news release

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ASTRONAUTS BEGIN FULL-SCALE TRAINING IN APOLLO AND LUNAR MISSION SIMULATORS

Houston: U.S. astronauts will begin full-scale training for the lunar mission in the Apollo and Lunar Mission Simulators which were unveiled here today at the National Aeronautics & Space Administration's Manned Spacecraft Center.

The astronauts will spend hundreds of training hours in simulated flights prior to the first manned flight scheduled for later this year.

The Apollo Mission Simulators (AMS) were built by Link Group, General Precision Systems Inc., under contracts to the Space Division of North American Rockwell Corp. and NASA. The Lunar Mission Simulators (LMS) were made by Link under contract to Grumman Aircraft Engineering Corp. and NASA. Apollo and Lunar Mission Simulators have also been installed at NASA's Cape Kennedy facility.

Link's parent firm, General Precision Systems Inc., is a subsidiary of General Precision Equipment Corp., Tarrytown, N. Y.

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INFORMATION ON
APOLLO MISSION SIMULATOR
&
LUNAR MISSION SIMULATOR

Before the Apollo astronauts leave for their first mission to the moon, they will be old hands at making the trip.

They will have spent hundreds of training hours in simulated flights prior to the mission and will have learned, in detail, all aspects of the mission in the Apollo Mission Simulator (AMS) and the Lunar Mission Simulator (LMS). The AMS simulator was built by Link Group of General Precision Systems Inc. under contracts to the Space Division of North American Rockwell Corporation and NASA, and the LMS to Grumman Aircraft Engineering Corp. and NASA. AMS and LMS complexes each have been installed at NASA's Houston and Cape Kennedy facilities.

The technical challenge of the manned lunar mission has presented the most advanced space undertaking ever attempted. Consequently, the training requirements for the astronauts, who must be familiar with every detail of both the spacecraft and mission, are phenomenal.

The interiors of the AMS and LMS are replicas of the actual spacecraft, containing all panels, controls, switches and equipment. The essential life-support systems are simulated and were designed so that a full 14-day lunar mission could be practiced realistically.

It is possible to simulate the entire mission beginning at T minus 60 seconds and including all phases - launch boost, earth orbit, translunar coast, lunar orbit, descent, lunar stay, ascent, rendezvous, docking, transearth

coast and re-entry. Both visual and acoustical effects are simulated. Simulation is complete except for the sensations of weightlessness and the gravitational forces of launch and re-entry.

In the design of the simulators, Link places great emphasis on the formulation of mathematical models and computer programs to provide rigorous functional simulation of on-board spacecraft systems, the equations of motion, controls and displays as well as visual simulation.

The AMS employs four digital computers which have been integrated into a single complex to provide real-time simulation of all Apollo sub-systems. The LMS employs three computers. Each of the seven computers is capable of performing as many as 500, 000 mathematical operations per second. The Apollo Mission Simulator computer complex contains 208, 000 memory core locations and the Lunar Module Simulator complex, 180, 000. Computer solution rates as high as 20 times per second are provided when required.

Each Link simulator is programmed to provide normal, emergency and abort flight conditions. Over 1, 000 training problems can be inserted into the simulated spacecraft systems with a Malfunction Insert Unit, thus enabling the crew to prepare for nearly every type of emergency situation. The computers also generate telemetry information in actual mission format for transmission to ground station equipment.

Precise computation of trajectories, orbits and re-entry corridors are extremely important to the success of the mission; hence, these are some of the most exacting aspects of the simulation. To provide such accuracies, the computers are programmed to determine the effect of even minor variations

in earth, sun and moon orbits relative to the projected flight of the spacecraft. The simulators are tied in with the Mission Control Center in Houston by way of the Simulation Checkout and Training Systems (SCATS). Thus, the complete Apollo Mission from lift-off to final earth re-entry can be realistically simulated.

Simulator Master Control allows instructors to choose from several modes of operation. In addition to the normal operating mode, there are three other primary modes - problem reset, step ahead and problem freeze.

The problem reset mode enables the instructor to initialize or return the trainer to a predetermined mission point. The step-ahead mode allows the simulator to operate at nearly 30 times its normal speed so that certain portions of the mission during which there is little astronaut activity can be accelerated if they do not have to be emphasized. Problem freeze enables the mission to be stopped and restarted at any point in real-time during the simulated flight.

The AMS and LMS visual systems, each of which contains over five tons of lenses and curved glass, present realistic external environments that change accordingly with the position of the spacecraft. Objects ranging from six feet to infinity are simulated. Separate units simulate the views seen through each of the four command module and three lunar module windows.

Both the AMS and LMS also have visual systems that simulate the telescope and sextant views, enabling the flight crew to make navigational measurements.

Presently, the simulator configuration is tailored to the first manned flight. After the training needs for that mission have been fulfilled, it can be updated for subsequent flights.

FACT SHEET

APOLLO MISSION SIMULATOR

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LUNAR MISSION SIMULATOR

APOLLO MISSION SIMULATORS (AMS)

.. Built by Link Group, General Precision Systems Inc., under contract to Space Division of North American Rockwell Corp. and NASA.

.. Dimensions - 65 feet wide
103 feet long
30 feet high
40 tons — weight

.. Computers - Four DDP 224 digital computers with 208,000 word core memory. Solution rates up to 20 times per second.

.. Malfunction Insertion Unit - 1,000 malfunction capability.

.. Visual System - Five tons of glass - lenses and mirrors. Simulates objects from distances of six feet to infinity.

LUNAR MISSION SIMULATORS (LMS)

.. Built by Link Group, General Precision Systems Inc., under contract to Grumman Aircraft Engineering Corp. and NASA.

.. Dimensions - 60 feet wide
103 feet long
30 feet high
45 tons — weight

.. Computers - Three DDP 224 digital computers with 180,000 word core memory. Solution rates up to 20 times per second.

.. Visual System - Five tons of glass - lenses and mirrors. Simulates objects from distances of six feet to infinity.

.. Landing Site Simulator - A three dimensional model, 16 feet in diameter, reflecting lunar terrain at a scale of 1,000 to 1.

SUBCONTRACTORS ON APOLLO AND LUNAR MISSION SIMULATORS

Of the more than 650 suppliers that Link Group of General Precision Systems Inc. utilized for the AMS and LMS programs, 70 per cent were small businesses of 500 employees or less. The major subcontractors are:

Collins Radio - Dallas	Communication & Data Systems Equip.
Computer Control Div., The Honeywell Corp.	Computer Systems
Con Serv Inc.	Lift Table
Control Data Corp.	Magnetic Tape Units
Decision Systems, Inc.	Diagnostics & Programming Services
Farrand Optical Company, Inc.	Visual Systems
General American Research Div., General American Transportation Corp.	Waste Management Support Assembly
Graflex, Inc.	Technical Services
Hughes Aircraft Co.	Engineering Services
Kollsman Instrument Corp.	Indicators
Librascope Group, General Precision Systems Inc.	Slide Frames, Digital to Resolver Converters
Liskey Aluminum, Inc.	Raised Mooring
North Atlantic Industries	Digital to Resolver Converters
Opcalite	Special Electroluminescent Panels
Patwin Electronics	Circuit Breakers
Photics Research Corp.	Moon Scenes, Earth Slides
Paul Rosenberg Associates	Technical Consultation
Simmonds Precision	Flight Instruments
Thomas Electronics	Special Cathode Ray Tubes
Wilding, Inc.	Special Graphic Art Work and Film