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# AERONAUTICAL INFORMATION CIRCULAR

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**Turbulence in the wake of large aircraft**

To highlight the dangers from turbulence in the wake of large aircraft.

The turbulence which an aircraft encounters when flying into the wake of another aircraft maybe of such severity as to make control difficult, or even induce failure of the primary structure following overloading caused by destructively energetic vortex turbulence in the wake of large aircraft. Jet efflux or propeller wash is only effective for a few hundred feet behind the originating aircraft and the turbulence experienced at greater range in the case of an aeroplane, arises mainly from the twin vortex system formed behind the wings. In the case of rotary wing aircraft similar vortices are created by the passage of the rotor blades, when it has more than about 30knots horizontal speed. As the intensity of the vortex system increases with aircraft weight and rotor size, turbulence will be greater in the wake of large aircraft.

Tests carried out in the U.K. with an aeroplane have shown that turbulence of this kind, in addition to varying with aircraft, also varies in relation to the wing loading, angle of attack and amount of flap. The most severe turbulence is to be expected in the wake of heavily loaded aircraft flying at low speeds. Flight experience has also suggested that the rate at which the vortices decay depends on the state of the air in which the aircraft is flying. If the layer of air in which the flight is being made is calm then the vortices can be expected to decay slowly, and under such conditions considerable turbulence may be expected to decay slowly, and under such conditions considerable turbulence may be expected several miles behind the aircraft.

The difficulty which a pilot may experience in controlling an aircraft in turbulence of this nature is due to the circulatory motion of the air. This circulatory motion can impart a rolling movement to an aircraft penetrating along the track of the vortices, which may be impossible to correct even by application of full aileron, and if caught between the cortices a strong downdraught will be experienced that could cause a sudden increase in rate of descent on approach, or a reduction in the rate of climb after take-off. The effect of the deflection of the air in the wake of large rotary wing aircraft may be comparable to a violent down gust.

Another form of encounter is a cross track penetration of the wake from another aircraft. This will subject the crossing aircraft to sudden changes of loading because of the rotary motion of the vortices which any instinctive control action by the pilot would tend to increase.

Although this type of encounter is generally less frequent and less serious than along track penetration of the vortices, it could be serious for low stressed aircraft crossing the wake close behind a large aircraft.

Several facts affect the external movements of vortices. In addition to being carried in the ambient wind the vortices have a downward movement imparted to them when they are shed, and near the ground an outward movement due to cushion effect, although the extent of the latter effect has not yet been measured by flight test, these factors should be borne in mind by a pilot trying to avoid turbulent wake when following a heavy aircraft for landing or take-off in weather conditions favourable for persistence of turbulent wake, i.e. when the surface wind is not very strong and there is little turbulence. In particular the following is advised:-

**Take off**

Light aircraft taking off from a runway which a large aircraft has just departed should start their take-off run from the end of the runway so as to be airborne before reaching the point at which the heavy aircraft lifted off. With a normal take-off and climb this should ensure that the light aircraft remains above the settling vortices of the heavy aircraft. A light aircraft taking off from a runway which intersects a runway from which a heavy aircraft has just taken off should ensure that its flight path is above the flight path of the large aircraft. If the take-off is being made after a heavy aircraft has landed the pilot should endeavour to become airborne beyond the point where the heavy aircraft touched down. The safest action is of course to delay take-off for approximately three minutes to permit the vortices to dissipate.

**Circuit area flying**

Pilots of light aircraft should avoid flying below and behind large aircraft in the circuit area. Pilots should if possible maintain a lateral separation from large aircraft at least several hundred feet and endeavour to fly above the flight path of the large aircraft at all times.

**Landing**

Maintaining the same above and behind position during final approach should place the pilot of a light aircraft in a good position to touch down beyond the point where a preceding large aircraft has landed. When a light aircraft is landing after a large aircraft has taken off, the pilot should aim to touch down well short of the point where the large aircraft has lifted off. Again as for take-off the safest action is to delay if possible to permit the vortex turbulence to dissipate.

Although vortex turbulence in the wake of large aircraft is without doubt the greater hazard, this is not to suggest that such turbulence generated by light aircraft can be disregarded. Accidents have occurred attributed to vortex turbulence from light aircraft. To avoid this possibility the same principles apply as for large aircraft.

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*This AIC is issued for information, guidance and necessary action.*