHNICIANS										
Q & R A										
SUBTOTAL				3,093				1		3,094
MAT. & ADM. BURDEN										
TOTAL MATERIAL				3,093				1		3,094
TOTAL PART II COST		73		3,093				125		3,291

*Specimen

AMLV
R & D TEST COST
NON-RECURRING

STAGE ASSEMBLY -- F/M
CONDUCT STATIC LOAD TEST

TABLE 4.3.1.3-IV

<u>Element of Cost</u>	<u>Manhours</u>	(In Thousands)
		<u>Dollars</u>
Engineering	5,504	64
Retest Allowance	<u>733</u>	<u>9</u>
TOTAL COST	<u><u>6,237</u></u>	<u><u>73</u></u>

✓ AMLLV
 R & D TEST COST
 NON-RECURRING

STAGE ASSEMBLY - F/M
CONDUCT STATIC LOAD TEST
 TABLE 4.3.1.3-V

(IN THOUSANDS)

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Manufacturing	3,343	63
(2) Retest Allowance	<u>2,010</u>	<u>19</u>
Subtotal	8,352	81
(3) Direct Distributable	<u>2,673</u>	<u>26</u>
Subtotal	11,025	107
(4) Training	<u>1,212</u>	<u>12</u>
Subtotal	12,237	119
(5) Q&RA	<u>557</u>	<u>5</u>
TOTAL LABOR	<u><u>12,794</u></u>	<u><u>124</u></u>
 <u>Material</u>		
(6) Raw Material & Parts		1
(7) Q&RA		
Material Subtotal		<u>1</u>
(8) Material & Admin. Burden		
TOTAL MATERIAL		<u><u>1</u></u>
TOTAL COST		<u><u><u>125</u></u></u>

4.3.2 Dynamic Testing - Injection Stage - Fuel Module

The total cost for performing the dynamic tests on the injection stage fuel module are displayed in Table 4.3.2.0-I. These costs include the labor and material to accomplish the following functions:

a. Engineering

- (1) Mechanical and electrical design
- (2) Drafting and support
- (3) Liaison
- (4) Conduct the test
- (5) Test reports

b. Manufacturing

- (1) Facility checkout and preparation
- (2) Specimen installation
- (3) Load fixture - fabrication and installation
- (4) Plumbing installation
- (5) Instrumentation installation
- (6) Mechanical checkout
- (7) Electrical checkout
- (8) Conduct the test
- (9) Teardown effort

c. Material and Parts

- (1) Raw materials
- (2) Mechanical components
- (3) Electrical transducers
- (4) Electrical components and equipment
- (5) Test specimen (from "C" costs)

d. Retest

- (1) Parts materials and labor costs

The test facilities and necessary equipment to conduct dynamic testing of the injection stage - fuel module are displayed in Table 4.3.2.0-I. These costs are additive to the dynamic test facility cost of the single stage vehicle, and injection stage - engine module, as that vehicle combination carries the majority of the costs associated with dynamic testing.

TABLE 4.3.2.0-I

AMLLV COST SUMMARY - DYNAMIC TEST - FUEL MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATTONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES						500					500
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR						500					500
MATERIAL											
LOGISTIC HARDWARE				*9,306							9,306
BURDEN											
TOTAL MATERIAL				9,306							9,306
TOTAL OTHER											
TOTAL COST				9,306		500					9,806

*Specimen

AMLIV
DYNAMIC TEST - FUEL MODULE

TABLE 4.3.2.0-II

Manhours for Conducting Dynamic Test on Fuel Module are insignificant.
Therefore the only Costs invalued for Testing Fuel Module are:

Specimen Cost	\$9,306
Additional Facility Cost	<u>500</u>
TOTAL COST FUEL MODULE	<u><u>\$9,806</u></u>

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4.3.3 Facility Checkout Module - Injection Stage - Fuel Module

The facility checkout injection - fuel module is defined as the test article that will be used to checkout the following:

1. The manufacturing tools, facilities and equipment
2. All R&D test facilities and equipment
3. Handling and transportation equipment
4. Launch complex facilities, and support area
5. All GSE (manufacturing facility and launch facility)
6. All processes and procedures

The primary objective of the facility vehicle is to achieve a state of operational readiness prior to processing of the flight modules. The costs associated with this facility vehicle are displayed in Table 4.3.3.0-I. The facility module consists of the following:

1. Fuel module structure
2. Systems
3. Transportation from the manufacturing plant to the launch site.
4. Launch cycle cost (based on one-year cost to checkout the facility)
5. Propellant cost

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TABLE 4.3.3.0-1

AMLLV COST SUMMARY - FACILITY VEHICLE - FUEL MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER									16,638		16,638
TOTAL COST									16,638		16,638

AMLV
NON-RECURRING
R&D COST
FACILITY VEHICLE FUEL MODULE

TABLE 4.3.3.0-II

<u>Element of Cost</u>	<u>Dollars</u> (In Thousands)
Structures	7,000
Systems	644
Launch Operations	8,264
Propellant	<u>730</u>
TOTAL COST	<u><u>16,638</u></u>

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4.3.4 Systems Development Facility (Breadboard) - Injection Stage - Fuel Module

The system development breadboard facility for the fuel module will provide for extensive testing, evaluation and verification of components, sub-systems and systems under controlled conditions that approximate those at the launch site.

Existing facilities at Michoud will be used to house the breadboard. (A new facility for this activity would cost approximately \$750,000). The equipment for these tests will primarily consist of the elements of vehicle and GSE hardware and/or simulators that make up the breadboard plus the computer complex.

The costs associated with the SDF for the fuel module are displayed in Table 4.3.4.0-I.

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TABLE 4.3.4.0-I
ANLLV COST SUMMARY

SDF- FUEL MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER									2,517		2,517
TOTAL COST									2,517		2,517

AMLLV
NON-RECURRING COST
R&D TEST FACILITIES
SYSTEMS DEVELOPMENT FACILITY - FUEL MODULE

TABLE 4.3.4.0-III

<u>ELEMENT OF COST</u>	<u>DOLLARS</u> (IN THOUSANDS)
Equipment	1,925
Operations (1)	<u>592</u>
TOTAL SDF	<u><u>2,517</u></u>

(1) Operation Cost Is estimated for a Five Year Period.

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4.3.5 R&D Flight Modules - Injection Stage - Fuel Module

The two R&D injection stage fuel modules are required for the final qualification testing that must precede the manned flights in order to qualify the system:

The prime objectives of flight tests are:

- a. Evaluation of hardware characteristics and operational procedures which cannot be adequately evaluated by ground testing.
- b. Acquisition of flight data and correlation of these data with the results of ground tests.
- c. Flight verification of the launch vehicle and ground support equipment prior to manned flight.
- d. Flight verification of stage subsystems affecting crew safety prior to manned flight.
- e. Ground crew training.

Individual modules (specimens) costs were obtained from the "C" category of estimates, with allowances for the additional R&D instrumentation.

The costs for the two R&D fuel modules are shown in Table 4.3.5.0-I. These costs include all of the cost associated with the fuel module hardware, additional R&D instrumentation, SE&I and launch cycle costs (the launch costs for each R&D flight are based on a nine month cycle), in addition, these costs include all appropriate transportation cost, facility and equipment maintenance costs.

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TABLE 4.3.5.0-I

AMLLV COST SUMMARY-TWO R&D FLIGHTS - INJ. STAGE FUEL MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER									37,398		37,398
TOTAL COST									37,398		37,398

TABLE 4.3.5.0-II
 AMLLV
 DEVELOPMENTAL COSTS
 NON-RECURRING
TWO R&D FLIGHTS - FUEL MODULE
 (DOLLARS IN THOUSANDS)

<u>Element of Cost</u>	<u>No. 1</u>	<u>No. 2</u>
Stage Hardware (1)	\$13,242	\$12,050
Propellants	730	730
Launch Operations	<u>5,323</u>	<u>5,323</u>
	\$19,295	\$18,103
Total Costs of Two R&D Flights		\$37,398

(1) Includes Transportation and Facility and Equipment Maintenance Costs

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4.4 SOLID ROCKET MOTOR STAGE TESTING

The summary costs for testing the Solid Rocket Motor Stages are displayed in Table 4.4.0.0-I. These costs include not only the cost associated with conducting the test but all the costs of the test specimens as well. Specimen costs were developed from the recurring costs contained in Book C of this volume. Figure 4.4.0.0-1 displays the total cost of the Solid Rocket Motor Stage Testing by type of test, and the appropriate sub-paragraph where the cost information is located.

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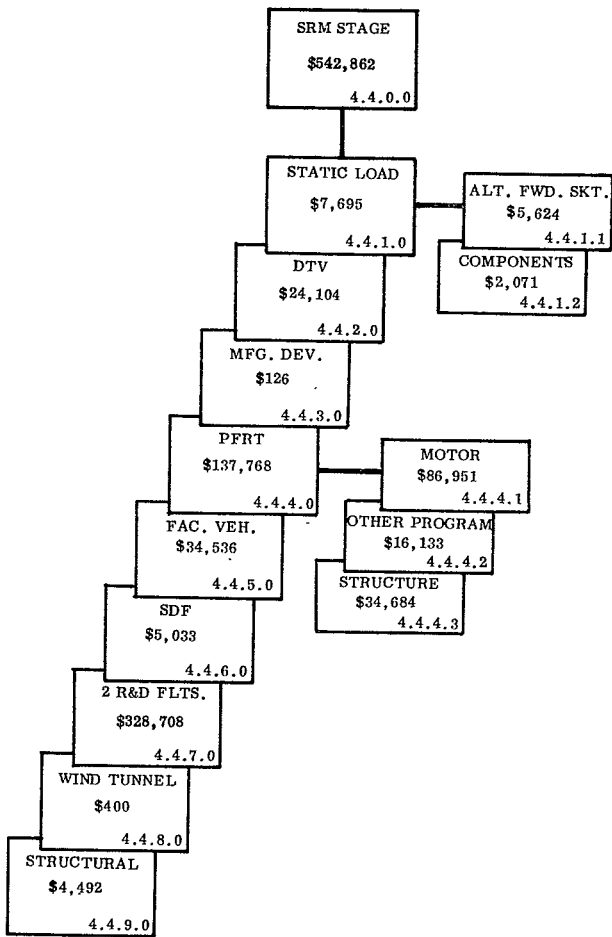
TABLE 4.4.0.0-I
 AMLLV COST SUMMARY

SRM STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	36	425								36	425
PROGRAM PLAN. & REPT.	88	1,037								88	1,037
INDUSTRIAL RELATIONS	22	220								22	220
ENGINEERING			711	8,400						711	8,400
LAB TECHNICIANS			6	58						6	58
TOOLING											
PRODUCTION											
MANUFACTURING TEST			1,269	12,339						1,269	12,339
MANUFACTURING TECH.											
Q & R A			199	1,932						199	1,932
FACILITIES											
DIRECT DIST			31	302						31	302
TRAINING			2	13						2	13
TOTAL DIRECT LABOR	146	1,682	2,218	23,044						2,364	24,726
MATERIAL				2,724	8,137						10,861
LOGISTIC HARDWARE											
BURDEN				167							167
TOTAL MATERIAL				2,891	8,137						11,028
TOTAL OTHER				121,431	17,000			368,677			507,108
TOTAL COST		1,682		147,366	25,137			389,281			542,862



(DOLLARS IN THOUSANDS)

FIGURE 4.4.0.0-1 AMLLV SOLID MOTOR STAGE COST DEVELOPMENT TEST, "B" COSTS

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4.4.1 Static Load Test - SRM Stage

Total cost of conducting all of the static load tests for the SRM stage vehicle are shown in Table 4.4.1.0-I. In addition, Figure 4.4.1.0-1 displays the costs and sub-paragraph number of the various components that require static testing. Paragraph 4.4.1.1 and paragraph 4.4.1.2 reflect the costs for the alternate forward skirt and other components, which include the labor, material and tooling to accomplish the following:

a. Engineering

- (1) Mechanical and electrical design
- (2) Drafting and support
- (3) Liaison
- (4) Conduct the test
- (5) Test reports

b. Manufacturing

- (1) Facility checkout and preparation
- (2) Specimen installation
- (3) Load fixture fabrication
- (4) Load fixture installation
- (5) Plumbing installation
- (6) Instrumentation installation
- (7) Mechanical checkout
- (8) Electrical checkout
- (9) Conduct the test
- (10) Teardown effort

c. Material and Parts

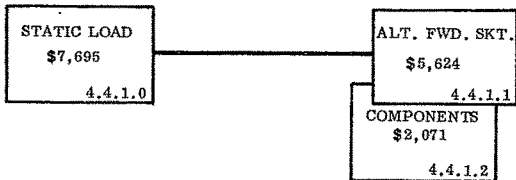
- (1) Raw material
- (2) Mechanical components
- (3) Electrical transducers
- (4) Electrical components and equipment
- (5) Test specimen (from "C" costs)

d. Retest Allowance

- (1) Parts, materials and labor

The test facilities and equipment that are required to produce the SRM stage and those required to static load test the single stage vehicle will be utilized to static load test the SRM stage.

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(DOLLARS IN THOUSANDS)

FIGURE 4.4.1.0-1 AMLLV SOLID MOTOR STAGES STATIC LOAD COST DEVELOPMENT TEST, "B" COSTS

TABLE 4.4.1.0-I

AMLLV COST SUMMARY

STATIC LOAD TEST - SRM STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	1	14								1	14
PROGRAM PLAN. & REPT.	3	35								3	35
INDUSTRIAL RELATIONS	1	6								1	6
ENGINEERING			29	343						29	343
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST			55	545						55	545
MANUFACTURING TECH.											
Q & R A			8	71						8	71
FACILITIES											
DIRECT DIST			18	175						18	175
TRAINING			1	7						1	7
TOTAL DIRECT LABOR	5	55	111	1,141						116	1,196
MATERIAL				108							108
LOGISTIC HARDWARE				*6,355							6,355
BURDEN				36							36
TOTAL MATERIAL				144							144
TOTAL OTHER											
TOTAL COST		55		7,640							7,695

*Specimen

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4.4.1.1 Alternate Forward Skirt (Heavy Weight Forward Skirt) - Static Load Test

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4.4.1.1-I

AMLLV COST SUMMARY STATIC LOAD TEST - DELTA FORWARD SKIRT

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
	PROGRAM EXECUTIVE	1	12								
PROGRAM PLAN. & REPT.	2	31								2	31
INDUSTRIAL RELATIONS	1	5								1	5
ENGINEERING			28	326						28	326
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST			37	367						37	367
MANUFACTURING TECH.											
Q & R A			4	35						4	35
FACILITIES											
DIRECT DIST			12	118						12	118
TRAINING			1	5						1	5
TOTAL DIRECT LABOR	4	48	82	851						86	899
MATERIAL				71							71
LOGISTIC HARDWARE				*4,630							4,630
BURDEN				24							24
TOTAL MATERIAL				4,725							4,725
TOTAL OTHER											
TOTAL COST		48		5,576							5,624

*Specimen

AMLLV

PART I

DELTA FORWARD SKIRT
ASSEMBLY OR SYSTEM

4.4.1.1-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	27,579		
Logistics			
Laboratory Technician			
Production	52,343		
Tooling			
Manufacturing Test			
Q&RA	4,920		
Facilities			
Manufacturing Technician			
Total Direct Labor	<u>84,842</u>		
Program Executive		1,018	12,023
Program Planning & Reporting		2,545	30,056
Industrial Relations		551	5,355
Total Labor - Part I		<u>4,114</u>	<u>47,434</u>
<u>Material</u>			
Program Planning & Reporting			52
Industrial Relations			55
Material Subtotal			107
Material & Administrative Burden			36
Total Material			<u>143</u>
TOTAL COST - PART I			<u>47,577</u>

4.4.1.1-III

AMLLV PART II COST SUMMARY-STATIC LOAD TEST - DELTA FORWARD SKIRT A B C (IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	28	326							28	326
LAB TECHNICIANS										
TOOLING										
PRODUCTION							37	367	37	367
MANUFACTURING TEST										
MANUFACTURING TECH.										
Q & R A							4	35	4	35
DIRECT DIST							12	118	12	118
TRAINING							1	5	1	5
TOTAL DIRECT LABOR	28	326					54	525	82	851
MATERIAL				*4,630				70		4,700
LAB. TECHNICIANS										
TOOLING										
PRODUCTION										
MFG. TECHNICIANS										
Q & R A								1		1
SUBTOTAL				4,630				71		4,701
MAT. & ADM. BURDEN								24		24
TOTAL MATERIAL				4,630				95		4,725
TOTAL PART II COST		326		4,630				620		5,576

*Specimen

AMLLV
R & D TEST COST
NON-RECURRING

DELTA FORWARD SKIRT
CONDUCT STATIC LOAD TEST

4.4.1.1-IV

<u>Element of Cost</u>	<u>Manhours</u>	(In Thousands)
		<u>Dollars</u>
Engineering	23,443	277
Retest Allowance	<u>4,136</u>	<u>49</u>
TOTAL COST	<u>27,579</u>	<u>326</u>

AMLLV
R & D TEST COST
NON-RECURRING

DELTA FORWARD SKIRT
CONDUCT STATIC LOAD TEST

4.4.1.1-V

(IN THOUSANDS)

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Manufacturing	29,957	291
(2) Retest Allowance	<u>7,849</u>	<u>76</u>
Subtotal	37,806	367
(3) Direct Distributable	<u>12,098</u>	<u>118</u>
Subtotal	49,904	485
(4) Training	<u>549</u>	<u>5</u>
Subtotal	50,453	490
(5) Q&RA	<u>3,520</u>	<u>35</u>
TOTAL LABOR	<u><u>53,973</u></u>	<u><u>525</u></u>
 <u>Material</u>		
(6) Raw Material & Parts		70
(7) Q&RA		<u>1</u>
Material Subtotal		<u>71</u>
(8) Material & Admin. Burden		<u>24</u>
TOTAL MATERIAL		<u><u>95</u></u>
TOTAL COST		<u><u>620</u></u>

4.4.1.2 Component Testing - Static Load Test

4.4.1.2-I

AMLLV COST SUMMARY STATIC LOAD TEST - DELTA - COMPONENTS

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE		2									2
PROGRAM PLAN. & REPT.	1	4								1	4
INDUSTRIAL RELATIONS		1									1
ENGINEERING			1	17						1	17
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST			18	178						18	178
MANUFACTURING TECH.											
Q & R A			4	36						4	36
FACILITIES											
DIRECT DIST			6	57						6	57
TRAINING				2							2
TOTAL DIRECT LABCR	1	7	29	290						30	297
MATERIAL				37							37
LOGISTIC HARDWARE				*1,725							1,725
BURDEN				12							12
TOTAL MATERIAL				1,774							49
TOTAL OTHER				1,725							1,774
TOTAL COST		7		2,064							2,071

*Specimen

AMLLV

PART I

STATIC LOAD TEST - DELTA - COMPONENTS
ASSEMBLY OR SYSTEM

4.4.1.2-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	1,480		
Logistics			
Laboratory Technician			
Production	7,679		
Tooling			
Manufacturing Test			
Q&RA	2,776		
Facilities			
Manufacturing Technician			
Total Direct Labor	<u>11,935</u>		
Program Executive		143	1,689
Program Planning & Reporting		358	4,228
Industrial Relations		<u>78</u>	<u>758</u>
Total Labor - Part I		<u>579</u>	<u>6,675</u>
<u>Material</u>			
Program Planning & Reporting			7
Industrial Relations			<u>8</u>
Material Subtotal			15
Material & Administrative Burden			<u>5</u>
Total Material			<u>20</u>
TOTAL COST - PART I			<u>6,695</u>

4.4.1.2-III

AMLLV PART II COST SUMMARY STATIC LOAD TEST - DELTA - COMPONENTS A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	S	M/H	\$	M/H	\$
ENGINEERING	1	17							1	17
LAB TECHNICIANS										
TOOLING										
PRODUCTION							18	178	18	178
MANUFACTURING TEST										
MANUFACTURING TECH.										
Q & R A							4	36	4	36
DIRECT DIST							6	57	6	57
TRAINING								2		2
TOTAL DIRECT LABOR	1	17					28	273	29	290
MATERIAL				1,725				36		1,761
LAB. TECHNICIANS										
TOOLING										
PRODUCTION										
MFG. TECHNICIANS										
Q & R A								1		1
SUBTOTAL				1,725				37		1,762
MAT. & ADM. BURDEN								12		12
TOTAL MATERIAL				1,725				49		1,774
TOTAL PART II COST		17		1,725				322		2,064

AMLLV
R & D TEST COST
NON-RECURRING

DELTA - COMPONENTS
CONDUCT STATIC LOAD TEST

4.4.1.2-IV

<u>Element of Cost</u>	<u>Manhours</u>	(In Thousands)
		<u>Dollars</u>
Engineering	1,333	16
Retest Allowance	<u>147</u>	<u>1</u>
TOTAL COST	<u>1,480</u>	<u>17</u>

AMLLV
R & D TEST COST
NON-RECURRING

DELTA - COMPONENTS
CONDUCT STATIC LOAD TEST
4.4.1.2-V

(IN THOUSANDS)

<u>Element of Cost.</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Manufacturing	15,542	151
(2) Retest Allowance	<u>2,742</u>	<u>27</u>
Subtotal	18,284	178
(3) Direct Distributable	<u>1,851</u>	<u>57</u>
Subtotal	24,135	235
(4) Training	<u>265</u>	<u>2</u>
Subtotal	24,400	237
(5) Q&RA	<u>3,686</u>	<u>36</u>
TOTAL LABOR	<u><u>28,086</u></u>	<u><u>273</u></u>
 <u>Material</u>		
(6) Raw Material & Parts		36
(7) Q&RA		<u>1</u>
Material Subtotal		<u>37</u>
(8) Material & Admin. Burden		12
TOTAL MATERIAL		<u>49</u>
TOTAL COST		<u><u>322</u></u>

4.4.2 Dynamic Testing - SRM Stage

The total cost for performing the simulation of the SRM's on the dynamic test on the vehicle are displayed in Table 4.4.2.0-I, which includes the labor and material to accomplish the following functions:

a. Engineering

- (1) Mechanical and electrical design
- (2) Drafting and support
- (3) Liaison
- (4) Conduct the test
- (5) Test reports

b. Manufacturing

- (1) Facility checkout and preparation
- (2) Specimen installation
- (3) Load fixture - fabrication and installation
- (4) Plumbing installation
- (5) Instrumentation installation
- (6) Mechanical checkout
- (7) Electrical checkout
- (8) Conduct the test
- (9) Teardown effort

c. Material and Parts

- (1) Raw materials
- (2) Mechanical components
- (3) Electrical transducers
- (4) Electrical components and equipment
- (5) Test specimen (from "C" costs)

d. Retest Allowance

- (1) Parts, Materials and labor costs

Also additional costs for the dynamic test facilities and the capital equipment required for simulation of the SRM effects on the main stage dynamic test are included. The maintenance costs of the test facility are not increased from the single stage dynamic testing costs.

TABLE 4.4.2.0-1

AMLLV COST SUMMARY

DYNAMIC TEST - SRM STAGE (DELTA)

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
	PROGRAM EXECUTIVE	1	9								
PROGRAM PLAN. & REPT.	2	21								2	21
INDUSTRIAL RELATIONS		5									5
ENGINEERING.			19	227						19	227
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST			35	337						35	337
MANUFACTURING TECH.											
Q & R A			6	67						6	67
FACILITIES											
DIRECT DIST			11	108						11	108
TRAINING			1	5						1	5
TOTAL DIRECT LABCR	3	35	72	744						75	779
MATERIAL				369							369
LOGISTIC HARDWARE											
BURDEN				126							126
TOTAL MATERIAL				495							495
TOTAL OTHER				5,830		17,000					22,830
TOTAL COST		35		7,069		17,000					24,104

AMLLV

PART I

DYNAMIC TEST - SRM STAGE (DELTA)
ASSEMBLY OR SYSTEM
 TABLE 4.4.2.0-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	19,234		
Logistics			
Laboratory Technician			
Production	34,688		
Tooling			
Manufacturing Test			
Q&RA	6,394		
Facilities			
Manufacturing Technician			
Total Direct Labor	<u>60,316</u>	724	8,550
Program Executive		724	8,550
Program Planning & Reporting		1,809	21,364
Industrial Relations		<u>392</u>	<u>3,810</u>
Total Labor - Part I		<u>2,925</u>	<u>33,724</u>
<u>Material</u>			
Program Planning & Reporting			36
Industrial Relations			<u>39</u>
Material Subtotal			75
Material & Administrative Burden			<u>26</u>
Total Material			<u>101</u>
TOTAL COST - PART I			<u>34,825</u>

TABLE 4.4.2.0-III

AMLV PART II COST SUMMARY

DYNAMIC TEST - SRM STAGE (DELTA)

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	S	M/H	\$	M/H	\$
ENGINEERING	19	227							19	227
LAB TECHNICIANS										
TOOLING										
PRODUCTION							35	337	35	337
MANUFACTURING TEST										
MANUFACTURING TECH.										
Q & R A							6	67	6	67
DIRECT DIST							11	108	11	108
TRAINING							1	5	1	5
TOTAL DIRECT LABOR	19	227					53	517	72	744
MATERIAL				5,830				367		6,197
LAB. TECHNICIANS										
TOOLING										
PRODUCTION										
MFG. TECHNICIANS										
Q & R A								2		2
SUBTOTAL				5,830				369		6,199
MAT. & ADM. BURDEN								126		126
TOTAL MATERIAL				5,830				495		6,325
TOTAL PART II COST		227		5,830				1,012		7,069

AMLLV
 R & D TEST COST
 NON-RECURRING

SRM STAGE - (DELTA)
 CONDUCT DYNAMIC TEST

TABLE 4.4.2.0-IV

<u>Element of Cost</u>	<u>Manhours</u>	(In Thousands)
		<u>Dollars</u>
Engineering	16,349	193
Retest Allowance	<u>2,885</u>	<u>34</u>
TOTAL COST	<u><u>19,234</u></u>	<u><u>227</u></u>

MLLV
R & D TEST COST
NON-RECURRING

SRM STAGE - (DELTA)
CONDUCT DYNAMIC TEST
TABLE 4.4.2.0-V

(IN THOUSANDS)

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Manufacturing	27,735	270
(2) Retest Allowance	<u>6,933</u>	<u>67</u>
Subtotal	34,668	337
(3) Direct Distributable	<u>11,100</u>	<u>108</u>
Subtotal	45,768	445
(4) Training	<u>503</u>	<u>5</u>
Subtotal	46,271	450
(5) Q&RA	<u>6,934</u>	<u>67</u>
TOTAL LABOR	<u><u>53,205</u></u>	<u><u>517</u></u>
 <u>Material</u>		
(6) Raw Material & Parts		367
(7) Q&RA		2
Material Subtotal		<u>369</u>
(8) Material & Admin. Burden		126
TOTAL MATERIAL		<u><u>495</u></u>
TOTAL COST		<u><u>1,012</u></u>

4.4.3 Manufacturing Development Test – SRM Stage

The manufacturing development task for the SRM stage is directed toward the development and implementation of fabrication and assembly processes.

Defined in broad terms, the procedure is as follows:

1. Determine manufacturing development requirements through coordination and review of engineering drawings and specifications, present methods and existing manufacturing capabilities.
2. Establish suitable manufacturing methods. Document and coordinate these methods with applicable organizations.
3. Define equipment requirements, tooling criteria, training requirements, and establish step-by-step procedures for critical manufacturing.
4. Coordinate with Factory, Manufacturing Engineering, Facilities Training, etc., to assist them in the implementation and proper application of newly developed methods.

Table 4.4.3.0-I displays the cost associated with this function for the SRM stage vehicle.

TABLE 4.4.3.0-I

AMLLV COST SUMMARY MANUFACTURING DEVELOPMENT - SRM STRUCTURE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	1	11								1	11
PROGRAM PLAN. & REPT.		2									2
INDUSTRIAL RELATIONS		1									1
ENGINEERING			6	58						6	58
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A			2	15						2	15
FACILITIES											
DIRECT DIST			2	19						2	19
TRAINING				1							1
TOTAL DIRECT LABOR	1	14	10	93						11	107
MATERIAL				14							14
LOGISTIC HARDWARE BURDEN				5							5
TOTAL MATERIAL				19							19
TOTAL OTHER											
TOTAL COST		14		112							126

AMLLV
 DEVELOPMENT COST
 PART I
 NON-RECURRING
 MANUFACTURING DEVELOPMENT - SRM
 ASSEMBLY OR SYSTEM

TABLE 4.4.3.0-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering			
Logistics			
Laboratory Technician	6,000		
Production			
Tooling			
Manufacturing Test			
Q&RA	1,601		
Facilities			
Manufacturing Technician			
Total Direct Labor	<u>7,601</u>		
Program Executive		912	10,771
Program Planning & Reporting		228	2,693
Industrial Relations		<u>49</u>	<u>470</u>
Total Labor - Part I		<u>1,189</u>	<u>13,740</u>
<u>Material</u>			
Program Planning & Reporting			5
Industrial Relations			<u>5</u>
Material Subtotal			10
Material & Administrative Burden			<u>3</u>
Total Material			<u>13</u>
TOTAL COST - PART I			<u>13,953</u>

AMLLV
DEVELOPMENT COST
NON-RECURRING

MANUFACTURING DEVELOPMENT - SRM

TABLE 4.4.3.0-III

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u> (In Thousands)
Lab Technician	6,000	58
Direct Distributable	<u>1,920</u>	<u>19</u>
Subtotal	7,920	77
Training	<u>87</u>	<u>1</u>
Subtotal	8,007	78
Q&RA	<u>1,601</u>	<u>15</u>
TOTAL LABOR	9,608	<u><u>93</u></u>
Material		.
Lab Tech		13
Q&RA		<u>1</u>
Material Subtotal		14
Material and Administrative Burden		<u>5</u>
Total Material		<u><u>19</u></u>
TOTAL COST		<u><u><u>112</u></u></u>

4.4.4 SRM Motor Pre-Flight Rating Testing (PFRT)

The tests listed herein are the tests that are required by the SRM manufacturer. The test categories are structure, motor, and other program costs as shown in Figure 4.4.4.0-1.

Structure

1. Structural components
2. Electrical system
3. Instrumentation
4. Separation components
5. Destruct charges and firing components

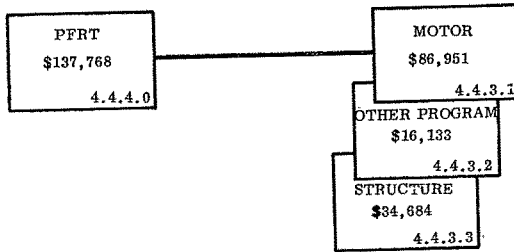
Motor Costs

1. Chamber
2. Nozzles
3. Case insulation
4. Propellant and liner materials
5. Igniter
6. Shipping
7. Manufacturing labor
8. Process and test
9. Inspection

Other Program Costs

1. Management and administration
2. Engineering
3. Test equipment design
4. Component development
5. Special test equipment
6. Test facilities
7. General and administrative expenses

These costs are displayed by Table 4.4.4.0-I.



(DOLLARS IN THOUSANDS)

FIGURE 4.4.4.0-1 AMLLV SRM PRE-FLIGHT RATING TEST (PFRT) COSTS DEVELOPMENT TEST, "B" COSTS

TABLE 4.4.4.0-1

AMLLV COST SUMMARY TOTAL DEV/PFRT - SRM STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST ..	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	33	391								33	391
PROGRAM PLAN. & REPT.	83	979								83	979
INDUSTRIAL RELATIONS	21	208								21	208
ENGINEERING			663	7,830						663	7,830
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST			1,139	11,049						1,139	11,049
MANUFACTURING TECH.											
Q & R A			183	1,779						183	1,779
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR	137	1,578	1,983	20,658						2,120	22,236
MATERIAL				1,743	8,137						9,880
LOGISTIC HARDWARE BURDEN				105,652							105,652
TOTAL MATERIAL				107,395	8,137						115,532
TOTAL OTHER											
TOTAL COST		1,578		128,053		8,137					137,768

605

* COST FOR TEN SRM'S & THREE SETS OF STRUCTURE & STAGE HARDWARE INC. TRANSPORTATION

TABLE 4.4.4.0-II

AMLLV COST SUMMARY DEV/PFRT TESTS - SRM

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING.											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST			624	6,067						624	6,067
MANUFACTURING TECH.											
Q & RA			183	1,779						183	1,779
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR			807	7,846						807	7,846
MATERIAL						8,137					8,137
LOGISTIC HARDWARE BURDEN				*70,968							70,968
TOTAL MATERIAL				70,968		8,137					79,105
TOTAL OTHER											
TOTAL COST				78,814		8,137					86,951

* TEN SOLID ROCKET MOTORS FOR DEV/PFRT TESTS CONDUCTED BY AEROJET INC. TRANSPORTATION

AMLLV
 SRM
 NON-RECURRING
 DEVELOPMENT TESTS
DEV/PFRT
 (DOLLARS IN THOUSANDS)

TABLE 4.4.4.0-III

AEROJET INPUT, OCTOBER 31, 1969

	<u>Motor Costs</u>	<u>Avg. Unit Cost</u>	<u>Quantity</u>	<u>Total Cost</u>
1.	Chamber	2,639	10	\$26,397
2.	Nozzle:			
	Shell	1,265	10	12,650
	Ablatives & Exit Cone	1,040	10	10,401
	Actuators (2/Motors)	87	10 Sets	872
	APU (2/Motors)	154	10 Sets	1,543
3.	Case Insulation	163	10	1,628
4.	Propellant and Liner Mat'ls	1,534		15,345
5.	Igniter	36	12	434
6.	Shipping	169	10	1,698
7.	Manufacturing Labor			
	Process and Test	606	10	6,071
	Inspection	177	10	1,777
	Subtotal			78,814
	Test Facility			8,137
	TOTAL AEROJET DEVELOPMENT MOTOR COST			<u>86,951</u>
	LESS FEE			<u> </u>

TABLE 4.4.4.0-IV
ANLLV COST SUMMARY

DEV/PFRT TEST STRUCTURE AND
OTHER HARDWARE - SRM

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH. Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE BURDEN				*34,684							34,684
TOTAL MATERIAL				34,684							34,684
TOTAL OTHER											
TOTAL COST				34,684							34,684

* THREE SETS OF STRUCTURE AND OTHER - STAGE HDWE, REQUIRED FOR DEV/PFRT TESTS
CONDUCTED BY AEROJET

AMLLV
SRM
NON-RECURRING - PFRT
(DOLLARS IN THOUSANDS)

TABLE 4.4.4.0-V

*STRUCTURE & OTHER SYSTEMS

*1.	Structural Components		
	Heat Shield	2,070	
	Raceway (Tunnel)	620	
	Environmental Control Ducts	410	
	Mounting and Fairings	<u>2,200</u>	\$5,300
*2.	Electrical System		9,400
*3.	Instrumentation		11,000
*4.	Stage Separation Components		
	Initiation Components		280
*5.	Destruct Charges and Firing Components		298
*6.	Attach Structure		5,532
*7.	Aft Skirt		1,668
8.	Fittings		<u>1,206</u>
	TOTAL STAGE COST		<u>\$34,684</u>

* Costs are for three complete sets to be used in PFRT Program by AeroJet.

TABLE 4.4.4.0-VI

AMLLV COST SUMMARY

OTHER PROGRAM COST - SRM

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	33	391								40	391
PROGRAM PLAN. & REPT.	83	979								83	979
INDUSTRIAL RELATIONS	21	208								21	208
ENGINEERING			663	7,830						663	7,830
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST			513	4,982						513	4,982
MANUFACTURING TECH. Q & RA											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR	137	1,578	1,176	12,812						1,313	14,390
MATERIAL				1,743							1,743
LOGISTIC HARDWARE BURDEN											
TOTAL MATERIAL				1,743							1,743
TOTAL OTHER											
TOTAL COST		1,578		14,555							16,133

AMLLV
 SRM
 DEVELOPMENT TESTS
 DEV/PFRT

(DOLLARS IN THOUSANDS)

TABLE 4.4.4.0-VII

OTHER PROGRAM COSTS (AEROJET INPUT, OCTOBER 31, 1968)

1.	Labor		
	Management & Administration		\$ 1,475
	Engineering		7,100
	Test Equipment Design		218
2.	Component Development		4,656
3.	Special Test Equipment		<u>1,028</u>
	Subtotal		\$14,477
	G/A		1,013
	Test Facilities		<u>643</u>
	TOTAL AEROJECT OTHER PROGRAM COSTS LESS FEE		<u><u>\$16,133</u></u>

COST SUMMARY
 PART I
 PROGRAM MANAGEMENT
OTHER PROGRAM COST - SRM
 ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 4.4.4.0-VIII

<u>Element of Cost</u>	<u>Man/Hours</u>	<u>Dollars</u>
(IN THOUSANDS)		
Direct Labor		
Program Executive	33,108	\$ 391
Program Planning & Reporting	82,896	979
Industrial Relations	<u>21,420</u>	<u>208</u>
Total Direct Labor	<u>137,434</u>	<u>\$1,578</u>
Material		
Program Planning & Reporting		
Industrial Relations		
Burden		
Total Material Costs		
 TOTAL PROGRAM MANAGEMENT COST		 <u><u>\$1,578</u></u>

TABLE 4.4.4.0-IX
 AMLLV PART II COST SUMMARY

OTHER PROGRAM COST - SRM
 DEVELOPMENT TEST

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	663	7,830							663	7,830
LAB TECHNICIANS										
TOOLING										
PRODUCTION										
MANUFACTURING TEST							513	4,982	513	4,982
MANUFACTURING TECH.										
Q & R A										
DIRECT DIST										
TRAINING										
TOTAL DIRECT LABOR	663	7,830					513	4,982	1,176	12,812
MATERIAL								1,743		1,743
LAB. TECHNICIANS										
TOOLING										
PRODUCTION										
MFG. TECHNICIANS										
Q & R A										
SUBTOTAL								1,743		1,743
MAT. & ADM. EXPLEN.										
TOTAL MATERIAL								1,743		1,743
TOTAL PART II COST		7,830						6,725		14,555

AMLLV
 NON-RECURRING COSTS
 PART II-A OTHER PROGRAM COST - SRM

ASSEMBLY OR SYSTEM
 DESIGN ENGINEERING

(IN THOUSANDS)

<u>ELEMENT OF COST</u>	<u>MANHOURS</u>	<u>DOLLARS</u>
TABLE 4.4.4.0-X		
BASIC DESIGN	<u>663</u>	<u>\$7,830</u>
1. Laboratory Technicians	_____	_____
Subtotal	=====	=====
2. Q&RA	_____	_____
TOTAL ENGINEERING LABOR	<u>663</u>	<u>\$7,830</u>
MATERIAL		
3. Laboratory Technicians	_____	_____
4. Q&RA	_____	_____
Subtotal	=====	=====
5. Material and Adm. Burden	_____	_____
TOTAL MATERIAL	=====	=====
TOTAL ENGINEERING COST	_____	<u>\$7,830</u>

4.4.5 Facility Checkout Vehicle - SRM Stage

The facility checkout SRM stage is defined as the test article that will be used to checkout the following:

1. The SRM manufacturing tools, facilities and equipment
2. All SRM related R&D test facilities and equipment
3. SRM handling and transportation equipment
4. SRM launch complex facilities and support areas
5. All SRM GSE (manufacturing facility and launch facility)
6. All SRM stage processes and procedures

The primary objective of the facility vehicle is to achieve a state of operational readiness prior to processing of the flight vehicles. The costs associated with this facility vehicle are displayed in Table 4.4.5.0-I. The facility vehicle consists of the following types of cost elements:

1. SRM stage structure
2. Systems
3. Transportation from the manufacturing plant to the launch site.
4. The cost of a larger dummy payload and instrument unit (basically required due to the larger payload capability provided by the solids).
5. Launch cycle cost (based on one years cost to check out the facility).

TABLE 4.4.5.0-I

AMLLV COST SUMMARY

FACILITY VEHICLE - SRM STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & RA											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER									34,536		34,536
TOTAL COST									34,536		34,536

AMLLV
NON-RECURRING
R&D COST
FACILITY VEHICLE - SRM

TABLE 4.4.5.0-II

<u>Element of Cost</u>	<u>Dollars</u> (In Thousands)
Structures	\$3,585
Systems	4,630
Transportation	30
Dummy Payload & IU	2,000
Launch Operations	<u>24,291</u>
Total Cost	<u>\$34,536</u>

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4.4.6 Systems Development Facility (Breadboard) - SRM Stage

The Systems Development Breadboard Facility operations required for the SRM stage will provide for extensive testing, evaluation, and verification of components, sub-systems and systems under controlled conditions that approximate those at the launch site.

Existing facilities at Michoud will be used to house the breadboard. (A new facility for this activity would cost approximately \$750,000). The equipment for these tests will primarily consist of the elements of vehicle and GSE hardware and/or simulators that make up the breadboard plus the computer complex.

The costs associated with the SDF for the SRM stage vehicle are displayed in Table 4.4.6.0-I.

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TABLE 4.4.6.0-I

AMLLV COST SUMMARY

SDF - SRM'S

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER									5,033		5,033
TOTAL COST									5,033		5,033

AMLLV
NON-RECURRING COSTS
R&D TEST FACILITIES
SYSTEMS DEVELOPMENT FACILITY - SRM'S

TABLE 4.4.6.0-II

<u>Element of Cost</u>	<u>Dollars</u> (IN THOUSANDS)
Equipment	\$3,850
Operations (1)	<u>1,183</u>
TOTAL SDF	<u><u>\$5,033</u></u>

(1) Operation Cost is estimated for a Five Year Period

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4.4.7 R&D Flight SRM Stages

The R&D flight vehicles are the final qualification testing that must precede the manned flights in order to qualify the system. The SRM stages required for the two R&D tests will assist in verifying the vehicle readiness.

The prime objectives of flight tests are:

- a. Evaluation of hardware characteristics and operational procedures which cannot be adequately evaluated by ground testing.
- b. Acquisition of flight data and correlation of these data with the results of ground tests.
- c. Flight verification of the launch vehicle and ground support equipment prior to manned flight.
- d. Flight verification of stage subsystems affecting crew safety prior to manned flight.
- e. Ground crew training.

Each flight space vehicle will be as complete as practicable; i.e., no dummy stage modules or subsystems, with the exception of a simulated payload.

Individual stage (specimen) costs were obtained from the "C" category estimates with allowances for the additional R&D instrumentation.

The costs for two SRM stage vehicles are shown in Table 4.4.7.0-I. This cost includes all the cost of stage hardware, R&D instrumentation, Instrument Unit, SE&I and Launch Cycle costs (these launch costs for each R&D flight are based on a nine month cycle). In addition these costs include all transportation, facility and equipment maintenance.

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TABLE 4.4.7.0-I

AMLIV COST SUMMARY TWO R&D FLIGHTS - 12 SOLID ROCKET MOTORS

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER									328,708		328,708
TOTAL COST									328,708		328,708

TABLE 4.4.7.0-II
 AMLLV
 DEVELOPMENTAL COSTS
 NON-RECURRING
TWO R&D FLIGHTS - 12 SRM'S
 (DOLLARS IN THOUSANDS)

<u>Element of Cost</u>	<u>No. 1</u>	<u>No. 2</u>
Stage Hardware (1)	\$138,633	\$126,389
Forward Skirt	4,630	4,630
Launch Operations	8,209	8,209
Launch Maintenance	1,150	1,150
SE&I	1,150	1,150
Instrumentation	<u>16,704</u>	<u>16,704</u>
	\$170,476	\$158,232
Total Costs of Two R&D Flights		\$328,708

(1) Includes Transportation and Facility and Equipment Maintenance Costs

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4.4.8 Wind Tunnel (Model Tests) - SRM Stage

Models will be used in wind tunnel tests to investigate the aerodynamic characteristics and dynamic behavior of the AMLLV SRM stages under laboratory conditions.

Test Description:

Force Model Tests - The purpose of these tests will be to ascertain range safety aerodynamics after inflight destruct, by checking the aerodynamic characteristics of models of selected fragments of the SRM stage.

AMLLV/SRM stage Base Heating Model Tests - Supersonic and transonic tests will be conducted. The tests will include heating and pressure measurements in the base region of possible configurations and anticipated flight environments.

Performance Characteristics of Various Vehicle Combinations - Model tests will determine aerodynamic performance characteristics of possible vehicle configurations within the vehicle family.

Resource Requirements:

The assumption is that adequate facilities already exist for the conduct of the model tests to develop the required information for the AMLLV program. It is anticipated, therefore, that costs for these tests will be based on procurement of the models and occupancy time at the test facility.

Based on prior test experience, the following estimate is shown in Table 4.4.8.0-I.

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TABLE 4.4.8.0-I

AMLLV COST SUMMARY

WIND TUNNEL - SRM STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER									400		400
TOTAL COST									400		400

AMLLV
DEVELOPMENTAL TESTING COSTS
NON-RECURRING
WIND TUNNEL TEST - SRM STAGE

TABLE 4.4.8.0-II

Element of Costs

Dollars
(IN THOUSANDS)

Wind Tunnel Models

400

These Costs based on Engineering Estimate.

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4.4.9 Structural Tests - SRM Stage

Structural tests for the SRM stage are defined as those tests that are required to prove the reliability of the following:

1. Attach Structure
2. Aft Skirt
3. Nose Cone
4. Fittings

Table 4.4.9.0-I displays the costs that are associated with these tests. Additional costs are shown for test facilities, material dollars, and cost of conducting the tests. These tests apply to the Boeing built structures only.

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TABLE 4.4.9.0-I

AMLIV COST SUMMARY STRUCTURAL TESTS - SRM

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST			42	408						42	408
MANUFACTURING TECH. Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR			42	408						42	408
MATERIAL				490							490
LOGISTIC HARDWARE BURDEN											
TOTAL MATERIAL				490							490
TOTAL OTHER									* 3,594		3,594
TOTAL COST				898					3,594		4,492

* ITEMS FOR STRUCTURAL TEST AT MICHOU D

AMLLV
 SRM
 NON-RECURRING
 STRUCTURAL TESTS
 (DOLLARS IN THOUSANDS)
 TABLE 4.4.9.0-II

BOEING TESTS AT MICHOU

1.	Test Facilities		\$ 263
2.	Cost of running tests		
	Material Dollars	\$ 227	
	Manhour Dollars	<u>408</u>	635
3.	Test Specimen		
	Attach Structure	1,844	
	Aft Skirt	556	
	Fittings	402	
	Nose Cone	<u>792</u>	<u>3,594</u>
	TOTAL TEST COST LESS FEE		<u><u>4,492</u></u>

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N70-10984

FINAL REPORT
FOR
COST STUDIES OF MULTIPURPOSE
LARGE LAUNCH VEHICLES

BASELINE AMLLV COSTS

BOOK C OF VOLUME IV

PREPARED UNDER CONTRACT NAS2-5056
FOR
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
OFFICE OF ADVANCE RESEARCH AND TECHNOLOGY
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NOTE: This is the third book (Book C) of the three books which comprise Volume IV of the final documentation for "Cost Studies of Multipurpose Large Launch Vehicles". This book is Section 5.0, AMLLV First Unit or "C" Cost. Sections 1.0 through 4.0 are contained in the other two books of Volume IV.

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5.0 FIRST UNIT OR "C" COST

This section contains a detailed breakdown of the total recurring cost for the first unit of the configuration elements of the Advanced Multipurpose Large Launch Vehicle (AMLLV) Baseline Family. The first unit has been defined as the first article for flight test.

The recurring costs have been categorized into subparagraphs as follows:

- 5.1 Single Stage Vehicle (Section 5.1.0.0)
- 5.2 One Module Injection Stage (Section 5.2.0.0)
- 5.3 Delta Costs for One (1) Fuel Module (Section 5.3.0.0)
- 5.4 SRM - Fixed Cost (Section 5.4.0.0)
- 5.5 SRM - Variable Cost (Section 5.5.0.0)

For convenience and easy reference, the costs associated with the above items are displayed by major component, system and subsystem in Figure 5.0.0.0-1. Section numbers are referenced to assist the reader in locating the desired item(s).

As stated in Section 1.0 of this volume, (see Book A, Volume IV), the output of Phase I, Task 1 was to produce "Modularized" cost data. The modularized data presented in this section provide an understanding of the costs associated with hardware production and utilization through launch and will enable the reader to evaluate the relative impact of specific items and/or elements on overall program costs. The first unit costs were developed in such a manner that the major vehicle configuration elements stand on their own, i.e., the costs for the Single Stage Vehicle (Section 5.1) are the total costs for production and launch of a single-stage-to-orbit vehicle. The costs of the Injection Stage Engine Module (Section 5.2) are the costs for production and launch of that configuration element. The same holds true for the costs of the Fuel Module and the costs of the SRM stages.

The format for displaying cost information, for each component or system consists of four major parts as follows:

- Part I Program Management, Program Planning and Reporting, and Industrial Relations.
- Part II Engineering, Production, Tooling, and Manufacturing Test.
- Part III Facilities.
- Part IV Logistics.

5.0 (Continued)

In addition, costs are displayed by element of cost, i. e., Engineering, Production, Test, Quality, etc. For an understanding of these elements, their makeup (direct input and/or factored), their base of application and in some instances their history, refer to Book A, Section 2.0 - Ground Rules and Assumptions.

The costs contained in this section are first unit costs only. To determine the costs associated with any other unit and/or block of units, learning curves must be used.

Table 5.0.0.0-I shows the learning curve values for the Program Elements (i. e., structures, systems, engines, etc.). These are divided into groups and are thereby defined by origin.

Table 5.0.0.0-II presents the method used to develop the composite learning curve used for the structure, systems, engine installation, and facilities and transportation. The learning curve values for the above vehicle components vary from 83% to 95%. These components were classified by engineering and management, manufacturing, quality, facilities and materials. The appropriate learning curve was applied to each of these cost categories to develop the weighted composite learning curve average of 91%.

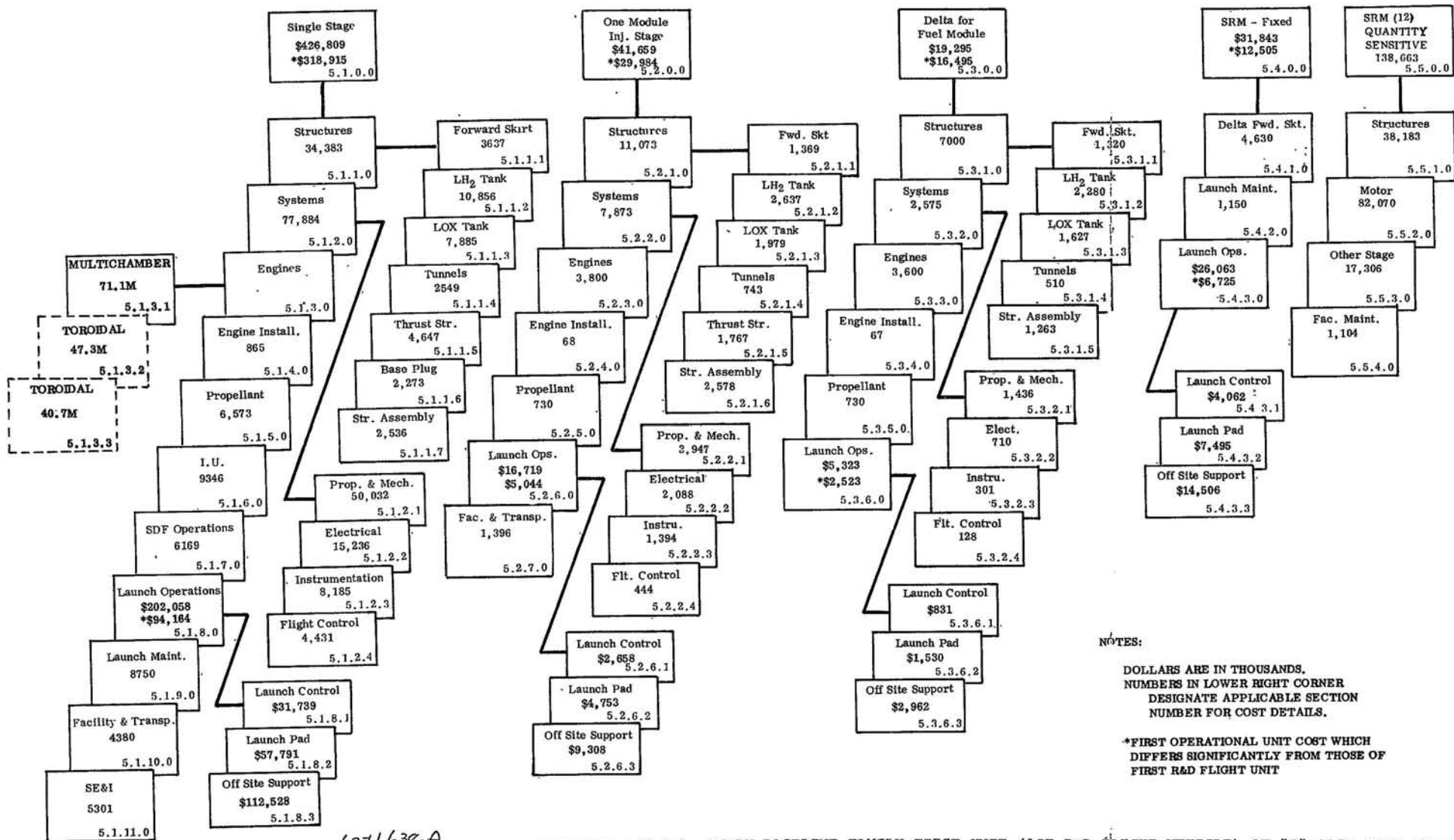


FIGURE 5.0.0.0-1 AMLV BASELINE FAMILY FIRST UNIT (1ST R&D FLIGHT VEHICLE) OF "C" COST FLOW DIAGRAM

TABLE 5. 0. 0. 0-I AMLLV COST ANALYSIS
 PHASE I TASK I
 DEVELOPMENT OF COMPOSITE LEARNING CURVE
 SINGLE STAGE VEHICLE

<u>Element</u>	<u>Learning Curve</u>	<u>Origin</u>
Structures	91%	See Table 5. 0. 0. 0-II
Systems	91%	
Engine Installation	91%	
Facility and Transportation	91%	
Engines	95%	Per Engine Contractor
Propellant	100%	Assumed not to be Affected by Learning Curve
I. U.	100%	
SDF Operations	100%	
Launch Maintenance	100%	
SE&I	100%	
Launch Operations	100%	

AMLLV COST ANALYSIS
 PHASE I TASK I
 DEVELOPMENT OF COMPOSITE LEARNING CURVE
 SINGLE STAGE VEHICLE

TABLE 5.0.0.0-II

	%	ENGR & MGT 95%	%	MFG 83%	%	QUAL & FAC 90%	%	MAT'L 98%	TOTAL
Engineering		4,430							
Lab Technicians		742							
PP&R		1,853							
IR		330							
Program Executive		741							
Logistics Engineering		687							
Subtotal	7.5%	8,783							
Tooling				1,917					
Manufacturing Technician				972					
Production (Inc Direct Dist & Trng)				41,222					
Manufacturing Testing				1,502					
Subtotal			38.8%	45,613					
Q&RA						9,248			
Facilities						5,111			
Subtotal					12.3%	14,359			
Material								48,757	
Subtotal							41.4%	48,757	
Total									117,512*

95% X 7.5% = 7.1%
 83% X 38.8% = 32.2%
 90% X 12.3% = 11.1%
 98% X 41.4% = 40.6%
 Total Composite - 91.0%

* Includes structures, systems, engine installation, and facility and transportation.

5.1 SINGLE STAGE VEHICLE

The summary costs for the first unit Single Stage AMLLV vehicle are displayed in Figure 5.1.0.0-1. These costs include not only the cost of the hardware, but all the costs associated with launching the vehicle and maintaining the production and launch facilities. Table 5.1.0.0-I displays the total cost of a single stage vehicle by part and by element of cost for the first R&D flight vehicle. Table 5.1.0.0-II displays (for reference) the costs for the first operational vehicle (third unit).

TABLE 5.1.0.0-I
AMLLV COST SUMMARY

*TOTAL SINGLE STAGE - 1 R&D LAUNCH VEHICLE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	253	2,964								253	2964
PROGRAM PLAN.& REPT.	618	7,308								618	7308
INDUSTRIAL RELATIONS	137	1,341								137	1341
ENGINEERING			1,631	22581			57	687		1688	23268
LAB TECHNICIANS			76	742						76	742
TOOLING			198	7117						198	7117
PRODUCTION			18,665	239337						18665	239337
MANUFACTURING TEST			154	6102						154	6102
MANUFACTURING TECH.			81	972						81	972
Q & RA			3,901	38143						3901	38143
FACILITIES					74	13861	57	687		74	13861
DIRECT DIST			918	8925						918	8925
TRAINING			51	48						51	484
TOTAL DIRECT LABOR	1,008	11,613	25,675	324403	74	13861		687		26814	350564
MATERIAL		7		34108							34115
LOGISTIC HARDWARE							2496				2496
BURDEN				11594			651				12245
TOTAL MATERIAL		7		45702			3147				48856
TOTAL OTHER (1)									27389		27389
TOTAL COST		11,620		370105		13861	3834	27389			426809

* With Multi-Chamber Plug Engine

NOTE: (1) includes Propellant, IU, SDF and SE&I.

*TOTAL SINGLE STAGE - FIRST OPERATIONAL LAUNCH

TABLE 5.1.0.0-II
AMLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	64	741								64	741
PROGRAM PLAN.& REPT.	156	1853								156	1,853
INDUSTRIAL RELATIONS	33	330								33	330
ENGINEERING			5271	54665			57	687		5,328	55,352
LAB TECHNICIANS			76	742						76	742
TOOLING			198	7117						198	7,117
*PRODUCTION OR OPER			9247	136498						9,247	136,498
MANUFACTURING TEST			154	6102						154	6,102
MANUFACTURING TECH.			81	972						81	972
Q & R A			928	9248						928	9,248
FACILITIES					74	13861				74	13,861
DIRECT DIST			918	8925						918	8,925
TRAINING			51	484						51	484
TOTAL DIRECT LABOR	253	2924	16924	224753	74	13861	57	687		17,308	242,225
MATERIAL		7		34577							34,584
LOGISTIC HARDWARE							2496				2,496
EURDEN				11570			651				12,221
TOTAL MATERIAL				46147			3147				49,301
TOTAL OTHER (1)									27389		27,389
TOTAL COST		2931		270900	13861		3834	27389			318,915

* WITH MULTI-CHAMBER PLUG ENGINES

** NOTE (1) INCLUDES: PROPELLANT, IU, SDF, AND SE&I

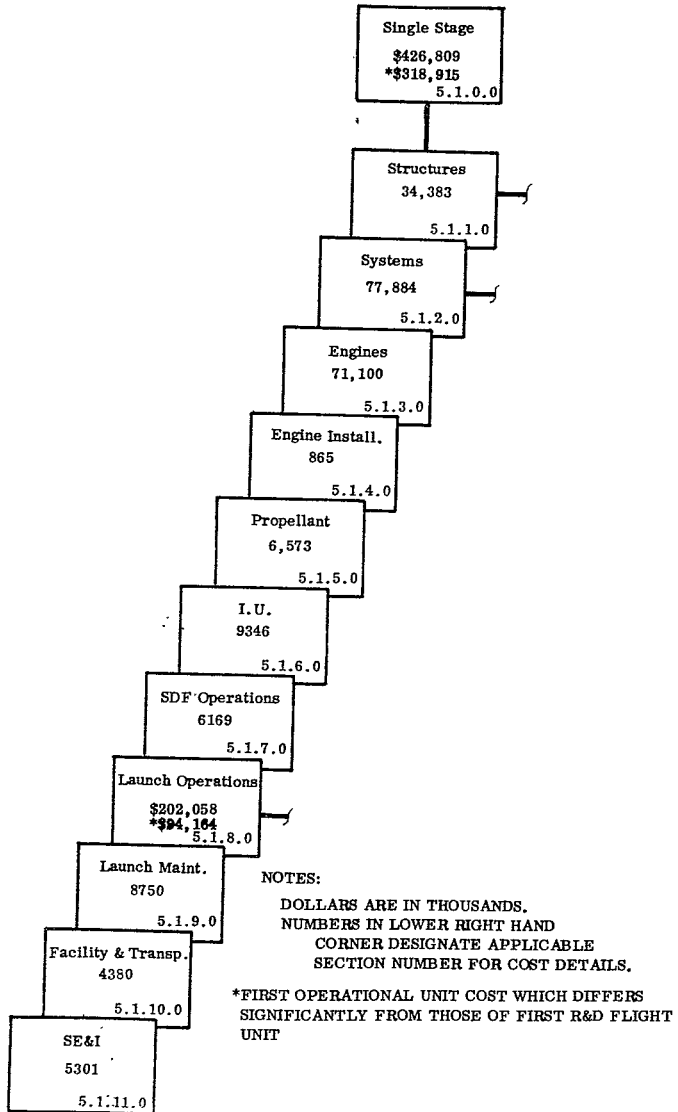


FIGURE 5.1.0.0-1 SINGLE STAGE VEHICLE COST FLOW DIAGRAM

5.1.1 Structures

The first R&D flight production cost for the structural components of the single stage vehicle are displayed in Figure 5.1.1.0-1. The cost details of the structural components are contained in appropriate subparagraphs, as indicated.

Table 5.1.1.0-I is a total cost summary of these structures.

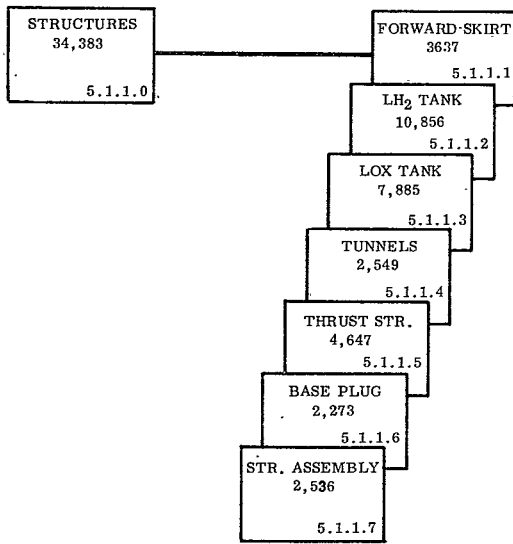


FIGURE 5.1.1.0-1 SINGLE STAGE STRUCTURES COST FLOW DIAGRAM

TABLE 5.1.1.0-I

AMLLV COST SUMMARY-TOTAL STRUCTURE - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	26	299								26	299
PROGRAM PLAN. & REPT.	64	748								64	748
INDUSTRIAL RELATIONS	13	134								13	134
ENGINEERING			209	2,460			30	372		239	2,832
LAB TECHNICIANS			42	406						42	406
TOOLING			75	723						75	723
PRODUCTION			1,273	12,382						1,273	12,382
MANUFACTURING TEST			59	576						59	576
MANUFACTURING TECH.			31	379						31	379
Q & R A			361	3,506						361	3,506
FACILITIES					28	284				28	284
DIRECT DIST			357	3,473						357	3,473
TRAINING			20	188						20	188
TOTAL DIRECT LABOR	103	1,181	2,427	24,093	28	284	30	372		2,588	25,930
MATERIAL		3		5,313							5,316
LOGISTIC HARDWARE								1,005			1,005
BURDEN				1,806				326			2,132
TOTAL MATERIAL		3		7,119				1,331			8,453
TOTAL OTHER											
TOTAL COST		1,184		31,212		284		1,703			34,383

5.1.1.1 Forward Skirt - Standard (Light Weight)

TABLE 5.1.1.1-I
 AMLLV COST SUMMARY

FORWARD SKIRT - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	3	37								3	37
PROGRAM PLAN. & REPT.	8	92								8	92
INDUSTRIAL RELATIONS	2	17								2	17
ENGINEERING			1	17				3		1	20
LAB TECHNICIANS			1	4						1	4
TOOLING			11	107						11	107
PRODUCTION			180	1,748						180	1,748
MANUFACTURING TEST			8	81						8	81
MANUFACTURING TECH.			5	53						5	53
Q & R A			51	491						51	491
FACILITIES					4	40				4	40
DIRECT DIST			50	490						50	490
TRAINING			3	27						3	27
TOTAL DIRECT LABOR	13	146	310	3,018	4	40		3		327	3,207
MATERIAL				306							306
LOGISTIC HARDWARE								15			15
BURDEN				104				5			109
TOTAL MATERIAL				410				20			430
TOTAL OTHER											
TOTAL COST		146		3,428		40		23			3,637

AMLLV

PART I

FORWARD SKIRT - S/S
ASSEMBLY OR SYSTEM
 TABLE 5.1.1.1-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	1,738		
Logistics	262		
Laboratory Technician	348		
Production	179,813		
Tooling	11,045		
Manufacturing Test	8,369		
Q&RA	50,543		
Facilities	4,142		
Manufacturing Technician	<u>4,515</u>		
Total Direct Labor	<u>260,775</u>		
Program Executive		3,129	36,957
Program Planning & Reporting		7,823	92,392
Industrial Relations		<u>1,695</u>	<u>16,475</u>
Total Labor - Part I		<u>12,647</u>	<u>145,824</u>
<u>Material</u>			
Program Planning & Reporting			156
Industrial Relations			170
Material Subtotal			<u>326</u>
Material & Administrative Burden			<u>111</u>
Total Material			<u>437</u>
TOTAL COST - PART I			<u>146,261</u>

TABLE 5.1.1.1-III

AMLV PART II COST SUMMARY FORWARD SKIRT - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	2	17							2	17
LAB TECHNICIANS		3								3
TOOLING					11	107			11	107
PRODUCTION			180	1,748					180	1,748
MANUFACTURING TEST							9	81	9	81
MANUFACTURING TECH.			4	51				3	4	54
Q & R A		1	45	440	3	29	2	22	50	492
DIRECT DIST			44	429	4	34	3	26	51	489
TRAINING			3	24		2		1	3	27
TOTAL DIRECT LABOR	2	21	276	2,692	18	172	14	133	310	3,018
MATERIAL										
LAB. TECHNICIANS		1								1
TOOLING						19				19
PRODUCTION				263						263
MFG. TECHNICIANS				7						7
Q & R A				14		1		1		16
SUBTOTAL		1		284		20		1		306
MAT. & ADM. BURDEN				97		7				104
TOTAL MATERIAL		1		381		27		1		410
TOTAL PART II COST		22		3,072		199		134		3,428

AMLLV
PART II
ENGINEERING

FORWARD SKIRT - S/S

ASSEMBLY OR SYSTEM
TABLE 5.1.1.1-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Design Development	1,702	\$16,543
Reliability Engineering	<u>36</u>	<u>350</u>
Subtotal	1,738	\$16,893
Laboratory Technicians	<u>348</u>	<u>3,383</u>
Subtotal	2,086	\$20,276
Q&A	<u>70</u>	<u>680</u>
Total Engineering Labor	<u><u>2,156</u></u>	<u><u>\$20,956</u></u>
Material		
Lab. Tech.		<u>\$ 731</u>
Q&A		<u>21</u>
Subtotal		\$ 752
Material & Adm. Burden		<u>256</u>
Total Material		<u>\$ 1,008</u>
Total Engineering Cost		<u><u>\$21,964</u></u>

AMLLV
PART II
MANUFACTURING
PRODUCTION

FORWARD SKIRT - S/S

ASSEMBLY OR SYSTEM
1ST UNIT COST
TABLE 5.1.1.1-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	126,779	\$1,232,292
(2) Miscellaneous Charges	9,889	96,121
(3) Maintain & Add in Scope Changes	1,395	13,559
Subtotal (A)	<u>138,063</u>	<u>1,341,972</u>
(4) Tool & Production Planning	41,750	405,810
Subtotal (B)	179,813	1,747,782
(5) Direct Distributable	44,180	429,430
Subtotal (C)	223,993	2,177,212
(6) Training	2,464	23,950
Subtotal (D)	226,457	2,201,162
(7) Q&RA	45,291	440,229
(8) Mfg. Tech.	4,303	50,818
Total Production Labor	<u>276,051</u>	<u>2,692,209</u>
 <u>Material</u>		
(9) Raw Material & Standards		262,977
(10) Q&RA		13,587
(11) Mfg. Tech.		7,530
Material Subtotal		<u>284,094</u>
(12) Material & Adm. Burden		96,592
Total Material		<u>380,686</u>
Total Production Cost		<u>\$3,072,895</u>

AMLLV
PART II
MANUFACTURING
TOOLING

FORWARD SKIRT - S/S
ASSEMBLY OR SYSTEM
1ST UNIT COST
TABLE 5.1.1.1-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	11,045	\$107,357
(2) Direct Distributabel	3,534	34,351
Subtotal (A)	14,579	141,708
(3) Training	160	1,555
Subtotal (B)	14,739	143,263
(4) Q&RA	2,948	28,655
Total Tooling Labor	17,687	171,918
 <u>Material</u>		
(5) Tooling		19,329
(6) Q&RA		884
Subtotal (C)		20,213
(7) Material & Adm. Burden		6,872
Total Material		27,085
Total Tooling Cost		\$199,003

AMLLV
 MANUFACTURING TEST
 FORWARD SKIRT - S/S
 TABLE 5.1.1.1-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	6,340	61,625
Component Test Planning	<u>2,029</u>	<u>19,720</u>
Subtotal	8,369	81,345
Direct Distributable	<u>2,678</u>	<u>26,030</u>
Subtotal	11,047	107,375
Training	<u>122</u>	<u>1,181</u>
Subtotal	11,169	108,556
Mfg. Tech.	<u>212</u>	<u>2,505</u>
Subtotal	11,380	111,061
Q&RA	<u>2,234</u>	<u>21,711</u>
Total Mfg. Test Labor	<u>13,614</u>	<u>132,772</u>
Material		
Q&RA		670
Mfg. Tech.		<u>371</u>
Subtotal		1,041
Material & Adm. Burden		<u>354</u>
Total Material		<u>1,395</u>
Total Mfg. Test Cost.		<u>134,167</u>

AMLLV
 PART III
 FACILITY LABOR
 AMLLV
FORWARD SKIRT - S/S
 ASSEMBLY OR SYSTEM
 1ST UNIT COST
 TABLE 5.1.1.1-VIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	4,142	\$ 40,260
TOTAL FACILITY LABOR COST		\$ <u>40,260</u>

AMLLV
PART IV
LOGISTIC LABOR

FORWARD SKIRT - S/S

ASSEMBLY OR SYSTEM

TABLE 5.1.1.1-IX

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Engineering	<u>262</u>	<u>\$ 3,094</u>
(2) Hardware		14,672
(3) Material & Adm. Burden		<u>4,988</u>
Total Material		<u>\$19,660</u>
Total Logistic Cost		<u>\$22,754</u>

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5.1.1.2

LH₂ Tank

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LH₂ TANK

TABLE 5.1.1.2-I

AMLLV COST SUMMARY

LH₂ - SINGLE STAGEA B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	7	79								7	79
PROGRAM PLAN. & REPT.	17	198								17	198
INDUSTRIAL RELATIONS	3	35								3	35
ENGINEERING			22	257			3	39		25	296
LAB TECHNICIANS			4	42						4	42
TOOLING			23	219						23	219
PRODUCTION			367	3,572						367	3,572
MANUFACTURING TEST			17	166						17	166
MANUFACTURING TECH.			9	109						9	109
Q & RA			104	1,011						104	1,011
FACILITIES					8	82				8	82
DIRECT DIST			103	1,001						103	1,001
TRAINING			6	55						6	55
TOTAL DIRECT LABOR	27	312	655	6,432	8	82	3	39		693	6,865
MATERIAL		1		2,806							2,807
LOGISTIC HARDWARE								183			183
BURDEN				954				47			1,001
TOTAL MATERIAL		1		3,760				230			3,991
TOTAL OTHER											
TOTAL COST		313		10,192		82		269			10,856

660

AMLLV

PART I
LH₂ TANK - S/S

ASSEMBLY OR SYSTEM

TABLE 5.1.1.2-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	21,725		
Logistics	3,275		
Laboratory Technician	4,345		
Production	367,442		
Tooling	22,570		
Manufacturing Test	17,009		
Q&RA	104,009		
Facilities	8,463		
Manufacturing Technician	<u>9,226</u>		
Total Direct Labor	<u>558,154</u>		
Program Executive		6,698	79,101
Program Planning & Reporting		16,745	197,754
Industrial Relations		<u>3,628</u>	<u>35,264</u>
Total Labor - Part		<u>27,071</u>	<u>312,119</u>
<u>Material</u>			
Program Planning & Reporting			335
Industrial Relations			<u>363</u>
Material Subtotal			698
Material & Administrative Burden			<u>237</u>
Total Material			<u>935</u>
TOTAL COST - PART I			<u>313,054</u>

TABLE 5.1.1.2-III

AMLLV PART II COST SUMMARY

LH₂ TANK - SINGLE STAGEA B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	22	227							22	257
LAB TECHNICIANS	4	42							4	42
TOOLING					23	219			23	219
PRODUCTION			367	3,572					367	3,572
MANUFACTURING TEST							17	166	17	166
MANUFACTURING TECH.			9	104				5	9	109
Q & R A	1	8	93	900	6	59	5	44	105	1,011
DIRECT DIST			90	877	7	70	6	53	103	1,000
TRAINING			5	49		3		3	5	55
TOTAL DIRECT LABOR	27	307	564	5,502	36	351	28	271	655	6,431
MATERIAL										
LAB. TECHNICIANS		9								9
TOOLING						40				40
PRODUCTION				2,710						2,710
MFG. TECHNICIANS				15				1		15
Q & R A		1		28		2		1		32
SUBTOTAL		10		2,753		42		2		2,807
MAT. & ADM. BURDEN		3		936		14		1		954
TOTAL MATERIAL		13		3,689		56		3		3,761
TOTAL PART II COST		320		9,191		407		274		10,192

AMLLV
PART II
ENGINEERING

LH₂ TANK - S/S
ASSEMBLY OR SYSTEM
TABLE 5.1.1.2-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Design Development	21,275	\$251,258
Reliability Engineering	<u>450</u>	<u>5,314</u>
(1) Subtotal (A)	21,725	\$256,572
(2) Laboratory Technicians	<u>4,345</u>	<u>42,233</u>
Subtotal (B)	26,070	\$298,805
(3) Q&RA	<u>869</u>	<u>8,447</u>
Total Engineering Labor	<u>26,939</u>	<u>\$307,252</u>
Material		
(4) Lab. Tech.		\$ 9,125
(5) Q&RA		<u>261</u>
Subtotal (C)		\$ 9,386
(6) Material & Adm. Burden		<u>3,191</u>
Total Material		<u>\$ 12,577</u>
Total Engineering Cost		<u>\$319,829</u>

AMLLV
PART II
MANUFACTURING
PRODUCTION

LH₂ TANK - S/S

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.1.1.2-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	259,070	\$2,518,160
(2) Miscellaneous Charges	20,207	196,412
(3) Maintain & Add in Scope Changes	<u>2,850</u>	<u>27,702</u>
Subtotal (A)	282,127	\$2,742,274
(4) Tool & Production Planning	<u>85,315</u>	<u>829,262</u>
Subtotal (B)	367,442	\$3,571,536
(5) Direct Distributable	<u>90,281</u>	<u>877,532</u>
Subtotal (C)	457,723	\$4,449,068
(6) Training	<u>5,035</u>	<u>48,940</u>
Subtotal (D)	462,758	\$4,498,008
(7) Q&RA	92,552	899,605
(8) Mfg. Tech.	<u>8,792</u>	<u>103,833</u>
Total Production Labor	<u>564,102</u>	<u>\$5,501,446</u>
 Material		
(9) Raw Material & Standards		\$2,710,109
(10) Q&RA		27,766
(11) Mfg. Tech.		<u>15,386</u>
Material Subtotal		\$2,753,261
(12) Material & Adm. Burden		<u>936,109</u>
Total Material		\$3,689,370
Total Production Cost		<u>\$9,190,816</u>

AMLLV
 PART II
 MANUFACTURING
 TOOLING

LH₂ TANK - S/S
 ASSEMBLY OR SYSTEM
 1ST UNIT COST
 TABLE 5.1.1.2-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	22,570	\$219,380
(2) Direct Distributable	<u>7,222</u>	<u>70,198</u>
Subtotal (A)	29,792	\$289,578
(3) Training	<u>328</u>	<u>3,188</u>
Subtotal (B)	30,120	\$292,766
(4) Q&RA	<u>6,024</u>	<u>58,554</u>
Total Tooling Labor	<u>36,144</u>	<u>\$351,320</u>
 Material		
(5) Tooling		\$ 39,498
(6) Q&RA		<u>1,807</u>
Subtotal (C)		\$ 41,305
(7) Material & Adm. Burden		<u>14,044</u>
Total Material		<u>\$ 55,349</u>
Total Tooling Cost		<u>\$406,669</u>

AMLLV

MANUFACTURING TEST

LH₂ TANK - S/S

TABLE 5.1.1.2-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	12,954	125,913
Component Test Planning	<u>4,145</u>	<u>40,291</u>
Subtotal	17,099	166,204
Direct Distributable	<u>5,472</u>	<u>53,185</u>
Subtotal	22,571	219,389
Training	<u>248</u>	<u>2,413</u>
Subtotal	22,819	221,802
Mfg. Tech.	<u>434</u>	<u>5,120</u>
Subtotal	23,253	226,922
Q&RA	<u>4,564</u>	<u>44,360</u>
Total Mfg. Test Labor	<u>27,817</u>	<u>271,282</u>
Material		
Q&RA		1,369
Mfg. Tech.		<u>759</u>
Subtotal		2,128
Material & Adm. Burden		<u>723</u>
Total Material		<u>2,851</u>
Total Mfg. Test Cost		<u>274,133</u>

AMLLV
 PART III .
 FACILITY LABOR
 AMLLV
LH₂ TANK - S/S

ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 5.1.1.2-VIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	<u>8,463</u>	<u>\$82,260</u>
TOTAL FACILITY LABOR COST		<u><u>\$82,260</u></u>

PART IV
 LOGISTIC LABOR
 AMLLV
LH₂ TANK - S/S
 ASSEMBLY OR SYSTEM
 TABLE 5.1.1.2-IX

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Engineering	<u>3,275</u>	<u>\$ 38,678</u>
(2) Hardware		183,400
(3) Material & Adm. Burden		<u>47,056</u>
Total Material		<u>\$230,456</u>
Total Logistic Cost		<u>\$269,134</u>

5.1.1.3

LOX Tank

TABLE 5.1.1.3-1
 AMLLV COST SUMMARY

LOX TANK - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	6	69								6	69
PROGRAM PLAN. & REPT.	15	172								15	172
INDUSTRIAL RELATIONS	3	31								3	31
ENGINEERING			39	462			6	70		45	532
LAB TECHNICIANS			8	76						8	76
TOOLING			19	181						19	181
PRODUCTION			303	2,949						303	2,949
MANUFACTURING TEST			14	137						14	137
MANUFACTURING TECH.			8	90						8	90
Q & R A			82	802						82	802
FACILITIES					7	68				7	68
DIRECT DIST			86	836						86	836
TRAINING			5	45						5	45
TOTAL DIRECT LABOR	24	272	564	5,578	7	68	6	70		601	5,988
MATERIAL		1		1,085							1,086
LOGISTIC HARDWARE							330				330
BURDEN				369			112				481
TOTAL MATERIAL		1		1,454			442				1,897
TOTAL OTHER											
TOTAL COST		273		7,032		68	512				7,885

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AMLLV

PART I

LOX TANK - S/S
ASSEMBLY OR SYSTEM

TABLE 5.1.1.3-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	39,105		
Logistics	5,895		
Laboratory Technician	7,821		
Production	303,381		
Tooling	18,635		
Manufacturing Test	14,177		
Q&RA	82,447		
Facilities	6,988		
Manufacturing Technician	7,637		
Total Direct Labor	<u>486,086</u>		
Program Executive		5,833	68,888
Program Planning & Reporting		14,583	172,219
Industrial Relations		<u>3,160</u>	<u>30,710</u>
Total Labor - Part I		<u>23,576</u>	<u>271,817</u>
<u>Material</u>			
Program Planning & Reporting			292
Industrial Relations			<u>316</u>
Material Subtotal			608
Material & Administrative Burden			<u>207</u>
Total Material			<u>815</u>
TOTAL COST - PART I			<u>272,632</u>

TABLE 5.1.1.3-III

AMLLV PART II COST SUMMARY - LOX TANK - SINGLE STAGE

 B C X

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	39	462							39	462
LAB TECHNICIANS	8	76							8	76
TOOLING					19	181			19	181
PRODUCTION			303	2,949					303	2,949
MANUFACTURING TEST							14	137	14	137
MANUFACTURING TECH.			7	86				4	7	90
Q & R A	1	15	77	745		5	4	37	82	802
DIRECT DIST			76	734	6	58	5	44	87	836
TRAINING			4	40		2		2	4	44
TOTAL DIRECT LABOR	48	553	467	4,554	25	246	23	224	563	5,577
MATERIAL										
LAB. TECHNICIANS		17								17
TOOLING						33				33
PRODUCTION				998						998
MFG. TECHNICIANS				13				1		14
Q & R A		1		23				1		25
SUBTOTAL		18		1,034		33		2		1,087
MAT. & ADM. BURDEN		5		352		11				368
TOTAL MATERIAL		23		1,386		44		2		1,455
TOTAL PART II COST		576		5,940		290		226		7,032

AMLLV
PART II
ENGINEERING

LOX TANK - S/S
ASSEMBLY OR SYSTEM
TABLE 5.1.1.3-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Design Development	38,295	\$452,264
Reliability Engineering	810	9,566
(1) Subtotal (A)	39,105	461,830
(2) Laboratory Technicians	7,821	76,020
Subtotal (B)	46,926	537,850
(3) Q&RA	1,564	15,201
Total Engineering Labor	48,490	553,051
Material		
(4) Lab. Tech.		16,424
(5) Q&RA		469
Subtotal (C)		16,893
(6) Material & Adm. Burden		5,744
Total Material		22,637
Total Engineering Cost		\$ 575,688

AMLLV
PART II
MANUFACTURING
PRODUCTION

LOX TANK - S/S

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.1.1.3-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	213,903	\$ 2,079,137
(2) Miscellaneous Charges	16,684	162,168
(3) Maintain & Add in Scope Changes	2,353	22,872
Subtotal (A)	<u>232,940</u>	<u>2,264,177</u>
(4) Tool & Production Planning	70,441	684,686
Subtotal (B)	<u>303,381</u>	<u>2,948,863</u>
(5) Direct Distributable	75,541	734,259
Subtotal (C)	<u>378,922</u>	<u>3,683,122</u>
(6) Training	4,168	40,513
Subtotal (D)	<u>383,090</u>	<u>3,723,635</u>
(7) Q&RA	76,618	744,727
(8) Mfg. Tech.	7,279	85,965
Total Production Labor	<u><u>466,987</u></u>	<u><u>4,554,327</u></u>
 Material		
(9) Raw Material & Standards		998,363
(10) Q&RA		22,985
(11) Mfg. Tech.		12,738
Material Subtotal		<u>1,034,086</u>
(12) Material & Adm. Burden		351,589
Total Material		<u><u>1,385,675</u></u>
Total Production Cost		<u><u>5,940,002</u></u>

AMLLV
PART II
MANUFACTURING
TOOLING

LOX TANK - S/S

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.1.1.3-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	18,635	181,132
(2) Direct Distributabel	5,963	57,961
Subtotal (A)	24,598	239,093
(3) Training	271	2,634
Subtotal (B)	24,869	241,727
(4) Q&RA	497	4,831
Total Tooling Labor	<u>25,366</u>	<u>246,558</u>
Material		
(5) Tooling		32,611
(6) Q&RA		149
Subtotal (C)		32,760
(7) Material & Adm. Burden		11,138
Total Material		<u>43,898</u>
Total Tooling Cost		<u>290,456</u>

AMLLV

MANUFACTURING TEST
LOX TANK - S/S

TABLE 5.1.1.3-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	10,695	\$103,955
Component Test Planning	<u>3,422</u>	<u>33,267</u>
Subtotal	14,117	137,222
Direct Distributable	<u>4,518</u>	<u>43,910</u>
Subtotal	18,635	181,132
Training	<u>205</u>	<u>1,992</u>
Subtotal	18,840	183,124
Mfg. Tech.	<u>358</u>	<u>4,227</u>
Subtotal	19,198	187,351
Q&RA	<u>3,768</u>	<u>36,624</u>
Total Mfg. Test Labor	<u>22,966</u>	<u>223,975</u>
Material		
Q&RA		1,130
Mfg. Tech.		<u>626</u>
Subtotal		1,756
Material & Adm. Burden		<u>597</u>
Total Material		<u>2,353</u>
Total Mfg. Test Cost		<u>\$226,328</u>

PART III
FACILITY LABOR

AMLLV
LOX TANK - S/S

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.1.1.3-VIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	<u>6,988</u>	<u>\$67,923</u>
TOTAL FACILITY LABOR COST		<u><u>\$67,923</u></u>

PART IV
 LOGISTIC LABOR
 AMLLV
LOX TANK - S/S
 ASSEMBLY OR SYSTEM
 TABLE 5.1.1.3-IX

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Engineering	<u>5,895</u>	<u>\$ 69,620</u>
(2) Hardware		330,120
(3) Material & Adm. Burden		<u>112,241</u>
Total Material		<u>\$442,361</u>
Total Logistic Cost		<u>\$511,981</u>

5.1.1.4 Tunnels

TABLE 5.1.1.4-I
A MLLV COST SUMMARY

TUNNELS - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	2	20								2	20
PROGRAM PLAN. & REPT.	4	50								4	50
INDUSTRIAL RELATIONS	1	9								1	9
ENGINEERING			16	185			2	28		18	213
LAB TECHNICIANS			3	30						3	30
TOOLING			5	50						5	50
PRODUCTION			83	809						83	809
MANUFACTURING TEST			4	37						4	37
MANUFACTURING TECH. Q & R A			2	25						2	25
FACILITIES			24	233	2	19				24	233
DIRECT DIST TRAINING			24	227						24	227
TOTAL DIRECT LABOR	7	79	162	1,608	2	19	2	28		173	1,734
MATERIAL				476							476
LOGISTIC HARDWARE BURDEN				162				132			132
TOTAL MATERIAL				638				177			815
TOTAL OTHER											
TOTAL COST		79		2,246		19		205			2,549

A MLLV

PART I

TUNNELS- S/S
ASSEMBLY OR SYSTEM

TABLE 5.1.1.4-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	15,642		
Logistics	2,358		
Laboratory Technician	3,128		
Production	83,221		
Tooling	5,112		
Manufacturing Test	3,873		
Q&RA	23,986		
Facilities	1,917		
Manufacturing Technician	<u>2,089</u>		
Total Direct Labor	<u>141,326</u>		
Program Executive		1,696	20,029
Program Planning & Reporting		4,240	50,071
Industrial Relations		<u>919</u>	<u>8,929</u>
Total Labor - Part I		<u>6,855</u>	<u>79,029</u>
<u>Material</u>			
Program Planning & Reporting			85
Industrial Relations			<u>92</u>
Material Subtotal			177
Material & Administrative Burden			<u>60</u>
Total Material			<u>237</u>
TOTAL COST - PART I			<u>79,266</u>

TABLE 5.1.1.4-III

AMLV PART II COST SUMMARY TUNNELS - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	16	185							16	185
LAB TECHNICIANS	3	30							3	30
TOOLING					5	50			5	50
PRODUCTION			83	809					83	809
MANUFACTURING TEST							4	38	4	38
MANUFACTURING TECH.			2	24				1	2	25
Q & R A		6	21	204	1	13	1	10	23	233
DIRECT DIST			21	199	2	16	1	12	24	227
TRAINING			1	11		1			1	12
TOTAL DIRECT LABOR	19	221	128	1,246	8	80	6	61	161	1,608
MATERIAL										
LAB. TECHNICIANS		7								7
TOOLING						9				9
PRODUCTION				450						450
MFG. TECHNICIANS				4						4
Q & R A				6				1		7
SUBTOTAL		7		460		9		1		477
MAT. & ADM. EXPEN		2		156		3				161
TOTAL MATERIAL		9		616		12		1		638
TOTAL PART II COST		230		1,862		92		62		2,246

AMLLV
PART II
ENGINEERING
TUNNELS - S/S

ASSEMBLY OR SYSTEM
TABLE 5.1.1.4-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Design Development	15,318	180,906
Reliability Engineering	324	3,826
(1) Subtotal (A)	<u>15,642</u>	<u>184,732</u>
(2) Laboratory Technicians	3,128	30,404
Subtotal (B)	<u>18,770</u>	<u>215,136</u>
(3) Q&RA	<u>626</u>	<u>6,085</u>
Total Engineering Labor	<u><u>19,396</u></u>	<u><u>221,221</u></u>
Material		
(4) Lab. Tech.		6,569
(5) Q&RA		188
Subtotal (C)		<u>6,757</u>
(6) Material & Adm. Burden		<u>2,297</u>
Total Material		<u><u>9,054</u></u>
Total Engineering Cost		<u><u>\$ 230,275</u></u>

AMLLV
 PART II
 MANUFACTURING
 PRODUCTION
 TUNNELS - S/S.

ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 5.1.1.4-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	58,676	570,331
(2) Miscellaneous Charges	4,577	44,489
(3) Maintain & Add in Scope Changes	645	6,269
Subtotal (A)	63,898	621,089
(4) Tool & Production Planning	19,323	187,820
Subtotal (B)	83,221	808,909
(5) Direct Distributable	20,447	198,745
Subtotal (C)	103,668	1,007,654
(6) Training	1,140	11,081
Subtotal (D)	104,808	1,018,735
(7) Q&RA	20,962	203,751
(8) Mfg. Tech.	1,991	23,514
Total Production Labor	127,761	1,246,000
Material		
(9) Raw Material & Standards		449,952
(10) Q&RA		6,289
(11) Mfg. Tech.		3,484
Material Subtotal		459,725
(12) Material & Adm. Burden		156,307
Total Material		616,032
Total Production Cost		\$1,862,032

AMLLV
PART II
MANUFACTURING
TOOLING

TUNNELS - S/S

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.1.1.4-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	5,112	49,689
(2) Direct Distributabel	<u>1,636</u>	<u>15,902</u>
Subtotal (A)	6,748	65,591
(3) Training	<u>74</u>	<u>719</u>
Subtotal (B)	6,822	66,310
(4) Q&RA	<u>1,364</u>	<u>13,258</u>
Total Tooling Labor	<u>8,186</u>	<u>79,568</u>
Material		
(5) Tooling		8,946
(6) Q&RA		<u>409</u>
Subtotal (C)		9,355
(7) Material & Adm. Burden		<u>3,181</u>
Total Material		<u>12,536</u>
Total Tooling Cost		<u>92,104</u>

AMLLV
 MANUFACTURING TEST
TUNNELS - S/S

TABLE 5.1.1.4-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	2,934	\$28,518
Component Test Planning	939	9,125
Subtotal	<u>3,873</u>	<u>37,643</u>
Direct Distributable	1,239	12,045
Subtotal	5,112	49,688
Training	56	546
Subtotal	<u>5,168</u>	<u>50,234</u>
Mfg. Tech.	98	1,159
Subtotal	5,266	51,393
Q&RA	1,034	10,047
Total Mfg. Test Labor	<u>6,300</u>	<u>\$61,440</u>
 Material		
Q&RA		310
Mfg. Tech.		172
Subtotal		482
Material & Adm. Burden		164
Total Material		<u>646</u>
Total Mfg. Test Cost		<u>\$62,086</u>

AMLLV
 PART III
 FACILITY LABOR
 AMLLV
 TUNNELS - S/S

ASSEMBLY OR SYSTEM
 1ST UNIT COST
 TABLE 5.1.1.4-VIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	<u>1,917</u>	\$18,633
TOTAL FACILITY LABOR COST		<u>\$18,633</u>

PART IV
 LOGISTIC LABOR
 AMLLV
 TUNNELS - S/S

ASSEMBLY OR SYSTEM
 TABLE 5.1.1.4-IX

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Engineering	<u>2,358</u>	\$ <u>27,848</u>
(2) Hardware		132,048
(3) Material & Adm. Burden		44,896
Total Material		<u>176,944</u>
Total Logistic Cost		<u>\$204,792</u>

5.1.1.5 Thrust Structure

TABLE 5.1.1.5-I
 AMLLV COST SUMMARY

THRUST STRUCTURE - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	4	47								414	47
PROGRAM PLAN. & REPT.	10	119								10	119
INDUSTRIAL RELATIONS	2	21								2	21
ENGINEERING			15	174			2	26		17	200
LAB TECHNICIANS			3	29						3	29
TOOLING			13	128						13	128
PRODUCTION			219	2,127						219	2,127
MANUFACTURING TEST			10	99						10	99
MANUFACTURING TECH.			5	65						5	65
Q & R A			62	602						62	602
FACILITIES					5	45				5	45
DIRECT DIST			61	595						61	595
TRAINING			3	32						3	32
TOTAL DIRECT LABOR	16	187	391	3,851	5	45	2	26		414	4,109
MATERIAL		1		276							277
LOGISTIC HARDWARE								125			125
BURDEN				94				42			136
TOTAL MATERIAL		1		370				167			538
TOTAL OTHER											
TOTAL COST		188		4,221		45		193			4,647

AMLLV

PART I

THRUST STRUCTURE - S/S
ASSEMBLY OR SYSTEM
 TABLE 5.1.1.5-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	14,773		
Logistics	2,227		
Laboratory Technician	2,955		
Production	218,791		
Tooling	13,144		
Manufacturing Test	10,185		
Q&RA	61,938		
Facilities	4,630		
Manufacturing Technician	<u>5,494</u>		
Total Direct Labor	<u>334,137</u>		
Program Executive		4,010.	47,353
Program Planning & Reporting		10,024	118,385
Industrial Relations		<u>2,172</u>	<u>21,110</u>
Total Labor - Part		<u>16,206</u>	<u>186,848</u>
<u>Material</u>			
Program Planning & Reporting			200
Industrial Relations			<u>217</u>
Material Subtotal			417
Material & Administrative Burden			<u>142</u>
Total Material			<u>559</u>
TOTAL COST - PART I			<u>187,407</u>

TABLE 5:1.1.5-III

AMLLV PART II COST SUMMARY THRUST STRUCTURE - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	15	174							15	174
LAB TECHNICIANS	3	29							3	29
TOOLING					13	128			13	128
PRODUCTION			219	2,126					219	2,126
MANUFACTURING TEST							10	99	10	99
MANUFACTURING TECH.			5	62			1	3	6	65
Q & R A		6	55	536	4	34	3	26	62	602
DIRECT DIST			54	523	4	41	3	32	61	596
TRAINING			3	29		2		2	3	33
TOTAL DIRECT LAECR	18	209	336	3,276	21	205	17	162	392	3,852
MATERIAL										
LAB. TECHNICIANS		6								6
TOOLING						23				23
PRODUCTION				219						219
MFG. TECHNICIANS				9						9
Q & R A				17		1		1		19
SUBTOTAL		6		245		24		1		276
MAT. & ADM. BURDEN		2		83		8				93
TOTAL MATERIAL		8		328		32		1		369
TOTAL PART II COST		217		3,604		237		163		4,221

PART II
ENGINEERING
AMLLV
THRUST STRUCTURE - S/S
ASSEMBLY OR SYSTEM
TABLE 5.1.1.5-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Design Development	14,467	\$ 170,855
Reliability Engineering	306	3,614
(1) Subtotal (A)	14,773	174,469
(2) Laboratory Technicians	2,955	28,723
Subtotal (B)	17,728	203,192
(3) Q&RA	<u>599</u>	<u>5,822</u>
Total Engineering Labor	<u>18,327</u>	<u>\$209,014</u>
Material		
(4) Lab. Tech.		\$ 6,206
(5) Q&RA		<u>180</u>
Subtotal (C)		6,386
(6) Material & Adm. Burden		\$ 2,171
Total Material		<u>8,557</u>
Total Engineering Cost		<u>\$ 217,571</u>

PART II
 MANUFACTURING
 PRODUCTION
 AMLLV
THRUST STRUCTURE - S/S

ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 5.1.1.5-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	154,320	\$1,499,990
(2) Miscellaneous Charges	12,037	117,000
(3) Maintain & Add in Scope Changes	<u>1,698</u>	<u>16,505</u>
Subtotal (A)	168,055	\$1,633,495
(4) Tool & Production Planning	<u>50,736</u>	<u>493,154</u>
Subtotal (B)	218,791	2,126,649
(5) Direct Distributable	<u>53,778</u>	<u>522,722</u>
Subtotal (C)	272,569	2,649,371
(6) Training	<u>2,998</u>	<u>29,141</u>
Subtotal (D)	275,567	2,678,512
(7) Q&RA	55,113	535,698
(8) Mfg. Tech.	<u>5,236</u>	<u>61,837</u>
Total Production Labor	<u>335,916</u>	<u>\$3,276,047</u>
 Material		
(9) Raw Material & Standards		\$ 218,765
(10) Q&RA		16,534
(11) Mfg. Tech.		<u>9,163</u>
Material Subtotal		244,462
(12) Material & Adm. Burden		<u>83,117</u>
Total Material		327,579
Total Production Cost		<u>\$3,603,626</u>

PART II
 MANUFACTURING
 TOOLING

AMLLV
THRUST STRUCTURE - S/S

ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 5.1.1.5-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	13,144	\$ 127,760
(2) Direct Distributable	<u>4,206</u>	<u>40,882</u>
Subtotal (A)	17,350	168,642
(3) Training	<u>191</u>	<u>1,857</u>
Subtotal (B)	17,541	170,499
(4) Q&RA	<u>3,508</u>	<u>34,097</u>
Total Tooling Labor	<u>21,049</u>	<u>\$ 204,596</u>
 Material		
(5) Tooling		\$ 23,002
(6) Q&RA		<u>1,052</u>
Subtotal (C)		24,054
(7) Material & Adm. Burden		<u>8,178</u>
Total Material		<u>32,232</u>
Total Tooling Cost		<u>\$ 236,828</u>

AMLLV

MANUFACTURING TEST
THRUST STRUCTURE - S/S

TABLE 5.1.1.5-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	7,716	\$ 75,000
Component Test Planning	<u>2,469</u>	<u>24,000</u>
Subtotal	10,185	99,000
Direct Distributable	<u>3,259</u>	<u>31,679</u>
Subtotal	13,444	130,679
Training	<u>148</u>	<u>1,437</u>
Subtotal	13,592	132,116
Mfg. Tech.	<u>258</u>	<u>3,049</u>
Subtotal	13,850	135,165
Q&RA	<u>2,718</u>	<u>26,423</u>
Total Mfg. Test Labor	16,568	161,587
Material		
Q&RA		816
Mfg. Tech.		<u>452</u>
Subtotal		1,268
Material & Adm. Burden		<u>431</u>
Total Material		<u>1,699</u>
Total Mfg. Test Cost		<u><u>\$163,286</u></u>

PART III -
 FACILITY LABOR
 AMLLV
THRUST STRUCTURE - S/S
 ASSEMBLY OR SYSTEM
 1ST UNIT COST
 TABLE 5.1.1.5-VIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	<u>4,630</u>	\$ <u>45,004</u>
TOTAL FACILITY LABOR COST		\$ <u>45,004</u>

PART IV
 LOGISTIC LABOR
 AMLLV
THRUST STRUCTURE- S/S
 ASSEMBLY OR SYSTEM
 TABLE 5.1.1.5-IX

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Engineering	<u>2,227</u>	\$ <u>26,301</u>
(2) Hardware		124,712
(3) Material & Adm. Burden		<u>42,402</u>
Total Material		<u>167,114</u>
Total Logistic Cost		<u>\$ 193,415</u>

5.1.1.6 Base Plug

TABLE 5.1.1.6-I
 AMLLV COST SUMMARY

BASE PLUG - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
	PROGRAM EXECUTIVE	1	18								
PROGRAM PLAN. & REPT.	4	45								4	45
INDUSTRIAL RELATIONS	1	8								1	8
ENGINEERING			26	308			4	46		30	354
LAB TECHNICIANS			5	81						5	51
TOOLING			4	38						4	38
PRODUCTION			63	611						63	611
MANUFACTURING TEST			3	29						3	29
MANUFACTURING TECH.			1	19						1	19
Q & R A			19	182						19	182
FACILITIES					1	14				1	14
DIRECT DIST			18	174						18	174
TRAINING			1	9						1	9
TOTAL DIRECT LABOR	6	71	140	1,421	1	14	4	46		151	1,552
MATERIAL				318							318
LOGISTIC HARDWARE								220			220
BURDEN				108				75			183
TOTAL MATERIAL				426				295			721
TOTAL OTHER											
TOTAL COST		71		1,847		14		341			2,273

AMLLV

PART I
BASE PLUG - S/S

ASSEMBLY OR SYSTEM

TABLE 5.1.1.6-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	26,070		
Logistics	3,930		
Laboratory Technician	5,214		
Production	62,824		
Tooling	3,926		
Manufacturing Test	2,975		
Q&RA	18,764		
Facilities	1,472		
Manufacturing Technician	<u>1,583</u>		
Total Direct Labor	<u>126,758</u>		
Program Executive		1,521	17,963
Program Planning & Reporting		3,803	44,910
Industrial Relations		<u>824</u>	<u>8,008</u>
Total Labor - Part I		<u>6,148</u>	<u>70,881</u>
<u>Material</u>			
Program Planning & Reporting			76
Industrial Relations			<u>82</u>
Material Subtotal			158
Material & Administrative Burden			<u>54</u>
Total Material			<u>212</u>
TOTAL COST - PART I			<u>71,093</u>

TABLE 5.1.1.6-III

AMLLV PART II CCST SUMMARY - BASE PLUG - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	26	308							26	308
LAB TECHNICIANS	5	51							5	51
TOOLING					4	38			4	38
PRODUCTION			63	611					63	611
MANUFACTURING TEST							3	29	3	29
MANUFACTURING TECH.			1	18				1	1	19
Q & R A	1	10	16	154	1	10	1	8	19	182
DIRECT DIST			16	153	1	12	1	9	18	174
TRAINING			1	8		1			1	9
TOTAL DIRECT LABOR	32	369	97	944	6	61	5	47	140	1,421
MATERIAL										
LAB. TECHNICIANS		11								11
TOOLING						7				7
PRODUCTION				291						291
MFG. TECHNICIANS				3						3
Q & R A				5				1		6
SUBTOTAL		11		299		7		1		318
MAT. & ADM. BURDEN		4		101		3				108
TOTAL MATERIAL		15		400		10		1		426
TOTAL PART II COST		384		1,344		71		48		1,847

AMLLV
 PART II
 ENGINEERING
 BASE PLUG - S/S

ASSEMBLY OR SYSTEM
 TABLE 5.1.1.6-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Design Development	25,530	301,509
Reliability Engineering	<u>540</u>	<u>6,377</u>
(1) Subtotal (A)	26,070	307,886
(2) Laboratory Technicians	<u>.5,214</u>	<u>50,680</u>
Subtotal (B)	31,284	358,566
(3) Q&RA	<u>1,043</u>	<u>10,138</u>
Total Engineering Labor	<u><u>32,327</u></u>	<u><u>368,704</u></u>
Material		
(4) Lab. Tech.		10,949
(5) Q&RA		<u>313</u>
Subtotal (C)		11,262
(6) Material & Adm. Burden		<u>3,829</u>
Total Material		<u><u>15,091</u></u>
Total Engineering Cost		<u><u>383,795</u></u>

AMLLV
 PART II
 MANUFACTURING
 PRODUCTION

BASE PLUG - S/S

ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 5.1.1.6-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	45,070	\$ 438,080
(2) Miscellaneous Charges	3,515	34,166
(3) Maintain & Add in Scope Changes	<u>496</u>	<u>4,821</u>
Subtotal (A)	49,081	\$ 477,067
(4) Tool & Production Planning	<u>13,743</u>	<u>133,582</u>
Subtotal (B)	62,824	\$ 610,649
(5) Direct Distributable	<u>15,706</u>	<u>152,663</u>
Subtotal (C)	78,530	\$ 763,312
(6) Training	<u>864</u>	<u>8,398</u>
Subtotal (D)	79,394	\$ 771,710
(7) Q&RA	15,879	154,344
(8) Mfg. Tech.	<u>1,508</u>	<u>17,809</u>
Total Production Labor	<u>96,781</u>	<u>\$ 943,863</u>
 Material		
(9) Raw Material & Standards		\$ 291,447
(10) Q&RA		4,764
(11) Mfg. Tech.		<u>2,639</u>
Material Subtotal		\$ 298,850
(12) Material & Adm. Burden		<u>101,609</u>
Total Material		\$ 400,459
Total Production Cost		<u>\$1,344,322</u>

AMLLV
PART II
MANUFACTURING
TOOLING

BASE PLUG - S/S

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.1.1.6-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	3,926	\$38,161
(2) Direct Distributabel	<u>1,256</u>	<u>12,208</u>
Subtotal (A)	5,182	\$50,369
(3) Training	<u>57</u>	<u>554</u>
Subtotal (B)	5,239	\$50,923
(4) Q&RA	<u>1,048</u>	<u>10,187</u>
Total Tooling Labor	<u>6,287</u>	<u>\$61,110</u>
 <u>Material</u>		
(5) Tooling		\$ 6,871
(6) Q&RA		<u>314</u>
Subtotal (C)		\$ 7,185
(7) Material & Adm. Burden		<u>2,443</u>
Total Material		<u>\$ 9,628</u>
Total Tooling Cost		<u>\$70,738</u>

AMLLV
 MANUFACTURING TEST
 BASE PLUG - S/S

TABLE 5.1.1.6-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	2,254	\$21,909
Component Test Planning	<u>721</u>	<u>7,100</u>
Subtotal	2,975	28,919
Direct Distributable	<u>952</u>	<u>9,253</u>
Subtotal	3,927	38,172
Training	<u>43</u>	<u>419</u>
Subtotal	3,970	38,591
Mfg. Tech.	<u>75</u>	<u>890</u>
Subtotal	4,045	39,481
Q&RA	<u>794</u>	<u>7,718</u>
Total Mfg. Test Labor	<u>4,839</u>	<u>47,199</u>
Material		
Q&RA		238
Mfg. Tech.		<u>132</u>
Subtotal		370
Material & Adm. Burden		<u>126</u>
Total Material		<u>496</u>
Total Mfg. Test Cost		<u>\$47,695</u>

PART III ·
 FACILITY LABOR
 AMLLV
BASE PLUG - S/S

ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 5.1.1.6-VIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	<u>1,472</u>	\$ <u>14,308</u>
TOTAL FACILITY LABOR COST		<u>14,308</u>

PART IV
 LOGISTIC LABOR
 AMLLV
BASE PLUG - S/S
 ASSEMBLY OR SYSTEM

TABLE 5.1.1.6-IX

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Engineering	<u>3,930</u>	\$ <u>46,414</u>
(2) Hardware		220,080
(3) Material & Adm. Burden		<u>74,827</u>
Total Material		294,907
Total Logistic Cost		<u>\$341,321</u>

5.1.1.7 Final Assembly

TABLE 5.1.1.7-I

A MLLV COST SUMMARY - FINAL ASSEMBLY - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	3	29								3	29
PROGRAM PLAN. & REPT.	6	72								6	72
INDUSTRIAL RELATIONS	1	13								1	13
ENGINEERING			90	1,057			13	160		103	1,217
LAB TECHNICIANS			18	174						18	174
TOOLING											
PRODUCTION			58	566						58	566
MANUFACTURING TEST			3	27						3	27
MANUFACTURING TECH.			1	18						1	18
Q & RA			19	185						19	185
FACILITIES					1	16				1	16
DIRECT DIST			15	150						15	150
TRAINING			1	8						1	8
TOTAL DIRECT LABOR	10	114	205	2,185	1	16	13	160		229	2,475
MATERIAL				46							46
LOGISTIC HARDWARE											
BURDEN				15							15
TOTAL MATERIAL				61							61
TOTAL OTHER											
TOTAL COST		114		2,246		16		160			2,536

AMLLV

PART I

FINAL ASSEMBLY - S/S
ASSEMBLY OR SYSTEM

TABLE 5.1.1.7-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	89,507		
Logistics	13,493		
Laboratory Technician	17,901		
Production	58,243		
Tooling			
Manufacturing Test	2,757		
Q&RA	19,037		
Facilities	1,365		
Manufacturing Technician	<u>1,468</u>		
Total Direct Labor	<u>203,771</u>		
Program Executive		2,445	28,878
Program Planning & Reporting		6,113	72,196
Industrial Relations		<u>1,325</u>	<u>12,874</u>
Total Labor - Part I		<u>9,883</u>	<u>113,948</u>
<u>Material</u>			
Program Planning & Reporting			122
Industrial Relations			<u>132</u>
Material Subtotal			254
Material & Administrative Burden			<u>87</u>
Total Material			<u>341</u>
TOTAL COST - PART I			<u>114,289</u>

TABLE 5.1.1.7-III

AMLLV PART II COST SUMMARY FINAL ASSEMBLY - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	90	1,057							90	1,057
LAB TECHNICIANS	18	174							18	174
TOOLING										
PRODUCTION			58	566					58	566
MANUFACTURING TEST							3	27	3	27
MANUFACTURING TECH.			1	16				1	1	17
Q & R A	3	35	15	143				7	18	185
DIRECT DIST			15	142			1	9	16	151
TRAINING			1	8					1	8
TOTAL DIRECT LABOR	111	1,266	90	875			4	44	205	2,185
MATERIAL										
LAB. TECHNICIANS		35								38
TOOLING										
PRODUCTION										
MFG. TECHNICIANS				3						3
Q & R A		1		4						5
SUBTOTAL		39		7						46
MAT. & ADM. BURDEN		13		2						15
TOTAL MATERIAL		52		9						61
TOTAL PART II COST		1,318		884				44		2,246

AMLLV
PART II
ENGINEERING

FINAL ASSEMBLY - S/S
ASSEMBLY OR SYSTEM
TABLE 5.1.1.7-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Design Development	87,653	\$ 1,035,182
Reliability Engineering	<u>1,854</u>	<u>21,896</u>
(1) Subtotal (A)	89,507	1,057,078
(2) Laboratory Technicians	<u>17,901</u>	<u>173,998</u>
Subtotal (B)	107,408	1,231,076
(3) Q&RA	<u>3,580</u>	<u>34,798</u>
Total Engineering Labor	<u><u>110,988</u></u>	<u><u>1,265,874</u></u>
Material		
(4) Lab. Tech.		37,592
(5) Q&RA		<u>1,074</u>
Subtotal (C)		38,666
(6) Material & Adm. Burden		<u>13,146</u>
Total Material		<u><u>51,812</u></u>
Total Engineering Cost		<u><u>\$ 1,317,686</u></u>

AMLEV
PART II
MANUFACTURING
PRODUCTION

FINAL ASSEMBLY - S/S

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.1.1.7-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	41,783	\$ 406,131
(2) Miscellaneous Charges	3,259	31,677
(3) Maintain & Add in Scope Changes	460	4,471
Subtotal (A)	45,502	442,279
(4) Tool & Production Planning	12,741	123,843
Subtotal (B)	58,243	566,122
(5) Direct Distributable	14,561	141,533
Subtotal (C)	72,804	707,655
(6) Training	801	7,786
Subtotal (D)	73,605	715,441
(7) Q&RA	14,721	143,088
(8) Mfg. Tech.	1,398	16,510
Total Production Labor	89,724	875,039
 Material		
(9) Raw Material & Standards		-0-
(10) Q&RA		4,416
(11) Mfg. Tech.		2,447
Material Subtotal		6,863
(12) Material & Adm. Burden		2,333
Total Material		9,196
Total Production Cost		\$ 884,235

AMLLV
 MANUFACTURING TEST
STRUCTURE ASSEMBLY - S/S

TABLE 5.1.1.7-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	2,089	\$20,305
Component Test Planning	<u>688</u>	<u>6,497</u>
Subtotal	2,757	26,802
Direct Distributable	<u>882</u>	<u>8,576</u>
Subtotal	3,639	35,378
Training	<u>40</u>	<u>389</u>
Subtotal	3,679	35,767
Mfg. Tech.	<u>70</u>	<u>826</u>
Subtotal	3,749	36,593
Q&RA	<u>736</u>	<u>7,153</u>
Total Mfg. Test Labor	4,485	43,746
Material		
Q&RA		221
Mfg. Tech.		<u>122</u>
Subtotal		343
Material & Adm. Burden		<u>117</u>
Total Material		<u>460</u>
Total Mfg. Test Cost		<u><u>\$44,206</u></u>

PART III
 FACILITY LABOR
 AMLLV
FINAL ASSEMBLY - S/S
 ASSEMBLY OR SYSTEM
 1ST UNIT COST
 TABLE 5.1.1.7-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	<u>1,365</u>	<u>\$16,121</u>
TOTAL FACILITY LABOR COST		<u>\$16,121</u>

AMLLV
 PART IV
 LOGISTIC LABOR
FINAL ASSEMBLY - S/S
 ASSEMBLY OR SYSTEM
 TABLE 5.1.1.7-VIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Engineering	<u>13,493</u>	<u>\$159,352</u>
(2) Hardware		None
(3) Material & Adm. Burden		None
Total Material		None
Total Logistic Cost		<u>\$159,352</u>

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5.1.2 Systems

The total first R&D flight test production unit cost of the systems for a single stage vehicle and the components thereof are displayed in Figure 5.1.2.0-1. Table 5.1.2.0-1 is a total cost summary of the systems. Supporting documentation for each of the major components that are included in this cost summary are in the appropriate sections.

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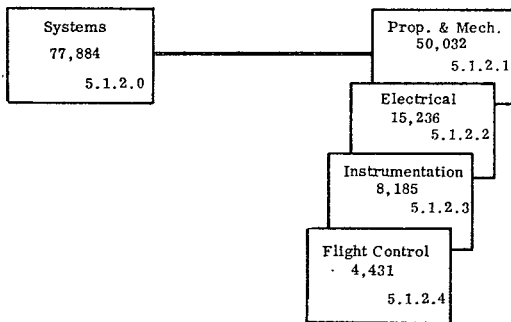


FIGURE 5.1.2.0-1 SINGLE STAGE SYSTEMS COST FLOW DIAGRAM

TOTAL SYSTEMS - SINGLE STAGE

TABLE 5.1.2.0-I
AMLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	37	432								37	432
PROGRAM PLAN. & REPT.	90	1,080								90	1,080
INDUSTRIAL RELATIONS	20	192								20	192
ENGINEERING			173	1,970			27	315		200	2,285
LAB TECHNICIANS			34	336						34	336
TOOLING			120	1,166						120	1,166
PRODUCTION			1,953	18,983						1,953	18,983
MANUFACTURING TEST			91	884						91	884
MANUFACTURING TECH.			45	579						49	579
Q & R A			554	5,611						554	5,611
FACILITIES					45	438				45	438
DIRECT DIST			547	5,320						547	5,320
TRAINING			30	289						30	289
TOTAL DIRECT LABOR	147	1,704	3,551	35,138	45	438	27	315		3,770	37,595
MATERIAL		4		28,709							28,713
LOGISTIC HARDWARE								1,491			1,491
BURDEN				9,760				325			10,085
TOTAL MATERIAL		4		38,469				1,816			40,289
TOTAL OTHER											
TOTAL COST		1,708		73,607		438		2,131			77,884

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5.1.2.1 Propulsion and Mechanical System

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TABLE 5.1.2.1-I

AMLLV COST SUMMARY PROPULSION & MECHANICAL - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	15	172								15	172
PROGRAM PLAN. & REPT.	36	431								36	431
INDUSTRIAL RELATIONS	8	77								8	77
ENGINEERING			62	728			9	110		71	838
LAB TECHNICIANS			12	120						12	120
TOOLING			48	469						48	469
PRODUCTION			786	7,642						786	7,642
MANUFACTURING TEST			37	356						37	356
MANUFACTURING TECH.			20	233						20	233
Q & R A			223	2,385						223	2,385
FACILITIES					18	176				18	176
DIRECT DIST			220	2,142						220	2,142
TRAINING			12	117						12	117
TOTAL DIRECT LABOR	59	680	1,420	14,192	18	176	9	110		1,506	15,158
MATERIAL		2		25,503							25,505
LOGISTIC HARDWARE								521			521
BURDEN				8,671				177			8,848
TOTAL MATERIAL		2		34,174				698			34,874
TOTAL OTHER											
TOTAL COST		682		48,366		176		808			50,032

AMLLV

PART I

PROPULSION & MECHANICAL - S/S
ASSEMBLY OR SYSTEM

TABLE 5.1.2.1-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	61,699		
Logistics	9,301		
Laboratory Technician	12,340		
Production	786,242		
Tooling	48,295		
Manufacturing Test	36,588		
Q&RA	223,162		
Facilities	18,111		
Manufacturing Technician	<u>19,742</u>		
Total Direct Labor	<u>1,215,480</u>		
Program Executive		14,586	172,257
Program Planning & Reporting		36,464	430,645
Industrial Relations		<u>7,901</u>	<u>76,794</u>
Total Labor - Part I		<u>58,951</u>	<u>579,696</u>
<u>Material</u>			
Program Planning & Reporting			729
Industrial Relations			<u>790</u>
Material Subtotal			1,519
Material & Administrative Burden			<u>517</u>
Total Material			<u>2,036</u>
TOTAL COST - PART I			<u>681,732</u>

TABLE 5.1.2.1-III

AMLV PART II COST SUMMARY - PROPULSION & MECHANICAL SYSTEM - S/S A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	62	728							62	728
LAB TECHNICIANS	12	120							12	120
TOOLING					48	470			48	470
PRODUCTION			786	7,642					786	7,642
MANUFACTURING TEST							37	356	37	356
MANUFACTURING TECH.			19	222			1	11	20	233
Q & R A	3	240	198	1,925	13	125	10	94	224	2,384
DIRECT DIST			193	1,878	15	150	12	114	220	2,142
TRAINING			11	105	1	7	1	5	13	117
TOTAL DIRECT LABOR	77	1,088	1,208	11,772	77	752	60	580	1,422	14,192
MATERIAL										
LAB. TECHNICIANS		26								26
TOOLING						84				84
PRODUCTION				25,291						25,291
MFG. TECHNICIANS				33				2		35
Q & R A		1		59		4		3		67
SUBTOTAL		27		25,383		88		5		25,503
MAT. & ADM. SUPDENSE		9		8,631		30		1		8,671
TOTAL MATERIAL		36		34,014		118		6		34,174
TOTAL PART II COST		1,124		45,786		870		586		48,366

AMLLV
PART II
ENGINEERING

PROPULSION & MECHANICAL SYSTEM -S/S

ASSEMBLY OR SYSTEM

TABLE 5.1.2.1-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Design Development	60,421	\$ 713,572
Reliability Engineering	<u>1,278</u>	<u>15,093</u>
(1) Subtotal	61,699	\$ 728,665
(2) Laboratory Technicians	<u>12,340</u>	<u>119,945</u>
Subtotal	74,039	\$ 848,610
(3) Q&RA	<u>2,468</u>	<u>239,890</u>
Total Engineering Labor	<u>76,507</u>	<u>\$1,088,500</u>
Material		
(4) Lab. Tech.		\$ 25,914
(5) Q&RA		<u>740</u>
Subtotal		\$ 26,654
(6) Material & Adm. Burden		<u>9,062</u>
Total Material		<u>\$ 35,716</u>
Total Engineering Cost		<u>\$1,124,216</u>

AMLLV
MANUFACTURING
PRODUCTION

PROPULSION & MECHANICAL SYSTEMS - S/S

FIRST UNIT

TABLE 5.1.2.1-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Fabrication & Assembly	554,350	5,388,282
Miscellaneous Charges	43,239	420,283
Maintain & Add in Scope Charges	6,098	59,273
Subtotal	603,687	5,867,838
Tool & Production Planning	182,555	1,774,435
Subtotal	786,242	7,642,273
Direct Distributable	193,180	1,877,711
Subtotal	979,422	9,519,984
Training	10,774	104,723
Subtotal	990,196	9,624,707
Q&RA	198,039	1,924,939
Mfg. Tech.	18,814	222,193
Total Production Labor	<u>1,207,049</u>	<u>11,771,839</u>
<u>Material</u>		
Raw Material & Standards		25,291,006
Q&RA		59,412
Mfg. Tech.		32,925
Material Subtotal		25,383,343
Material & Adm. Burden		8,630,337
Total Material		<u>34,013,680</u>
Total Production Cost		<u>45,785,519</u>

AMLLV
MANUFACTURING
TOOLING

PROPULSION & MECHANICAL SYSTEM- S/S

FIRST UNIT

TABLE 5.1.2.1-VI

<u>Element of Cost</u>	<u>Manhour</u>	<u>Dollars</u>
Sustaining Tooling	48,295	469,427
Direct Distributable	<u>15,454</u>	<u>150,213</u>
Subtotal	63,749	619,640
Training	<u>701</u>	<u>6,814</u>
Subtotal	64,450	626,454
Q&RA	<u>12,890</u>	<u>125,291</u>
Total Tooling Labor	<u><u>77,340</u></u>	<u><u>751,745</u></u>
 Material		
Tooling		84,515
Q&RA		<u>3,867</u>
Subtotal		88,382
Material & Adm. Burden		<u>30,050</u>
Total Material		<u><u>118,432</u></u>
Total Tooling Cost		<u><u>870,177</u></u>

AMLLV
MANUFACTURING
MANUFACTURING TEST

PROPULSION & MECHANICAL SYSTEM- S/S
FIRST UNIT

TABLE 5.1.2.1-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	27,718	269,419
Component Test Planning	<u>8,870</u>	<u>86,213</u>
Subtotal	36,588	355,632
Direct Distributable	<u>11,708</u>	<u>113,802</u>
Subtotal	48,296	469,434
Training	<u>531</u>	<u>5,163</u>
Subtotal	48,827	474,597
Mfg. Tech.	<u>928</u>	<u>10,956</u>
Subtotal	49,755	485,553
Q&RA	<u>9,765</u>	<u>94,919</u>
Total Mfg. Test Labor	<u>59,520</u>	<u>580,472</u>
 Material		
Q&RA		2,930
Mfg. Tech.		<u>1,623</u>
Subtotal		4,553
Material & Adm. Burden		<u>1,548</u>
Total Material		<u>6,101</u>
Total Mfg. Test Cost		<u>586,573</u>

5

PART III
 FACILITY LABOR
 AMLLV
PROPULSION & MECHANICAL SYSTEM- S/S
 ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 5.1.2.1-VIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	<u>18,111</u>	<u>\$176,039</u>
TOTAL FACILITY LABOR COST		<u>\$176,039</u>

PART IV
 LOGISTIC LABOR
 AMLLV
 PROPULSION & MECHANICAL SYSTEM -S/S
 ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 5.1.2.1--IX

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Engineering	<u>9,301</u>	<u>\$109,845</u>
(2) Hardware		520,856
(3) Material & Adm. Burden		<u>177,091</u>
Total Material		<u>\$697,947</u>
Total Logistic Cost		<u>\$807,792</u>

5.1.2.2 Electrical System

TABLE 5.1.2.2-1

AMLLV COST SUMMARY

ELECTRICAL - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
	PROGRAM EXECUTIVE	14	162								
PROGRAM PLAN. & REPT.	34	405								34	405
INDUSTRIAL RELATIONS	7	72								7	72
ENGINEERING			30	290			5	58		35	348
LAB TECHNICIANS			6	58						6	58
TOOLING			47	458						47	458
PRODUCTION			766	7,451						766	7,451
MANUFACTURING TEST			36	347						36	347
MANUFACTURING TECH. Q & R A			19	227						19	227
FACILITIES			216	2,103						216	2,103
DIRECT DIST					18	172				18	172
TRAINING			215	2,088						215	2,088
TOTAL DIRECT LABOR	55	639	1,347	13,135	18	172	5	58		1,425	14,004
MATERIAL		1		646							645
LOGISTIC HARDWARE								273			273
BURDEN				219				93			312
TOTAL MATERIAL		1		865				366			1,232
TOTAL OTHER											
TOTAL COST		640		14,000		172		424			15,236

. AMLLV

PART I

ELECTRICAL - S/S
ASSEMBLY OR SYSTEM

TABLE 5.1.2.2-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	29,785		
Logistics	4,885		
Laboratory Technician	5,957		
Production	766,552		
Tooling	47,086		
Manufacturing Test	35,670		
Q&RA	216,358		
Facilities	17,657		
Manufacturing Technician	<u>19,247</u>		
Total Direct Labor	<u>1,143,197</u>		
Program Executive		13,718	162,010
Program Planning & Reporting		34,296	405,036
Industrial Relations		<u>7,431</u>	<u>72,229</u>
Total Labor - Part I		<u>55,445</u>	<u>639,275</u>
<u>Material</u>			
Program Planning & Reporting			686
Industrial Relations			<u>74</u>
Material Subtotal			760
Material & Administrative Burden			<u>258</u>
Total Material			<u>1,018</u>
TOTAL COST - PART I			<u>640,293</u>

TABLE 5.1.2.2-III

AMLLV PART II COST SUMMARY

ELECTRICAL - S/S

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	30	289							20	289
LAB TECHNICIANS	6	58							6	58
TOOLING					47	458			47	458
PRODUCTION			767	7,451					747	7,451
MANUFACTURING TEST							36	347	36	347
MANUFACTURING TECH.			18	216			1	11	19	227
Q & R A	1	12	193	1,877	12	122	10	92	216	2,103
DIRECT DIST			188	1,831	15	146	11	111	214	2,088
TRAINING			11	102	1	7		5	12	114
TOTAL DIRECT LABOR	37	359	1,177	11,477	75	733	58	566	1,347	13,135
MATERIAL										
LAB. TECHNICIANS		13								13
TOOLING						82				82
PRODUCTION				452						452
MFG. TECHNICIANS				32				2		34
Q & R A				58		4		3		65
SUBTOTAL		13		542		86		5		646
MAT. & ADM. BURDEN		4		185		29		1		219
TOTAL MATERIAL		17		727		115		6		865
TOTAL PART II COST		376		12,204		848		572		14,000

AMLLV
PART II
ENGINEERING

ELECTRICAL SYSTEM - S/S

ASSEMBLY OR SYSTEM

TABLE 5.1.2.2-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Design Development	29,155	\$283,387
Reliability Engineering	<u>630</u>	<u>6,123</u>
(1) Subtotal	29,785	\$289,510
(2) Laboratory Technicians	<u>5,957</u>	<u>57,902</u>
Subtotal	35,742	\$347,412
(3) Q&RA	<u>1,191</u>	<u>11,577</u>
Total Engineering Labor	<u>36,933</u>	<u>\$358,989</u>
Material		
(4) Lab. Tech.		\$ 12,510
(5) Q&RA		<u>357</u>
Subtotal		\$ 12,867
(6) Material & Adm. Burden		<u>4,375</u>
Total Material		<u>\$ 17,242</u>
Total Engineering Cost		<u>\$376,231</u>

AMLLV
 PART II
 MANUFACTURING
 PRODUCTION
ELECTRICAL SYSTEM - S/S

TABLE 5.1.2.2-V

<u>Element of Cost</u>	<u>Man/Hours</u>	<u>Dollars</u>
Fabrication & Assembly	540,467	5,253,339
Miscellaneous Charges	42,156	409,756
Maintain & Add in Scope Changes	<u>5,945</u>	<u>57,785</u>
Subtotal (A)	588,568	5,720,885
Tool & Production Planning	<u>177,983</u>	<u>1,729,996</u>
Subtotal (B)	766,557	7,450,881
Direct Distributable	<u>188,341</u>	<u>1,830,683</u>
Subtotal (C)	954,892	9,281,564
Training	<u>10,503</u>	<u>102,097</u>
Subtotal (D)	965,395	9,383,661
Q&RA	193,079	1,876,732
Mfg. Tech.	<u>18,343</u>	<u>216,625</u>
Total Production Labor	<u>1,176,817</u>	<u>11,477,018</u>
 Material		
Raw Material & Standards		452,285
Q&RA		57,924
Mfg. Tech.		<u>32,099</u>
Material Subtotal		542,308
Material & Adm. Burden		<u>184,385</u>
Total Material		<u>726,693</u>
Total Production Cost		<u>12,203,711</u>

AMLLV
 PART II
 MANUFACTURING
 TOOLING

ELECTRICAL SYSTEM - S/S

ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 5.1.2.2-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	47,086	\$ 457,676
(2) Direct Distributable	15,068	146,456
Subtotal	62,154	604,132
(3) Training	684	6,645
Subtotal	62,837	610,777
(4) Q&RA	12,567	122,155
Total Tooling Labor	75,404	\$ 732,932
Material		
(5) Tooling		\$ 82,401
(6) Q&RA		3,770
Subtotal		86,171
(7) Material & Adm. Burden		29,298
Total Material		115,469
Total Tooling Cost		\$ 848,401

AMLLV
 PART II
 MANUFACTURING
 MANUFACTURING TEST
ELECTRICAL SYSTEM - S/S

TABLE 5.1.2.2-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	27,023	262,664
Component Test Planning	<u>8,647</u>	<u>84,052</u>
Subtotal (A)	35,670	346,716
Direct Distributable	<u>11,414</u>	<u>110,948</u>
Subtotal (B)	47,084	457,664
Training	<u>518</u>	<u>5,034</u>
Subtotal (C)	47,602	462,698
Mfg. Tech.	<u>904</u>	<u>10,681</u>
Subtotal (D)	48,506	473,379
Q&RA	<u>9,521</u>	<u>92,539</u>
Total Mfg. Test Labor	<u>58,027</u>	<u>565,918</u>
Material		
Q&RA		2,856
Mfg. Tech.		<u>1,583</u>
Subtotal (E)		4,439
Material & Adm. Burden		<u>1,509</u>
Total Material		<u>5,948</u>
Total Mfg. Test Cost		<u>571,866</u>

PART III
FACILITY LABOR
AMLLV
ELECTRICAL SYSTEM - S/S

ASSEMBLY OR SYSTEM
1ST UNIT COST

5.1.2.2-VIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	17,657	\$171,626
TOTAL FACILITY LABOR COST	<u>17,657</u>	<u>\$171,626</u>

PART IV
 LOGISTIC LABOR
 AMLLW
ELECTRICAL SYSTEM- S/S

ASSEMBLY OR SYSTEM

TABLE 5.1.2.2-IX

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Engineering	<u>4,885</u>	<u>\$ 57,692</u>
(2) Hardware		273,560
(3) Material & Adm. Burden		<u>93,010</u>
Total Material		<u>\$366,570</u>
Total Logistic Cost		<u>\$424,262</u>

5.1.2.3 Instrumentation System

TABLE 5.1.2.3-1

AMLV COST SUMMARY-INSTRUMENTATION - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	6	77								6	77
PROGRAM PLAN. & REPT.	16	193								16	193
INDUSTRIAL RELATIONS	4	34								4	34
ENGINEERING			69	808			11	126		80	934
LAB TECHNICIANS			14	134						14	134
TOOLING			19	186						19	186
PRODUCTION			312	3,030						312	3,030
MANUFACTURING TEST			14	141						14	141
MANUFACTURING TECH.			8	93						8	93
Q & R A			90	877						90	877
FACILITIES					7	70				7	70
DIRECT DIST			87	849						87	849
TRAINING			5	46						5	46
TOTAL DIRECT LABOR	26	304	618	6,164	7	70	11	126		662	6,664
MATERIAL		1		676							677
LOGISTIC HARDWARE								594			594
BURDEN				230				20			250
TOTAL MATERIAL		1		906				614			1,521
TOTAL OTHER											
TOTAL COST		305		7,070		70		740			8,185

AMLLV

PART I

INSTRUMENTATION - S/S
ASSEMBLY OR SYSTEM

TABLE 5.1.2.3-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	68,931		
Logistics	10,611		
Laboratory Technician	13,786		
Production	311,727		
Tooling	19,148		
Manufacturing Test	14,505		
Q&RA	90,258		
Facilities	7,180		
Manufacturing Technician	7,827		
Total Direct Labor	<u>543,973</u>		
Program Executive		6,528	77,091
Program Planning & Reporting		16,319	192,729
Industrial Relations		<u>3,536</u>	<u>34,368</u>
Total Labor - Part I		<u>26,383</u>	<u>304,188</u>
<u>Material</u>			
Program Planning & Reporting			326
Industrial Relations			354
Material Subtotal			680
Material & Administrative Burden			<u>231</u>
Total Material			<u>911</u>
TOTAL COST - PART I			<u>305,099</u>

TABLE 5.1.2.3-III

AMLLV PART II COST SUMMARY INSTRUMENTATION - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	69	808							69	808
LAB TECHNICIANS	14	134							14	134
TOOLING					19	186			19	186
PRODUCTION			312	3,030					312	3,030
MANUFACTURING TEST							15	140	15	140
MANUFACTURING TECH.			7	88				5	7	93
Q & R A	3	27	79	763	5	50	4	38	91	878
DIRECT DIST			77	744	6	59	5	45	88	848
TRAINING			4	42	1	3		2	5	47
TOTAL DIRECT LABOR	86	969	479	4,667	31	298	24	230	620	6,164
MATERIAL										
LAB. TECHNICIANS		29								29
TOOLING						33				33
PRODUCTION				573						573
MFG. TECHNICIANS				13				1		14
Q & R A		1		23		2		1		27
SUBTOTAL		30		609		35		2		676
MAT. & ADM. BURDEN		10		207		12		1		230
TOTAL MATERIAL		40		816		47		3		906
TOTAL PART II COST		1,009		5,483		345		233		7,070

AMLLV
PART II
ENGINEERING

INSTRUMENTATION SYSTEM-S/S
ASSEMBLY OR SYSTEM
TABLE 5.1.2.3-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Design Development	66,977	\$ 790,998
Reliability Engineering	<u>1,458</u>	<u>17,219</u>
(1) Subtotal	68,931	\$ 808,217
(2) Laboratory Technicians	<u>13,786</u>	<u>134,000</u>
Subtotal	82,712	\$ 942,217
(3) Q&RA	<u>2,757</u>	<u>26,798</u>
Total Engineering Labor	<u>85,474</u>	<u>\$ 969,015</u>
Material		
(4) Lab. Tech.		\$ 28,951
(5) Q&RA		<u>827</u>
Subtotal		\$ 29,778
(c) Material & Adm. Burden		<u>10,125</u>
Total Material		<u>\$ 39,903</u>
Total Engineering Cost		<u>\$1,008,918</u>

AMLLV
 MANUFACTURING
 INSTRUMENTATIONS SYTEMS - S/S
PRODUCTION
FIRST UNIT

TABLE 5.1.2.3-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Fabrication & Assembly	219,787	2,136,330
Miscellaneous Charges	17,143	166,630
Maintain & Add in Scope Changes	2,418	23,503
Subtotal	<u>239,348</u>	<u>2,326,463</u>
Tool & Production Planning	72,379	703,523
Subtotal	<u>311,727</u>	<u>3,029,986</u>
Direct Distributable	76,591	744,465
Subtotal	<u>388,318</u>	<u>3,774,451</u>
Training	4,271	41,514
Subtotal	<u>392,589</u>	<u>3,815,965</u>
Q&RA	78,518	763,195
Mfg. Tech.	7,459	88,091
Total Production Labor	<u><u>478,566</u></u>	<u><u>4,667,251</u></u>
 Material		
Raw Material & Standards		572,783
Q&RA		23,555
Mfg. Tech.		13,053
Material Subtotal		<u>609,391</u>
Material & Adm. Burden		207,193
Total Material		<u>816,584</u>
Total Production Cost		<u><u>5,483,835</u></u>

AMLLV

MANUFACTURING
INSTRUMENTATIONS SYSTEMS - S/S
 TOOLING
 FIRST UNIT

.. TABLE 5.1.2.3-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Sustaining Tooling	19,148	186,119
Direct Distributable	<u>6,127</u>	<u>59,554</u>
Subtotal	25,275	245,673
Training	278	2,702
Subtotal	25,553	248,375
Q&RA	<u>5,111</u>	<u>49,679</u>
Total Tooling Labor	<u>30,664</u>	<u>298,054</u>
 Material		
Tooling		33,509
Q&RA		<u>1,533</u>
Subtotal		35,042
Material & Adm. Burden		<u>11,914</u>
Total Material		<u>46,956</u>
Total Tooling Cost		<u>345,010</u>

AMLLV
 MANUFACTURING
INSTRUMENTATION - S/S
 MANUFACTURING TEST
 FIRST UNIT

TABLE 5.1.2.3-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	10,989	106,813
Component Test Planning	<u>3,516</u>	<u>34,179</u>
Subtotal	14,505	140,992
Direct Distributable	<u>4,642</u>	<u>45,117</u>
Subtotal	19,147	186,109
Training	<u>211</u>	<u>2,047</u>
Subtotal	19,358	188,156
Mfg. Tech.	<u>368</u>	<u>4,343</u>
Subtotal	19,726	192,499
Q&RA	<u>3,872</u>	<u>37,631</u>
Total Mfg. Test Labor	<u><u>23,597</u></u>	<u><u>230,130</u></u>
Material		
Q&RA		1,161
Mfg. Tech.		<u>643</u>
Subtotal		1,804
Material & Adm. Burden		614
Total Material		<u><u>2,418</u></u>
Total Mfg. Test Cost		<u><u>232,548</u></u>

PART III
 FACILITY LABOR
 AMLLV
 INSTRUMENTATION SYSTEM - S/S

ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 5.1.2.3-VIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	<u>7,180</u>	\$ 69,790
TOTAL FACILITY LABOR COST		<u>\$ 69,790</u>

AMLLV
 PART IV
 LOGISTIC LABOR
INSTRUMENTATION SYSTEM- S/S
 ASSEMBLY OR SYSTEM
 TABLE 5.1.2.3-IX

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Engineering	<u>10,611</u>	\$ <u>125,316</u>
(2) Hardware		594,216
(3) Material & Adm. Burden		<u>20,233</u>
Total Material		<u>614,449</u>
Total Logistic Cost		<u>\$ 739,765</u>

5.1.2.4 Flight Control System

TABLE 5.1.2.4-I
 AMLLV COST SUMMARY

FLIGHT CONTROL - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	2	21								2	21
PROGRAM PLAN. & REPT.	4	51								4	51
INDUSTRIAL RELATIONS	1	9								1	9
ENGINEERING			12	144			2	21		14	165
LAB TECHNICIANS			2	24						2	24
TOOLING			6	53						6	53
PRODUCTION			89	860						89	860
MANUFACTURING TEST			4	40						4	40
MANUFACTURING TECH. Q & R A			2	26						2	26
FACILITIES			25	246						25	246
DIRECT DIST					2	20				2	20
TRAINING			25	241						25	241
TOTAL DIRECT LABOR	7	81	166	1,647	2	20	2	21		177	1,769
MATERIAL				1,884							1,884
LOGISTIC HARDWARE BURDEN				640				103			103
TOTAL MATERIAL				2,524				35			675
TOTAL OTHER								138			2,662
TOTAL COST		81		4,171		20		159			4,431

AMLLV

PART I

FLIGHT CONTROL - S/S
ASSEMBLY OR SYSTEM

TABLE 5.1.2.4-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	12,166		
Logistics	1,834		
Laboratory Technician	2,433		
Production	88,518		
Tooling	5,437		
Manufacturing Test	4,120		
Q&RA	25,336		
Facilities	2,039		
Manufacturing Technician	<u>2,222</u>		
Total Direct Labor	<u>144,105</u>		
Program Executive		1,729	20,422
Program Planning & Reporting		4,323	51,056
Industrial Relations		<u>937</u>	<u>9,104</u>
Total Labor - Part I		<u>6,989</u>	<u>80,582</u>
<u>Material</u>			
Program Planning & Reporting			86
Industrial Relations			<u>94</u>
Material Subtotal			180
Material & Administrative Burden			<u>61</u>
Total Material			<u>241</u>
TOTAL COST - PART I			<u>80,823</u>

TABLE 5.1.2.4-III

AMLLV PART II COST SUMMARY - FLIGHT CONTROL - S/S

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	12	144							12	144
LAB TECHNICIANS	2	23							2	23
TOOLING					5	53			5	53
PRODUCTION			89	860					89	860
MANUFACTURING TEST							4	40	4	40
MANUFACTURING TECH.			2	25				1	2	26
Q & R A	1	5	22	217	2	14	1	11	26	247
DIRECT DIST			22	211	2	17	2	13	26	241
TRAINING			1	12		1			1	13
TOTAL DIRECT LABOR	15	172	136	1,325	9	85	7	65	167	1,647
MATERIAL										
LAB. TECHNICIANS		5								5
TOOLING						9				9
PRODUCTION				1,857						1,857
MFG. TECHNICIANS				4						4
Q & R A				7		1		1		9
SUBTOTAL		5		1,868		10		1		1,884
MAT. & ADM. BURDEN		2		635		3				640
TOTAL MATERIAL		7		2,503		13		1		2,524
TOTAL PART II COST		179		3,828		98		66		4,171

AMLLV
PART II
ENGINEERING

FLIGHT CONTROL SYSTEMS - S/S
ASSEMBLY OR SYSTEM
TABLE 5.1.2.4-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Design Development	11,914	\$140,704
Reliability Engineering	<u>252</u>	<u>2,976</u>
(1) Subtotal	12,166	\$143,680
(2) Laboratory Technicians	<u>2,433</u>	<u>23,649</u>
Subtotal	14,599	\$167,329
(3) Q&RA	<u>489</u>	<u>4,734</u>
Total Engineering Labor	<u>15,086</u>	<u>\$172,063</u>
Material		
(4) Lab. Tech.		\$ 5,109
(5) Q&RA		<u>146</u>
Subtotal		\$ 5,255
(6) Material & Adm. Burden		<u>1,787</u>
Total Material		<u>\$ 7,042</u>
Total Engineering Cost		<u>\$179,105</u>

AMLLV
FLIGHT CONTROL- S/S
 PRODUCTION
 FIRST UNIT
 TABLE 5.1.2.4-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Fabrication & Assembly	62,410	606,625
Miscellaneous Charges	4,868	47,317
Maintain & Add in Scope Changes	687	6,678
Subtotal	<u>67,965</u>	660,620
Tool & Production Planning	20,553	199,775
Subtotal	88,518	860,395
Direct Distributable	21,749	211,400
Subtotal	110,267	1,071,795
Training	1,213	11,790
Subtotal	111,480	1,083,585
Q&RA	22,296	216,717
Mfg. Tech.	2,118	25,014
Total Production Labor	<u>135,894</u>	<u>1,325,316</u>
Material		
Raw Material & Standards		1,857,421
Q&RA		6,689
Mfg. Tech.		3,707
Material Subtotal		1,867,817
Material & Adm. Burden		635,058
Total Material		<u>2,502,875</u>
Total Production Cost		<u>3,828,191</u>

AMLLV
FLIGHT CONTROL- S/S

TOOLING
 FIRST UNIT

TABLE 5.1.2.4-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Sustaining Tooling	5,437	52,848
Direct Distributable	1,740	16,912
Subtotal	7,177	69,760
Training	79	768
Subtotal	7,256	70,528
Q&RA	1,451	14,104
Total Tooling Labor	<u>8,707</u>	<u>84,632</u>
Material		
Tooling		9,515
Q&RA		435
Subtotal		9,950
Material & Adm. Burden		3,383
Total Material		<u>13,333</u>
Total Tooling Cost		<u>97,965</u>

AMLLV

FLIGHT CONTROL - S/S
MANUFACTURING TEST
FIRST UNIT

<u>Element of Cost</u>	<u>TABLE 5.1.2.4-VII</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test		3,121	30,336
Component Test Planning		999	9,707
Subtotal		4,120	40,043
Direct Distributable		1,318	12,814
Subtotal		5,438	52,857
Training		60	581
Subtotal		5,498	53,438
Mfg. Tech.		104	1,233
Subtotal		5,602	54,671
Q&RA		1,100	10,687
Total Mfg. Test Labor		<u>6,702</u>	<u>65,358</u>
Material			
Q&RA			330
Mfg. Tech.			183
Subtotal			513
Material & Adm. Burden			174
Total Material			<u>687</u>
Total Mfg. Test Cost			<u>66,045</u>

PART III
FACILITY LABOR
AMLLV
FLIGHT CONTROL - S/S

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.1.2.4-VIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	<u>2,039</u>	<u>\$19,819</u>
TOTAL FACILITY LABOR COST	<u>2,039</u>	<u>\$19,819</u>

PART IV
 LOGISTIC LABOR
AMLIY
FLIGHT CONTROL - S/S
 ASSEMBLY OR SYSTEM
 TABLE 5.1.2.4-IX

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Engineering	<u>1,834</u>	\$ <u>21,660</u>
(2) Hardware		102,704
(3) Material & Adm. Burden		<u>34,919</u>
Total Material		<u>\$137,623</u>
Total Logistic Cost		<u>\$159,283</u>

5.1.3 Liquid Engine Costs

This section shows the first R&D flight test engine costs for the following types of engines:

- 5.1.3.1 Multichamber/Plug (with 24 modules having fixed nozzles and a vacuum thrust of 793,000 pounds)
- 5.1.3.2 Toroidal/aerospike (2000 psia with 16 modules each producing one million pound thrust)
- 5.1.3.3 Toroidal/aerospike (2000 psia with 8 modules each producing two million pound thrust)

5.1.3.1 Multichamber Plug Engine

Parametric cost data was received from Pratt and Whitney for the multi-chamber/plug propulsion system. This data covered a range of propulsion system sizes from above the requirements for a full size AMLLV engine to below that of a half size (MLLV) engine (Figure 5.1.3.1-I). The data received was gross and included only a total cost for Production. To develop this data into more meaningful cost information, detailed subdivisions of cost were developed from historical data for the J-2 engine system.

As illustrated in Figure 5.1.3.1-I, total production costs were provided in terms of average unit costs for a 100, 200, and 500 module program as a function of module vacuum thrust. The average unit cost of a 100 engine program (for a 793,000 lb thrust engine) is \$2.7M. Using this data, it was necessary to determine a first unit cost. The module first unit cost and the cost for the first set of 24 multichamber/plug engines were developed as shown below:

First Unit

\$2.7M Average X 100 = \$270M
100 Unit (Cum) 95% Curve = 76.58
 $\$270M \div 76.58 = \$3.5M$
24 Units = 20.30 (95%) X \$3.5M = \$71.1M

The engine system costs are summarized below:

"C" Costs

Engineering	\$.3.4M
Test	4.6M
Tooling (maintenance)	5.2M
Fabrication	<u>\$57.9M</u>
Subtotal	<u>\$71.1M</u>

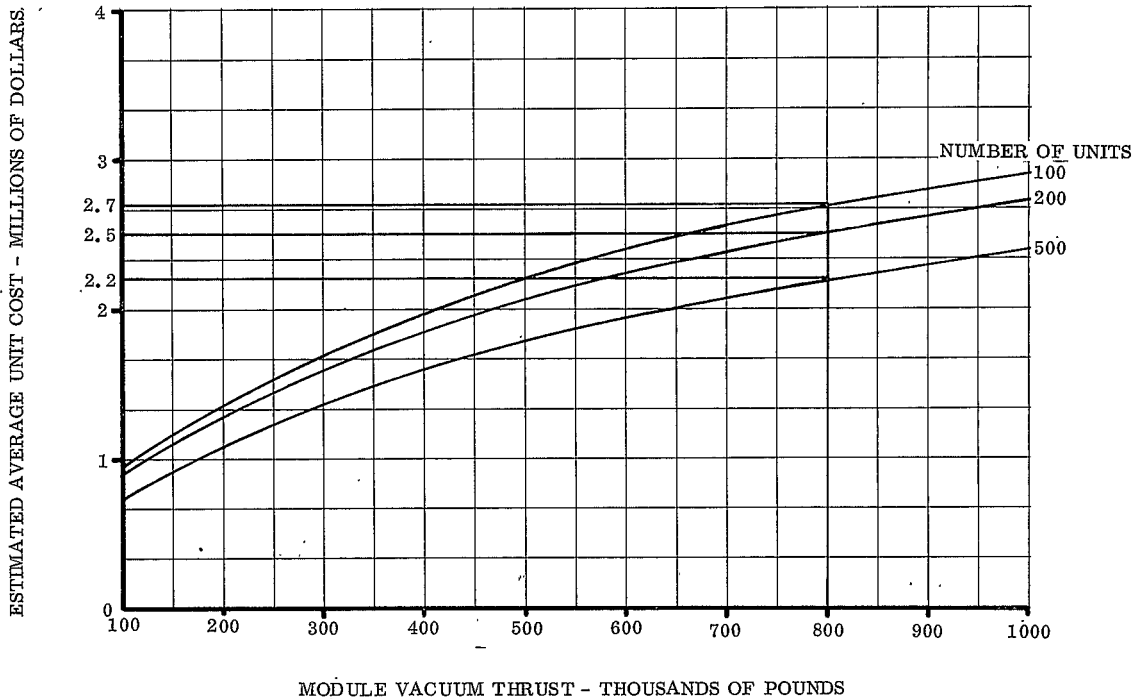


FIGURE 5.1.3.1-1 AMLLV MULTICHAMBER/PLUG ENGINE MODULE AVERAGE UNIT COST

TABLE 5.1.3.1-I

AMLLV COST SUMMARY MULTI-CHAMBER PLUG ENGINE - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING				3,400							3,400
LAB TECHNICIANS											
TOOLING				5,200							5,200
PRODUCTION				57,900							57,900
MANUFACTURING TEST				4,600							4,600
MANUFACTURING TECH.											
Q & RA											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR				71,100							71,100
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER											
TOTAL COST				71,100							71,100

5.1.3.2 Toroidal Engine Cost - 16 Modules, One Million Pounds Thrust Each

This section presents the cost for a toroidal/aerospike engine system with a chamber pressure consisting of 2000 psia and sixteen modules, each of which will produce one million pounds of sea level thrust. Costs for this alternative engine were supplied by Rocketdyne.

The costs for this engine configuration are not added in the cost summary for the single stage vehicle shown in Table 5.1.0.0-I above. The reader must substitute these costs in lieu of those for the multichamber/plug engine, to define the cost of the single stage vehicle with the toroidal/aerospike engine system.

The module costs and the overall engine system costs are summarized below.

"C" Costs

Engineering	\$.15M
Test	.18M
Tooling (maintenance)	.26M
Fabrication	<u>2.51M</u>

Subtotal \$ 3.10M

(Including Fee) \$ 3.40M

16 Module Per Engine = 13,9065 (95%) X \$3.40M = \$47.3M

TABLE 5.1.3.2-I

AMLLV COST SUMMARY TORODIAL ENGINE - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING				2,270							2,270
LAB TECHNICIANS											
TOOLING				3,880							3,880
PRODUCTION				38,410							38,410
MANUFACTURING TEST				2,740							2,740
MANUFACTURING TECH. Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR				47,300							47,300
MATERIAL											
LOGISTIC HARDWARE BURDEN											
TOTAL MATERIAL											
TOTAL OTHER											
TOTAL COST				47,300							47,300

5.1.3.3 Toroidal Engine Cost - 8 Modules, Two Million Pounds Thrust Each

This section presents the cost for a toroidal/aerospike engine system consisting of eight 2000 psia modules, each of which will produce two million pounds of sea level thrust. Costs for this alternative engine were supplied by Rocketdyne.

The costs for this engine configuration are not added in the cost summary for the single stage vehicle shown in Table 5.1.0.0-I above. The reader, must substitute these costs in lieu of those for the multichamber/plug engine to define the cost of the single stage vehicle with the toroidal/aerospike engine system.

The module costs and the overall engine system costs are summarized below.

"C" Costs

Engineering	\$ 1.8
Test	2.1
Tooling (maintenance)	3.1
Fabrication	<u>30.0</u>

Subtotal \$37.0

(Including Fee) \$40.66

8 Module Per Engine = (\$5.60 X 8 Modules (95%) = \$40.66

TABLE 5.1.3.3-I
 AMLLV COST SUMMARY

SINGLE STAGE ENGINES - (TORODIAL)

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING				1,800							1,800
LAB TECHNICIANS											
TOOLING				3,100							3,100
PRODUCTION				30,000							30,000
MANUFACTURING TEST				2,100							2,100
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR				37,000							37,000
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER									*3,660		3,660
TOTAL COST				37,000					3,660		40,660

FEE

5.1.4 Engine Installation

Installation costs associated with the twenty-four (24) multichamber/plug engines were based on manhour estimates which were derived from Saturn V historical data. In addition to the direct factory labor all supporting costs were included

TABLE 5.1.4.0-I

AMLLV COST SUMMARY

ENGINE INSTALLATION - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	1	10								1	10
PROGRAM PLAN. & REPT.	2	25								2	25
INDUSTRIAL RELATIONS ENGINEERING		4									4
LAB TECHNICIANS											
TOOLING			3	28						3	28
PRODUCTION			46	448						46	448
MANUFACTURING TEST			4	42						4	42
MANUFACTURING TECH.			1	14						1	14
Q & R A			13	131						13	131
FACILITIES					1	9				1	9
DIRECT DIST			14	132						14	132
TRAINING			1	7						1	7
TOTAL DIRECT LABOR	3	39	82	802	1	9				86	850
MATERIAL				11							11
LOGISTIC HARDWARE BURDEN				4							4
TOTAL MATERIAL				15							15
TOTAL OTHER											
TOTAL COST		39		817		9					86

AMLLV
 NON-RECURRING
 PART I
 ENGINE INSTALLATION - S/S
 ASSEMBLY OR SYSTEM
 TABLE 5.1.4.0-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering			
Logistics			
Laboratory Technician			
Production	46,047		
Tooling	2,828		
Manufacturing Test	4,335		
Q&RA	13,510		
Facilities	971		
Manufacturing Technician	<u>1,212</u>		
Total Direct Labor	<u>68,903</u>		
Program Executive		827	9,767
Program Planning & Reporting		2,067	24,411
Industrial Relations		<u>448</u>	<u>4,353</u>
Total Labor - Part I		<u>3,342</u>	<u>38,533</u>
<u>Material</u>			
Program Planning & Reporting			41
Industrial Relations			<u>45</u>
Material Subtotal			86
Material & Administrative Burden			<u>29</u>
Total Material			<u>115</u>
TOTAL COST - PART I			<u>38,648</u>

TABLE 5.1.4.0-III

 AMLLV PART II COST SUMMARY ENGINE INSTALLATION - SINGLE STAGE A B C (IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING										
LAB TECHNICIANS										
TOOLING					3	27			3	27
PRODUCTION			46	448					46	448
MANUFACTURING TEST							4	42	4	42
MANUFACTURING TECH.			1	13				1	1	14
Q & R A			12	113	1	7	1	11	14	131
DIRECT DIST			11	110	1	9	1	14	13	132
TRAINING			1	6		1		1	1	8
TOTAL DIRECT LABOR			71	690	5	44	7	69	82	802
MATERIAL										
LAB. TECHNICIANS										
TOOLING						5				5
PRODUCTION										
MFG. TECHNICIANS				2						2
Q & R A				3				1		4
SUBTOTAL				5		5		1		11
MAT. & ADM. BURDEN				2		2				4
TOTAL MATERIAL				7		7		1		15
TOTAL PART II COST				696		51		70		817

AMLLV
PART II
MANUFACTURING
PRODUCTION

ENGINE INSTALLATION - S/S

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.1.4.0-IV

<u>Element of Cost</u>	<u>Man/Hours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	32,467	\$ 315,579
(2) Miscellaneous Charges	2,532	24,611
(3) Maintain & Add in Scope Changes	357	3,470
Subtotal	35,356	\$ 343,660
(4) Tool & Production Planning	10,691	103,917
Subtotal	46,047	\$ 447,577
(5) Direct Distributable	11,314	109,972
Subtotal	57,361	\$ 557,549
(6) Training	631	6,133
Subtotal	57,992	\$ 563,682
(7) Q&RA	11,598	112,733
(8) Mfg. Techn.	1,102	13,015
Total Production Labor	70,692	\$ 689,430
<u>Material</u>		
(9) Raw Material & Standards		3,479
(10) Q&RA		1,929
(11) Mfg. Tech.		5,408
Material Subtotal		1,839
(12) Material & Adm. Burden		7,247
Total Material		\$ 7,247
Total Production Cost		\$ 696,677

AMLLV
PART II.
MANUFACTURING
TOOLING

ENGINE INSTALLATION - S/S

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.1.4.0-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	2,828	\$ 27,488
(2) Direct Distributable	905	8,797
Subtotal (A)	<u>3,733</u>	<u>36,285</u>
(3) Training	41	399
Subtotal (B)	<u>3,774</u>	<u>36,683</u>
(4) Q&RA	755	7,339
Total Tooling Labor	<u><u>4,529</u></u>	\$ <u><u>44,023</u></u>
 Material		
(5) Tooling		\$ 3,949
(6) Q&RA		<u>227</u>
Subtotal (C)		5,176
(7) Material & Adm. Burden		<u>1,760</u>
Total Material		<u><u>6,936</u></u>
Total Tooling Cost		\$ <u><u>50,959</u></u>

AMLEV
PART II
MANUFACTURING
MANUFACTURING TEST

ENGINE INSTALLATION- S/S
ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.1.4.0-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	2,948	\$ 28,655
Component Test Planning	<u>1,387</u>	<u>13,482</u>
(1) Subtotal (A)	4,335	\$ 42,137
(2) Direct Distributable	<u>1,387</u>	<u>13,482</u>
Subtotal (B)	5,722	\$ 55,619
(3) Training	<u>63</u>	<u>612</u>
Subtotal (C)	5,785	\$ 56,231
(4) Mfg. Tech.	<u>110</u>	<u>1,299</u>
Subtotal (D)	5,895	\$ 57,530
(5) Q&RA .	<u>1,157</u>	<u>11,246</u>
Total Mfg. Test Labor	<u>7,052</u>	<u>\$ 68,776</u>
Material		
(6) Q&RA		\$ 347
(7) Mfg. Tech.		<u>193</u>
Subtotal (E)		\$ 540
(8) Material & Adm. Burden		<u>184</u>
Total Material		<u>\$ 724</u>
Total Mfg. Test Cost		<u>\$ 69,500</u>

PART III
FACILITY LABOR

AMLLV ENGINE INSTALLATION - S/S

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.1.4.0-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	971	\$9,438
		<u> </u>
TOTAL FACILITY LABOR COST		<u>\$9,438</u>

5.1.5 Propellant, Pressurants, and Gases

Propellant costs used on the AMLLV Single Stage Vehicle were estimated for the following types of propellants: 1) LOX, 2) LH₂, 3) LN₂, 4) GHe, and 5) GH₂. The costs were based on the requirements for one single stage vehicle.

These costs were based on current actual costs for the Saturn V. An appropriate burden was added to account for the support activities required for procurement.

TABLE 5.1.5.0-I
 AMLIV COST SUMMARY

PROPELLANT - SINGLE STAGE

A B C X

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & RA											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER									6,573		6,573
TOTAL COST									6,573		6,573

AMLLV
 LAUNCH OPERATIONS
PROPELLANT
 (IN THOUSANDS)
 SINGLE STAGE

TABLE 5.1.5.0-II

	<u>Cubit Ft.</u>	<u>Pounds</u>	<u>Dollars</u>
LOX		26,812	335
LH ₂		4,739	2,369
LN ₂		9,600	260
GH _e	30,000		1,872
GH ₂	7,350		<u>69</u>
Propellant Cost			4,905
Mat'l & Administrative Burden			<u>1,668</u>
TOTAL COST			<u><u>6,573</u></u>

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5.1.6 Instrument Unit (IU)

The IU for the AMLLV will be basically identified to the IU used in the Saturn V Launch Vehicle. The recurring costs for the AMLLV Instrument Unit were, therefore, extrapolated from the Saturn V IU costs contained in the Chrysler Corporation "National Space Booster Study".

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TABLE 5.1.6.0-I

AMLLV COST SUMMARY INSTRUMENT UNIT

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE BURDEN											
TOTAL MATERIAL											
TOTAL OTHER									9,346		9,346
TOTAL COST									9,346		9,346

AMLLV
RECURRING COSTS

INSTRUMENT UNIT
1ST UNIT COST
TABLE 5.1.6.0-II

Element of Cost

Dollars
(In Thousands)

Instrument Unit	\$9,346
(1) TOTAL COST	<u>\$9,346</u>

(1) Cost based upon Engineering estimate.

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5.1.7 Systems Development Facility (SDF - Breadboard)

The costs for the breadboard cover that activity to:

- a. Provide for system development and evaluation of computer controlled checkout of the AMLLV/Electrical Support Equipment (ESE).
- b. Develop and prove checkout techniques procedures and displays.
- c. Provide a basis for maintainability analysis.
- d. Provide personnel familiarization and training.
- e. Provide a facility where changes and modifications to the vehicle and computer controlled ESE may be evaluated.
- f. Design and evaluate many parts of the computer programs required for the checkout and launch site operations.
- g. Provide support to operational personnel at the launch site by being available to investigate any problem that may arise after the flight vehicle has been delivered to the site.
- h. Electrical simulation.

The cost information was based on the average Saturn V SDF operation cost.

SDF Ref: Paragraph 4.2.5, Volume III, Resource Implications

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TABLE 5.1.7.0-I

AMLLV COST SUMMARY-SYSTEMS DEVELOPMENT FACILITY - SINGLE STAGE

A B C

(I: THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER									6,169		6,169
TOTAL COST									6,169		6,169

AMLLV
 RECURRING COST
 SYSTEMS DEVELOPMENT FACILITY
 BREADBOARD

SINGLE STAGE
 TABLE 5.1.7.0-II

<u>Element of Cost</u>	<u>Dollars</u>
<u>Annual Operation</u>	
Engineering	\$1,727
Operations	<u>4,442</u>
(1) TOTAL COST	<u>\$6,169</u>

(1) This Cost based on Saturn V SDF.

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5.1.8 Launch Operations

The launch operations for the single stage vehicle will consist of three major categories: 1) Launch Control, 2) Launch Pad Operations, and 3) Off Site Support. Figure 5.1.8.0-1 shows the costs for each of these categories and indicates the applicable sub-sections where the costs are shown in detail. The costs reflected in this section are for launch of one vehicle at a two per year launch rate. Costs for Launch Operations include the costs for receiving the vehicles, static firing, refurbishment of the launch pad, assembly of the vehicle, checkout, prelaunch test and checkout, servicing, launching and refurbishing of the launch pad.

They also include costs for management of the overall site operations and maintenance.

The costs do not include costs for down range operation.

The launch operations for the single stage are divided into two parts. The first part represents the costs for the first and second launches which are the R&D flight tests. The second part represents the costs for launches of the operational flight vehicles. These parts are each further divided into three major categories.

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LAUNCH OPERATIONS - SINGLE STAGE - AFTER 2ND LAUNCH

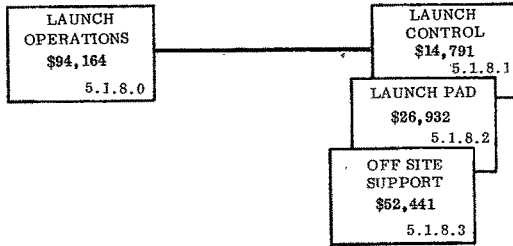
TABLE 5.1.8.0-II
AMLLV COST SUMMARY

A B C

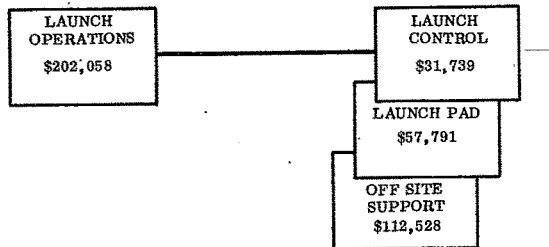
(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING			4889	46835						4,889	46,835
LAB TECHNICIANS											
TOOLING											
PRODUCTION OR OPER			5975	46785						5,975	46,785
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR			10864	93620						10,864	93,620
MATERIAL				544							544
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL				544							544
TOTAL OTHER											
TOTAL COST				94164							94,164

FIXED COSTS - AFTER 2ND LAUNCH



FIXED COSTS - 2 R&D FLIGHT VEHICLES (INCLUDES ADDITIONAL COSTS FOR 9 MONTH CYCLE TIME INCREASED SE&I AND INSTRUMENTATION)



NOTES:

DOLLARS ARE IN THOUSANDS,
 NUMBERS IN LOWER RIGHT CORNER
 DESIGNATE APPLICABLE SECTION
 NUMBER FOR COST DETAILS.

*COSTS SHOWN ABOVE ARE INCREASED
 BY A FACTOR OF APPROXIMATELY
 2.146

FIGURE 5.1.8.0-1 SINGLE STAGE LAUNCH OPERATIONS COST FLOW DIAGRAM

5.1.8.1 Launch Control

TABLE 5.1.8.1-I LAUNCH CONTROL CENTER - SINGLE STAGE - 1 R&D FLIGHT VEHICLE

AMLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	30	349								30	349
PROGRAM PLAN.& REPT.	73	857								73	857
INDUSTRIAL RELATIONS	16	159								16	159
ENGINEERING			186	2317						196	2317
LAB TECHNICIANS											
TOOLING											
PRODUCTION or OPER.			2418	23503						2418	23503
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A			467	4539						467	4539
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABCR	119	1365	3081	30359						3200	31724
MATERIAL				11							11
LOGISTIC HARDWARE											
BURDEN				4							4
TOTAL MATERIAL				15							15
TOTAL OTHER											
TOTAL COST		1365		30374							31739

AMLLV
 PART I
 LAUNCH CONTROL CENTER - S/S
 ASSEMBLY OR SYSTEM

TABLE 5.1.8.1-II

(In Thousands)

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	196		
Logistics			
Laboratory Tech			
Production	2,418		
Tooling			
Manufacturing Test			
Q&RA	467		
Facilities			
Mfg Technician			
Total Direct Labor	<u>3,081</u>		
Program Executive		30	349
Program Planning & Rept.		73	857
Industrial Relations		<u>16</u>	<u>159</u>
Total Labor - Part I		<u>119</u>	<u>1,365</u>
 <u>Material</u>			
Program Planning & Rept.			
Industrial Relations			
Material Subtotal			
Material & Adm. Burden			
Total Material			
TOTAL COST - PART I			<u>1,365</u>

LAUNCH CONTROL CENTER - SINGLE STAGE

TABLE 5.1.8.1-III

AMLLV PART II COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	196	2317							196	2317
LAB TECHNICIANS										
TOOLING										
OPERATIONS			2418	23503					2418	23503
MANUFACTURING TEST										
MANUFACTURING TECH.										
Q & R A			467	4539					467	4539
DIRECT DIST										
TRAINING										
TOTAL DIRECT LABOR	196	2317	2885	28042					3081	30359
MATERIAL										
LAB. TECHNICIANS										
TOOLING										
PRCDUCTION										
MFG. TECHNICIANS										
Q & R A				11						11
SUBTOTAL				11						11
MAT. & ADM. BURDEN				4						4
TOTAL MATERIAL				15						15
TOTAL PART II COST		2317		28057						30374

AMLLV
 RECURRING
 LAUNCH OPERATIONS
 LAUNCH CONTROL CENTER - S/S
 TABLE 5.1.8.1-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Engineering:		
Design Support	<u>196</u>	<u>2,317</u>
TOTAL COST	<u>196</u>	<u>2,317</u>

(In Thousands)

AMLLV
 RECURRING
 LAUNCH OPERATIONS
 LAUNCH CONTROL CENTER - S/S
 TABLE 5.1.8.1-V

<u>Element of Cost</u>	<u>Manhours</u>	(In Thousands) <u>Dollars</u>
Operations:		
Launch Vehicle	1,330	12,927
Technical Support	<u>1,088</u>	<u>10,576</u>
Subtotal	2,418	23,503
Q&RA	<u>467</u>	<u>4,539</u>
Subtotal	<u>2,885</u>	28,042
Material		
Q&RA		11
Material & Adm. Burden		<u>4</u>
Total Material		<u>15</u>
TOTAL COST		<u>28,057</u>

5.1.8.2 Launch Pad

TABLE 5.1.8.2-I
 AMLLV COST SUMMARY

LAUNCH PAD - SINGLE STAGE - 1 R&D FLIGHT VEHICLE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	54	636								54	636
PROGRAM PLAN.& REPT.	132	1,560								132	1,560
INDUSTRIAL RELATIONS	30	289								30	289
ENGINEERING			357	4,219						357	4,219
LAB TECHNICIANS											
TOOLING											
PRODUCTION OR OPER.			4,403	42,794						4,403	42,794
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A			850	8,264						850	8,264
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR	216	2,485	5,610	55,277						5,826	57,762
MATERIAL				22							22
LOGISTIC HARDWARE											
BURDEN				7							7
TOTAL MATERIAL				29							29
TOTAL OTHER											
TOTAL COST		2,485		55,306							57,791

AMLLV

PART I

LAUNCH PAD - S/S
ASSEMBLY OR SYSTEM

TABLE 5.1.8.2-II

(In Thousands)

Element of Cost	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	357		
Logistics			
Laboratory Technician			
Production	4403		
Tooling			
Manufacturing Test			
Q&RS	850		
Facilities			
Manufacturing Technician			
Total Direct Labor	<u>5,610</u>		
Program Executive		54	636
Program Planning & Reporting		132	1,560
Industrial Relations		<u>30</u>	<u>289</u>
Total Labor - Part I		<u>216</u>	<u>2,485</u>
<u>Material</u>			
Program Planning & Reporting			
Industrial Relations			
Material Subtotal			
Material & Administrative Burden			
Total Material			
TOTAL COST - PART I			<u>2,485</u>

TABLE 5.1.8.2-III

AMLLV PART II COST SUMMARY

LAUNCH PAD - SINGLE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	357	4,219							357	4,219
LAB TECHNICIANS										
TOOLING										
OPERATIONS			4,403	42,794					4,403	42,794
MANUFACTURING TEST										
MANUFACTURING TECH.										
Q & R A			850	8,264					850	8,264
DIRECT DIST										
TRAINING										
TOTAL DIRECT LABOR	357	4,219	9,472	51,058					5,610	55,277
MATERIAL										
LAB. TECHNICIANS										
TOOLING										
PRDUCTION										
MFG. TECHNICIANS										
Q & R A				22						22
SUBTOTAL				22						22
MAT. & ADM. BURDEN				7						7
TOTAL MATERIAL				29						29
TOTAL PART II COST		4,219		51,087						55,306

AMLLV
 RECURRING
 LAUNCH OPERATIONS
 DESIGN
LAUNCH PAD -- S/S

TABLE 5.1.8.2-IV

<u>Element of Cost</u>	(In Thousands)	
	<u>Manhours</u>	<u>Dollars</u>
Engineering:		
Design Support	357	4,219
TOTAL COST	<u>357</u>	<u>4,219</u>

AMLLV

RECURRING
LAUNCH OPERATIONS
PRODUCTION
LAUNCH PAD - S/S

TABLE 5.1.8.2-V

<u>Element of Cost</u>	(In Thousands)	
	<u>Manhours</u>	<u>Dollars</u>
Operations:		
Launch Vehicle	2,422	\$23,537
Technical Support	<u>1,981</u>	<u>19,257</u>
Subtotal	4,403	\$42,794
Q&RA	<u>850</u>	<u>8,264</u>
Total Labor	<u>5,253</u>	<u>51,058</u>
Material		
Q&RA		22
Material and Administrative Burden		<u>7</u>
Total Material		<u>29</u>
TOTAL COST		\$51,087

5.1.8.3 Offsite Support

TABLE 5.1.8.3-I OFF-SITE SUPPORT COMPLEX - SINGLE STAGE - 1 R&D FLIGHT VEHICLE
 AMLLV COST SUMMARY

A B C (IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	105	1,238								105	1,238
PROGRAM PLAN. & REPT.	257	3,038								257	3,038
INDUSTRIAL RELATIONS	58	563								58	563
ENGINEERING			696	8,215						696	8,215
LAB TECHNICIANS											
TOOLING											
PRODUCTION OR OPER.			8,573	83,327						8,573	83,327
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A			1,656	16,092						1,656	16,092
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR	420	4,839	10,925	107,634						11,345	112,473
MATERIAL				42							42
LOGISTIC HARDWARE											
BURDEN				13							13
TOTAL MATERIAL				55							55
TOTAL OTHER											
TOTAL COST		4,839		107,689							112,528

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AMLLV

PART I

OFF SITE SUPPORT COMPLEX - S/S
ASSEMBLY OR SYSTEM

TABLE 5.1.8.3-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>(IN THOUSANDS)</u>	
		<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	696		
Logistics			
Laboratory Technician			
Production	8,573		
Tooling			
Manufacturing Test			
Q&RA	1,656		
Facilities			
Manufacturing Technician	_____		
Total Direct Labor	<u>10,925</u>		
Program Executive		105	1,238
Program Planning & Reporting		257	3,038
Industrial Relations		<u>58</u>	<u>563</u>
Total Labor - Part I		<u>420</u>	<u>4,839</u>
<u>Material</u>			
Program Planning & Reporting			
Industrial Relations			
Material Subtotal			
Material & Administrative Burden			
Total Material			
TOTAL COST - PART I			<u>4,839</u>

TABLE 5.1.8.3-III

AMLLV PART II COST SUMMARY - OFF SITE SUPPORT COMPLEX - SINGLE STAGE E C X

IN THOUSANDS

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	696	8,215							696	8,215
LAB TECHNICIANS										
TOOLING										
OPERATIONS			8,573	83,327					8,573	83,327
MANUFACTURING TEST										
MANUFACTURING TECH.										
Q & R A			1,656	16,092					1,656	16,092
DIRECT DIST										
TRAINING										
TOTAL DIRECT LABOR	696	8,215	10,229	99,419					10,925	107,634
MATERIAL										
LAB. TECHNICIANS										
TOOLING										
PRODUCTION										
MFG. TECHNICIANS										
Q & R A				42						42
SUBTOTAL				42						42
MAT. & ADM. BURDEN				13						13
TOTAL MATERIAL				55						55
TOTAL PART II COST		8,215		99,474						107,689

AMLLV
RECURRING
LAUNCH OPERATIONS
DESIGN
OFF SITE SUPPORT COMPLEX
SINGLE STAGE

TABLE 5.1.8.3-IV

<u>Element of Cost</u>	(In Thousands)	
	<u>Manhours</u>	<u>Dollars</u>
Engineering:		
Design Support	696	8,215
TOTAL COST	<u>696</u>	<u>8,215</u>

AMLLV
 RECURRING
 LAUNCH OPERATIONS
 PRODUCTION
 OFF SITE SUPPORT COMPLEX
 SINGLE STAGE

TABLE 5.1.8.3-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u> (IN THOUSANDS)
Operations:		
Launch Vehicle	4,715	45,830
Technical Support	<u>3,858</u>	<u>37,497</u>
Subtotal	8,573	83,327
Q&RA	<u>1,656</u>	<u>16,092</u>
Total Labor	<u>10,229</u>	<u>99,419</u>
Material		
Q&RA		42
Material and Administrative Burden		<u>13</u>
Total Material		<u>55</u>
Total Cost		<u>99,474</u>

5.1.9 Launch Site Maintenance

Launch Site Maintenance includes the costs associated with Brick and Mortar and equipment maintenance for such items as; canals, launch pad, gantry crane, unloading crane, service structure, umbilical tower, propellant storage, transfer and disposal systems, launch and test control center and the off-site support complex.

LAUNCH FACILITY MAINTENANCE - SINGLE STAGE

TABLE 5.1.9.0-I
 AMLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES						8,750					8,750
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR						8,750					8,750
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER											
TOTAL COST						8,750					8,750

AMLLV
RECURRING
*LAUNCH FACILITY MAINTENANCE
SINGLE STAGE
(IN THOUSANDS)

TABLE 5.1.9.0-II

Brick and Mortar	\$7,000
Equipment	<u>1,750</u>
Total	<u><u>\$8,750</u></u>

* Maintenance for six (6) months or for one (1) vehicle.

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5.1.10 Manufacturing Facility Maintenance and Transportation

Maintenance costs include costs for maintenance of the manufacturing building, the vertical assembly building, post manufacturing and stage test building, the office building, and the capital equipment.

Transportation costs include costs for such items as the barges (for stage transportation), the tow vehicle, the land transporter, and the cost for the barge trip from the manufacturing facility to the launch site.

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AMLLV FACILITIES MAINTENANCE & TRANSPORTATION - SINGLE STAGE

TABLE 5.1.10-I
AMLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
	PROGRAM EXECUTIVE										
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES						4,380					4,380
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR						4,380					4,380
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER											
TOTAL COST						4,380					4,380

AMLLV
RECURRING COST SUMMARY

SINGLE STAGE
FACILITIES & TRANSPORTATION
(DOLLARS IN THOUSANDS)
TABLE 5.1.10-II

<u>Element of Cost</u>	<u>Facilities</u>	<u>Equipment</u>	<u>Transportation</u>
Manufacturing Bldg.	4,631	1,984	
Vertical Assy. Bldg.	137	59	
Post Mfg. & Stage Test Bldg.	75	37	
Liquid Engine Mfg. Bldg.			
Office	<u>1,095</u>	<u>2,574</u>	
Subtotal	<u><u>5,938</u></u>	<u><u>2,654</u></u>	
 <u>Transportation</u>			
Barge			90
Tow Vehicle			2
Land Transporter			<u>6</u>
Subtotal			<u><u>98</u></u>
 Totals			
Transportation			98
Equipment			2,654
Facilities			5,938
Barge Trips *			<u>70</u>
MANUFACTURING FACILITIES COST			<u><u>8,760</u></u>
Recurring Cost for one vehicle or six months			<u><u>4,380</u></u>

* Barge trips are estimated @ 4 per year.

$$4 \times \$17,500 = \$70,000$$

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5.1.11 Systems Engineering and Integration (SE&I)

The Systems Engineering and Integration costs per vehicle were based on the Saturn V cost data submitted to the Chrysler Corporation in support of the "National Space Booster Study". The costs include support activity relative to:

- a. Systems Management
- b. Pre-Flight Analysis and Planning
- c. Post-Flight Data Evaluation
- d. Documentation

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TABLE 5.1.11-1

AMLLV COST SUMMARY

SYSTEMS EVALUATION & INTEGRATION-SINGE STAGE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
	PROGRAM EXECUTIVE										
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER									5,301		5,301
TOTAL COST									5,301		5,301

5.2 ENGINE MODULE - INJECTION STAGE

The summary costs for the first unit injection stage - engine module are displayed in Figure 5.2.0.0-1. These costs include not only the hardware, but all the costs associated with launching the stage and maintaining that portion of the facility associated with the engine module. Table 5.2.0.0-I summarized the cost of the engine module by part and by element of costs for the first R&D flight vehicles.

Table 5.2.0.0-II displays (for reference) the costs for the first operational vehicle (third unit).

TABLE 5.2.0.0-I TOTAL ENGINE MODULE - 1 R&D LAUNCH VEHICLE
 AMLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
	PROGRAM EXECUTIVE	29	349								
PROGRAM PLAN.& REPT.	74	868								36	417
INDUSTRIAL RELATIONS	15	159								7	75
ENGINEERING			226	2,912			19	227		1,011	10,242
LAB TECHNICIANS			25	244						25	244
TOOLING			44	732						44	732
PRODUCTION OR CPER.			1,963	22,185						1,751	18,107
MANUFACTURING TEST			34	512						34	512
MANUFACTURING TECH.			17	208						17	208
Q & RA			448	364	4					202	1,973
FACILITIES					15	1,552				15	1,552
DIRECT DIST			209	2,034						209	2,034
TRAINING			10	106						10	106
TOTAL DIRECT LABOR		1,376		33,297	15	1,552	19	227		3,375	36,368
MATERIAL				2,271							2,356
LOGISTIC HARDWARE								1,070			1,070
BURDEN				771				365			1,135
TOTAL MATERIAL				3,042				1,435			4,561
TOTAL OTHER									730		730
TOTAL COST		1,376		36,699		1,552		1,662	730		41,659

TOTAL ENGINE MODULE - OPERATIONAL VEHICLES
(THIRD VEHICLE AND SUBSEQUENT VEHICLES)

TABLE 5.2.0.0-II
AWLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	14	166								14	166
PROGRAM PLAN. & REPT.	36	417								36	417
INDUSTRIAL RELATIONS	7	75								7	75
ENGINEERING			386	4203			19	227		405	4,430
LAB TECHNICIANS			25	244						25	244
TOOLING			44	732						44	732
PRODUCTION OR OPER			1010	12309						1,010	12,309
MANUFACTURING TEST			34	512						34	512
MANUFACTURING TECH.			17	208						17	208
Q & R A			202	1973						202	1,973
FACILITIES					15	1552				15	1,552
DIRECT DIST			209	2034						209	2,034
TRAINING			10	106						10	106
TOTAL DIRECT LABOR	57	658	1937	22321	15	1552	19	227		2,028	24,758
MATERIAL				2291							2,291
LOGISTIC HARDWARE							1070				1,070
BURDEN				770			365				1,135
TOTAL MATERIAL				3061			1435				4,496
TOTAL OTHER									730		730
TOTAL COST		658		25382	1552		1662		730		29,984

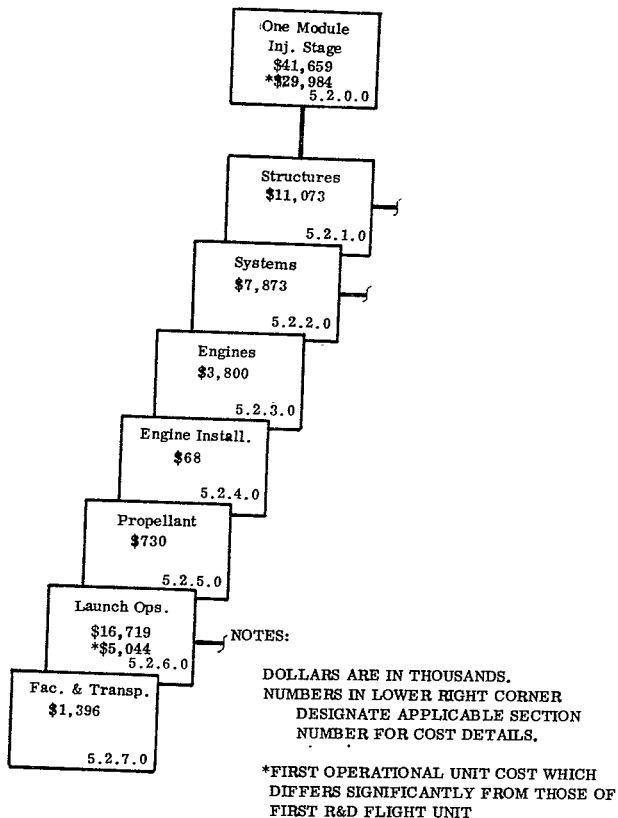


FIGURE 5.2.0.0-1 ENGINE MODULE INJECTION STAGE COST FLOW DIAGRAM

5.2.1 Structures

The first unit production cost for the structural components of the engine module are displayed in Figure 5.2.1.0-1. The cost details of the structural components are contained in appropriate subparagraphs as indicated. Table 5.1.1.0-I is a total cost summary of these structures.

TABLE 5.2.1.0-I
AMLLV COST SUMMARY

TOTAL STRUCTURE - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	9	104								9	104
PROGRAM PLAN. & REPT.	23	260								23	260
INDUSTRIAL RELATIONS	5	47								5	47
ENGINEERING			67	814			11	124		78	938
LAB TECHNICIANS			14	133						14	133
TOOLING			29	284						29	284
PRODUCTION			442	4,294						442	4,294
MANUFACTURING TEST			21	201						21	201
MANUFACTURING TECH.			11	132						11	132
Q & R A			127	1,232						127	1,232
FACILITIES					10	99				10	99
DIRECT DIST			121	1,183						121	1,183
TRAINING			6	66						6	66
TOTAL DIRECT LABOR	37	411	838	8,339	10	99	11	124		896	8,973
MATERIAL				980							980
LOGISTIC HARDWARE								586			586
BURDEN				333				201			534
TOTAL MATERIAL				1,313				787			2,100
TOTAL OTHER											
TOTAL COST		411		9,652		99		911			11,073

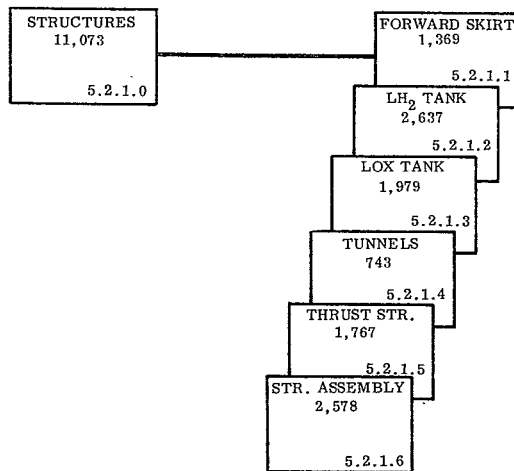


FIGURE 5.2.1.0-1 ENGINE MODULE STRUCTURES COST FLOW DIAGRAM

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5.2.1.1 Forward Skirt

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TABLE 5.2.1.1-I
 AMLLV COST SUMMARY

FORWARD SKIRT - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	1	12								1	12
PROGRAM PLAN. & REPT.	2	29								2	29
INDUSTRIAL RELATIONS	1	5								1	5
ENGINEERING			2	20				3		2	23
LAB TECHNICIANS				3							3
TOOLING			3	33						3	33
PRODUCTION			55	537						55	537
MANUFACTURING TEST			3	25						3	25
MANUFACTURING TECH.			1	17						1	17
Q & R A			16	151						16	151
FACILITIES					1	12				1	12
DIRECT DIST			15	150						15	150
TRAINING			1	8						1	8
TOTAL DIRECT LABOR	4	46	96	944	1	12		3		101	1,005
MATERIAL				257							257
LOGISTIC HARDWARE								14			14
BURDEN				88				5			93
TOTAL MATERIAL				345				19			364
TOTAL OTHER											
TOTAL COST		46		1,289		12		22			1,369

AMLLV

PART I

FORWARD SKIRT - E/M
ASSEMBLY OR SYSTEM

TABLE 5.2.1.1-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	1,661		
Logistics	251		
Laboratory Technician	332		
Production	55,222		
Tooling	3,392		
Manufacturing Test	2,570		
Q&RA	15,566		
Facilities	1,272		
Manufacturing Technician	<u>1,386</u>		
Total Direct Labor	<u>81,652</u>		
Program Executive		980	11,571
Program Planning & Reporting		2,450	28,929
Industrial Relations		<u>531</u>	<u>5,158</u>
Total Labor - Part I		<u>3,961</u>	<u>45,658</u>
<u>Material</u>			
Program Planning & Reporting			49
Industrial Relations			<u>53</u>
Material Subtotal			102
Material & Administrative Burden			<u>35</u>
Total Material			<u>137</u>
TOTAL COST - PART I			<u>45,795</u>

TABLE 5.2.1.1-III
 AMLLV PART II COST SUMMARY

FORWARD SKIRT - E/M

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	2	20							2	20
LAB TECHNICIANS		3								3
TOOLING					3	33			3	33
PRODUCTION			55	537					55	537
MANUFACTURING TEST							3	25	3	25
MANUFACTURING TECH.			1	16				1	1	17
Q & R A		1	14	135	1	9	1	7	16	152
DIRECT DIST			14	132	1	11	1	8	16	151
TRAINING			1	7					1	7
TOTAL DIRECT LABOR	2	24	85	827	5	53	5	41	97	945
MATERIAL										
LAB. TECHNICIANS		1								1
TOOLING						6				6
PRODUCTION				244						244
MFG. TECHNICIANS				2						2
Q & R A				4						4
SUBTOTAL		1		250		6				257
MAT. & ADM. BURDEN				85		2				87
TOTAL MATERIAL		1		335		8				344
TOTAL PART II COST		25		1,162		61		41		1,289

AMLLV
PART II
ENGINEERING

FORWARD SKIRT - E/M
ASSEMBLY OR SYSTEM
TABLE 5.2.1.1-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Design Development	1,627	19,215
Reliability Engineering	<u>34</u>	<u>401</u>
(1) Subtotal (A)	1,661	19,616
(2) Laboratory Technicians	<u>332</u>	<u>3,227</u>
Subtotal (B)	1,993	22,843
(3) Q&RA	<u>66</u>	<u>642</u>
Total Engineering Labor	<u>2,059</u>	<u>23,485</u>
Material		
(4) Lab. Tech.		697
(5) Q&RA		<u>20</u>
Subtotal (C)		717
(6) Material & Adm. Burden		<u>244</u>
Total Material		<u>961</u>
Total Engineering Cost		<u>24,446</u>

AMLLV
PART II
MANUFACTURING
PRODUCTION

FORWARD SKIRT - E/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.2.1.1-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	38,935	378,448
(2) Miscellaneous Charges	3,037	29,520
(3) Maintain & Add in Scope Changes	428	4,160
Subtotal (A)	<u>42,400</u>	<u>412,128</u>
(4) Tool & Production Planning	<u>12,822</u>	<u>124,630</u>
Subtotal (B)	55,222	536,758
(5) Direct Distributable	<u>13,568</u>	<u>131,881</u>
Subtotal (C)	68,790	668,639
(6) Training	<u>757</u>	<u>7,358</u>
Subtotal (D)	69,547	675,997
(7) Q&RA	13,909	135,195
(8) Mfg. Tech.	<u>1,321</u>	<u>15,601</u>
Total Production Labor	<u>84,777</u>	<u>826,793</u>
 <u>Material</u>		
(9) Raw Material & Standards		243,543
(10) Q&RA		4,173
(11) Mfg. Tech.		<u>2,312</u>
Material Subtotal		250,028
(12) Material & Adm. Burden		<u>85,010</u>
Total Material		<u>335,038</u>
Total Production Cost		<u>1,161,831</u>

AMLLV
PART II
MANUFACTURING
TOOLING

FORWARD SKIRT - E/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.2.1.1.1-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	3,392	32,970
(2) Direct Distributable	<u>1,085</u>	<u>10,546</u>
Subtotal (A)	4,477	43,516
(3) Training	<u>49</u>	<u>476</u>
Subtotal (B)	4,526	43,992
(4) Q&RA	<u>905</u>	<u>8,797</u>
Total Tooling Labor	<u><u>5,431</u></u>	<u><u>52,789</u></u>
 Material		
(5) Tooling		5,936
(6) Q&RA		<u>272</u>
Subtotal (C)		6,208
(7) Material & Adm. Burden		<u>2,111</u>
Total Material		<u><u>8,319</u></u>
Total Tooling Cost		<u><u>61,108</u></u>

AMLLV
 PART II
 MANUFACTURING
 MANUFACTURING TEST
FORWARD SKIRT - E/M
 ASSEMBLY OR SYSTEM
 1ST UNIT COST
 TABLE 5.2.1.1-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	1,947	18,925
Component Test Planning	<u>623</u>	<u>6,056</u>
(1) Subtotal (A)	2,570	24,981
(2) Direct Distributable	<u>822</u>	<u>7,994</u>
Subtotal (B)	3,392	32,974
(3) Training	<u>37</u>	<u>363</u>
Subtotal (C)	3,429	33,337
(4) Mfg. Tech.	<u>65</u>	<u>769</u>
Subtotal (D)	3,494	34,106
(5) Q&RA	<u>686</u>	<u>6,667</u>
Total Mfg. Test Labor	<u>4,180</u>	<u>40,773</u>
Material		
(6) Q&RA		206
(7) Mfg. Tech.		<u>114</u>
Subtotal (E)		320
(8) Material & Adm. Burden		<u>109</u>
Total Material		<u>429</u>
Total Mfg. Test Cost		<u>41,202</u>

AMLLV
PART III
FACILITY LABOR

FORWARD SKIRT - E/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.2.1.1-VIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	<u>1,272</u>	<u>12,364</u>
TOTAL FACILITY LABOR COST		<u><u>12,364</u></u>

AMLLV
 PART IV
 LOGISTIC LABOR
 FORWARD SKIRT - E/M
 TABLE 5.2.1.1-IX

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Engineering	<u>251</u>	<u>2,964</u>
(2) Hardware		14,056
(3) Material & Adm. Burden		<u>4,779</u>
Total Material		<u>18,835</u>
Total Logistic Cost		<u>21,799</u>

5.2.1.2 LH₂ Tank

TABLE 5.2.1.2-1
 AMLLV COST SUMMARY

LH₂ TANK - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	2	25								2	25
PROGRAM PLAN. & REPT.	6	63								6	63
INDUSTRIAL RELATIONS	1	12								1	12
ENGINEERING			12	147			2	22		14	169
LAB TECHNICIANS			2	24						2	24
TOOLING			7	67						7	67
PRODUCTION			112	1,086						112	1,086
MANUFACTURING TEST			5	51						5	51
MANUFACTURING TECH.			3	33						3	33
Q & RA			32	310						32	310
FACILITIES					3	25				3	25
DIRECT DIST			31	304						31	304
TRAINING			2	17						2	17
TOTAL DIRECT LABOR	9	100	206	2,039	3	25	2	22		220	2,186
MATERIAL				231							231
LOGISTIC HARDWARE								105			105
BURDEN				79				36			115
TOTAL MATERIAL				310				141			451
TOTAL OTHER											
TOTAL COST		100		2,349		25		163			2,637

AMLLV

PART I

LH₂ TANK - E/M
ASSEMBLY OR SYSTEM

TABLE 5.2.1.2-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	12,461		
Logistics	1,879		
Laboratory Technician	2,492		
Production	111,769		
Tooling	6,865		
Manufacturing Test	5,194		
Q&RA	31,869		
Facilities	2,575		
Manufacturing Technician	<u>2,806</u>		
Total Direct Labor	<u>177,910</u>		
Program Executive		2,135	25,213
Program Planning & Reporting		5,337	63,034
Industrial Relations		<u>1,156</u>	<u>11,240</u>
Total Labor - Part I		<u>8,629</u>	<u>99,487</u>
<u>Material</u>			
Program Planning & Reporting			107
Industrial Relations			<u>116</u>
Material Subtotal			223
Material & Administrative Burden			<u>76</u>
Total Material			<u>299</u>
TOTAL COST - PART I			<u>99,786</u>

TABLE 5.2.1.2-III

AMLLV PART II COST SUMMARY LH₂ TANK - E/MA B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	12	147							12	147
LAB TECHNICIANS	2	24							2	24
TOOLING					7	67			7	67
PRODUCTION			112	1,086					112	1,086
MANUFACTURING TEST							5	50	5	50
MANUFACTURING TECH.			3	32				2	3	34
Q & R A	1	5	28	274	2	18	1	13	32	310
DIRECT DIST			27	267	2	21	2	16	31	304
TRAINING			2	15		1		1	2	17
TOTAL DIRECT LABOR	15	176	172	1,674	11	107	8	82	206	2,039
MATERIAL										
LAB. TECHNICIANS		5								5
TOOLING						12				12
PRODUCTION				200						200
MFG. TECHNICIANS				5						5
Q & R A				8		1		1		10
SUBTOTAL		5		213		13		1		232
MAT. & ADM. BURDEN		2		72		4				78
TOTAL MATERIAL		7		285		117		1		310
TOTAL PART II COST		183		1,959		124		83		2,349

AMLLV
PART II
ENGINEERING

LH₂ TANK - E/M
ASSEMBLY OR SYSTEM
TABLE 5.2.1.2-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Design Development	12,203	144,117
Reliability Engineering	<u>258</u>	<u>3,057</u>
(1) Subtotal (A)	12,461	147,164
(2) Laboratory Technicians	<u>2,492</u>	<u>24,222</u>
Subtotal (B)	14,953	171,386
(3) Q&RA	<u>498</u>	<u>4,841</u>
Total Engineering Labor	<u>15,451</u>	<u>176,227</u>
Material		
(4) Lab. Tech.		5,233
(5) Q&RA		<u>149</u>
Subtotal (C)		5,382
(6) Material & Adm. Burden		<u>1,830</u>
Total Material		<u>7,212</u>
Total Engineering Cost		<u>183,349</u>

AMLLV
PART II
MANUFACTURING
PRODUCTION
LH₂ TANK - E/M

ASSEMBLY OR SYSTEM
1ST UNIT COST
TABLE 5.2.1.2-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	78,804	\$ 765,975
(2) Miscellaneous Charges	6,147	59,749
(3) Maintain & Add in Scope Changes	<u>867</u>	<u>8,427</u>
Subtotal (A)	85,818	834,151
(4) Tool & Production Planning	<u>25,951</u>	<u>252,244</u>
Subtotal (B)	111,769	1,086,395
(5) Direct Distributable	<u>27,462</u>	<u>266,930</u>
Subtotal (C)	139,231	1,353,325
(6) Training	<u>1,532</u>	<u>14,891</u>
Subtotal (D)	140,763	1,368,216
(7) Q&RA	28,153	273,647
(8) Mfg. Tech.	<u>2,674</u>	<u>31,580</u>
Total Production Labor	<u>171,590</u>	<u>\$ 1,673,443</u>
 Material		
(9) Raw Material & Standards		\$ 199,700
(10) Q&RA		8,446
(11) Mfg. Tech.		<u>4,680</u>
Material Subtotal		212,826
(12) Material & Adm. Burden		<u>72,361</u>
Total Material		<u>285,187</u>
Total Production Cost		<u>\$ 1,958,630</u>

AMLLV
PART II
MANUFACTURING
TOOLING

LH₂ TANK - E/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.2.1.2-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	6,865	\$ 66,728
(2) Direct Distributable	<u>2,197</u>	<u>21,355</u>
Subtotal (A)	9,062	88,083
(3) Training	<u>100</u>	<u>972</u>
Subtotal (B)	9,162	89,055
(4) Q&RA	<u>1,832</u>	<u>17,807</u>
Total Tooling Labor	<u>10,994</u>	<u>\$ 106,862</u>
 Material		
(5) Tooling		12,014
(6) Q&RA		<u>550</u>
Subtotal (C)		12,564
(7) Material & Adm. Burden		<u>4,272</u>
Total Material		<u>16,836</u>
Total Tooling Cost		<u>\$ 123,698</u>

AMLLV
PART II
MANUFACTURING
MANUFACTURING TEST

LH₂ TANK - E/M
ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.2.1.2-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	3,935	38,248
Component Test Planning	<u>1,259</u>	<u>12,239</u>
(1) Subtotal (A)	5,194	50,487
(2) Direct Distributable	<u>1,662</u>	<u>16,156</u>
Subtotal (B)	6,856	66,643
(3) Training	<u>75</u>	<u>733</u>
Subtotal (C)	6,931	67,376
(4) Mfg. Tech.	<u>132</u>	<u>1,555</u>
Subtotal (D)	7,063	68,931
(5) Q&RA	<u>1,386</u>	<u>13,475</u>
Total Mfg. Test Labor	<u><u>8,449</u></u>	<u><u>82,406</u></u>
Material		
(6) Q&RA		416
(7) Mfg. Tech.		<u>230</u>
Subtotal (E)		646
(8) Material & Adm. Burden		<u>220</u>
Total Material		<u><u>866</u></u>
Total Mfg. Test Cost		<u><u>83,272</u></u>

AMLLV
PART III
FACILITY LABOR

LH₂ TANK - E/M
ASSEMBLY OR SYSTEM
1ST UNIT COST
TABLE 5.2.1.2-VIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	<u>2,575</u>	<u>\$ 25,029</u>
TOTAL FACILITY LABOR COST		<u><u>\$ 25,029</u></u>

AMLLV
 PART IV
 LOGISTIC LABOR
LH₂ TANK - E/M
 ASSEMBLY OR SYSTEM
 TABLE 5.2.1.2-IX

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Engineering	1,879	22,191
Hardware		105,224
Material & Adm. Burden		35,776
Total Material		141,000
Total Logistic Cost		163,191

5.2.1.3 LOX Tank

TABLE 5.2.1.3-I
 AMLLV COST SUMMARY

LOX TANK - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	2	19								2	19
PROGRAM PLAN. & REPT.	4	49								4	49
INDUSTRIAL RELATIONS	1	9								1	9
ENGINEERING			12	147			2	22		14	169
LAB TECHNICIANS			3	24						3	24
TOOLING			5	50						5	50
PRODUCTION			84	816						84	816
MANUFACTURING TEST			4	38						4	38
MANUFACTURING TECH.			2	25						2	25
Q & R A			24	234						24	234
FACILITIES					2	19				2	19
DIRECT DIST			24	229						24	229
TRAINING			1	12						1	12
TOTAL DIRECT LABOR	7	77	159	1,575	2	19	2	22		170	1,693
MATERIAL				108							108
LOGISTIC HARDWARE								105			105
BURDEN				37				36			73
TOTAL MATERIAL				145				141			286
TOTAL OTHER											
TOTAL COST		77		1,720		19		163			1,979

AMLLV

PART I

LOX TANK - E/M
ASSEMBLY OR SYSTEM

TABLE 5.2.1.3-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	12,461		
Logistics	1,879		
Laboratory Technician	2,492		
Production	83,937		
Tooling	5,156		
Manufacturing Test	3,906		
Q&RA	24,508		
Facilities	1,933		
Manufacturing Technician	<u>2,107</u>		
Total Direct Labor	<u>137,929</u>		
Program Executive		1,655	19,547
Program Planning & Reporting		4,138	48,867
Industrial Relations		<u>897</u>	<u>8,714</u>
Total Labor - Part I		<u>6,690</u>	<u>77,128</u>
<u>Material</u>			
Program Planning & Reporting			83
Industrial Relations			<u>90</u>
Material Subtotal			173
Material & Administrative Burden			<u>59</u>
Total Material			<u>232</u>
TOTAL COST - PART I			<u>77,360</u>

TABLE 5.2.1.3-III

LOX TANK - E/M

AMLLV PART II COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	12	147							12	147
LAB TECHNICIANS	2	24							2	24
TOOLING					5	50			5	50
PRODUCTION			84	816					84	816
MANUFACTURING TEST							4	38	4	38
MANUFACTURING TECH.			2	24				1	2	25
Q & R A	1	5	21	206	1	13	1	10	24	234
DIRECT DIST			21	200	2	16	1	12	24	228
TRAINING			1	11		1		1	1	13
TOTAL DIRECT LABOR	15	176	129	1,257	8	80	6	62	158	1,575
MATERIAL		5								5
LAB. TECHNICIANS										
TOOLING						9				9
PRODUCTION				83						83
MFG. TECHNICIANS				4						4
Q & R A				6		1		1		8
SUBTOTAL		5		93		10		1		109
MAT. & ADM. EXPENSE		2		31		3				36
TOTAL MATERIAL		7		124		13		1		145
TOTAL PART II COST		183		1,381		93		63		1,720

AMLIV
 PART II
 ENGINEERING
LOX TANK - E/M
 ASSEMBLY OR SYSTEM
 TABLE 5.2.1.3-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Design Development	12,203	144,117
Reliability Engineering	<u>258</u>	<u>3,047</u>
(1) Subtotal (A)	12,461	147,164
(2) Laboratory Technicians	<u>2,492</u>	<u>24,222</u>
Subtotal (B)	14,953	171,386
(3) Q&RA	<u>498</u>	<u>4,841</u>
Total Engineering Labor	<u>15,451</u>	<u>176,227</u>
Material		
(4) Lab. Tech.		5,233
(5) Q&RA		<u>149</u>
Subtotal (C)		5,382
(6) Material & Adm. Burden		<u>1,830</u>
Total Material		<u>7,212</u>
Total Engineering Cost		<u>183,349</u>

AMLLV
PART II.
MANUFACTURING
PRODUCTION

LOX TANK - E/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.2.1.3-V

<u>Element of Cost</u>	<u>Mainhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	59,181	575,239
(2) Miscellaneous Charges	4,616	44,868
(3) Maintain & Add in Scope Changes	<u>651</u>	<u>6,328</u>
Subtotal (A)	64,448	626,435
(4) Tool & Production Planning	<u>19,489</u>	<u>189,433</u>
Subtotal (B)	83,937	815,868
(5) Direct Distributable	<u>20,623</u>	<u>200,455</u>
Subtotal (C)	104,560	1,016,323
(6) Training	<u>1,150</u>	<u>11,178</u>
Subtotal (D)	105,710	1,027,501
(7) Q&RA	21,142	205,500
(8) Mfg. Tech.	<u>2,008</u>	<u>23,714</u>
Total Production Labor	<u><u>128,860</u></u>	<u><u>1,256,715</u></u>
 Material		
(9) Raw Material & Standards		82,733
(10) Q&RA		6,343
(11) Mfg. Tech.		<u>3,514</u>
Material Subtotal		92,590
(12) Material & Adm. Burden		<u>31,481</u>
Total Material		<u><u>124,071</u></u>
Total Production Cost		<u><u>1,380,786</u></u>

AMLLV
PART II
MANUFACTURING
TOOLING

LOX TANK - E/M
ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.2.1.3-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	5,156	50,116
(2) Direct Distributable	<u>1,650</u>	<u>16,038</u>
Subtotal (A)	6,806	66,154
(3) Training	<u>75</u>	<u>729</u>
Subtotal (B)	6,881	66,883
(4) Q&RA	<u>1,376</u>	<u>13,375</u>
Total Tooling Labor	<u><u>8,257</u></u>	<u><u>80,258</u></u>
 Material		
(5) Tooling		9,023
(6) Q&RA		<u>413</u>
Subtotal (C)		9,436
(7) Material & Adm. Burden		<u>3,208</u>
Total Material		<u><u>12,644</u></u>
Total Tooling Cost		<u><u>92,902</u></u>

AMLLV
PART II
MANUFACTURING
MANUFACTURING TEST

LOX TANK - E/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.2.1.3-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	2,959	28,761
Component Test Planning	<u>947</u>	<u>9,203</u>
(1) Subtotal (A)	3,906	37,964
(2) Direct Distributable	<u>1,250</u>	<u>12,148</u>
Subtotal (B)	5,156	50,112
(3) Training	<u>57</u>	<u>551</u>
Subtotal (C)	5,213	50,663
(4) Mfg. Tech.	<u>99</u>	<u>1,169</u>
Subtotal (D)	5,312	51,832
(5) Q&RA	<u>1,042</u>	<u>10,132</u>
Total Mfg. Test Labor	<u><u>6,354</u></u>	<u><u>61,694</u></u>
Material		
(6) Q&RA		313
(7) Mfg. Tech.		<u>173</u>
Subtotal (E)		486
(8) Material & Adm. Burden		<u>165</u>
Total Material		<u><u>651</u></u>
Total Mfg. Test Cost		<u><u>62,615</u></u>

AMLLV
PART III
FACILITY LABOR

LOX TANK - E/M
ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.2.1.3-VIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	<u>1,933</u>	<u>\$ 18,789</u>
TOTAL FACILITY LABOR COST		<u><u>\$ 18,789</u></u>

AMLLV
 PART IV
 LOGISTIC LABOR
 LOX TANK - E/M
 TABLE 5.2.1.3-IX

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Engineering	<u>1,879</u>	<u>22,191</u>
(2) Hardware		105,224
(3) Material & Adm. Burden		<u>33,776</u>
Total Material		<u>141,000</u>
Total Logistic Cost		<u>163,191</u>

5.2.1.4

Tunnels

TABLE 5.2.1.4-I
AMLLV COST SUMMARY

TUNNELS - ENGINE MODULE

A B C X

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	1	7								1	7
PROGRAM PLAN. & REPT.	2	18								2	18
INDUSTRIAL RELATIONS		3									3
ENGINEERING			8	98			1	15		9	113
LAB TECHNICIANS			2	16						2	16
TOOLING			2	16						2	16
PRODUCTION			27	262						27	262
MANUFACTURING TEST			1	12						1	12
MANUFACTURING TECH.			1	8						1	8
Q & R A			8	77						8	77
FACILITIES					1	6				1	6
DIRECT DIST			7	74						7	74
TRAINING				4							4
TOTAL DIRECT LABOR	3	28	56	567	1	6	1	15		61	616
MATERIAL				25							25
LOGISTIC HARDWARE								70			70
BURDEN				8				24			32
TOTAL MATERIAL				33				94			127
TOTAL OTHER											
TOTAL COST		28		600	6		109				743

AMLLV

PART I

TUNNELS - E/M

ASSEMBLY OR SYSTEM

TABLE 5.2.1.4-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	8,308		
Logistics	1,252		
Laboratory Technician	1,662		
Production	26,948		
Tooling	1,655		
Manufacturing Test	1,254		
Q&RA	7,897		
Facilities	621		
Manufacturing Technician	<u>677</u>		
Total Direct Labor	<u>50,274</u>		
Program Executive		603	7,124
Program Planning & Reporting		1,508	17,812
Industrial Relations		<u>327</u>	<u>3,176</u>
Total Labor - Part I		<u>2,438</u>	<u>28,112</u>
<u>Material</u>			
Program Planning & Reporting			30
Industrial Relations			<u>33</u>
Material Subtotal			63
Material & Administrative Burden			<u>21</u>
Total Material			<u>84</u>
TOTAL COST - PART I			<u>28,196</u>

TABLE 5.2.1.4-III

AMLLV PART II CCST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	8	98							8	98
LAB TECHNICIANS	2	16							2	16
TOOLING					2	16			2	16
PRODUCTION			27	262					27	262
MANUFACTURING TEST							1	12	1	12
MANUFACTURING TECH.			1	7				1	1	8
Q & R A		3	7	66		5		3	7	77
DIRECT DIST			6	65	1	5	1	4	8	74
TRAINING				4						4
TOTAL DIRECT LABOR	10	117	41	404	3	26	2	20		567
MATERIAL										
LAB. TECHNICIANS		4								4
TOOLING						3				3
PRODUCTION				15						15
MFG. TECHNICIANS				1						1
Q & R A				2						2
SUBTOTAL		4		18		3				25
MAT. & ADM. BURDEN		1		6		1				8
TOTAL MATERIAL		5		24		4				33
TOTAL PART II COST		122		428		30		20		600

AMLLV
PART II
ENGINEERING

TUNNELS - E/M

ASSEMBLY OR SYSTEM

TABLE 5.2.1.4-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Design Development	8,136	96,086
Reliability Engineering	<u>172</u>	<u>2,031</u>
(1) Subtotal (A)	8,308	98,117
(2) Laboratory Technicians	<u>1,662</u>	<u>16,155</u>
Subtotal (B)	9,965	114,273
(3) Q&RA	<u>332</u>	<u>3,227</u>
Total Engineering Labor	<u>10,297</u>	<u>117,500</u>
Material		
(4) Lab. Tech.		3,490
(5) Q&RA		<u>100</u>
Subtotal (C)		3,590
(6) Material & Adm. Burden		<u>1,221</u>
Total Material		<u>4,811</u>
Total Engineering Cost		<u>122,312</u>

AMLLV
PART II
MANUFACTURING
PRODUCTION

TUNNELS - E/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.2.1.4-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	19,000	\$ 184,680
(2) Miscellaneous Charges	1,482	14,405
(3) Maintain & Add in Scope Changes	<u>209</u>	<u>2,031</u>
Subtotal (A)	20,691	201,116
(4) Tool & Production Planning	<u>6,257</u>	<u>60,818</u>
Subtotal (B)	26,948	261,934
(5) Direct Distributable	<u>6,621</u>	<u>64,356</u>
Subtotal (C)	33,569	326,290
(6) Training	<u>369</u>	<u>3,587</u>
Subtotal (D)	33,938	329,877
(7) Q&RA	6,788	65,979
(8) Mfg. Tech.	<u>645</u>	<u>7,617</u>
Total Production Labor	<u>41,371</u>	<u>\$ 403,473</u>
 Material		
(9) Raw Material & Standards		\$ 14,685
(10) Q&RA		2,036
(11) Mfg. Tech.		<u>1,129</u>
Material Subtotal		17,850
(12) Material & Adm. Burden		<u>6,069</u>
Total Material		<u>23,919</u>
Total Production Cost		<u>\$ 427,392</u>

AMLLV
PART II
MANUFACTURING
TOOLING

TUNNELS - E/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.2.1.4-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	1,655	\$ 16,087
(2) Direct Distributable	<u>530</u>	<u>5,151</u>
Subtotal (A)	2,185	21,238
(3) Training	<u>24</u>	<u>233</u>
Subtotal (B)	2,209	21,471
(4) Q&RA	<u>442</u>	<u>4,296</u>
Total Tooling Labor	<u>2,651</u>	<u>\$ 25,767</u>
 Material		
(5) Tooling		\$ 2,896
(6) Q&RA		<u>133</u>
Subtotal (C)		3,029
(7) Material & Adm. Burden		<u>1,030</u>
Total Material		<u>4,059</u>
Total Tooling Cost		<u>\$ 29,826</u>

AMLLV
PART II
MANUFACTURING
MANUFACTURING TEST

TUNNELS - E/M
ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.2.1.4-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	950	9,234
Component Test Planning	<u>304</u>	<u>2,955</u>
(1) Subtotal (A)	1,254	12,189
(2) Direct Distributable	<u>401</u>	<u>3,900</u>
Subtotal (B)	1,655	16,089
(3) Training	<u>18</u>	<u>177</u>
Subtotal (C)	1,673	16,266
(4) Mfg. Tech.	<u>32</u>	<u>374</u>
Subtotal (D)	1,705	16,640
(5) Q&RA	<u>335</u>	<u>3,252</u>
Total Mfg. Test Labor	<u>2,040</u>	<u>19,892</u>
 Material		
(6) Q&RA		100
(7) Mfg. Tech.		<u>55</u>
Subtotal (E)		155
(8) Material & Adm. Burden		<u>53</u>
Total Material		<u>208</u>
Total Mfg. Test Cost		<u>20,100</u>

AMLLV
PART III
FACILITY LABOR

TUNNELS - E/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.2.1.4-VIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	<u>621</u>	<u>\$ 6,036</u>
TOTAL FACILITY LABOR COST		<u>\$ 6,036</u>

AMLLV
 PART IV
 LOGISTIC LABOR
TUNNELS - E/M
 ASSEMBLY OR SYSTEM
 TABLE 5.2.1.4-IX

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Engineering	1,252	<u>14,786</u>
(2) Hardware		70,112
(3) Material & Adm. Burden		<u>23,838</u>
Total Material		<u>93,950</u>
Total Logistic Cost		<u>108,736</u>

5.2.1.5 Thrust Structure

TABLE 5.2.1.5-I
 AMLLV COST SUMMARY

THRUST STRUCTURE - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	1	14								1	14
PROGRAM PLAN. & REPT.	3	35								3	35
INDUSTRIAL RELATIONS	1	6								1	6
ENGINEERING			10	123			2	19		12	142
LAB TECHNICIANS			2	20						2	20
TOOLING			4	35						4	35
PRODUCTION			59	571						59	571
MANUFACTURING TEST			3	27						3	27
MANUFACTURING TECH.			1	18						1	18
Q & R A			17	164						17	164
FACILITIES					1	13				1	13
DIRECT DIST			16	160						16	160
TRAINING			1	9						1	9
TOTAL DIRECT LABOR	5	55	113	1,127	1	13	2	19		121	1,214
MATERIAL				325							325
LOGISTIC HARDWARE								88			88
BURDEN				110				30			140
TOTAL MATERIAL				435				118			553
TOTAL OTHER											
TOTAL COST		55		1,562		13		137			1,767

AMLLV

PART I

THRUST STRUCTURE - E/M
ASSEMBLY OR SYSTEM

TABLE 5.2.1.5-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	10,428		
Logistics	1,572		
Laboratory Technician	2,086		
Production	58,756		
Tooling	3,609		
Manufacturing Test	2,734		
Q&RA	16,910		
Facilities	1,353		
Manufacturing Technician	<u>1,475</u>		
Total Direct Labor	<u>98,923</u>		
Program Executive		1,187	14,018
Program Planning & Reporting		2,968	35,047
Industrial Relations		<u>643</u>	<u>6,249</u>
Total Labor - Part I		<u>4,798</u>	<u>55,314</u>
<u>Material</u>			
Program Planning & Reporting			59
Industrial Relations			<u>64</u>
Material Subtotal			123
Material & Administrative Burden			<u>42</u>
Total Material			<u>165</u>
TOTAL COST - PART I			<u>55,479</u>

TABLE 5.2.1.5-III

THRUST STRUCTURE - E/M

AMLLV PART II COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	10	123							10	123
LAB TECHNICIANS	2	21							2	21
TOOLING					4	35			4	35
PRODUCTION			59	571					59	571
MANUFACTURING TEST							3	27	3	27
MANUFACTURING TECH.			1	17				1	1	18
Q & R A	1	4	15	144	1	9	1	7	18	164
DIRECT DIST			14	140	1	11	1	9	16	160
TRAINING			1	8		1			1	9
TOTAL DIRECT LABOR	13	148	90	880	6	56	5	44	114	1,128
MATERIAL										
LAB. TECHNICIANS		4								4
TOOLING						6				6
PRODUCTION				306						306
MFG. TECHNICIANS				2						2
Q & R A				5		1				6
SUBTOTAL		4		313		7				324
MAT. & ADM. EXPEN.		2		107		2				111
TOTAL MATERIAL		6		420		9				435
TOTAL PART II COST		154		1,300		65		44		1,563

AMLLV .
 PART II
 ENGINEERING
THRUST STRUCTURE - E/M
 ASSEMBLY OR SYSTEM
 TABLE 5.2.1.5-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Design Development	10,212	120,604
Reliability Engineering	<u>216</u>	<u>2,551</u>
(1) Subtotal (A)	10,428	123,155
(2) Laboratory Technicians	<u>2,086</u>	<u>20,276</u>
Subtotal (B)	12,514	143,431
(3) Q&RA	<u>417</u>	<u>4,053</u>
Total Engineering Labor	<u>12,931</u>	<u>147,484</u>
Material		
(4) Lab. Tech.		4,381
(5) Q&RA		<u>125</u>
Subtotal (C)		4,506
(6) Material & Adm. Burden		<u>1,532</u>
Total Material		<u>6,038</u>
Total Engineering Cost		<u>153,522</u>

AMLLV
PART II
MANUFACTURING
PRODUCTION

THRUST STRUCTURE - E/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.2.1.5-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	41,427	402,670
(2) Miscellaneous Charges	3,231	31,408
(3) Maintain & Add in Scope Changes	<u>456</u>	<u>4,428</u>
Subtotal (A)	45,114	438,506
(4) Tool & Production Planning	<u>13,642</u>	<u>132,604</u>
Subtotal (B)	58,756	571,110
(5) Direct Distributable	<u>14,436</u>	<u>140,321</u>
Subtotal (C)	73,192	711,431
(6) Training	<u>805</u>	<u>7,826</u>
Subtotal (D)	73,997	719,257
(7) Q&RA	14,800	143,851
(8) Mfg. Tech.	<u>1,406</u>	<u>16,604</u>
Total Production Labor	<u>90,203</u>	<u>879,712</u>
 Material		
(9) Raw Material & Standards		306,306
(10) Q&RA		4,440
(11) Mfg. Tech.		<u>2,460</u>
Material Subtotal		313,206
(12) Material & Adm. Burden		<u>106,490</u>
Total Material		<u>419,696</u>
Total Production Cost		<u>1,299,408</u>

AMLLV
 PART II
 MANUFACTURING
 TOOLING

THRUST STRUCTURE - E/M
 ASSEMBLY OR SYSTEM
 1ST UNIT COST
 TABLE 5.2.1.5-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	3,609	35,079
(2) Direct Distributabel	<u>1,155</u>	<u>11,225</u>
Subtotal (A)	4,764	46,304
(3) Training	<u>52</u>	<u>509</u>
Subtotal (B)	4,816	46,813
(4) Q&RA	<u>963</u>	<u>9,362</u>
Total Tooling Labor	<u>5,779</u>	<u>56,175</u>
 <u>Material</u>		
(5) Tooling		6,316
(6) Q&RA		<u>289</u>
Subtotal (C)		6,605
(7) Material & Adm. Burden		<u>2,246</u>
Total Material		<u>8,851</u>
Total Tooling Cost		<u>65,026</u>

AMIIIV
PART II
MANUFACTURING
MANUFACTURING TEST

THRUST STRUCTURE - E/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.2.1.5-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	2,071	20,130
Component Test Planning	<u>663</u>	<u>6,441</u>
(1) Subtotal (A)	2,734	26,571
(2) Direct Distributable	<u>875</u>	<u>8,502</u>
Subtotal (B)	3,609	35,073
(3) Training	<u>40</u>	<u>385</u>
Subtotal (C)	3,649	35,458
(4) Mfg. Tech.	<u>69</u>	<u>818</u>
Subtotal (D)	3,718	36,276
(5) Q&RA	<u>730</u>	<u>7,092</u>
Total Mfg. Test Labor	<u><u>4,448</u></u>	<u><u>43,368</u></u>
Material		
(6) Q&RA		219
(7) Mfg. Tech.		<u>121</u>
Subtotal (E)		340
(8) Material & Adm. Burden		<u>115</u>
Total Material		<u><u>456</u></u>
Total Mfg. Test Cost		<u><u>43,824</u></u>

AMLLV
PART III
FACILITY LABOR
THRUST STRUCTURE - E/M
TABLE 5.2.1.5-VIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	1,353	13,151
Total Facility Labor Costs	<u>1,353</u>	<u>13,151</u>

AMLLV
 PART IV
 LOGISTIC LABOR
 THRUST STRUCTURE - E/M
 TABLE 5.2.1.5-IX

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Engineering	<u>1,572</u>	<u>18,565</u>
(2) Hardware		88,032
(3) Material & Adm. Burden		<u>29,931</u>
Total Material		<u>117,963</u>
Total Logistic Cost		<u>136,528</u>

5.2.1.6 Structure Assembly

TABLE 5.2.1.6-I
AMLLV COST SUMMARY

STRUCTURE ASSEMBLY - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	2	27								2	27
PROGRAM PLAN. & REPT.	6	66								6	66
INDUSTRIAL RELATIONS	1	12								1	12
ENGINEERING			23	279			4	43		27	322
LAB TECHNICIANS			5	46						5	46
TOOLING			8	83						8	83
PRODUCTION			105	1,022						105	1,022
MANUFACTURING TEST			5	48						5	48
MANUFACTURING TECH.			3	31						3	31
Q & RA			30	296						30	296
FACILITIES					2	24				2	24
DIRECT DIST			28	266						28	266
TRAINING			1	16						1	16
TOTAL DIRECT LABOR	9	105	208	2,087	2	24	4	43		223	2,259
MATERIAL				34							34
LOGISTIC HARDWARE								204			204
BURDEN				11				70			81
TOTAL MATERIAL				45				274			319
TOTAL OTHER											
TOTAL COST		105		2,132		24		317			2,578

AMLLV

PART I

STRUCTURE ASSEMBLY - E/M
ASSEMBLY OR SYSTEM

TABLE 5.2.1.6-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	24,000		
Logistics	4,000		
Laboratory Technician	5,000		
Production	105,000		
Tooling	8,000		
Manufacturing Test	5,000		
Q&RA	30,000		
Facilities	2,000		
Manufacturing Technician	3,000		
Total Direct Labor	<u>186,000</u>		
Program Executive		2,232	26,360
Program Planning & Reporting		5,590	65,900
Industrial Relations		<u>1,209</u>	<u>11,751</u>
Total Labor - Part I		<u>9,021</u>	<u>104,011</u>
<u>Material</u>			
Program Planning & Reporting			112
Industrial Relations			<u>121</u>
Material Subtotal			233
Material & Administrative Burden			<u>79</u>
Total Material			<u>312</u>
TOTAL COST - PART I			<u>104,323</u>

TABLE 5.2.1.6-III

STRUCTURE ASSEMBLY - E/M

AMLLV PART II COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	23	279							23	279
LAB TECHNICIANS	5	46							5	46
TOOLING					8	83			8	83
PRODUCTION			105	1,022					105	1,022
MANUFACTURING TEST							5	48	5	48
MANUFACTURING TECH.			3	30				1	3	31
Q & R A	1	9	26	257	2	17	1	13	30	296
DIRECT DIST			26	251			2	15	28	266
TRAINING			1	14		1		1	1	16
TOTAL DIRECT LABOR	29	334	161	1,574	10	101	8	78	208	2,087
MATERIAL										
LAB. TECHNICIANS		10								10
TOOLING						11				11
PRODUCTION				8						8
MFG. TECHNICIANS										
Q & R A				5						5
SUBTOTAL		10		13		11				34
MAT. & ADM. BURDEN		3		4		4				11
TOTAL MATERIAL		13		17		15				45
TOTAL PART II COST		347		1,591		116		78		2,132

AMLLV
PART II
ENGINEERING

STRUCTURE ASSEMBLY-E/M

ASSEMBLY OR SYSTEM

TABLE 5.2.1.6-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Design Development	23,094	272,740
Reliability Engineering	<u>499</u>	<u>5,893</u>
(1) Subtotal (A)	23,593	278,633
(2) Laboratory Technicians	<u>4,719</u>	<u>45,869</u>
Subtotal (B)	28,312	324,502
(3) Q&RA	<u>944</u>	<u>9,176</u>
Total Engineering Labor	<u>29,256</u>	<u>333,678</u>
Material		
(4) Lab. Tech.		9,910
(5) Q&RA		<u>283</u>
Subtotal (C)		10,193
(6) Material & Adm. Burden		<u>3,466</u>
Total Material		<u>13,659</u>
Total Engineering Cost		<u>347,337</u>

AMLLV
PART II
MANUFACTURING
PRODUCTION

STRUCTURE ASSEMBLY - E/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.2.1.6-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	74,132	720,563
(2) Miscellaneous Charges	5,782	56,202
(3) Maintain & Add in Scope Changes	815	<u>7,925</u>
Subtotal (A)	80,729	784,691
(4) Tool & Production Planning	<u>24,412</u>	<u>237,290</u>
Subtotal (B)	105,142	1,021,981
(5) Direct Distributable	<u>25,833</u>	<u>251,100</u>
Subtotal (C)	130,975	1,273,082
(6) Training	<u>1,440</u>	<u>14,003</u>
Subtotal (D)	132,416	1,287,086
(7) Q&RA	26,483	257,416
(8) Mfg. Tech.	<u>2,515</u>	<u>29,712</u>
Total Production Labor	<u>161,415</u>	<u>1,574,215</u>
 <u>Material</u>		
(9) Raw Material & Standards		0
(10) Q&RA		7,944
(11) Mfg. Tech.		<u>4,402</u>
Material Subtotal		12,347
(12) Material & Adm. Burden		<u>4,198</u>
Total Material		<u>16,545</u>
Total Production Cost		<u>1,590,761</u>

AMLLV
PART II
MANUFACTURING
TOOLING

STRUCTURE ASSEMBLY - E/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.2.1.6-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	6,458	62,771
(2) Direct Distributabel	<u>2,066</u>	<u>20,086</u>
Subtotal (A)	8,524	82,858
(3) Training	<u>93</u>	<u>910</u>
Subtotal (B)	8,618	83,768
(4) Q&RA	<u>1,723</u>	<u>16,753</u>
Total Tooling Labor	<u><u>10,341</u></u>	<u><u>100,522</u></u>
 Material		
(5) Tooling		11,301
(6) Q&RA		<u>517</u>
Subtotal (C)		11,818
(7) Material & Adm. Burden		<u>4,018</u>
Total Material		<u><u>15,836</u></u>
Total Tooling Cost		<u><u><u>116,358</u></u></u>

AMLLV
 PART II
 MANUFACTURING
 MANUFACTURING TEST
STRUCTURE ASSEMBLY - E/M
 ASSEMBLY OR SYSTEM
 1ST UNIT COST
 TABLE 5.2.1.6-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	3,706	36,022
Component Test Planning	<u>1,185</u>	<u>11,526</u>
(1) Subtotal (A)	4,891	47,549
(2) Direct Distributable	<u>1,565</u>	<u>15,215</u>
Subtotal (B)	6,457	62,764
(3) Training	<u>71</u>	<u>690</u>
Subtotal (C)	6,528	63,454
(4) Mfg. Tech.	<u>124</u>	<u>1,464</u>
Subtotal (D)	6,652	64,919
(5) Q&RA	<u>1,305</u>	<u>12,690</u>
Total Mfg. Test Labor	<u><u>7,957</u></u>	<u><u>77,609</u></u>
Material		
(6) Q&RA		391
(7) Mfg. Tech.		<u>217</u>
Subtotal (E)		608
(8) Material & Adm. Burden		<u>206</u>
Total Material		<u><u>815</u></u>
Total Mfg. Test Cost		<u><u>78,425</u></u>

AMLLV
 PART III
 FACILITY LABOR
 STRUCTURE ASSEMBLY - E/M
 TABLE 5.2.1.6-VIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	<u>2,421</u>	<u>23,532</u>
Total Facility Labor Cost	<u><u>2,421</u></u>	<u><u>23,532</u></u>

AMLLV
 PART IV
 LOGISTIC LABOR
STRUCTURE ASSEMBLY-- E/M
 ASSEMBLY OR SYSTEM
 TABLE 5.2.1.6-IX

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Engineering	3,652	43,130
(2) Hardware		204,512
(3) Material & Adm. Burden		<u>69,534</u>
Total Material		<u>274,046</u>
Total Logistic Cost		<u>317,176</u>

5.2.2 Systems

The total first production unit cost of the systems for an engine module and the components thereof are displayed in Figure 5.2.2.0-1. Table 5.2.2.0-I is a total cost summary of the systems. Supporting documentation for each of the major components that are included in this cost summary are in the appropriate subparagraphs.

TOTAL SYSTEMS - ENGINE MODULE

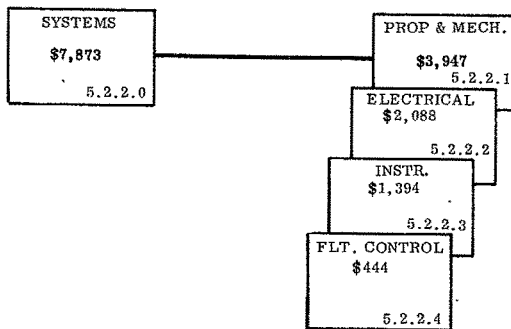
TABLE 5.2.2.0-I

AMLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	5	61								5	61
PROGRAM PLAN. & REPT.	13	155								13	155
INDUSTRIAL RELATIONS	2	28								2	28
ENGINEERING			57	678			8	103		65	781
LAB TECHNICIANS			11	111						11	111
TOOLING			15	146						15	146
PRODUCTION			244	2,373						244	2,373
MANUFACTURING TEST			12	110						12	110
MANUFACTURING TECH.			6	75						6	75
Q & R A			74	730						74	730
FACILITIES					5	56				5	56
DIRECT DIST			87	841						87	841
TRAINING			4	39						4	39
TOTAL DIRECT LABOR	20	244	510	5,103	5	56	8	103		543	5,506
MATERIAL				1,282							1,282
LOGISTIC HARDWARE								484			484
BURDEN				437				164			601
TOTAL MATERIAL				1,719				648			2,367
TOTAL OTHER											
TOTAL COST		244		6,822		56		751			7,873



NOTES:

**DOLLARS ARE IN THOUSANDS.
 NUMBERS IN LOWER RIGHT CORNER
 DESIGNATE APPLICABLE SECTION
 NUMBER FOR COST DETAILS.**

FIGURE 5.2.2.0-1 ENGINE MODULE SYSTEMS COST FLOW DIAGRAM

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5.2.2.1

Propulsion and Mechanical System

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TABLE 5.2.2.1-I
 AMLLV COST SUMMARY

PROP. & MECH. - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	2	25								2	25
PROGRAM PLAN. & REPT.	5	62								5	62
INDUSTRIAL RELATIONS	1	11								1	11
ENGINEERING			22	267			3	40		25	307
LAB TECHNICIANS			4	44						4	44
TOOLING			6	58						6	58
PRODUCTION			98	955						98	955
MANUFACTURING TEST			5	45						5	45
MANUFACTURING TECH.			3	30						3	30
Q & R A			30	292						30	292
FACILITIES					2	22				2	22
DIRECT DIST			35	339						35	339
TRAINING			2	15						2	15
TOTAL DIRECT LABOR	8	98	205	2,045	2	22	3	40		218	2,205
MATERIAL				1,110							1,110
LOGISTIC HARDWARE							191				191
BURDEN				377			65				442
TOTAL MATERIAL				1,487			256				1,742
TOTAL OTHER											
TOTAL COST		98		3,532		22		296			3,947

AMLLV

PART I

PROP. & MECH. - E/M
ASSEMBLY OR SYSTEM
 FIRST UNIT

TABLE 5:2.2.1-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	22,594		
Logistics	3,406		
Laboratory Technician	4,519		
Production	98,262		
Tooling	6,036		
Manufacturing Test	4,572		
Q&RA	29,962		
Facilities	2,263		
Manufacturing Technician	<u>2,608</u>		
Total Direct Labor	<u>174,222</u>		
Program Executive		2,091	24,690
Program Planning & Reporting		5,227	61,726
Industrial Relations		<u>1,132</u>	<u>11,007</u>
Total Labor - Part I		<u>8,450</u>	<u>97,423</u>
<u>Material</u>			
Program Planning & Reporting			105
Industrial Relations			<u>113</u>
Material Subtotal			218
Material & Administrative Burden			<u>74</u>
Total Material			<u>292</u>
TOTAL COST - PART I			<u>97,715</u>

TABLE 5.2.2.1-III

AMLV PART II COST SUMMARY - PROP. & MECH.

FIRST UNIT

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	22	267							22	267
LAB TECHNICIANS	5	44							5	44
TOOLING					6	58			6	58
PRODUCTION			98	955					98	955
MANUFACTURING TEST							5	45	5	45
MANUFACTURING TECH.			3	29				1	3	30
Q & R A	1	9	26	255	2	16	1	12	30	292
DIRECT DIST			31	306	2	19	1	14	34	339
TRAINING			2	14		1		1	2	15
TOTAL DIRECT LABOR	28	320	160	1,559	10	94	7	73	205	2,045
MATERIAL										
LAB. TECHNICIANS		10								10
TOOLING						10				10
PRODUCTION				1,076						1,076
MFG. TECHNICIANS				4				2		6
Q & R A				8		1		1		10
SUBTOTAL		10		1,088		11		3		1,110
MAT. & ADM. BURDEN				370		4				377
TOTAL MATERIAL		13		1,458		15		3		1,487
TOTAL PART II COST		333		3,017		109		76		3,532

AMLLV
 PART II
 ENGINEERING
 PROPULSION & MECHANICAL SYSTEM - E/M
 ASSEMBLY OR SYSTEM
 TABLE 5.2.2.1-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Design Development	22,126	261,308
Reliability Engineering	<u>468</u>	<u>5,527</u>
(1) Subtotal (A)	22,594	266,835
(2) Laboratory Technicians	<u>4,519</u>	<u>43,924</u>
Subtotal (B)	27,113	310,759
(3) Q&RA	<u>904</u>	<u>8,787</u>
Total Engineering Labor	<u><u>28,017</u></u>	<u><u>319,546</u></u>
Material		
(4) Lab. Tech.		9,490
(5) Q&RA		<u>271</u>
Subtotal (C)		9,761
(6) Material & Adm. Burden		<u>3,319</u>
Total Material		<u><u>13,080</u></u>
Total Engineering Cost		<u><u>332,626</u></u>

AMLLV
PART II
MANUFACTURING
PRODUCTION

PROPULSION & MECHANICAL SYSTEMS - E/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.2.2.1-V

(In thousands)

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	69,281	\$ 673
(2) Miscellaneous Charges	5,404	53
(3) Maintain & Add in Scope Changes	<u>762</u>	<u>7</u>
Subtotal (A)	75,447	733
(4) Tool & Production Planning	<u>22,815</u>	<u>222</u>
Subtotal (B)	98,262	955
(5) Direct Distributable	<u>31,444</u>	<u>306</u>
Subtotal (C)	129,706	1,261
(6) Training	<u>1,427</u>	<u>14</u>
Subtotal (D)	131,133	1,275
(7) Q&RA	26,227	255
(8) Mfg. Tech.	<u>2,492</u>	<u>29</u>
Total Production Labor	<u>159,852</u>	<u>1,559</u>
 <u>Material</u>		
(9) Raw Material & Standards		1,076
(10) Q&RA		8
(11) Mfg. Tech.		<u>4</u>
Material Subtotal		1,088
(12) Material & Adm. Burden		<u>370</u>
Total Material		<u>\$ 1,458</u>
Total Production Cost		<u><u>\$ 3,017</u></u>

AMLLV
PART II
MANUFACTURING
TOOLING

PROPULSION & MECHANICAL SYSTEM - E/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.2.2.1-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	6,036	\$ 58,670
(2) Direct Distributabel	<u>1,932</u>	<u>18,779</u>
Subtotal (A)	7,968	77,449
(3) Training	<u>88</u>	<u>855</u>
Subtotal (B)	8,056	78,304
(4) Q&RA	<u>1,611</u>	<u>15,659</u>
Total Tooling Labor	<u>9,667</u>	<u>93,963</u>
Material		
(5) Tooling		10,563
(6) Q&RA		<u>483</u>
Subtotal (C)		11,046
(7) Material & Adm. Burden		<u>3,756</u>
Total Material		<u>14,802</u>
Total Tooling Cost		<u>\$ 108,765</u>

AMLLV
 PART II.
 MANUFACTURING
 MANUFACTURING TEST

PROP. & MECH. SYSTEM - E/M

ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 5.2.2.1-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	3,464	33,670
Component Test Planning	<u>1,108</u>	<u>10,774</u>
(1) Subtotal (A)	4,572	44,444
(2) Direct Distributable	<u>1,463</u>	<u>14,221</u>
Subtotal (B)	6,036	58,665
(3) Training	<u>66</u>	<u>644</u>
Subtotal (C)	5,102	59,309
(4) Mfg. Tech.	<u>116</u>	<u>1,369</u>
Subtotal (D)	6,218	60,678
(5) Q&RA	<u>1,220</u>	<u>11,861</u>
Total Mfg. Test Labor	<u><u>7,438</u></u>	<u><u>72,539</u></u>
Material		
(6) Q&RA		1,366
(7) Mfg. Tech.		<u>2,208</u>
Subtotal (E)		3,568
(8) Material & Adm. Burden		<u>193</u>
Total Material		<u><u>3,762</u></u>
Total Mfg. Test Cost		<u><u>76,301</u></u>

AMLLV
PART III
FACILITY LABOR

PROPULSION & MECHANICAL SYSTEM- E/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.2.2.1-VIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	2,263	\$ 21,996
TOTAL FACILITY LABOR COST		<u>\$ 21,996</u>

AMLLV
PART 1V
LOGISTIC LABOR

PROPULSION & MECHANICAL SYSTEM - E/M
ASSEMBLY OR SYSTEM

TABLE 5.2.2.1-IX

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Engineering	<u>3,406</u>	<u>40,225</u>
Hardware		190,736
Material & Adm. Burden		<u>64,850</u>
Total Material		<u>255,586</u>
Total Logistic Cost		<u>295,811</u>

5.2.2.2 Electrical System

TABLE 5.2.2.2-I
 AMLLV COST SUMMARY

ELECTRICAL - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	2	21								2	21
PROGRAM PLAN. & REPT.	4	54								4	54
INDUSTRIAL RELATIONS	1	10								1	10
ENGINEERING			9	103			1	16		10	119
LAB TECHNICIANS			2	17						2	17
TOOLING			6	57						6	57
PRODUCTION			96	931						96	931
MANUFACTURING TEST			4	43						4	43
MANUFACTURING TECH.			2	30						2	30
Q & R A			29	279						29	279
FACILITIES					2	22				2	22
DIRECT DIST			34	330						34	330
TRAINING			1	15						1	15
TOTAL DIRECT LABOR	7	85	183	1,805	2	22	1	16		193	1,928
MATERIAL				46							46
LOGISTIC HARDWARE								73			73
BURDEN				16				25			41
TOTAL MATERIAL				62				98			160
TOTAL OTHER											
TOTAL COST		85		1,867		22		114			2,088

AMLLV
 PART I
 ELECTRICAL - E/M
 ASSEMBLY OR SYSTEM
 TABLE 5.2.2.2-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	8,690		
Logistics	1,310		
Laboratory Technician	1,738		
Production	95,820		
Tooling	5,886		
Manufacturing Test	4,459		
Q&RA	28,684		
Facilities	2,207		
Manufacturing Technician	<u>2,543</u>		
Total Direct Labor	<u>151,337</u>		
Program Executive		1,816	21,447
Program Planning & Reporting		4,540	53,619
Industrial Relations		<u>984</u>	<u>9,561</u>
Total Labor - Part I		<u>7,340</u>	<u>84,627</u>
<u>Material</u>			
Program Planning & Reporting			91
Industrial Relations			<u>98</u>
Material Subtotal			189
Material & Administrative Burden			<u>64</u>
Total Material			<u>253</u>
TOTAL COST - PART I			<u>84,880</u>

TABLE 5.2.2.2-III

AMLLV PART II COST SUMMARY

ELECTRICAL - E/M

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	9	103							9	103
LAB TECHNICIANS	2	17							2	17
TOOLING					6	57			6	57
PRODUCTION			96	931					96	931
MANUFACTURING TEST							4	43	4	43
MANUFACTURING TECH.			2	29					2	30
Q & R A			26	249	1	15	1	12	28	279
DIRECT DIST			31	298	2	19	2	14	35	330
TRAINING			1	13		1		1	2	15
TOTAL DIRECT LABOR	11	123	156	1,520	9	92	7	70	183	1,805
MATERIAL										
LAB. TECHNICIANS		4								4
TOOLING						10				10
PRODUCTION				19						19
MFG. TECHNICIANS				4						4
Q & R A				8		1		1		10
SUBTOTAL		4		31		11		1		46
MAT. & ADM. BURDEN		1		11		3				16
TOTAL MATERIAL		5		42		14		1		62
TOTAL PART II COST		128		1,562		106		71		1,867

AMLLV
PART II
ENGINEERING

ELECTRICAL SYSTEM - E/M

ASSEMBLY OR SYSTEM

TABLE 5.2.2.2-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Design Development	8,510	100,503
Reliability Engineering	<u>180</u>	<u>2,126</u>
(1) Subtotal (A)	8,690	102,629
(2) Laboratory Technicians	<u>1,738</u>	<u>16,893</u>
Subtotal (B)	10,428	119,522
(3) Q&RA	<u>348</u>	<u>3,383</u>
Total Engineering Labor	<u>10,776</u>	<u>122,905</u>
Material		
(4) Lab. Tech.		3,650
(5) Q&RA		<u>104</u>
Subtotal (C)		3,754
(6) Material & Adm. Burden		<u>1,276</u>
Total Material		<u>5,030</u>
Total Engineering Cost		<u>127,935</u>

AMLLV
PART II
MANUFACTURING
PRODUCTION

ELECTRICAL SYSTEM - E/M .

ASSEMBLY OR SYSTEM
1ST UNIT COST

(Dollars in Thousands)

TABLE 5.2.2.2-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	67,559	\$ 657
(2) Miscellaneous Charges	5,270	51
(3) Maintain & Add in Scope Changes	743	7
Subtotal (A)	73,572	715
(4) Tool & Production Planning	22,248	216
Subtotal (B)	95,820	931
(5) Direct Distributable	30,662	298
Subtotal (C)	126,482	1,229
(6) Training	1,391	13
Subtotal (D)	127,873	1,242
(7) Q&RA	25,575	249
(8) Mfg. Tech.	2,430	29
Total Production Labor	155,878	\$ 1,520
 <u>Material</u>		
(9) Raw Material & Standards		19
(10) Q&RA		8
(11) Mfg. Tech.		4
Material Subtotal		31
(12) Material & Adm. Burden		11
Total Material		\$ 42
Total Production Cost		\$ 1,562

AMLLV
PART II
MANUFACTURING
TOOLING

ELECTRICAL SYSTEMS - E/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.2.2.2-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	5,886	\$ 57,212
(2) Direct Distributabel	<u>1,884</u>	<u>18,312</u>
Subtotal (A)	7,770	75,524
(3) Training	<u>85</u>	<u>826</u>
Subtotal (B)	7,855	76,350
(4) Q&RA	<u>1,571</u>	<u>15,270</u>
Total Tooling Labor	<u><u>9,426</u></u>	<u><u>\$ 91,620</u></u>
 Material		
(5) Tooling		10,301
(6) Q&RA		<u>471</u>
Subtotal (C)		10,772
(7) Material & Adm. Burden		<u>3,662</u>
Total Material		<u>\$ 14,434</u>
Total Tooling Cost		<u><u>\$ 106,054</u></u>

AMLLV
PART II
MANUFACTURING
MANUFACTURING TEST

ELECTRICAL SYSTEM - E/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.2.2.2-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	3,378	32,834
Component Test Planning	<u>1,081</u>	<u>10,506</u>
(1) Subtotal (A)	4,459	43,340
(2) Direct Distributable	<u>1,427</u>	<u>13,868</u>
Subtotal (B)	5,886	57,208
(3) Training	<u>65</u>	<u>629</u>
Subtotal (C)	5,951	57,837
(4) Mfg. Tech.	<u>113</u>	<u>1,335</u>
Subtotal (D)	6,034	59,172
(5) Q&RA	<u>1,190</u>	<u>11,567</u>
Total Mfg. Test Labor	<u>7,254</u>	<u>70,739</u>
Material		
(6) Q&RA		357
(7) Mfg. Tech.		<u>198</u>
Subtotal (E)		555
(8) Material & Adm. Burden		<u>189</u>
Total Material		<u>744</u>
Total Mfg. Test Cost		<u>71,483</u>

AMLLV
 PART III
 FACILITY LABOR
ELECTRICAL SYSTEMS- E/M
 ASSEMBLY OR SYSTEM
 1ST UNIT COST
 TABLE 5.2.2.2-VIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	<u>2,207</u>	\$21,452
TOTAL FACILITY LABOR COST		<u>\$21,452</u>

AMLLV
PART IV
LOGISTIC LABOR

ELECTRICAL SYSTEM - E/M
ASSEMBLY OR SYSTEM

TABLE 5.2.2.2-IX

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Engineering	<u>1,310</u>	<u>15,471</u>
Hardware		73,360
Material & Adm. Burden		<u>24,942</u>
Total Material		<u>98,302</u>
Total Logistic Cost		<u>113,773</u>

5.2.2.3 Instrumentation System

TABLE 5.2.2.3-I
 AMLLV COST SUMMARY

INSTRUMENTATION - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	1	12								1	12
PROGRAM PLAN. & REPT.	3	31								3	31
INDUSTRIAL RELATIONS		6									6
ENGINEERING			22	257			3	39		25	296
LAB TECHNICIANS			4	42						4	42
TOOLING			2	23						2	23
PRODUCTION			39	379						39	379
MANUFACTURING TEST			2	18						2	18
MANUFACTURING TECH.			1	12						1	12
Q & R A			12	120						12	120
FACILITIES					1	9				1	9
DIRECT DIST			14	134						14	134
TRAINING			1	6						1	6
TOTAL DIRECT LABOR	4	49	97	991	1	9	3	39		105	1,088
MATERIAL				45							45
LOGISTIC HARDWARE								183			183
BURDEN				16				62			78
TOTAL MATERIAL				61				245			306
TOTAL OTHER											
TOTAL COST		49		1,052		9		284			1,394

AMLLV

PART I

INSTRUMENTATION - E/M
ASSEMBLY OR SYSTEM

TABLE 5.2.2.3-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	21,725		
Logistics	3,275		
Laboratory Technician	4,345		
Production	38,967		
Tooling	2,394		
Manufacturing Test	1,814		
Q&RA	12,392		
Facilities	898		
Manufacturing Technician	<u>1,034</u>		
Total Direct Labor	<u>86,844</u>		
Program Executive		1,042	12,307
Program Planning & Reporting		2,605	30,769
Industrial Relations		<u>564</u>	<u>5,486</u>
Total Labor - Part I		<u>4,211</u>	<u>48,562</u>
<u>Material</u>			
Program Planning & Reporting			52
Industrial Relations			<u>56</u>
Material Subtotal			108
Material & Administrative Burden			<u>37</u>
Total Material			<u>145</u>
TOTAL COST - PART I			<u>48,707</u>

TABLE 5.2.2.3-III

AMLLV PART II COST SUMMARY

INSTRUMENTATION - E/M

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	22	257							22	257
LAB TECHNICIANS	4	42							4	42
TOOLING					2	23			2	23
PRODUCTION			39	379					39	379
MANUFACTURING TEST							2	17	2	17
MANUFACTURING TECH.			1	12					1	12
Q & R A	1	9	10	101	1	6		5	12	121
DIRECT DIST			12	121	1	8	1	6	14	135
TRAINING			1	5					1	5
TOTAL DIRECT LABOR	27	308	63	618	4	37	3	28	97	991
MATERIAL										
LAB. TECHNICIANS		9								9
TOOLING						4				4
PRODUCTION				26						26
MFG. TECHNICIANS				2						2
Q & R A		1		3						4
SUBTOTAL		10		31		4				45
MAT. & ADM. BURDEN		3		11		2				16
TOTAL MATERIAL		13		42		6				61
TOTAL PART II COST		321		660		43		28		1,052

AMLLV
PART II
ENGINEERING

INSTRUMENTATION SYSTEM - E/M
ASSEMBLY OR SYSTEM
TABLE 5.2.2.3-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Design Development	21,275	251,258
Reliability Engineering	<u>450</u>	<u>5,314</u>
(1) Subtotal (A)	21,725	256,572
(2) Laboratory Technicians	<u>4,345</u>	<u>42,233</u>
Subtotal (B)	26,070	298,805
(3) Q&RA	<u>869</u>	<u>8,447</u>
Total Engineering Labor	<u><u>26,939</u></u>	<u><u>307,252</u></u>
Material		
(4) Lab. Tech.		9,125
(5) Q&RA		<u>1,261</u>
Subtotal (C)		10,386
(6) Material & Adm. Burden		<u>3,191</u>
Total Material		<u><u>13,577</u></u>
Total Engineering Cost		<u><u>320,829</u></u>

AMLLV
 PART II
 MANUFACTURING
 PRODUCTION

INSTRUMENTATION SYSTEM - E/M

ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 5.2.2.3-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u> (In Thousands)
(1) Fabrication & Assembly	27,474	\$ 267
(2) Miscellaneous Charges	2,143	21
(3) Maintain & Add in Scope Changes	<u>302</u>	<u>3</u>
Subtotal (A)	29,919	291
(4) Tool & Production Planning	<u>9,048</u>	<u>88</u>
Subtotal (B)	38,967	379
(5) Direct Distributable	<u>12,469</u>	<u>121</u>
Subtotal (C)	51,436	500
(6) Training	<u>566</u>	<u>5</u>
Subtotal (D)	52,002	505
(7) Q&RA	10,400	101
(8) Mfg. Tech.	<u>988</u>	<u>12</u>
Total Production Labor	<u>63,390</u>	\$ <u>618</u>
 Material		
(9) Raw Material & Standards		\$ 26
(10) Q&RA		3
(11) Mfg. Tech.		<u>2</u>
Material Subtotal		31
(12) Material & Adm. Burden		<u>11</u>
Total Material		<u>42</u>
Total Production Cost		\$ <u>660</u>

AMLLV
 PART II
 MANUFACTURING
 TOOLING

INSTRUMENTATION SYSTEM - E/M

ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 5.2.2.3-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	2,394	\$ 23,270
(2) Direct Distributable	766	7,446
Subtotal (A)	<u>3,160</u>	<u>30,716</u>
(3) Training	35	340
Subtotal (B)	<u>3,195</u>	<u>31,056</u>
(4) Q&RA	<u>639</u>	<u>6,211</u>
Total Tooling Labor	<u>3,834</u>	<u>\$ 37,267</u>
 Material		
(5) Tooling		\$ 4,190
(6) Q&RA		<u>192</u>
Subtotal (C)		4,382
(7) Material & Adm. Burden		<u>1,490</u>
Total Material		<u>5,872</u>
Total Tooling Cost		<u>\$ 43,139</u>

AMLLV
 PART IJ
 MANUFACTURING
 MANUFACTURING TEST
 INSTRUMENTATION SYSTEM - E/M
 ASSEMBLY OR SYSTEM
 1ST UNIT COST
 TABLE 5.2.2.3-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	1,374	13,355
Component Test Planning	<u>440</u>	<u>4,273</u>
(1) Subtotal (A)	1,814	17,628
(2) Direct Distributable	<u>580</u>	<u>5,641</u>
Subtotal (B)	2,394	23,269
(3) Training	<u>26</u>	<u>256</u>
Subtotal (C)	2,420	23,525
(4) Mfg. Tech.	<u>46</u>	<u>542</u>
Subtotal (D)	2,466	24,067
(5) Q&RA	<u>484</u>	<u>3,704</u>
Total Mfg. Test Labor	<u>2,950</u>	<u>27,771</u>
Material		
(6) Q&RA		145
(7) Mfg. Tech.		<u>80</u>
Subtotal (E)		225
(8) Material & Adm. Burden		<u>77</u>
Total Material		<u>302</u>
Total Mfg. Test Cost		<u>28,073</u>

AMLLV
PART III
FACILITY LABOR

INSTRUMENTATION SYSTEM - E/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.2.2.3-VIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	898	\$ 8,729
TOTAL FACILITY LABOR COST		\$ <u>8,729</u>

AMLLV
PART IV
LOGISTIC LABOR

INSTRUMENTATION SYTEM - E/M
ASSEMBLY OR SYSTEM

TABLE 15.2.2.3-IX

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Engineering	<u>3,275</u>	<u>38,678</u>
Hardware		183,400
Material & Adm. Burden		<u>62,356</u>
Total Material		<u>245,756</u>
Total Logistic Cost		<u>284,434</u>

5.2.2.4 Flight Control

TABLE 5.2.2.4-I

AMLLV COST SUMMARY

FLIGHT CONTROL - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE		3									3
PROGRAM PLAN. & REPT.	1	8								1	8
INDUSTRIAL RELATIONS		1									1
ENGINEERING			4	51			1	8		5	59
LAB TECHNICIANS			1	8						1	8
TOOLING			1	7						1	7
PRODUCTION			11	108						11	108
MANUFACTURING TEST			1	5						1	5
MANUFACTURING TECH.				3							3
Q & RA			3	40						3	40
FACILITIES						3					3
DIRECT DIST			4	38						4	38
TRAINING				2							2
TOTAL DIRECT LABOR	1	12	25	262	3		1	8		27	285
MATERIAL				82							82
LOGISTIC HARDWARE								37			37
BURDEN				28				12			40
TOTAL MATERIAL				110				49			159
TOTAL OTHER											
TOTAL COST		12		372	3			57			444

AMLLV

PART I

FLIGHT CONTROL - E/M
ASSEMBLY OR SYSTEM

TABLE 5.2.2.4-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	4,345		
Logistics	655		
Laboratory Technician	869		
Production	11,067		
Tooling	680		
Manufacturing Test	515		
Q&RA	3,447		
Facilities	255		
Manufacturing Technician	<u>294</u>		
Total Direct Labor	<u>22,127</u>		
Program Executive		266	3,136
Program Planning & Reporting		664	7,839
Industrial Relations		<u>144</u>	<u>1,398</u>
Total Labor - Part I		<u>1,074</u>	<u>12,373</u>
<u>Material</u>			
Program Planning & Reporting			13
Industrial Relations			<u>14</u>
Material Subtotal			27
Material & Administrative Burden			<u>9</u>
Total Material			<u>36</u>
TOTAL COST - PART I			<u>12,409</u>

TABLE 5.2.2.4-III

AMLLV PART II COST SUMMARY -- FLIGHT CONTROL - E/M

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	S	M/H	\$	M/H	\$
ENGINEERING	4	51							4	51
LAB TECHNICIANS	1	8							1	8
TOOLING					1	7			1	7
PRODUCTION			11	108					11	108
MANUFACTURING TEST							1	5	1	5
MANUFACTURING TECH.				3						3
Q & R A		2	3	35		2		1	3	40
DIRECT DIST			4	34		2		2	4	38
TRAINING				2						2
TOTAL DIRECT LABOR	5	61	18	182	1	11	1	8	25	262
MATERIAL										
LAB. TECHNICIANS		2								2
TOOLING						1				1
PRODUCTION				78						78
MFG. TECHNICIANS										
Q & R A				1						1
SUBTOTAL		2		79		1				82
MAT. & ADM. SUPPLEM		1		27						28
TOTAL MATERIAL		3		106		1				110
TOTAL PART II COST		64		288		12		8		372

AMLLV
 PART II
 ENGINEERING
 FLIGHT CONTROL SYSTEM - E/M

 ASSEMBLY OR SYSTEM
 TABLE 5.2.2.4-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Design Development	4,255	50,252
Reliability Engineering	<u>90</u>	<u>1,062</u>
(1) Subtotal (A)	4,345	51,314
(2) Laboratory Technicians	<u>869</u>	<u>8,447</u>
Subtotal (B)	5,214	59,761
(3) Q&RA	<u>174</u>	<u>1,691</u>
Total Engineering Labor	<u>5,388</u>	<u>61,452</u>
Material		
(4) Lab. Tech.		1,825
(5) Q&RA		<u>52</u>
Subtotal (C)		1,877
(6) Material & Adm. Burden		<u>638</u>
Total Material		<u>2,515</u>
Total Engineering Cost		<u>63,967</u>

AMLLV
 PART II
 MANUFACTURING
 PRODUCTION
 FLIGHT CONTROL SYSTEM - E/M

ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 5.2.2.4-V

(Dollars in Thousands)

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	7,802	\$ 76
(2) Miscellaneous Charges	609	6
(3) Maintain & Add in Scope Changes	86	1
Subtotal (A)	8,497	83
(4) Tool & Production Planning	2,570	25
Subtotal (B)	11,067	108
(5) Direct Distributable	3,541	34
Subtotal (C)	14,608	142
(6) Training	161	2
Subtotal (D)	14,769	144
(7) Q&RA	2,954	35
(8) Mfg. Tech.	281	3
Total Production Labor	18,004	\$ 182
 Material		
(9) Raw Material & Standards		78
(10) Q&RA		1
(11) Mfg. Tech.		1
Material Subtotal		79
(12) Material & Adm. Burden		27
Total Material		\$ 106
Total Production Cost		\$ 288

AMLLV
PART II
MANUFACTURING
TOOLING

FLIGHT CONTROL SYSTEM - E/M
ASSEMBLY OR SYSTEM
1ST UNIT COST
TABLE 5.2.2.4-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	680	\$ 6,610
(2) Direct Distributabel	218	2,119
Subtotal (A)	898	8,729
(3) Training	10	97
Subtotal (B)	908	8,826
(4) Q&RA	182	1,769
Total Tooling Labor	1,090	\$ 10,595
Material		
(5) Tooling		1,190
(6) Q&RA		55
Subtotal (C)		1,245
(7) Material & Adm. Burden		423
Total Material		\$ 1,668
Total Tooling Cost		\$ 12,263

AMLLV
 PART II
 MANUFACTURING
 MANUFACTURING TEST
FLIGHT CONTROL SYSTEM - E/M
 ASSEMBLY OR SYSTEM
 1ST. UNIT COST

TABLE 5.2.2.4-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	390	3,791
Component Test Planning	<u>125</u>	1,213
(1) Subtotal (A)	515	5,004
(2) Direct Distributable	<u>165</u>	1,601
Subtotal (B)	680	6,605
(3) Training	<u>7</u>	72
Subtotal (C)	687	6,677
(4) Mfg. Tech.	<u>13</u>	154
Subtotal (D)	700	6,831
(5) Q&RA	<u>137</u>	1,335
Total Mfg. Test Labor.	<u>837</u>	<u>8,166</u>
Material		
(6) Q&RA		41
(7) Mfg. Tech.		23
Subtotal (E)		<u>64</u>
(8) Material & Adm. Burden		22
Total Material		<u>86</u>
Total Mfg. Test Cost		<u>8,252</u>

AMLLV
PART III
FACILITY LABOR

FLIGHT CONTROL SYSTEM - E/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.2.2.4-VIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	<u>255</u>	\$ 2,479
TOTAL FACILITY LABOR COST		<u>\$ 2,479</u>

AMLLV
PART IV
LOGISTIC LABOR

FLIGHT CONTROL SYSTEM - E/M
ASSEMBLY OR SYSTEM
TABLE 5.2.2.4-IX

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Engineering	<u>655</u>	7,736
Hardware		36,680
Material & Adm. Burden		<u>12,471</u>
Total Material		<u>49,151</u>
Total Logistic Cost		<u>56,887</u>

5.2.3 Injection Stage Liquid Engines

Costs for the 250,000 pound (vacuum) thrust engine were developed from the parametric cost data supplied by Pratt and Whitney.

TABLE 5.2.3-I
 AMLIV COST SUMMARY

ENGINES - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING				200							200
LAB TECHNICIANS											
TOOLING				300							300
PRODUCTION				3,100							3,100
MANUFACTURING TEST				200							200
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR				3,800							3,800
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER											
TOTAL COST				3,800							3,800

AMLLV
ONE MODULE INJECTION STAGE
ENGINE

TABLE 5.2.3.-II

1ST UNIT

$$\$1.50\text{M Avg.} \times 100 = \$150\text{M}$$

$$100\text{th Unit (Cum.) } 95\% \text{ Curve} = 76.5863$$

$$\$150\text{M} \div 76.5863 = \$1.96\text{M}$$

$$2 \text{ Units} = 1.9500 (95\%) \times \$1.96\text{M} = \$3.8\text{M}$$

"C" COSTS

Engineering	.2M
Test	.2M
Tooling (Maint.)	.3M
Fabrication	3.1M

Subtotal	<u>\$3.8M</u>

* 250,000 Thrust

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5.2.4 Engine Installation

Installation costs associated with two engines were based on manhour estimates which were derived from Saturn V historical data. In addition to the direct factory labor all supporting costs were included.

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TABLE 5.2.4-1
 AMLLV COST SUMMARY

ENGINE INSTALLATION - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE		1									1
PROGRAM PLAN. & REPT.		2									2
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING				2							2
PRODUCTION			4	37						4	37
MANUFACTURING TEST			1	1						1	1
MANUFACTURING TECH.				1							1
Q & R A			1	11						1	11
FACILITIES					1						1
DIRECT DIST			1	10						1	10
TRAINING				1							1
TOTAL DIRECT LABOR		3	7	63	1					7	67
MATERIAL				1							1
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL				1							1
TOTAL OTHER											
TOTAL COST		3		64	1						68

AMLLV

PART I

ENGINE INSTALLATION - E/M

ASSEMBLY OR SYSTEM

TABLE 5.2.4-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering			
Logistics			
Laboratory Technician			
Production	3,838		
Tooling	236		
Manufacturing Test	132		
Q&RA	1,065		
Facilities	88		
Manufacturing Technician	95		
Total Direct Labor	<u>5,454</u>		
Program Executive		65	772
Program Planning & Reporting		164	1,932
Industrial Relations		35	344
Total Labor - Part I		<u>264</u>	<u>3,048</u>
<u>Material</u>			
Program Planning & Reporting			3
Industrial Relations			4
Material Subtotal			7
Material & Administrative Burden			2
Total Material			<u>9</u>
TOTAL COST - PART I			<u>3,057</u>

TABLE 5.2.4-III

AMLLV PART II COST SUMMARY

ENGINE INSTALLATION - E/M

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING										
LAB TECHNICIANS										
TOOLING					2					2
PRODUCTION			4	37					4	37
MANUFACTURING TEST							1			1
MANUFACTURING TECH.				1						1
Q & R A			1	10					1	10
DIRECT DIST			1	9	1		1		1	11
TRAINING				1						1
TOTAL DIRECT LABOR			6	58	3		2		6	63
MATERIAL										
LAB. TECHNICIANS										
TOOLING					1					1
PRODUCTION										
MFG. TECHNICIANS										
Q & R A										
SUBTOTAL					1					1
MAT. & ADM. EXPEN										
TOTAL MATERIAL					1					1
TOTAL PART II COST				58	4		2			64

AMLLV
PART II
MANUFACTURING
PRODUCTION

ENGINE INSTALLATION - E/M
ASSEMBLY OR SYSTEM
1ST UNIT COST
TABLE 5.2.4-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	2,706	\$ 26,302
(2) Miscellaneous Charges	211	2,051
(3) Maintain & Add in Scope Changes	<u>30</u>	<u>292</u>
Subtotal (A)	2,947	28,645
(4) Tool & Production Planning	<u>891</u>	<u>8,660</u>
Subtotal (B)	3,838	37,305
(5) Direct Distributable	<u>943</u>	<u>9,166</u>
Subtotal (C)	4,781	46,471
(6) Training	<u>53</u>	<u>515</u>
Subtotal (D)	4,834	46,986
(7) Q&RA	967	9,399
(8) Mfg. Tech.	<u>92</u>	<u>1,087</u>
Total Production Labor	<u>5,893</u>	<u>\$ 57,472</u>
 <u>Material</u>		
(9) Raw Material & Standards		\$ -0-
(10) Q&RA		290
(11) Mfg. Tech.		<u>161</u>
Material Subtotal		<u>451</u>
(12) Material & Adm. Burden		153
Total Material		<u>604</u>
Total Production Cost		<u>\$ 58,076</u>

AMLLV
PART II
MANUFACTURING
TOOLING

ENGINE INSTALLATION - E/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.2.4-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	236	\$ 2,294
(2) Direct Distributable	<u>76</u>	<u>739</u>
Subtotal (A)	312	3,033
(3) Training	<u>3</u>	<u>29</u>
Subtotal (B)	315	3,062
(4) Q&RA	<u>63</u>	<u>612</u>
Total Tooling Labor	<u><u>378</u></u>	<u><u>\$ 3,674</u></u>
 Material		
(5) Tooling		\$ 413
(6) Q&RA		<u>19</u>
Subtotal (C)		432
(7) Material & Adm. Burden		<u>147</u>
Total Material		<u><u>579</u></u>
Total Tooling Cost		<u><u>\$ 4,253</u></u>

AMLLV
 PART II
 MANUFACTURING
 MANUFACTURING TEST
 ENGINE INSTALLATION - E/M
 ASSEMBLY OR SYSTEM
 1ST UNIT COST
 TABLE 5.2.4-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	100	972
Component Test Planning	32	311
(1) Subtotal (A)	<u>132</u>	<u>1,283</u>
(2) Direct Distributable	42	410
Subtotal (B)	<u>174</u>	<u>1,693</u>
(3) Training	2	18
Subtotal (C)	<u>176</u>	<u>1,711</u>
(4) Mfg. Tech.	3	39
Subtotal (D)	<u>179</u>	<u>1,750</u>
(5) Q&RA	35	342
Total Mfg. Test Labor	<u>214</u>	<u>2,092</u>
Material		
(6) Q&RA		11
(7) Mfg. Tech.		6
Subtotal (E)		<u>17</u>
(8) Material & Adm. Burden		6
Total Material		<u>23</u>
Total Mfg. Test Cost		<u>2,115</u>

AMLLV
PART III
FACILITY LABOR

ENGINE INSTALLATION - E/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.2.4-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	<u>88</u>	<u>\$ 855</u>
TOTAL FACILITY LABOR COST		<u>\$ 855</u>

5.2.5 Propellant, Pressurants, and Gases

Propellant costs used on the AMLLV Engine module were estimated for the following types of propellants:

- (1) LOX
- (2) LH₂
- (3) LN₂
- (4) GHe
- (5) GH₂

These costs were based on current actual costs for the Saturn V. An appropriate burden was added to account for the support activities required for procurement.

TABLE 5.2.5-1
 AMLLV COST SUMMARY

PROPELLANT - ENGINE MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER									730		730
TOTAL COST									730		730

AMLLV
 RECURRING
 PROPELLANT - E/M
 (IN THOUSANDS)

TABLE 5.2.5-II

	<u>Cubic Ft.</u>	<u>Pounds</u>	<u>Dollars</u>
LOX		2,977	\$ 37
LH ₂		518	263
LN ₂		1,066	29
GH _e	3,332		208
GH ₂	816		<u>8</u>
Propellant Cost			\$545
Material and Administrative Burden			<u>185</u>
TOTAL COST			<u>\$730</u>

* For one complete Launch Cycle.

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5.2.6 Launch Operations

The launch operations for the engine module are divided into two parts. The first and second launches (R&D flight test vehicles). The second part represents the costs for launches of the operational vehicles (third vehicle and subsequent vehicles). Each of these parts are divided into three major categories:

1) Launch Control, 2) Launch Pad Operations, and 3) Off Site Support. Figure 5.2.6.0-1 shows the delta costs of these categories and indicates the applicable sub-sections where the costs are shown in detail.

The costs reflected in this section are for launching of one engine module at a two per year launch rate.

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TABLE 5.2.6.0-I LAUNCH OPERATIONS - ENGINE MODULE - 1 R&D FLIGHT VEHICLE
 A MLLV COST SUMMARY

A B C

(IN THOUS. DS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	15	183								15	183
PROGRAM PLAN. & REPT.	38	451								38	451
INDUSTRIAL RELATIONS	8	84								8	84
ENGINEERING			102	1,220						102	1,220
LAB TECHNICIANS											
TOOLING											
PRODUCTION OR OPER.			1,273	12,381						1,273	12,381
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A			246	2,391						246	2,391
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR	61	718	1,621	15,992						1,682	16,710
MATERIAL				8							8
LOGISTIC HARDWARE											
BURDEN				1							1
TOTAL MATERIAL				9							9
TOTAL OTHER											
TOTAL COST		718		16,001							16,719

LAUNCH OPERATIONS - OPERATIONAL VEHICLES (THIRD VEHICLE

TABLE 5.2.6.0-I
A MLLV COST SUMMARY

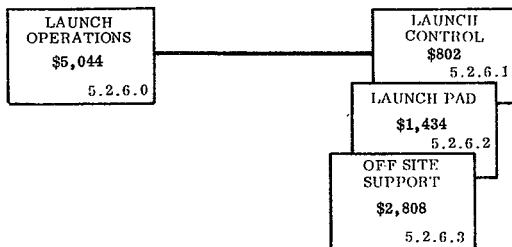
AND SUBSEQUENT VEHICLES)

A B C K

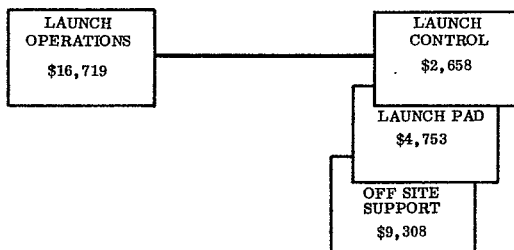
(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING			262	2511						262	2,511
LAB TECHNICIANS											
TOOLING											
PRODUCTION			320	2505						320	2,505
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR			582	5016						582	5,016
MATERIAL				28							28
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL				28							28
TOTAL OTHER											
TOTAL COST				5044							5,044

FIXED COSTS - AFTER 2ND LAUNCH



FIXED COSTS - 2 R&D FLIGHT VEHICLES (INCLUDES ADDITIONAL COSTS FOR 9 MONTH CYCLE TIME, INCREASED SE&I AND INSTRUMENTATION)



NOTES:

DOLLARS ARE IN THOUSANDS.
 NUMBERS IN LOWER RIGHT CORNER
 DESIGNATE APPLICABLE SECTION
 NUMBER FOR COST DETAILS.

*COSTS SHOWN ABOVE ARE INCREASED
 BY A FACTOR OF APPROXIMATELY
 3.315 FOR THE FLIGHT VEHICLES

FIGURE 5.2.6.0-1 ENGINE MODULE LAUNCH OPERATIONS COST FLOW DIAGRAM

5.2.6.1 Launch Control

TABLE 5.2.6.1-I LAUNCH CONTROL CENTER - ENGINE MODULE - 1 R&D FLIGHT VEHICLE
 AMLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	2	29								2	29
PROGRAM PLAN.& REPT.	6	72								6	72
INDUSTRIAL RELATIONS	1	13								1	13
ENGINEERING			16	194						16	194
LAB TECHNICIANS											
TOOLING											
PRODUCTION OR OPER.			202	1,968						202	1,968
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A			39	380						39	380
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR	9	114		2,542						266	2,656
MATERIAL				2							2
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL				2							2
TOTAL OTHER											
TOTAL COST		114		2,544							2,658

AMLLV

PART I

LAUNCH CONTROL CENTER - E/M
ASSEMBLY OR SYSTEM
 FIRST UNIT
 TABLE 5.2.6.1-II

<u>Element of Cost</u>	<u>Manhours</u>	(In Thousands)	
		<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	16		
Logistics			
Laboratory Technician			
Production	202		
Tooling			
Manufacturing Test			
Q&RA	39		
Facilities			
Manufacturing Technician	---		
Total Direct Labor	<u>257</u>		
Program Executive		2	29
Program Planning & Reporting		6	72
Industrial Relations		<u>1</u>	<u>13</u>
Total Labor - Part I		<u>9</u>	<u>114</u>
<u>Material</u>			
Program Planning & Reporting			
Industrial Relations			
Material Subtotal			
Material & Administrative Burden			
Total Material			
TOTAL COST - PART I			114

TABLE 5.2.6.1-III

LAUNCH CONTROL CENTER - E/M

A MLLV PART II COST SUMMARY

A B C

IN THOUSANDS

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	S	M/H	\$
ENGINEERING	16	194							16	194
LAB TECHNICIANS										
TOOLING										
PRODUCTION			202	1,968					202	1,968
MANUFACTURING TEST										
MANUFACTURING TECH.										
Q & R A			39	380					39	380
DIRECT DIST										
TRAINING										
TOTAL DIRECT LABOR	16	194	241	2,348					257	2,542
MATERIAL										
LAB. TECHNICIANS										
TRAINING										
PRODUCTION										
MFG. TECHNICIANS										
Q & R A				2						2
SUBTOTAL				2						2
MAT. & ADM. BURDEN										
TOTAL MATERIAL				2						2
TOTAL PART II COST		194		2,350						2,544

ANLLV
RECURRING
LAUNCH OPERATIONS

LAUNCH CONTROL CENTER - E/M
TABLE 5.2.6.1-IV

<u>Element of Cost</u>	<u>Manhours</u>	(IN THOUSANDS) <u>Dollars</u>
Engineering:		
Design Support	<u>16</u>	<u>194</u>
TOTAL COST	<u>16</u>	<u>194</u>

AMLLV
 LAUNCH OPERATIONS
 LAUNCH CONTROL CENTER - E/M
 FIRST UNIT

TABLE 5.2.6.1-V

<u>Element of Cost</u>	(In Thousands)	
	<u>Manhours</u>	<u>Dollars</u>
Operations:		
Launch Vehicle	111	1,082
Technical Support	<u>91</u>	<u>886</u>
Subtotal A	202	1,968
Q&RA	<u>39</u>	<u>380</u>
Total Labor	<u>241</u>	<u>2,348</u>
Material		
Q&RA		2
Total Material		<u>2</u>
TOTAL COST		<u>\$2,350</u>

5.2.6.2 Launch Pad

TABLE 5.2.6.2-I LAUNCH PAD - ENGINE MODULE - 1 R&D FLIGHT VEHICLE
 A MLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	4	52								4	52
PROGRAM PLAN. & REPT.	11	128								11	128
INDUSTRIAL RELATIONS	2	24								2	24
ENGINEERING			29	347						29	347
LAB TECHNICIANS											
TOOLING											
PRODUCTION OR OPER.			362	3,520						362	3,520
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A			70	680						70	680
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR	17	204	461	4,547						478	4,751
MATERIAL				2							2
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL				2							2
TOTAL OTHER											
TOTAL COST		204		4,549							4,753

AMLLV

PART I
 LAUNCH PAD - E/M
 ASSEMBLY OR SYSTEM
 FIRST UNIT

TABLE 5.2.6.2-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>(In Thousands)</u>	
		<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	29		
Logistics			
Laboratory Technician			
Production	362		
Tooling			
Manufacturing Test			
Q&RA	70		
Facilities			
Manufacturing Technician			
Total Direct Labor	<u>461</u>		
Program Executive		4	52
Program Planning & Reporting		11	128
Industrial Relations		<u>2</u>	<u>24</u>
Total Labor - Part I		<u>17</u>	<u>204</u>

TABLE 5.2.6.2-III

LAUNCH PAD - E/M

AMLLV PART II COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	29	347							29	347
LAB TECHNICIANS										
TOOLING										
PRODUCTION			362	3,520					362	3,520
MANUFACTURING TEST										
MANUFACTURING TECH.										
Q & R A			70	680					70	680
DIRECT DIST										
TRAINING										
TOTAL DIRECT LABOR	29	347	432	4,200					461	4,547
MATERIAL										
LAB. TECHNICIANS										
TOOLING										
PRODUCTION										
MFG. TECHNICIANS										
Q & R A				2						2
SUBTOTAL				2						2
MAT. & ADM. BURDEN										
TOTAL MATERIAL				2						2
TOTAL PART II COST		347		4,202						4,549

AMLIV
 LAUNCH OPERATIONS
 LAUNCH PAD -- E/M
 FIRST UNIT
 TABLE 5.2.6.2-IV

<u>Element of Cost</u>	(In Thousands)	
	<u>Manhours</u>	<u>Dollars</u>
Engineering:		
Design Support	<u>29</u>	<u>347</u>
TOTAL COST	<u>29</u>	<u>347</u>

AMLLV
 LAUNCH OPERATIONS
 LAUNCH PAD - E/M
 FIRST UNIT
 TABLE 5.2.6.2-V

<u>Element of Cost</u>	(In Thousands)	
	<u>Manhours</u>	<u>Dollars</u>
Operations:		
Launch Vehicle	199	\$1,936
Technical Support	<u>163</u>	<u>1,584</u>
Subtotal A	362	3,520
Q&RA	<u>70</u>	<u>680</u>
Total Labor	<u>432</u>	<u>\$4,200</u>
Material		
Q&RA		<u>2</u>
Total Material		<u><u>2</u></u>
TOTAL COST		<u><u>\$4,202</u></u>

5.2.6.3 Offsite Support

TABLE 5.2.6.3-I OFF SITE SUPPORT COMPLEX - ENGINE MODULE - 1 R&D FLIGHT VEHICLE
 AMLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	9	102								9	102
PROGRAM PLAN. & REPT.	21	251								21	251
INDUSTRIAL RELATIONS	5	47								5	47
ENGINEERING			57	679						57	679
LAB TECHNICIANS											
TOOLING											
PRODUCTION OR OPER.			709	6,893						709	6,893
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A			137	1,331						137	1,331
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR	35	400	903	8,903						938	9,303
MATERIAL				4							4
LOGISTIC HARDWARE											
BURDEN				1							1
TOTAL MATERIAL				5							5
TOTAL OTHER											
TOTAL COST		400		8,908							9,308

AMLLV
 PART I
 OFF SITE SUPPORT COMPLEX
 ASSEMBLY OR SYSTEM
 ENGINE MODULE
 TABLE 5.2.6.3-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	(In Thousands <u>Dollars</u>)
<u>Direct Labor</u>			
Engineering	57		
Logistics			
Laboratory Technician			
Production	709		
Tooling			
Manufacturing Test			
Q&RA	137		
Facilities			
Manufacturing Technician	—		
Total Direct Labor	<u>903</u>		
Program Executive		9	102
Program Planning & Reporting		21	251
Industrial Relations		<u>5</u>	<u>47</u>
Total Labor - Part I		<u>35</u>	<u>400</u>
TOTAL COST - PART I			<u>400</u>

TABLE 5.2.6.3-III
 AMLLV PART II COST SUMMARY

OFFSITE SUPPORT COMPLEX - ENGINE MODULE

A B C

IN DOLLARS

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	57	679							57	679
LAB TECHNICIANS										
TOOLING										
PRODUCTION			709	6,893					709	6,893
MANUFACTURING TEST										
MANUFACTURING TECH.										
Q & R A			137	1,331					137	1,331
DIRECT DIST										
TRAINING										
TOTAL DIRECT LABOR	57	679	846	8224					903	8908
SUBTOTAL										
LAB. TECHNICIANS										
TRAINING										
PRODUCTION										
MFG. TECHNICIANS										
Q & R /				4						4
SUBTOTAL				4						4
MAT. & ADM. BURDEN				1						1
TOTAL MATERIAL				5						5
TOTAL PART II COST		679		8229						8908

ANLLV
 LAUNCH OPERATIONS
OFF SITE SUPPORT COMPLEX - E/M
FIRST UNIT
 TABLE 5.2.6.3-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Engineering:		
Design Support	57	679
	---	---
TOTAL COST	<u>57</u>	<u>679</u>

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5.2.7 Manufacturing Facility Maintenance and Transportation

Maintenance costs include cost for maintenance of the manufacturing building, the vertical assembly building, post manufacturing and stage test building, the office building and the capital equipment.

Transportation costs include costs for such items as the barges, the tow vehicle, the land transporter, and the cost for the barge trip from the manufacturing facility to the launch site.

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TABLE 5.2.7-1 FACILITIES & TRANSP. - ENGINE MODULE
 ANLLV COST SUMMARY-

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES						1,396					1,396
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR						1,396					1,396
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER											
TOTAL COST						1,396					1,396

AMLV
RECURRING COST SUMMARY

INJECTION STAGE - E/M

FACILITIES & TRANSPORTATION
(DOLLARS IN THOUSANDS)

TABLE 5.2.7-II

<u>Element of Cost</u>	<u>Facilities</u>	<u>Equipment</u>	<u>Transportation</u>
Manufacturing Bldg.	1,543	662	
Vertical Assy. Bldg.	45	20	
Post Mfg. & Stage Test Bldg.	25	13	
Liquid Engine Mfg. Bldg.			
Office	<u>365</u>	<u>41</u>	
Subtotal	<u>1,978</u>	<u>736</u>	
 <u>Transportation</u>			
Barge			40
Tow Vehicle			2
Land Transporter			<u>4</u>
Subtotal			<u>46</u>
 Totals			
Transportation			46
Equipment			736
Facilities			1,978
Barge Trips *			<u>32</u>
MANUFACTURING FACILITIES COST			<u>2,792</u>
Recurring Costs for one vehicle or six (6) months			<u>1,396</u>

Barge trips are estimated @ 4 per year

4 X \$8,000 = \$32,000

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5.3 FUEL MODULE INJECTION STAGE

The summary costs for the first unit injection stage - fuel module are displayed in Figure 5.3.0.0-1. These costs include not only the hardware, but all the costs associated with launching the stage and maintaining that portion of the facility associated with the fuel module. Table 5.3.0.0-I summarizes the cost of the fuel module by part and elements of costs for the first R&D flight vehicles.

Table 5.3.0.0-II displays (for reference) the costs for the first operational vehicle (third unit).

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TABLE 5.3.0.0-I TOTAL FUEL MODULE - 1 R&D FLIGHT VEHICLE
 AMLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	13	150								13	150
PROGRAM PLAN.& REPT.	32	369								32	369
INDUSTRIAL RELATIONS	6	66								6	66
ENGINEERING			35	580				17		35	597
LAB TECHNICIANS				1							1
TOOLING			25	496						25	496
PRODUCTION			850	11,193						850	11,193
MANUFACTURING TEST			18	472						18	472
MANUFACTURING TECH.			11	132						11	132
Q & R A			204	1,979						204	1,979
FACILITIES					11	98				11	98
DIRECT DIST			133	1,270						133	1,270
TRAINING			7	65						7	65
TOTAL DIRECT LABOR	51	585	1,283	16,188	11	98		17		1,334	16,888
MATERIAL				1,256							1,256
LOGISTIC HARDWARE BURDEN				421							421
TOTAL MATERIAL				1,677							1,677
TOTAL OTHER									730		730
TOTAL COST		585		17,865		98		17	730		19,295

TOTAL FUEL MODULE - OPERATIONAL VEHICLES
(THIRD VEHICLE AND SUBSEQUENT VEHICLES)

TABLE 5.3.0.0-II
AMLLV COST SUMMARY

B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	8	93								8	93
PROGRAM PLAN. & REPT.	20	226								20	226
INDUSTRIAL RELATIONS	4	39								4	39
ENGINEERING			134	1446				17		134	1,463
LAB TECHNICIANS				1							1
TOOLING			25	496						25	496
PRODUCTION OR OPER			604	8503						604	8,503
MANUFACTURING TEST			18	472						18	472
MANUFACTURING TECH.			11	132						11	132
Q & RA			125	1218						125	1,218
FACILITIES					11	98				11	98
DIRECT DIST			133	1270						133	1,270
TRAINING			7	65						7	65
TOTAL DIRECT LABOR	32	358	1057	13603	11	98		17		1,100	14,106
MATERIAL				1268							1,252
LOGISTIC HARDWARE											
BURDEN				421							421
TOTAL MATERIAL				1689							1,673
TOTAL OTHER								730			730
TOTAL COST		358		15292	98		17	730			16,495

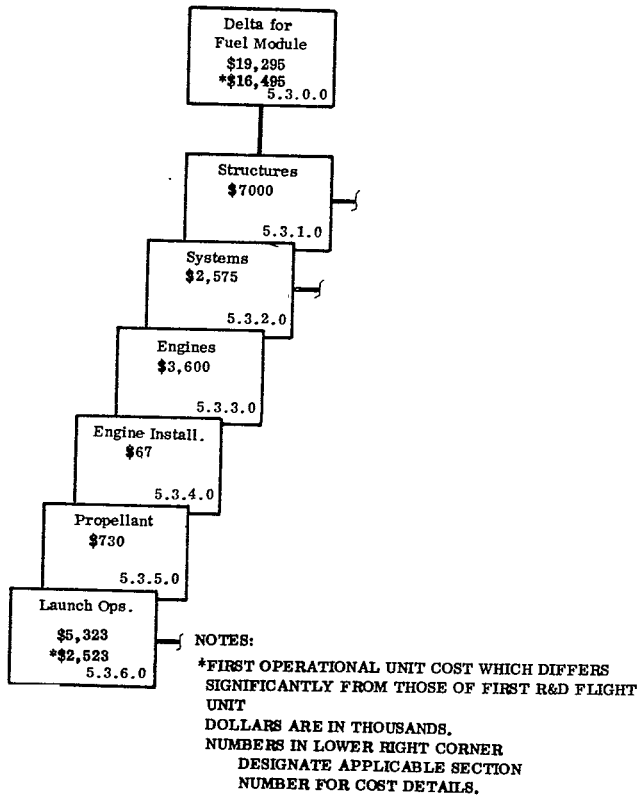


FIGURE 5.3.0.0-1 FUEL MODULE - INJECTION STAGE COST FLOW DIAGRAM

5.3.1 Structures

The first unit production cost for the structural components of the fuel module are displayed in Figure 5.3.1.0-1. The cost details of the structural components are contained in appropriate sub-sections as indicated.

Table 5.3.1.0-I is a total cost summary of these structures .

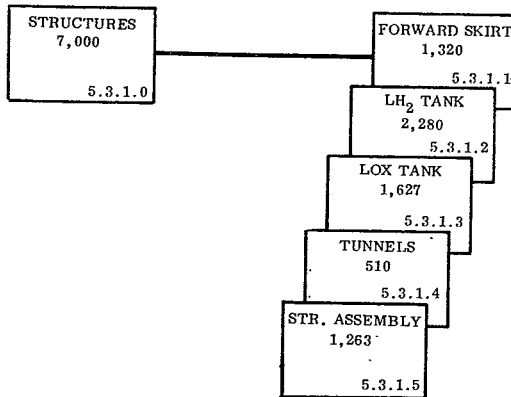


FIGURE 5.3.1.0-1 FUEL MODULE STRUCTURES COST FLOW DIAGRAM

TABLE 5.3.1.0-I
AMLLVCOST SUMMARY

TOTAL STRUCTURES - FUEL MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	6	72								6	72
PROGRAM PLAN. & REPT.	15	176								15	176
INDUSTRIAL RELATIONS	4	31								4	31
ENGINEERING			3	31				17		3	48
LAB TECHNICIANS				1							1
TOOLING			19	191						19	191
PRODUCTION			346	3,373						346	3,373
MANUFACTURING TEST			13	156						13	156
MANUFACTURING TECH.			9	101						9	101
Q & R A			97	945						97	945
FACILITIES					9	78				9	78
DIRECT DIST			99	944						99	944
TRAINING			5	49						5	49
TOTAL DIRECT LABOR	25	279	591	5,791	9	78		17		625	6,165
MATERIAL				624							624
LOGISTIC HARDWARE BURDEN				211							211
TOTAL MATERIAL				835							835
TOTAL OTHER											
TOTAL COST		279		6,626		78		17			7,000

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5.3.1.1 Forward Skirt

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TABLE 5.3.1.1-I

AMLLV COST SUMMARY

FORWARD SKIRT - FUEL MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	1	12								1	12
PROGRAM PLAN. & REPT.	2	28								2	28
INDUSTRIAL RELATIONS	1	5								1	5
ENGINEERING				4				1			5
LAB TECHNICIANS				1							1
TOOLING			3	33						3	33
PRODUCTION			55	537						55	537
MANUFACTURING TEST			2	24						2	24
MANUFACTURING TECH.			1	12						1	12
Q & R A			16	150						16	150
FACILITIES					1	12				1	12
DIRECT DIST			16	151						16	151
TRAINING			1	7						1	7
TOTAL DIRECT LABOR	4	45	94	919	1	12	1			99	977
MATERIAL				256							256
LOGISTIC HARDWARE BURDEN				87							87
TOTAL MATERIAL				343							343
TOTAL OTHER											
TOTAL COST		45		1,262		12		1			1,320

AMLLV

PART I

FORWARD SKIRT - F/M
ASSEMBLY OR SYSTEM

TABLE 5.3.1.1-II.

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	39		
Logistics	5		
Laboratory Technician	8		
Production	55,222		
Tooling	3,392		
Manufacturing Test	1,629		
Q&RA	15,470		
Facilities	1,272		
Manufacturing Technician	<u>1,383</u>		
Total Direct Labor	<u>79,242</u>		
Program Executive		951	11,231
Program Planning & Reporting		2,377	28,076
Industrial Relations		<u>515</u>	<u>5,007</u>
Total Labor - Part I		<u>3,843</u>	<u>44,314</u>
<u>Material</u>			
Program Planning & Reporting			48
Industrial Relations			<u>52</u>
Material Subtotal			100
Material & Administrative Burden			<u>33</u>
Total Material			<u>133</u>
TOTAL COST - PART I			<u>44,447</u>

TABLE 5.3.1.1-III

AMLLV PART II COST SUMMARY

FORWARD SKIRT - F/M

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING		4								4
LAB TECHNICIANS		1								1
TOOLING					3	33			3	33
PRODUCTION			55	537					55	537
MANUFACTURING TEST							2	24	2	24
MANUFACTURING TECH.			1	11				1	1	12
Q & R A			14	135	1	9	1	6	16	150
DIRECT DIST			14	132	1	11	1	8	16	151
TRAINING			1	7					1	7
TOTAL DIRECT LABOR		5	85	822	5	53	4	39	94	919
MATERIAL										
LAB. TECHNICIANS										
TOOLING						6				6
PRODUCTION				244						244
MFG. TECHNICIANS				2						2
Q & R A				4						4
SUBTOTAL				250		6				256
MAT. & ADM. EXPEN:				85		2				87
TOTAL MATERIAL				335		8				343
TOTAL PART II COST		5		1,157		61		39		1,262

AMLLV
PART II
ENGINEERING

FORWARD SKIRT - F/M

ASSEMBLY OR SYSTEM

TABLE 5.3.1.1-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Design Development	38	449
Reliability Engineering		
(1) Subtotal (A)	38	449
(2) Laboratory Technicians	<u>8</u>	<u>74</u>
Subtotal (B)	46	523
(3) Q&RA	<u>2</u>	<u>15</u>
Total Engineering Labor	<u>48</u>	<u>538</u>
Material		
(4) Lab. Tech.		16
(5) Q&RA		
Subtotal (C)		16
(6) Material & Adm. Burden		<u>6</u>
Total Material		<u>22</u>
Total Engineering Cost		<u>560</u>

AMELV
PART II
MANUFACTURING
PRODUCTION

FORWARD SKIRT - F/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.3.1.1-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	38,935	\$ 378,448
(2) Miscellaneous Charges	3,037	29,520
(3) Maintain & Add in Scope Changes	428	4,160
Subtotal (A)	<u>42,400</u>	412,128
(4) Tool & Production Planning	<u>12,822</u>	<u>124,630</u>
Subtotal (B)	55,222	536,758
(5) Direct Distributable	<u>13,568</u>	<u>131,881</u>
Subtotal (C)	68,790	668,639
(6) Training	<u>757</u>	<u>7,358</u>
Subtotal (D)	69,547	675,997
(7) Q&RA	13,909	135,195
(8) Mfg. Tech.	<u>1,321</u>	<u>10,601</u>
Total Production Labor	<u>84,777</u>	\$ <u>821,793</u>
 Material		
(9) Raw Material & Standards		\$ 243,545
(10) Q&RA		4,173
(11) Mfg. Tech.		<u>2,312</u>
Material Subtotal		250,028
(12) Material & Adm. Burden		<u>85,010</u>
Total Material		<u>335,038</u>
Total Production Cost		<u>\$ 1,156,831</u>

AMLLV
 PART 11
 MANUFACTURING
 TOOLING

FORWARD SKIRT - F/M

ASSEMBLY OR SYSTEM
 1ST UNIT COST
 TABLE 5.3.1.1-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	3,392	\$ 32,970
(2) Direct Distributable	<u>1,085</u>	<u>10,546</u>
Subtotal (A)	4,477	43,516
(3) Training	<u>49</u>	<u>476</u>
Subtotal (B)	4,526	43,992
(4) Q&RA	<u>905</u>	<u>8,797</u>
Total Tooling Labor	<u>5,431</u>	<u>\$ 52,789</u>
 Material		
(5) Tooling		\$ 5,936
(6) Q&RA		<u>272</u>
Subtotal (C)		6,208
(7) Material & Adm. Burden		<u>2,111</u>
Total Material		<u>8,319</u>
Total Tooling Cost		<u>\$ 61,108</u>

AMLLV
PART II
MANUFACTURING
MANUFACTURING TEST

FORWARD SKIRT - F/M
ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.3.1.1-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	1,857	18,050
Component Test Planning	<u>594</u>	<u>5,776</u>
Subtotal	2,451	23,826
Direct Distributable	<u>784</u>	<u>7,623</u>
Subtotal	3,235	31,449
Training	<u>36</u>	<u>345</u>
Subtotal	3,271	31,794
Mfg. Tech.	<u>62</u>	<u>733</u>
Subtotal	3,333	32,527
Q&RA	<u>654</u>	<u>6,359</u>
Total Mfg. Test Labor	<u><u>3,987</u></u>	<u><u>38,886</u></u>
 Material		
Q&RA		196
Mfg. Tech.		<u>109</u>
Subtotal		305
Material & Adm. Burden		<u>104</u>
Total Material		<u>409</u>
Total Mfg. Test Cost		<u><u>39,295</u></u>

AMLLV
PART III
FACILITY LABOR

FORWARD SKIRT - F/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.3.1.1-VIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	<u>1,272</u>	<u>\$ 12,364</u>
TOTAL FACILITY LABOR COST		<u>\$ 12,364</u>

AMLLV
PART IV
LOGISTIC LABOR

FORWARD SKIRT
ASSEMBLY OR SYSTEM

TABLE 5.3.1.1-IX

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Engineering	5	<u>59</u>
Hardware		280
Material & Adm. Burden		<u>95</u>
Total Material		<u>375</u>
Total Logistic Cost		<u>434</u>

5.3.1.2 LH₂ Tank Torus

TABLE 5.3.1.2-I
 AMLLV COST SUMMARY

LH₂ TANK - FUEL MODULE

A B C

(IN THOUSANDS)

966

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	2	23								2	23
PROGRAM PLAN. & REPT.	5	57								5	57
INDUSTRIAL RELATIONS	1	10								1	10
ENGINEERING											
LAB TECHNICIANS								4			4
TOOLING			7	67						7	67
PRODUCTION			111	1,084						111	1,084
MANUFACTURING TEST			5	50						5	50
MANUFACTURING TECH.			3	34						3	34
Q & R A			31	304						31	304
FACILITIES					3	25				3	25
DIRECT DIST			31	303						31	303
TRAINING			2	16						2	16
TOTAL DIRECT LABOR	8	90	190	1,858	3	25		4		201	1,977
MATERIAL				226							226
LOGISTIC HARDWARE											
BURDEN				77							77
TOTAL MATERIAL				303							303
TOTAL OTHER											
TOTAL COST		90		2,161		25		4			2,280

AMLLV

PART I

LH₂TANK - F/M
ASSEMBLY OR SYSTEM
 TABLE 5.3.1.2-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	23		
Logistics	43		
Laboratory Technician	5		
Production	111,485		
Tooling	6,866		
Manufacturing Test	5,194		
Q&RA	31,301		
Facilities	2,574		
Manufacturing Technician	<u>2,799</u>		
Total Direct Labor	<u>160,290</u>		
Program Executive		1,923	22,717
Program Planning & Reporting		4,809	56,790
Industrial Relations		<u>1,042</u>	<u>10,127</u>
Total Labor - Part I		<u>7,773</u>	<u>89,634</u>
<u>Material</u>			
Program Planning & Reporting			96
Industrial Relations			<u>104</u>
Material Subtotal			200
Material & Administrative Burden			<u>68</u>
Total Material			<u>268</u>
TOTAL COST - PART I			<u>89,902</u>

TABLE 5.3.1.2-III

LH₂ TANK - F/M

AMLLV PART II COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING										
LAB TECHNICIANS										
TOOLING					7	67			7	67
PRODUCTION			111	1,084					111	1,084
MANUFACTURING TEST							5	50	5	50
MANUFACTURING TECH.			3	32				2	3	34
Q & R A			28	273	2	18	1	13	31	304
DIRECT DIST			27	266	2	21	2	16	31	303
TRAINING			2	14		1		1	2	16
TOTAL DIRECT LABOR			171	1,669	11	107	8	82	190	1,858
MATERIAL								1		1
LAB. TECHNICIANS										
TOOLING						12				12
PRODUCTION				200						200
MFG. TECHNICIANS				5						5
Q & R A				8		1				9
SUBTOTAL				213		13				226
MAT. & ADM. BURDEN				72		4		1		77
TOTAL MATERIAL				285		17		1		303
TOTAL PART II COST				1,954		124		83		2,161

AMLLV

PART II
ENGINEERING

LH₂ TANK - F/M

ASSEMBLY OR SYSTEM

TABLE 5.3.1.2-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Design Development	17	201
Reliability Engineering	—	—
(1) Subtotal (A)	17	201
(2) Laboratory Technicians	<u>3</u>	<u>33</u>
Subtotal (B)	20	234
(3) Q&RA	<u>1</u>	<u>6</u>
Total Engineering Labor	21	240
Material		
(4) Lab. Tech.		7
(5) Q&RA		—
Subtotal (C)		7
(6) Material & Adm. Burden		<u>2</u>
Total Material		<u>9</u>
Total Engineering Cost		<u>249</u>

AMLLV

PART II
MANUFACTURING
PRODUCTION

LH₂ TANK - F/M
ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.3.1.2-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	78,604	764,031
(2) Miscellaneous Charges	6,131	59,594
(3) Maintain & Add in Scope Changes	<u>865</u>	<u>8,403</u>
Subtotal (A)	85,600	832,028
(4) Tool & Production Planning	<u>25,885</u>	<u>251,605</u>
Subtotal (B)	<u>111,485</u>	<u>1,083,633</u>
(5) Direct Distributable	27,392	266,249
Subtotal (C)	<u>138,877</u>	<u>1,349,882</u>
(6) Training	1,528	14,848
Subtotal (D)	<u>140,405</u>	<u>1,364,730</u>
(7) Q&RA	28,081	272,946
(8) Mfg. Tech.	<u>2,668</u>	<u>31,504</u>
Total Production Labor	<u>171,154</u>	<u>1,669,180</u>
Material		
(9) Raw Material & Standards		199,700
(10) Q&RA		8,424
(11) Mfg. Tech.		<u>4,668</u>
Material Subtotal		212,792
(12) Material & Adm. Burden		<u>72,349</u>
Total Material		<u>285,141</u>
Total Production Cost		<u>1,954,321</u>

AMLLV
PART II
MANUFACTURING
TOOLING

LH₂ TANK - F/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.3.1.2-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Doll. amt.</u>
(1) Sustaining Tooling	6,865	66,728
(2) Direct Distributabel	<u>2,197</u>	<u>21,355</u>
Subtotal (A)	9,062	88,083
(3) Training	<u>100</u>	<u>972</u>
Subtotal (B)	9,162	89,055
(4) Q&RA	<u>1,832</u>	<u>17,807</u>
Total Tooling Labor	<u>10,994</u>	<u>106,862</u>
 Material		
(5) Tooling		12,014
(6) Q&RA		<u>550</u>
Subtotal (C)		12,564
(7) Material & Adm. Burden		<u>4,272</u>
Total Material		<u>16,836</u>
Total Tooling Cost		<u>123,698</u>

AMLIV
 PART II
 MANUFACTURING
 MANUFACTURING TEST

LH₂ TANK - F/M

ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 5.3.1.2-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	3,935	38,248
Component Test Planning	1,259	12,239
(1) Subtotal (A)	<u>5,194</u>	<u>50,487</u>
(2) Direct Distributable	<u>1,662</u>	<u>16,156</u>
Subtotal (B)	6,856	66,643
(3) Training	<u>75</u>	<u>733</u>
Subtotal (C)	6,931	67,376
(4) Mfg. Tech.	<u>132</u>	<u>1,555</u>
Subtotal (D)	7,063	67,376
(5) Q&RA	<u>1,386</u>	<u>13,475</u>
Total Mfg. Test Labor	<u>8,449</u>	<u>82,406</u>
Material		
(6) Q&RA		416
(7) Mfg. Tech.		<u>230</u>
Subtotal (E)		646
(8) Material & Adm. Burden		<u>220</u>
Total Material		<u>866</u>
Total Mfg. Test Cost		<u>83,272</u>

AMLLV

PART III
FACILITY LABOR

LH₂ TANK - F/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.3.1.2-VIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Direct Labor Hours.	<u>2,575</u>	<u>25,029</u>
TOTAL FACILITY LABOR COST		<u>25,029</u>

AMLLV
 PART IV
 LOGISTIC LABOR
LH₂ TANK - F/M
 ASSEMBLY OR SYSTEM
 TABLE 5.3.1.2-IX

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Engineering	<u>43</u>	<u>508</u>
Hardware	—	2,408
Material & Adm. Burden		<u>819</u>
Total Material		<u>3,227</u>
Total Logistic Cost		<u>3,735</u>

5.3.1.3 LOX Tank Torus

TABLE 5.3.1.3-I

AMLLV COST SUMMARY

LOX TANK - FUEL MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	1	17								1	17
PROGRAM PLAN. & REPT.	4	42								4	42
INDUSTRIAL RELATIONS	1	8								1	8
ENGINEERING								4			4
LAB TECHNICIANS											
TOOLING			5	50						5	50
PRODUCTION			84	816						84	816
MANUFACTURING TEST			4	38						4	38
MANUFACTURING TECH.			2	25						2	25
Q & R A			23	229						23	229
FACILITIES					2	19				2	19
DIRECT DIST			24	228						24	228
TRAINING			1	13						1	13
TOTAL DIRECT LABOR	6	67	143	1,399	2	19		4		151	1,489
MATERIAL				104							104
LOGISTIC HARDWARE											
BURDEN				34							34
TOTAL MATERIAL				138				4			142
TOTAL OTHER											
TOTAL COST		67		1,537	19			4			1,627

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AMLLV

PART I

LOX TANK - F/M
ASSEMBLY OR SYSTEM
 TABLE 5.3.1.3-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	5,767		
Logistics	888		
Laboratory Technician	1,154		
Production	78,010		
Tooling	4,764		
Manufacturing Test	3,609		
Q&RA	22,000		
Facilities	1,786		
Manufacturing Technician	<u>1,947</u>		
Total Direct Labor	<u>119,925</u>		
Program Executive		1,439	16,994
Program Planning & Reporting		3,598	42,492
Industrial Relations		<u>780</u>	<u>7,582</u>
Total Labor - Part I		<u>5,817</u>	<u>67,068</u>
<u>Material</u>			
Program Planning & Reporting			72
Industrial Relations			<u>78</u>
Material Subtotal			150
Material & Administrative Burden			<u>51</u>
Total Material			<u>201</u>
TOTAL COST - PART I			<u>67,269</u>

TABLE 5.3.1.3-III

AMLLV PART II COST SUMMARY LOX TANK - F/M

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING										
LAB TECHNICIANS										
TOOLING					5	50			5	50
PRODUCTION			84	816					84	816
MANUFACTURING TEST							4	38	4	38
MANUFACTURING TECH.			2	24				1	2	25
Q & R A			21	206	1	13	1	10	23	229
DIRECT DIST			21	200	2	16	1	12	24	228
TRAINING			1	11		1		1	1	13
TOTAL DIRECT LABOR			129	1,257	8	80	6	62	143	1,399
MATERIAL										
LAB. TECHNICIANS										
TOOLING						9		1		10
PRODUCTION				83						83
MFG. TECHNICIANS				4						4
Q & R A				6		1				7
SUBTOTAL				93		10		1		104
MAT. & ADM. BURDEN				31		3				34
TOTAL MATERIAL				124		13		1		138
TOTAL PART II COST				1,381		93		63		1,537

AMLLV
 PART II
 ENGINEERING
 LOX TANK - F/M

ASSEMBLY OR SYSTEM
 TABLE 5.3.1.3-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Design Development	17	201
Reliability Engineering		
(1) Subtotal (A)	<u>17</u>	<u>201</u>
(2) Laboratory Technicians	<u>3</u>	<u>33</u>
Subtotal (B)	20	234
(3) Q&RA	<u>1</u>	<u>6</u>
Total Engineering Labor	<u>21</u>	<u>240</u>
Material		
(4) Lab. Tech.		7
(5) Q&RA		
Subtotal (C)		<u>7</u>
(6) Material & Adm. Burden		<u>2</u>
Total Material		<u>9</u>
Total Engineering Cost		<u>249</u>

AMLLV
 PART IIB
 MANUFACTURING
 PRODUCTION
 LOX TANK - E/M :

ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 5.3.1.3-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	59,181	\$ 575,239
(2) Miscellaneous Charges	4,616	44,868
(3) Maintain & Add in Scope Changes	<u>651</u>	<u>6,328</u>
Subtotal (A)	64,448	626,435
(4) Tool & Production Planning	<u>19,489</u>	<u>189,433</u>
Subtotal (B)	83,937	815,868
(5) Direct Distributable	<u>20,623</u>	<u>200,455</u>
Subtotal (C)	104,560	1,016,323
(6) Training	<u>1,150</u>	<u>11,178</u>
Subtotal (D)	105,710	1,027,501
(7) Q&RA	21,142	205.500
(8) Mfg. Tech.	<u>2,008</u>	<u>23,714</u>
Total Production Labor	<u>128,860</u>	<u>\$ 1,256,715</u>
 <u>Material</u>		
(9) Raw Material & Standards		\$ 82,733
(10) Q&RA		6,343
(11) Mfg. Tech.		<u>3,514</u>
Material Subtotal		92,590
(12) Material & Adm. Burden		<u>31,481</u>
Total Material		<u>124,071</u>
Total Production Cost		<u>\$ 1,380,786</u>

' AMLLV '
PART II
MANUFACTURING
TOOLING

LOX TANK - F/M

ASSEMBLY OR SYSTEM
1ST UNIT COST
TABLE 5.3.1.3-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	5,156	\$ 50,116
(2) Direct Distributable	<u>1,650</u>	<u>16,038</u>
Subtotal (A)	6,806	66,154
(3) Training	<u>75</u>	<u>729</u>
Subtotal (B)	6,881	66,883
(4) Q&RA	<u>1,376</u>	<u>13,375</u>
Total Tooling Labor	<u>8,257</u>	<u>\$ 80,258</u>
 Material		
(5) Tooling		\$ 9,023
(6) Q&RA		<u>413</u>
Subtotal (C)		9,436
(7) Material & Adm. Burden		<u>3,208</u>
Total Material		<u>12,644</u>
Total Tooling Cost		<u>\$ 92,902</u>

AMLLV
PART II³
MANUFACTURING
MANUFACTURING TEST

LOX TANK - F/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.3.1.3-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	2,959	28,761
Component Test Planning	<u>947</u>	<u>9,203</u>
(1) Subtotal (A)	3,906	37,964
(2) Direct Distributable	<u>1,250</u>	<u>12,148</u>
Subtotal (B)	5,156	50,112
(3) Training	<u>57</u>	<u>551</u>
Subtotal (C)	5,213	50,663
(4) Mfg. Tech.	<u>99</u>	<u>1,169</u>
Subtotal (D)	5,312	51,832
(5) Q&RA	<u>1,042</u>	<u>10,132</u>
Total Mfg. Test Labor	<u><u>6,354</u></u>	<u><u>61,964</u></u>
Material		
(6) Q&RA		313
(7) Mfg. Tech.		<u>173</u>
Subtotal (E)		486
(8) Material & Adm. Burden		<u>165</u>
Total Material		<u>651</u>
Total Mfg. Test Cost		<u><u>62,615</u></u>

AMLLV
PART III
FACILITY LABOR.

LOX TANK - F/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.3.1.3-VIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	<u>1,933</u>	<u>\$ 18,789</u>
TOTAL FACILITY LABOR COST		<u><u>\$ 18,789</u></u>

AMLLV
 PART IV
 LOGISTIC LABOR
 LOX TANK - F/M

 ASSEMBLY OR SYSTEM
 TABLE 5.3.1.3-IX

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Engineering	<u>43</u>	<u>508</u>
(2) Hardware		<u>2,408</u>
(3) Material & Adm. Burden		<u>819</u>
Total Material		<u>3,227</u>
Total Logistic Cost		<u>3,735</u>

5.8.1.4 Tunnels

TABLE 5.3.1.4-I
 AMLLV COST SUMMARY

TUNNELS - FUEL MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	1	6								1	6
PROGRAM PLAN. & REPT.	1	14								1	14
INDUSTRIAL RELATIONS		2									2
ENGINEERING			2	19						2	19
LAB TECHNICIANS											
TOOLING											
PRODUCTION			27	262						27	262
MANUFACTURING TEST			1	12						1	12
MANUFACTURING TECH.			1	9						1	9
Q & R A			7	73						7	73
FACILITIES					1	6				1	6
DIRECT DIST			8	73						8	73
TRAINING				3				3			6
TOTAL DIRECT LABOR	2	22	46	451	1	6		3		49	482
MATERIAL				21							
LOGISTIC HARDWARE BURDEN				7							
TOTAL MATERIAL				28							
TOTAL OTHER											
TOTAL COST		22		479		6		3			510

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AMLLV

PART I

TUNNELS - F/M
ASSEMBLY OR SYSTEM

TABLE 5.3:1.4-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	187		
Logistics	29		
Laboratory Technician	37		
Production	26,948		
Tooling	2,144		
Manufacturing Test	1,254		
Q&RA	7,563		
Facilities	608		
Manufacturing Technician	677		
Total Direct Labor	<u>39,444</u>		
Program Executive		533	6,295
Program Planning & Reporting		1,183	13,971
Industrial Relations		<u>256</u>	<u>2,488</u>
Total Labor - Part I		<u>1,972</u>	<u>22,754</u>
<u>Material</u>			
Program Planning & Reporting			23
Industrial Relations			<u>26</u>
Material Subtotal			49
Material & Administrative Burden			<u>17</u>
Total Material			<u>66</u>
TOTAL COST - PART I			<u>22,820</u>

TABLE 5.3.1.4-III

TUNNELS - FUEL MODULE

AMLLV PART II COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING		3			2	16			2	19
LAB TECHNICIANS										
TOOLING										
PRODUCTION			27	262					27	262
MANUFACTURING TEST							1	12	1	12
MANUFACTURING TECH.			1	8				1	1	9
Q & R A			7	66		4		3	7	73
DIRECT DIST			6	64	1	5	1	4	8	73
TRAINING				3						3
TOTAL DIRECT LABOR		3	41	403	3	25	2	20	46	451
MATERIAL				15						15
LAB. TECHNICIANS										
TOOLING						3				3
PRODUCTION										
MFG. TECHNICIANS				1						1
Q & R A				2						2
SUBTOTAL				18		3				21
MAT. & ADM. EXPEN				6		1				7
TOTAL MATERIAL				24		4				28
TOTAL PART II COST		3		427		29		20		479

AMLLV
PART II
ENGINEERING

TUNNELS - F/M

ASSEMBLY OR SYSTEM

. TABLE 5.3.1.4-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Design Development	187	2,208
Reliability Engineering	—	—
(1) Subtotal (A)	187	2,208
(2) Laboratory Technicians	<u>37</u>	<u>364</u>
Subtotal (B)	224	2,572
(3) Q&RA	<u>7</u>	<u>72</u>
Total Engineering Labor	<u>231</u>	<u>2,644</u>
Material		
(4) Lab. Tech.		79
(5) Q&RA		<u>2</u>
Subtotal (C)		81
(6) Material & Adm. Burden		<u>27</u>
Total Material		<u>108</u>
Total Engineering Cost		<u>2,752</u>

AMLLV
 PART II
 MANUFACTURING
 PRODUCTION
 TUNNELS-F/M

ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 5.3.1.4-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	19,100	184,680
(2) Miscellaneous Charges	1,482	14,405
(3) Maintain & Add in Scope Changes	<u>209</u>	<u>2,031</u>
Subtotal (A)	20,691	201,116
(4) Tool & Production Planning	<u>6,257</u>	<u>60,818</u>
Subtotal (B)	26,948	261,934
(5) Direct Distributable	<u>6,621</u>	<u>64,356</u>
Subtotal (C)	33,569	326,290
(6) Training	<u>369</u>	<u>3,587</u>
Subtotal (D)	33,938	329,877
(7) Q&RA	6,788	65,979
(8) Mfg. Tech.	<u>645</u>	<u>7,617</u>
Total Production Labor	<u>41,371</u>	<u>403,473</u>
 Material		
(9) Raw Material & Standards		14,685
(10) Q&RA		2,036
(11) Mfg. Tech.		<u>1,129</u>
Material Subtotal		17,850
(12) Material & Adm. Burden		<u>6,069</u>
Total Material		<u>23,919</u>
Total Production Cost		<u>427,392</u>

AMLLV
PART II
MANUFACTURING
TOOLING

TUNNELS - F/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.3.1.4-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	1,624	15,785
(2) Direct Distributabel	<u>520</u>	<u>5,050</u>
Subtotal (A)	2,144	20,835
(3) Training	<u>24</u>	<u>228</u>
Subtotal (B)	2,168	21,063
(4) Q&RA	<u>433</u>	<u>4,212</u>
Total Tooling Labor	<u>2,601</u>	<u>25,275</u>
 Material		
(5) Tooling		2,842
(6) Q&RA		<u>130</u>
Subtotal (C)		2,972
(7) Material & Adm. Burden		<u>1,010</u>
Total Material		<u>3,982</u>
Total Tooling Cost		<u>29,257</u>

AMLLV
 PART II
 MANUFACTURING
 MANUFACTURING TEST

 TUNNELS - F/M

 ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 5.3.1.4-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	950	9,234
Component Test Planning	<u>304</u>	<u>2,955</u>
(1) Subtotal (A):	1,254	12,189
(2) Direct Distributable	<u>401</u>	<u>3,900</u>
Subtotal (B)	1,655	16,089
(3) Training	<u>18</u>	<u>177</u>
Subtotal (C)	1,673	16,266
(4) Mfg. Tech.	<u>32</u>	<u>374</u>
Subtotal (D)	1,705	16,640
(5) Q&RA	<u>335</u>	<u>3,252</u>
Total Mfg. Test Labor	<u>2,040</u>	<u>19,892</u>
Material		
(6) Q&RA		100
(7) Mfg. Tech.		<u>55</u>
Subtotal (E)		155
(8) Material & Adm. Burden		<u>53</u>
Total Material		<u>208</u>
Total Mfg. Test Cost		<u>20,100</u>

AMLLV
 PART III
 FACILITY LABOR
 TUNNELS - F/M ,
 TABLE 5.3.1.4-VIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	<u>608</u>	<u>5,910</u>
Total Facility Labor	<u>608</u>	<u>5,910</u>

AMLLV
 PART IV
 LOGISTIC LABOR
 TUNNELS - F/M
 TABLE 5.3.1.4-IX

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Engineering	<u>29</u>	<u>342</u>
(2) Hardware		1,624
(3) Material & Adm. Burden		<u>552</u>
Total Material		<u>2,176</u>
Total Logistic Cost		<u>2,518</u>

5.3.1.5 Structure Assembly

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TABLE 5.3.1.5-I STRUCTURES ASSEMBLY - FUEL MODULE
 AMLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	1	14								1	14
PROGRAM PLAN. & REPT.	3	35								3	35
INDUSTRIAL RELATIONS	1	6								1	6
ENGINEERING			1	8				5		1	13
LAB TECHNICIANS											
TOOLING			4	41						4	41
PRODUCTION			69	674						69	674
MANUFACTURING TEST			3	32						3	32
MANUFACTURING TECH.			2	21						2	21
Q & R A			20	189						20	189
FACILITIES					2	16				2	16
DIRECT DIST			20	189						20	189
TRAINING			1	10						1	10
TOTAL DIRECT LABOR	5	55	120	1,164	2	16		5		127	1,240
MATERIAL				17							17
LOGISTIC HARDWARE BURDEN				6							6
TOTAL MATERIAL				23							23
TOTAL OTHER											
TOTAL COST		55		1,187		16		5			1,263

AMLLV

PART I

STRUCTURES ASSEMBLY - F/M
ASSEMBLY OR SYSTEM

TABLE 5.3.1.5-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	8,412		
Logistics	1,285		
Laboratory Technician	1,670		
Production	60,504		
Tooling	3,709		
Manufacturing Test	2,810		
Q&RA	17,284		
Facilities	1,391		
Manufacturing Technician	<u>1,516</u>		
Total Direct Labor	<u>98,581</u>		
Program Executive		1,183	\$ 13,971
Program Planning & Reporting		2,957	34,922
Industrial Relations		<u>641</u>	<u>6,231</u>
Total Labor - Part I		<u>4,781</u>	<u>\$ 55,124</u>
<u>Material</u>			
Program Planning & Reporting			\$ 60
Industrial Relations			<u>64</u>
Material Subtotal			\$ 124
Material & Administrative Burden			<u>42</u>
Total Material			<u>\$ 146</u>
TOTAL COST - PART I			<u>\$ 55,270</u>

TABLE 5.3.1.5-III STRUCTURES ASSEMBLY - F/M
 AMLLV PART II COST SUMMARY

A B C K

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	1	8							1	8
LAB TECHNICIANS										
TOOLING					4	41			4	41
PRODUCTION			69	674					69	674
MANUFACTURING TEST							3	32	3	32
MANUFACTURING TECH.			2	20				1	2	21
Q & R A			18	170	1	11	1	8	20	189
DIRECT DIST			17	166	2	13	1	10	20	189
TRAINING			1	9		1			1	10
TOTAL DIRECT LABOR	1	8	107	1,039	7	66	5	51	120	1,164
MATERIAL								1		1
LAB. TECHNICIANS										
TOOLING						7				7
PRODUCTION										
MFG. TECHNICIANS				3						3
Q & R A				5		1				6
SUBTOTAL				8		8		1		17
MAT. & ADM. BURDEN				3		3				6
TOTAL MATERIAL				11		11		1		23
TOTAL PART II COST		8		1,050		77		52		1,187

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. AMLLV
PART II
ENGINEERING

STRUCTURE ASSEMBLY - F/M

ASSEMBLY OR SYSTEM

TABLE 5.3.1.5-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Design Development	529	\$ 6,247
Reliability Engineering	13	154
(1) Subtotal (A)	<u>542</u>	<u>6,401</u>
(2) Laboratory Technicians	106	1,049
Subtotal (B)	<u>648</u>	<u>7,450</u>
(3) Q&RA	21	205
Total Engineering Labor	<u><u>669</u></u>	<u><u>\$ 7,655</u></u>
 Material		
(4) Lab. Tech.		\$ 222
(5) Q&RA		<u>6</u>
Subtotal (C)		<u>\$ 228</u>
(6) Material & Adm. Burden		<u>85</u>
Total Material		<u><u>\$ 313</u></u>
Total Engineering Cost		<u><u>\$ 7,968</u></u>

AMLLV
PART II
MANUFACTURING
PRODUCTION

STRUCTURE ASSEMBLY-F/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.3.1.5-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	48,920	\$ 475,502
(2) Miscellaneous Charges	3,816	37,089
(3) Maintain & Add in Scope Changes	<u>538</u>	<u>5,230</u>
Subtotal (A)	53,274	\$ 517,821
(4) Tool & Production Planning	<u>16,110</u>	<u>156,588</u>
Subtotal (B)	69,384	\$ 674,409
(5) Direct Distributable	<u>17,048</u>	<u>165,703</u>
Subtotal (C)	86,432	\$ 840,112
(6) Training	<u>951</u>	<u>9,241</u>
Subtotal (D)	87,383	\$ 849,353
(7) Q&RA	17,476	169,871
(8) Mfg. Tech.	<u>1,660</u>	<u>19,607</u>
Total Production Labor	<u>106,519</u>	<u>\$ 1,038,831</u>
 Material		
(9) Raw Material & Standards		-0-
(10) Q&RA		\$ 5,243
(11) Mfg. Tech.		<u>\$ 2,905</u>
Material Subtotal		\$ 8,148
(12) Material & Adm. Burden		<u>\$ 2,775</u>
Total Material		<u>\$ 10,923</u>
Total Production Cost		<u>\$ 1,049,754</u>

AMLLV
PART II.
MANUFACTURING
TOOLING

STRUCTURE ASSEMBLY - F/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.3.1.5-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	4,262	\$ 41,427
(2) Direct Distributabel	1,364	13,256
Subtotal (A)	<u>5,626</u>	<u>\$ 54,683</u>
(3) Training	62	601
Subtotal (B)	5,688	\$ 55,284
(4) Q&RA	1,138	<u>11,057</u>
Total Tooling Labor	<u>6,826</u>	<u>\$ 66,341</u>
 Material		
(5) Tooling		\$ 7,458
(6) Q&RA		341
Subtotal (C)		<u>\$ 7,799</u>
(7) Material & Adm. Burden		2,654
Total Material		<u>\$ 10,453</u>
Total Tooling Cost		<u>\$ 76,794</u>

AMLLV
 PART II
 MANUFACTURING
 MANUFACTURING TEST
STRUCTURE ASSEMBLY - F/M
 ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 5.3.1.5-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	2,447	\$ 23,785
Component Test Planning	<u>783</u>	<u>7,610</u>
(1) Subtotal (A)	3,230	\$ 31,395
(2) Direct Distributable	<u>1,034</u>	<u>10,047</u>
Subtotal (B)	4,264	\$ 41,442
(3) Training	<u>47</u>	<u>455</u>
Subtotal (C)	4,311	\$ 41,897
(4) Mfg. Tech.	<u>82</u>	<u>966</u>
Subtotal (D)	4,393	\$ 42,863
(5) Q&RA	<u>862</u>	<u>8,379</u>
Total Mfg. Test Labor	<u>5,255</u>	<u>\$ 51,242</u>
 Material		
(6) Q&RA		\$ 259
(7) Mfg. Tech.		<u>\$ 143</u>
Subtotal (E)		\$ 402
(8) Material & Adm. Burden		<u>\$ 140</u>
Total Material		<u>\$ 542</u>
Total Mfg. Test Cost		<u>\$ 51,784</u>

AMLLV
PART III
FACILITY LABOR

STRUCTURE ASSEMBLY - F/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.3.1.5-VIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	1,599	\$ 15,542
TOTAL FACILITY LABOR COST	<u>1,599</u>	<u>\$ 15,542</u>

AMLLV
PART IV
LOGISTIC LABOR

STRUCTURE ASSEMBLY - F/M

ASSEMBLY OR SYSTEM

TABLE 5.3.1.5-IX

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Engineering	<u>63</u>	<u>\$ 744</u>
(2) Hardware		\$ 3,529
(3) Material & Adm. Burden		<u>\$ 1,199</u>
Total Material		<u>\$ 4,728</u>
Total Logistic Cost		<u>\$ 5,472</u>

5.3.2 Systems

The total first production unit cost of the systems for an Fuel module and the components thereof are displayed in Figure 5.3.2.0-1. Table 5.3.2.0-I is a total cost summary of the systems. Supporting documentation for each of the major components that are included in this cost summary are in the appropriate sub-paragraphs.

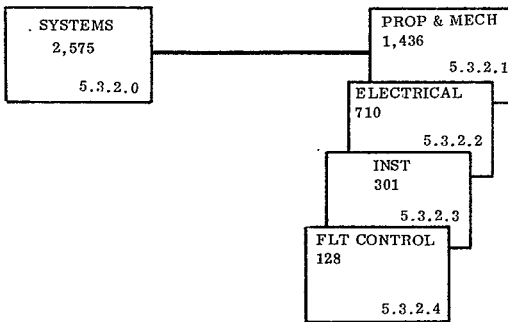


FIGURE 5.3.2.0-1 FUEL MODULE SYSTEMS COST FLOW DIAGRAM

TABLE 5.3.2.0-1
 AMLLV COST SUMMARY

TOTAL SYSTEMS - FUEL MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	2	20								2	20
PROGRAM PLAN. & REPT.	5	49								5	49
INDUSTRIAL RELATIONS		8									8
ENGINEERING											
LAB TECHNICIANS											
TOOLING			6	61						6	61
PRODUCTION			94	911						94	911
MANUFACTURING TEST			5	44						5	44
MANUFACTURING TECH.			2	31						2	31
Q & R A			27	263						27	263
FACILITIES					2	20				2	20
DIRECT DIST			33	316						33	316
TRAINING			2	15						2	15
TOTAL DIRECT LABOR	7	77	169	1,641	2	20				178	1,738
MATERIAL				627							627
LOGISTIC HARDWARE											
BURDEN				210							210
TOTAL MATERIAL				837							837
TOTAL OTHER											
TOTAL COST		77		2,478		20					2,575

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5.3.2.1 Propulsion and Mechanical System

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TABLE 5.3.2.1-I

AMLLV COST SUMMARY

PROP. & MECH. - FUEL MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	1	8								1	8
PROGRAM PLAN. & REPT.	2	19								2	19
INDUSTRIAL RELATIONS		4									4
ENGINEERING											
LAB TECHNICIANS											
TOOLING			2	23						2	23
PRODUCTION			38	367						38	367
MANUFACTURING TEST			2	17						2	17
MANUFACTURING TECH.			1	13						1	13
Q & R A			11	109						11	109
FACILITIES					1	8				1	8
DIRECT DIST			13	129						13	129
TRAINING			1	5						1	5
TOTAL DIRECT LABOR	3	31	68	663	1	8				72	702
MATERIAL				548							548
LOGISTIC HARDWARE BURDEN				186							186
TOTAL MATERIAL				734							734
TOTAL OTHER											
TOTAL COST		31		1,397		8					1,436

AMLLV

PART I

PROP. & MECH. - F/M

ASSEMBLY OR SYSTEM

TABLE 5.3.2.1-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering			
Logistics			
Laboratory Technician			
Production	37,731		
Tooling	2,317		
Manufacturing Test	1,756		
Q&RA	11,157		
Facilities	870		
Manufacturing Technician	1,000		
Total Direct Labor	<u>54,831</u>		
Program Executive		658	7,771
Program Planning & Reporting		1,645	19,426
Industrial Relations		<u>357</u>	<u>3,464</u>
Total Labor - Part I		<u>2,600</u>	<u>30,661</u>
<u>Material</u>			
Program Planning & Reporting			33
Industrial Relations			<u>36</u>
Material Subtotal			69
Material & Administrative Burden			<u>23</u>
Total Material			<u>92</u>
TOTAL COST - PART I			<u>30,753</u>

TABLE 5.3.2.1-III

AMLLV PART II COST SUMMARY-PROPULSION & MECHANICAL SYSTEM - F/M A B C (IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING										
LAB TECHNICIANS										
TOOLING					2	23			2	23
PRODUCTION			38	367					38	367
MANUFACTURING TEST							2	17	2	17
MANUFACTURING TECH.			1	12				1	1	13
Q & R A			10	98	1	6		5	11	109
DIRECT DIST			11	117	1	7	1	5	13	129
TRAINING			1	5					1	5
TOTAL DIRECT LABOR			61	599	4	36	3	28	68	663
MATERIAL				538		4				542
LAB. TECHNICIANS										
TOOLING										
PRODUCTION										
MFG. TECHNICIANS				2						2
Q & R A				3						3
SUBTOTAL				544		4				548
MAT. & ADM. BURDEN				185		1				186
TOTAL MATERIAL				729		5				734
TOTAL PART II COST				1,328		41		28		1,397

AMLLV

PART II
MANUFACTURING
PRODUCTION

PROPULSION & MECHANICAL SYSTEM - F/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.3.2.1-IV (DOLLARS IN THOUSANDS)

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	26,603	259
(2) Miscellaneous Charges	2,075	20
(3) Maintain & Add in Scope Changes	<u>292</u>	<u>2</u>
Subtotal (A)	28,980	282
(4) Tool & Production Planning	<u>8,761</u>	<u>85</u>
Subtotal (B)	37,731	367
(5) Direct Distributable	<u>12,074</u>	<u>117</u>
Subtotal (C)	49,805	484
(6) Training	<u>548</u>	<u>5</u>
Subtotal (D)	50,353	489
(7) Q&RA	10,070	98
(8) Mfg. Tech.	<u>956</u>	<u>12</u>
Total Production Labor	<u>61,379</u>	<u>599</u>
<u>Material</u>		
(9) Raw Material & Standards		538
(10) Q&RA		3
(11) Mfg. Tech.		<u>2</u>
Material Subtotal		543
(12) Material & Adm. Burden		<u>185</u>
Total Material		<u>728</u>
Total Production Cost		<u>1,327</u>

AMLLV

PART II
MANUFACTURING
TOOLING

PROPULSION & MECHANICAL SYSTEM - F/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.3.2.1-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	2,317	22,521
(2) Direct Distributable	741	7,203
Subtotal (A)	3,058	29,724
(3) Training	33	321
Subtotal (B)	3,091	30,045
(4) Q&RA	618	6,007
Total Tooling Labor	<u>3,709</u>	<u>36,052</u>
Material		
(5) Tooling		4,055
(6) Q&RA		186
Subtotal (C)		4,241
(7) Material & Adm. Burden		1,442
Total Material		<u>5,683</u>
Total Tooling Cost		<u>41,735</u>

AMLLV
 PART II
 MANUFACTURING
 MANUFACTURING TEST
 PROP & MECH SYSTEMS - F/M
 ASSEMBLY OR SYSTEM
 1ST UNIT COST
 TABLE 5.3.2.1-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	1,330	21,928
Component Test Planning	<u>426</u>	<u>4,136</u>
(1) Subtotal (A)	1,756	17,064
(2) Direct Distributable	<u>562</u>	<u>5,461</u>
Subtotal (B)	2,318	22,525
(3) Training	<u>26</u>	<u>248</u>
Subtotal (C)	2,344	22,773
(4) Mfg. Tech.	<u>44</u>	<u>525</u>
Subtotal (D)	2,388	23,298
(5) Q&RA	<u>469</u>	<u>4,555</u>
Total Mfg. Test Labor	<u>2,857</u>	<u>27,853</u>
Material		
(6) Q&RA		141
(7) Mfg. Tech.		<u>78</u>
Subtotal (E)		219
(8) Material & Adm. Burden		<u>75</u>
Total Material		<u>294</u>
Total Mfg. Test Cost		<u>28,147</u>

AMLLV

PART III
FACILITY LABOR

PROPULSION & MECHANICAL SYTEM - F/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.3.2.1-VIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Direct Labor Hours	<u>870</u>	<u>8,457</u>
TOTAL FACILITY LABOR COST		<u>8,457</u>

5.3.2.2 Electrical System

TABLE 5.3.2.2-1
ANALY COST SUMMARY

ELECTRICAL SYSTEMS - FUEL MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H.	\$
PROGRAM EXECUTIVE	1	8								1	8
PROGRAM PLAN. & REPT.	2	19								2	19
INDUSTRIAL RELATIONS		3									3
ENGINEERING											
LAB TECHNLCIANS											
TOOLING			2	22						2	22
PRODUCTION			36	358						36	358
MANUFACTURING TEST			2	17						2	17
MANUFACTURING TECH.			1	12						1	12
Q & RA			11	106						11	106
FACILITIES					1	8				1	8
DIRECT DIST			14	125						14	125
TRAINING			1	6						1	6
TOTAL DIRECT LABOR	3	30	67	646	1	8				71	684
MATERIAL				20							20
LOGISTIC HARDWARE											
BURDEN				6							6
TOTAL MATERIAL				26							26
TOTAL OTHER											
TOTAL COST		30		672		8					710

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PART I
ELECTRICAL - F/M
ASSEMBLY OR SYSTEM

TABLE 5.3.2.2-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering			
Logistics			
Laboratory Technician			
Production	36,794		
Tooling	2,260		
Manufacturing Test	1,712		
Q&RA	10,884		
Facilities	848		
Manufacturing Technician	976		
Total Direct Labor	<u>53,474</u>		
Program Executive		642	7,578
Program Planning & Reporting		1,604	18,945
Industrial Relations		<u>347</u>	<u>3,378</u>
Total Labor - Part I		<u>2,593</u>	<u>29,901</u>
<u>Material</u>			
Program Planning & Reporting			32
Industrial Relations			<u>35</u>
Material Subtotal			67
Material & Administrative Burden			<u>23</u>
Total Material			<u>90</u>
TOTAL COST - PART I			<u>29,991</u>

TABLE 5.3.2.2-III

ELECTRICAL SYSTEM - F/M

AMLY PART II COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING										
LAB TECHNICIANS										
TOOLING					2	22			2	22
PRODUCTION			36	358					36	358
MANUFACTURING TEST							2	17	2	17
MANUFACTURING TECH.			1	11				1	1	12
Q & R A			10	95	1	7		4	11	106
DIRECT DIST			12	114	1	6	1	5	14	125
TRAINING			1	6					1	6
TOTAL DIRECT LABOR			60	584	4	35	3	27	67	646
MATERIAL				10		5				15
LAB. TECHNICIANS										
TOOLING										
PRODUCTION										
MFG. TECHNICIANS				2						2
Q & R A				3						3
SUBTOTAL				15		5				20
MAT. & ADM. BURDEN				5		1				6
TOTAL MATERIAL				20		6				26
TOTAL PART II COST				604		41		27		672

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PART II
MANUFACTURING
PRODUCTION

ELECTRICAL SYSTEM - F/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.3.2.2-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	25,942	252
(2) Miscellaneous Charges	2,023	20
(3) Maintain & Add in Scope Changes	<u>286</u>	<u>3</u>
Subtotal (A)	28,251	275
(4) Tool & Production Planning	<u>8,543</u>	<u>83</u>
Subtotal (B)	36,794	358
(5) Direct Distributable	<u>11,774</u>	<u>114</u>
Subtotal (C)	48,568	472
(6) Training	<u>535</u>	<u>6</u>
Subtotal (D)	49,103	478
(7) Q&RA	9,824	95
(8) Mfg. Tech.	<u>933</u>	<u>11</u>
Total Production Labor	<u>59,860</u>	<u>584</u>
Material		
(9) Raw Material & Standards		10
(10) Q&RA		3
(11) Mfg. Tech.		<u>2</u>
Material Subtotal		15
(12) Material & Adm. Burden		<u>5</u>
Total Material		<u>20</u>
Total Production Cost		<u>604</u>

AMLLV

PART II
MANUFACTURING
TOOLING

ELECTRICAL SYSTEM - F/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.3.2.2-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	2,260	21,967
(2) Direct Distributabel	<u>723</u>	<u>7,028</u>
Subtotal (A)	2,983	28,995
(3) Training	<u>33</u>	<u>321</u>
Subtotal (B)	3,016	29,316
(4) Q&RA	603	5,861
Total Tooling Labor	<u>3,619</u>	<u>35,177</u>
Material		
(5) Tooling		3,955
(6) Q&RA		<u>181</u>
Subtotal (C)		4,136
(7) Material & Adm. Bureau		<u>1,407</u>
Total Material		<u>5,543</u>
Total Tooling Cost		<u><u>40,720</u></u>

ANLLV
 PART II
 MANUFACTURING
 MANUFACTURING TEST

ELECTRICAL SYSTEM - F/M
 ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 5.3.2.2-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	1,297	12,607
Component Test Planning	<u>415</u>	<u>4,035</u>
(1) Subtotal (A)	1,712	16,642
(2) Direct Distributable	<u>547</u>	<u>5,326</u>
Subtotal (B)	2,259	21,968
(3) Training	<u>24</u>	<u>241</u>
Subtotal (C)	2,283	22,209
(4) Mfg. Tech.	<u>43</u>	<u>512</u>
Subtotal (D)	2,326	22,721
(5) Q&RA	<u>457</u>	<u>4,441</u>
Total Mfg. Test Labor	<u>2,783</u>	<u>27,162</u>
Material		
(6) Q&RA		137
(7) Mfg. Tech.		<u>76</u>
Subtotal (E)		213
(8) Material & Adm. Burden		<u>72</u>
Total Material		<u>285</u>
Total Mfg. Test Cost		<u>27,447</u>

AMLLV

PART III

FACILITY LABOR

ELECTRICAL SYSTEM - F/M

ASSEMBLY OR SYSTEM

1ST UNIT COST

TABLE 5.3.2.2-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Direct Labor Hours	<u>848</u>	<u>8,243</u>
TOTAL FACILITY LABOR COST		<u>8,243</u>

5.3.2.3 Instrumentation

INSTRUMENTATION SYSTEM - FUEL MODULE

TABLE 5.3.2.3-I
 AMLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE		3									3
PROGRAM PLAN. & REPT.	1	8								1	8
INDUSTRIAL RELATIONS		1									1
ENGINEERING											
LAB TECHNICIANS											
TOOLING			1	12						1	12
PRODUCTION			15	145						15	145
MANUFACTURING TEST			1	7						1	7
MANUFACTURING TECH.				4							4
Q & RA			4	43						4	43
FACILITIES						\$3					3
DIRECT DIST			5	49						5	49
TRAINING				3							3
TOTAL DIRECT LABOR	1	\$12	26	\$263		\$3				27	\$278
MATERIAL				18							18
LOGISTIC HARDWARE											
BURDEN				5							5
TOTAL MATERIAL				23							23
TOTAL OTHER											
TOTAL COST		\$12		\$286		\$3					\$301

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AMLLV

PART I

INSTRUMENTATION - F/M
ASSEMBLY OR SYSTEM

TABLE 5.3.2.3-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering			
Logistics			
Laboratory Technician			
Production	14,962		
Tooling	919		
Manufacturing Test	695		
Q&RA	4,425		
Facilities	344		
Manufacturing Technician	397		
Total Direct Labor	<u>21,742</u>		
Program Executive		261	3,081
Program Planning & Reporting		653	7,702
Industrial Relations		142	<u>1,374</u>
Total Labor - Part I		<u>1,056</u>	<u>\$12,157</u>
<u>Material</u>			
Program Planning & Reporting			13
Industrial Relations			<u>15</u>
Material Subtotal			28
Material & Administrative Burden			9
Total Material			<u>37</u>
TOTAL COST - PART I			<u>\$12,194</u>

TABLE 5.3.2.3-III

A MLLV PART II COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL.	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING										
LAB TECHNICIANS										
TOOLING					1	12			1	12
PRODUCTION			15	145					15	145
MANUFACTURING TEST							1	7	1	7
MANUFACTURING TECH.				4						4
Q & R A			4	39	2			2	4	43
DIRECT DIST			5	47				2	5	49
TRAINING				3						3
TOTAL DIRECT LABOR			24	238	1	14	1	11	26	263
MATERIAL				14		3				16
LAB. TECHNICIANS										
TOOLING										
PRODUCTION										
MFG. TECHNICIANS										
Q & R A				1						1
SUBTOTAL				15		3				18
MAT. & ADM. BURDEN				5						5
TOTAL MATERIAL				20		3				23
TOTAL PART II COST				\$258		\$17		\$11		\$286

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AMLLV
PART II
MANUFACTURING
PRODUCTION

INSTRUMENTATION SYSTEM - F/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.3.2.3-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	10,549	\$103
(2) Miscellaneous Charges	823	8
(3) Maintain & Add in Scope Changes	<u>116</u>	<u>0</u>
Subtotal (A)	11,488	111
(4) Tool & Production Planning	<u>3,474</u>	<u>34</u>
Subtotal (B)	14,962	145
(5) Direct Distributable	<u>4,788</u>	<u>47</u>
Subtotal (C)	19,750	192
(6) Training	<u>217</u>	<u>3</u>
Subtotal (D)	19,967	195
(7) Q&RA	3,994	39
(8) Mfg. Tech.	<u>379</u>	<u>4</u>
Total Production Labor	<u>24,340</u>	<u>\$238</u>
 Material		
(9) Raw Material & Standards		14
(10) Q&RA		1
(11) Mfg. Tech.		<u> </u>
Material Subtotal		15
(12) Material & Adm. Burden		<u>5</u>
Total Material		<u>20</u>
Total Production Cost		<u>\$258</u>

AMLLY
PART II
MANUFACTURING
TOOLING

INSTRUMENTATION SYSTEM - F/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.3.2.3-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	919	8,932
(2) Direct Distributabel	<u>294</u>	<u>2,857</u>
Subtotal (A)	1,213	11,789
(3) Training	<u>13</u>	<u>127</u>
Subtotal (B)	1,226	11,916
(4) Q&RA	<u>245</u>	<u>2,381</u>
Total Tooling Labor	<u><u>1,471</u></u>	<u><u>\$14,297</u></u>
 Material		
(5) Tooling		1,590
(6) Q&RA		<u>73</u>
Subtotal (C)		1,663
(7) Material & Adm. Burden		<u>565</u>
Total Material		<u><u>2,228</u></u>
Total Tooling Cost		<u><u>\$16,525</u></u>

AMLLV
PART II
MANUFACTURING
MANUFACTURING TEST

INSTRUMENTATION SYSTEM - F/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.3.2.3-VI.

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	527	5,123
Component Test Planning	<u>168</u>	<u>1,640</u>
(1) Subtotal (A)	695	6,763
(2) Direct Distributable	<u>223</u>	<u>2,163</u>
Subtotal (B)	918	8,926
(3) Training	<u>10</u>	<u>98</u>
Subtotal (C)	928	9,024
(4) Mfg. Tech.	<u>18</u>	<u>209</u>
Subtotal (D)	946	9,233
(5) Q&RA	<u>186</u>	<u>1,805</u>
Total Mfg. Test Labor	<u><u>1,132</u></u>	<u><u>\$11,038</u></u>
Material		
(6) Q&RA		56
(7) Mfg. Tech.		<u>31</u>
Subtotal (E)		87
(8) Material & Adm. Burden		<u>29</u>
Total Material		<u><u>116</u></u>
Total Mfg. Test Cost		<u><u>\$11,154</u></u>

AMLLV
PART III
FACILITY LABOR
INSTRUMENTATION SYSTEM - F/M

ASSEMBLY OR SYSTEM
1ST UNIT COST
TABLE 5.3.2.3-VII

<u>ELEMENT OF COST</u>	<u>MANHOURS</u>	<u>DOLLARS</u>
(1) Direct Labor Hours	344	\$3,343
TOTAL FACILITY LABOR COST		<u>\$3,343</u>

5.3.2.4 Flight Control System

TABLE 5.3.2.4-I
 AMLV COST SUMMARY

FLIGHT CONTROL SYSTEM - FUEL MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE		1									1
PROGRAM PLAN. & REPT.		3									3
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING			1	4						1	4
PRODUCTION			5	41						5	41
MANUFACTURING TEST				3							3
MANUFACTURING TECH.				2							2
Q & RA			1	5						1	5
FACILITIES						1					1
DIRECT DIST			1	13						1	13
TRAINING				1							1
TOTAL DIRECT LABOR		4	8	69		1				8	74
MATERIAL				41							41
LOGISTIC HARDWARE											
BURDEN				13							13
TOTAL MATERIAL				54							54
TOTAL OTHER											
TOTAL COST		\$4		\$123		\$1					\$128

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A MLLV

PART I

FLIGHT CONTROL - F/M
ASSEMBLY OR SYSTEM

TABLE 5.3.2.4-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering			
Logistics			
Laboratory Technician			
Production	4,248		
Tooling	261		
Manufacturing Test	198		
Q&RA	1,256		
Facilities	98		
Manufacturing Technician	112		
Total Direct Labor	<u>6,173</u>		
Program Executive		74	875
Program Planning & Reporting		185	2,188
Industrial Relations		<u>40</u>	<u>390</u>
Total Labor - Part I		<u>299</u>	<u>3,453</u>
<u>Material</u>			
Program Planning & Reporting			4
Industrial Relations			<u>4</u>
Material Subtotal			8
Material & Administrative Burden			<u>3</u>
Total Material			<u>11</u>
TOTAL COST - PART I			<u>\$3,464</u>

TABLE 5.3.2.4-III

FLIGHT CONTROL SYSTEM - F/M

AMLLV PART II COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING										
LAB TECHNICIANS										
TOOLING					1	4			1	4
PRODUCTION			5	41					5	41
MANUFACTURING TEST								3		3
MANUFACTURING TECH.				2						2
Q & R A			1	5					1	5
DIRECT DIST			1	13					1	13
TRAINING				1						1
TOTAL DIRECT LABOR			7	62	1	4		3	8	69
MATERIAL				39		1				40
LAB. TECHNICIANS										
TOOLING										
PRODUCTION										
MFG. TECHNICIANS				1						1
Q & R A										
SUBTOTAL				40		1				41
MAT. & ADM. BURDEN				13						13
TOTAL MATERIAL				53		1				54
TOTAL PART II COST				\$115		\$5		\$3		\$123

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AMLLV
PART II
MANUFACTURING
PRODUCTION

FLIGHT CONTROL SYSTEM - F/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.3.2.4-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	2,996	\$ 29
(2) Miscellaneous Charges	233	2
(3) Maintain & Add in Scope Changes	33	0
Subtotal (A)	3,262	\$ 31
(4) Tool & Production Planning	986	10
Subtotal (B)	4,248	\$ 41
(5) Direct Distributable	1,360	13
Subtotal (C)	5,608	\$ 54
(6) Training	61	1
Subtotal (D)	5,669	\$ 55
(7) Q&RA	1,134	5
(8) Mfg. Tech.	107	2
Total Production Labor	6,910	\$ 62
 Material		
(9) Raw Material & Standards		39
(10) Q&RA		0
(11) Mfg. Tech.		1
Material Subtotal		\$ 40
(12) Material & Adm. Burden		13
Total Material		\$ 53
Total Production Cost		\$ 115

AMLLV
 PART II
 MANUFACTURING
 TOOLING

FLIGHT CONTROL SYSTEM - F/M
 ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 5.3.2.4-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	261	\$2,537
(2) Direct Distributabel	<u>83</u>	<u>807</u>
Subtotal (A)	344	3,344
(3) Training	<u>4</u>	<u>39</u>
Subtotal (B)	348	3,383
(4) Q&RA	<u>69</u>	<u>671</u>
Total Tooling Labor	<u>417</u>	<u>\$4,054</u>
 Material		
(5) Tooling		457
(6) Q&RA		<u>20</u>
Subtotal (C)		477
(7) Material & Adm. Burden		<u>162</u>
Total Material		<u>639</u>
Total Tooling Cost		<u>\$4,693</u>

AMLV
 PART II
 MANUFACTURING
 MANUFACTURING TEST

FLIGHT CONTROL SYSTEM - F/M

ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 5.3.2.4-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	150	\$1,458
Component Test Planning	48	467
(1) Subtotal (A)	198	\$1,925
(2) Direct Distributable	63	615
Subtotal (B)	261	\$2,540
(3) Training	3	28
Subtotal (C)	264	\$2,568
(4) Mfg. Tech.	5	59
Subtotal (D)	269	\$2,627
(5) Q&RA	53	514
Total Mfg. Test Labor	<u>322</u>	<u>\$3,141</u>
Material		
(6) Q&RA		16
(7) Mfg. Tech.		9
Subtotal (E)		\$ 25
(8) Material & Adm. Burden		8
Total Material		<u>\$ 33</u>
Total Mfg. Test Cost		<u>\$3,174</u>

AMLLV
PART III
FACILITY LABOR

FLIGHT CONTROL SYSTEM - F/M

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.3.2.4-VIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	98	\$ 952
TOTAL FACILITY LABOR COST		<u>\$ 952</u>

5.3.3 Injection Stage Liquid Engine

Costs for the 250,000 pound (vacuum) thrust engine for the injection stage were developed from the parametric cost data supplied by Pratt and Whitney.

TABLE 5.3.3.0-I

AMLLV COST SUMMARY MULTI-CHAMBER PLUG ENGINE - FUEL MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
	PROGRAM EXECUTIVE										
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING				160							160
LAB TECHNICIANS											
TOOLING				240							240
PRODUCTION				2,930							2,930
MANUFACTURING TEST				270							270
MANUFACTURING TECH. Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR				3,600							3,600
MATERIAL											
LOGISTIC HARDWARE BURDEN											
TOTAL MATERIAL											
TOTAL OTHER											
TOTAL COST				3,600							3,600

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AMLLV

FUEL MODULE

TABLE 5.3.3.0-II

<u>"C" COSTS</u>	<u>DOLLARS</u> (IN THOUSANDS)
Engineering	160
Test	270
Tooling (Maint.)	240
Fabrication	<u>2,930</u>
TOTAL	<u><u>3,600</u></u>

Units - 3 & 4

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5.3.4 Engine Installation

Installation costs associated with two engines were based on manhour estimates which were derived from Saturn v historical data. In addition to the direct factory labor all supporting costs were included.

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TABLE 5.3.4.0-I

AMLLV COST SUMMARY,

ENGINE INSTALLATION - FUEL MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE		1									1
PROGRAM PLAN. & REPT.		1									1
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING				4							4
PRODUCTION			4	37						4	37
MANUFACTURING TEST				2							2
MANUFACTURING TECH.											
Q & R A			1	10						1	10
FACILITIES											
DIRECT DIST			1	10						1	10
TRAINING											
TOTAL DIRECT LABOR		2	6	63				1		6	66
MATERIAL				1							1
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL				1							1
TOTAL OTHER											
TOTAL COST		2		64				1			67

AMLLV

PART I

ENGINE INSTALLATION - FUEL MODULE

ASSEMBLY OR SYSTEM

TABLE 5.3.4.0-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering			
Logistics			
Laboratory Technician			
Production	3,838		
Tooling	236		
Manufacturing Test	132		
Q&RA	1,064		
Facilities	89		
Manufacturing Technician	96		
	<u>5,455</u>		
Total Direct Labor			
Program Executive		66	421
Program Planning & Reporting		163	1,042
Industrial Relations		36	176
		<u>265</u>	<u>1,639</u>
Total Labor - Part I			
<u>Material</u>			
Program Planning & Reporting			3
Industrial Relations			3
Material Subtotal			<u>6</u>
Material & Administrative Burden			<u>3</u>
Total Material			<u>9</u>
TOTAL COST - PART I			<u>1,648</u>

TABLE 5.3.4.0-III

AMLIV PART II COST SUMMARY ENGINE INSTALLATION - FUEL MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING										
LAB TECHNICIANS										
TOOLING					4					4
PRODUCTION			4	37					4	37
MANUFACTURING TEST							2			2
MANUFACTURING TECH.										
Q & R A			1	10					1	10
DIRECT DIST			1	10					1	10
TRAINING										
TOTAL DIRECT LABOR			6	57	4		2		6	63
MATERIAL				1						1
LAB. TECHNICIANS										
TOOLING										
PRODUCTION										
MFG. TECHNICIANS										
Q & R A										
SUBTOTAL				1						1
MAT. & ADM. BURDEN										
TOTAL MATERIAL				1						1
TOTAL PART II COST				58	4		2			64

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AMLLV
PART II
MANUFACTURING
PRODUCTION

ENGINE INSTALLATION - FUEL MODULE

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.3.4.0-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	2,706	26,303
(2) Miscellaneous Charges	211	2,051
(3) Maintain & Add in Scope Changes	30	291
Subtotal (A)	2,947	28,645
(4) Tool & Production Planning	891	8,661
Subtotal (B)	3,838	37,306
(5) Direct Distributable	943	9,166
Subtotal (C)	4,781	46,472
(6) Training	52	506
Subtotal (D)	4,833	46,978
(7) Q&RA	.966	9,390
(8) Mfg. Tech.	92	1,086
Total Production Labor	5,891	57,454
<u>Material</u>		
(9) Raw Material & Standards		
(10) Q&RA		290
(11) Mfg. Tech.		161
Material Subtotal		451
(12) Material & Adm. Burden		154
Total Material		605
Total Production Cost		58,059

AMLLV
PART II
MANUFACTURING
TOOLING

ENGINE INSTALLATION - FUEL MODULE

ASSEMBLY OR SYSTEM
1ST UNIT COST
TABLE 5.3.4.0-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	236	2,294
(2) Direct Distributabel	<u>75</u>	<u>729</u>
Subtotal (A)	311	3,023
(3) Training	<u>4</u>	<u>39</u>
Subtotal (B)	315	3,062
(4) Q&RA	<u>63</u>	<u>613</u>
Total Tooling Labor	<u>378</u>	<u>3,675</u>
 Material		
(5) Tooling		413
(6) Q&RA		<u>19</u>
Subtotal (C)		432
(7) Material & Adm. Burden		<u>147</u>
Total Material		<u>579</u>
Total Tooling Cost		<u>4,254</u>

AMLLV
 PART II
 MANUFACTURING
 MANUFACTURING TEST

ENGINE INSTALLATION - FUEL MODULE
 ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 5.3.4.0-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	100	972
Component Test	<u>32</u>	<u>311</u>
Subtotal	132	1,283
Direct Distributable	<u>42</u>	<u>410</u>
Subtotal	174	1,693
Training	<u>2</u>	<u>19</u>
Subtotal	176	1,712
Mfg. Tech.	<u>4</u>	<u>39</u>
Subtotal	180	1,751
Q&RA	<u>35</u>	<u>342</u>
Total Mfg. Test Labor	<u>215</u>	<u>2,093</u>
Material		
Q&RA		10
Mfg. Tech.		<u>6</u>
Subtotal		16
Material & Adm. Burden		<u>5</u>
Total Material		<u>21</u>
Total Mfg. Test Cost		<u>2,714</u>

AMLLV
PART III
FACILITY LABOR

ENGINE INSTALLATION - FUEL MODULE
ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.3.4.0-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	<u>89</u>	<u>865</u>
TOTAL FACILITY LABOR COST		<u><u>865</u></u>

5.3.5 Launch Operations

The launch operations for the fuel module are divided into two parts. The first module is divided into two parts. The first part represents the costs for the first and second launches (R&D flight vehicles). The second part represents the costs for operational vehicle (third vehicle and subsequent vehicle). These parts are each divided into three major categories: 1) Launch Control, 2) Launch Pad Operations, and 3) Off Site Support. Figure 5.3.5.0-1 shows the delta costs of these categories and indicates the applicable sub-sections where the costs are shown in detail. The costs reflected in this section are for launching of one fuel module at a two per year rate.

LAUNCH OPERATIONS - FUEL MODULE - 1 R&D FLIGHT VEHICLES

TABLE 5.3.5.0-I
MILLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	5	57								5	57
PROGRAM PLAN.& REPT.	12	143								12	143
INDUSTRIAL RELATIONS	2	27								2	27
ENGINEERING			32	389						32	389
LAB TECHNICIANS											
TOOLING											
PRODUCTION OR OPER			406	3942						406	3,942
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A			79	761						79	761
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR	19	227	517	5092						536	5,319
MATERIAL				4							4
LOGISTIC HARDWARE BURDEN											
TOTAL MATERIAL				4							4
TOTAL OTHER											
TOTAL COST		227		5096							5,323

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LAUNCH OPERATIONS - FUEL MODULE - OPERATIONAL VEHICLES (THIRD VEHICLE
AND SUBSEQUENT VEHICLES)

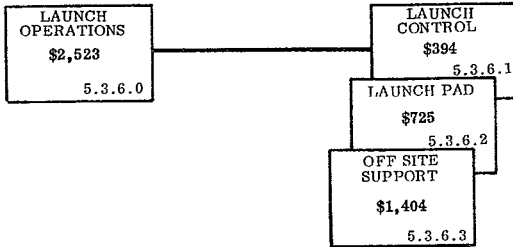
TABLE 5.3.5.0-II
A MLLV COST SUMMARY

A B C

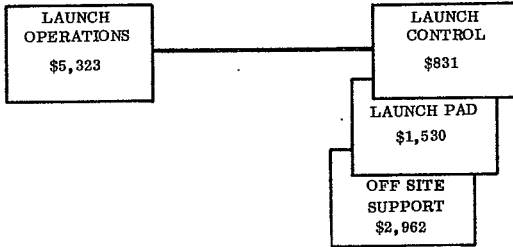
(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN.& REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING			131	1255						131	1,255
LAB TECHNICIANS											
TOOLING											
PRODUCTION OR OPER			160	1252						160	1,252
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR			291	2507						291	2,507
MATERIAL				16							16
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL				16							16
TOTAL OTHER											
TOTAL COST				2523							2,523

FIXED COSTS - AFTER 2ND LAUNCH



FIXED COSTS - 2 R&D FLIGHT VEHICLES (INCLUDES ADDITIONAL COSTS FOR
9 MONTH CYCLE TIME, INCREASED SE&I AND INSTRUMENTATION)



NOTES:

DOLLARS ARE IN THOUSANDS.
NUMBERS IN LOWER RIGHT CORNER
DESIGNATE APPLICABLE SECTION
NUMBER FOR COST DETAILS.

FIGURE 5.3.6.0-1 FUEL MODULE - LAUNCH OPERATIONS COST FLOW DIAGRAM

5.3.5.1 Launch Control

LAUNCH CONTROL CENTER - FUEL MODULE - 2 R&D FLIGHT VEHICLES

TABLE 5.3.5.1-I
 AMLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	1	9								1	9
PROGRAM PLAN.& REPT.	2	22								2	22
INDUSTRIAL RELATIONS		4									4
ENGINEERING			5	61						5	61
LAB TECHNICIANS											
TOOLING											
PRODUCTION OR OPER			63	616						63	616
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A			12	119						12	119
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR	3	35	80	796						83	831
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER											
TOTAL COST		35		796							831

1080T

AMLIV
 PART I
LAUNCH CONTROL CENTER - F/M
ASSEMBLY OR SYSTEM
 TABLE 5.3.5.1-II

<u>Element of Cost</u>	<u>Manhours</u>	(In Thousands)	
		<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	5		
Logistics			
Laboratory Technician			
Production	63		
Tooling			
Manufacturing Test			
Q&RA	12		
Facilities			
Manufacturing Technician	—		
Total Direct Labor	<u>80</u>		
Program Executive		1	9
Program Planning & Reporting		2	22
Industrial Relations		—	<u>4</u>
Total Labor - Part I		<u>3</u>	<u>35</u>
<u>Material</u>			
Program Planning & Reporting			
Industrial Relations			
Material Subtotal			
Material & Administrative Burden			
Total Material			
TOTAL COST - PART I			<u>35</u>

LAUNCH CONTROL CENTER - F/M

TABLE 5.3.5.1-III

AMLLV PART II COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	5	61							5	61
LAB TECHNICIANS										
TOOLING										
PRODUCTION			63	616					63	616
MANUFACTURING TEST										
MANUFACTURING TECH.										
Q & R A			12	119					12	119
DIRECT DIST										
TRAINING										
TOTAL DIRECT LABOR	5	61	75	735					80	796
MATERIAL										
LAB. TECHNICIANS										
TOOLING										
PRODUCTION										
MFG. TECHNICIANS										
Q & R A										
SUBTOTAL										
MAT. & ADM. BURDEN										
TOTAL MATERIAL										
TOTAL PART II COST		61		735						796

1090

AMLLV
LAUNCH OPERATIONS
LAUNCH CONTROL CENTER - F/M
TABLE 5.3.5.1-IV

<u>Element of Cost</u>	(In Thousands)	
	<u>Manhours</u>	<u>Dollars</u>
Engineering:		
Design Support	5	61
TOTAL COST	<u>5</u>	<u>61</u>

AMLLV
 LAUNCH OPERATIONS
LAUNCH CONTROL CENTER - F/M
TABLE 5.3.5.1-V

(In Thousands)

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Operations:		
Launch Vehicle	35	339
Technical Support	<u>28</u>	<u>277</u>
Subtotal	63	616
Q&RA	<u>12</u>	<u>119</u>
Total Labor	<u>75</u>	<u>735</u>
Material		
Q&RA		
Material and Administrative Burden		
Total Material		
TOTAL COST		

5.3.5.2 LAUNCH PAD

LAUNCH PAD - FUEL MODULE - 1 R&D FLIGHT VEHICLES

TABLE 5.3.5.2-I
AMLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	1	15								1	15
PROGRAM PLAN.& REPT.	3	41								3	41
INDUSTRIAL RELATIONS	1	8								1	8
ENGINEERING			9	112						9	112
LAB TECHNICIANS											
TOOLING											
PRODUCTION OR OPER			117	1133						117	1,133
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A			23	219						23	219
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR	5	64	149	1464						154	1,528
MATERIAL				2							2
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL				2							2
TOTAL OTHER											
TOTAL COST		64		1466							1,530

1094

AMLLV
 PART I
 LAUNCH PAD - F/M
 ASSEMBLY OR SYSTEM
 TABLE 5.3.5.2-II

<u>Element of Cost</u>	<u>Manhours</u>	(In Thousands)	
		<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	9		
Logistics			
Laboratory Technician			
Production	117		
Tooling			
Manufacturing Test			
Q&RA	23		
Facilities			
Manufacturing Technician	—		
Total Direct Labor	<u>149</u>		
Program Executive		1	15
Program Planning & Reporting		3	41
Industrial Relations		<u>1</u>	<u>8</u>
Total Labor - Part I		<u>5</u>	<u>64</u>
<u>Material</u>			
Program Planning & Reporting			
Industrial Relations			
Material Subtotal			
Material & Administrative Burden			
Total Material			
TOTAL COST - PART I			<u>64</u>

LAUNCH PAD - F/M

TABLE 5.3.5.2-III
 AMLLV PART II COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	9	112							9	112
LAB. TECHNICIANS										
TOOLING										
PRODUCTION			117	1133					117	1,133
MANUFACTURING TEST										
MANUFACTURING TECH.										
Q & R A			23	219					23	219
DIRECT DIST										
TRAINING										
TOTAL DIRECT LABOR	9	112	140	1352					149	1,464
MATERIAL										
LAB. TECHNICIANS										
TOOLING										
PRODUCTION										
MFG. TECHNICIANS										
Q & R A				2						2
SUBTOTAL				2						2
MAT. & ADM. BURDEN										
TOTAL MATERIAL				2						2
TOTAL PART II COST		112		1354						1,466

1096

AMLLV
LAUNCH OPERATIONS
LAUNCH PAD - F/M
TABLE 5.3.5.2-IV

<u>Element of Cost</u>	(In Thousands)	
	<u>Manhours</u>	<u>Dollars</u>
Engineering:		
Design Support	9	112
TOTAL COST	<u>9</u>	<u>112</u>

AMLLV
 LAUNCH OPERATIONS
LAUNCH PAD - F/M
TABLE 5.3.5.2-V

<u>Element of Cost</u>	(In Thousands)	
	<u>Manhours</u>	<u>Dollars</u>
Operations:		
Launch Vehicle	64	623
Technical Support	<u>53</u>	<u>510</u>
Subtotal	117	1,133
Q&RA	<u>23</u>	<u>219</u>
Total Labor	<u>140</u>	<u>1,352</u>
Material		
Q&RA		2
Material and Administrative Burden		<u> </u>
Total Material		<u>2</u>
TOTAL COST		<u>1,354</u>

5.3.5.3 Off Site Support Complex

OFF SITE SUPPORT COMPLEX - FUEL MODULE - 2 R&D FLIGHT VEHICLES

TABLE 5.3.5.3-I
 AMLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	3	33								3	33
PROGRAM PLAN.& REPT.	7	80								7	80
INDUSTRIAL RELATIONS	1	15								1	15
ENGINEERING			18	216						18	216
LAB TECHNICIANS											
TOOLING											
PRODUCTION OR OPER			226	2193						226	2,193
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A			44	423						44	423
FACILITIES											
DIRECT DLST											
TRAINING											
TOTAL DIRECT LABOR	11	128	288	2832						299	2,960
MATERIAL				2							2
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL				2							2
TOTAL OTHER											
TOTAL COST		128		2834							2,962

1100

AMLLV
 PART I
OFF SITE SUPPORT COMPLEX - F/M
ASSEMBLY OR SYSTEM
 TABLE 5.3.5.3-II

<u>Element of Cost</u>	<u>Manhours</u>	(In Thousands)	
		<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	18		
Logistics			
Laboratory Technician			
Production	226		
Tooling			
Manufacturing Test			
Q&RA	44		
Facilities			
Manufacturing Technician	---		
Total Direct Labor	<u>288</u>		
Program Executive		3	33
Program Planning & Reporting		7	80
Industrial Relations		<u>1</u>	<u>15</u>
Total Labor - Part I		<u>11</u>	<u>128</u>
<u>Material</u>			
Program Planning & Reporting			
Industrial Relations			
Material Subtotal			
Material & Administrative Burden			
Total Material			
TOTAL COST - PART I			

OFF SITE SUPPORT COMPLEX - F/M

TABLE 5.3.5.3-III
 AMLLV PART II COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	18	216							18	216
LAB TECHNICIANS										
TOOLING										
PRODUCTION			226	2193					226	2,193
MANUFACTURING TEST										
MANUFACTURING TECH.										
Q & R A			44	423					44	423
DIRECT DIST										
TRAINING										
TOTAL DIRECT LABOR	18	216	270	2616					288	2,832
MATERIAL										
LAB. TECHNICIANS										
TOOLING										
PRODUCTION										
MFG. TECHNICIANS										
Q & R A				2						2
SUBTOTAL				2						2
MAT. & ADM. BURDEN										
TOTAL MATERIAL				2						2
TOTAL PART II COST		216		2618						2,834

1102

AMLLV
 LAUNCH OPERATIONS
OFF SITE SUPPORT COMPLEX - F/M
 TABLE 5.3.5.3-IV

<u>Element of Cost</u>	(In Thousands)	
	<u>Manhours</u>	<u>Dollars</u>
Engineering:		
Design Support	18	216
TOTAL COST	<u>18</u>	<u>216</u>

AMLLV
 LAUNCH OPERATIONS
OFF SITE SUPPORT COMPLEX - F/M
TABLE 5.3.5.3-V

<u>Element of Cost</u>	(In Thousands)	
	<u>Manhours</u>	<u>Dollars</u>
Operations:		
Launch Vehicle	124	1,206
Technical Support	<u>102</u>	<u>987</u>
Subtotal	226	2,193
Q&RA	<u>44</u>	<u>423</u>
Total Labor	<u>270</u>	<u>2,616</u>
Material		
Q&RA		2
Material and Administrative Burden		_____
Total Material		<u>2</u>
TOTAL COST		<u>2,618</u>

5.3.6 Propellant, Pressurants and Gases

Propellant costs used on the AMLLV Engine module were estimated for the following types of propellants:

- (1) LOX
- (2) LH₂
- (3) LN₂
- (4) GHe
- (5) GH₂

These costs were based on current actual costs for the Saturn V. An appropriate burden was added to account for the support activities required for procurement.

TABLE 5.3.6-1

AMLLV COST SUMMARY

PROPELLANT - FUEL - MODULE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
	PROGRAM EXECUTIVE										
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER									730		730
TOTAL COST									730		730

910T

AMLLV
 RECURRING
PROPELLANT - F/M
 (IN THOUSANDS)

TABLE 5.3.6-II

	<u>Cubic Ft.</u>	<u>Pounds</u>	<u>Dollars</u>
LOX		2,977	37
LH ₂		518	263
LN ₂		1,066	29
GH _e	3,332		208
GH ₂	816		<u>8</u>
	Propellant Cost		545
	Material & Admin. Burden		<u>185</u>
	* TOTAL COST		<u><u>\$730</u></u>

* For one complete Launch Cycle



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5.4 SRM FIXED COST

Costs associated with the SRM were classified into two categories, i.e: (1) SRM fixed costs and (2) SRM quantity sensitive costs due to the various combinations of SRM's that can be used within the baseline AMLLV vehicle family, i.e., 2 to 12 SRM's per vehicle.

The costs in this category are for those items which are not considered quantity sensitive to the number of SRM's per vehicle, i.e:

- (1) The delta cost associated with the alternate forward skirt
- (2) The launch operations costs
- (3) The launch maintenance cost

These costs are additive to (1) the number of SRM's required per vehicle times the individual SRM variable cost plus (2) the cost of the single stage vehicle (and costs of injection stages where applicable).

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TABLE 5.4.0.0-I SRM - FIXED - 1 R&D FLIGHT VEHICLE
 ALLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	29	335								29	335
PROGRAM PLAN.& REPT.	69	825								69	825
INDUSTRIAL RELATIONS	18	150								18	150
ENGINEERING			164	1,948			1	6		165	1,954
LAB TECHNICIANS			1	7						1	7
TOOLING			14	139						14	139
PRODUCTION OR OPER.			2,318	21,565						2,218	21,565
MANUFACTURING TEST			11	105						11	105
MANUFACTURING TECH.			6	69						6	69
Q & R A			450	4,373						450	4,373
FACILITIES					5	1,202				5	1,202
DIRECT DIST			66	636						66	636
TRAINING			3	35						3	35
TOTAL DIRECT LABOR	116	1,310	2,933	28,877	5	1,202	1	6		3,055	31,395
MATERIAL		1		307							308
LOGISTIC HARDWARE								30			30
BURDEN				100				10			110
TOTAL MATERIAL		1		407				40			448
TOTAL OTHER											
TOTAL COST		1,311		29,284		1,202		46			31,843

1110

SRM - FIXED - OPERATIONAL VEHICLES
(THIRD VEHICLE AND SUBSEQUENT VEHICLES)

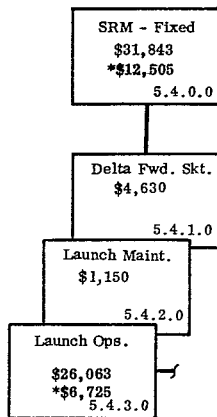
TABLE 5.4.0.0-II
AMLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	4	48								4	48
PROGRAM PLAN.& REPT.	10	121								10	121
INDUSTRIAL RELATIONS	2	21								2	21
ENGINEERING			352	3388			1	6		353	3,394
LAB TECHNICIANS			1	7						1	7
TOOLING			14	139						14	139
PRODUCTION			660	5610						660	5,610
MANUFACTURING TEST			11	105						11	105
MANUFACTURING TECH.			6	69						6	69
Q & R A			67	646						67	646
FACILITIES					5	1202				5	1,202
DIRECT DIST			66	636						66	636
TRAINING			3	35						3	35
TOTAL DIRECT LABOR	16	190	1180	10635	5	1202	1	6		202	12,033
MATERIAL		1		331							332
LOGISTIC HARDWARE								30			30
BURDEN				100				10			110
TOTAL MATERIAL		1		431				40			472
TOTAL OTHER											
TOTAL COST		191		11066		1202		46			12,505

1111



NOTES:

*FIRST OPERATIONAL UNIT COST WHICH DIFFERS SIGNIFICANTLY FROM THOSE OF FIRST R&D FLIGHT UNIT
 DOLLARS ARE IN THOUSANDS.
 NUMBERS IN LOWER RIGHT CORNER DESIGNATE APPLICABLE SECTION NUMBER FOR COST DETAILS.

FIGURE 5.4.0.0-1 SRM - FIXED COST FLOW DIAGRAM

5.4.1 Delta Costs for Alternate Forward Skirt

The costs shown in this section are those associated with the heavy weight forward skirt which are over and above those costs required for the standard (light weight) forward skirt.

TABLE 5.4.1.0-I
 AMLLV COST SUMMARY

DELTA FORWARD SKIRT

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	4	48								4	48
PROGRAM PLAN. & REPT.	10	121								10	121
INDUSTRIAL RELATIONS	2	21								2	21
ENGINEERING			3	45			1	6		4	51
LAB TECHNICIANS			1	7						1	7
TOOLING			14	139						14	139
PRODUCTION			233	2,265						233	2,265
MANUFACTURING TEST			11	105						11	105
MANUFACTURING TECH.			6	69						6	69
Q & RA			67	646						67	646
FACILITIES					5	52				5	52
DIRECT DIST			66	636						66	636
TRAINING			3	35						3	35
TOTAL DIRECT LABOR	16	190	404	3,947	5	52	1	6		427	4,195
MATERIAL		1		294							295
LOGISTIC HARDWARE								30			30
BURDEN				100				10			110
TOTAL MATERIAL		1		394				40			435
TOTAL OTHER											
TOTAL COST		191		4,340		52		46			4,630

1114

AMLLV

PART I

Delta Forward Skirt
ASSEMBLY OR SYSTEM

TABLE 5.4.1.0-II

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	3,476		
Logistics	.524		
Laboratory Technician	695		
Production	233,001		
Tooling	14,312		
Manufacturing Test	10,841		
Q&RA	66,584		
Facilities	5,367		
Manufacturing Technician	<u>5,850</u>		
Total Direct Labor	<u>340,654</u>		
Program Executive		4,088	48,277
Program Planning & Reporting		10,220	120,693
Industrial Relations		<u>2,214</u>	<u>21,522</u>
Total Labor - Part I		<u>16,522</u>	<u>\$190,492</u>
<u>Material</u>			
Program Planning & Reporting			235
Industrial Relations			<u>221</u>
Material Subtotal			456
Material & Administrative Burden			<u>145</u>
Total Material			<u>601</u>
TOTAL COST - PART I			<u>\$191,093</u>

TABLE 5.4.1.0-III

AMLLV PART II COST SUMMARY

DELTA FORWARD SKIRT

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	3	45							3	45
LAB TECHNICIANS	1	7							1	7
TOOLING					14	139			14	139
PRODUCTION			233	2,265					233	2,265
MANUFACTURING TEST							11	105	11	105
MANUFACTURING TECH.			6	66				3	6	69
Q & R A	1	11	59	570	4	37	3	28	67	646
DIRECT DIST			57	557	5	45	4	34	66	636
TRAINING			3	31		2		2	3	35
TOTAL DIRECT LABOR	5	63	358	3,489	23	223	18	172	404	3,947
MATERIAL										
LAB. TECHNICIANS		1								1
TOOLING						25				25
PRODUCTION				237						237
MFG. TECHNICIANS				10						10
Q & R A		1		18		1		1		21
SUBTOTAL		2		265		26		1		294
MAT. & ADM. BURDEN				90		9		1		100
TOTAL MATERIAL		2		355		35		2		394
TOTAL PART II COST		65		3,844		258		174		4,340

AMLLV
PART II
ENGINEERING

Delta Forward Skirt
ASSEMBLY OR SYSTEM
TABLE 5.4.1.0-IV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Design Development	3,404	\$43,758
Reliability Engineering	<u>72</u>	<u>926</u>
(1) Subtotal (A)	3,476	\$44,684
(2) Laboratory Technicians	<u>695</u>	<u>6,755</u>
Subtotal (B)	4,171	\$51,439
(3) Q&RA	<u>1,181</u>	<u>11,480</u>
Total Engineering Labor	<u>5,352</u>	<u>\$62,919</u>
Material		
(4) Lab. Tech.		1,462
(5) Q&RA		<u>354</u>
Subtotal (C)		<u>1,816</u>
(6) Material & Adm. Burden		<u>616</u>
Total Material		<u>2,432</u>
Total Engineering Cost		<u>\$65,351</u>

AMLLV
PART II
MANUFACTURING
PRODUCTION

Delta Forward Skirt

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.4.1.0-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	164,283	\$1,596,831
(2) Miscellaneous Charges	12,814	124,552
(3) Maintain & Add in Scope Changes	<u>1,807</u>	<u>17,564</u>
Subtotal (A)	178,904	\$1,738,947
(4) Tool & Production Planning	<u>54,101</u>	<u>525,862</u>
Subtotal (B)	233,005	\$2,264,809
(5) Direct Distributable	<u>57,249</u>	<u>556,460</u>
Subtotal (C)	290,254	\$2,821,269
(6) Training	<u>3,193</u>	<u>31,036</u>
Subtotal (D)	293,445	\$2,852,305
(7) Q&RA	58,690	570,466
(8) Mfg. Tech.	<u>5,575</u>	<u>65,841</u>
Total Production Labor	<u>357,710</u>	<u>\$3,488,612</u>
 Material		
(9) Raw Material & Standards		237,514
(10) Q&RA		17,607
(11) Mfg. Tech.		<u>9,757</u>
Material Subtotal		<u>264,878</u>
(12) Material & Adm. Burden		<u>90,058</u>
Total Material		<u>354,936</u>
Total Production Cost		<u>\$3,843,548</u>

AMLLV
PART II
MANUFACTURING
TOOLING

Delta Forward Skirt
ASSEMBLY OR SYSTEM
1ST UNIT COST
TABLE 5.4.1.0-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	14,312	\$139,113
(2) Direct Distributabel	<u>4,508</u>	<u>44,517</u>
Subtotal (A)	18,820	\$183,630
(3) Training	<u>208</u>	<u>2,022</u>
Subtotal (B)	19,028	\$185,652
(4) Q&RA	<u>3,820</u>	<u>37,130</u>
Total Tooling Labor	<u>22,848</u>	<u>\$222,782</u>
 Material		
(5) Tooling		25,046
(6) Q&RA		<u>1,146</u>
Subtotal (C)		26,192
(7) Material & Adm. Burden		<u>8,906</u>
Total Material		<u>35,098</u>
Total Tooling Cost		<u>\$257,880</u>

AMLLV
PART II
MANUFACTURING
MANUFACTURING TEST

Delta Forward Skirt

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.4.1.0-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	8,213	\$ 79,830
Component Test Planning	<u>2,628</u>	<u>25,545</u>
(1) Subtotal (A)	10,841	\$105,375
(2) Direct Distributable	<u>3,469</u>	<u>33,720</u>
Subtotal (B)	14,310	\$139,095
(3) Training	<u>157</u>	<u>1,530</u>
Subtotal (C)	14,467	\$140,625
(4) Mfg. Tech.	<u>275</u>	<u>3,246</u>
Subtotal (D)	14,742	\$143,871
(5) Q&RA	<u>2,893</u>	<u>28,124</u>
Total Mfg. Test Labor	<u><u>17,635</u></u>	<u><u>\$171,995</u></u>
Material		
(6) Q&RA		868
(7) Mfg. Tech.		<u>481</u>
Subtotal (E)		1,349
(8) Material & Adm. Burden		<u>459</u>
Total Material		<u><u>1,808</u></u>
Total Mfg. Test Cost		<u><u>173,803</u></u>

AMLLV
PART III
FACILITIES LABOR
Delta Forward Skirt
TABLE 5.4.1.0-VIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Direct Labor Hours	5,367	<u>\$52,167</u>
Total Facility Labor Cost		<u><u>\$52,167</u></u>

AMLLV

PART IV
LOGISTIC LABOR

Delta Forward Skirt

ASSEMBLY OR SYSTEM

TABLE 5.4.1.0-IX

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Engineering	524	<u>6,189</u>
(2) Hardware		29,344
(3) Material & Adm. Burden		<u>9,977</u>
Total Material		<u>39,321</u>
Total Logistic Cost		<u>45,510</u>

5.4.2 **Launch Maintenance Cost**

TABLE 5.4.2.0-I SRM LAUNCH MAINTENANCE

AMLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
	PROGRAM EXECUTIVE										
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES						1,150					1,150
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR						1,150					1,150
MATERIAL											
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL											
TOTAL OTHER											
TOTAL COST						1,150					1,150

AMLLV
RECURRING
SRM
*LAUNCH FACILITY MAINTENANCE

TABLE 5.4.2.0-II

(IN THOUSANDS)

Brick & Mortar	\$ 920
Equipment	<u>230</u>
TOTAL	<u>\$1,150</u>

*Maintenance for six (6) months or for one (1) vehicle.

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5.4.3 Launch Operations Cost

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TABLE 5.4.3.0-I SRM LAUNCH OPERATIONS - 1 R&D FLIGHT VEHICLE

A MLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	25	287									287
PROGRAM PLAN.& REPT.	59	704									704
INDUSTRIAL RELATIONS	16	129									129
ENGINEERING			161	1,903						161	1,903
LAB TECHNICIANS											
TOOLING											
PRODUCTION OR OPER.			1,985	19,300						1,985	19,300
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A			383	3,727						383	3,727
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR	100	1,120	2,529	24,930						2,529	26,049
MATERIAL				13							13
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL				13							13
TOTAL OTHER											
TOTAL COST		1,120		24,943							26,063

SRM LAUNCH OPERATIONS - OPERATIONAL VEHICLES (THIRD VEHICLE
AND SUBSEQUENT VEHICLES)

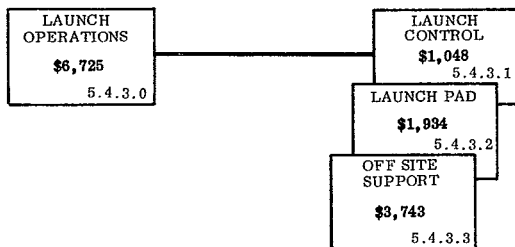
TABLE 5.4.3.0-II
MILV COST SUMMARY

A B C

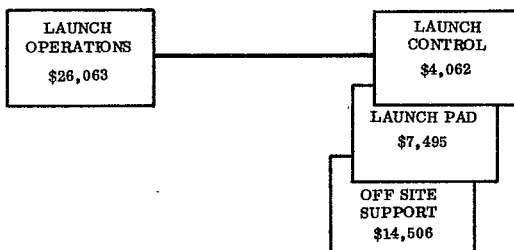
(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN.& REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING			349	3343						349	3,343
LAB TECHNICIANS											
TOOLING											
PRODUCTION OR OPER			427	3345						427	3,345
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR			776	6688						776	6,688
MATERIAL				37							37
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL				37							37
TOTAL OTHER											
TOTAL COST				6725							6,725

FIXED COSTS - AFTER 2ND LAUNCH



FIXED COSTS - 2 R&D FLIGHT VEHICLES (INCLUDES ADDITIONAL COSTS FOR 9 MONTH CYCLE TIME, INCREASED SE&I AND INSTRUMENTATION)



NOTES:

DOLLARS ARE IN THOUSANDS.
 NUMBERS IN LOWER-RIGHT CORNER
 DESIGNATE APPLICABLE SECTION
 NUMBER FOR COST DETAILS.

FIGURE 5.4.3.0-1 SRM LAUNCH OPERATIONS COST FLOW DIAGRAM

5.4.3.1 Launch Control

TABLE 5.4.3.1-1
 AMLLV COST SUMMARY

SRM LAUNCH CONTROL CENTER - 1 R&D FLIGHT VEHICLE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	4	45								4	45
PROGRAM PLAN.& REPT.	9	110								9	110
INDUSTRIAL RELATIONS	2	20								2	20
ENGINEERING			25	297						25	297
LAB TECHNICIANS											
TOOLING											
PRODUCTION OR OPER.			309	3,008						309	3,008
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A			60	580						60	580
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR	15	175	394	3,885						409	4,060
MATERIAL				2							2
LOGISTIC HARDWARE											
EURDEN											
TOTAL MATERIAL				2							2
TOTAL OTHER											
TOTAL COST		175		3,887							4,062

AMLLV
RECURRING
PART I

LAUNCH CONTROL CENTER
ASSEMBLY OR SYSTEM
TABLE 5.4.3.1-II

<u>Element of Cost</u>	<u>Manhours</u>	(In Thousands)	
		<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	25		
Logistics			
Laboratory Technician			
Production	309		
Tooling			
Manufacturing Test			
Q&RA	60		
Facilities			
Manufacturing Technician	_____		
Total Direct Labor	<u>394</u>		
Program Executive		4	45
Program Planning & Reporting		9	110
Industrial Relations		<u>2</u>	<u>20</u>
Total Labor - Part I		<u>15</u>	<u>175</u>
<u>Material</u>			
Program Planning & Reporting			
Industrial Relations			
Material Subtotal			
Material & Administrative Burden			
Total Material			
TOTAL COST - PART I			

TABLE 5.4.3.1-III SRM LAUNCH CONTROL CENTER
 AMLLV PART II COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	25	297							25	297
LAB. TECHNICIANS										
TOOLING										
PRODUCTION			309	3,008					309	3,008
MANUFACTURING TEST										
MANUFACTURING TECH.										
Q & R A			60	580					60	580
DIRECT DIST										
TRAINING										
TOTAL DIRECT LABOR	25	297	369	3,588					394	3,885
MATERIAL										
LAB. TECHNICIANS										
TOOLING										
PRODUCTION										
MFG. TECHNICIANS										
Q & R A				2						2
SUBTOTAL				2						2
MAT. & ADM. BURDEN										
TOTAL MATERIAL				2						2
TOTAL PART II COST		297		3,590						3,887

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AMLLV
LAUNCH OPERATIONS
SRM
LAUNCH CONTROL CENTER

TABLE 5.4.3.1-IV

<u>Element of Cost</u>	(In Thousands)	
	<u>Manhours</u>	<u>Dollars</u>
Engineering:		
Design Support	<u>25</u>	<u>297</u>
TOTAL COST	<u>25</u>	<u>297</u>

AMLLV
 RECURRING
 LAUNCH OPERATIONS
 SRM
 LAUNCH CONTROL CENTER

TABLE 5.4.3.1-V

<u>Element of Cost</u>	(In Thousands)	
	<u>Manhours</u>	<u>Dollars</u>
Operations:		
Launch Vehicle	170	1,654
Technical Support	<u>139</u>	<u>1,354</u>
Subtotal	309	3,008
Q&RA	<u>60</u>	<u>580</u>
Total Labor	<u>369</u>	<u>3,588</u>
Material		
Q&RA		2
Material and Administrative Burden		<u> </u>
Total Material		<u>2</u>
TOTAL COST		<u>3,590</u>

5.4.3.2 Launch Pad

TABLE 5.4.3.2-I
A MLLV COST SUMMARY

SRM LAUNCH PAD - 1 R&D FLIGHT VEHICLE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	7	82								7	82
PROGRAM PLAN.& REPT.	17	202								17	202
INDUSTRIAL RELATIONS	4	37								4	37
ENGINEERING			46	547						46	547
LAB TECHNICIANS											
TOOLING											
PRODUCTION OR OPER.			571	5,550						571	5,550
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A			110	1,073						110	1,073
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR	28	321	727	7,170						755	7,491
MATERIAL				4							4
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL				4							4
TOTAL OTHER											
TOTAL COST		321		7,174							7,495

AMLLV
RECURRING
PART I

SRM LAUNCH PAD
ASSEMBLY OR SYSTEM
TABLE 5.4.3.2-II

<u>Element of Cost</u>	<u>Manhours</u>	(In Thousands)	
		<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	46		
Logistics			
Laboratory Technician			
Production	571		
Tooling			
Manufacturing Test			
Q&RA	110		
Facilities			
Manufacturing Technician	_____		
Total Direct Labor	<u>727</u>		
Program Executive		7	82
Program Planning & Reporting		17	202
Industrial Relations		<u>4</u>	<u>37</u>
Total Labor - Part I		<u>28</u>	<u>321</u>
<u>Material</u>			
Program Planning & Reporting			
Industrial Relations			
Material Subtotal			
Material & Administrative Burden			
Total Material			
TOTAL COST - PART I			

TABLE 5.4.3.2-III SRM LAUNCH PAD
 AMLLV PART II COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	46	547							46	547
LAB TECHNICIANS										
TOOLING										
PRODUCTION			571	5,550					571	5,550
MANUFACTURING TEST										
MANUFACTURING TECH.										
Q & R A			110	1,073					110	1,073
DIRECT DIST										
TRAINING										
TOTAL DIRECT LABOR	46	547	681	6,623					727	7,170
MATERIAL										
LAB. TECHNICIANS										
TOOLING										
PRODUCTION										
MFG. TECHNICIANS										
Q & R A				4						4
SUBTOTAL				4						4
MAT. & ADM. BURDEN										
TOTAL MATERIAL				4						4
TOTAL PART II COST		547		6,627						7,174

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AMLLV
RECURRING
LAUNCH OPERATIONS
SRM LAUNCH PAD

TABLE 5.4.3.2-IV

<u>Element of Cost</u>	(In Thousands)	
	<u>Manhours</u>	<u>Dollars</u>
Engineering:		
Design Support	<u>46</u>	<u>547</u>
TOTAL COST	<u>46</u>	<u>547</u>

AMLLV
 RECURRING
 LAUNCH OPERATIONS
 SRM LAUNCH PAD

TABLE 5.4.3.2-V

<u>Element of Cost</u>	(In Thousands)	
	<u>Manhours</u>	<u>Dollars</u>
Operations:		
Launch Vehicle	314	3,052
Technical Support	<u>257</u>	<u>2,498</u>
Subtotal	<u>571</u>	<u>5,550</u>
Q&RA	<u>110</u>	<u>1,073</u>
Total Labor	<u>681</u>	<u>6,623</u>
Material		
Q&RA		4
Material and Administrative Burden		<u> </u>
Total Material		<u>4</u>
TOTAL COST		<u>6,627</u>

5.4.3.3 Offsite Support

TABLE 5.4.3.3-I
 AMLLV COST SUMMARY

SRM OFF SITE SUPPORT COMPLEX - 1 R&D FLIGHT VEHICLE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	14	160								14	160
PROGRAM PLAN.& REPT.	33	392								33	392
INDUSTRIAL RELATIONS	10	72								10	72
ENGINEERING			90	1,059						90	1,059
LAB TECHNICIANS											
TOOLING											
PRODUCTION OR OPER.			1,105	10,742						1,105	10,742
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A			213	2,074						213	2,074
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR	57	624	1,408	13,875						1,465	14,499
MATERIAL				7							7
LOGISTIC HARDWARE BURDEN											
TOTAL MATERIAL				7							7
TOTAL OTHER											
TOTAL COST		624		13,882							14,506

AMLLV
RECURRING
PART I

SRM
OFF SITE SUPPORT COMPLEX
ASSEMBLY OR SYSTEM

TABLE 5.4.3.3-II

<u>Element of Cost</u>	<u>Manhours</u>	(In Thousands)	
		<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	90		
Logistics			
Laboratory Technician			
Production	1,105		
Tooling			
Manufacturing Test			
Q&RA	213		
Facilities			
Manufacturing Technician			
Total Direct Labor	<u>1,408</u>		
Program Executive		14	160
Program Planning & Reporting		33	392
Industrial Relations		<u>10</u>	<u>72</u>
Total Labor - Part I		<u>57</u>	<u>624</u>
<u>Material</u>			
Program Planning & Reporting			
Industrial Relations			
Material Subtotal			
Material & Administrative Burden			
Total Material			
TOTAL COST - PART I			

TABLE 5.4.3.3-III

SRM OFF SITE SUPPORT COMPLEX

AMLLV PART II COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H.	\$	M/H	\$	M/H	\$
ENGINEERING	90	1,059							90	1,059
LAB TECHNICIANS										
TOOLING										
PRODUCTION			1,105	10,742					1,105	10,742
MANUFACTURING TEST										
MANUFACTURING TECH.										
Q & R A			213	2,074					213	2,074
DIRECT DIST										
TRAINING										
TOTAL DIRECT LABOR	90	1,059	1,318	12,816					1,408	13,875
MATERIAL										
LAB. TECHNICIANS										
TOOLING										
PRODUCTION										
MFG. TECHNICIANS										
Q & R A				5						5
SUBTOTAL				2						2
MAT. & ADM. BURDEN				7						7
TOTAL MATERIAL										
TOTAL PART II COST		1,059		12,823						13,882

AMLLV
 LAUNCH OPERATIONS
 RECURRING
 SRM
 OFF SITE SUPPORT COMPLEX
 TABLE 5.4.3.3-IV

<u>Element of Cost</u>	(In Thousands)	
	<u>Manhours</u>	<u>Dollars</u>
Engineering:		
Design Support	<u>90</u>	<u>1,059</u>
TOTAL COST	<u><u>90</u></u>	<u><u>1,059</u></u>

AMLIV
 RECURRING
 LAUNCH OPERATIONS
 SRM
 OFF SITE SUPPORT COMPLEX
 TABLE 5.4.3.3-V

<u>Element of Cost</u>	(In Thousands)	
	<u>Manhours</u>	<u>Dollars</u>
Operations:		
Launch Vehicle	608	5,908
Technical Support	<u>497</u>	<u>4,834</u>
Subtotal	<u>1,105</u>	<u>10,742</u>
Q&RA	<u>213</u>	<u>2,074</u>
Total Labor	<u>1,318</u>	<u>12,816</u>
Material		
Q&RA		5
Material and Administrative Burden		<u>2</u>
Total Material		<u>12,823</u>
TOTAL COST		

5.5 SRM QUANTITY SENSITIVE COST

The cost details for the first unit 260 inch SRM are reflected in sections 5.5.1 through 5.5.4. Table 5.5.0.0-I displays the total cost associated with the first unit cost. Table 5.5.0.0-II displays the costs for twelve units.

The SRM motor costs were supplied by Aerojet-General Corporation. These costs were supplemented by the costs for the other stage hardware and cost for maintenance of the applicable portion of the manufacturing facility at Michoud.

TABLE 5.5.0.0-I

SOLID ROCKET MOTOR (1ST) UNIT

AMLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	3	35								3	35
PROGRAM PLAN. & REPT.	7	87								7	87
INDUSTRIAL RELATIONS	1	12								1	12
ENGINEERING			18	216			3	33		21	249
LAB TECHNICIANS			4	35						4	35
TOOLING			9	92						9	92
PRODUCTION			214	2,088						214	2,088
MANUFACTURING TEST			5	49						5	49
MANUFACTURING TECH.			4	45						4	45
Q & R A			62	595						62	595
FACILITIES					15	139				15	139
DIRECT DIST			43	414						43	414
TRAINING			2	23						2	23
TOTAL DIRECT LABOR	11	134	361	3,557	15	139	3	33		387	3,863
MATERIAL				8,794							8,794
LOGISTIC HARDWARE								69			69
BURDEN				127				23			150
TOTAL MATERIAL				8,921				92			9,013
TOTAL OTHER				176							176
TOTAL COST		134		12,654		139		125			13,052

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AMLLV

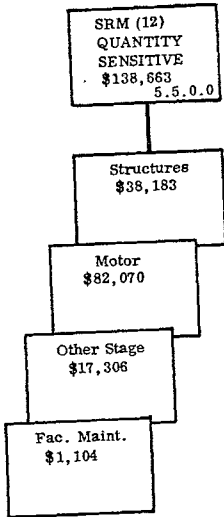
TOTAL SRM STAGE
 VARIABLE COSTS
 (DOLLARS IN THOUSANDS)
 TABLE #5.5.0.0 - II

	<u>1ST UNIT COST</u>		<u>*LEARNING CURVE FACTOR</u>		<u>1ST (12) UNITS</u>
1. Solid Rocket Motor	\$ 7,725	X	10.6239	=	\$ 82,070
2. Structures	3,594	X	"	=	38,183
3. Other Stage Hardware	1,629	X	"	=	17,306
4. Mfg. Facility Maint.	<u>104</u>	X	"	=	<u>1,104</u>
Total	<u>\$13,052</u>	X	10.6239	=	<u>\$138,663</u>

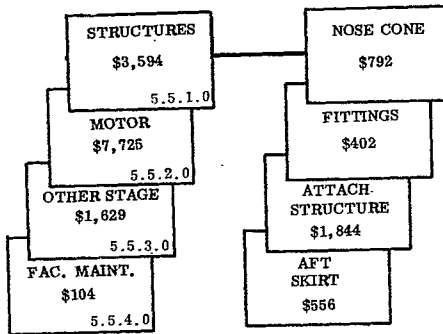
1151

Composite 95%

**FULL COMPLEMENT
OF SRM**



**SRM
SINGLE STAGE**



NOTES:

DOLLARS ARE IN THOUSANDS.
NUMBERS IN LOWER RIGHT CORNER
DESIGNATE APPLICABLE SECTION
NUMBER FOR COST DETAILS.

FIGURE 5.5.0.0-1 SRM QUANTITY SENSITIVE COST FLOW DIAGRAM

5.5.1 Structures for SRM

TABLE 5.5.1.0-I
AMLLV COST SUMMARY

SRM STRUCTURE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	3	35								3	35
PROGRAM PLAN: & REPT.	7	87								7	87
INDUSTRIAL RELATIONS	1	12								1	12
ENGINEERING			18	216			3	33		21	249
LAB TECHNICIANS			4	35						4	35
TOOLING			9	92						9	92
PRODUCTION			154	1,503						154	1,503
MANUFACTURING TEST			5	49						5	49
MANUFACTURING TECH.			4	45						4	45
Q & R A			44	423						44	423
FACILITIES					4	35				4	35
DIRECT DIST			43	414						43	414
TRAINING			2	23						2	23
TOTAL DIRECT LABOR	11	134	283	2,800	4	35	3	33		301	3,002
MATERIAL				373							373
LOGISTIC HARDWARE								69			69
BURDEN				127				23			150
TOTAL MATERIAL				500				92			592
TOTAL OTHER											
TOTAL COST		134		3,300		35		125			3,594

TABLE 5.5.1.0-II

SRM ATTACH STRUCTURE

AMLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	1	18								1	18
PROGRAM PLAN. & REPT.	4	44								4	44
INDUSTRIAL RELATIONS	1	6								1	6
ENGINEERING			6	72			1	11		7	83
LAB TECHNICIANS			1	12						1	12
TOOLING			55	49						4	49
PRODUCTION			82	800						82	800
MANUFACTURING TEST			2	19						2	19
MANUFACTURING TECH.			2	24						2	24
Q & R A			23	222						23	222
FACILITIES					2	19					
DIRECT DIST			23	218						23	218
TRAINING			1	12						1	12
TOTAL DIRECT LABOR	6	68	145	1,428	2	19	1	11		154	1,526
MATERIAL				214							214
LOGISTIC HARDWARE								23			23
BURDEN				73				8			81
TOTAL MATERIAL				287				31			318
TOTAL OTHER											
TOTAL COST		68		1,715		19		42			1,844

AMLLV

PART I

SRM - ATTACH STRUCTURE
ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 5:5.1.0-III

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	6,083		
Logistics	917		
Laboratory Technician	1,217		
Production	82,262		
Tooling	5,053		
Manufacturing Test	2,000		
Q&RA	22,856		
Facilities	1,895		
Manufacturing Technician	<u>2,019</u>		
Total Direct Labor	<u>124,302</u>		
Program Executive		1,492	17,621
Program Planning & Reporting		3,729	44,039
Industrial Relations		<u>633</u>	<u>6,153</u>
Total Labor - Part I		<u>5,854</u>	<u>67,813</u>
<u>Material</u>			
Program Planning & Reporting			75
Industrial Relations			<u>63</u>
Material Subtotal			138
Material & Administrative Burden			<u>47</u>
Total Material			<u>185</u>
TOTAL COST - PART I			<u>67,998</u>

TABLE 5.5.1.0-IV

SRM ATTACH STRUCTURE

AMLV PART II COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	6	72							6	72
LAB. TECHNICIANS	1	12							1	12
TOOLING					5	49			5	49
PRODUCTION			82	800					82	800
MANUFACTURING TEST							2	20	2	20
MANUFACTURING TECH.			2	23				1	2	24
Q & R A	1	2	21	201	1	13		5	23	221
DIRECT DIST			20	196	2	16	1	6	23	218
TRAINING			1	11		1			1	12
TOTAL DIRECT LABOR	8	86	126	1,231	8	79	3	32	145	1,428
MATERIAL										
LAB. TECHNICIANS		3								3
TOOLING						9				9
PRODUCTION				192						192
MFG. TECHNICIANS				4						4
Q & R A				6						6
SUBTOTAL		3		202		9				214
MAT. & ADM. BURDEN		1		69		3				73
TOTAL MATERIAL		4		271		12				287
TOTAL PART II COST		90		1,502		91		32		1,715

PART II
ENGINEERING
AMLLV SEM
ATTACH STRUCTURE
ASSEMBLY OR SYSTEM
TABLE 5.5.1.0-V

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Design Development	5,957	70,352
Reliability Engineering	126	1,488
(1) Subtotal (A)	<u>6,083</u>	<u>71,840</u>
(2) Laboratory Technicians	1,217	11,829
Subtotal (B)	<u>7,300</u>	<u>83,669</u>
(3) Q&RA	<u>243</u>	<u>2,362</u>
Total Engineering Labor	<u><u>7,543</u></u>	<u><u>86,031</u></u>
Material		
(4) Lab. Tech.		2,556
(5) Q&RA		<u>73</u>
Subtotal (C)		2,629
(6) Material & Adm. Burden		894
Total Material		<u><u>3,523</u></u>
Total Engineering Cost		<u><u>89,554</u></u>

PART II
 MANUFACTURING
 PRODUCTION
 AMLLY SRM
 ATTACH STRUCTURE

ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 5.5.1.0-VI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	58,000	563,760
(2) Miscellaneous Charges	4,524	43,973
(3) Maintain & Add in Scope Changes	638	6,201
Subtotal (A)	<u>63,162</u>	<u>613,934</u>
(4) Tool & Production Planning	19,100	185,652
Subtotal (B)	<u>82,262</u>	<u>799,586</u>
(5) Direct Distributable	20,212	196,461
Subtotal (C)	<u>102,474</u>	<u>996,047</u>
(6) Training	1,127	10,954
Subtotal (D)	<u>103,601</u>	<u>1,007,001</u>
(7) Q&RA	20,720	201,398
(8) Mfg. Tech.	1,968	23,242
Total Production Labor	<u>126,289</u>	<u>1,231,641</u>
 Material		
(9) Raw Material & Standards		192,225
(10) Q&RA		6,216
(11) Mfg. Tech.		3,444
Material Subtotal		<u>201,885</u>
(12) Material & Adm. Burden		68,641
Total Material		<u>270,526</u>
Total Production Cost		<u>1,502,167</u>

PART II
 MANUFACTURING
 TOOLING
 AMLLV SRM
ATTACH STRUCTURE
 ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 5.5.1.0-VII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	5,053	49,115
(2) Direct Distributabel	1,617	15,717
Subtotal (A)	6,670	64,832
(3) Training	73	710
Subtotal (B)	6,743	65,542
(4) Q&RA	1,349	13,112
Total Tooling Labor	8,092	78,654
 Material		
(5) Tooling		8,843
(6) Q&RA		405
Subtotal (C)		9,248
(7) Material & Adm. Burden		3,144
Total Material		12,392
Total Tooling Cost		\$91,046

PART II
 MANUFACTURING
 MANUFACTURING TEST
 ALLV SRM
 ATTACH STRUCTURE

ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 5.5.1.0-VIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	1,360	13,219
Component Test Planning	640	6,221
(1) Subtotal (A)	<u>2,000</u>	<u>19,440</u>
(2) Direct Distributable	640	6,221
Subtotal (B)	<u>2,640</u>	<u>25,661</u>
(3) Training	29	282
Subtotal (C)	<u>2,669</u>	<u>25,943</u>
(4) Mfg. Tech.	51	602
Subtotal (D)	<u>2,720</u>	<u>26,545</u>
(5) Q&RA	544	5,288
Total Mfg. Test Labor	<u>3,264</u>	<u>31,833</u>
Material		
(6) Q&RA		163
(7) Mfg. Tech.		89
Subtotal (E)		<u>252</u>
(8) Material & Adm. Burden		86
Total Material		<u>338</u>
Total Mfg. Test Cost		<u>\$32,171</u>

PART III -
FACILITY LABOR
AMLLV SRM
ATTACH STRUCTURE

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.5.1.0-IX

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	1,895	18,419
TOTAL FACILITY LABOR COST		<u>\$18,419</u>

PART IV
 LOGISTIC LABOR
 AMLIV SEM
 ATTACH STRUCTURE

 ASSEMBLY OR SYSTEM
 TABLE 5.5.1.0-X

<u>Element of Cost.</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Engineering	<u>917</u>	<u>10,830</u>
(2) Hardware		22,925
(3) Material & Adm. Burden		7,795
Total Material		<u>30,720</u>
Total Logistic Cost		<u>\$41,550</u>

TABLE 5.5.1.0-XI

AMLLV COST SUMMARY

SRM NOSE CONE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	1	8								1	8
PROGRAM PLAN. & REPT.	1	20								1	20
INDUSTRIAL RELATIONS		3									3
ENGINEERING			4	51			1	8		5	59
LAB TECHNICIANS			1	8						1	8
TOOLING			2	21						2	21
PRODUCTION			35	345						35	345
MANUFACTURING TEST			1	10						1	10
MANUFACTURING TECH.			1	10						1	10
Q & R A			10	97						10	97
FACILITIES					1	8				1	8
DIRECT DIST			10	94						10	94
TRAINING			1	5						1	5
TOTAL DIRECT LABOR	2	31	65	641	1	8	1	8		69	688
MATERIAL				61							61
LOGISTIC HARDWARE								17			17
BURDEN				21				5			26
TOTAL MATERIAL				82				22			104
TOTAL OTHER											
TOTAL COST		31		723		8		30			792

AMLLV

PART I

SRM NOSE CONE
ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.5.1.0-XII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>	4,340		
Engineering	4,340		
Logistics	660		
Laboratory Technician	868		
Production	35,457		
Tooling	2,178		
Manufacturing Test	1,000		
Q&RA	9,958		
Facilities	817		
Manufacturing Technician	873		
Total Direct Labor	<u>56,151</u>		
Program Executive		674	7,960
Program Planning & Reporting		1,684	19,888
Industrial Relations		288	2,799
Total Labor - Part I		<u>2,646</u>	<u>30,647</u>
<u>Material</u>			
Program Planning & Reporting			34
Industrial Relations			<u>29</u>
Material Subtotal			63
Material & Administrative Burden			<u>22</u>
Total Material			<u>85</u>
TOTAL COST - PART I			<u>30,732</u>

TABLE 5.5.1.0-XIII

AMLLV PART II COST SUMMARY

SRM NOSE CONE

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	4	51							4	51
LAB TECHNICIANS	1	8							1	8
TOOLING					2	21			2	21
PRODUCTION			35	344					35	344
MANUFACTURING TEST							1	10	1	10
MANUFACTURING TECH.			1	10					1	10
Q & R A		2	9	87		6		3	9	98
DIRECT DIST			9	85	1	7	1	3	11	95
TRAINING				5						5
TOTAL DIRECT LABOR	5	61	54	531	3	34	2	16	64	642
MATERIAL										
LAB. TECHNICIANS		2								2
TOOLING						4				4
PRODUCTION				51						51
MFG. TECHNICIANS				1						1
Q & R A				3						3
SUBTOTAL		2				4				61
MAT. & ADM. BURDEN		1		18		1				20
TOTAL MATERIAL		3		73		5				81
TOTAL PART II COST		64		604		39		16		723

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AMLLV
PART II
ENGINEERING

NOSE CONE.- SRM
ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.5.1.0-XIV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Design Development	4,250	\$ 50,193
Reliability Engineering	<u>90</u>	<u>1,063</u>
(1) Subtotal (A)	4,340	51,256
(2) Laboratory Technicians	<u>868</u>	<u>8,437</u>
Subtotal (B)	5,208	59,693
(3) Q&RA	<u>174</u>	<u>1,691</u>
Total Engineering Labor	<u>5,382</u>	<u>61,384</u>
Material		
(4) Lab. Tech.		1,823
(5) Q&RA		<u>52</u>
Subtotal (C)		1,875
(6) Material & Adm. Burden		<u>638</u>
Total Material		<u>2,513</u>
Total Engineering Cost		\$ <u>63,897</u>

AMLLV
PART II
MANUFACTURING
PRODUCTION

NOSE CONE - SRM

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.5.1.0-XV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	25,000	243,000
(2) Miscellaneous Charges	1,950	18,954
(3) Maintain & Add in Scope Changes	<u>275</u>	<u>2,673</u>
Subtotal (A)	27,225	264,627
(4) Tool & Production Planning	<u>8,232</u>	<u>80,015</u>
Subtotal (B)	35,457	344,642
(5) Direct Distributable	<u>8,712</u>	<u>84,681</u>
Subtotal (C)	44,169	429,323
(6) Training	<u>486</u>	<u>4,724</u>
Subtotal (D)	44,655	434,047
(7) Q&RA	8,931	86,809
(8) Mfg. Tech.	<u>848</u>	<u>10,015</u>
Total Production Labor	<u>54,434</u>	<u>530,871</u>
 Material		
(9) Raw Material & Standards.		50,650
(10) Q&RA		2,679
(11) Mfg. Tech.		<u>1,484</u>
Material Subtotal		54,813
(12) Material & Adm. Burden		<u>18,636</u>
Total Material		73,449
Total Production Cost		<u><u>604,320</u></u>

AMLLV
PART II:
MANUFACTURING
TOOLING

NOSE CONE - SRM

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.5.1.0-XVI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	2,178	\$ 21,170
(2) Direct Distributabel	<u>697</u>	<u>6,775</u>
Subtotal (A)	2,875	27,945
(3) Training	<u>32</u>	<u>311</u>
Subtotal (B)	2,907	28,256
(4) Q&RA	<u>581</u>	<u>5,647</u>
Total Tooling Labor	<u>3,488</u>	<u>33,903</u>
 Material		
(5) Tooling		3,811
(6) Q&RA		<u>174</u>
Subtotal (C)		3,985
(7) Material & Adm. Burden		<u>1,355</u>
Total Material		<u>5,340</u>
Total Tooling Cost		<u>\$ 39,243</u>

AMLLV
 PART II
 MANUFACTURING
 MANUFACTURING TEST

NOSE CONE - SRM

ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 5.5.1.0-XVII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	680	\$ 6,610
Component Test Planning	<u>320</u>	<u>3,110</u>
(1) Subtotal (A)	1,000	9,720
(2) Direct Distributable	<u>320</u>	<u>3,110</u>
Subtotal (B)	1,320	12,830
(3) Training	<u>15</u>	<u>146</u>
Subtotal (C)	1,335	12,976
(4) Mfg. Tech.	<u>25</u>	<u>295</u>
Subtotal (D)	1,360	13,271
(5) Q&RA	<u>272</u>	<u>2,644</u>
Total Mfg. Test Labor	<u><u>1,632</u></u>	<u><u>15,915</u></u>
Material		
(6) Q&RA		82
(7) Mfg. Tech.		<u>44</u>
Subtotal (E)		126
(8) Material & Adm. Burden		<u>43</u>
Total Material		<u><u>169</u></u>
Total Mfg. Test Cost		<u><u>\$ 16,084</u></u>

· AMLLV
PART III -
FACILITY LABOR

NOSE CONE - SRM

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.5.1.0-XVIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	817	7,941
TOTAL FACILITY LABOR COST	<u>817</u>	<u>7,941</u>

AMLLV
 PART IV
 LOGISTIC LABOR
NOSE CONE - SRM.
 ASSEMBLY OR SYSTEM
 TABLE 5.5.1.0-XIX

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Engineering	660	<u>7,795</u>
(2) Hardware		16,500
(3) Material & Adm. Burden		<u>5,610</u>
Total Material		<u>22,110</u>
Total Logistic Cost		<u>29,905</u>

TABLE 5.5.1.0-XX SRM AFT SKIRT

AMLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE	1	5	3							1	5
PROGRAM PLAN. & REPT.	1	13								1	13
INDUSTRIAL RELATIONS		2									2
ENGINEERING			3	41				6		4	47
LAB TECHNICIANS			1	7						1	7
TOOLING			1	13						1	13
PRODUCTION			23	220						23	221
MANUFACTURING TEST			1	10						1	10
MANUFACTURING TECH.			1	7						1	7
Q & RA			7	63						6	63
FACILITIES					1	5				1	5
DIRECT DIST			6	62						6	62
TRAINING				4							3
TOTAL DIRECT LABOR	2	20	43	427	1	5		6		46	458
MATERIAL				60							60
LOGISTIC HARDWARE								13			13
BURDEN				20				5			25
TOTAL MATERIAL				80				18			98
TOTAL OTHER											
TOTAL COST		20		507		5		24			556

AMLLV
 PART I
 SRM - AFT SKIRT
ASSEMBLY OR SYSTEM
 TABLE 5.5.1.0-XXI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	3,476		
Logistics	524		
Laboratory Technician	695		
Production	22,693		
Tooling	1,394		
Manufacturing Test	1,000		
Q&RA	6,499		
Facilities	523		
Manufacturing Technician	<u>568</u>		
Total Direct Labor	<u>37,372</u>		
Program Executive		448	5,291
Program Planning & Reporting		1,121	13,239
Industrial Relations		<u>190</u>	<u>1,847</u>
Total Labor - Part I		<u>1,759</u>	<u>20,377</u>
<u>Material</u>			
Program Planning & Reporting			22
Industrial Relations			<u>19</u>
Material Subtotal:			41
Material & Administrative Burden			<u>13</u>
Total Material			<u>54</u>
TOTAL COST - PART I			<u>20,431</u>

TABLE 5.5.1.0-XXII

SRM - AFT SKIRT

AMLLV PART II COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	.3	41							3	41
LAB TECHNICIANS	1	7							1	7
TOOLING					1	14			1	14
PRODUCTION			23	221					23	221
MANUFACTURING TEST							1	10	1	10
MANUFACTURING TECH.			1	6					1	6
Q & R A		1	6	56		4		3	6	64
DIRECT DIST			5	54	1	4	1	3	7	61
TRAINING				3						3
TOTAL DIRECT LABOR	4	49	35	340	2	22	2	16	43	427
MATERIAL										
LAB. TECHNICIANS		2								2
TOOLING						2				2
PRODUCTION				53						53
MFG. TECHNICIANS				1						1
Q & R A				2						2
SUBTOTAL		2		56		2				60
MAT. & ADM. BURDEN				19		1				20
TOTAL MATERIAL		2		75		3				80
TOTAL PART II COST		51		415		25		16		507

AMLLV
PART II
ENGINEERING

SRM - AFT SKIRT

ASSEMBLY OR SYSTEM

TABLE 5.5.1.0-XXIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Design Development	3,404	40,201
Reliability Engineering	<u>72</u>	<u>850</u>
(1) Subtotal (A)	3,476	41,051
(2) Laboratory Technicians	<u>695</u>	<u>6,755</u>
Subtotal (B)	4,171	47,806
(3) Q&RA	<u>139</u>	<u>1,351</u>
Total Engineering Labor	<u>4,310</u>	<u>49,157</u>
Material		
(4) Lab. Tech.		<u>1,460</u>
(5) Q&RA		42
Subtotal (C)		1,502
(6) Material & Adm. Burden		<u>511</u>
Total Material		<u>2,013</u>
Total Engineering Cost		<u>51,170</u>

AMLLV
PART II :
MANUFACTURING
PRODUCTION.

SRM - AFT SKIRT

· ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.5.1.0-XXIV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	16,000	155,520
(2) Miscellaneous Charges	1,248	12,131
(3) Maintain & Add in Scope Changes	176	1,711
Subtotal (A)	<u>17,424</u>	<u>169,362</u>
(4) Tool & Production Planning	5,269	51,215
Subtotal (B)	<u>22,693</u>	<u>220,577</u>
(5) Direct Distributable	5,576	54,199
Subtotal (C)	<u>28,269</u>	<u>274,776</u>
(6) Training	311	3,023
Subtotal (D)	<u>28,580</u>	<u>277,799</u>
(7) Q&RA	5,716	55,560
(8) Mfg. Tech.	543	6,413
Total Production Labor	<u>34,839</u>	<u>339,772</u>
 Material		
(9) Raw Material & Standards		53,030
(10) Q&RA		1,715
(11) Mfg. Tech.		950
Material Subtotal		<u>55,695</u>
(12) Material & Adm. Burden		18,936
Total Material		<u>24,631</u>
Total Production Cost		<u>414,403</u>

AMLLV
 PART II
 MANUFACTURING
 TOOLING

SRM - AFT SKIRT

ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 5.5.1.0-XXV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	1,394	13,550
(2) Direct Distributabel	<u>446</u>	<u>4,335</u>
Subtotal (A)	1,840	17,885
(3) Training	<u>20</u>	<u>194</u>
Subtotal (B)	1,860	18,079
(4) Q&RA	<u>372</u>	<u>3,616</u>
Total Tooling Labor	<u>2,232</u>	<u>21,695</u>
 Material		
(5) Tooling		2,440
(6) Q&RA		<u>112</u>
Subtotal (C)		2,552
(7) Material & Adm. Burden		<u>868</u>
Total Material		<u>3,420</u>
Total Tooling Cost		25,115

AMLLV
 PART II
 MANUFACTURING
 MANUFACTURING TEST

SRM - AFT SKIRT

ASSEMBLY OR SYSTEM
 1ST UNIT COST

TABLE 5.5.1.0-XXVI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	680	6,610
Component Test Planning	320	3,110
(1) Subtotal (A)	<u>1,000</u>	<u>9,720</u>
(2) Direct Distributable	320	3,110
Subtotal (B)	<u>1,320</u>	<u>12,830</u>
(3) Training	15	146
Subtotal (C)	<u>1,335</u>	<u>12,976</u>
(4) Mfg. Tech.	25	295
Subtotal (D)	<u>1,360</u>	<u>13,271</u>
(5) Q&RA	272	2,644
Total Mfg. Test Labor	<u><u>1,632</u></u>	<u><u>15,915</u></u>
Material		
(6) Q&RA		82
(7) Mfg. Tech.		44
Subtotal (E)		<u>126</u>
(8) Material & Adm. Burden		43
Total Material		<u>169</u>
Total Mfg. Test Cost		<u><u>16,084</u></u>

AMLLV
PART III
FACILITY LABOR

SRM - AFT SKIRT
ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.5.1.0-XXVII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Direct Labor Hours	523	5,084
TOTAL FACILITY LABOR COST		<u>5,084</u>

AMLLV
PART IV
LOGISTIC LABOR

SRM - AFT SKIRT

ASSEMBLY OR SYSTEM

TABLE 5.5.1.0-XXVIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Engineering	524	<u>6,188</u>
(2) Hardware		13,100
(3) Material & Adm. Burden		<u>4,454</u>
Total Material		<u>17,554</u>
Total Logistic Cost		<u>23,742</u>

TABLE 5.5.1.0-XXIX (FITTINGS

AMLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE		4									4
PROGRAM PLAN. & REPT.	1	10								1	10
INDUSTRIAL RELATIONS		1									1
ENGINEERING			5	52			1	8		6	60
LAB TECHNICIANS			1	8						1	8
TOOLING			1	9						1	9
PRODUCTION			14	138						14	138
MANUFACTURING TEST			1	10						1	10
MANUFACTURING TECH.				4							4
Q & R A			4	41						4	41
FACILITIES						3					3
DIRECT DIST			4	40						4	40
TRAINING				2							2
TOTAL DIRECT LABOR	1	15	30	304		3	1	8		32	330
MATERIAL				38							38
LOGISTIC HARDWARE								16			16
BURDEN				13				5			18
TOTAL MATERIAL				51				21			72
TOTAL OTHER											
TOTAL COST		15		355		3		29			402

AMLLV
 PART I
SRM FITTINGS
ASSEMBLY OR SYSTEM
 1ST UNIT COST
 TABLE 5.5.1.0-XXX

<u>Element of Cost</u>	<u>Manhours</u>	<u>Manhours</u>	<u>Dollars</u>
<u>Direct Labor</u>			
Engineering	4,340		
Logistics	660		
Laboratory Technician	868		
Production	14,183		
Tooling	871		
Manufacturing Test	1,000		
Q&RA	4,251		
Facilities	327		
Manufacturing Technician	364		
	<hr/>		
Total Direct Labor	26,864		
	<hr/>		
Program Executive		322	3,803
Program Planning & Reporting		806	9,519
Industrial Relations		138	1,341
		<hr/>	<hr/>
Total Labor - Part I		1,266	14,663
		<hr/>	<hr/>
<u>Material</u>			
Program Planning & Reporting			16
Industrial Relations			14
Material Subtotal			30
Material & Administrative Burden			10
			<hr/>
Total Material			40
			<hr/>
TOTAL COST - PART I			14,703
			<hr/>

TABLE 5.5.1.0-XXXI SRM FITTINGS

AMLLV PART II COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	ENGINEERING		PRODUCTION		TOOLING		TEST		TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$	M/H	\$
ENGINEERING	4	51							4	51
LAB TECHNICIANS	1	8							1	8
TOOLING					1	9			1	9
PRODUCTION			14	138					14	138
MANUFACTURING TEST							1	10	1	10
MANUFACTURING TECH.				4						4
Q & R A		2	4	34		2		3	4	41
DIRECT DIST			4	34		3	1	3	5	40
TRAINING				2						2
TOTAL DIRECT LABOR	5	61	22	212	1	14	2	16	30	303
MATERIAL										
LAB. TECHNICIANS		2								2
TOOLING						2				2
PRODUCTION				33						33
MFG. TECHNICIANS				1						1
Q & R A				1						1
SUBTOTAL		2		35		2				39
MAT. & ADM. BURDEN		1		12						13
TOTAL MATERIAL		3		47		2				52
TOTAL PART II COST		64		259		16		16		355

AMLLV
PART II
ENGINEERING

SRM FITTINGS

ASSEMBLY OR SYSTEM

TABLE 5.5.1.0-XXXII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Design Development	4,250	50,193
Reliability Engineering	<u>90</u>	<u>1,063</u>
(1) Subtotal (A)	4,340	51,256
(2) Laboratory Technicians	<u>868</u>	<u>8,437</u>
Subtotal (B)	5,208	59,693
(3) Q&RA	<u>174</u>	<u>1,691</u>
Total Engineering Labor	<u>5,382</u>	<u>61,384</u>
Material		
(4) Lab. Tech.		1,823
(5) Q&RA		<u>52</u>
Subtotal (C)		1,875
(6) Material & Adm. Burden		<u>638</u>
Total Material		<u>2,513</u>
Total Engineering Cost		<u>63,897</u>

AMLLV
PART II
MANUFACTURING
PRODUCTION

SRM FITTINGS

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.5.1.0-XXXIII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Fabrication & Assembly	10,000	97,200
(2) Miscellaneous Charges	780	7,582
(3) Maintain & Add in Scope Changes	110	1,069
Subtotal (A)	<u>10,890</u>	<u>105,851</u>
(4) Tool & Production Planning	<u>3,293</u>	<u>32,008</u>
Subtotal (B)	14,183	137,859
(5) Direct Distributable	<u>3,485</u>	<u>33,874</u>
Subtotal (C)	17,668	171,733
(6) Training	<u>194</u>	<u>1,886</u>
Subtotal (D)	17,862	173,619
(7) Q&RA	3,572	34,720
(8) Mfg. Tech.	<u>339</u>	<u>4,004</u>
Total Production Labor	<u>21,773</u>	<u>212,343</u>
 Material		
(9) Raw Material & Standards		33,135
(10) Q&RA		1,072
(11) Mfg. Tech.		<u>593</u>
Material Subtotal		34,800
(12) Material & Adm. Burden		<u>11,832</u>
Total Material		<u>46,632</u>
Total Production Cost		<u>258,975</u>

AMLLV
PART II
MANUFACTURING
TOOLING

SRM FITTINGS

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.5.1.0-XXXIV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Sustaining Tooling	871	\$ 8,466
(2) Direct Distributabel	<u>279</u>	<u>2,712</u>
Subtotal (A)	1,150	11,178
(3) Training	<u>13</u>	<u>126</u>
Subtotal (B)	1,163	11,304
(4) Q&RA	<u>233</u>	<u>2,265</u>
Total Tooling Labor	<u>1,396</u>	<u>13,569</u>
 Material		
(5) Tooling		1,524
(6) Q&RA		<u>70</u>
Subtotal (C)		1,594
(7) Material & Adm. Burden		<u>542</u>
Total Material		<u>2,136</u>
Total Tooling Cost		\$ <u>15,705</u>

AMLLV
PART II
MANUFACTURING
MANUFACTURING TEST

SRM FITTINGS

ASSEMBLY OR SYSTEM
1ST UNIT COST

TABLE 5.5.1.0-XXXV

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
Component Test	680	6,610
Component Test Planning	<u>320</u>	<u>3,110</u>
(1) Subtotal (A)	1,000	9,720
(2) Direct Distributable	<u>320</u>	<u>3,110</u>
Subtotal (B)	1,320	12,830
(3) Training	<u>15</u>	<u>146</u>
Subtotal (C)	1,335	12,976
(4) Mfg. Tech.	<u>25</u>	<u>295</u>
Subtotal (D)	1,360	13,271
(5) Q&RA	<u>272</u>	<u>2,644</u>
Total Mfg. Test Labor	<u><u>1,632</u></u>	<u><u>15,915</u></u>
 Material		
(6) Q&RA		82
(7) Mfg. Tech.		<u>44</u>
Subtotal (E)		126
(8) Material & Adm. Burden		<u>43</u>
Total Material		<u>169</u>
Total Mfg. Test Cost		<u><u>16,084</u></u>

AMLLV
 PART III
 FACILITY LABOR
 SRM FITTINGS

 ASSEMBLY OR SYSTEM
 1ST UNIT COST
 TABLE 5,5.1.0-XXXVI

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(j) Direct Labor Hours	327	3,178
TOTAL FACILITY LABOR COST		<u><u>\$3,178</u></u>

AMLLV
 PART IV
 LOGISTIC LABOR
SRM FITTINGS
 ASSEMBLY OR SYSTEM
 TABLE 5.5.1.0-XXXVII

<u>Element of Cost</u>	<u>Manhours</u>	<u>Dollars</u>
(1) Engineering	<u>660</u>	<u>7,795</u>
(2) Hardware		16,500
(3) Material & Adm. Burden		5,610
Total Material		<u>22,110</u>
Total Logistic Cost		<u>29,905</u>

5.5.2 Solid Motor

TABLE 5.5.2-1

SOLID ROCKET MOTOR

AMLLV COST SUMMARY

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
PROGRAM EXECUTIVE											
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION			60	585						60	585
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A			18	172						18	172
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR			78	757						78	757
MATERIAL				6,792							6,792
LOGISTIC HARDWARE											
BURDEN											
TOTAL MATERIAL				6,792							6,792
TOTAL OTHER				176							176
TOTAL COST				7,725							7,725

AMLLV
SOLID ROCKET MOTOR

RECURRING 1ST UNIT COST
(DOLLARS IN THOUSANDS)

TABLE 5.5.2-II

<u>AEROJET INPUT, OCT 31, 1968 MOTOR COST</u>		
1.	Chamber	\$2,552
2.	Nozzle	
	Shell	1,223
	Ablatives & Exit Cone	1,005
	Actuators (2/motor)	85
	APU (2/motor)	<u>148</u>
		2,461
3.	Case Insulation	157
4.	Propellant and Liner Materials	1,587
5.	Igniter	35
6.	Shipping	176
7.	Manufacturing Labor	
	Process & Assembly	585
	Inspection	<u>172</u>
	TOTAL MOTOR COST LESS FEE	<u><u>\$7,725</u></u>

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5.5.3 Other Stage Components

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TABLE 5.5.3.0-1

AMLLV COST SUMMARY

SRM OTHER STAGE HARDWARE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
	PROGRAM EXECUTIVE										
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH.											
Q & R A											
FACILITIES											
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR											
MATERIAL											
LOGISTIC HARDWARE				1,629							1,629
BURDEN											
TOTAL MATERIAL				1,629							1,629
TOTAL OTHER											
TOTAL COST				1,629							1,629

PART II
 AMLLV
 SRM OTHER STAGE HARDWARE

TABLE 5.5.3.0-II

(DOLLARS IN THOUSANDS)

<u>OTHER STAGE COST</u>	<u>1ST UNIT</u>
* Instrumentation	\$ 464
* Electrical System	360
* Stage Separation Components	
Separation Rockets (7 Motor) set	35
Initiation Components	<u>9</u> 44
* Destruct Charges Firing Components	21
* Other Structural Components	
Heat Shield	311
Raceway (Tunnel)	126
Environmental Control Ducts	83
Mounting & Fairings	<u>220</u> 740
Total Stage 1st Unit Cost	
Less Fee	<u>\$1,629</u>

* Aerojet input on October 31, 1967.

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5.3.4 SRM FACILITY MAINTENANCE



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TABLE 5.5.4-I

AMLV COST SUMMARY

SRM MANUFACTURING FACILITIES MAINTENANCE

A B C

(IN THOUSANDS)

ELEMENT OF COST	PROGRAM MGMT. PART I		CONT. END ITEM PART II		FACILITIES PART III		LOGISTICS PART IV		OTHER	TOTAL	
	M/H	\$	M/H	\$	M/H	\$	M/H	\$		M/H	\$
	PROGRAM EXECUTIVE										
PROGRAM PLAN. & REPT.											
INDUSTRIAL RELATIONS											
ENGINEERING											
LAB TECHNICIANS											
TOOLING											
PRODUCTION											
MANUFACTURING TEST											
MANUFACTURING TECH. Q & R A											
FACILITIES					11	104				11	104
DIRECT DIST											
TRAINING											
TOTAL DIRECT LABOR					11	104				11	104
MATERIAL											
LOGISTIC HARDWARE BURDEN											
TOTAL MATERIAL											
TOTAL OTHER											
TOTAL COST						104					104

1200

AMLLV
RECURRING
SRM

* FACILITIES MAINTENANCE
(DOLLARS IN THOUSANDS)

TABLE 5.5.4-II

1.	Maintenance of Equipment	\$ 67
2.	Maintenance of Brick and Mortar	<u>37</u>
	TOTAL	<u>\$104</u>

* Allocated per vehicle. Dollars shown are for structural components built at Michoud.