PERFORMANCE/DESIGN AND PRODUCT CONFIGURATION REQUIREMENTS

for the

LASER RANGING RETRO-REFLECTOR (300) CREW TRAINING MODEL

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1.0 PURPOSE AND SCOPE

1.1 Purpose - This specification defines the performance, design, construction, and interface requirements for the Crew Training Model of the Laser Ranging Retro-Reflector (LRRR). This model is a mechanical simulation of the LRRR (300) flight configuration incorporating most visual, and all handling and manipulative features and characteristics suitable for training a space-suited astronaut on a simulated lunar surface.

1.2 Scope - This document specifies technical requirements agreed to by the Bendix Corporation and NASA/MSC. Nothing contained in this document shall be deemed to alter the terms of any existing contract or purchase order negotiated between the Bendix Corporation and NASA/MSC.

2.0 APPLICABLE DOCUMENTS

The following documents, of exact issue shown, form a part of this specification to the extent specified herein. Unless otherwise stated, the applicable issue of each document shall be that in effect on 20 July 1970. In the event of conflict between the referenced documents and the content of Sections 3.0, 4.0 and 5.0, the detailed requirements of Sections 3.0, 4.0 and 5.0 shall be considered superseding requirements.

STANDARDS

Military

MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130C	Identification Marking of U.S. Military Property

DRAWINGS

Grumman

LID 360-22830	LM/LRRR Structural Interface (LM Descent Stage) (Quad I, LM-8)

OTHER PUBLICATIONS

NASA

NPC 500-1	Apollo Configuration Management Manual as ammended by MSC Supplement No. 1, Revision B, dated 26 April 1956

3.0 REQUIREMENTS

The LRRR (300) Crew Training Model shall be configured to simulate the flight hardware in terms of most visual, and all the handling and manipulative features required to satisfactorily train a space-suited astronaut on a simulated lunar surface, at 1G. Precise duplication of non-astronaut interface flight model details shall not necessarily be reflected in the LRRR (300) Crew Training Model design.

3.1 Performance - The lightweight LRRR (300) Crew Training Model shall be ballastable to earth weight, be fully deployable, ruggedly constructed, and shall simulate the LRRR (300) flight configuration in most visual, and all astronaut interface mechanical, crew handling, and manipulative features. It shall provide functionally accurate astronaut interfaces. The alignment mechanisms shall provide the exact flight performance characteristics. The retroreflectors will not be incorporated into the LRRR (300) Crew Training Model. The array panel structure and thermal control insulation cover shall be visually simulated. The dust cover, mounting hardware, astronaut carry handle, UHT socket(s), array tilting mechanism and fasteners shall be accurately simulated.

3.2 Reliability - The LRRR (300) Crew Training Model will reliably duplicate the interface between the astronaut and the LRRR (300) flight model and will reliably permit astronaut training for a flight deployment, with reasonable handling care on the part of the user.

3.3 Maintainability - Whenever possible, the design of the LRRR (300)Crew Training Model shall incorporate features to minimize maintenance of components during training. There shall be a minimum number of damage-prone components. Discrete design variations from the flight design will be built into the Crew Training Model to assist the customer (NASA/MSC) in the maintenance and replacement of damage-prone components.

3.3.1 Logistic Support - Logistics spares, as selected by BxA and approved by NASA/MSC, shall be provided to permit maintenance to support failures generated by normal wear and/or normal training performance, only, for a period of nine months.

3.4 Service and Access - Equipment arrangement, accessibility and interchangeability features shall be incorporated into the design to permit efficient servicing and maintenance. LRRR (300) Crew Training Model components with the same part numbers shall be physically and functionally interchangeable.

3.5 Useful Life - The LRRR (300) Crew Training Model shall be designed to be capable of ten deployment cycles without scheduled maintenance, with reasonable handling care by qualified personnel only.

3.6 Natural Environment - The LRRR (300) Crew Training Model shall be capable of being deployed by a space-suited astronaut, during training exercises on a simulated lunar surface, at 1G, and shall be capable of sustaining loads of 1.5G.

3.7 Transportability - Full design recognition shall be given to the durability requirements of the LRRR (300) Crew Training Model relative to its handling before and after training exercises.

3.8 Human Performance - The human factors characteristics of the LRRR (300) flight model design shall be reflected in the design of the LRRR (300) Crew Training Model.

3.9 Safety - The LRRR (300) Crew Training Model design will ensure the safety of the space-suited astronaut while unloading, transporting, and deploying the equipment; it will ensure the safety of support personnel while handling the equipment before, during and after training exercises; and it will be compatible with the safety requirements for LRRR (300) flight equipment.

3.10 Induced Environment - The LRRR (300) Crew Training Model shall not be submerged in water, placed in a vacuum chamber, or used for thermal or stress testing.

3.11 Interface Requirements - The LRRR (300) Crew Training Model shall be capable of installation in and removal from Quadrant I of the LM Descent Stage as defined in LID 360-22830. Tolerance increases to facilitate the design and manufacture of the LRRR (300) Crew Training Model shall be incorporated, as required, only if they cause no change to the LM interface or to crew visual, handling and manipulative features.

3.12 Design and Construction

3.12.1 Design Configuration - The LRRR (300) Crew Training Model shall be constructed by the fabrication and assembly of new components using Class C drawings, and shall visually and manipulatively simulate the LRRR flight design in both the stowed and deployed configurations.

3.12.2 General Design Features

3.12.2.1 Volume - The LRRR (300) Crew Training Model mounting provision configuration, envelope dimensions, and form factor shall be identical to those of the flight model and shall meet the LM interface requirements specified for the flight equipment to be stowed in Quadrant I of the LM Descent Stage as defined in LID 360-22830.

3.12.2.2 Weight - The weight of the LRRR (300) Crew Training Model shall be a maximum of 25 pounds in the unballasted configuration and as close to lunar weight as is structurally practical (consistent with the requirement for repeated Crew Training Model usage), and a maximum of 100 pounds in the ballasted configuration.

3.12.2.3 Center of Gravity - The center of gravity of the ballasted LRRR (300) Crew Training Model shall be within the spherical envelope, +20% and -0%,as defined in LID 360-22830.

3.12.3 Materials, Parts and Processes - Materials, parts and processes used in the LRRR (300) Crew Training Model shall be compatible with the intended usage of this equipment, consistent with the number of deployment cycles specified in paragraph 3.5, and the environmental requirements specified in paragraphs 3.6 and 3.10.

3.12.3.1 Welding - Welding shall be structurally sound and neat in appearance.

3.12.3.2 Protective Treatment - Exposed surfaces which are primed and painted shall be resistant to cracking, chipping, peeling or scaling. Exposed surfaces shall be coated for resistance to corrosion. Colors shall be representative of flight hardware finishes.

3.12.4 Standardization - Maximum economic standardization of parts and components shall be provided. Flight design parts shall be used where applicable. Where identical or similar functions are performed in more than one application with the LRRR (300) Crew Training Model, an effort shall be made to use the same design for all applications.

3.12.5 Moisture and Fungus Resistance - There are no special requirements on this item.

3.12.6 Corrosion of Metal Parts - Metals shall be of a corrosion-resistant type or suitably treated to resist the corrosive conditions likely to be met in storage or in normal service, as defined in paragraphs in paragraphs 3.6 and 3.10.

3.12.7 Interchangeability and Replaceability - See paragraph 3.4.

3.12.8 Workmanship - The LRRR (300) Crew Training Model shall be constructed, finished and assembled in accordance with good commercial practices and procedures.

3.12.9 Electromagnetic Interference - Not applicable.

3.12.10 Identification and Marking - The LRRR (300) Crew Training Model shall be marked for identification in the same manner as the flight hardware.

3.12.10.1 Nameplate Data - Standard Bendix Aerospace System nameplates shall be utilized. Nameplates shall be in the flight unit locations. The nameplate shall include the following data, per MIL-STD-130:

a. Item nomenclature
b. Item part number
c. Item serial number

3.12.11 Storage - A reusable wooden shipping container shall be provided for the LRRR (300) Crew Training Model for protection against deterioration and damage during short periods of storage between training cycles.

3.12.12 Shelf Life - The LRRR (300) Crew Training Model shall have a shelf life of two years, when stored in its packing container, in an environment having an ambient temperature controlled within the range of 50°F to 80°F and a relative humidity less than 50%. This shelf life shall extend from customer acceptance of the unit to just prior to customer use of the LRRR (300) Crew Training Model in the first training exercise.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 Inspection - The following requirements of Section 3.0 of this specification shall be verified and documented by an inspection of the final assembly of the LRRR (300) Crew Training Model at the contractor's plant at the time of NASA acceptance (execution of DD Form 250).

3.1	-Performance (verified by the performance of a 1G, space-suited, functional deployment with the model in the unballasted configuration, in a carpeted area of the contractor's facility - the deployment will not include LRRR (300) removal from a LM model or separation of the LRRR (300) from the GAC subpallet)
3.11	-Interface Requirements
3.12.1	-Design Configuration (verified by a visual inspection)
3.12.2.2	-Weight
3.12.2.3	-Center of Gravity (there is no requirement to determine the center of gravity of the unballasted LRRR (300) Crew Training Model)
3.12.8	-Workmanship
3.12.10	-Identification and Marking

5.0 PREPARATION FOR DELIVERY

The methods of preparing, packaging and shipping the LRRR (300) Crew Training Model shall ensure satisfactory performance of the equipment following shipment and shelf storage in its container, as specified in paragraph 3.12.12. The shipping container shall incorporate a mounting fixture and a three inch clearance between the training unit and the interior surface of the shipping container. Materials and the container used for packaging and shipping shall be in accordance with good commercial packaging. The marking of the package for shipment and storage shall be in accordance with MIL-STD-129.

6.0 NOTES

6.1 Specification Preparation - This specification was prepared in accordance with the format and content requirements of Exhibit II of NPC 500-1 and Appendix A of MSC Supplement No. 1, as appropriate.