# Flight Tests planning

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**Timeline**

- **Initial evaluation**
- **Development**
- **Certification**
- **Post-certification development**
First flight – 27th April 2005
Flight envelope opening
Speed and altitude

Flutter tests completed end November 05

Flight controls in direct law and in normal law

All weights and Cg

Aircraft very similar to simulator models

Results: excellent
Systems

Stall warning
VFE
MMO
MD
VMO
VD
Flight envelope opening
Weight & Centre of gravity position

MTOW

MLW

MZFW

Forward CG
Rear CG
Airshows

- Le Bourget 2005 (less than 2 months after the first flight!)
- Dubai 2005
- Singapore 2006
- Berlin 2006
- Farnborough 2006
- Le Bourget 2007
Le Bourget Airshow

45 days after first flight…
Performance. Aerodynamic configuration freeze. Tufting campaign

**Test objectives:**
Optimise low speed capability
Tufting campaign – strakes effect
Tufting campaign - In flight
VMU: July 13^{th} and 14^{th}, 2005
Noise measurements in Moron October 05 and June/July 06
Noise measurements in Moron October 05 and June/July 06

TEST OBJECTIVES:
- Preliminary campaign October 2005
- Certification campaign June/July 2006

TESTS DONE:
Certification campaign:
- 5 specific flights
- Over 100 flyovers
- Approach and take-off noise measured.
Noise Related Changes introduced at the launch

~ 6 EPNdB cumulative noise reduction

- High lift system modifications including optimised aileron droop for take-off
- Optimised slat setting and droop nose device

Wing tip device optimisation

Nacelle improvements including lengthening and additional acoustic treatment

Engine fan diameter increased (110” to 116”)

Graphical illustrations showing changes and improvements.
Numerous tests performed to establish wake vortex characteristics

About 180 flight hours

- A380,
- B747,
- B777,
- A340-600,
- A318
- Falcon 20
Wake vortex: cruise
Tests to be done in «contrails» MTO conditions:
- vortex captures the contrails
- vortex core visualized by the contrails
- contrails provide reflection to Lidar signal

132 back-to-back encounters behind A380, B747 and A340-600.
Such a large experiment on wake vortex had never been done before.
Wake vortex: cruise
Cruise vortex tests

Enable measurement down to at least 20 Nm
Wake vortex in cruise: B747 vs A380

A380 – M0.85
B744 – M0.85
FA20 – M0.7
A318 – M0.7/0.8

Falcon 20 relative track, centered on 380-744, drifting backward

A318 relative track, drifting back from them

Flight profile

2000 ft
Wake vortex in cruise

Results: No penalty, same separation as existing aircraft
Wake vortex in approach

- Estimation of vortex strength performed via back-to-back analysis using LIDAR. (2 aircraft in the circuit)
Separations in approach: before the A380

4 NM

5 NM

6 NM
Separations in approach: current ICAO recommendations

- 4 NM
- 6 NM
- 8 NM
- 10 NM
Separations: the situation will probably evolve
Water trough tests (first trials October 2005)
Water trough tests (first trials October 2005)

1 acceleration + 1 deceleration at ~70 kt
Water trough tests (first trials October 2005)

Static engines operation in reverse mode over water trough
Water trough tests (second trials September 2006)

- Additional runs:
  - High speed
  - Engines water ingestion from NLG jet
Water trough tests (second trials September 2006)
Water trough tests (second trials September 2006)
First visits at international airports

- 29th October 05 : Frankfurt
- 10th – 24th November : Singapore, Brisbane, Sydney, Melbourne, Kuala Lumpur, Dubai (airshow)

Airport compatibility checks :
- Positioning of airport bridges
- Upper deck catering vehicles
- Positioning of cargo loaders
- Check of GSE
- Ground services (toilets servicing, fueling, electricity…)
Far East Tour – 10th - 18th November 2005
Hot & high campaign in Medellin (Colombia)
Cold weather campaign in Iqaluit (Canada)
Singapore Airshow + preliminary hot weather 17-28 February
TEST OBJECTIVES:
- Assess Wing Anti-Ice behaviour
- Check aircraft behaviour with natural ice

TESTS DONE:
- 5 flights (in thunderstorms…)
- Some complementary tests done with Wing Anti-Ice inactive

MAIN RESULTS:
- Natural ice accreted are far less critical than artificial ice shapes
- No Handling Qualities issue identified, even with Wing Anti-Ice inactive
- Side result: more than 100 lightning strikes in one flight. No problem.
Natural Icing trials – May 2006
Artificial ice shapes trials
Natural Icing trials – May 2006

- 3 configurations assessed:
  - Shapes representative of slat 4 de-iced (nominal case)
  - Shapes representative of slat 4 de-icing failed (failure case)
  - Shapes representative of an aircraft without Wing-Anti-Ice

- Main results:
  - Artificial ice shapes confirmed more critical than natural ice
  - Configuration with slat 4 de-iced confirmed
VMCs

- VMC tests have all been performed in June

- VMCL = 120 kt
- VMCA = 120 kt
- VMCG = 119 kt
- VMCL-2 = 144 kt

(70KB rating)
Hot Weather Campaign 23-30 July 2006

Main results:

- Temperature range: 43 – 46 °C
- Overall very good, no major problem encountered
  - Engines cleared up to 80K
  - Electrics, Hydraulics: ok
  - Good behaviour of Air Conditioning
Cross wind demonstrated at Keflavik (10th November 2006):

- Landing: 6 landings with average cross wind 42 kt, maximum gust 56 kt and maximum deviation from center line 5.4 m.

- Take off: 5 take off with average cross wind 39 kt, maximum gust 51 kt and maximum deviation 5.4 m.
Crosswind
Cabin evacuation test – 26\textsuperscript{th} March 06

- MSN 7 fitted with a high density cabin
- 853 passengers + 20 crew members
Cabin evacuation test – 26th March 06

- Certification requirement: Evacuation must be fulfilled in less than 90 seconds using half the number of doors
- Result: 873 people evacuated in ~80 seconds
Cockpit evacuation
Certification
4th April 06

3 additional foam disks should be ok for all sizes
Cabin Virtual First Flight – 10th May 2006

TEST OBJECTIVES:

- Test all cabin functions on ground with a representative passenger and crew loading
- 474 passengers
- 22 crew members

TEST RESULTS:

- Overall good results, only minor points identified
  - Ventilation
  - I.F.E.
  - Toilets
TEST OBJECTIVES:
- Assess all cabin functions in flight with a representative passenger and crew loading
- 4 flights: 7h, 10h, 12h (night), 15h
- 474 passengers + crew members

PRELIMINARY RESULTS: Outstanding!
- Cabin Systems & IFE already mature
- Temperatures correct all along the cabin
- Very calm and silent cabin
- Cabin feels spacious

Minor (anecdotic) problems:
- Some ventilation fine tuning to avoid condensation
- Cooling system
A380 – the quietest cockpit in the sky

Cockpit acoustic environment of in production aircraft*:

- The A380 is the quietest working environment for pilots
- Airbus has consistently improved cockpit acoustics
- Preliminary data from flight test aircraft.

The A380 is the quietest working environment for pilots
A380 – the quietest airliner ever

> 5 dB difference make the A380 outstandingly quiet

1800 passengers were impressed: A380 has the quietest cabin in the sky
In their own words: what A380 passengers said

'It's fabulous, impressive,' gushed Ludovic

The thing that seemed to strike most people the most was how quiet the cabin was, with barely a change even between taxiing and take-off”

Elisabeth V., Airbus France
Trip 1
TLS
SIN
HKG
NRT
CAN
PEK
PVG
JNB
SYD
YVR
ICN

Trip 2
Trip 3
Trip 4
A380 MSN 2 Technical Route Proving Campaign
A380: what airline pilots have to say

“Compared to the A320, you do not feel the difference in flight. Although much bigger than the A320, the A380 is easy to taxi.”

“I have been flying all the fly-by-wire types of Airbus. It’s the same situation here with the A380: it’s very easy to fly these aircraft because handling characteristics are extremely similar and it’s a real family.”

“The aircraft is much more responsive than anticipated, it does not feel like a big aircraft. Cockpit innovation and new technologies are combined well with Airbus cockpit philosophy. Coming from the A330, you feel at home and the transition is very easy.”

“The aircraft, for its size, is extremely manoeuvrable: very responsive, easy to fly, very stable. Actually, I would like to take this plane home and start flying with it immediately.”

“The cockpit and flying characteristics are similar, so it is easy for somebody who has flown an Airbus before to fly this airplane. I thought that because the A380 is bigger there would be a lot more lag in the controls, but to my pleasant surprise it is very lively and very stable - it’s a lovely plane.”

“The aircraft is very stable but also very responsive; more like flying an A320 than an A340.”

“Please do not change the handling qualities of this a/c!”
Large aircraft operations are concentrated today

A closer look at where the 747 really flies

80% of all 747 movements are concentrated into just 37 airports

The 37 Airports which handle 80% of all 747 flights today
The remaining 183 which handle 20%

All of these, and more, are either ready, preparing, or planning for A380 operations.

Today the A380 has landed on 60 airports. 10 more to be reached in the coming weeks.
From small airports to major hubs, airport compatibility is proven with more than 60 visited during flight tests. And more will be before EIS.
Turns on existing taxiway

A380 can use existing taxiways already used by A340-600 or 777-300 aircraft
The operational U-Turn width for the A380 has been demonstrated at 55m

A380-800 -> 55m
777-300 -> 55m
A380/A330-340  –  Landing Deviation

Runway edge

Runway centerline

Outer wheel position

Y(m)

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A380 Nominal LDG
LR Nominal LDG
Threshold for Investigation

- A380 Nominal LDG
- LR Nominal LDG
- Threshold for Investigation

Airbus
A380/A330-340 – Landing in crosswind

Record! mean 42 kt gusting 56 kt
Four A380 in formation flight: 30 August 2006
A superb achievement!