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General guidelines for Operation in Turbulence

For monitoring execution it is advised to use TCAS indicator on VS, as well as readout of time intervals determined by a stop-watch. In any case the flight crew has the right, if necessary, to request the increased interval for take-off or landing.

The highest goal of the International Civil Aviation Organization (ICAO) is to identify and monitor existing types of threats to aviation security in civil aviation. After that, effective and adequate measures to eliminate emerging risks are developed and implemented.

Ensuring the timely implementation of ICAO provisions is carried out by constantly monitoring the progress of their implementation in States.

In turn, scientific research is being carried out in all states, a flight safety management system is being created, covering all areas of flight support and flight operation.

Undoubtedly, the flight operation of aircraft has been and remains the main and determining factor in this system. Operation in difficult climatic conditions, turbulence conditions deserves special attention.

This area of research has been and remains very challenging in practical experiments and theoretical analysis.

Therefore, practical experience in research for science is very important and valuable.

Wake turbulence is generated by a pressure disparity between the lower and upper wing surface. This pressure exchange causes counter rotating in the opposite direction vortices trailing from the external wing tips. The larger the aircraft is the larger those vortices will be. The wake of a large aircraft may require large control inputs when flying in the area after preceding aircraft. Those control inputs may exceed the roll control capability of an aircraft. the pilot must envisage the location of the vortex wakes generated by the preceding aircraft and adjust his flight path. Tests with large/heavy aircrafts have shown that the wake vortex flow field - in a plan of cutting through the wake at any downstream point covers an area exceeding about twice the wing span area in width and one wing span in depth. The vortices from the two tips remain spaced and will drift with the wind.

The vortices will sink with a rate of descent of 400-500 fpm. There is a tendency that the vortices will level off about 800-1,000 ft below the flight path of the vortex-generating aircraft. Vortex strength diminishes with time and distance behind the aircraft. Vortex generation will begin on rotation when the nose wheel lifts off the ground and ends, when the nose wheel touches down on landing. In conditions with very weak or calm winds, the remaining vortices from a landing aicraft may pereserve up to 5 min or even longer.

All this has prompted National Civil Aviation Authority Body and the ICAO to establish minimum separation criteria.

In case when an adequate separation cannot be provided - or when vortices are still perceptible (despite of the adequate spacing), the following shall be bore in mind:

- while taking off, note the take off point of the preceding aircraft. If possible operate an aircraft take off form the point prior to the take off point of the preceding aircraft. If it impossible, a take-off is to be delayed for some seconds - subject to aircraft and wind conditions on ground.

- while approach/landing behind a vortex generating aircraft, if runway length permits attempt to land at a runway touchdown past the touchdown of the heavier aircraft.

- while approaching behind a vortex generating aircraft, it shall be realized, that flying above the flight path of the proceeding aircraft means avoiding the vortex areas at least until touchdown.

However under windshear conditions and head wind over the runway surface, while the tail wind prevailed at approach, wake vortices may shift ahead and even upward, above a flight path of preceding aircraft. So, one must be ready to abnormal aircraft behavior and automatic landing impracticability.

The following figures may illustrate the problem of wake vortices.

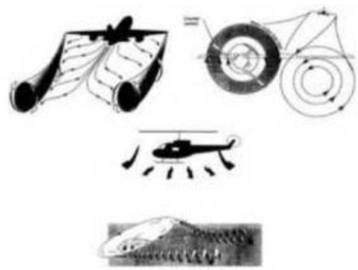

Fig.2 Illustrate the problem of wake vortices.

An aircrat operating in complaince with VFR will be informed about heavier aicrcraft types when they may affect it.

Aicrafts and vehicles will also be cautioned about wake turbulence whenever the potential for it exists.

Thus, rolling take-off by a heavy aircrat will not be approved if its jet engine blast may be hazardous to a following aircrat or vehicle, or to taxiway lights. Helicopters hovering or airborne should be kept well clear of light aircrafts while taxiing.

An aircraft approaching behind a departing heavy aircraft, or a medium aircraft, using a crossing runway will be warned if flight paths cross.

An aircraft approaching behind a heavy aircraft, or a light aircraft approaching behind a medium aircraft, shall be warned while approaching about tt) the same runway; s) a parallel runway with centerlines less than 760m (2500 ft) away, a crossing runway if their flight paths cross.

In cases of getting into wake turbulence at flight level within MNPS area it is allowed to follow lateral deviation stipulated by AERONAUTICAL INFORMATION CIRCULAR, Application of Strategic Lateral Offsets in North Atlantic Region

Airspace. In case of wake turbulence, if considered necessary, the pilot may offset from the cleared track by up to a maximum of 2NM in order to alleviate the effects of wake turbulence. ATC should be advised of this contingency action but will not issue clearance for any such lateral offset. The aircraft should be returned to cleared track as soon as the situation allows.

General guidelines for Operation in Turbulence/Windshear and Thunderstorms:

- Fasten shoulder harness.
- Switch on cockpit lighting to high intensity to avoid dazzling by lightning in thunderstorm.
- Turn off the autothrottle and set manually prescribed engine thrust to maintain necessary airspeed.
- Use Autopilot, as recommended in AOM.
- Fly the recommended turbulence speed according to AOM.
- Switch on engine ignition and/or de-icing equipment according AOM procedures.

Altitude

At maximum cruise altitude, the margin between low speed and high speed buffet is rather small and any increase of G-loads, whether caused by maneuvering or by turbulence, may lead to serious difficulties. This shall be considered when trying to top a turbulence region. Therefore do not select maximum cruise altitude. Allow altitude to vary. Large altitude variations are possible in severe turbulence. Sacrifice altitude in order to maintain the desired attitude and airspeed. Never chase altitude!

Large and persistent altitude variations may smoothly be corrected by only small elevator inputs and appropriate power corrections.

Large speed fluctuations and difficulties in instrument reading are to be expected due to yawing and head-on gusts, therefore: Do not chase airspeed!

Airspeed setting

Maintain the recommended turbulence speed as target speed. Set thrust as required and then do not change it unless required by large and/or persistent airspeed or altitude variations. The aircraft's real airspeed will remain within reasonable limits as long as thrust is set properly, while avoiding large and rapid throttle movements, and a reasonable constant attitude maintained. If caught unaware by turbulence, do not slow down aircraft hurriedly.

Attitude

Control pitch attitude with smooth control inputs to the elevator. Closely monitor the EADI/FD as it is the only instruments that may be seriously erratic. Maintain Constant Attitude!

Use of Autopilot and Flight Director.

Since the autopilot will not be subject or false attitude interpretations or difficulties in erratic instruments, its use in the appropriate mode is strongly recommended.

The Flight Director can effectively reduce workload and is therefore recommended for use in turbulence. It will give a good reference for control about all axes and will further call for proper control inputs.

Recovery

Should control be partially lost due to severe turbulence, resulting in a steep dive, the following recommendations may be helpful for a successful recovery:

- Use appropriate means to prevent a rapid speed build-up. The pitch up effect caused thereby is secondary to the need to keep the speed at a reasonable value.
- Elevator forces can become very heavy as speed increases, thus being a safeguard against excessive g-loads. If stabilizer trim is used for recovery, use it with utmost caution so as to avoid heavy loads and a possible overtrim which could result in a renewed loss of control.
- If strong elevator forces are applied, the trim motors might become ineffective (stalled). By reducing the elevator forces, the trim motors will be enabled to drive the stabilizer in the desired direction.

Conclusions

Flight crews should consider probability of getting into wake turbulence during take-off, landing or flying at prescribed flight level. Within take-off and landing area the responsibility for adhereing to the minimal recommended intervals is assigned to ATC Department in the presence of continuous radar control. In case of VFR operations the flight crew bears the responsibility adhereing to the minimum recommended intervals. For monitoring execution it is advised to use TCAS indicator on VSI, as well as readout of time intervals determined by a stopwatch. In any case the flight crew has the right, if necessary, to request the increased interval for take-off or landing.

References

1. Doc.4444 (4.9.1.1 4.9.1.2) - Air Traffic Management-ICAO