Flight Test NEWS

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HARRIER STARTS BIS TRIALS

Formal Board of Inspection and Survey (BIS) trials have begun at the Naval Air Test Center for the Marine Corps' AV-8A Harrier — the only operational jet in the world with V/STOL (vertical and short takeoff and landing capability.)

The first of the compact attack jets to arrive at Patuxent River is undergoing service suitability tests. Over the next two and one-half months, four Harriers will be examined for their flying quality, carrier suitability and weapons suitability.

Arriving aboard an Air Force C-133 the evening of Jan. 25, the first Harrier was reassembled in three days and made its first test flight on Jan. 29. Subsequent flights have been made daily.

Flights of the single-seat, close air support jet are generating much interest at Pax River, since the Harrier can take off or land vertically. It also gets wide-eyed stares of disbelief when on passes across the field it comes to a dead stop, makes a 90-degree turn, then zooms off in another direction.

Another shocker even for the aviation oriented personnel at Patuxent River is a look at the Harrier as it hovers as effortlessly as a helicopter.

The hover and vertical takeoffs and landings are achieved by rotating the Rolls-Royce Bristol Pegasus engine's four jet exhaust nozzles downward. After the Harrier is airborne, the pilot slowly rotates the nozzles to a rearward position to accelerate to conventional flight.

Attitude control of the Harrier during landing, hovering and slow flight operation is provided by a jet reaction control system using air drawn from the engine compressor and ducted to shutter valves at the extremities of the aircraft.

Downward blowing valves at the nose and tail provide pitch control. Laterally-oriented valves at the tail provide yaw control, and upward and downward valves at each wing tip give roll control.

As the engine exhaust nozzles are directed rearward and airspeed increases, compressor air ceases to

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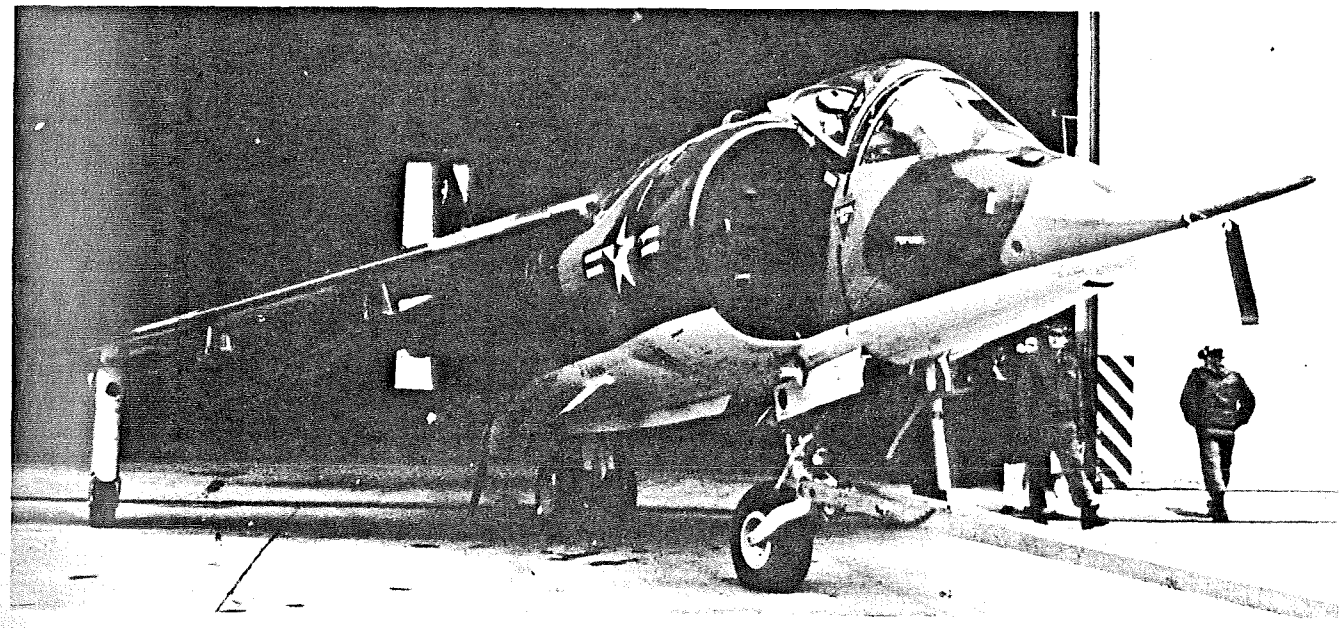

The Harrier Is Rolled Out to Start Test Program.

Harrier Start BIS Trials

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flow to the shutter valves and conventional aerodynamic controls take affect. The conventional controls are mechanically linked to the shutter valves at all times.

During development trials, the Harrier attained speeds of 625 knots and exceeded Mach 1 in a shallow dive. It has operated from grass and dirt strips and has landed and taken off from helicopter platforms onboard ship.

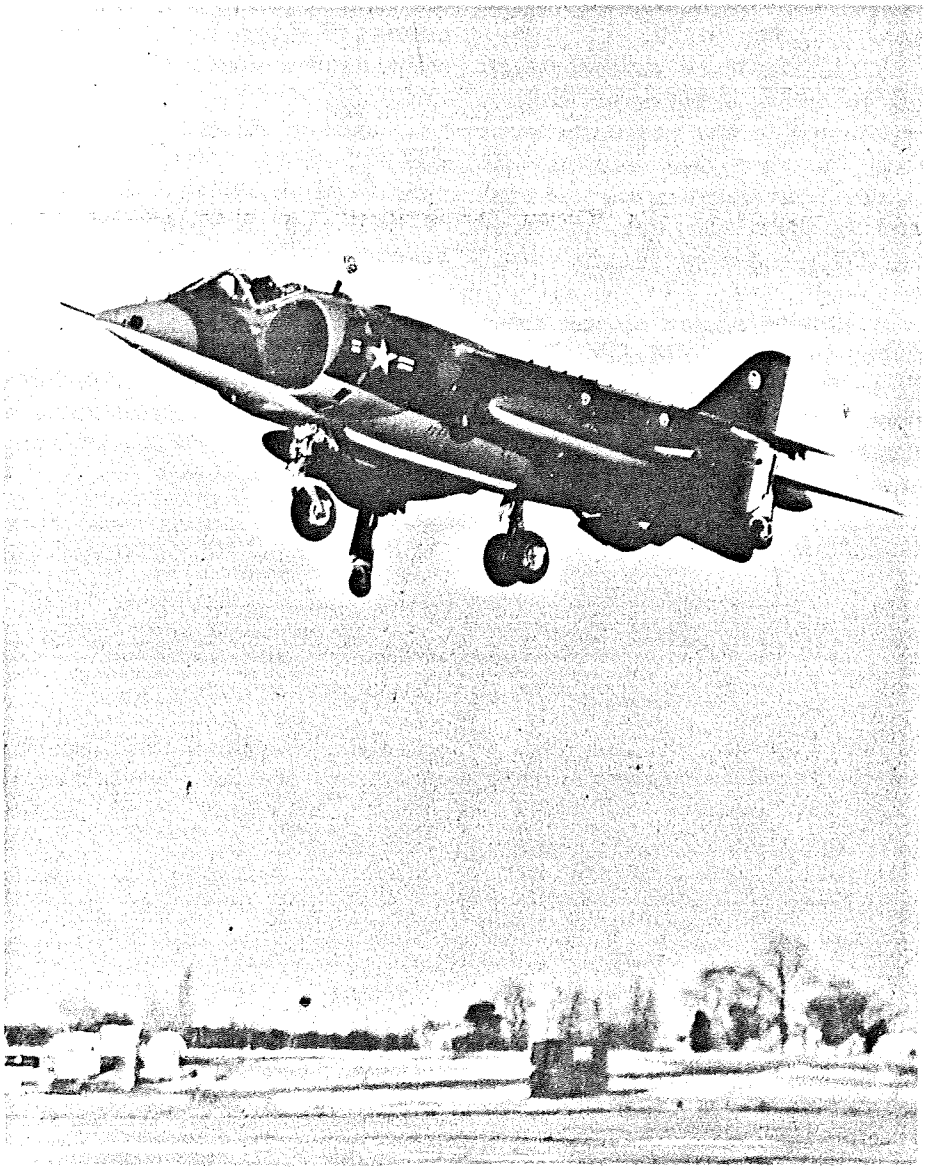
While the Harrier is unique in its ability to operate vertically, it is often practical to use short ground rolls to gain the advantage of aerodynamic lift. This permits increased fuel and ordnance to be carried, resulting in greater range and firepower.

The tradeoff for a ground roll approximates one gallon of fuel or its equivalent in ordnance for every foot of ground roll. For example, the Harrier's payload could be doubled by using its short takeoff capability on an unpaved strip of less than 1,000 feet in lieu of the vertical takeoff.

The British government spent 10 years in research and development of the V/STOL. Designed and developed by Hawker Siddeley Aviation Limited, the Harrier was introduced into military service by the Royal Air Force in April 1969 and was deployed with NATO forces.

The Marine Corps took delivery of the first Harrier in formal ceremonies on Jan. 6.

Major Bill Scheuren, USMC, Ready for First Test Hop.



The Harrier Rises Vertically from the Deck.

EA-6B Initial Carrier Trials Completed

The initial carrier trials of the Grumman EA-6B were completed in January. The test aircraft was flown by Navy pilots from the Carrier Suitability Branch of the Naval Air Test Center (NATC), Patuxent River, Maryland. The trials were conducted aboard the USS Midway (CVA 41), off the coast of California.

The EA-6B, a four place electronics countermeasures (ECM) aircraft is a derivative of the A-6A "Intruder." The EA-6B is designed to perform standoff jamming and ECM penetration missions. The aircraft can carry up to five tactical jamming pods on one fuselage centerline and four wing stations. For ferry missions, 300 gallon drop tanks can be carried on these stations.

These trials were part of the Board of Inspection and Survey (BIS) evaluation of the aircraft. They allowed Navy evaluation of the compatability of the aircraft with the carrier environment. The trials were preceded by a contractor carrier suitability demonstration and a Navy land base carrier suitability BIS evaluation.

The contractor carrier suitability demonstration, which was performed last summer, demonstrated the aircraft's structural integrity and dynamic characteristics when operating with carrier type catapulting and arresting gear. These tests were performed using the TC-7 steam catapult and the MK-7 arresting gear installed at NATC. The carrier suitability BIS, which followed, allowed Navy familiarization with, and evaluation of the airplane, using the NATC facilities, prior to the carrier trials.

During the trials, minimum catapulting end speeds, approach characteristics, and deck handling were evaluated. Minimum end speeds were determined in three aircraft store configurations, by conducting a series of catapult launches, in each, at decreasing end of launch airspeeds. A portable L-band telemetry ground station, operated by NATC personnel, allowed immediate evaluation of critical parameters after each launch. Each series of launches was continued until a minimum end speed was reached, due to flying qualities or excessive aircraft sink off the bow of the ship. The values determined during these trials will be used in determining end speed criteria for fleet operations.

The trials permitted evaluation of the aircraft's handling characteristics during approaches through the turbulence generated by the carrier. The test airplane was maneuvered on the flight and hangar decks, using standard Navy handling equipment to demonstrate compatability with this equipment under shipboard conditions.

Volume of Symposium Papers To Be Printed

The initial printing of the technical papers presented at the SFTE symposium on computer aided flight testing was sold out during the symposium. Since there are still unfilled requests for sets of these papers, the Long Island Chapter plans to print a bound volume containing a complete set of the symposium papers. This volume will cost ten dollars.

If you are interested in obtaining one or more copies of this volume, send your order and a check for the total amount to:

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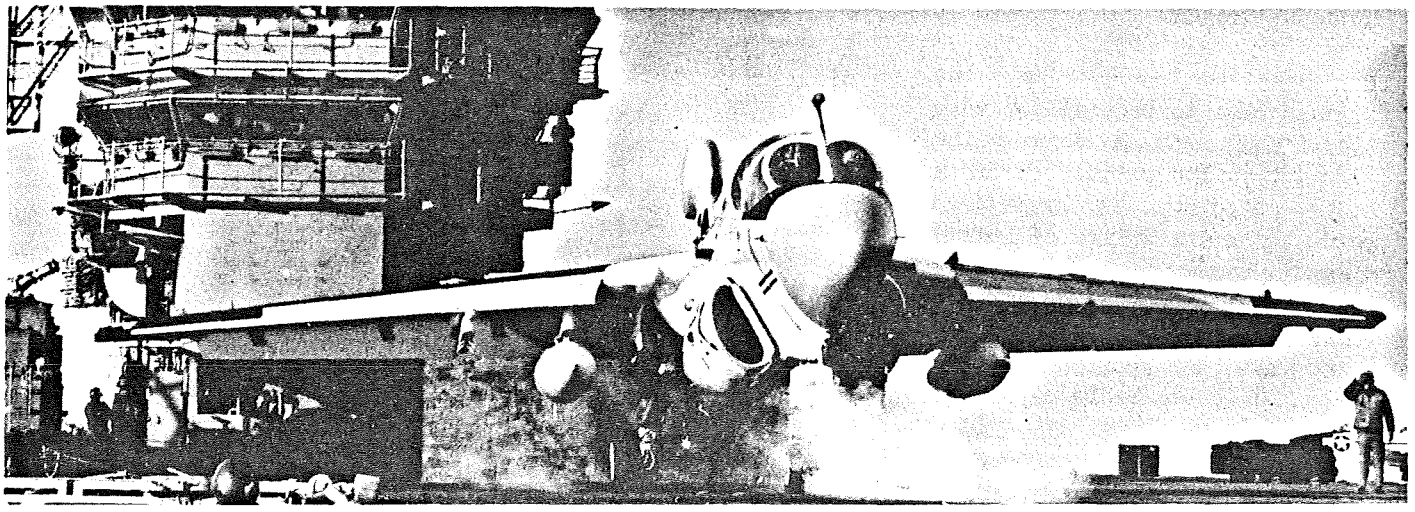
Att: D. Desfosse



EA-6B Is Launched from the USS Midway During the Aircraft's Initial Sea Trials.

NATC Evaluates First Navy Mid-Air Recovery System

Test pilots and engineers from the Naval Air Test Center, Patuxent River, Maryland recently evaluated the first Navy Mid-Air Recovery System (MARS) at El Centro, California. Navy test pilots, LCDR M. A. Cosby and LCDR D. L. Larson, flew successful mid-air recoveries of test vehicles of up to 2,500 lb to qualify the SH-3A helicopter for performing the MARS mission. Dr. G. E. Clarke, President of the Society, and Mr. D. A. DuFresne, a charter member of the Patuxent River Chapter, analyzed the structural and aerodynamic aspects of the total system.

The MARS concept will enable the Navy to retrieve valuable airborne payloads prior to ground impact and subsequent damage. Initial use of the Navy's MARS is for recovery of target drones at the Naval Missile Center, Pt. Mugu, California. The drones deploy a main parachute at the end of the mission run and descend to earth. In the past the drones have incurred costly damage due to ground impact and salt water contamination when descending over the sea. Considerable savings in time and money will be realized by retrieving the drones with the MARS and flying them directly to the launch area in a condition for immediate re-use.

Both the helicopter and the payload have to be modified with MARS equipment. As shown in the photograph, the payload descends on two parachutes. The larger main parachute arrests the rate of descent while the smaller chute flying above the main is the engagement chute, to be snagged by the MARS equipment aboard the helicopter. A 350 ft load line connects the payload to the engagement chute via a release mechanism that disengages the main canopy when sufficient tension is applied to the load line by the retrieving helicopter.

The MARS helicopter incorporates a rope loop assembly with three strategically located hooks which are spread between two externally mounted poles that can be lowered hydraulically below the helicopter. The loop assembly is connected to an energy absorbing winch inside the helicopter by means of a cable running through the underside of the helicopter and over sheaves at a point close to the aircraft center of gravity (CG).

In effecting a mid-air recovery, the pilot maneuvers the aircraft over the engagement chute and snags the chute with one or more hooks. The loop assembly and hooks then pull away from the poles and cable is payed out until the pre-set brakes on the winch bring the cable to a gradual stop. Thus, a gradual acceleration is applied to the payload in the direction of flight. The payload is then reeled in to a stowed position 30 ft below the helicopter until it is finally landed and released.

A white "aiming gore" in the otherwise orange colored main chute indicates to the pilot the proper direction in which to approach the engagement chute. This prevents the load line from being pulled through the main chute and burned, with eventual loss of the

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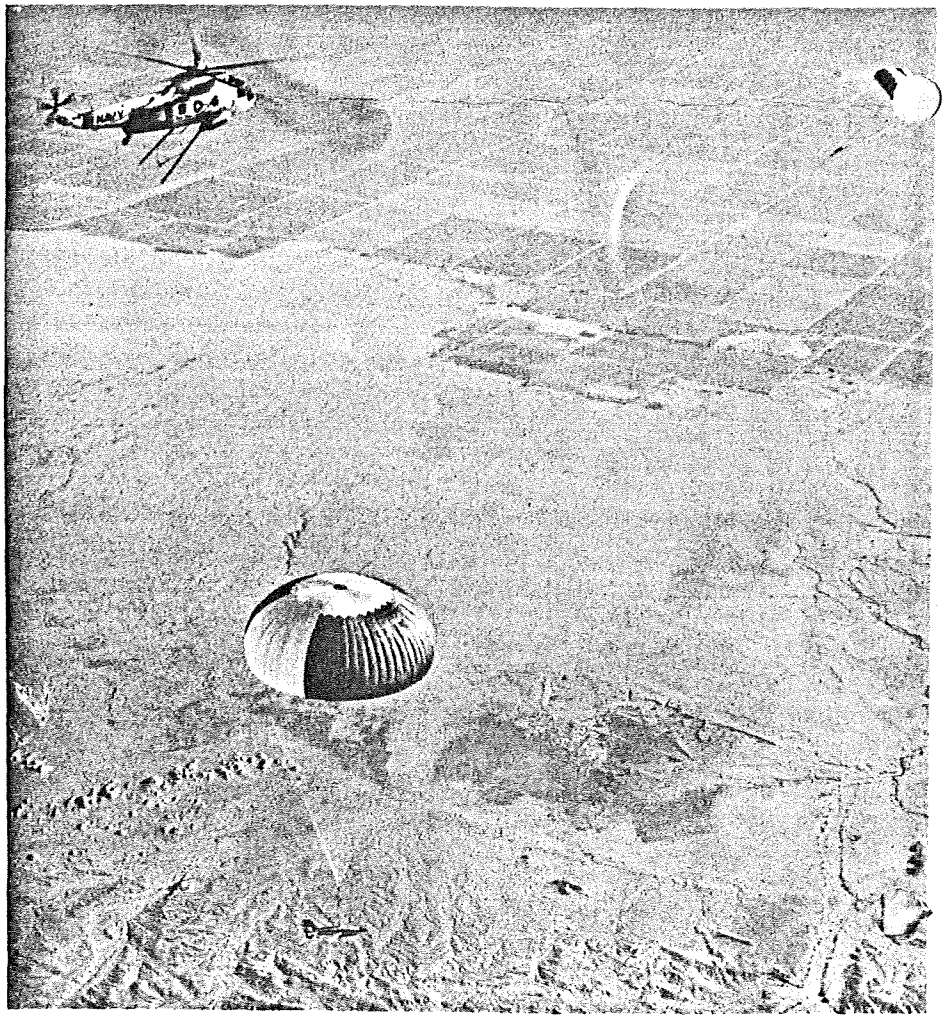

SH-3A Helicopter Maneuvers for a MARS Pickup.

NATC Evaluates First Navy Mid-Air Recovery System

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payload. Airspeed for the recovery is 55 kt (±5) while descending relative to the payload system at 1,000 to 1,200 ft. A maximum normal acceleration of 2g is normally applied to the payload during the recovery. The possibility of exceeding the helicopter maximum allowable gross weight of 19,100 lb with the aircraft and payload weight combination can be averted prior to the catch with the 900 lb/min fuel dump capability of the MARS SH-3A helicopter.

During the four week evaluation, the Patuxent River team evaluated stability and control, performance, structural integrity, and equipment suitability of the SH-3A helicopter. The test aircraft was equipped with two 36 channel oscillographs and a photopanel for recording the extensive list of flying qualities, performance, and structural parameters. Ground to air, air to air, and on-board camera coverage was used and proved invaluable in analyzing some of the mid-air recovery problems, particularly tail rotor clearance and engagement chute stability. Due to an inherent aft CG condition in the MARS configuration, tail rotor clearance was of concern. The stability of the engagement chute was variable with each successful recovery and proved to be a problem for the pilot during his approach. This instability partly accounted for an accident that damaged the right landing gear sponson and terminated the evaluation prior to its last two scheduled recoveries. Within the last few seconds during the approach, the engagement chute rose a few feet, snagged the sponson, until the chute, loadline and dummy drone were possibly cut away by the jagged metal of the damaged sponson.

Pending further airframe modification to the landing gear sponsons to preclude recurrence of engagement chute hang-ups, the aircraft will be considered acceptable for service use. Future uses of the Navy MARS may include retrieval of space exploratory systems, weather data recording packages, etc.

USS Enterprise ACLS Certification Trials

A certification team comprised of engineers and pilots from the Carrier Suitability Branch of Flight Test Division and the Automatic Carrier Landing System Branch of the Naval Electronic Systems Test and Evaluation Facility, recently conducted SPN-42 Mode I (automatic control to touchdown) certification trials in USS ENTERPRISE (CVAN-65) using NATC instrumented and Carrier Air Wing Fourteen F-4J aircraft. Project engineers, instrumentation and maintenance support personnel loaded aboard ENTERPRISE at anchorage at Hampton Roads, Virginia, on 17 January, 1971. Project pilots flew the test airplanes aboard and tests commenced 18 January at 1400.

The primary purpose of the certification trials was to verify safe and satisfactory performance of the newly installed SPN-42 automatic carrier landing system under operational conditions prior to clearance for fleet usage. A statistical sample of forty landings using each SPN-42 channel was required to evaluate vertical and lateral glidepath control, longitudinal and lateral touchdown dispersion, hook-to-ramp clearance, sink speed and airplane attitude at touchdown. Most of these data were obtained from photo-instrumentation of the landing area and SPN-42 instrumentation.

During the January trials strong gusty winds were encountered in the VaCapes area, and due to the extreme turbulence, only 42 of 117 attempted automatic landings were completed. Glideslope control and touchdown dispersion were not acceptable and trials were rescheduled for 4—6 February. The test team personnel again journeyed to Norfolk and boarded ENTERPRISE the afternoon of 3 February. She sailed 4 February in fog and rain with more of the same predicted for the VaCapes area. Pax had poor visibility and freezing rain and aircraft could not launch. Chances for flight operations in the VaCapes area were grim and time was running out as ENTERPRISE had a schedule to meet on the west coast. That evening the decision was made to move east into an area with better weather. The ship requested and received permission to operate near Bermuda and Pax River was advised.

Four F-4J aircraft arrived overhead at 1600 5 February and made ACLS approaches until sundown. Flight operations were continued all day the sixth and until 1030 the seventh. A total of 232 approaches were flown, 172 of which were completed to touchdown. Based on qualitative observations by the engineers, pilots and LSO it was concluded that the SPN-42 performance was acceptable for automatic landing control under limited conditions and an interim Mode I certification was recommended. More precise information will be obtained from analysis of the large volume of data collected.

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Joint Program To Develop Dynamic Performance Test Techniques

The Naval Air Test Center began participation in February in a Joint Test program with the Air Force Flight Test Center and the NASA Flight Research Center to develop methods of dynamic (non-steady) performance flight test techniques. The method consists of using highly accurate accelerometers to measure aircraft accelerations during acceleration, deceleration, "roller-coasters" or similar maneuvers, from which the aircraft performance parameters can be deduced. In recent years, several contractors and government agencies have investigated dynamic methods as an improved means of determining aircraft lift/drag and excess thrust characteristics. Dynamic methods offer potential advantages of increased accuracies, reduced flight time and increased data. Because of these reasons, dynamic performance methods are being considered as the prime method of future aircraft performance investigation programs.

The purpose of the one-year joint program at Edwards Air Force Base is to refine and document dynamic methods to the point where they may be employed routinely in future test programs. Of primary importance is that aspect of performance testing which yields increased data for flight regimes which permit only limited testing due to high fuel consumption rates. These areas are supersonic flight, (range, endurance, excess thrust, turning performance), and transonic flight (drag rise, engine performance). Standard static test techniques are not employed in these areas because of the numerous flights required to define parameters and establish a correlation in the data.

Of secondary importance are those areas where a substantial decrease in flight test time can be realized by dynamic methods (e.g., subsonic level flight performance), and where greater accuracies can be expected (climbs, descents and accelerations).

USS Enterprise ACLS Certification Trials

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Pax River personnel were flown-off to NAS Bermuda on the seventh and ENTERPRISE began her transit around "The Horn."

Carrier Suitability Branch project work in ENTERPRISE went smoothly although faced with adverse weather and a ~~tight~~ schedule. The successful completion of the sea trials was accomplished through the cooperation and efforts of all concerned and resulted in increased capabilities for the Fleet.

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