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NASA TMX 51662

SAFE FLIGHT IN ROUGH AIR

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To be presented at SAE Luncheon

April 29, 1964

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If we will pay the cost, areas of severe turbulence can be safely penetrated by aircraft on an almost routine basis. This has been shown by the many special projects that have been carried out over past years to investigate severe weather phenomena. Since we build aircraft to perform a useful military or civil function, we quickly find that an airplane designed on the basis of complete disregard for the weather ahead is of little or no value so far as its basic mission is concerned. Common sense dictates that we follow the alternate approach of evasion and avoidance of turbulence when possible. Design, therefore, accounts for the expected environment for the particular mission and the continuing question which is judged by experience is: Have we provided the proper degree of capability in rough air or properly anticipated the new problems of rough air flight?

Let us first take a look at what has been done when the prime requirement was safe flight in severe to extreme rough air. In these studies to evaluate the characteristics of storms (which started with the XC-35 project in 1941) we have utilized all of our specialized knowledge at the time of the project to insure safe flight. The highlights can be summarized as:

(1) A high-strength, high-performance aircraft which was not gust critical.

(2) Specially selected and trained flight crews.

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(3) Optimized stability and flying qualities.

(4) Reserved airspace as to area and altitude.

(5) Special ground support such as radar or meteorological services for guidance and assistance.

(6) Specific flight conditions for penetration as to speed, trim, and control manipulation.

The average operational pilot would enjoy flight with this much individual attention and it might be noted that in the more recent projects, it has not always been easy to come by the reserved airspace or the special support. Of particular importance, in our opinion, is the fact that during the flight the research pilot can concentrate on the single objective of rough air penetration. In contrast, if we consider the operational approach and environment, the objective is to avoid rough air by all means at the military or civil operator's command whenever feasible. The use of forecasts, pilots' reports, and radar are all aimed at avoidance of the problem.

When turbulence is to be encountered or is encountered, let us see what the operational crews face in contrast to the special test crews:

(1) An airplane whose strength and characteristics are defined by its operational mission. Evidence is that the industry has done a good job here but, nevertheless, the airplane is not optimized to rough air flight.

(2) Crews are trained and selected to have their prime competence in the day-to-day mission.

(3) Stability and flying qualities are adjusted to the overall requirements of the mission.

(4) Rationed airspace, particularly under IFR conditions.

(5) No special services from the ground aimed only at their particular flight.

(6) Flight conditions controlled to some degree by traffic control and the route restrictions of modern airspace.

We cannot go into detail on what is meant by each phrase, but I believe it will be apparent that the operational air crew, be it military or civil, tends to have many factors calling for their attention, resulting in an increased workload in rough air. They not only have to worry about the rough air, but other traffic, and their navigation. It is felt, therefore, that for penetration of a given atmospheric situation, the chance of mistake on the part of the average aircrew is considerably higher than for the special research team and the forgiveness of the system becomes of prime importance.

The question is, of course: Is the risk significantly higher considering the reduced exposure to the hazard, and, if so, what can be done? To answer the first part of the question, there is the feeling that events indicate a significant trend toward increasing incidents, particularly with our increasingly complex flight environment but that there is still time to modify the situation in the future. As to what can be done, we can say that work will be required in at least four areas as to their impact on safe flight: airplane and instrument characteristics, crew training, air traffic control, and turbulence detection and forecasting.

In this respect, a major problem is establishing the interrelation of such elements as air traffic control and "unsafe" flight in rough air.

Steps have been taken by all segments of industry to stand back and review the elements of safe flight in rough air and what they believe are the significant factors. This is being done by NASA, FAA, USAF, Army, Navy, ATA, the airlines, and the manufacturers. I can not speak for the various organizations, but from my own experience and background I find that the deficiencies that exist are, in part, due to a lack of appreciation of the whole environment of modern aircraft which is difficult for one group to encompass. We have a tendency to follow our own paths, touching base with other groups through committees or special investigations. Unless some feeling of urgency is created, these contacts affect our long-range plans but do not, in general, change our immediate course or accelerate our efforts. In a sense, this applies to all segments of the industry. In conclusion, one of the major problems of effective operations is the integration of the knowledge of all groups to form a base for study and a mechanism for implementing the results obtained.

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4-7-64