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WAKE TURBULENCE AND SEPARATION STANDARDS

INTRODUCTION

The hazards associated with wake turbulance have long been demonstrated by a number of accidents and incidents. There is at the present time insufficient understanding of the correlation between turbulant wake theory and operational experience to state with an acceptable degree of certainty what weight classifications should be denoted and what separation should be applied between them. In the meantime ICAO has issued guidance material and this forms the basics of procedures being introduced in Botswana with immediate effect.

CHARACTERISTICS

Wake turbulence vortices are present behind every aircraft, but are particularly severe when generated by large and wide-bodied jet aircraft. These vortices are two counter-rotating cylindrical air masses trailing aft from the aircraft. The vortices are most dangerous to following aircraft during the take-off, initial climb, final approach and landing phases of flight. They tend to drift down, and when close to the ground move sideways from the track of the generating aircraft occasionally rebounding upwards.

The characteristics of the wake vortex generated by an aircraft in flight are established initially by factors related to the aircraft gross weight, airspeed, configuration and wingspan. Subsequently, the vortices characteristics are altered and eventually dominated by interactions between the vortices and the ambient atmosphere. The wind,wind shear, turbulence and atmospheric stability affect the motion and decay of a vortex system.

Vortex wake generation begins on rotation when the nose wheel lifts off the runway and ends when the nose wheel touches down on landing. Vortex strength increases proportionally to weight, is greatest when the generating aircraft is heavy,is in a clean configuration and is slow.

Helicopters produce vortices when in -flight and there is some evidence that, per kilogramme of gross weight, their vortices are more intense than those of fixed wing aircraft. When hovering or while air taxiing they should be kept well clear of light aircraft.

Special attention needs to be given to situations of light wind, where vortices may stay in the approach and runway touchdown areas, or sink to the landing or take - off paths of succeeding aircraft.

WAKE TURBULANCE SEPARATION MINIMA-FINAL APPROACH

LEADING AIRCRAFT CATEGORY	FOLLOWING AIRCRAFT CATEGORY	MINIMA
Heavy	Heavy	4 NM
	Medium	5 NM
Medium	Heavy	3 NM
	Medium	3 NM
	Light	4 NM

These minima should be applied when;-

a) An aircraft is operating directly behind another aircraft at the same altitude or less than 1000FT below or
b) Both aircraft are using the same runway; or
c) An aircraft is crossing behind another aircraft at the six o'clock position.

DEPARTING AIRCRAFT

1. Except as set out in sub - paragraph (2) below, a minimum of 2 minutes will be applied between a light or medium aircraft taking off behind a heavy aircraft when they are using;-
    a) The same runway; or
    b) Crossing runways if projected flight paths will cross.
2. A separation of 3 minutes will be applied between a light or medium aircraft when taking - off behind a heavy aircraft from an intermediate part of the same runway.

DISPLACED LANDING THRESHOLD

A separation minimum of 2 minutes will be applied between a light or medium aircraft and a heavy aircraft when operating on a runway with a displaced landing threshold when:-

a) A departure follows a heavy aircraft arrival; or
b) An arrival follows a heavy aircraft departure if the projected flight paths are expected to cross.

OPPOSITE DIRECTION

A separation minimum of 2 minutes will be applied between a light or medium aircraft, and a heavy aircraft making a low or missed approach when:-

a) Utilising an opposite direction runway for take – off; or
b) Landing the same runway in the opposite direction.

EFFECTS OF WAKE TURBULANCE ON AIRCRAFT

The three basic effects of wake turbulence on a following aircraft are impossed roll, loss of hight, or rate climb and possible structural stress. The greatest danger is the impossed roll on the penetrating aircraft to a degree exceeding its counter control capability. Should the vortex encounter occur in the approach area, its impact is hightened because the following aircraft is in a critical state with regard to speed thrust, altitude and reaction time.

WAKE TURBULENCE CATEGORISATION OF AIRCRAFT

Wake turbulence separation minima are based on a grouping of aircraft types into three categories according to the maximum certificated take – off weight. The three categories, which correspond to those to be entered in item nine (9) of the flight plan form are;-

a) Heavy (H) - All aircraft types of 136 000kg (300 000lb) or more;
b) Medium (M) - Aircraft types of less than 136 000kg (300 000lb) and more than 7 000kg (15 500 lb) and
c) Light (L) – Aircraft types of 7 000kg (15 500 lb) or less

APPLICATION OF WAKE TURBULENCE MINIMA

Wake turbulence minima are intended to minimise the potential hazards of wake turbulence. When the separation minima normally required for IFR purposes is greater than for wake turbulence, such IFR minima will apply.

Wake turbulence minima may be applied for any situation not covered by specific minima when ever ATC believes there is a potential hazard due to wake turbulence. Since wake turbulence is invisible, its presence and exact location can not be determined with precision. Consequently, all concerned should thorouly understand the likely situations where hazardous wake turbulence may be encouraged.
Air Traffic Control is able to ensure sepation of departing traffic by regulation of take – off times necessary.
In the absence of any radar service in Botswana, pilots should be aware of the circumstances in which the minima in respect of the arriving aircraft need to be applied. These are when flights are approaching visually e.g:-

a) IFR flights making visual approaches, or maintaining VMC and they are on separation; or
b) VFR flights

When minima in respect of arriving aircraft apply, pilots will be advised of the required spacing and must then ensure that the required separation is established and maintained.

When the separation is given in minutes, this is the time required before the flight paths of the two conflicting aircraft cross or intersect.

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