NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

REPLY TO ATTN OF: RRT

June 18, 1969

To: Members of the Research and Technology Advisory Committee on Basic Research

The attached note by Professor Hertzberg on High Reynolds Number Wind Tunnels is forwarded for your information.

Werner C. Steinle
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Executive Secretary

Enclosure

ROUGH DRAFT

HIGH REYNOLDS NUMBER WIND TUNNELS

At the present time our airlines are engaged in a program of re-equipment and expansion. Also, a refurbishing of our military aircraft inventory is being initiated. The aerodynamic testing facilities which are currently supporting these major programs were largely conceived of and constructed in the late 1940's and the early 1950's. While these facilities are doing an excellent job, an examination should be made of the necessity of extending our ground test aerodynamic facilities.

Recent experiences with the development of aircraft such as the F-111 have shown that these facilities are not always adequate to meet our needs. While the F-111 is the most notorious example, other examples can be cited. The cost of a failure in predicting the aerodynamic performance of a modern aircraft is intolerable. A major modification program, based on flight test, has rarely been successful and seldom has the cost of a modification program proved economically salvagable. Therefore, any new facility must be capable of minimizing the possibility of aerodynamic error by closely simulating actual flight conditions.

The most significant failure of our current facilities is their inability to conveniently simulate full-scale flight Ryenolds Number. Most of the errors in estimating aerodynamic performance can be traced to this deficiency. Therefore, the first requirement of any new facility involving the flight envelope of manned military vehicles or commercial air transports should involve the consideration of achieving full-scale Reynolds Number capability.

The power requirements for a conventional transonic tunnel capable of meeting these needs is large and involves capital investments which, in our current funding capabilities, appear to be prohibitive. While this point is open to argument, since the cost of such a facility would have been more than recouped, for example, by the salvaging of the F-111 system, other solutions should also be examined. The development of non-steady aerodynamic testing techniques which were created by the development of the shock tube as a tool for re-entry research has created the basis of new technology which can be exploited to achieve these means in a relatively economical fashion. A modification of the shock tube, commonly called the Ludweig tube, in which short duration supersonic and transonic flows can be created can achieve full-scale Reynolds Number for periods long enough to obtain the required test data. Further modifications of the Ludweig tube could lead to the creation of tubes capable of powering extremely large test sections whose dimensions could approach fifty feet. Such a facility would have the unrivalled capability of true simulation of flight conditions in a laboratory environment. While the data production rate of such a facility is relatively slow compared to that of a conventional wind tunnel, critical check point data could be obtained so that a more objective evaluation of wind tunnel data is available to the designer.

In view of these requirements and possibilities, I strongly recommend that the short duration approach be explored as vigorously as possible. This draft is only a brief outline of some of the critical points relating to this concept and I will be pleased to expand on any section at your request.