Technical Comment

Comments on "Development of a Nonrecirculating Wind-Tunnel Configuration Insensitive to External Winds"

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REFERENCE 1 is significant in that it shows that the work of Leef and Hendry has confirmed in many respects the work leading to the configuration of the 15-ft 15-ft VSTOL wind tunnel at Hawker Siddeley Aviation, Hatfield. This was described by Kirk in Ref. 2. The present author would like to emphasize that this configuration has proved satisfactory in practice under climatic conditions which may well be more arduous than those anticipated by Leef and Hendry.

The H.S.A. 15-ft wind tunnel has been in continuous operation since 1965 and some of its work was described in Ref. 2. More recently the work has included civil and military VSTOL research and development programs including a significant part of the H.S.A. Harrier VTOL fighter development.

It has been our experience at H.S.A. that scale model work is essential for developing a wind tunnel of this type. Reference 2 mentions briefly the correlation obtained between model and full-scale measurements. One point which was learnt by bitter experience, however, was that in order to assess the over-all effect of external winds it was essential to test complete models of the wind tunnel. Tests on isolated parts, such as the front screen assembly, proved misleading.

When deciding the quality of flow required for VSTOL testing, it must be remembered that a great deal of testing will be required at very low velocities. It is, therefore, essential to calibrate over a much greater velocity range than for a conventional low-speed wind tunnel. Operation of the 15-ft wind tunnel has indicated that a reasonable minimum speed is about 30–40 ft/sec. At lower velocities, recirculation effects may occur with some models and also the accuracy of measuring the test section velocity becomes much more difficult. Therefore, the normal standard of $\pm 0.5\%$ for variation in tunnel dynamic head in low-speed wind tunnels becomes unreasonable at very low values of dynamic head. Also VSTOL models do not usually occupy such a large part of the wind-tunnel cross section, therefore, it is reasonable to relax the requirements over the outer parts of the test section. Having used this argument, one is then faced with having to test larger conventional models in order to obtain greater Reynold's numbers!

With regard to weather conditions, experience with the 15-ft wind tunnel has shown that external winds have not been such a severe problem as some authorities had suggested. The number of occasions on which external wind gusts have prevented the wind tunnel from running have been very few and repeatability checks during various wind conditions have been very good. It is true to say, however, that under gust conditions much greater care is required from the wind-tunnel crew in order to obtain satisfactory results. Typical runs may take 50% longer during gusty wind conditions. In this context we have not yet found an automatic speed control system which is better than an experienced human operator. Difficulty has also been experienced occasionally during very cold damp weather which caused ice to form on the control station Pitot static tubes and also on various parts of the model. This happened on two occasions during the winter of 1968–1969. During the summer months, we have a slight problem of contamination by insects being drawn into the test section and impinging on the leading edges of wings, struts, etc. These have to be cleaned periodically unless a transition fixing strip is required!

Continued operation of the 15-ft wind tunnel has confirmed that external winds have a greater effect on test section sidewash than upwash. This has manifested itself mainly in that difficulties under gusty conditions are most pronounced when floor mounted semispan models are being tested. This is presumably due to the two-dimensional nature of the intake arrangement. Several interesting questions arise as a result of this; the alternative of mounting semispan models from a vertical false wall and the validity of semispan models for VSTOL testing. These are techniques currently being investigated.

Two detail points arise from the work of Ref. 1. First, has the effect of heavy rainfall been considered in relation to porous slot proposed in the inlet roof? Second, mechanical reliability of the proposed flapper valves on the inside of the inlet enclosure would need to be very high as a partial blockage due to malfunction might well lead to distorted flow distributions in the test section.

In conclusion, the author would confirm that the nonrecirculating configuration has proved to be a thoroughly workable proposition for commercial VSTOL research and development. It would be wrong to say there are no problems but equally so, it would be wrong to say there are no problems with the large return circuit wind tunnels now in operation in various parts of the world. A dynamic head distribution within $\pm 1\%$ is not always easy to obtain.

The main problems that have been encountered are common to all VSTOL wind tunnels, namely, such items as getting compressed air ducted into the models, designing minimum interference support systems and coping with the extreme attitude angles required for VSTOL testing. Another problem has been that of overcoming the prejudice of conventional return circuit disciples.

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References

[1] Leef. C. R. and Hendry, R. G., "Development of a Nonrecirculating Wind-Tunnel Configuration Insensitive to External Winds," *Journal of Aircraft*, Vol. 6, No. 3, May–June, 1969.

[2] Kirk, J. A., "Experience with a VSTOL Wind Tunnel," *Journal of Royal Aeronautical Society*, Sept. 1969.