NASA CONTRACTOR REPORT

NASA CR - 61021

NASA CR - 61021

APOLLO LOGISTICS SUPPORT SYSTEMS
MOLAB STUDIES

Task Report On

MOLAB Concept Evaluation Method

GPO PRICE $ _____

OTS PRICE(S) $ _____

Hard copy (HC) $2.00

Microfiche (MF) $0.50

Prepared under Contract No. NAS8-11096 by

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Huntsville, Alabama

For

NASA - GEORGE C. MARSHALL SPACE FLIGHT CENTER
Huntsville, Alabama

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PROPULSION AND VEHICLE ENGINEERING LABORATORY

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PREFACE

This report was prepared by the Northrop Space Laboratories, Huntsville Department, for the George C. Marshall Space Flight Center under authorization of Task Order N-29, Contract NAS8-11096. The NASA Technical Representatives were Mr. Charles R. Darwin and Mr. Jay Laue of the MSFC Propulsion and Vehicle Engineering Laboratory (R-P & VE-AB).

The work completed was a ten man-week effort commencing on 8 June 1964 and ending 21 August 1964. The data and methods presented herein are intended as a guide to aid in the technical evaluation and selection of a MOLAB concept.

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SECTION 1.0

INTRODUCTION

The NASA Manned Lunar Exploration Program has as its objective the scientific investigation of the moon. The Apollo project is the first approved effort in this program and has as its specific objective the landing of two astronauts on the moon and their safe return to earth within this decade.

The Apollo Logistic Support System (ALSS) is being considered for use in conjunction with Apollo missions. Its broad objective is to assure: maximum scientific benefits from lunar exploration, crew stay-time extension, crew safety during these operations and the safe return of the astronauts to earth.

A Manned Lunar Surface Mobile Laboratory Vehicle called MOLAB has been proposed for accomplishing these objectives and is now being studied by MSFC, both with respect to mission definition and investigations of supporting technologies. During the course of the MOLAB concept studies, several concept designs have been produced. These concepts differ in configuration, internal volume, internal and external arrangement and performance characteristics. All of the concepts have the capability of performing the presently defined scientific mission for the MOLAB.

This task is an endeavor to establish a model with which to technically evaluate the various design concepts. The concept parameters considered are: crew safety, reliability, design simplicity, lunar terrain negotiability, performance efficiency, weight, development risk, weight and cost. These parameters are considered for the stowage, deployment, dormant and operational phases of the mission.

SECTION 2.0

CONCEPT EVALUATION OBJECTIVES

The objective of this evaluation model is to establish a matrix of the pertinent technical parameters of a MOLAB along with a numerical grading scheme which includes factors for item and system importance and system redundancy. This matrix is the model which the evaluator uses in assessing the merits of a system or subsystem with a number as the end result. The sum of all the subsystem and system numbers is the evaluation merit number for the concept.

The establishment of the pertinent technical parameters for this matrix is the most difficult part of this task. The technical parameters, which we shall call items, should be general enough to apply to any design concept. A sub-matrix will be established for the MOLAB and for each system of the MOLAB using the breakdown as established by the "MOLAB Payload Mass Format", no date or document number, issued by MSFC R-P & VE-AB. This will allow comparison of the systems of the various concepts on a common format basis.

Each system evaluation matrix will consider the following general parameters in addition to those parameters which are peculiar to a particular system.

1. Power Requirements.
2. Reliability Assessment.
3. Performance Parameters
4. Simplicity of Design.
5. Weight, Total MOLAB and individual systems.
6. Development risk, time frame for.
7. Cost

When the parameters are not sufficently defined it will be necessary for the evaluator to make an assessment of the probable value.

SECTION 3.0

CONCEPT EVALUATION AND COMPARISON OUTLINE

3.1 SYSTEM RATING CRITERIA

The method which is proposed to evaluate the previously discussed matrices is a numerical grading system. This system uses the numerals of "0" (zero) through "10" (ten) in accordance with the degree of design excellence. In addition to the numerical grade factor an importance factor for the item is applied to denote the relative importance of the item to the system of which it is a part. This importance factor is a multiplier for the item grade factor, the product is the item grade.

An importance factor is also assigned to each MOLAB system, This factor indicates the importance of the system to the safety of the astronauts and the consequent mission success, i.e., the communication system failure would not be as serious as would a power system failure, or an environmental control system failure. The importance factor is used as a multiplier for the system grade.

In addition to the system importance factor, a redundancy factor is also applied to each system. This factor is applied by the evaluator as a measure of redundancy that the system contains, i.e., the electric power system may have 3 or 4 individual and separately supplied fuel cells in addition to a backup storage battery. This system could be considered fully redundant and would receive a high redundancy factor rating. This factor is used as a multiplier for the product of the system grade and the importance factor.

In summary, each system of the MOLAB is graded by its design excellence factor, item importance factor, system importance factor and redundancy factor. The equation for the system grading would be

$$Gs = \left(\frac{\sum_{i=1}^{n} Ef_i \, If_i}{n} \right) Sf \quad Rf$$

G_s = System Grade

E_f = Design Excellence Grade Factor

I_f = Item Importance Factor

n = Number of Items

S_f = System Importance Factor

R_f = Redundancy Factor

Grade Factor Values:

A Item Importance Factor:

The item importance factor applies to each item listed and is chosen by the evaluator and represents his assessment of the relative importance of each item to the system being evaluated.

2 = Least Important
4 = Less Important
6 = Important
8 = More Important
10 = Very Important

B Grade Factor:

The grade factors are chosen by the evaluator and represent his assessment of the design excellence of each item.

0 = Item is not included in the concept = No Grade.
1 = Poor
2 = Fair
3 = Good
4 = Very Good
5 = Excellent

C System Importance Factor

The system importance factor is applied to each system and is used as a multiplier. To the system Grade. The system importance factor chosen depends upon the evaluators judgement of the MOLAB mission impairment, expressed in percent, if that system became inoperative. This establishes the relative importance of the system to other MOLAB systems and provides a multiplier for equalization of the system grades based on system importance.

D Redundant Factor:

The redundant factor is applied to each system of the MOLAB and represents the evaluators judgement of the amount of redundancy a particular system contains.

1.0 = System has no redundancy.
1.10 = System has redundant characteristics*
1.25 = System has designed critical redundancy.
1.50 = System has full designed redundancy.

* Redundant characteristics means that the system has redundant capabilities by nature of its design but not planned as such, i.e., the mobility system may have traction motors in each wheel, if one malfunctioned the other three could provide mobility.

SYSTEM RATING SHEET

PAGE Nº. ____

REDUNDANT FACTOR

IMPORTANCE FACTOR

ITEM	ITEM DESCRIPTION	ASSESSMENT METHOD	ITEM FACTOR	GRADE FACTOR	GRADE
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

GRADE TOTAL: ____

GRADE=(GRADE TOTAL)÷(Nº. OF ITEMS): ____

(GRADE)×(REDUNDANT FACTOR×IMPORTANCE FACTOR): ____

FIGURE 1

The form to be used for the system matrix is shown as a blank form in Figure 1. The name of the system is to be shown on the dashed line at the top of the page. The system importance factor will appear in the block in the upper right hand corner of the form. The redundant factor will be entered in the block just above the importance factor. The system items will be listed in the item description blocks. The assessment method blocks will show the source of the data used for evaluation of the item. Enter the item factor determined for the item in the item factor block. Enter the grade factor determination in the grade factor block. Multiply the item factor by the grade factor and enter the product in the grade block. Add the grades of the items and enter the sum in in the grade total line in the lower right hand corner of the form. Divide the grade total by the number of items graded and enter in next lower line. Multiply this line by the product of the importance factor X the redundant factor and enter on the next lower line. This represents the system grade. A complete set of MOLAB system forms with suggested items, filled in is included elsewhere in this report.

3.2 CONCEPT RATING CRITERIA

There are many aspects of the completely assembled and integrated concept which require evaluation. These parameters in general, are: performance, reliability, integration, weight and cost. Forms are provided for this evaluation matrix, a blank form is shown in Figure 2. This form is similar to the forms for systems except for the system importance factor and the redundancy factor blocks, these factors are not applicable for a concept evaluation. The blocks for item description, assessment method, item factor, grade factor and grade are the same and use the same factors as used for the system grading sheet shown on Figure 1. The sum of the item grades is divided by the number of items to obtain the concept grade.

A complete set of MOLAB concept evaluation forms with suggested items filled in is included elsewhere in this report.

3.3 SYSTEM SUMMARY

A system summary sheet (Figure 3) has been provided for entering the scores and pertinent data taken from the system rating sheet (Figure 1) and the concept rating sheet (Figure 2). The sum of these ratings is the concept comparison rating and can be used to select a design concept.

CONCEPT RATING SHEET

PAGE Nº. ____

_____

ITEM	ITEM DESCRIPTION	ASSESSMENT METHOD	ITEM FACTOR	GRADE FACTOR	ITEM GRADE
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

ITEM GRADE TOTAL: _____

GRADE = (GRADE TOTAL) ÷ (Nº OF ITEMS): _____

FIGURE 2

SYSTEM SUMMARY SHEET

PAGE No. ____

ITEM	SYSTEM	IMPORT. FACTOR	GRADE TOTAL	RATING
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

CONCEPT COMPARISON RATING: _____

FIGURE 3

SECTION 4.0

CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

A matrix of approximately 500 technical items has been assembled for the evaluation of the various systems including items of the operational MOLAB. An attempt was made to keep these items as general in nature as possible, in some instances this was not considered adequate to properly evaluate the system, in those cases the items are of a more specific nature.

The systems breakdown follows the "MOLAB Payload Mass Format" with the exception of the "cabin System" which begins with 1.2 for the "Structural Subsystem", this matrix lists this subsystem 1.1. The subsequent subsystems are all one digit less for the "Cabin System". All of the other systems are per the mass format numbering system.

This matrix does not endeavor to cover every parameter of each system but does endeavor to cover some of the major technical parameters of each system. The matrix as presented herein along with the method of grading and represents a system which will accomplish a general evaluation of the MOLAB and the systems which make up the MOLAB.

4.2 RECOMMENDATIONS

It is recommended that the various system groups evaluate the systems of the concept studies for which they are responsible. These groups have the technical background necessary to intelligently make an evaluation. This will eliminate some of the prejudices which would exist if one person attempted to evaluate all of the systems.

The matrix herein which was generated for this task should be upgraded and expanded as system requirements and operational environments become better defined. The more parameters that are analyzed the more accurate an evaluation becomes.

SYSTEM RATING SHEET

1.1

PAGE Nº. ____

CABIN SYSTEM - STRUCTURAL

REDUNDANT FACTOR

IMPORTANCE FACTOR

ITEM	ITEM DESCRIPTION	ASSESSMENT METHOD	ITEM FACTOR	GRADE FACTOR	GRADE
1	Cabin Structure Simplicity Assessment				
2	Structure Load Path Simplicity Assessment				
3	Structure Rigidity Assessment				
4	Pressure Vessel Shape Efficiency Assessment				
5	Pressure Vessel Shock Load Efficiency Assessment				
6	Cabin Thermal Insulation Efficiency Assessment				
7	Cabin Micro-Meteoroid Penetration Efficiency Assessment				
8	Cabin Volume Adequacy Assessment				
9	Floor to Ceiling Height Adequacy Assessment				
10	Cabin Materials Compatibility with Lunar Environment				
11	Cabin Structural Attachments Thermal Isolation Efficiency Assessment				
12	Cabin Equipment Appendages Thermal Isolation Efficiency Assessment				
13	Minimum Press. Vessel Penetrations Required Assessment				
14	Cabin Weight/Unit Volume Efficiency Assessment				
15	Cabins Ability to perform during Stowage Deployment, Dormant & Operation Phases Assessment				
16	Development Risk Assessment				
17	Total Power Requirement Assessment				
18	Weight Assessment				
19	Cost Assessment				
20					

GRADE TOTAL: ____

GRADE = (GRADE TOTAL) ÷ (Nº. OF ITEMS): ____

(GRADE) × (REDUNDANT FACTOR × IMPORTANCE FACTOR): ____

SYSTEM RATING SHEET

1.2

PAGE Nº. ____

CABIN SYSTEM - AIR LOCK

REDUNDANT FACTOR

IMPORTANCE FACTOR

ITEM	ITEM DESCRIPTION	ASSESSMENT METHOD	ITEM FACTOR	GRADE FACTOR	GRADE
1	Airlock Structure Simplicity Assessment				
2	Structure Load Path Simplicity Assessment				
3	Airlock Volume Adequacy Assessment				
4	Floor to ceiling height adequacy Assessment				
5	Outer door design simplicity Assessment				
6	Outer Door seal simplicity Assessment				
7	Outer Door Locking Adequacy Assessment				
8	Inner Door Design Simplicity Assessment				
9	Inner Door Seal Simplicity Assessment				
10	Inner Door Locking Adequacy Assessment				
11	Airlock/Cabin Volume Utilization Efficency Assessment				
12	Pumping Power Requirement Assessment				
13	Pumping Equipment Weight Assessment				
14	Materials Compatibility with Lunar Environment				
15	Ability to Perform Entire Mission Assessment				
16	Development Risk Assessment				
17	Thermial Isolation Effectiveness				
18	Total Power Requirement Assessment				
19	Weight Assessment				
20	Cost Assessment				

GRADE TOTAL: ____

GRADE = (GRADE TOTAL) ÷ (Nº. OF ITEMS): ____

(GRADE) × (REDUNDANT FACTOR × IMPORTANCE FACTOR): ____

SYSTEM RATING SHEET

1.3

PAGE Nº. _ _ _

CABIN SYSTEM - DOCKING ADAPTER _ _

REDUNDANT FACTOR

IMPORTANCE FACTOR

ITEM	ITEM DESCRIPTION	ASSESSMENT METHOD	ITEM FACTOR	GRADE FACTOR	GRADE
1	Structure Simplicity				
2	Structure Load Path Simplicity				
3	Internal Volume Utilization Efficency				
4	Hatch Design Simplicity				
5	Hatch Seal Adequacy				
6	Emergency Exit Capability (Space Suit)				
7	CM Access To IMU Adequacy				
8	CM Access To MOLAB Adequacy				
9	Ability To Perform Entire Mission				
10	Thermal Isolation Effectiveness				
11	Development Risk Assessment				
12	Materials Compatibility with Lunar Environment				
13	Weight Assessment				
14	Cost Assessment				
15	Total Power Requirement Assessment				
16					
17					
18					
19					
20					

GRADE TOTAL: _ _ _ _

GRADE = (GRADE TOTAL) ÷ (Nº. OF ITEMS): _ _ _ _

(GRADE) × (REDUNDANT FACTOR × IMPORTANCE FACTOR): _ _ _ _

SYSTEM RATING SHEET

1.4

CABIN SYSTEM - VIEWING PORTS

REDUNDANT FACTOR

IMPORTANCE FACTOR

ITEM	ITEM DESCRIPTION	ASSESSMENT METHOD	ITEM FACTOR	GRADE FACTOR	GRADE
1	Structure Simplicity				
2	Structure Load Path Simplicity				
3	Field Of Vision Adequacy				
4	Port Area/Field of Vision Ratio				
5	Port Mounting Thermal Isolation Adequacy				
6	Port Micro-Meteoroid Protection Adequacy				
7	Radiation Stability of Port Materials				
8	Redundancy In Multiple Ports				
9	Redundancy In Other Optical Methods				
10	Materials Compatibility With Lunar Environment				
11	Development Risk Assessment				
12	Ability To Perform Entire Missions				
13	Port Electromagnetic Transmission Characteristics.				
14	Port Brightness Control Characteristics				
15	Port Seal Adequacy				
16	Weight Assessment				
17	Cost Assessment				
18	Total Power Requirement Assessment				
19					
20					

GRADE TOTAL: ____

GRADE = (GRADE TOTAL) ÷ (Nº. OF ITEMS): ____

(GRADE) × (REDUNDANT FACTOR × IMPORTANCE FACTOR): ____

SYSTEM RATING SHEET

1.5

PAGE Nº. ____

CABIN SYSTEM - CONTROLS & DISPLAY

REDUNDANT FACTOR

IMPORTANCE FACTOR

ITEM	ITEM DESCRIPTION	ASSESSMENT METHOD	ITEM FACTOR	GRADE FACTOR	GRADE
1	Controls Arrangement, Simplicity				
2	Controls Arrangement, Convenience				
3	Space Suit Operation Compatibility				
4	Controls Identification Ease Assessment				
5	Dual Operation Capability Assessment				
6	Control Operational Room Assessment				
7	Automatic Control Capability Adequacy				
8	Automatic Overide Capability				
9	Displays/View Port Relation Assessment				
10	Displays Arrangement Organization				
11	Display Illumination Controllability Assessment				
12	Display Eye Accommodation Assessment				
13	Display/Controls Relation Assessment				
14	Display, Malfunction Alarm Capability				
15	Materials Compatibility With Lunar Environment				
16	Total Power Requirement Assessment				
17	Weight Assessment				
18	Cost Assessment				
19					
20					

GRADE TOTAL: ____

GRADE = (GRADE TOTAL) ÷ (Nº. OF ITEMS): ____

(GRADE) × (REDUNDANT FACTOR × IMPORTANCE FACTOR): ____

SYSTEM RATING SHEET

1.6

PAGE Nº. ____

CABIN SYSTEM - CREW SYSTEMS ____

REDUNDANT FACTOR

IMPORTANCE FACTOR

ITEM	ITEM DESCRIPTION	ASSESSMENT METHOD	ITEM FACTOR	GRADE FACTOR	GRADE
1	Recumbent Sleeping Position (S) Adequacy				
2	Erect Standing Position Adequacy				
3	Gymnastic Equipment Adequacy				
4	Personel Hygiene Facilities Adequacy				
5	Toilet Adequacy Assessment				
6	Waste Disposal, Human & Non-Human Adequacy				
7	Food, Water & Preparation Adequacy				
8	Medical Instru & Literature Adequacy				
9	Medical Supplies & Drugs Adequacy				
10	Interior Lighting Adequacy (All Ta sks)				
11	Interior Thermal Control Adequacy				
12	Atmospheric Constituants Cont. Adequacy				
13	Auditory Noise Level Control Adequacy				
14	Materials Compatibility With Lunar Environment				
15	Ability To Perform Entire Mission				
16	Development Risk Assessment				
17	Weight Assessment				
18	Cost Assessment				
19	Total Power Requirement Assessment				
20					

GRADE TOTAL: ____

GRADE=(GRADE TOTAL)÷(Nº. OF ITEMS): ____

(GRADE)×(REDUNDANT FACTOR×IMPORTANCE FACTOR): ____

SYSTEM RATING SHEET

1.7

PAGE Nº. ____

CABIN SYSTEM - ENVIRONMENTAL CONTROL SYS.

REDUNDANT FACTOR

IMPORTANCE FACTOR

ITEM	ITEM DESCRIPTION	ASSESSMENT METHOD	ITEM FACTOR	GRADE FACTOR	GRADE
1	Capability Of Maintaining O_2 (Essentially Pure) Atmosphere of 5.0 PSIA				
2	Capability of Maintaining 3.5 PSIA for Emergency Assessment				
3	Cabability of Making Up O_2 Lost By 56 Airlock Cycles / Mission				
4	Odor & Noxious Gas Removal Adequacy				
5	Caribon Dioxide Removal Adequacy				
6	Internal Thermal Control Capacity				
7	Equip. Thermal Control Adequacy				
8	Humidity Control Adequacy				
9	Emergency Capability Adequacy				
10	Back Pack Re-Fill Capability				
11	Interior & Exterior Suit Umbilical Adequacy				
12	Suit Thermal Control Capability				
13	Servicing ECS Simplicity				
14	Materials Compatibility with Lunar Environment				
15	Ability to Perform Entire Mission				
16	Development Risk Assessment				
17	Heat Rejection Capability (Lunar Noon)				
18	Weight Assessment				
19	Cost Assessment				
20	Total Power Requirement Assessment				

GRADE TOTAL: ____

GRADE = (GRADE TOTAL) ÷ (Nº. OF ITEMS): ____

(GRADE) × (REDUNDANT FACTOR × IMPORTANCE FACTOR): ____

SYSTEM RATING SHEET

2.1

PAGE Nº. ____

MOBILITY SYSTEM - CHASSIS

REDUNDANT FACTOR

IMPORTANCE FACTOR

ITEM	ITEM DESCRIPTION	ASSESSMENT METHOD	ITEM FACTOR	GRADE FACTOR	GRADE
1	Structural Simplicity Assessment				
2	Load Path Simplicity Assessment				
3	Structure Rigidity Assessment				
4	Adequate Chassis / Cabin Thermal Isolation Assessment				
5	Cabin Supports Simplicty Assessment				
6	Tiedown Support Hard Point Provisions Adequacy				
7	Equipment Support Hard Point Provisions Adequacy				
8	Suspension System Mounting Hard Point Provisions Adequacy				
9	Load Handling Capability, For All Mission Phases Loads, Adequacy				
10	Compatibility of Materials With Lunar Environment				
11	Ability to Perform Entire Mission				
12	Development Risk Assessment				
13	Weight Assessment				
14	Cost Assessment				
15	Total Power Requirement Assessment				
16					
17					
18					
19					
20					

GRADE TOTAL: ____

GRADE = (GRADE TOTAL) ÷ (Nº. OF ITEMS): ____

(GRADE) × (REDUNDANT FACTOR × IMPORTANCE FACTOR): ____

SYSTEM RATING SHEET

2.2

PAGE Nº. ____

MOBILITY SYSTEM - CRYOGENIC STORAGE

REDUNDANT FACTOR

IMPORTANCE FACTOR

ITEM	ITEM DESCRIPTION	ASSESSMENT METHOD	ITEM FACTOR	GRADE FACTOR	GRADE
1	Optimum Tank Isulation Provision For 180 Days Dormant + 14 Days Operational				
2	Vacuum Jacket Provisions Adequacy				
3	Optimum Storage Pressure Capability				
4	Optimum Vent Pressure Capability				
5	Tank Mounting Structure Adequacy				
6	Micro-Meteoroid Protection Adequacy				
7	Tank Refill & Topping Provisions				
8	Plumbing & Control Sys. Adequacy				
9	Service & Repair Accessability				
10	Activation & Deactivation Capability				
11	Materials Compatibility with Lunar Environment				
12	Ability to Perform Entire Mission				
13	Development Risk Assessment				
14	Weight Assessment				
15	Cost Assessment				
16	Total Power Requirement Assessment				
17					
18					
19					
20					

GRADE TOTAL: ____

GRADE=(GRADE TOTAL)÷(Nº. OF ITEMS): ____

(GRADE)×(REDUNDANT FACTOR×IMPORTANCE FACTOR): ____

SYSTEM RATING SHEET

2.3

PAGE Nº. ____

MOBILITY SYSTEM - DRIVE MECHANISM

REDUNDANT FACTOR

IMPORTANCE FACTOR

ITEM	ITEM DESCRIPTION	ASSESSMENT METHOD	ITEM FACTOR	GRADE FACTOR	GRADE
1	Optimum HP/RPM Ratio 14 Day Mission				
2	Optimum Gear Reduction Efficency				
3	Minimum No. Mechanical Active Seals				
4	Optimum Vehicle Propulsion Efficency				
5	Optimum Power Conditioning for Efficent Speed Control				
6	Heat Rejection Adequacy				
7	Cold Operational Provisions Adequacy				
8	Lubrication Provisions Adequacy				
9	Vacuum Operational Adequacy				
10	Fail Safe Provisions Adequacy				
11	Materials Compatibility With Lunar Environment				
12	Ability to Perform Entire Mission				
13	Development Risk Assessment				
14	WT/HP Ratio Of Drive Mechanism				
15	Weight Assessment				
16	Cost Assessment				
17	Total Power Requirement Assessment				
18					
19					
20					

GRADE TOTAL: ____

GRADE = (GRADE TOTAL) ÷ (Nº. OF ITEMS): ____

(GRADE) × (REDUNDANT FACTOR × IMPORTANCE FACTOR): ____

SYSTEM RATING SHEET

2.4

PAGE Nº. ____

MOBILITY SYSTEM - WHEEL ASS'Y ____

REDUNDANT FACTOR

IMPORTANCE FACTOR

ITEM	ITEM DESCRIPTION	ASSESSMENT METHOD	ITEM FACTOR	GRADE FACTOR	GRADE
1	Wheel Diameter Suitability				
2	Effective Wheel Dia. Adequacy				
3	Wheel Rolling Radius Suitability				
4	Torsional Rigidity Adequacy				
5	Lateral Rigidity Adequacy				
6	Wheel Spring Rate Suitability				
7	Optimum Tread Width				
8	Foot Print Area Adequacy, Hard Surface				
9	Wearing Surface Adequacy for Mission				
10	Materials Compatibility with Lunar Environment				
11	Ability to Perform Entire Mission				
12	Floatation Characteristics on Weak Soils				
13	Development Risk Assessment				
14	Weight Assessment				
15	Cost Assessment				
16	Total Power Requirement Assessment				
17					
18					
19					
20					

GRADE TOTAL: ____

GRADE = (GRADE TOTAL) ÷ (Nº. OF ITEMS): ____

(GRADE) × (REDUNDANT FACTOR × IMPORTANCE FACTOR): ____

SYSTEM RATING SHEET

2.5

PAGE Nº. ____

MOBILITY SYSTEM - SUSPENSION ASS'Y

REDUNDANT FACTOR

IMPORTANCE FACTOR

ITEM	ITEM DESCRIPTION	ASSESSMENT METHOD	ITEM FACTOR	GRADE FACTOR	GRADE
1	Linkage Geometry Assessment				
2	Spring Rate Assessment				
3	Spring Efficency Assessment				
4	Dampening Characteristics Assessment				
5	Alignment Adequacy Assessment				
6	Design Simplicity Assessment				
7	Fail Safe Characteristics Assessment				
8	Materials Compatibility With Lunar Environment				
9	Development Risk Assessment				
10	Weight Assessment				
11	Cost Assessment				
12	Total Power Requirement Assessment				
13	Suspension Reliability Assessment				
14					
15					
16					
17					
18					
19					
20					

GRADE TOTAL: ____

GRADE = (GRADE TOTAL) ÷ (Nº. OF ITEMS): ____

(GRADE) × (REDUNDANT FACTOR × IMPORTANCE FACTOR): ____

SYSTEM RATING SHEET

3.1

PAGE Nº. ____

POWER SYSTEM - PRIMARY POWER ___

REDUNDANT FACTOR

IMPORTANCE FACTOR

ITEM	ITEM DESCRIPTION	ASSESSMENT METHOD	ITEM FACTOR	GRADE FACTOR	GRADE
1	Power Source Reliability Assessment				
2	Powersource Efficency Assessment				
3	Power Source Simplicity				
4	Usable Water Production Capability				
5	Operation Capability in Lunar Environment				
6	Compatibility with Other Systems				
7	Efficent Throttling Characteristics				
8	Inertial Effect on Molab Assessment				
9	Min. Conversion Phases from Fuel to Power				
10	Min. Power Conditioning Requirements				
11	Materials Compatibility with Lunar Environment				
12	Development Risk Assessment				
13	Weight Assessment				
14	Cost Assessment				
15	Activation Cycling Assessment				
16	Total Power Requirements for Cell Oper. & Maint. Assessment				
17					
18					
19					
20					

GRADE TOTAL: ____

GRADE=(GRADE TOTAL)÷(Nº. OF ITEMS): ____

(GRADE)×(REDUNDANT FACTOR×IMPORTANCE FACTOR): ____

SYSTEM RATING SHEET

3.2

PAGE Nº. _ _ _

POWER SYSTEM - SECONDARY POWER _ _

REDUNDANT FACTOR

IMPORTANCE FACTOR

ITEM	ITEM DESCRIPTION	ASSESSMENT METHOD	ITEM FACTOR	GRADE FACTOR	GRADE
1	Power Source Reliability Assessment				
2	Power Source Efficency Assessment				
3	Power Source simplicity				
4	Operational Capability in Lunar Environ.				
5	Compatibility with Other Systems				
6	Efficent Throttling Characteristics				
7	Inertial Effect on Molab Assessment				
8	Min. Conversion Phases from Fuel to Power				
9	Min. Power Conditioning Requirements				
10	Materials Compatibility with Lunar Environment				
11	Development Risk Assessment				
12	Weight Assessment				
13	Cost Assessment				
14	Activation Cycling Assessment				
15	Total Power Requirement for sys. Oper. and Maint. Assessment.				
16					
17					
18					
19					
20					

GRADE TOTAL: _ _ _ _

GRADE=(GRADE TOTAL)÷(Nº. OF ITEMS): _ _ _ _

(GRADE)×(REDUNDANT FACTOR×IMPORTANCE FACTOR): _ _ _ _

SYSTEM RATING SHEET

3.3

PAGE Nº. ____

POWER SYSTEM - AUXILIARY POWER ___

REDUNDANT FACTOR

IMPORTANCE FACTOR

ITEM	ITEM DESCRIPTION	ASSESSMENT METHOD	ITEM FACTOR	GRADE FACTOR	GRADE
1	Power Source Reliability Assessment				
2	Power Source Efficency Assessment				
3	Power Source Simplicity Assessment				
4	Operational Capability in Lunar Environment				
5	Compatibility with Other Systems				
6	Efficent Throttling Characteristics				
7	Inertial Effects on MOLAB Assessment				
8	Min. Conversion Phases from Fuel to Power				
9	Min. Power Conditioning Requirements				
10	Materials Compatibility with Lunar Environment				
11	Activation Cycling Assessment				
12	Development Risk Assessment				
13	Weight Assessment				
14	Cost Assessment				
15	Total Power Requirement for Sys. Oper. and Maint. Assessment				
16					
17					
18					
19					
20					

GRADE TOTAL: ____

GRADE = (GRADE TOTAL) ÷ (Nº. OF ITEMS): ____

(GRADE) × (REDUNDANT FACTOR × IMPORTANCE FACTOR): ____

SYSTEM RATING SHEET

3.4

PAGE Nº. ____

POWER SYSTEM- POWER DISTRIBUTION

REDUNDANT FACTOR

IMPORTANCE FACTOR

ITEM	ITEM DESCRIPTION	ASSESSMENT METHOD	ITEM FACTOR	GRADE FACTOR	GRADE
1	Distribution Reliability Assessment				
2	System Efficency Assessment				
3	System Simplicity Assessment				
4	Operational Capability in Lunar Environment				
5	Compatibility with Other Systems				
6	Conversion Equip. Reliability Assessment				
7	Conversion Equip. Efficency. Assessment				
8	Control Equip. Reliability Assessment				
9	Control Equip. Efficency Assessment				
10	Operational Degradation Assessment				
11	Service & Repairability Assessment				
12	Development Risk Assessment				
13	Weight Assessment				
14	Cost Assessment				
15	Total Power Requirement for Sys. Supervision & Maint. Assessment				
16					
17					
18					
19					
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GRADE TOTAL: ____

GRADE=(GRADE TOTAL)÷(Nº. OF ITEMS): ____

(GRADE)×(REDUNDANT FACTOR×IMPORTANCE FACTOR): ____

SYSTEM RATING SHEET

3.5

PAGE Nº. ____

POWER SYSTEM - HEAT DISSIPATION ___

REDUNDANT FACTOR

IMPORTANCE FACTOR

ITEM	ITEM DESCRIPTION	ASSESSMENT METHOD	ITEM FACTOR	GRADE FACTOR	GRADE
1	System Reliability Assessment				
2	Emissivity Efficency, Lunar Noon				
3	System Efficency Assessment				
4	System Simplicity Assessment				
5	System Adequacy for Entire Mission				
6	Compatability with Other Systems Assessment				
7	Pumping Equipment Adequacy				
8	Control Equipment Adequacy				
9	Development Risk Assessment				
10	Meteoroid Damage Assessment				
11	Weight Assessment				
12	Cost Assessment				
13	Total Power Requirement Assessment				
14					
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GRADE TOTAL: ____

GRADE = (GRADE TOTAL) ÷ (Nº. OF ITEMS): ____

(GRADE) × (REDUNDANT FACTOR × IMPORTANCE FACTOR): ____

SYSTEM RATING SHEET

4.1

PAGE Nº. ____

ASTRIONICS SYSTEM-NAVIGATION & GUIDANCE

REDUNDANT FACTOR

IMPORTANCE FACTOR

ITEM	ITEM DESCRIPTION	ASSESSMENT METHOD	ITEM FACTOR	GRADE FACTOR	GRADE
1	Remote Operation Mode (Unmanned) Accuracy Assessment (Unloading)				
2	Remote operation mode (Unmanned) Accuracy Assessment (Lunar Traveres)				
3	Manned Operation Mode, Circle of Error, Probable Position Determination Error				
4	Odometer, Sensor Accuracy				
5	Vehicle Attitude Sensor Accuracy				
6	Gyro Azimuth Sensor Accuracy				
7	Speedometer Sensor Accuracy				
8	Astro-Sextant Adequacy				
9	Optical Transit Adequacy				
10	Guidance Computer Adequacy				
11	Guidance Controller Adequacy				
12	System Reliability Assessment				
13	Compatibility with other Systems				
14	Service & Repairability Assessment				
15	Materials Compatibility with Lunar Environment				
16	Development Risk Assessment				
17	Weight Assessment				
18	Cost Assessment				
19	Total Power Requirement Assessment				
20					

GRADE TOTAL: ____

GRADE = (GRADE TOTAL) ÷ (Nº. OF ITEMS): ____

(GRADE) × (REDUNDANT. FACTOR × IMPORTANCE FACTOR): ____

SYSTEM RATING SHEET

4.2

PAGE Nº. ____

ASTRIONICS SYSTEM - COMMUNICATIONS _ REDUNDANT FACTOR

IMPORTANCE FACTOR

ITEM	ITEM DESCRIPTION	ASSESSMENT METHOD	ITEM FACTOR	GRADE FACTOR	GRADE
1	UHF Transm. To DSIF & Apollo Net During Operation, Capability Assessment				
2	UHF Command Capability During Dormant Period, Capability Assessment				
3	UHF Transmission (Telem) During Dormant Period, Capability Assessment				
4	UHF & VHF Video Transmission During Dormant & Manned Phases Assessment				
5	Comm. System Compatability with RFI & EMI, Assessment				
6	Homing Capability Assessment				
7	Comm. System/ Astronaut interface Compatibility Assessment				
8	St'd Electronic Packaging Adequacy Assessment				
9	Service & Maintainability Assessment				
10	Materials Compatibility with Space				
11	Development Risk Assessment				
12	Weight Assessment				
13	Cost Assessment				
14	Total Power Requirement Assessment				
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GRADE TOTAL: ____

GRADE = (GRADE TOTAL) ÷ (Nº. OF ITEMS): ____

(GRADE) × (REDUNDANT FACTOR × IMPORTANCE FACTOR): ____

SYSTEM RATING SHEET

4.3

PAGE Nº. ____

ASTRIONICS SYSTEM - ELECTRONICS ___

REDUNDANT FACTOR

IMPORTANCE FACTOR

ITEM	ITEM DESCRIPTION	ASSESSMENT METHOD	ITEM FACTOR	GRADE FACTOR	GRADE
1	Automatic Checkout sys. Electronics Assessment				
2	Auto. Checkout sys. Capability Assessment				
3	Auto. Checkout sys. instrumentation Adequacy Assessment				
4	Leak Detection Sys. (Cabin) Electronics Adequacy Assessment				
5	Development Risk Assessment				
6	Total Power Requirement Assessment				
7	Weight Assessment				
8	Cost Assessment				
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GRADE TOTAL: ____

GRADE=(GRADE TOTAL)÷(Nº. OF ITEMS): ____

(GRADE)×(REDUNDANT FACTOR×IMPORTANCE FACTOR): ____

SYSTEM RATING SHEET

4.4

PAGE Nº. ____

ASTRIONICS SYSTEM-COMMAND & CONTROL

REDUNDANT FACTOR

IMPORTANCE FACTOR

ITEM	ITEM DESCRIPTION	ASSESSMENT METHOD	ITEM FACTOR	GRADE FACTOR	GRADE
1	Command Functions Adequacy				
2	Functions Verification Assessment				
3	Command Status Functions Monitoring Adequacy				
4	Command-Verification time Lag Penalty Assessment				
5	Antenna Remote Control Adequacy Assessment				
6	Development Risk Assessment				
7	Total Power Requirement Assessment				
8	Weight Assessment				
9	Cost Assessment				
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GRADE TOTAL: ____

GRADE = (GRADE TOTAL) ÷ (Nº. OF ITEMS): ____

(GRADE) × (REDUNDANT FACTOR × IMPORTANCE FACTOR): ____

SYSTEM RATING SHEET

5.1

PAGE Nº. ____

SCIENTIFIC EQUIP. - ESS EQUIPMENT ___

REDUNDANT FACTOR

IMPORTANCE FACTOR

ITEM	ITEM DESCRIPTION	ASSESSMENT METHOD	ITEM FACTOR	GRADE FACTOR	GRADE
1	Tidal Gravimeter Adequacy				
2	Quake Seismometer Adequacy				
3	Star Tracker Adequacy				
4	Lunar Ejecta Spectrometer Adequacy				
5	Solar Plasma Spectrometer Adequacy				
6	Magnetometer Adequacy				
7	Charged Particle Spectrometer Adequacy				
8	Gama Ray Detector Adequacy				
9	Neutron Phoswich Detector Adequacy				
10	Atmosphere Mass Spectrometer Adequacy				
11	Total Gas Press. Gauge Adequacy				
12	Charged Dust Spectrometer Adequacy				
13	Lunar Atmosphereic Hydrogen, Lyman-Alpha Detector Adequacy				
14	Permanent Thermal Probe Adequacy				
15	Telecommunications Sys. Adequacy				
16	Power Supply Adequacy				
17	Antenna Adequacy				
18	Materials Compatibility with Lunar Environment Assessment				
19	Weight Assessment				
20	Cost Assessment				

GRADE TOTAL: ____

GRADE=(GRADE TOTAL)÷(Nº. OF ITEMS): ____

(GRADE)×(REDUNDANT FACTOR×IMPORTANCE FACTOR): ____

SYSTEM RATING SHEET

5.2

SCIENTIFIC EQUIP.-INSTRUMENTS-FIXED VEHICLE

REDUNDANT FACTOR

IMPORTANCE FACTOR

ITEM	ITEM DESCRIPTION	ASSESSMENT METHOD	ITEM FACTOR	GRADE FACTOR	GRADE
1	T. V. Camera Coverage Adequacy				
2	Theodolite Location Adequacy				
3	Gravimeter Operational Adequacy				
4	Seismic Survey Instrumentation Adequacy				
5	Magnetometer, Boom Mt. Adequacy				
6	Interferometer Operational Adequacy				
7	Mass Spectrometer (Solids) Adequacy				
8	X-Ray Diffractometer Oper. Adequacy				
9	Drill (6.1 M. Depth) Mounting Adequacy				
10	Drill (30.5M. Depth) Mounting Adequacy				
11	Sample Collection & Preservation Assessment				
12	Spectrometer Refraction Grating Type Operational Adequacy				
13	Ejecta Detector Assessment				
14	Lunar Environment Exposure Panel Assessment				
15	Total Radiation Dosimeter Assessment				
16	Total Power Requirement Assessment				
17					
18					
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GRADE TOTAL: ____

GRADE=(GRADE TOTAL)÷(Nº. OF ITEMS): ____

(GRADE)×(REDUNDANT FACTOR×IMPORTANCE FACTOR): ____

SYSTEM RATING SHEET

5.3

PAGE Nº. _____

SCIENTIFIC EQUIP. - INSTRUMENTS, PORTABLE

REDUNDANT FACTOR

IMPORTANCE FACTOR

ITEM	ITEM DESCRIPTION	ASSESSMENT METHOD	ITEM FACTOR	GRADE FACTOR	GRADE
1	T.V. Camera Operational Assessment				
2	Theodolite Operational Assessment				
3	Electric Field Meter Assessment				
4	Charged Dust Spectrometer Assessment				
5	Temperature Profile, Thermal Conductivity & Diffusivity Instruments Adequacy				
6	Gamma-Ray Densitometer Assessment				
7	Electrical Measurement Instru. Adequacy				
8	Acoustic Velocity Instru.				
9	Radio Activity Probe, Radio Activity Detector (Alpha; Beta, Gamma) Assessment				
10	Neutron Gamma-Ray Detector Assessment				
11	Alpha Particle Mass Spectrometer Assessment				
12	Gas Chromatograph Oper. Assessment				
13	Geophysical Subsurface Probe Adequacy				
14	Mass Spectrometer, Atmospheric Gas, Assessment				
15	Total Gas Press; Gauge Adequacy				
16	Photographic Cameras Adequacy				
17	Total Power Requirement Assessment				
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GRADE TOTAL: _____

GRADE = (GRADE TOTAL) ÷ (Nº. OF ITEMS): _____

(GRADE) × (REDUNDANT FACTOR × IMPORTANCE FACTOR): _____

SYSTEM RATING SHEET

6.1

PAGE Nº. ____

UNLOADING & TIEDOWN SYS.-SUPPORTS & TIEDOWN

REDUNDANT FACTOR

IMPORTANCE FACTOR

ITEM	ITEM DESCRIPTION	ASSESSMENT METHOD	ITEM FACTOR	GRADE FACTOR	GRADE
1	Chassis Support Structure Adequacy				
2	Chassis Support Load Path Simplicity				
3	Wheel Support Structure Adequacy				
4	Wheel Support Load Path Simplicity				
5	Chassis Support Deployment Adequacy				
6	Chassis Support Reliability Assessment				
7	Chassis Supt. Deployment Shock Assessment				
8	Wheel Support Deployment Adequacy				
9	Wheel Support Reliability Assessment				
10	Wheel Supt. Deployment Shock Assessment				
11	Supt's Deployment at Max. Tilt Assessment				
12	Ordinance Devices Safety Assessment				
13	Materials Compatibility with Lunar Environment				
14	Development Risk Assessment				
15	Weight Assessment				
16	Cost Assessment				
17	Total Power Requirement Assessment				
18					
19					
20					

GRADE TOTAL: ____

GRADE = (GRADE TOTAL) ÷ (Nº. OF ITEMS): ____

(GRADE) × (REDUNDANT FACTOR × IMPORTANCE FACTOR): ____

SYSTEM RATING SHEET

6.2

PAGE Nº. ____

UNLOADING & TIEDOWN SY'S-VARIABLE AZIMUTH DEVICE

REDUNDANT FACTOR

IMPORTANCE FACTOR

ITEM	ITEM DESCRIPTION	ASSESSMENT METHOD	ITEM FACTOR	GRADE FACTOR	GRADE
1	Loaded Operational Capability Assessment				
2	Selected Azimuth Accuracy Assessment				
3	Structural Simplicity Assessment				
4	Operational Characteristics at Max. Deck Tilt Assessment.				
5	Azimuth Holding Ability Assessment				
6	Azimuth Selection Efficency Assessment				
7	Mechanism Seals Capability Assessment				
8	Materials Compatibility with Lunar Environ.				
9	Development Risk Assessment				
10	Weight Assessment				
11	Cost Assessment				
12	Total Power Requirement Assessment				
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GRADE TOTAL: ____

GRADE = (GRADE TOTAL) ÷ (Nº. OF ITEMS): ____

(GRADE) × (REDUNDANT FACTOR × IMPORTANCE FACTOR): ____

SYSTEM RATING SHEET

6.3

PAGE Nº. ____

UNLOADING & TIEDOWN SYS. - DEPLOYMENT _

REDUNDANT FACTOR

IMPORTANCE FACTOR

ITEM	ITEM DESCRIPTION	ASSESSMENT METHOD	ITEM FACTOR	GRADE FACTOR	GRADE
1	Ramps Extension, Any Azimuth Capability Assessment				
2	Ramps Load Capacity Adequacy Assessment				
3	Ramps Extension at Max. Deck Tilt Angle Capability Assessment				
4	Ramps Lunar Contact Angle Adequacy Assessment				
5	Ramps Extension Dimensional Adequacy				
6	Ramps Retracted Dimensional Adequacy				
7	Manual Unloading Capability Assessment				
8	Remote Command Track Extension Efficency Assessment				
9	MOLAB Unloading LEM-T Clearance Assessment				
10	MOLAB Unloading Nose Clearance Lunar Surface Assessment				
11	Materials Compatability with Lunar Environment				
12	Development Risk Assessment				
13	Stability of MOLAB During Unloading Assessment				
14	Stability of LEM-T During Unloading Assessment				
15	MOLAB unloading Velocity Adequacy Assessment				
16	MOLAB Unloading Velocity control Adequacy Assessment				
17	Weight Assessment				
18.	Cost Assessment				
19	Total Power Requirement Assessment				
20					

GRADE TOTAL: ____

GRADE = (GRADE TOTAL) ÷ (Nº. OF ITEMS): ____

(GRADE) × (REDUNDANT FACTOR × IMPORTANCE FACTOR): ____

SYSTEM RATING SHEET

6.4

UNLOADING & TIEDOWN SYS.-ELECTRONIC EQUIP.

REDUNDANT FACTOR

IMPORTANCE FACTOR

ITEM	ITEM DESCRIPTION	ASSESSMENT METHOD	ITEM FACTOR	GRADE FACTOR	GRADE
1	Unloading Sequence Programmer Adequacy Assessment				
2	Sequence Command Capability Assessment				
3	Sequence Arming Adequacy Assessment				
4	Sequence Command Verification Assessment				
5	T.V. Surface Condition Capability Assessment				
6	Electrical Power Adequacy Assessment				
7	MOLAB Unload Velocity Monitor Adequacy Assessment				
8	Telemetry Verification Monitoring Adequacy Assessment				
9	Materials Compatability with Lunar Environ.				
10	Development Risk Assessment				
11	Weight Assessment				
12	Cost Assessment				
13	Total Power Requirement Assessment				
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GRADE TOTAL: ____

GRADE=(GRADE TOTAL)÷(Nº. OF ITEMS): ____

(GRADE)×(REDUNDANT FACTOR×IMPORTANCE FACTOR): ____

CONCEPT RATING SHEET

MOLAB VEHICLE

ITEM	ITEM DESCRIPTION	ASSESSMENT METHOD	ITEM FACTOR	GRADE FACTOR	ITEM GRADE
1	Cabin Radiation Shielding Adequacy Assessment				
2	Cabin Micro-Meteroroid Protection Adequacy Assessment				
3	Cabin EMI Emissivity Adequacy Assessment				
4	Cabin Leakage Detection System Adequacy Assessment				
5	Cabin To Lunar Surface Access Adequacy Assessment				
6	Docking Guide Adequacy				
7	Docking Instrumentation Adequacy				
8	Docking Securing Adequacy				
9	View Port Locations Adequacy				
10	MOLAB Astronauts Command Post Adequacy				
11	MOLAB Ground Clearence Adequacy				
12	Step Negotiability Assessment				
13	Crevice Negotiability Assessment				
14	Max. Assending Slope Negotiability Assessment				
15	Max. Decending Slope Negotiability Assessment				
16	Negotiability Range of Soil Softness Assessment				
17	Maximun Vehicle Range, Hard Soil, Capability Assessment				
18	Maximun Vehicle Velocity, Hard Soil, Assessment				
19	Braking Adequacy, Dynamic & Static, Assessment				
20	Vehicle Turning Radius Adequacy				

SYSTEM SUMMARY SHEET

PAGE Nº. ____

_ MOLAB VEHICLE _____

ITEM	SYSTEM	IMPORT. FACTOR	GRADE TOTAL	RATING
21	Vehicle Ride Control Adequacy			
22	Vehicle Performance Capabiltiy Assessment for all Mission Phases			
23	Mass Properties Optimizations Assessment			
24	External Equip. Micrometeroid Protection Adequacy			
25	External Equip. Thermal Protection Adequacy			
26	External Storage of Scientific Equip. Adequacy			
27	Maintainability of Externally Mounted Equipment Assessment			
28	MOLAB/Unloader, LEM-T Umbilical Fouling Hazard Assessment			
29	MOLAB/Scientific Equip. Umbilicals Accessability Assessment			
30	MOLAB Outside Astrounaut Umbilical Utilization Assessment			
31	Space Suit Damage from MOLAB Projections. Probability Assessment			
32	Development Risk Assessment			
33	Total Weight Assessment			
34	Total Vehicle System Cost Assessment			
35	Total Vehicle Power Requirements Assessments			
36	MOLAB/LEM-T Integration Adequacy Assessment			
37	MOLAB/Ground Support Equipment Integration Adequacy			
38	MOLAB/Saturn & Apollo CSM Integration Adequacy			
39				
40				

ITEM GRADE TOTAL: _____

GRADE = (GRADE TOTAL ÷ Nº OF ITEMS): _____

SYSTEM SUMMARY SHEET

MOLAB VEHICLE

ITEM	SYSTEM	IMPORT. FACTOR	GRADE TOTAL	RATING
1	Cabin System - Structural (1.1)			
2	Cabin System - Airlock (1.2)			
3	Cabin System - Docking Adapter (1.3)			
4	Cabin System - Viewing Ports (1.4)			
5	Cabin System - Controls & Display (1.5)			
6	Cabin System - Crew Systems (1.6)			
7	Cabin System - Environmental Control Sys. (1.7)			
8	Mobility System - Chassis (2.1)			
9	Mobility System - Cryogenic Storage (2.2)			
10	Mobility System - Drive Mechanism (2.3)			
11	Mobility System - Wheel Assembly (2.4)			
12	Mobility System - Suspension Assy (2.5)			
13	Mobility System - Steering Mechanism (2.6)			
14	Power System - Primary Power (3.1)			
15	Power System - Secondary Power (3.2)			
16	Power System - Auxiliary Power (3.3)			
17	Power System - Power Distribution (3.4)			
18	Power System - Heat Dissipation (3.5)			
19	Astridnics system-Navigation and Guidance (4.1)			
20	Astrionics system-Communication (4.2)			

SYSTEM SUMMARY SHEET

PAGE Nº. ____

ITEM	SYSTEM	IMPORT. FACTOR	GRADE TOTAL	RATING
21	Astrionics System - Electronics (4.3)			
22	Astrionics System - Command & Control (4.4)			
23	Scientific Equip - ESS Equipment (5.1)			
24	Scientific Equip - Instruments, Fixed Vehicle (5.2)			
25	Scientific Equip - Instruments, Portable (5.3)			
26	Unloading & Tiedown systems - Support & Tiedown (6.1)			
27	Unloading & Tiedown Systems - Var. Azimuth Device (6.2)			
28	Unloading & Tiedown Systems -Deployment (6.30			
29	Unloading & Tiedown Systems - Electronic Equipment (6.4)			
30	Concept Rating Sheet Total			
31				
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CONCEPT COMPARISON RATING: _____

DISTRIBUTION

INTERNAL

R-DIR
H. K. Weidner
DEP-T
R-AERO-DIR
-S
-SP (23)
R-ASTR-DIR
-A (13)
R-P&VE-DIR
-A
-AB (15)
-AL (5)
R-RP-DIR
-J (5)
R-FP-DIR
R-FP (2)
R-QUAL-DIR
-J (3)
R-COMP-DIR
R-ME-DIR
-X
R-TEST-DIR
I-DIR
MS-IP
MS-IPL (8)

EXTERNAL

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