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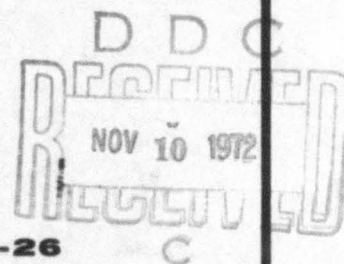
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**Addendum
CATEGORY II
ICING TEST OF THE
HH-53C HELICOPTER**

CLARK E. LOVRIEN, JR.
Major, USAF
Project Officer and Project Pilot



TECHNICAL REPORT No. 71-26

SEPTEMBER 1972

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FOREWORD

The Category II test plan required penetration into moderate natural icing conditions to verify experience in artificial icing. Moderate icing conditions were not encountered during the Category II test program and the natural icing was limited to five flights in trace to light icing conditions. A subsequent unplanned flight through natural light/moderate icing occurred and is reported in this addendum to FTC-TR-71-26, June 1971.

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12 September 1972



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TEST AND EVALUATION

Natural icing was encountered by the icing test helicopter, USAF S/N 68-10354, while on a ferry flight manned by the same crew that conducted formal icing tests. Light/moderate rime icing was encountered while flying at 9,000 feet MSL on the low altitude airway between El Paso and Fort Stockton, Texas. Flight conditions were 115 knots indicated airspeed (KIAS), minus 10 degrees C, 9,000 feet MSL, 65-percent torque on both engines at approximately 105-percent rotor speed, approximately 50 percent indicated on the cruise guide, and a gross weight of approximately 40,000 pounds. Flight was entirely in the clouds. Rime ice accumulated at the rate of approximately 1/4 inch per 10 minutes. When a noticeable accumulation was evident on the engine air particle separator (EAPS) inlets, the EAPS doors were closed.

When almost 3/4-inch of ice had been accumulated, the indicated airspeed began falling off and the power requirement increased. The pilot asked Air Traffic Control for descent to 7,000 feet MSL, but was unable to descend for approximately 20 minutes. The worst conditions existed just before descent when a full inch of ice had accumulated on the windshield wiper arms (the recommended area for observation of ice accretion rate). Approximately 80-percent torque was required to maintain level flight at 90 KIAS. When a descent was made to 7,000 feet MSL the airspeed increased to 115 KIAS again, and the power requirement decreased to the normal 65 percent for that speed. All of the ice was still intact on fuselage areas visible from the cockpit. Some ice was shed from the main rotor blades. This was made evident by seeing and hearing ice strike the fuselage and windshield. A few pieces of ice were also seen departing to the front quadrants. While at 7,000 feet MSL an additional 1/8-inch clear ice accumulated on top of the rime ice.

The special instrumentation installed in the helicopter for the tests was operating on this flight. With EAPS doors open, the EAPS differential pressure was +5.7 inches of water. When the EAPS doors were closed, the EAPS differential pressure decreased to -7.2 inches of water. As ice accumulated adjacent to the EAPS strata tube inlets, the pressure decreased to as low as -8.2 inches of water. The ice eventually shed from the area adjacent to the strata tube inlets, and the differential pressure increased to or near the original pressure (from -7.6 to -7.2 inches of water). The cycle was repeated as the ice again built up on the EAPS. This duplicated the process that occurred during the artificial icing tests in Alaska. Apparently the artificial icing trials were at least as severe as natural icing under the same conditions. The medium frequency vertical vibrations or lateral shuffle associated with ice shedding from the tail and main blades, respectively, that occurred in the artificial icing trails, did not occur in natural conditions.

The pitot heat and windshield anti-ice were completely effective (as they were during the artificial icing tests also). The engine anti-ice was not turned on, so bleed air was not heating the inlet guide vanes. It is believed that there was no significant icing of the inlet guide vanes because no abnormal engine parameters were noted. The EAPS were not opened again until all ice had sublimated or melted from the inlets. The aircraft was exposed to icing conditions for approximately 50 minutes.

This icing encounter correlated with the results observed and reported during the artificial icing trials. The H-53 performed very well in light/moderate natural icing. The present clearance for operation in moderate icing is valid.

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13. ABSTRACT		
<p>The Category II test plan required penetration into moderate natural icing conditions to verify experience in artificial icing. Moderate icing conditions were not encountered during the Category II test program and the natural icing was limited to five flights in trace to light icing conditions. A subsequent unplanned flight through natural light/moderate icing occurred and is reported in this addendum to FTC-TR-71-26, June 1971.</p>		

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