

CAB Recommendations

Great strides have been made in the last two years, but the Board believes that still greater efforts are required to reduce this potential hazard to a minimum. If the Board were restricted to making a single recommendation on the problems associated with safe flight in turbulence, it would be to urge that a unified, cohesive federal program be formulated, with a high level board or commission assigned the responsibility for integrating and coordinating the research efforts of all government agencies presently working on this field, and for providing appropriate liaison with all pertinent private groups and industry organizations. The work currently underway within the Interdepartmental Committee for Meteorological Services could well form the nucleus for this broader program which should include not only the meteorological aspects of the problem, but also the operational, human factors, and design characteristic aspects. In this way, unnecessary duplication of effort can be avoided, and research priorities can be established in the interest of conserving available research funds and personnel.

Pending the establishment of such a "Federal Turbulence Program, the Board believes that early FAA and industry attention should be directed to the following:

- (1) Explore the possibility of increasing the horizontal stabilizer drive motor torque capacity so as to preclude motor stalling under anticipated conditions, taking proper care against structural damage in the case of a runaway the more powerful motor.
- (2) Consider modifying the elevator control force characteristics to eliminate any appreciable stick force lightening under all reasonable flight conditions inside and outside of the normal operational flight envelope.
- (3) Evaluate the desirability of providing a "Turbulence Mode" feature on the autopilot wherein the stabilizer trim and Mach trim systems would be deactivated in this mode.
- (4) Expedite the mandatory installation of improved attitude indicators which, by means of size, markings, lettering and/or color coding methods, would provide greater assistance to the pilot in maintaining attitude control even at high pitch and roll angles.
- (5) Develop improved flight simulators that can more realistically duplicate aircraft motions and rough air penetrations, and require their use in initial and recurrent flight training programs.
- (6) Seek further improvement in the utilization of airborne and surface radar to more safely navigate aircraft through areas of severe weather.

On May 27, 1964, shortly after the NASA longitudinal control force analysis report had been received and evaluated, the Board forwarded to the FAA a recommendation covering essentially the area of elevator control force lightening listed above. Specifically, it was recommended that (a) a spot check of the Boeing 720 fleet be conducted to determine if the cove gap and SAE tab tolerances were within Boeing specifications; (b) Boeing be requested to make a detailed evaluation of aeroelastic effects on elevator control forces in the down elevator range

at high negative load factors; and (c) Boeing be requested to assess the feasibility and advisability of modifying the SAE tab linkage as to preclude the lightening of control forces.

The FAA acknowledged the Board's letter on June 4, 1964, stating that our recommendation was being studied, and that we could expect a full report on the matter later. An interim letter from the FAA; dated July 16, 1964; indicated that they were taking action in line with our recommendations and would provide definitive comments in the near future. It was also noted that their PROJECT TAPER flight tests should provide valuable information on the general problem and that this information would be considered in their assessment of the Boeing 720 airplane. In a lengthy, detailed reply, dated December 30, 1964; they advised that after a thorough study and evaluation of all available information it was their opinion that the data did not justify a requirement for modifying the longitudinal control system to preclude control force lightening during extreme conditions such as those experienced in the accident. In specific reply to the three points in the Board's May 27, 1964, letter, FAA advised that (a) an assessment of operational information obtained from eight operators regarding their ability to maintain the pertinent cove gap and SAE tab tolerances indicated no discrepancies were found which would indicate "out of tolerance" settings were probable; (b) Boeing was asked to provide information on the aeroelastic effects on control forces, and the information supplied showed the net aeroelastic effect would reduce the control force lightening -and (c) they concurred with Boeing's conclusion that neither modification was justified because the SAE tab linkage would become too complex, and changing the cove gap to improve the down' elevator characteristics would result in undesirable force characteristics for other important flight conditions. In summarizing their views on the general problem, FAA advised that current industry actions directed toward avoiding extreme regimes of flight beyond the aircraft design envelope will provide needed improvements in the level of safety for turbulence operation of this and other transport aircraft. Some of the current actions noted were improvements in attitude indicators and stabilizer trim setting displays, better turbulence penetration techniques, and flight and simulator studies Adams, Member, did not take part in the adoption of this report.