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An Experimental Study on Air Intakes for a Jet Lift Engine

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The air flow into the jet lift engines installed in a composite type VTOL (Vertical Take-Off and Landing) aircraft is generally turned by almost a right angle to the axis of the lift engine. That brings rather high total pressure losses at the engine entry, maldistribution of the intake velocity at the engine face and large attack angle of intake flow to the inlet guide vanes. These effects cause the thrust down of the engine, vibration of compressor vanes that leads to fatigue and damage.

By using the National Aerospace Laboratory's low speed wind tunnel the tests were conducted on four types bellmouth models (three of them are axis symmetry, and the remainder asymmetry) and on the flat scoop attached to the one of the symmetric bellmouth. The maximum velocity of air flow from wind tunnel simulated to the VTOL aircraft's forward speed was about 57 m/s (200 km/h), and the maximum intake volocity was about 180 m/s. The Reynolds Number was $(0.2-0.3)\times10^6$, taking the model engine diameter at the inlet guide vanes as the standard length.

The results indicate that the high total pressure losses and the maldistribution of air flow at the engine face occur in case of the bellmouth without scoop at high velocity ratio (forward speed / engine intake velocity) over 0 3—0.5, but with a scoop more than 30 degrees open, this bad effects are prevented to some extent. Out of the tests on the asymmetric bellmouth, the way to reduce these effects was led. The intake flow directions to the inlet guide vanes and distribution of static pressures on the bellmouth surface were also measured.

From these results of the tests the basic datum available for design of the inlet for jet lift engine was obtained, but further investigations with the actual conditions of installation of the lift engines to a VTOL aircraft will be needed, in course of full development of VTOL.

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