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NATIONAL TRANSPORTATION SAFETY BOARD
DEPARTMENT OF TRANSPORTATION
WASHINGTON, D.C. 20591

Mr. David D. Thomas
Acting Administrator
Federal Aviation Administration
Department of Transportation
Washington, D. C. 20590

SEP 30 1968

Dear Mr. Thomas:

It has come to the Board's attention that operation of aircraft powered by the Rolls-Royce Dart engine/Dowty Rotol propeller installation under a negative "g" condition, even at only -0.1g for no longer than two seconds, can cause automatic propeller feathering.

This is a potentially hazardous operational characteristic unless the crew is forewarned of the reason for such auto-feathering and of the appropriate corrective action. Without this awareness, the unexpected loss of power and/or the sudden asymmetric power condition could be serious, especially if the triggering negative "g" were a result of atmospheric turbulence when aircraft control might already be marginal. In addition, there is the possibility of engine failure as a result of the overtemperature that would accompany auto-feathering under these conditions, if prompt remedial action is not taken.

The automatic feathering systems in question are designed to initiate auto-feathering when two basic conditions are met: (1) cockpit power lever setting is above that representing a certain cruise range rpm, and (2) the engine torquemeter oil pressure is below a triggering value, usually set at 50 psi. In addition, there is an interlock arrangement in the twin-engine installation so that auto-feathering action can take place only if not already initiated in the other propeller. However, there are two four-engine aircraft, the Vickers Viscount and the de Havilland Argosy AW-650, in which auto-feathering can take place in all four propeller systems simultaneously under these conditions.

The reduced engine oil pressure accompanying negative "g" operation is the auto-feather triggering element. Rolls-Royce has been cognizant of this inherent characteristic of the Dart oil system, and published information thereof in a March 1965 revision to the various Dart engine model operating instructions, in the following manner:

> "Negative 'g' maneuvers should be avoided where possible. If, however, sustained negative 'g' flight is encountered, close both throttles to IDLE until normal flight is resumed and normal oil pressure is restored. This action will prevent any tendency of the auto-feathering circuit to energize through a temporary reduction in oil pressure in the torque measuring system."

However, there has been a lack of followthrough in appropriately apprizing the flightcrews of this auto-feathering mode. It is considered that this information should be in the applicable Airplane Flight Manuals in consonance with the intent of Section 25.1501 and of Paragraphs 25.1581 (c) and 25.1587 (c) (4) of the Federal Aviation Regulations.

It is therefore recommended that all operators of the affected aircraft types be expeditiously advised on this matter, and that followup action be accomplished for twin-engine installations in the form of Airplane Flight Manual revisions along the lines of the above-quoted Rolls-Royce advisory. For the four-engine installations, the recommended method of accomplishing the basic purpose is to prescribe deactivation of the auto-feathering systems when turbulence is encountered, or at any other time negative "g" operation might be anticipated. This second method is suggested as an alternative, or supplemental, method for the twin-engine installations.

The known affected aircraft operational in this country are the Grumman Gulfstream G-159, the Fairchild F-27, the Fairchild Hiller FH-227, the Vickers Viscount, the Convair 600, the Convair 640, the de Havilland Argosy AW-650, and the Nihon YS-11. Close to 500 aircraft are involved among these types.

The above recommended measure, of making these negative "g" powerplant phenomena and operating techniques common knowledge among operational people, is considered the optimum action to be taken at this time for currently certificated aircraft. In consideration of future certifications, it is presumed that, under a comparatively recent addition to the FAR's, turbine-powered aircraft will no longer be certificated with powerplant operation as sensitive to negative "g" forces. Section 25.939, "Turbine Engine Operating Characteristics," now is additionally specific in this area by stating that no hazardous malfunction may occur under negative acceleration and that "This must be shown for the greatest duration expected for that acceleration."

However, we are taking this opportunity to recommend that full cognizance be taken of the inadvertent negative "g" probabilities when judgments are made, during future certification proceedings, regarding compliance with Section 25.939. Airworthiness is, of course, involved as long as aircraft are occasionally subjected to sustained negative "g" forces resulting from operation in extreme turbulence, with the attendant tendencies toward reductions in fuel and oil pressures. It is suggested that possible magnitudes and durations of negative "g," for which allowances should be made, could be obtained from flight recorder readouts of extreme turbulence encounters.

A recent airline experience serves as a case in point illustrating some cause of our concern. An Air West F-27 encountered extreme turbulence on November 6, 1968, during an instrument approach to North Bend, Oregon. Negative "g" and auto-feathering of the right propeller

were experienced. Passenger injury was sustained as a result of the violent yaw induced by the auto-feathering. Apparently, prompt corrective action by the pilot was largely responsible in averting a serious accident. But if the pilot had been forewarned with the aforementioned negative "g" advisory, it is likely that he would have been forearmed sufficiently to have circumvented the sudden auto-feathering and yaw.

A Board representative has discussed the foregoing with personnel of your Flight Standards Service in New York as well as here in Washington. Our technical staff is available to provide you with further information or assistance as required.

Sincerely yours,

Original signed by

Joseph J. O'Connell, Jr.

Joseph J. O'Connell, Jr.
Chairman