Wake Turbulence: See You On The Flip(ped over) Side

OPSGROUP Team
15 June, 2021

We last wrote about this back in 2017, after the en-route wake of an A380 flipped a Challenger 604 upside down over the Arabian Sea. But as the skies start to grow busier again it's worth having a think about **how to avoid** wake turbulence or **deal with it** when you come across it.

If you are going to run into wake turbulence, there is a good chance it will happen **near the ground**. Not the ideal place to suddenly find yourself banking sharply without warning.

The levels of **traffic operating in close proximity** (and in configurations specifically designed to produce lots of lift which is what basically leads to wake) can make the approach, departure, takeoff or landing **a gauntlet of swirling vortices of doom.** Added to that, aircraft are generally operating at low speed with lower controllability margins.

A study in Australia looked at the vortices of an A380 and in 35 knot winds, at 2,400ft, it took **72 seconds for the vortices to cover 1300m**. They move, and they take a while to dissipate. This study took place after a Saab 340B temporarily lost control, dropping 300-400ft in altitude and **rolling 52 degrees left and 21 degrees right.**

An ILS calibration aircraft crashed in OMDB/Dubai after breaching minimum separation distances from commercial traffic. Hitting wake is not fun and can lead to catastrophic consequences.

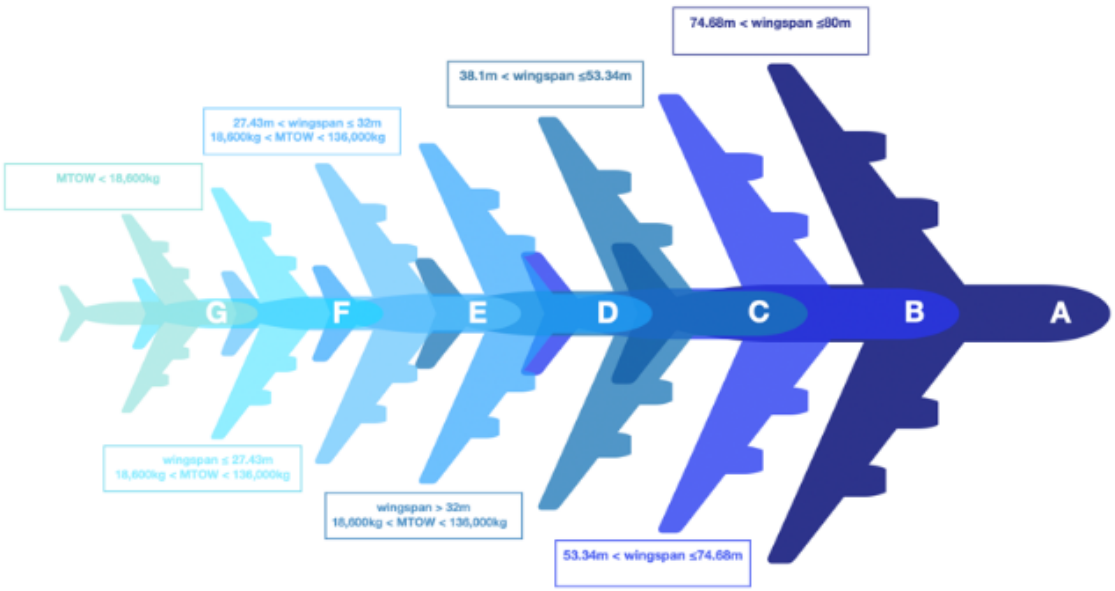
Thankfully, wake turbulence is taken seriously. In fact, in 2016, wake turbulence categories were rethought.

They used to just be based off MTOWs:

- Super (the A380 held this spot)
- Heavy (anything with a MTOW more than or equal to 136 tons)

- Medium (7 tons to 136 tons)
- Light (anything under 7 tons)

Nowadays, the categories are a little more complex and consider **both weight and wingspan,** because wing design is a big contributor to what sort of vortices roll off the tips. **Now we have 7 categories: G-A.** Ultimately, the important thing to remember is the distance you need from each depending on what you are in.



G	F	E	D	C	B	A
	FA10 FA20 D328 E120 BE40 BE45 H25B JS32 JS41 LJ35 LJ60 SF34 P180 C650 C525C1 80 C152	AT43/45 AT72 B712 B737… CL60 CRJ1/2 CRJ7/9 DH8D E135 E145 E170/5 E190/5 F70 F100 GLF4 RJ85 RJ1H	A318 A319 A320 A321 AN12 B736 B737 B738 B739 C130 IL18 MD81 MD82 MD83 MD87 MD88 MD90 T204 TU16	A306 A30B A310 B703 B752 B753 B762 B763 B764 B783 C135 DC10 DC85 IL76 MD11 TU22 TU95	A322 A333 A343 A345 A346 A359 B744 B758 B772 B773 B77L B77W B788 B789 IL96	A388 A124

Distance-based separation minima for app/dep

Time-based separation minima on departure

Follower / Leader	A	B	C	D	E	F
A	3 NM	4 NM	5 NM	5 NM	6 NM	8 NM
B		3NM	4 NM	4 NM	5 NM	7NM
C		(*)	3 NM	3 NM	4NM	6NM
D						5NM
E						4NM
F						3 NM

*MRS 2.5nm

Follower / Leader	A	B	C	D	E	F
A		100s	120s	140s	160s	180s
B				100s	120s	140s
C				80s	100z	120s
D						120s
E						100s
F						80s

Here’s one we made earlier

Get woke about wake.

So, we have our 7 categories, and we have our distance based separation (which ICAO allows to go as low as 2.5NM).

Something to remember – these have been designed to allow **maximum runway capacity and**

operational efficiency. You won't be ATC's favorite pilot if you ask for more separation (you might even lose your spot in the sequence) but safety is ultimately up to you.

If you need more space, say something.

There are a few other things you can do to help avoid wake in the airport area:

- Consider requesting a **SLOP on arrival** – yes, this is possible. Except where they have super strict NABT routes.
- Consider asking for an **extended holding pattern, or opposite direction hold** – just check where that might fly you (if you're close to the border with another airspace you might run into another sort of trouble).
- Try and **remain above the flightpath** of the preceding aircraft, and avoid long level sections by flying a **CDA**.
- **Watch those speed margins** – if you think you might meet some wake, think about taking some flap a little earlier so you have more margin.
- If you are a 'heavy' or a 'super' then **ATC might not want you to fly a CDA**, especially in high density airspace. JFK are one such spot.
- **Look at what the wind is doing** – if it's light or variable then those vortexes are going to sit there, waiting for you to fly into them…

Is there any technology to help?

There is indeed. In fact, there are several interesting projects and technologies being tested to help with wake.

Vortex modelling is playing a major part in the EU's Single European Sky ATM Research and has led to some rather clever folk in Germany discovering that if you **build a "plate line"** (basically a wall of large wooden boards) this effectively cancels out most of the wake. This is being tested at EDDF/Frankfurt and EDDM/Munich airport using smoke and lasers.

Not so clear air turbulence

Turbulence can really CAT-ch you out.

Going back to the 2017 **Airbus 380 vs Challenger 604** battle – the Challenger came off a lot worse.

The big takeaway from this: **the risk of wake in cruise is a pretty big one as well**. So what can you do about it?

- **SLOP** – It is one of the things it was designed for.

But use a bit of common sense here – if the wind is from the left (and slopping to the left is not available), then flying to the right of track just means when you get to abeam where the aircraft in front was, their wake has probably been blown right of track as well. **Maybe ask them to SLOP!**

Don’t play Chicken, be a chicken and SLOP

Of course, **severe turbulence isn’t only caused by wake**. Weather, mountains, atmospheric stuff are all to blame as well.

There are technologies out there to help with this as well. **Lidar is just such a thing.** The Japanese Aerospace Exploration Agency and Boeing have discovered that if you stick one of these onto the side of an airplane then it can detect aerosols on the air. These are tiny particles, such smaller than water droplets so a conventional radar won’t detect them. The Lidar system does though, and can **provide up to around 70 seconds warning (about 10 miles).**

This might not always be enough to avoid, but it’s **enough to switch the seatbelt sign on** and warn everyone down the back.

So, sometimes there are warning signs, but sometimes there aren’t. We aren’t going to bore you with a science lesson on Clear Air Turbulence or how to check your shear rates. **What we do think is worth talking** about is what ICAO, EASA, the FAA et al. have say about what to do when you have

inadvertently come across something that has *really* upset your airplane.

UPRT

Upset Prevention and Recovery Training. **This is a big (and very good) thing.** Since the AF447 accident it has become mandatory for crew to be trained in UPRT.

But what actually is it?

Well, it is one answer which is hoping to solve the issue of **LOC-I incidents** amongst other things. Loss of Control in flight is the biggest cause of fatal accidents over the last two decades (on commercial jet aircraft), having led to **33% of fatal accidents.**

It is designed to **solve the "startle" factor** by giving a clear, defined method of what to do if you don't really know what is going on. Basically, when you experience an "unusual attitude" (with the airplane, not with a strange co-pilot).

Not what you want be seeing

An unusual attitude is anything outside your aircraft's normal limits. For a large transport category aircraft we are probably talking **nose up more than 25 degrees of pitch, or down more than 10, a bank angle greater than 45 degrees** or any flight within these parameters but with airspeeds "inappropriate for the conditions".

What has changed here from the old-school stall recovery type training?

Well, the big change is what we are really learning during the training. Upsets are not "some aerodynamic phenomenon lurking in the atmosphere to grab pilots following well structured procedures" – they happen when things have gone very, very wrong and procedures have flown out the window.

So, UPRT is about **training to deal with the startle and the confusion** – giving a method to right the

airplane when that startle and confusion is likely preventing you from doing so. It is also about learning how to **recognize a potential threat** that might lead to an upset, and it is about **better monitoring** to prevent the startle.

Tell me how to do it.

Probably more for a trained instructor, but the general gist is this:

- **Push**
- **Roll**
- **Power**
- **Stabilise**

(Sometimes Roll and Power might want to go in the opposite order.)

Pushing does not mean ramming the stick forward. It means unloading the wings. And once they are unloaded you want to stop the push, but that **doesn't mean yanking the nose back up into a negative-G maneuver.** You are going to have to trade some height for speed (and safety) here. When the aircraft is back under control, that means *gently* returning it to the horizon.

Roll is similar – it is all about **giving the wings the best chance of performing**, and that means getting them level and not barrel-rolling around the sky. But… if your nose is mega high, and you have power on, then pushing forward is going to be tough to do. So adding some roll can also help us out here, getting the nose to drop, and giving us control of, well, the controls.

UPRT is about monitoring, recognizing and handling.

Fancy some further reading?

- Here is a link to the FAA Advisory telling you all about their **recommendations for UPRT.**
- Here is a big old document on **Wake RECAT,** by EASA.

Caution Wake Turbulence: New Rules for the EU

Mark Zee
15 June, 2021

What Wake Turbulence Category is a B757? That long favoured question by Dispatch Trainers and ATC Instructors will become a thing of the past under new rules slowly being introduced in Europe, where the current four (Light, Medium, Heavy, Super) will become **six**. The first place you will see this happening is at LFPG/Paris Charles de Gaulle and LFPB/Paris Le Bourget, from 22 MAR 2016.

Those **six new categories** are Light, Medium (with Lower and Upper), and Heavy (with Lower, Upper and Super). The rules are part of the RECAT-EU project, with the intention of squeezing more traffic into busy European Airports by applying more precise turbulence separation rules.

The separation minima are determined specific to each Aircraft Pair. For example, at the moment, an A330 following a B777 (Heavy behind heavy) requires 4 miles in trail. With the new rules, that is reduced to **3nm**. An A320 can now follow 4 miles behind a B777, instead of the current 5nm.

There are no Flight Planning Changes (continue to use /L,M,H,J for the ICAO Category). For crews, you'll notice the smaller separation, but there are no changes to callsigns or pilot obligations – for now.

New Wake Turbulence Categories
Phased Introduction from 22MAR2016
\\\ Flight Service Bureau ®

	Max Take Off Weight (**MTOW**)	Wing Span
SUPER **HEAVY**		> 72m
UPPER **HEAVY**	**100,000** KGS +	60 – 72m
LOWER **HEAVY**		< 52m
UPPER **MEDIUM**		> 32m
LOWER **MEDIUM**	**15 – 100,000** KGS	< 32m
LIGHT	**15,000** KGS -	

SUPER HEAVY	UPPER HEAVY	LOWER HEAVY	UPPER MEDIUM	LOWER MEDIUM	LIGHT
A380	B777*	B757*	B737-6	B737-3	D328
	B747*	B767*	B737-7	B737-4	FA10/20
A124	B787*		B737-8	B737-5	C560
			B737-9		C56X
	A340*	A310*	A318	all ATR	C650
	A330*	A300*	A319	all DH8	C680
	A350*		A320	all BAE	H25B
			A321	all CRJ	LJ35/45
	IL96	C135	C130/C160		SF34
	AN22	MD11/DC10	all MD80	EMB 135	SW4
		IL76	MD90	at 195	BE40
	* all current types	TU95/22	TU204		EMB120
			BCS1	F70/F100	
		*all types	BCS3	GLF2/4	
				CL30/60	

References:

- **France AIC 03/16**
- **Eurocontrol RECAT-EU Project**