

OFFICIAL



Australian Government
Civil Aviation Safety Authority

**ADVISORY CIRCULAR
AC 91-16 v1.2**

Wake turbulence

File ref: D25/238803

July 2025

OFFICIAL



Acknowledgement of Country

The Civil Aviation Safety Authority (CASA) respectfully acknowledges the Traditional Custodians of the lands on which our offices are located and their continuing connection to land, water and community, and pays respect to Elders past, present and emerging.

Artwork: James Baban.

Advisory circulars are intended to provide advice and guidance to illustrate a means, but not necessarily the only means, of complying with the Regulations, or to explain certain regulatory requirements by providing informative, interpretative and explanatory material.

Advisory circulars should always be read in conjunction with the relevant regulations.

Audience

This Advisory Circular (AC) is relevant to pilots, operators and persons providing air traffic services.

Purpose

The purpose of this AC is to provide foundational information on wake vortex behaviour, alert pilots to the hazards of aircraft wake turbulence and to outline recommended operational procedures to avoid or manage wake turbulence encounters.

For further information

For further information or to provide feedback on this AC, visit CASA's [contact us](#) page.

Status

This version of the AC is approved by the National Manager, Flight Standards Branch.

Note: Changes made in the current version are annotated with change bars.

Table 1: Status

Version	Date	Details
v1.2	July 2025	The following changes have been made: <ul style="list-style-type: none"> added new advisory material in section 1.3 related to helicopter downwash added additional information in section 3.2 on helicopter wake turbulence encounters and separation requirements added a note to section 3.3 created new section 6.1 to enable the numbering of existing paragraphs that immediately followed the section 6 title, which also required the re-numbering of existing section 6.1 as section 6.2 new CASA style template applied.
v1.1	September 2023	Added information about wake turbulence categories.
v1.0	December 2020	Initial AC.

Unless specified otherwise, all subregulations, regulations, Divisions, Subparts and Parts referenced in this AC are references to the *Civil Aviation Safety Regulations 1998 (CASR)*.

Contents

1	Reference material	5
1.1	Acronyms	5
1.2	Definitions	5
1.3	References	6
1.4	Acknowledgement	7
2	Introduction	8
2.1	What is wake turbulence?	8
3	Characteristics of wake vortices	9
3.1	General characteristics	9
3.2	Helicopter vortices	9
3.3	Vortex encounters	11
3.4	Encountering a wake vortex?	11
3.5	Effect on the trajectory of the follower	12
3.6	Severity of the encounters	12
3.7	Duration of an encounter	12
4	Pilot action to avoid wake vortices	13
4.1	Departing behind a larger aircraft— same runway	13
4.2	Landing behind a larger aircraft— same runway	14
4.3	Landing behind a larger aircraft— parallel runways	14
4.4	Landing behind a larger aircraft— crossing runways	15
4.5	Landing behind a departing larger aircraft— same runway	16
4.6	Landing behind a departing larger aircraft— crossing runways	16
4.7	En route	17
4.8	Operating near helicopters	18
4.9	Further pilot action in relation to wake vortices	18
5	Pilot action when encountering wake turbulence	20
5.1	General information	20
5.2	Warning regarding the use of rudder	20
5.3	Recommended pilot response	20
6	Wake vortex separation – ATC measures	21
6.1	Wake turbulence separation minima used by ATC	21
6.2	Pilot initiated waiver of wake turbulence separation	22

1 Reference material

1.1 Acronyms

The acronyms and abbreviations used in this AC are listed in the table below.

Table 2: Acronyms

Acronym	Description
AC	advisory circular
AIP	Australian Information Publication
ATC	air traffic control
EASA	European Aviation Safety Agency
FAA	Federal Aviation Administration
MTOW	maximum take-off weight
NM	nautical mile(s)
SIB	Safety Information Bulletin
SLOP	strategic lateral offset procedure
VMC	visual meteorological conditions

1.2 Definitions

Terms that have specific meaning within this AC are defined in the table below. Where definitions from the civil aviation legislation have been reproduced for ease of reference, these are identified by 'grey shading'. Should there be a discrepancy between a definition given in this AC and the civil aviation legislation, the definition in the legislation prevails.

Table 3: Definitions

Term	Definition
maximum take-off weight	for an aircraft, means the maximum take-off weight for the aircraft permitted by: <ol style="list-style-type: none"> a. for an aircraft that is type certificated—the flight manual for the aircraft; or b. for an aircraft that is not type certificated: <ol style="list-style-type: none"> i. if a document, published by the manufacturer of the aircraft setting out the operating limitations for the aircraft, specifies a weight—that document; or ii. if the certificate of airworthiness for the aircraft specifies a different weight to the weight specified in the document mentioned in subparagraph (i)—the certificate of airworthiness for the aircraft; or iii. if no weight is specified in the document mentioned in subparagraph (i) or in the certificate of airworthiness for the aircraft and the aircraft is a Part 103 aircraft in relation to which a statement of acceptance for the aircraft has been issued by a Part 103 ASAO in accordance with regulation 103.030—the weight specified in the

Term	Definition
	statement of acceptance.
wake turbulence category	<p>means one of the following:</p> <ul style="list-style-type: none"> • SUPER – Airbus A380 • HEAVY – All other aircraft types with a maximum take-off weight (MTOW) of 136 000 kg or more • MEDIUM – Aircraft types with an MTOW of less than 136 000 kg, but more than 7 000 kg • LIGHT – Aircraft types with an MTOW of 7 000 kg or less.

1.3 References

Legislation

Legislation is available on the Federal Register of Legislation website <https://www.legislation.gov.au/>

Table 4: Legislation references

Document	Title
Part 91 of CASR	General operating and flight rules
Part 172 of CASR	Air traffic service providers
Part 172 Manual of Standards	Air traffic services

International Civil Aviation Organization documents

International Civil Aviation Organization (ICAO) documents are available for purchase from <http://store1.icao.int/>

Many ICAO documents are also available for reading, but not purchase or downloading, from the ICAO eLibrary (<https://elibrary.icao.int/home>).

Table 5: ICAO references

Document	Title
Doc. 4444	Doc 4444 AN/501 titled Procedures for Air Navigation Services – Air Traffic Management (PANS-ATM) approved by the Council of the International Civil Aviation Organization, as in force from time to time.

Advisory material

CASA's advisory materials are available at <https://www.casa.gov.au/publications-and-resources/guidance-materials>

Table 6: Advisory material references

Document	Title
AC 91-29	Guidelines for helicopters - suitable places to take-off and land
AC 139.R-01	Guidelines for heliports - design and operation

Document	Title
Helicopter Rotor Downwash Safety Guidebook	Preventing the Adverse Effects of Rotor Downwash. Director Générale de l'Aviation Civil (DGAC) France and French Aviation Safety Network (RSAF) (https://www.ecologie.gouv.fr/sites/default/files/documents/guidance_material_helicopter_downwash.pdf)

1.4 Acknowledgement

- 1.4.1 This AC contains information and advice originally published in Federal Aviation Administration (FAA) Advisory Circular (AC) 90-23G, European Aviation Safety Agency (EASA) Safety Information Bulletin (SIB) No. 2017-10, the Airbus safety magazine – Safety first (Ed. January 2016) and The United States Helicopter Safety Team website - Meiris, J. (n.d.). Avoiding helicopter wake turbulence. <https://ushst.org/avoiding-helicopter-wake-turbulence/>

2 Introduction

2.1 What is wake turbulence?

- 2.1.1 All aircraft generate wake vortices, also known as wake turbulence. When an aircraft is flying, there is an increase in pressure below the wing and a decrease in pressure on the top of the aerofoil. Therefore, at the tip of the wing, there is a differential pressure that concentrates the roll up of the airflow aft of the wing tip. Limited smaller vortex swirls also exist for the same reason at the tips of the flaps. Behind the aircraft all these small vortices mix and roll up into two main vortices turning in opposite directions — clockwise behind the left wing (seen from behind) and anti-clockwise behind the right one wing (see Figure 1).

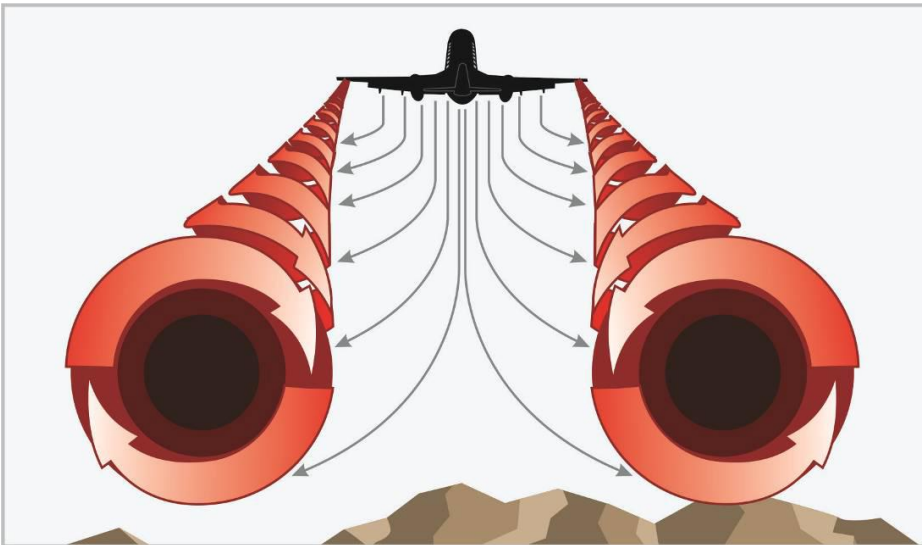


Figure 1: Development of wingtip vortices

(Source: FAA AC 90-23G.)

3 Characteristics of wake vortices

3.1 General characteristics

- 3.1.1 Wake vortex generation begins when the nose wheel lifts off the runway on take-off and continues until the nose wheel touches down on landing. It has the following general characteristics:
- Size:** The active part of a vortex has a very small radius, not more than a few metres. However, there is a lot of energy due to the high rotation speed of the air.
 - Intensity:** The characteristics of the wake vortices generated by an aircraft in flight are determined initially by the aircraft's gross weight, wingspan, aircraft configuration and attitude. Generally, the heavier the aircraft, the more intense are the wake vortices. However, there are exceptions – for example, the Boeing 757 generates particularly intense wake vortices that require special treatment for wake turbulence separation purposes.
 - Descent rate:** In calm air, a wake vortex descends slowly. As an order of magnitude, in cruise, it could be 1 000 feet below and behind the generating aircraft at a range of around 15 nautical miles (NM). Then, when far away from the generating aircraft, the rate of descent becomes very small. In approach, the descent is usually limited to around 700 feet. However, depending on weather conditions the descent rate may vary significantly and may even be very small. One of the key factors affecting this descent rate is the variation of the temperature with the altitude. A temperature inversion can limit the rate of descent.
 - Decay rate:** One important parameter of a wake vortex is the decay of its strength with time. The decay rate varies slightly from one aircraft type to another and is also affected by environmental conditions. Unfortunately, in calm air and due to low external interference, the rate of decay is low, and this is why the separation between aircraft needs to be so large. In the en-route environment, wake can be encountered more than 25 NM behind the generating aeroplane. The most significant encounters are reported within 15 NM.
 - Ground effect:** When the aircraft is close to the ground, less than a wingspan, the two vortices tend to drift out from the centre line, each towards its own side, at a speed of around 2 to 3 knots. It is this phenomenon, when associated with a light crosswind component that tends to hold the 'into wind' vortex roughly on the centreline, whilst the 'downwind' vortex moves away. Wake vortex decay is much faster in ground effect compared to higher levels.

3.2 Helicopter vortices

- 3.2.1 A hovering or slow hover-taxiing helicopter generates a downwash from its main rotor(s). The downwash can contain high wind speeds within a three-rotor diameter of the helicopter. In forward flight even when slow, the downwash energy is transformed into a pair of strong, high-speed, trailing vortices similar to wing-tip vortices of larger fixed-wing aircraft. (See Figure 2 and Figure 3).

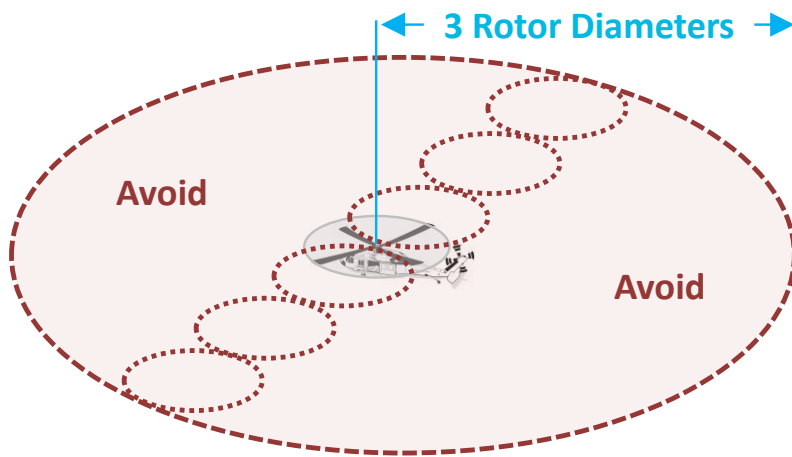


Figure 2: Downwash during slow hover taxi and stationary hover

(Source: FAA AC 90-23G.)

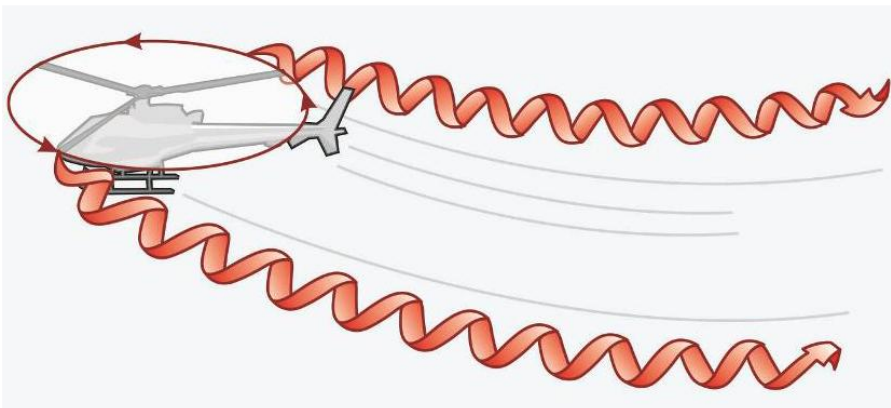


Figure 3: Helicopter wake turbulence during forward flight

(Source: FAA AC 90-23G.)

- 3.2.2 Pilots of small aircraft should avoid operating within 3 rotor diameters of any helicopter in a slow hover taxi or stationary hover. In forward flight, departing or landing helicopters produce a pair of strong, high-speed trailing vortices similar to wing tip vortices of larger fixed wing aircraft. Pilots of small aircraft should use caution when operating behind, or crossing behind, landing and departing helicopters [source FAA Aeronautical Information Manual - Chapter 7, Section 4, 7-4-7].
- 3.2.3 Flight tests have demonstrated that helicopter wake turbulence is comparatively larger and less predictable in its behaviour than for aeroplanes of the same weight. Helicopter rotor vortices can descend, remain level or climb, and the duration of their persistence can increase significantly in conducive weather conditions.
- 3.2.4 The United States Helicopter Safety Team website - Meiris, J. (n.d.). Avoiding helicopter wake turbulence. <https://ushst.org/avoiding-helicopter-wake-turbulence/> - recommends:
- remaining 3 rotor disks clear of a hovering or taxiing helicopter
 - for forward flight allowing a minimum 3 NM and/or 2 minutes for the rotor wake from a preceding helicopter to dissipate.
- 3.2.5 Pilots and operators should note helicopter wake turbulence encounters are possible during any stage of the flight when operating within reasonable proximity of another operating helicopter. For example, when enroute in busy helicopter access or transit lanes or when being

overtaken enroute by another larger or higher performance rotorcraft. In these situations, pilots in command must apply appropriate vertical and/or horizontal separation strategies to ensure a wake turbulence encounter does not impact on the safety of their operation.

Example

When enroute in busy helicopter access or transit lanes or when being overtaken enroute by another larger or higher performance rotorcraft. In these situations, pilots in command must apply appropriate vertical and/or horizontal separation strategies to ensure a wake turbulence encounter does not impact on the safety of their operation.

3.3 Vortex encounters

3.3.1 When an aircraft enters the vortex of another aircraft, the situation is called an encounter. The aircraft emitting the vortex is called the generator and the one experiencing it, the follower.

Note: See section 3.2 for information on helicopter wake vortex encounters.

- 3.3.2 It is not possible to implement navigation procedures where the probability of an encounter is zero. For example, during Airbus wake vortex flight tests in the cruise, Airbus A319 vortices were identified at a range of 42 NM. An encounter with such a vortex is obviously very weak and would have been stronger behind an aircraft with a wake turbulence classification of Super or Heavy. During terminal area operations, it is also common to encounter wake turbulence at distances greater than the air traffic control (ATC) minimum wake turbulence separation distances.
- 3.3.3 Avoiding all encounters would require very significant spacing and would dramatically limit the traffic on all airports and airways without significantly improving safety. It is also to be noted that statistics show that the probability of injury to passengers and crew is about five times greater in turbulence due to weather, than with a wake vortex encounter.

3.4 Encountering a wake vortex?

- 3.4.1 In most cases the effect of the vortex is mainly felt in roll. Consider the case of an aircraft entering laterally in a vortex, which is the most frequent situation. Assuming the lead aircraft is crossing the track of the following aircraft from left to right, the following aircraft will enter the right vortex of the leading aircraft on the following aircraft's left side. Seen from behind, this vortex is rotating anticlockwise. When the left wing of the follower first enters the vortex, there is a local angle of attack increase and the lift on the wing becomes greater than on the right wing. The initial roll motion is therefore to the right. Then, when the aircraft is in the middle of the vortex, it will be subjected to the full strength of the vortex and roll in the same direction as the vortex, to the left (see Figure 4). This is the main rolling motion that creates the strongest roll acceleration.
- 3.4.2 The typical signature of a severe encounter is an initial small roll in one direction followed by a much more significant roll in the other direction. When in cruise, this roll motion may be associated with significant load factor variations.

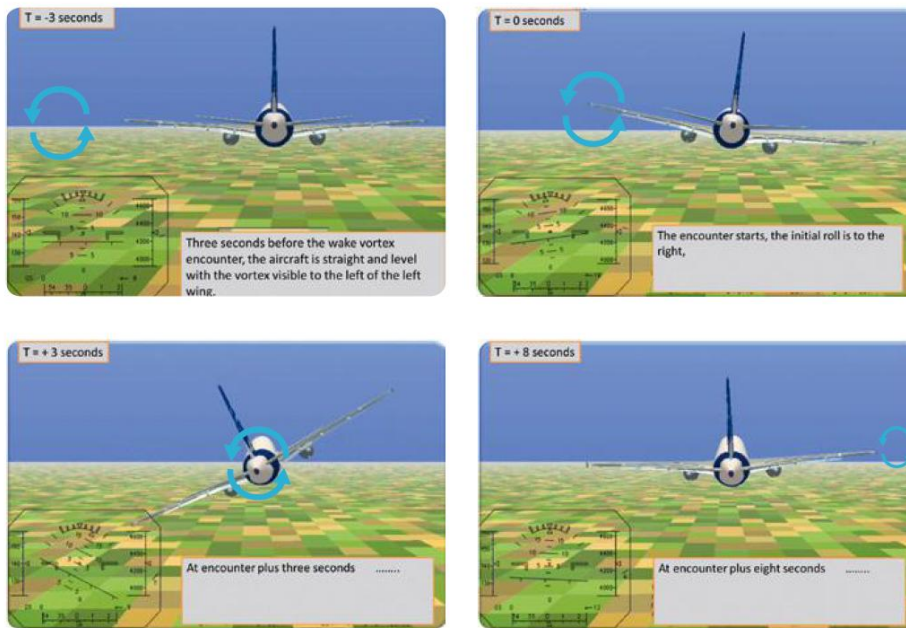


Figure 4: Aircraft behaviour in a wake vortex encounter (Bank angle exaggerated to show the effect)

(Source: Airbus safety magazine – *Safety first* (January 2016 Edition))

3.5 Effect on the trajectory of the follower

3.5.1 To experience a severe roll encounter, it is necessary for the follower to have a trajectory with a small closing angle with the vortex. However, if this angle is too small, the aircraft will be smoothly ejected from the vortex (due to the initial roll in the example above). When perpendicular, there will be no rotation, and any encounter will be a very brief but sharp turbulence effect. To experience a severe encounter, the most critical angle between the trajectory of the follower and the vortex is around 10 degrees.

3.6 Severity of the encounters

3.6.1 When aircraft are separated by the appropriate ATC separation minimum, the severity of the encounters should not result in an unsafe control situation. When the aircraft is not in ground effect, the order of magnitude of the bank angle for a severe encounter on the approach is around 20°. But when in ground effect, as explained in subparagraph 3.1.1 (e), the decay is much faster and the worldwide experience over many years shows that the bank angle achieved is much lower and does not lead to a risk of touching the ground with the wingtip.

3.7 Duration of an encounter

3.7.1 A severe encounter, as described above, where the trajectories of both aircraft have an angle around 10°, typically lasts around 4 to 6 seconds. It is not possible to remain for a long time in a severe vortex as the rotating airflow on the wing and on the fin, will eject the aircraft from the vortex. Recent Airbus flight tests showed that a large aircraft can only be stabilised inside a vortex if a large sideslip angle is established. Therefore, a vortex should not be the cause of long duration turbulence during normal flight.

4 Pilot action to avoid wake vortices

This section provides specific guidance for wake turbulence avoidance in certain situations on departure and landing. It is most applicable in situations where ATC is not providing wake turbulence separation (i.e. operations at non-controlled aerodromes or when a pilot accepts responsibility for own separation from another aircraft). However, it can also be used by pilots to reduce the likelihood or severity of a wake turbulence encounter.

Pilots should have keen awareness about avoiding wake vortices in all stages of flight. It is useful to exercise vortex visualisation and avoidance procedures using the same degree of awareness as for collision avoidance.

For any advice in this section about noting a larger aircraft's rotation or touchdown point, be aware that the prevailing wind will displace the vortices. For example, a 20-knot headwind will, in one minute, displace the vortices by 600 m in the direction of the threshold.

4.1 Departing behind a larger aircraft— same runway

4.1.1 When departing behind a larger aircraft on the same runway, pilots should:

- If possible, note the larger aircraft's rotation point and visualise the movement of the vortices as a result of the prevailing wind.
- Endeavour to rotate prior to the larger aircraft's rotation point or anticipated position of the wake vortices as a result of the surface wind.
- Continue climb above the larger aircraft's climb path until turning clear of the wake (see Figure 5).
- Avoid subsequent headings which will cross below and behind the larger aircraft (see Figure 6).
- Be alert for any critical take-off situation which could lead to a vortex encounter.

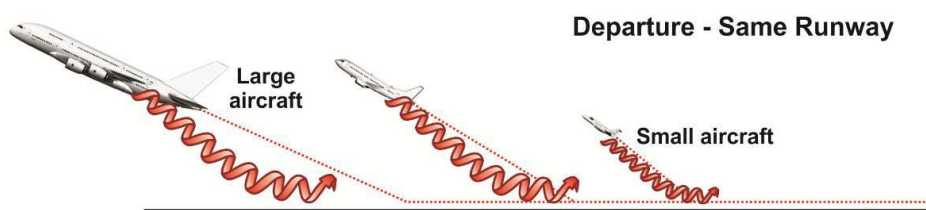


Figure 5: Departing same runway behind a larger aircraft

(Source: FAA AC 90-23G.)

- 4.1.2 **Intersection take-offs.** When conducting intersection take-offs, pilots should note the larger aircraft's rotation point and visualise the movement of the vortices as a result of the prevailing wind. Rotate prior to the larger aircraft's rotation point or anticipated position of the vortices. Also, be alert to adjacent large aircraft operations, particularly upwind of your runway. If intersection take-off clearance is received, avoid a flightpath which will cross below a larger aircraft's flightpath.
- 4.1.3 **Departing or landing after a larger aircraft executing a low/missed approach or touch-and-go landing.** Because vortices settle and move laterally near the ground, the vortex hazard may exist along the runway and in your flightpath after a larger aircraft has executed a low/missed approach or a touch-and-go landing, particularly in light quartering wind conditions. You should ensure that an interval of at least 2 mins has elapsed before your take-off or landing (and at least 3 mins when operating behind Super aircraft).

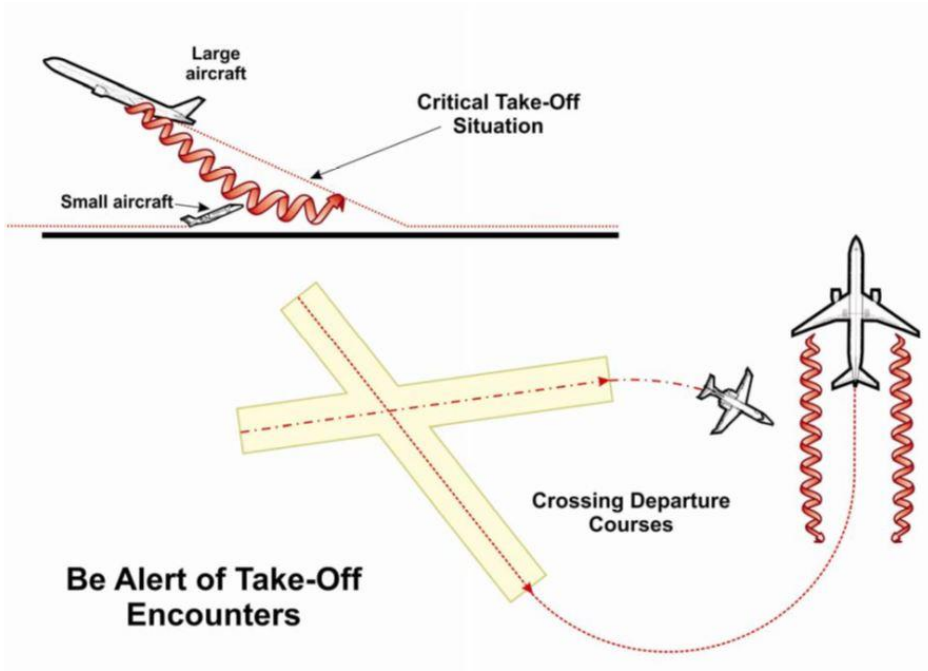


Figure 6: Critical take-off situation and crossing departure courses

(Source: FAA AC 90-23G.)

4.2 Landing behind a larger aircraft— same runway

4.2.1 When landing behind a larger aircraft on the same runway stay at or above the larger aircraft’s final approach flightpath. Note the touchdown point and land beyond it (see Figure 7). See Section 4.9 for advice relevant to larger aircraft.

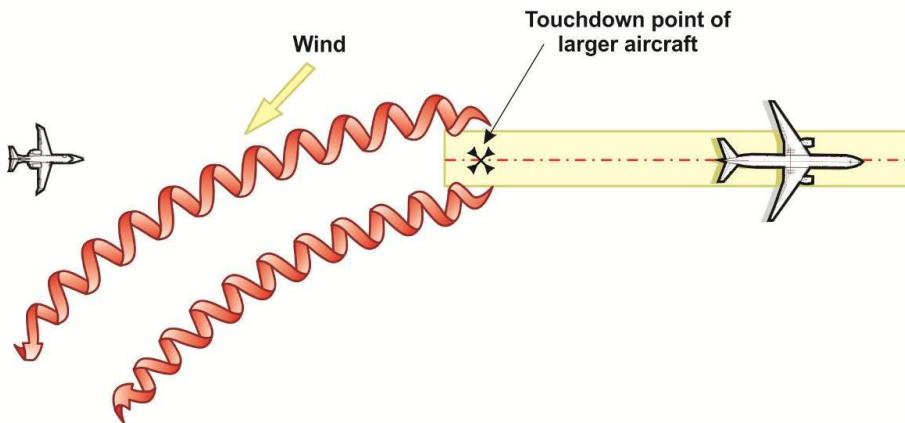


Figure 7: Avoidance procedures landing behind larger aircraft on the same runway

(Source: FAA AC 90-23G.)

4.3 Landing behind a larger aircraft— parallel runways

4.3.1 When landing behind a larger aircraft on a parallel runway, particularly runways spaced closer than 760 m apart, pilots need to consider the relationship between the runway threshold locations, the relative descent paths/locations, and possible vortex drift onto your runway. If you

have visual contact with the larger aircraft landing on the parallel runway, whenever possible, stay at or above the larger aircraft’s final approach flightpath. Note its touchdown point. Be aware that the aircraft descending to the more distant threshold will generally be slightly higher depending on the amount of threshold stagger (see Figure 8).

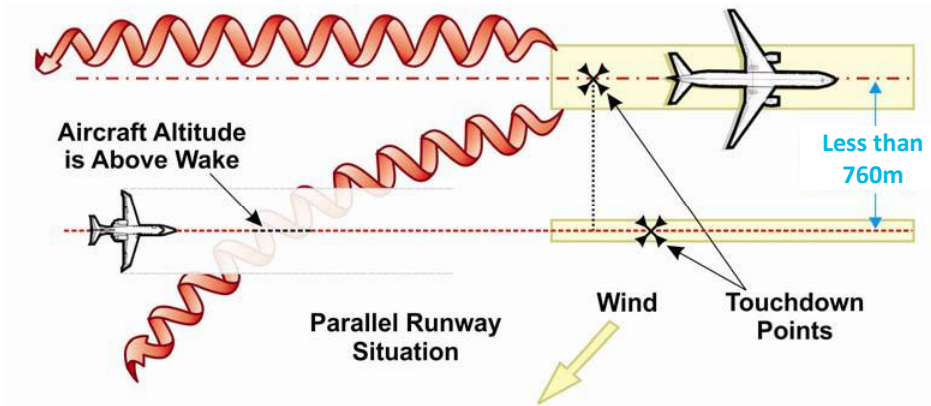


Figure 8: Avoidance procedure landing on parallel runways closer than 760 m apart

(Source: FAA AC 90-23G.)

Note: While the guidance refers to parallel runways spaced less than 760 m apart, wake vortex encounters can occur during operations on parallel runways with wider spacing. Hence the guidance is relevant for parallel runways generally.

4.4 Landing behind a larger aircraft— crossing runways

4.4.1 When landing behind a larger aircraft on a crossing runway, pilots should adjust the aircraft’s flight path to create at least 3 mins spacing at the point of intersection with the other aircraft’s vortices (see Figure 9). Avoid crossing above the larger aircraft’s flightpath because this can result in a long landing.

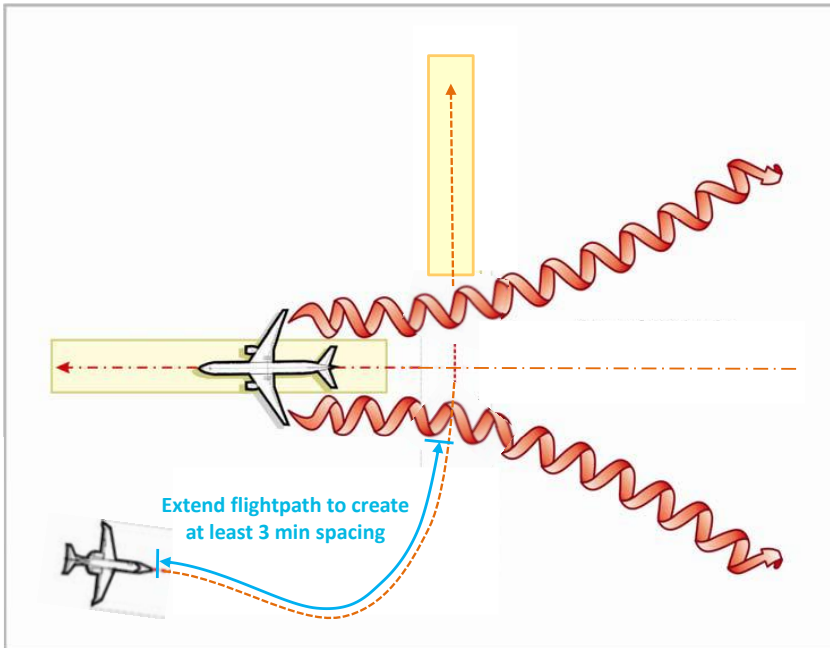


Figure 9: Avoidance procedure for landing behind larger aircraft that is using a crossing runway
 (Source: FAA AC 90-23G.)

4.5 Landing behind a departing larger aircraft—same runway

4.5.1 When landing behind a departing larger aircraft on the same runway, pilots should note the larger aircraft’s rotation point and visualise the movement of the vortices as a result of the prevailing wind. Endeavour to touch down well before the larger aircraft’s rotation point or anticipated position of the wake vortices as a result of the surface wind (see Figure 10).

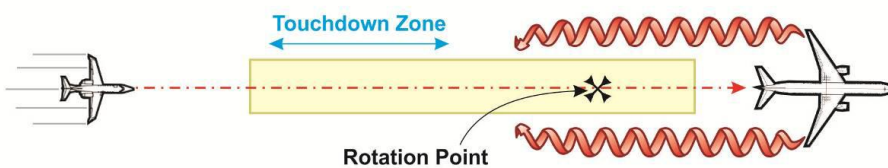


Figure 10: Avoidance when landing behind a departing aircraft on the same runway
 (Source: FAA AC 90-23G.)

4.6 Landing behind a departing larger aircraft—crossing runways

4.6.1 When landing behind a departing larger aircraft on a crossing runway, pilots should note the larger aircraft’s rotation point. If rotation is past the intersection, continue the approach and land before the intersection. If the larger aircraft rotates prior to the intersection, avoid flight below the larger aircraft’s flightpath. Consider abandoning the approach unless a landing is ensured well before reaching the intersection (see Figure 11). Account for anticipated movement of the wake vortices as a result of the surface wind.

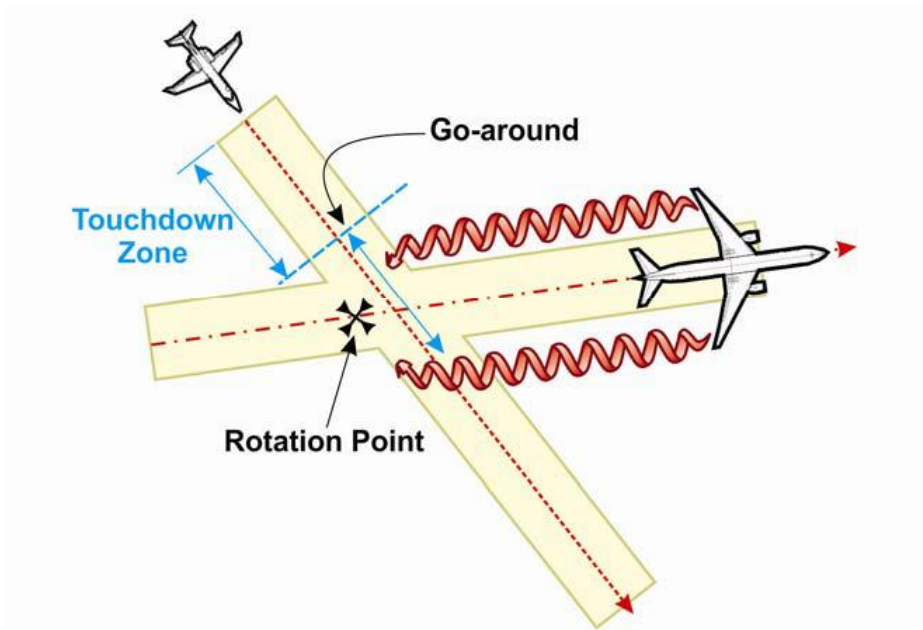


Figure 11: Avoidance for landing when larger departing aircraft rotates prior to the intersection

(Source: FAA AC 90-23G.)

4.7 En route

4.7.1 En route — outside controlled airspace

- 4.7.1.1 Pilots should avoid flight below and behind a larger aircraft's flightpath. If a larger aircraft is observed above on the same track (meeting or overtaking), adjust your position laterally, preferably upwind.

4.7.2 En route — inside controlled airspace / oceanic airspace

- 4.7.2.1 In surveillance airspace, Australian ATC may provide air traffic advice when aircraft will pass with the minimum vertical separation spacing and will provide a wake turbulence caution when opposite direction aircraft will pass and a lighter category aircraft will enter the wake turbulence envelope of a heavier category aircraft.
- 4.7.2.2 If appropriate, request an ATC clearance for an offset track or a change of level. In oceanic airspace, pilots can use Strategic Lateral Offset Procedures (SLOP) to strategically offset horizontally from their route for up to 2 NM without seeking ATC permission (refer to the AIP) (see Figure 12).
- 4.7.2.3 However, it can be difficult to detect if the other aircraft is also flying with an offset. Therefore, offsetting is no guarantee that an encounter will be avoided (unless the vortices are clearly visible by contrails).
- 4.7.2.4 If crosswind exists and if the two aircraft are flying exactly on the same track, the wind will move the vortices out of the track of the following aircraft whilst they are descending. In this situation, if a lateral offset is decided for reasons other than wake vortex avoidance, an offset upwind by the follower is to be preferred, since a downwind one may potentially create an encounter.

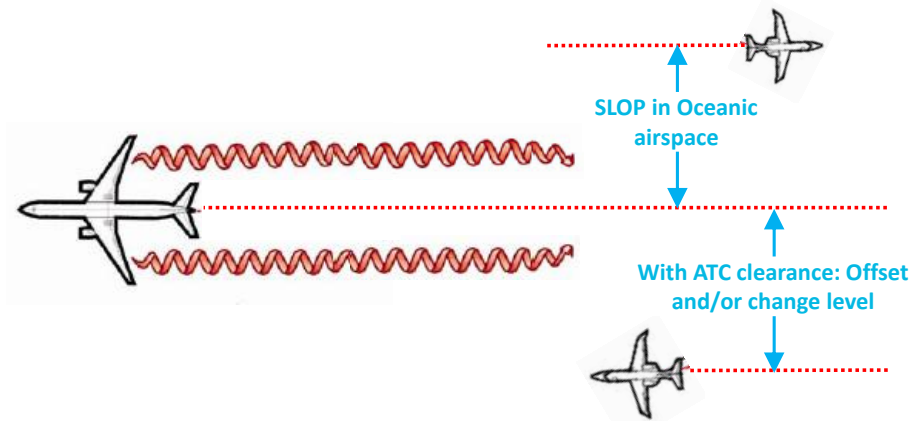


Figure 12: Use of Track offset or SLOP

4.8 Operating near helicopters

- 4.8.1 It is recommended that pilots of light aircraft should avoid operating within *three rotor diameters* of any helicopter in a slow hover taxi or stationary hover (see Figure 2). A useful visual indicator is that if the skids or wheels of the helicopter are resting on the surface then the helicopter is likely to be producing significantly reduced downwash. However, caution should be exercised since the helicopter may lift into the hover with little or no notice which would significantly increase the downwash.

4.9 Further pilot action in relation to wake vortices

- 4.9.1 **Flight crew and passenger safety.** In addition to the situations prescribed in regulation 91.570, where flight crew and passengers must be directed fasten their seat belts fastened, pilots should always remind passengers of the safety benefits of having safety belts fastened when seated irrespective of seat belt sign illumination, unless moving around the cabin. This minimises the risk of passenger injury in case of a turbulence encounter en-route (wake or atmospheric).
- 4.9.2 **ATC instructions and advice.** According to the standards for ATC wake turbulence separation specified in Part 172 of the *Civil Aviation Safety Regulations 1998 (CASR)*, several aspects of ATC instructions and advice are relevant for pilots:
- IFR aircraft — a clearance to maintain own separation with another aircraft or to follow another aircraft includes a requirement for the pilot to provide own wake turbulence separation.
 - VFR aircraft — ATC does not provide wake turbulence separation for VFR aircraft in flight.
 - Pay careful attention to a 'CAUTION – WAKE TURBULENCE' advice
 - This generally means the time or distance spacing between the relevant aircraft is less than the equivalent wake turbulence separation minimum for the aircraft involved.
- 4.9.3 **Identify Heavy or Super aircraft.** Pilots of aircraft in the Super or Heavy wake turbulence categories should include the word 'SUPER' or 'HEAVY' respectively immediately after the aircraft callsign in the initial radiotelephony contact with approach, departures, director or the aerodrome control tower.
- 4.9.4 **Larger aircraft - Fly on the glide path.** Larger aircraft should make every effort to fly on the glide path, not above it, to minimize vortex exposure to other aircraft. This establishes a dependable baseline from which pilots of in-trail, lighter aircraft may reasonably expect to make effective flightpath adjustments to avoid serious wake vortex turbulence. At airports without glide path indication, it is recommended that pilots use a '300 feet per mile' glide path.

Example

Fly 3 000 feet at 10 NM from touchdown, 1 500 feet at 5 NM, and so on, to touchdown.

- 4.9.5 **Techniques for lighter aircraft.** It is recommended that pilots operating lighter aircraft behind heavier aircraft should consider the following techniques to assist in avoiding wake turbulence:
- Flying slightly above the glidepath but following the glidepath angle to a touchdown point beyond the touchdown point of the larger preceding aircraft.
 - Be aware of the risk associated with long landings including potential for runway excursion.
 - When possible, note the touchdown point of the larger preceding aircraft and adjust the touchdown point as necessary.

Example

A puff of smoke may appear at the touchdown point of the lead aircraft; adjust your touchdown point to approximately 150 m beyond. Be aware that some Heavy or Super aircraft may require a longer touchdown point to ensure adequate clearance over the landing threshold.

- During visual approaches, consider asking ATC for updates on separation and groundspeed with respect to larger preceding aircraft, especially when there is any question of safe separation from a wake turbulence perspective. This enables the pilot to adjust the flightpath.
- When any doubt exists about maintaining safe separation distances between aircraft to avoid wake turbulence, consider asking ATC for additional spacing.

5 Pilot action when encountering wake turbulence

5.1 General information

- 5.1.1 When an encounter occurs, a pilot's actions can lessen or aggravate the situation.
- 5.1.2 Considering the way a vortex acts on an aircraft, if the pilot reacts at the first roll motion, to the right in the example previously given, the natural correction is to roll to the left. When in the core of the vortex, the main roll motion to the left will then be amplified by this initial piloting action. The result will be a final bank angle greater than if the pilot had not moved the controls.
- 5.1.3 In addition, in-flight incidents have demonstrated that the pilot inputs may exacerbate the unusual attitude situation with rapid roll control reversals carried out in an 'out of phase' manner.

5.2 Warning regarding the use of rudder

- 5.2.1 Rapid and gross side-to-side deflection of the rudder in response to a wake turbulence encounter can give rise to very large forces on the fin that may exceed structural limits. An accident has already occurred for this reason. It is important to be aware that use of the rudder does not reduce the severity of the encounter or improve the ease of recovery.

5.3 Recommended pilot response

- 5.3.1 A pilot's best response to a wake turbulence encounter is to follow the recommended procedure from the aircraft manufacturer. Refer to the specific Aircraft Flight Manual for further guidance.
- 5.3.2 In the absence of specific aircraft manufacturer procedures, pilots should exercise caution with pilot control inputs, especially avoiding abrupt reversal of aileron and rudder control inputs. If altitude and conditions permit, it may be better to allow the aircraft to transition through the wake and then recover from any resultant unusual attitude, rather than aggressively trying to control the aircraft during the wake encounter.
- 5.3.3 As a rule of thumb:

When encountering serious wake turbulence:

- Initially just wait
- Resist the urge to immediately move the controls
- Do not use the rudder to counteract the effects
- Only once clear of turbulence: Start recovery control inputs.

- 5.3.4 If the autopilot is engaged and remains engaged, it may be better to allow the autopilot to recover from the wake vortex encounter rather than disconnecting the autopilot and using manual control inputs. However, be prepared to assume manual control of the aircraft if the autopilot disengages.

6 Wake vortex separation – ATC measures

6.1 Wake turbulence separation minima used by ATC

- 6.1.1 According to the regulatory arrangements in Part 172 of CASR, the Part 172 Manual of standards (MOS) and ICAO Procedures for Air Navigation Services - Air Traffic Management (PANS-ATM, Doc 4444), ATC apply wake turbulence separation measures between aircraft depending on the wake turbulence category (see description below) of the aircraft preceding and the aircraft following, and whether the aircraft following is VFR or IFR.
- 6.1.2 These measures include delaying a take-off or increasing the spacing between aircraft to achieve either a time interval spacing of between 2 and 4 mins or a distance spacing of between 4 and 8 NM. ATC can also give a wake turbulence warning to alert a pilot when the minimum time interval or distance spacing may be compromised or when a pilot agrees or is required to follow another aircraft or to maintain own separation with another aircraft.
- 6.1.3 Wake turbulence categories are as follows:
- SUPER – Airbus A380
 - HEAVY – All other aircraft types with a maximum take-off weight (MTOW) of 136 000 kg or more
 - MEDIUM – Aircraft types with an MTOW of less than 136 000 kg, but more than 7 000 kg
 - LIGHT – Aircraft types with an MTOW of 7 000 kg or less.
- 6.1.4 It is important for pilots to be aware that wake turbulence separation minima are only intended to reduce the probability of encountering wake turbulence to an acceptably low level and to minimise the magnitude of the upset when an encounter occurs. Wake turbulence separation minima cannot entirely remove the possibility of a wake turbulence encounter.
- 6.1.5 In controlled airspace, ATC will normally apply wake turbulence separation measures between IFR aircraft. ATC will also apply wake turbulence separation measures between a VFR aircraft that is taking off and a larger aircraft that has taken off ahead.
- 6.1.6 ATC is not required to apply wake turbulence separation:
- for VFR aircraft already in flight
 - for IFR aircraft – when the pilot of the IFR aircraft is maintaining own separation or is visually following another aircraft
 - for an IFR or VFR aircraft on take-off – if the pilot of an aircraft has requested a waiver of wake turbulence separation (see section 6.2 of this AC for advice about wake turbulence waivers).

In these situations, the pilot is solely responsible for avoiding wake turbulence.

- 6.1.7 The controllers will provide a wake turbulence warning to pilots when, in the controller's opinion, wake turbulence may have an adverse effect. This warning includes the position, altitude and direction of flight of larger aircraft followed by the phrase "**CAUTION-WAKE TURBULENCE.**" After issuing the caution for wake turbulence, the air traffic controllers generally do not provide additional information to the aircraft following behind.

6.2 Pilot initiated waiver of wake turbulence separation

- 6.2.1 The Part 172 MOS permits ATC to waive the application of wake turbulence separation for certain departing aircraft, but only at the specific request of the pilot.
- 6.2.2 A request for waiver can only be made:
- in visual meteorological conditions (VMC) by day
 - after carefully assessing that the wake vortices of the preceding aircraft can be avoided or safely managed.
- 6.2.3 If other traffic permits, ATC may then issue a take-off clearance without applying wake turbulence separation measures.
- 6.2.4 However, ATC will not waive wake turbulence separation if the preceding aircraft is a HEAVY or SUPER wake turbulence category aircraft (e.g. Airbus A330 or larger).
- 6.2.5 A pilot requesting a waiver of wake turbulence separation must be keenly aware that a waiver makes the requesting pilot responsible for avoiding or mitigating the effects of wake turbulence from preceding aircraft.
- 6.2.6 Pilots should be extremely cautious about requesting a waiver because an encounter with wake vortices at low altitude and low airspeed can be particularly hazardous.