Advanced Subsonic Transports (Whitcomb)
Transonic Aerodynamics
Memorandum

TO: Full-Scale Research Division Research Program Leaders

FROM: Assistant Chief, Full-Scale Research Division

DATE: August 28, 1968

SUBJECT: Preparation of material for a proposed publication "The Langley Program"

REFERENCE: Memo for Research Division Chiefs, Group 3, dated August 19, 1968, Request for information to be used in preparing a possible publication, "The Langley Program" from Assistant Director, Group 3

It is requested that all FSRD Research Program Leaders submit to the Full-Scale Research Division Office by September 5, 1968, a concise summary statement of the research program or project area under their cognizance. Approximate length should be no more than two pages double spaced with several appropriate illustrative figures.

These writeups will be incorporated into a Langley document of about 130 pages of which 80 will be text. This will be a PIO-type document with technical overtones. Upgrading once a year is envisioned. The eventual audience will be Washington Headquarters personnel (Payne, Beggs, etc.) as well as selected Congressmen and officials of the Executive Branch.

This program overview should reflect the BIG picture and answer such basic questions as:

a. Why is this work important (what happens if we drop it)?
b. What are the key problems? Our goals.
c. How are we attacking them?
d. Where do we stand re technical solutions (any major accomplishments along way)?
e. Where should we go from here?

The quality of the above writeup should compare to the preamble of the old NACA reports. The text and illustrative figures should be aimed toward a non-technical audience. For such a short document there will be dangers on both sides. On one hand there may be too much technical detail; on the other hand too many anemic platitudes.

Enclosed for your information (where available) is the material submitted in March relative to a review of FSRD research programs. This material should be of benefit. GOOD LUCK.

Donald D. Baals
4661, M/S 403

Langley Research Center
Advanced Subsonic Transports

The present subsonic transports produced by American manufacturers are recognized throughout the world as the most effective of any produced. These superior American transports contribute substantially to our exports and of course, conversely, reduce the possibility of imports of foreign aircraft. It is extremely important that the superiority of our commercial airplanes be maintained. However, the costs of developing advanced subsonic transports is exceptionally high and the industry is loath to incorporate radical aerodynamic improvements beyond the existing state-of-the-art because of possible problems associated with using an untried idea. It therefore becomes the responsibility of the Government to provide the initial advances in the state-of-the-art which later can be utilized by the private manufacturer.

The direct operating costs of subsonic aircraft are greatly influenced by the cruise speed of the airplane since a higher speed increases utilization and the range factor. A higher speed of an airplane also increases the attractiveness to the public in flying in such an airplane since it does reduce time in flight. Because of the importance of cruise speed, a substantial research effort is being carried out by the Langley Research Center to provide new aerodynamic approaches which will allow the achievement of these higher speeds.

One means for achieving higher speeds being developed is a new wing section or airfoil shape (see fig. 1). This airfoil allows the development of
local supersonic flow above the upper surface of the wing at high subsonic speeds without the usual drag penalty associated with such a phenomena. It is generally described as a supercritical airfoil. Wind-tunnel investigations have indicated that the use of this airfoil will allow an increase in the cruise speed of approximately 13 percent above that of transports currently in operation. Because of the high promise of this new airfoil shape as demonstrated by wind-tunnel tests, a flight demonstration of the airfoil using an existing aircraft as a test bed is being actively planned.

Another approach to achieving higher cruise speeds of subsonic aircraft for which research is actively carried out is the extension of the concepts of the area rule to lifting conditions for high subsonic speeds. This approach involves the use of a thickening glove ahead of the root sections of the wing and substantial indentation and cambering of the fuselage (see fig. 2). Analysis and exploratory wind-tunnel results indicate that such changes should increase the cruise speed of subsonic aircraft approximately 7 percent, which is additive to the effects of the supercritical airfoil described previously.

The operating efficiency of subsonic aircraft is also improved by increasing the lift-to-drag ratio. One means of improving this ratio for such airplanes, discovered and developed through Langley wind-tunnel research, is to properly locate the engine and camber the pylon of wing mounted engines. The wind-tunnel investigations made thus far indicate that an increase in lift-to-drag ratio of approximately 15 percent is possible through this approach. Research on this concept is continuing.

Richard T. Whitcomb