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ICAO WAKE TURBULENCE GROUPS (WTG)

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Outline

- Information on Wake Turbulence
- Legacy Wake Turbulence
- Background on WTG
- WTG
- Distance-based separation minima based on WTG
- Time-based separation minima based on WTG
- WTG vs Legacy Wake separation minima
- 8643
- Monitoring and reporting (WTER)

Information on Wake Turbulence

- Wake vortices:
  - are present behind every aircraft and are generated from the time the aircraft lifts off until it touches down.
  - are particularly intense when generated by a large and wide-bodied jet aircraft.
  - tend to drift downward and when close to the ground they spread apart from the track of the generating aircraft, occasionally rebounding upwards.

- the term "wake vortex" or "wake vortices" which describes the nature of the air masses.

Information on Wake Turbulence

- Vortices from large aircraft generally sink at a rate of about 1.5 to 2.5 m/s (300 to 500 ft/min).
- Wake can descend more than 300 m (1,000ft) below the generating aircraft.

- The term "wake turbulence" is used to describe the effect of the rotating air masses generated behind the wing tips of jet aircraft.

Effects on aircraft

Wake turbulence encounters could cause severe upset and even structural damage

- Wake turbulence encounter **severity** has been classified according to the reported roll angle:

✓ Severe — a reported roll angle in excess of 30°
✓ Moderate — a reported roll angle of 10 to 30°
✓ Slight — a reported roll angle of less than 10

- The basic **effects** of wake turbulence on the following aircraft:

❖ Induced roll
❖ Normal load factor (positive or negative)
❖ Loss or gain of altitude or rate of climb
❖ possible structural stress.

Operational Information

- Wake Turbulence Separation minima are intended to greatly reduce the potential hazards of wake turbulence.
- When the separation minima normally applied to IFR flights are greater than those for wake turbulence, no special measures need to be taken by controllers since the IFR minima apply.
- Controllers and flight crews should thoroughly understand the likely situations where hazardous wake turbulence may be encountered.
- Wake turbulence separation minima should be applied for situations not covered by other specified minima whenever a controller believes there is a potential hazard due to wake turbulence.

Legacy Wake Turbulence Categories

a) SUPER (J) — aircraft types specified as such in Doc 8643, *Aircraft Type Designators*;

b) HEAVY (H) — aircraft types of 136 000 kg or more, with the exception of aircraft types listed in Doc 8643 in the SUPER (J) category;

c) MEDIUM (M) — aircraft types less than 136 000 kg but more than 7 000 kg; and

d) LIGHT (L) — aircraft types of 7 000 kg or less.

Legacy Wake Turbulence Distance Separation

Aircraft category		
Preceding aircraft	*Succeeding aircraft*	*Distance-based wake turbulence separation minima*
SUPER	HEAVY	9.3 km (5.0 NM)
	MEDIUM	13.0 km (7.0 NM)
	LIGHT	14.9 km (8.0 NM
HEAVY	HEAVY	7.4 km (4.0 NM)
	MEDIUM	9.3 km (5.0 NM)
	LIGHT	11.1 km (6.0 NM)
MEDIUM	LIGHT	9.3 km (5.0 NM)

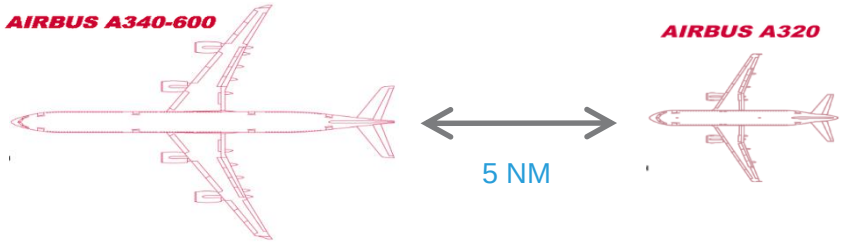
For aircraft being provided with an ATS surveillance service in the approach and departure phases of flight

Background on Wake Turbulence Separation Minima Based on Aircraft Groups (WTG)

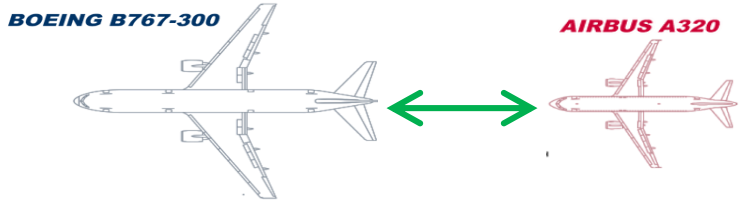
- ✓ A380 & B747-8 wake turbulence separation
  - Joint Steering Groups and Working Groups formed
  - A380 State Letter
- ✓ RECAT (RE-CATegorisation) Phase I and Phase II initiatives
- ✓ Joint development by FAA and ECTL – Phase I (6-CAT) & II (Pairwise separation)
- ✓ This was the basis for the proposal for amendment to the procedures in PANS-ATM related to WTG.

Wake Generation and Encounter Resistance

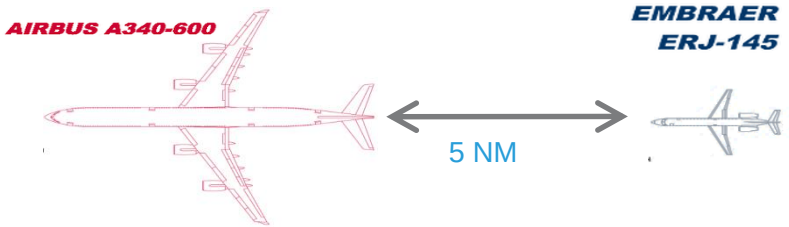
If this is safe…



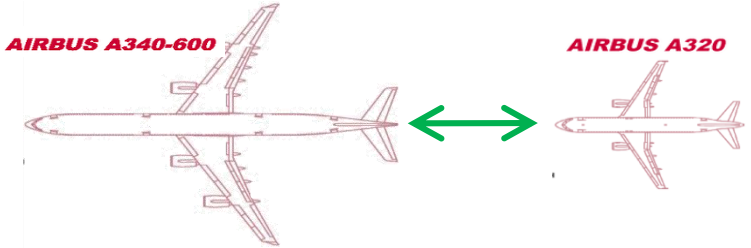
… this can be reduced (lower wake generation)



If this is safe…



… this can be reduced (higher wake resistance)



Data-driven Safety Assessment

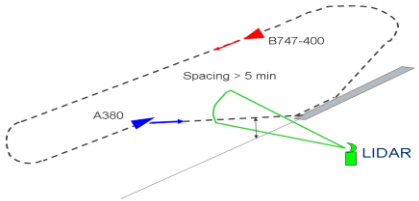
Extensive wake data collection.

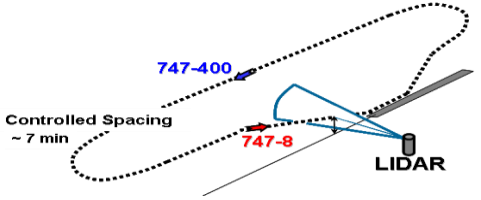
Use of flight test data, flight simulation, risk metrics based wake science research & knowledge

- Build on safety assessment methodology defined and used for the A380 and B747-8

- Study of Wake Vortex separation design

Comparative analysis of long-lasting wakes in "reasonable worst-case" conditions





ICAO WTG Provisions – PANS-ATM Doc 4444

(applicable since Nov 2020)

Address runway capacity constraints at major airport hubs through the reduction of applicable separation minima for arrivals and departures.

Incorporate related procedures to facilitate a globally harmonized implementation.

Provide a global solution for enhancing arrival & departure throughput at capacity-constrained airports by providing an alternative to the conservative legacy wake turbulence separation minima.

The new *Manual on the Implementation of Wake Turbulence Separation Minima* (Doc 10122), will be available soon, which will include the required guidance for implementation.

WTG – Aircraft based on 7 Groups

a) GROUP A — aircraft types of 136 000 kg or more, and a wing span less than or equal to 80 m but greater than 74.68 m;

b) GROUP B — aircraft types of 136 000 kg or more, and a wing span less than or equal to 74.68 m but greater than 53.34 m;

c) GROUP C — aircraft types of 136 000 kg or more, and a wing span less than or equal to 53.34 m but greater than 38.1 m;

d) GROUP D — aircraft types less than 136 000 kg but more than 18 600 kg, and a wing span greater than 32 m;

e) GROUP E — aircraft types less than 136 000 kg but more than 18 600 kg, and a wing span less than or equal to 32 m but greater than 27.43 m;

f) GROUP F — aircraft types less than 136 000 kg but more than 18 600 kg, and a wing span less than or equal to 27.43 m;

g) GROUP G — aircraft types of 18 600 kg or less (without wing span criterion).

Wake turbulence Group A is equivalent to the SUPER wake turbulence category, and Groups B and C are equivalent to the HEAVY category

Distance-based separation minima for Arrival and Departure (with ATS surveillance service)

based on 7 wake turbulence groups

Preceding aircraft group	*Succeeding aircraft group*	*Distance-based wake turbulence separation minima*
A	B	7.4 km (4.0 NM)
	C	9.3 km (5.0 NM)
	D	9.3 km (5.0 NM)
	E	11.1 km (6.0 NM)
	F	11.1 km (6.0 NM)
	G	14.9 km (8.0 NM)
B	B	5.6 km (3.0 NM)
	C	7.4 km (4.0 NM)
	D	7.4 km (4.0 NM)
	E	9.3 km (5.0 NM)
	F	9.3 km (5.0 NM)
	G	13.0 km (7.0 NM)
C	D	5.6 km (3.0 NM)
	E	6.5 km (3.5 NM)
	F	6.5 km (3.5 NM)
	G	11.1 km (6.0 NM)
D	G	7.4 km (4 NM)
E	G	7.4 km (4 NM)

Separation Minima Based on Seven Wake Turbulence Groups

Following Aircraft		Required Separation	Preceding Aircraft	
Wake Turbulence Group	Aircraft Type		Wake Turbulence Group	Aircraft Type
B	Boeing 747-400	4,0 NM	A	Airbus A-380-800
C	Boeing 767-400	5,0 NM	A	Airbus A-380-800
D	Airbus A-320	5,0 NM	A	Airbus A-380-800
E	Embraer EMB-190	6,0 NM	A	Airbus A-380-800
F	ATR 72	6,0 NM	A	Airbus A-380-800
G	Cessna 172	8,0 NM	A	Airbus A-380-800
B	Boeing 747-400	3,0 NM	B	Boeing 747-400
C	Boeing 767-400	4,0 NM	B	Boeing 747-400
D	Airbus A-320	4,0 NM	B	Boeing 747-400
E	Embraer EMB-190	5,0 NM	B	Boeing 747-400
F	ATR 72	5,0 NM	B	Boeing 747-400
G	Cessna 172	7,0 NM	B	Boeing 747-400
D	Airbus A-320	3,0 NM	C	Boeing 767-400
E	Embraer EMB-190	3,5 NM	C	Boeing 767-400
F	ATR 72	3,5 NM	C	Boeing 767-400
G	Cessna 172	6,0 NM	C	Boeing 767-400
G	Cessna 172	4,0 NM	D	Airbus A-320
G	Cessna 172	4,0 NM	E	Embraer EMB-190

Differences with ICAO legacy minima

Difference with legacy	A380	A124	A330 / B777	MD11 / B767	B757	A320 / B737NG	E190 / DH8D	E170 / ATR72 / CRJ1	CL30	LIGHT
A380	0	-2	-2	-1	-2	-2	-1	-1	1	0
A124	0	-1	-1	0	-1	-1	0	0	2	1
A330 / B777	0	-1	-1	0	-1	-1	0	0	2	1
MD11 / B767	0	-1.5	-1.5	-1.5	-2	-2	-1.5	-1.5	1	0
B757	0	0	0	0	0	0	0	0	1.5	-1
A320 / B737NG	0	0	0	0	0	0	0	0	1.5	-1
E190 / DH8D	0	0	0	0	0	0	0	0	1.5	-1
E170 / ATR72 / CRJ1	0	0	0	0	0	0	0	0	0	-2.5
CL30	0	0	0	0	0	0	0	0	0	-2.5
LIGHT	0	0	0	0	0	0	0	0	0	0

- 2 NM
-1,5 NM
-1 NM
- 0,5 NM
0
+ 0,5 NM
+ 1 NM
+ 1,5 NM
+ 2 NM

Note: WTG separation minima smaller (in NM) than Legacy are shown in blue, and WTG separation minima (in NM) larger than Legacy shown in green

Time separation minima for Departure

based on 7 wake turbulence groups

Preceding aircraft wake turbulence group	*Succeeding aircraft wake turbulence group*	*Time-based wake turbulence separation minima*
A	B	100 seconds
	C	120 seconds
	D	140 seconds
	E	160 seconds
	F	160 seconds
	G	180 seconds
B	D	100 seconds
	E	120 seconds
	F	120 seconds
	G	140 seconds
C	D	80 seconds
	E	100 seconds
	F	100 seconds
	G	120 seconds
D	G	120 seconds
E	G	100 seconds

For aircraft taking off from an intermediate part of the same runway or an intermediate part of a parallel runway separated by less than 760 m (2 500 ft)

Preceding aircraft wake turbulence group	*Succeeding aircraft wake turbulence group*	*Time-based wake turbulence separation minima*
A	B	160 seconds
	C	180 seconds
	D	200 seconds
	E	220 seconds
	F	220 seconds
	G	240 seconds
B	D	160 seconds
	E	180 seconds
	F	180 seconds
	G	200 seconds
C	D	140 seconds
	E	160 seconds
	F	160 seconds
	G	180 seconds
D	G	180 seconds
E	G	160 seconds

Differences with ICAO legacy minima

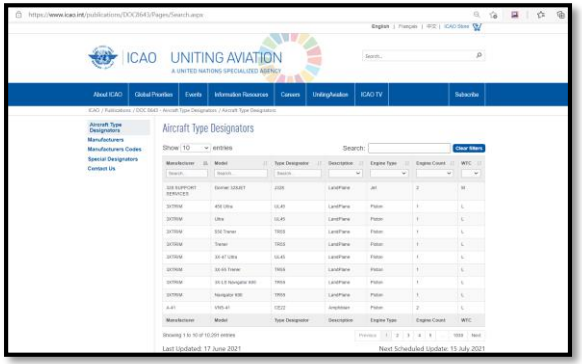
Difference ICAO	A380	A124	A330 / B777	MD11 / B767	B757	A320 / B737NG	E190 / DH8D	E170 / ATR72 / CRJ1	CL30	LIGHT
A380	0	-20	-20	0	-40	-40	-20	-20	0	0
A124	0	0	0	0	-20	-20	0	0	20	20
A330 / B777	0	0	0	0	-20	-20	0	0	20	20
MD11 / B767	0	0	0	0	-40	-40	-20	-20	0	0
B757	0	0	0	0	0	0	0	0	60	0
A320 / B737NG	0	0	0	0	0	0	0	0	60	0
E190 / DH8D	0	0	0	0	0	0	0	0	40	-20
E170 / ATR72 / CRJ1	0	0	0	0	0	0	0	0	0	-60
CL30	0	0	0	0	0	0	0	0	0	-60
LIGHT	0	0	0	0	0	0	0	0	0	0

-40
-20
0
20
40
60

Note 1: WTG separation minima smaller (in NM) than Legacy are shown in blue, and WTG separation minima (in NM) larger than Legacy shown in green

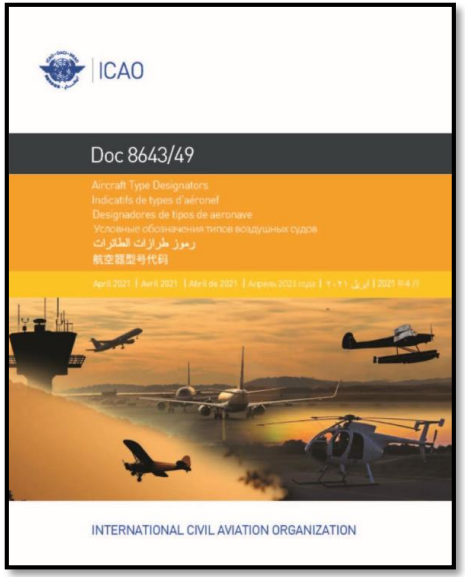
Note 2: when no separation minimum is defined, 60 seconds is taken as reference for comparison

ICAO Doc 8643 – Aircraft Type Designator



Online version only contains the wake turbulence categories

Includes both Wake Turbulence Categories and Groups



The wake turbulence groups is available in the paid subscription of Doc 8643 (please visit https://store.icao.int/ or contact sales@icao.int)

Monitoring

Collaborative framework between:

- Aircraft Operators, providing
  - Pilot reports
  - Flight data analysis
  - Wake Turbulence Reports
- ANSPs
  - ATC Surveillance data
  - Wake Turbulence Reports
  - MET information

Wake turbulence encounter reporting (WTER)

The new WTER PORTAL was developed to facilitate data collection, storage and analysis, of wake turbulence occurrences.

From the global perspective, the WTER offers the opportunity for a more diverse and representative dataset of wake encounters which would provide the quantitative validation necessary to support future developments.

At the national level, States would be able to analyze their wake encounter risk evolution to support any wake turbulence separation implementation or procedure development.

Data analysis should support post-implementation monitoring and safety risk assessment as an important aspect of WTG implementation.

States are encouraged to integrate the WTER submission as part of their existing reporting procedure and benefit from the analytical tools.

States will be invited to nominate focal points to access and provide data to the WTER portal.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THANK YOU!