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NACA - Langley

Transonic Tunnel

~~Wright, R. Fld.~~

Langley Field, Va.
October 13, 1947

MEMORANDUM For Chief of Full-Scale Research Division

Subject: Investigation of immediate practical application of slotted wind tunnel

References: (a) Memo. for Comp. Res. Div. Files, (1) 3-12-47, RHW VGW:plf

(b) Memo. for Comp. Res. Div. Files, (2) 5-29-47, RHW VGW:mh

1. The results of references (a) and (b) indicate that the solid constriction interference effects in a circular closed wind tunnel can be greatly reduced by means of axial slots in the test section wall. The phenomenon of choking can by the same means be eliminated. The power required is much less than that required to operate a comparable open tunnel. In the tests of reference (b), however, a serious axial pressure gradient existed with the model in the tunnel, but the model tested was much larger in comparison with the tunnel diameter than would be employed in practical model tests. With a model of the size usually tested the pressure gradient would likely be greatly reduced. It has therefore been suggested that the slotted tunnel in its present state of development might operate quite satisfactorily with a "practical" sized model. The following program of tests is therefore proposed.

2. Pressure distributions about a "practical" body tested in the slotted tunnel will be compared with those obtained on the same body in the 8-foot high-speed wind tunnel. Because a slotted tunnel with slots tapering downstream from 1/8 of the periphery open to 1/4 open is currently available, this configuration will be tested first. If this configuration does not effect practical elimination of the blockage and pressure gradient interference, further steps based on the data obtained will be taken. Possible steps include other slot configuration tests, boundary layer and other surveys designed to determine the causes for unsatisfactory operation, and also any corrective measures required.

~~Slotted Tunnel~~

Further machining of test sections may be required. Two unslotted castings now on hand will be conserved so far as possible to satisfy the needs of this program. The model may be tested at 10° as well as 0° angle of attack. In all tests described in this memorandum various test Mach numbers up to the maximum attainable will be employed.

3. When and if item (2) has been satisfactorily disposed of, a wing will be placed on the body. Pressures on the wing and body combination in the slotted tunnel found satisfactory in item (2) will be compared with those obtained on the same wing and body combination at identical angles of attack in the 8-foot high-speed tunnel, where the wall interference for so small a body may be assumed sensibly zero. The model will be tested at angles of attack of 0° and 10° and possibly others. With at least 0° angle the model in the slotted tunnel will be rotated about its axis for tests in various angular positions in order to discover any angular variation in the interference. If the wing-body combination at 0 lift fails to show the same characteristics in the slotted tunnel as found with the body alone, the reason for the difference will be investigated and any modification found necessary to eliminate the difference will, if practicable, be made.

4. If items (2) and (3) have been satisfactorily completed, the lifting model will be tested at angles of attack of 0°, ±3° 10° and possibly others in open, closed, and slotted 12-inch diameter test sections and in the 8-foot high-speed wind tunnel. Comparison of the lift-curve slopes will indicate the lift interference.

5. The tunnels used are the 12-inch diameter open, closed, and various 10-slotted tunnels at the 16-foot high-speed wind tunnel (reference (a)) and 8-foot high-speed wind tunnel. Two models will be constructed as follows:

(a) A prolate spheriod body of fineness ratio 6 similar to the body of reference (a) and with pressure orifices in the same relative positions. The length of this body will be 8 inches. A wing, which can be installed on this body, is a 65-series, symmetrical, 10-percent thick and will contain 13 orifices arranged in chordwise and spanwise directions. The aspect ratio is 4. This wing-body combination was judged to represent satisfactorily the largest practical sized model that would be tested in transonic wind tunnels.

This body will be mounted on a sting support of which the part near the model will remain unaltered for all tests. Angle of attack changes will be made by means of elbows in the sting placed about 10 inches back of the tail of the body.

(b) A duplicate of the wing-body model described in (a) but designed to obtain lift at angles of attack of 0°, ±3°, 10° and possibly others. No pressure orifices are required. The lift forces will be measured by means of an internal balance. The choice of balance will depend on what type appears most reliable. A strain gauge balance is tentatively being adopted.

6. It is requested that a job order be assigned to carry out this investigation.

RHW

Ray H. Wright
Physicist

Vernon G. Ward
Aeronautical Engineer

RHW:mh
VGW

BWC
ATM