European Proposed RECAT Amendment for Capacity Optimisation
WakeNet3-Europe

4th Major & Final Workshop
Wake Turbulence in Current Operations and Beyond

Prepared by :

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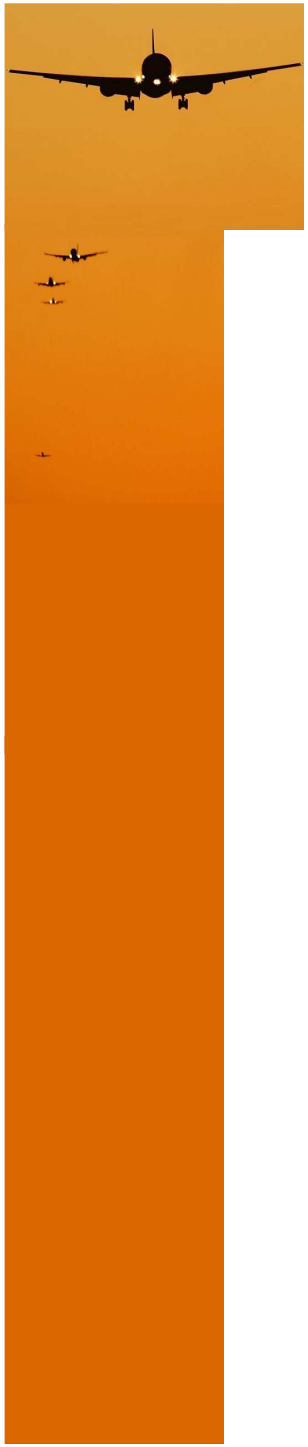
WakeNet3-Europe
A network on Aircraft Wake Turbulence



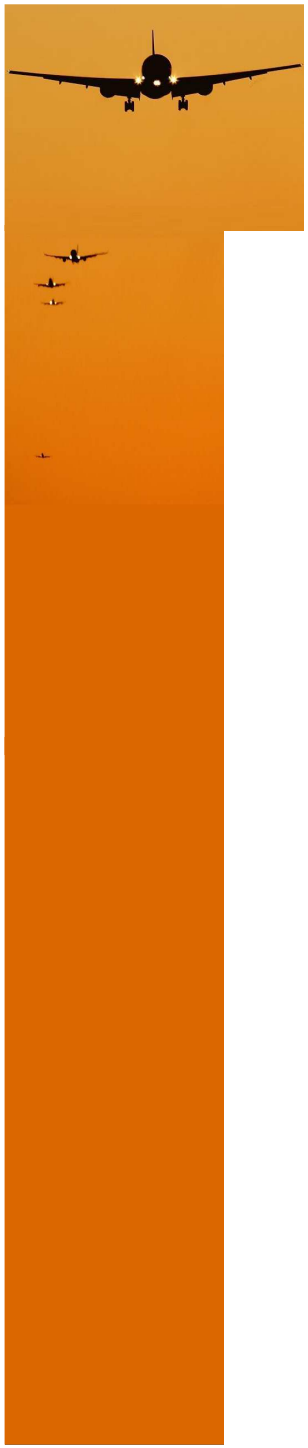
Introduction

A first RECAT proposal (RECAT A) was presented at ICAO end of last year

During consultation/review process, stakeholders identified some improvements to the initial proposal that could lead to significant capacity improvement

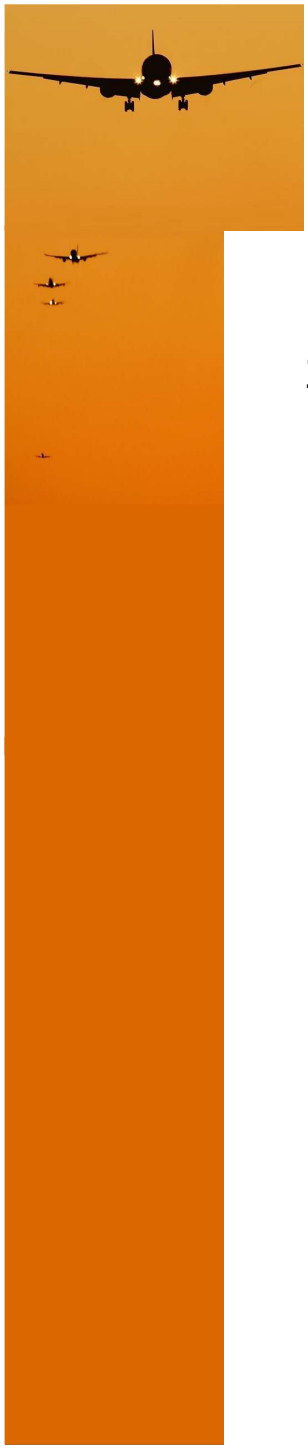
This presentation introduces the key principles on which EUROCONTROL, will propose an amendment the current RECAT proposal (RECAT B) for capacity optimization

The following results and separation tables should only be considered as EUROCONTROL initial proposal to be consolidated through a new consultation process involving all stakeholders



Outline

1. RECAT key principles
2. RECAT proposal
3. RECAT potential improvement
4. RECAT amendment key principles
5. RECAT amendment safety assessment
6. RECAT amendment proposal
7. RECAT amendment capacity assessment
8. Next steps



RECAT key principles

1. A list of 61 aircraft representing 85% of the U.S. and European traffic (operations) is used for the analysis

AC TYPE
A380
B744
A346
B773
B772
A343
A333
A332
MD11
B763
A306
B753
B752
B739
B738
B737
B736
A319
A318
A321
A320
B722
MD83
MD82
F50
B734
B733
B735
E190
B717
GLF5
DC95
DC93
DH8D
F100
F70

AC TYPE
DH8C
AT72
RJ100
RJ85
B463
B462
E170
DH8B
DH8A
CRJ9
AT45
AT43
GLF4
CRJ7
SB34
CRJ2
CRJ1
E45X
E145
E135
E120
B190
C650
H25B
C525

RECAT key principles

2. Using the vortex circulation decay line in eqn. 9, the approach speed profile shown in Figure 3, and the aircraft characteristics database in Table 1, the vortex circulations generated by the lead aircraft at the ICAO separation minima for the 61x61 leader-follower aircraft pairs are computed

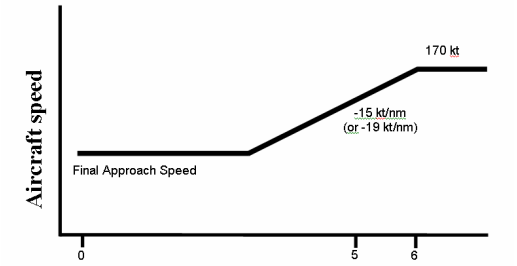
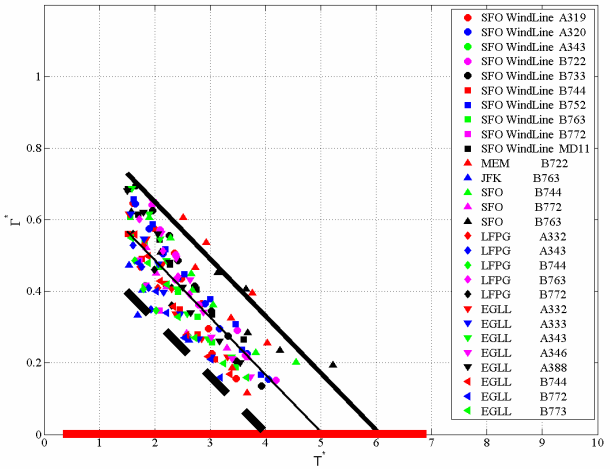


Figure 3

Table 1



decay line in eqn. 9

RECAT key principles

3. <u>Principle 1</u>

   To allow for capacity increases, the vortex strength of potential encounters for a follower aircraft is allowed to be increased to the maximum median vortex strength potentially encountered by this aircraft following any of the 61 aircraft under current ICAO separations

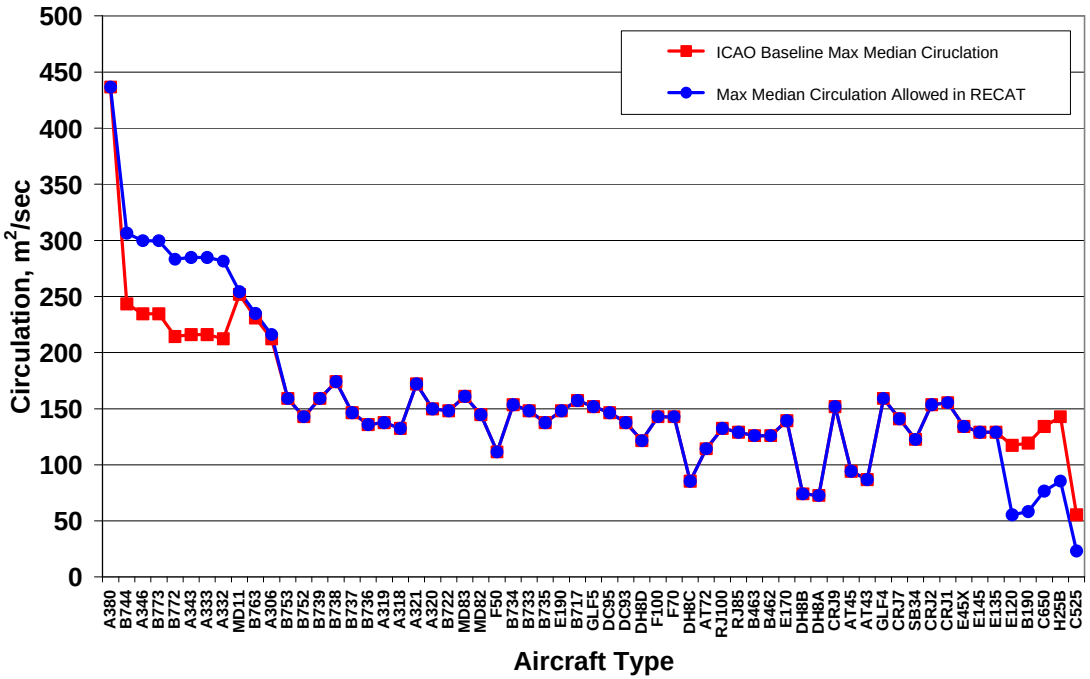
   Exemple:

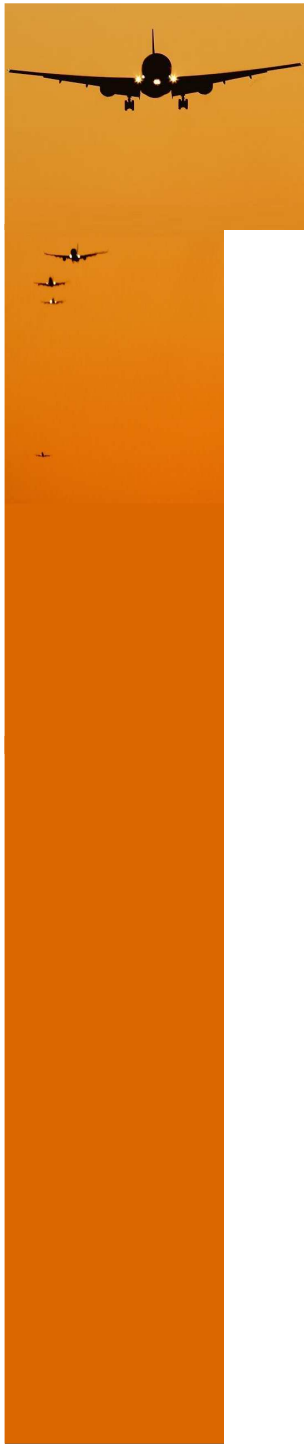
1. Medium X behind B744 @ 5 Nm encounter a wake of maximum 300m²/s
2. Medium X behind B763 @ 5 Nm encounter a wake of maximum 250m²/s
3. Medium X separation behind B763 can be reduced @3.5Nm if the wake encountered doesn't exceed 300m²/s

RECAT key principles

4. Principle 2

The maximum allowable circulations for aircraft in the current ICAO Heavy category are allowed to increase to the blue circles shown for the A332 to the B744 in Figure 4. These increases are based on using the rolling moment coefficient as the severity metric for these aircraft (combined with the roll control authority)





RECAT proposal

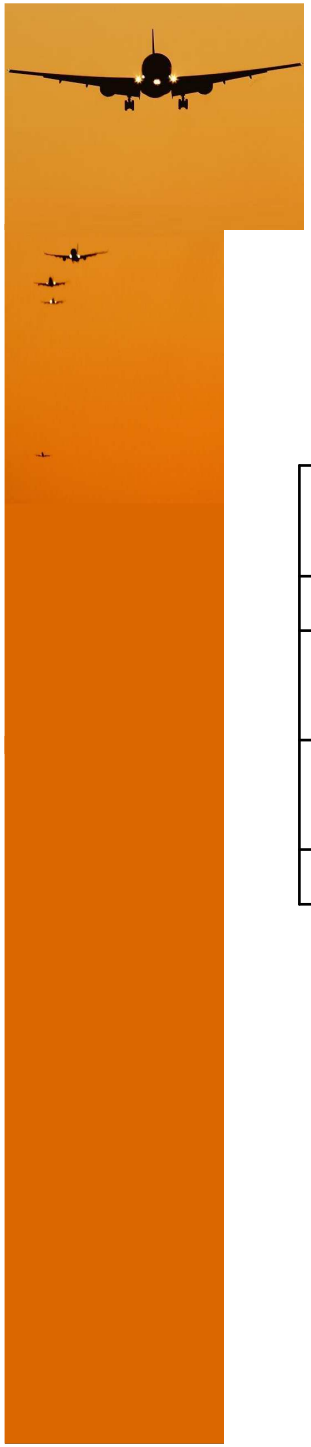
ICAO

	S	H	M	L
S				
H		4	5	6
M		2.5	2.5	5
L		2.5	2.5	2.5

RECAT proposal

ICAO

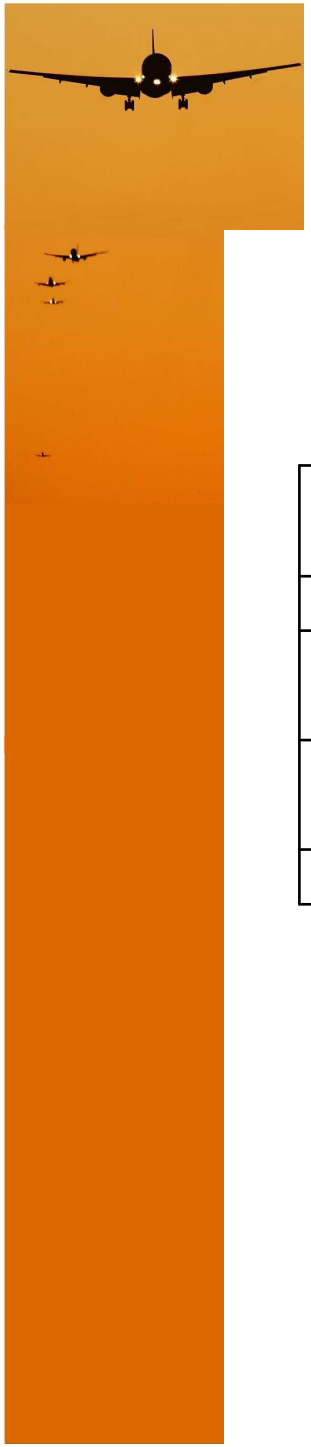
		S	H		M		L
		A	B	C	D	E	F
S	A						
H	B		4.0	4.0	5.0	5.0	6.0
	C		4.0	4.0	5.0	5.0	6.0
M	D		2.5	2.5	2.5	2.5	5.0
	E		2.5	2.5	2.5	2.5	4.0
L	F		2.5	2.5	2.5	2.5	2.5



RECAT proposal

RECAT A

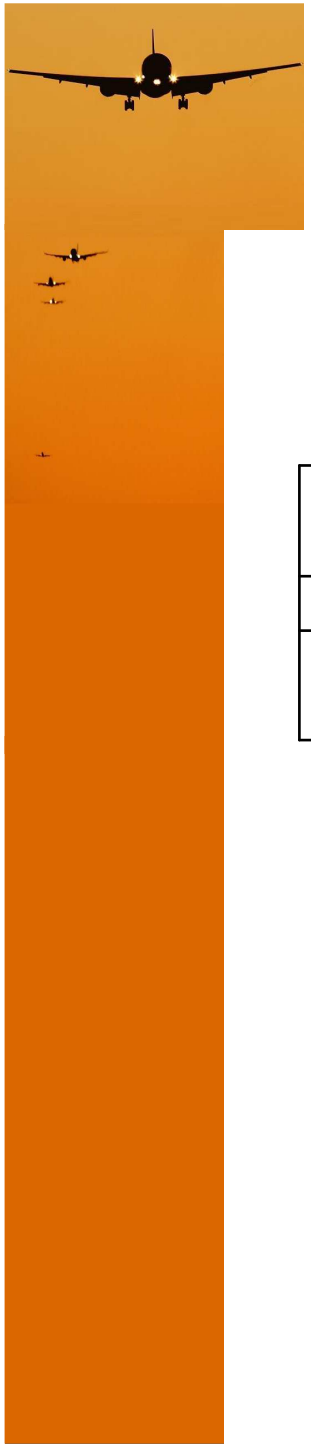
		S	H		M		L
		A	B	C	D	E	F
S	A						
H	B		3.0	4.0	5.0	5.0	6.0
	C		**2.5**	**2.5**	**3.5**	**3.5**	6.0
M	D		2.5	2.5	2.5	2.5	5.0
	E		2.5	2.5	2.5	2.5	4.0
L	F		2.5	2.5	2.5	2.5	2.5



RECAT proposal

RECAT A

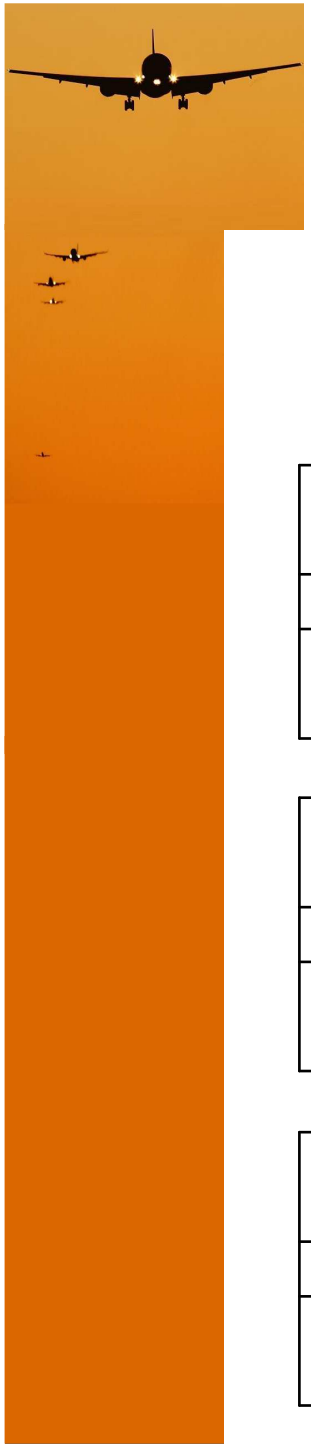
		S	H		M		L
		A	B	C	D	E	F
S	A						
H	B		**3.0**	4.0	5.0	5.0	6.0
	C		**2.5**	**2.5**	**3.5**	**3.5**	6.0
M	D		2.5	2.5	2.5	2.5	5.0
	E		2.5	2.5	2.5	2.5	4.0
L	F		2.5	2.5	2.5	2.5	2.5



RECAT proposal

RECAT A

		S	H		M	
		A	B	C	D	E
S	A					
H	B		**3.0**	4.0	5.0	5.0
	C		**2.5**	**2.5**	**3.5**	**3.5**



RECAT potential improvement

Percentage of pairs potentially reduced:

EGLL		S	H		M	
		A	B	C	D	E
S	A					
H	B		**13%**	2%	10%	~0%
	C		**3%**		**3%**	

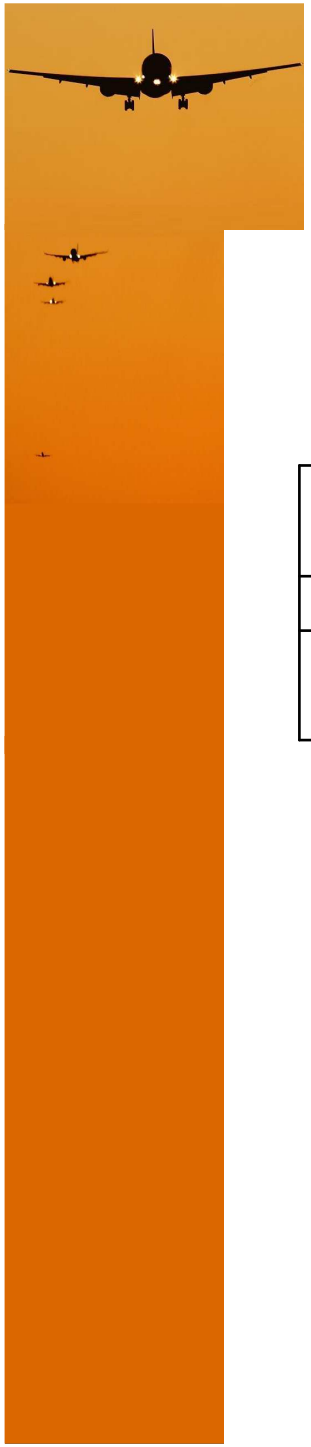
RECAT A	RECAT B
19%	29%

LFPG		S	H		M	
		A	B	C	D	E
S	A					
H	B		**5%**	0.5%	9%	1.5%
	C		**1.5%**		**2%**	

RECAT A	RECAT B
8.5%	17.5%

EDDF		S	H		M	
		A	B	C	D	E
S	A					
H	B		**5.5%**	1.5%	10%	1.5%
	C		**1%**		**3.5%**	

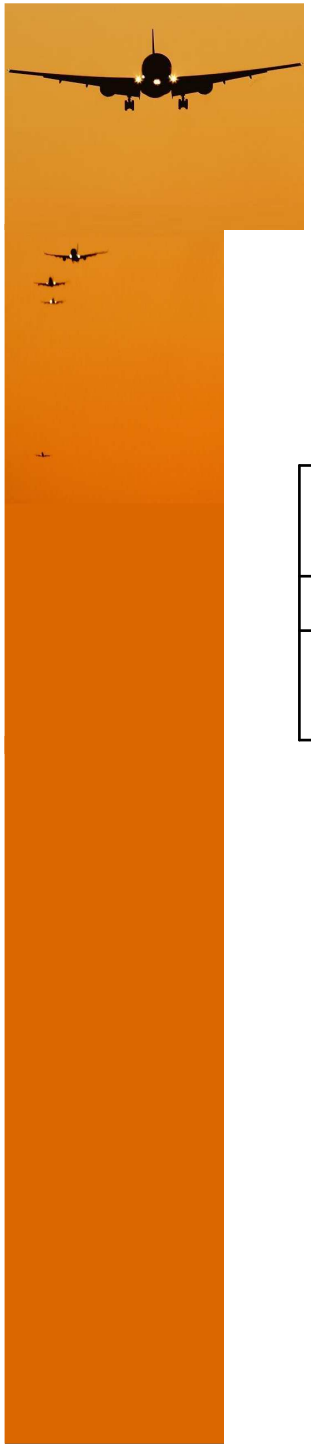
RECAT A	RECAT B
10%	20%



RECAT potential improvement

RECAT A

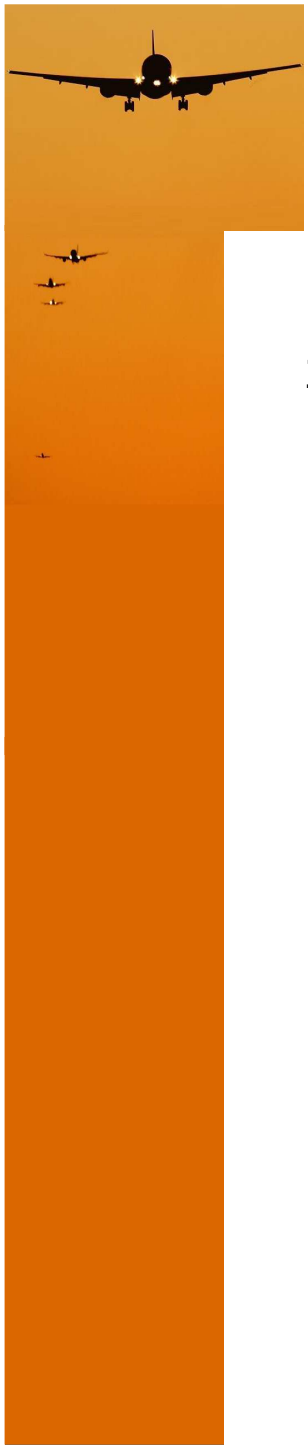
		S	H		M	
		A	B	C	D	E
S	A					
H	B		**3.0**	4.0	5.0	5.0
	C		**2.5**	**2.5**	**3.5**	**3.5**



RECAT potential improvement

RECAT B

		S	H		M	
		A	B	C	D	E
S	A					
H	B		**3.0**	4.0	**4.0**	5.0
	C		**2.5**	**2.5**	**3.5**	**3.5**

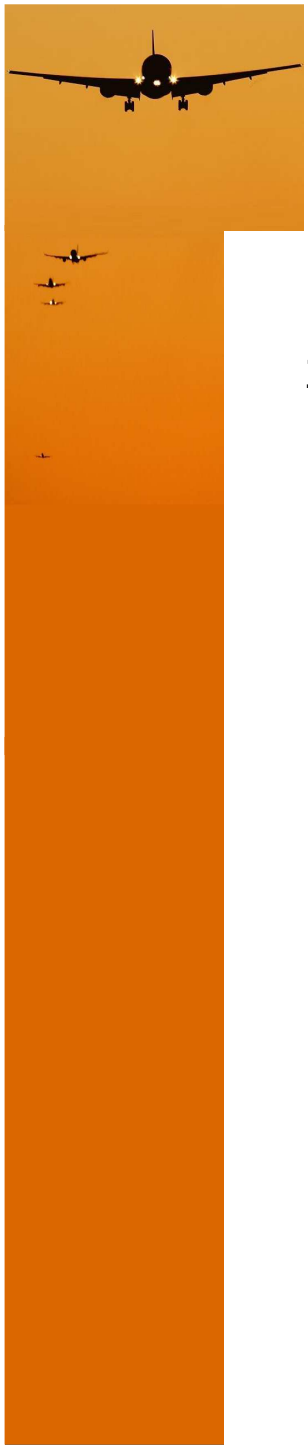


RECAT amendment key principles

1. CAT D is restricted to the very upper part of the Medium category

AC TYPE	ICAO	RECAT A
A380	S	1
B744	H	2
A346	H	2
B773	H	2
B772	H	2
A343	H	2
A333	H	2
A332	H	2
MD11	H	3
B763	H	3
A306	H	3
B753	H / M	4
B752	H / M	4
B739	M	4
B738	M	4
B737	M	4
B736	M	4
A319	M	4
A318	M	4
A321	M	4
A320	M	4
B722	M	4
MD83	M	4
MD82	M	4
F50	M	4
B734	M	4
B733	M	4
B735	M	4
E190	M	4
B717	M	4
GLF5	M	4
DC95	M	4
DC93	M	4
DH8D	M	4
F100	M	4
F70	M	4

AC TYPE	ICAO	RECAT A
DH8C	M	5
AT72	M	5
RJ100	M	5
RJ85	M	5
B463	M	5
B462	M	5
E170	M	5
DH8B	M	5
DH8A	M	5
CRJ9	M	5
AT45	M	5
AT43	M	5
GLF4	M	5
CRJ7	M	5
SB34	M	5
CRJ2	M	5
CRJ1	M	5
E45X	M	5
E145	M	5
E135	M	5
E120	L	6
B190	L	6
C650	L	6
H25B	L	6
C525	L	6



RECAT amendment key principles

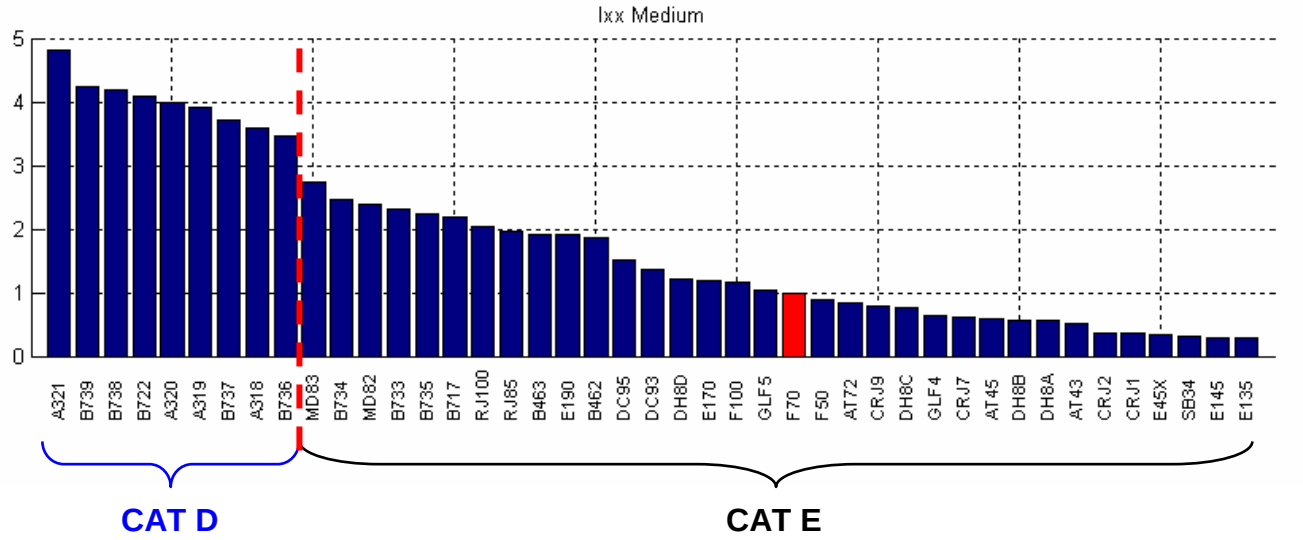
1. CAT D is restricted to the very upper part of the Medium category

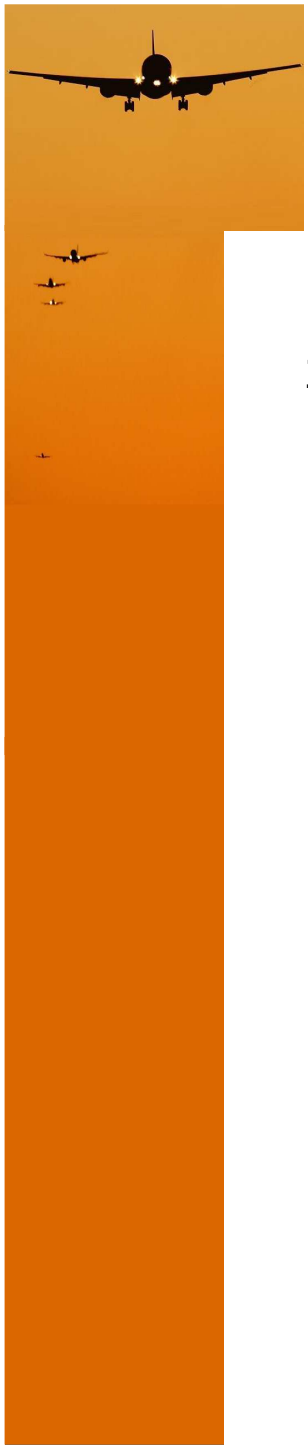
AC TYPE	ICAO	RECAT A	RECAT B
A380	S	1	1
B744	H	2	2
A346	H	2	2
B773	H	2	2
B772	H	2	2
A343	H	2	2
A333	H	2	2
A332	H	2	2
MD11	H	3	3
B763	H	3	3
A306	H	3	3
B753	H M	4	4
B752	H M	4	4
B739	M	4	4
B738	M	4	4
B737	M	4	4
B736	M	4	4
A319	M	4	4
A318	M	4	4
A321	M	4	4
A320	M	4	4
B722	M	4	4
MD83	M	4	5
MD82	M	4	5
F50	M	4	5
B734	M	4	5
B733	M	4	5
B735	M	4	5
E190	M	4	5
B717	M	4	5
GLF5	M	4	5
DC95	M	4	5
DC93	M	4	5
DH8D	M	4	5
F100	M	4	5
F70	M	4	5

AC TYPE	ICAO	RECAT A	RECAT B
DH8C	M	5	5
AT72	M	5	5
RJ100	M	5	5
RJ85	M	5	5
B463	M	5	5
B462	M	5	5
E170	M	5	5
DH8B	M	5	5
DH8A	M	5	5
CRJ9	M	5	5
AT45	M	5	5
AT43	M	5	5
GLF4	M	5	5
CRJ7	M	5	5
SB34	M	5	5
CRJ2	M	5	5
CRJ1	M	5	5
E45X	M	5	5
E145	M	5	5
E135	M	5	5
E120	L	6	6
B190	L	6	6
C650	L	6	6
H25B	L	6	6
C525	L	6	6

RECAT amendment key principles

2. CAT B – CAT D pair is reduced because of the higher resistance of the upper Medium aircraft (in new CAT D)





RECAT B safety assessment principles

1. The same list of 61 aircraft representing 85% of the U.S. and European traffic (operations) is used for the analysis

AC TYPE
A380
B744
A346
B773
B772
A343
A333
A332
MD11
B763
A306
B753
B752
B739
B738
B737
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A319
A318
A321
A320
B722
MD83
MD82
F50
B734
B733
B735
E190
B717
GLF5
DC95
DC93
DH8D
F100
F70

AC TYPE
DH8C
AT72
RJ100
RJ85
B463
B462
E170
DH8B
DH8A
CRJ9
AT45
AT43
GLF4
CRJ7
SB34
CRJ2
CRJ1
E45X
E145
E135
E120
B190
C650
H25B
C525

RECAT B safety assessment principles

2. Using vortex decay based on LIDAR measurement from EGLL and the approach speed profile shown in Figure 3, the vortex circulations generated by the lead aircraft at the ICAO separation minima for the 61x61 leader-follower aircraft pairs are computed

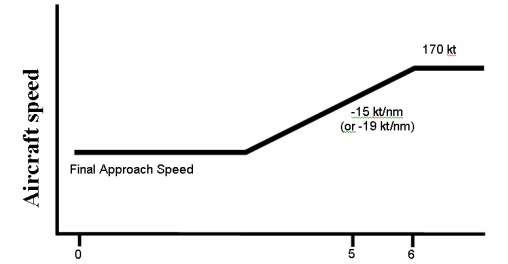
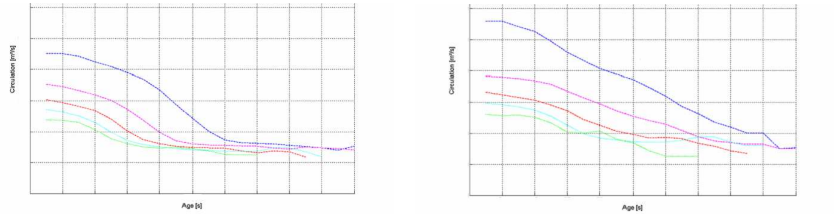
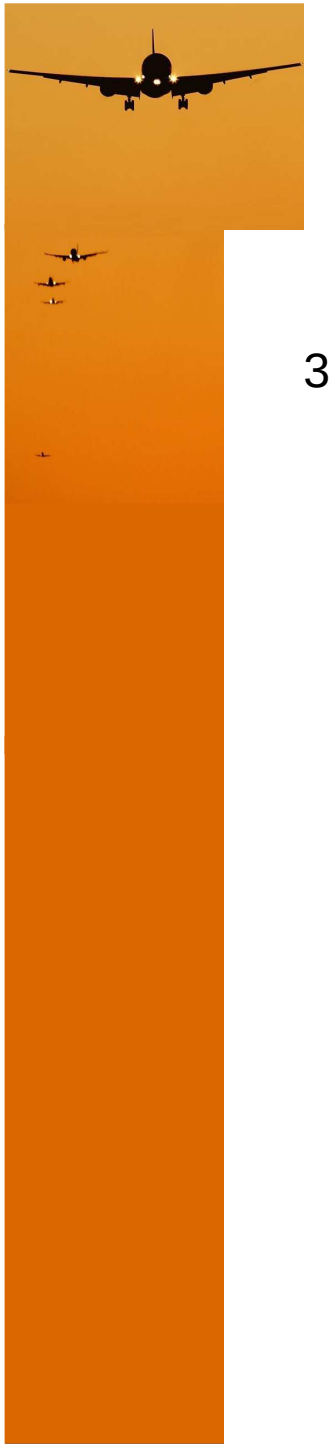


Figure 3



LIDAR measurement from EGLL



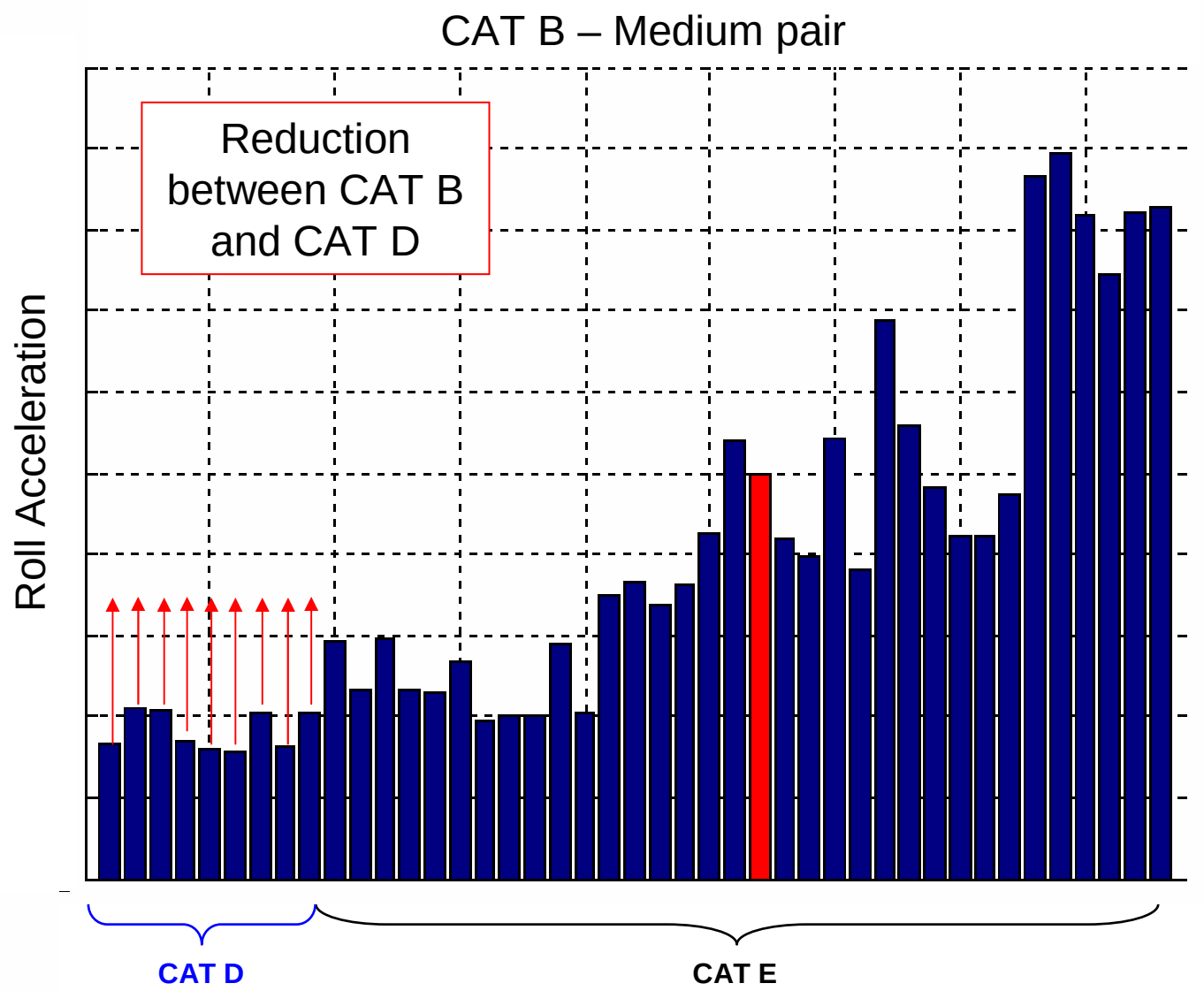
RECAT amendment key principles

3. The severity of a potential encounter is assessed using :

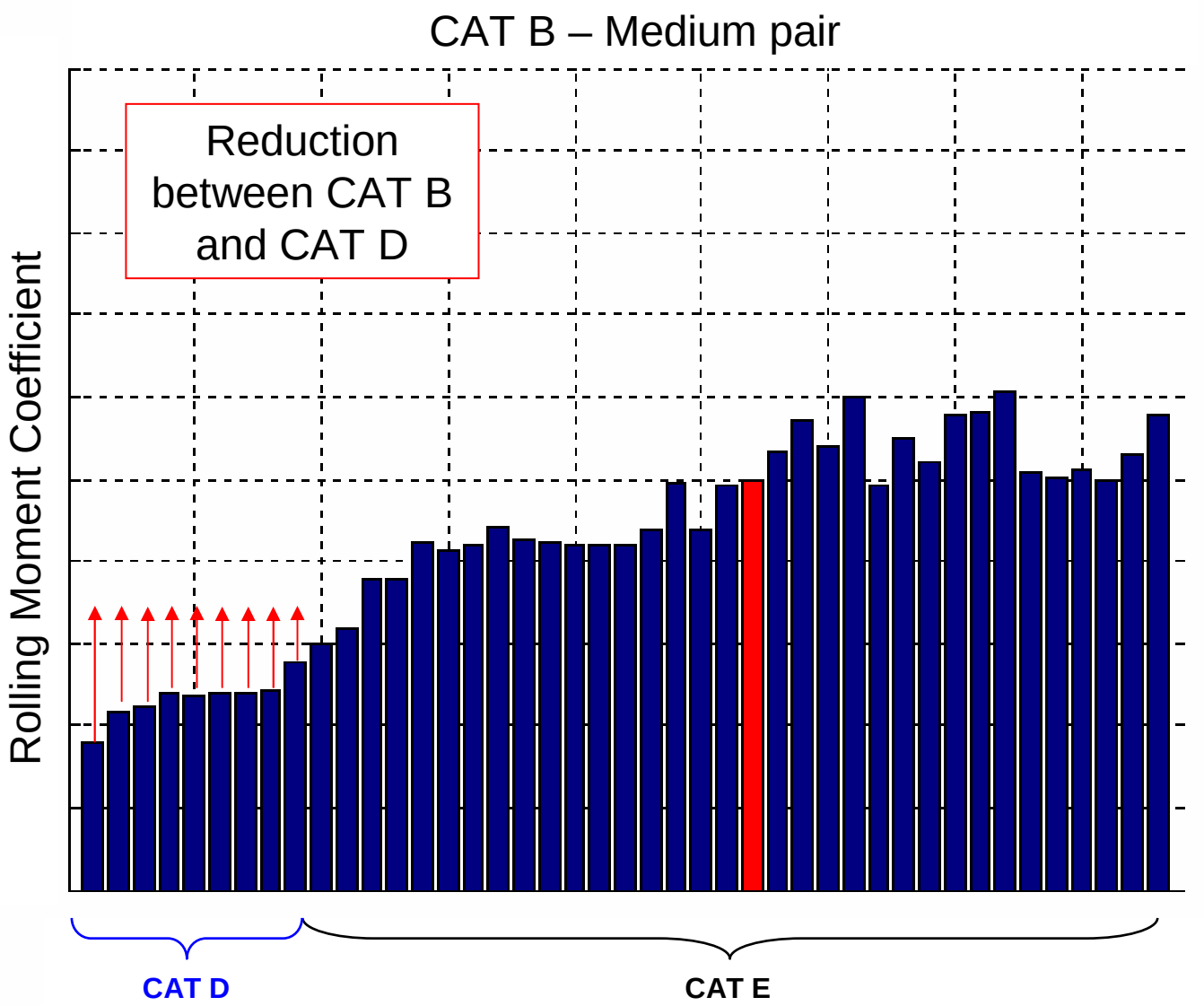
$$Roll\ acceleration = \frac{\Delta M_i}{I_j} \propto \frac{\Gamma_i \cdot V_{f\,i} \cdot b_{f_i}^2}{I_j}$$

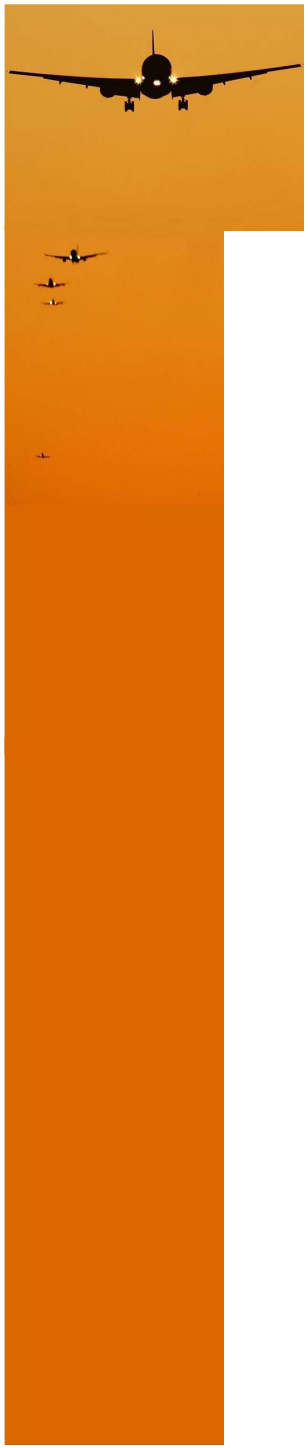
$$Rolling\ Moment\ Coefficient \propto \frac{\Gamma_i}{V_{f_j}.b_{f_j}}$$

RECAT amendment key principles



RECAT amendment key principles





RECAT amendment safety assessment

Heavy - Heavy

RECAT amendment safety assessment

ICAO - Heavy-Heavy pairs

		S	H	
		A	B	C
S	A			
H	B	4.0	4.0	4.0
	C		4.0	4.0

RECAT amendment safety assessment

RECAT A & B - Heavy-Heavy pairs

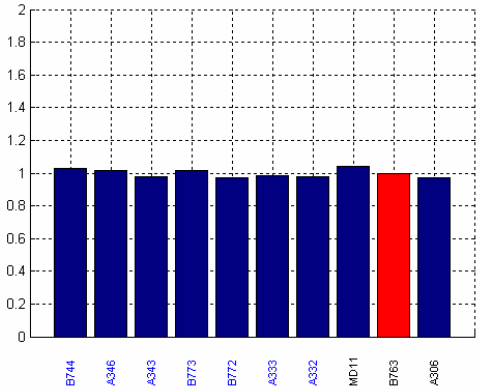
		S	H	
		A	B	C
S	A			
H	B		**3.0**	4.0
	C		**2.5**	**2.5**

RECAT amendment safety assessment

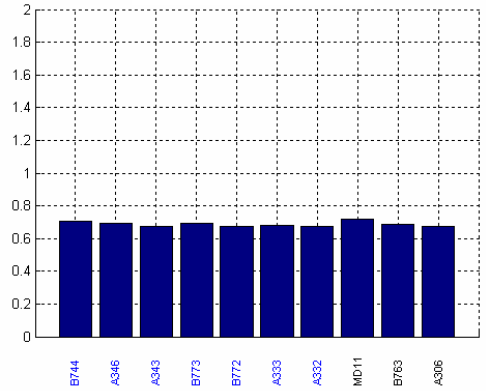
ICAO - Heavy-Heavy pairs

ICAO		S	H		M		L
		A	B	C	D	E	F
S	A						
H	B		4.0	4.0	5.0	5.0	6.0
	C		4.0	4.0	5.0	5.0	6.0
M	D		2.5	2.5	2.5	2.5	5.0
	E		2.5	2.5	2.5	2.5	5.0
L	F		2.5	2.5	2.5	2.5	2.5

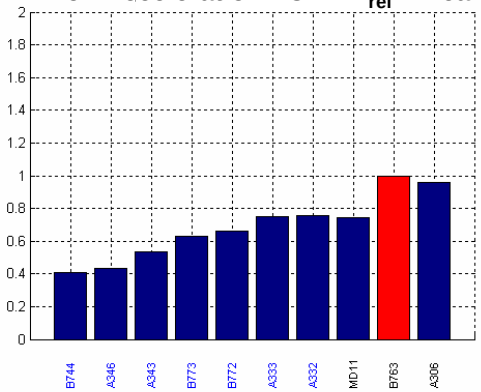
Circulation : CAT B_{ref} – Heavy



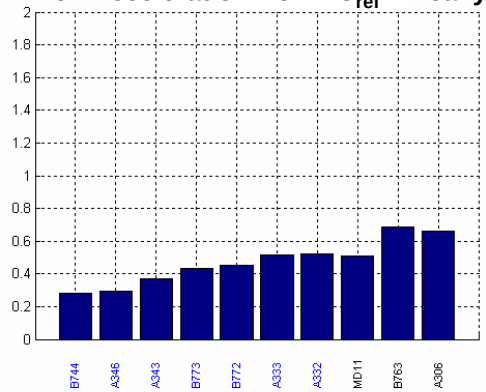
Circulation : CAT C_{ref} – Heavy



Roll Acceleration : CAT B_{ref} – Heavy



Roll Acceleration : CAT C_{ref} – Heavy



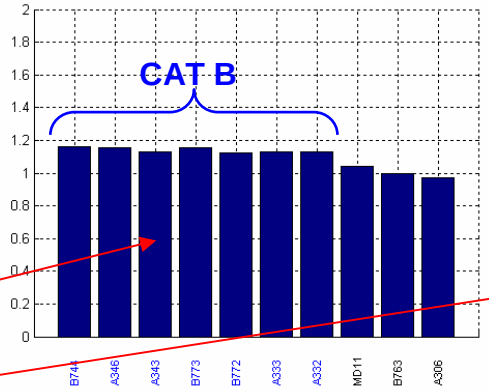
Roll Acceleration

RECAT amendment safety assessment

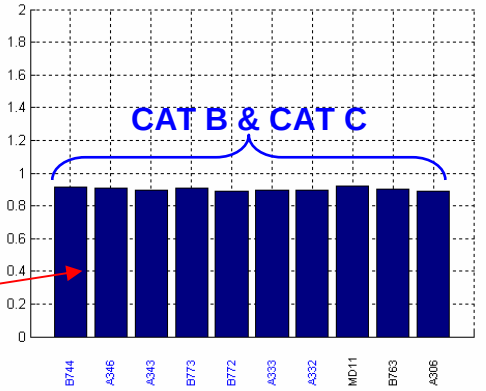
RECAT A & B - Heavy-Heavy pairs

RECAT A/B		S	H		M		L
		A	B	C	D	E	F
S	A						
H	B		**3.0**	4.0	5.0	5.0	7.0
	C		**2.5**	**2.5**	3.5	3.5	6.0
M	D		2.5	2.5	2.5	2.5	5.0
	E		2.5	2.5	2.5	2.5	4.0
L	F		2.5	2.5	2.5	2.5	2.5

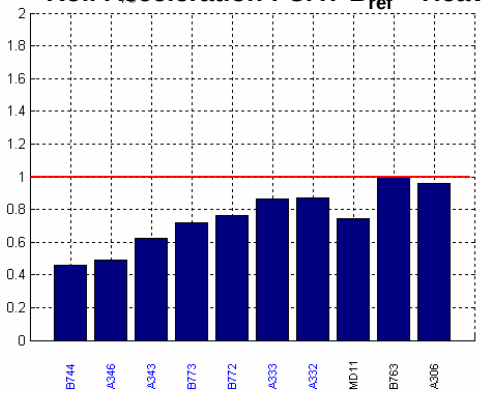
Circulation : CAT B_{ref} – Heavy



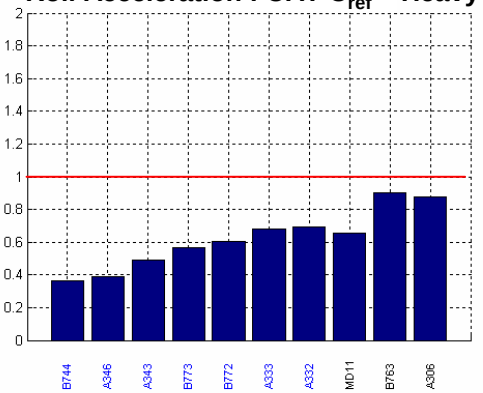
Circulation : CAT C_{ref} – Heavy



Roll Acceleration : CAT B_{ref} – Heavy



Roll Acceleration : CAT C_{ref} – Heavy

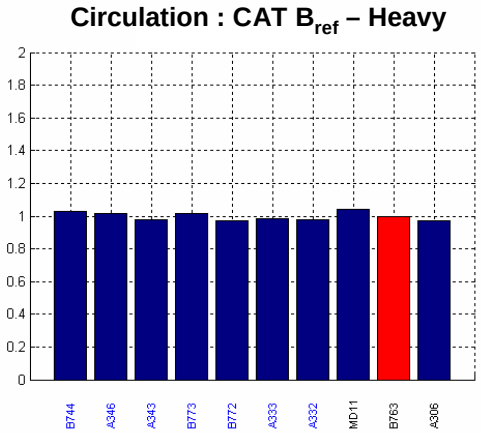


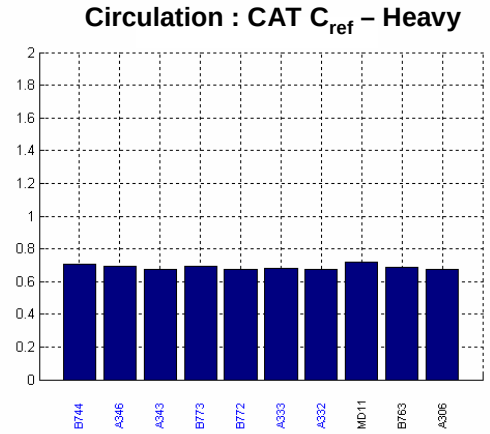
Roll Acceleration

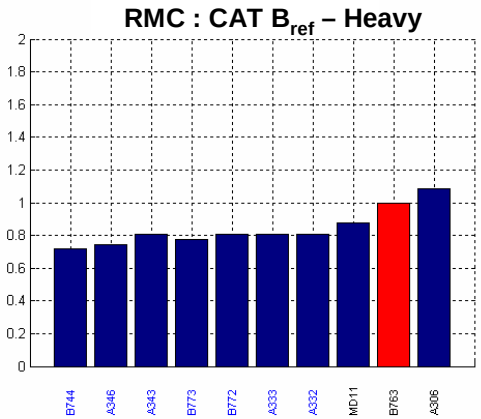
RECAT amendment safety assessment

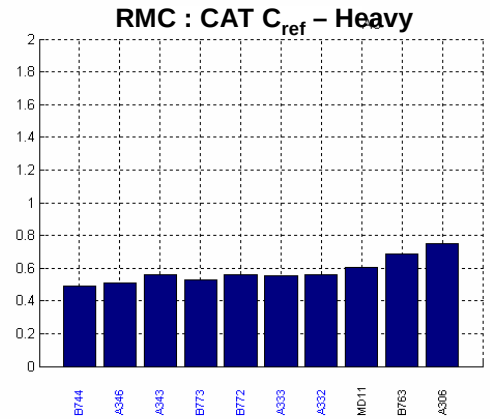
ICAO - Heavy-Heavy pairs

ICAO		S	H		M		L
		A	B	C	D	E	F
S	A						
H	B		4.0	4.0	5.0	5.0	6.0
	C		4.0	4.0	5.0	5.0	6.0
M	D		2.5	2.5	2.5	2.5	5.0
	E		2.5	2.5	2.5	2.5	5.0
L	F		2.5	2.5	2.5	2.5	2.5









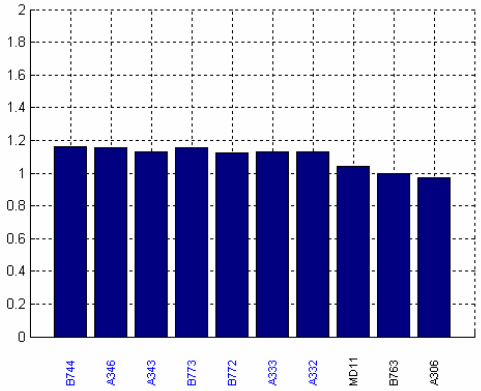
Rolling Moment Coefficient

RECAT amendment safety assessment

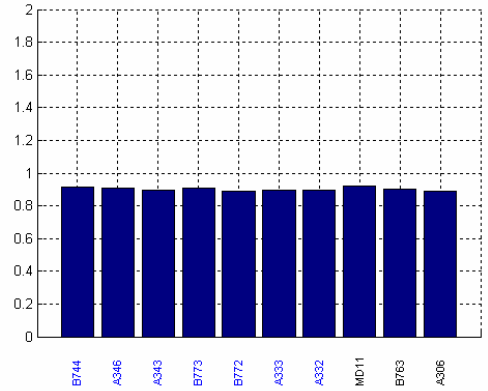
RECAT A & B - Heavy-Heavy pairs

RECAT A/B		S	H		M		L
		A	B	C	D	E	F
S	A						
H	B		**3.0**	4.0	5.0	5.0	7.0
	C		**2.5**	**2.5**	3.5	3.5	6.0
M	D		2.5	2.5	2.5	2.5	5.0
	E		2.5	2.5	2.5	2.5	4.0
L	F		2.5	2.5	2.5	2.5	2.5

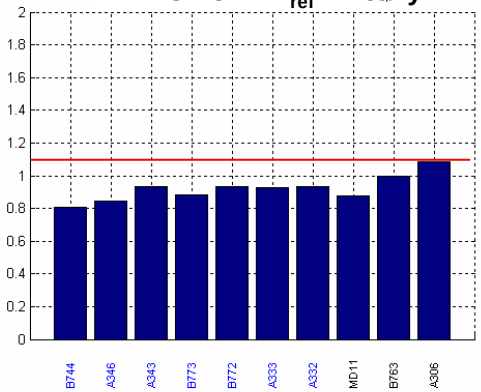
Circulation : CAT B_{ref} – Heavy



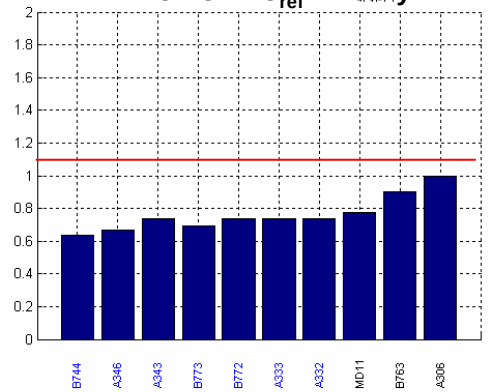
Circulation : CAT C_{ref} – Heavy



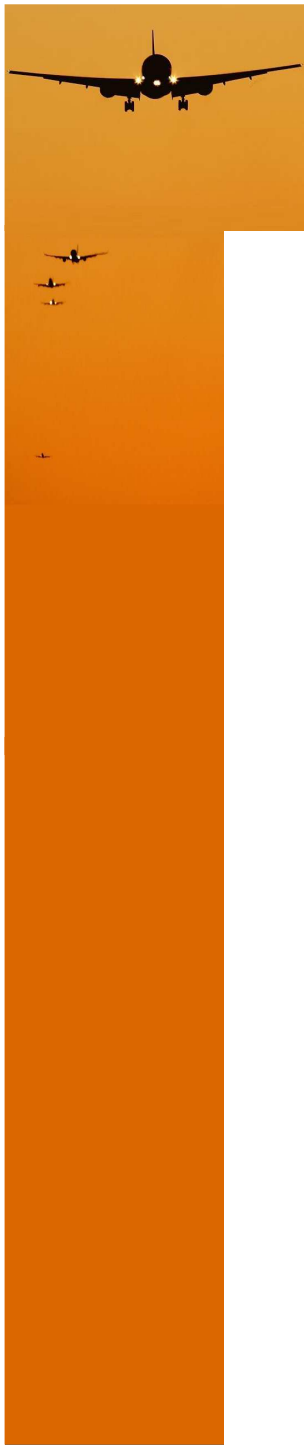
RMC : CAT B_{ref} – Heavy



RMC : CAT C_{ref} – Heavy



Rolling Moment Coefficient

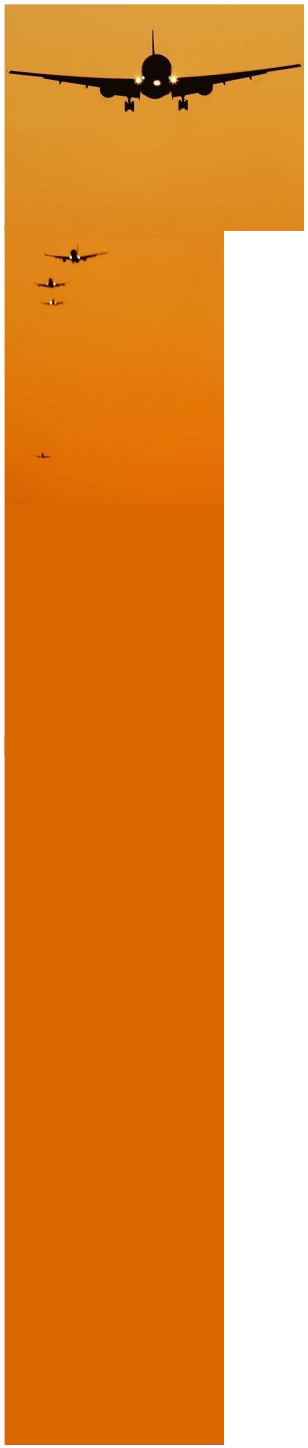


RECAT amendment safety assessment

Preliminary Conclusion

Heavy – Heavy

RECAT A proposal confirmed
to be acceptably safe



RECAT amendment safety assessment

Heavy - Medium

RECAT amendment safety assessment

ICAO - Heavy-Medium pairs

		S	H		M		L
		A	B	C	D	E	F
S	A						
H	B		4.0	4.0	5.0	5.0	6.0
	C		4.0	4.0	5.0	5.0	6.0
M	D		2.5	2.5	2.5	2.5	5.0
	E		2.5	2.5	2.5	2.5	5.0
L	F		2.5	2.5	2.5	2.5	2.5

RECAT amendment safety assessment

RECAT A - Heavy-Medium pairs

		S	H		M		L
		A	B	C	D	E	F
S	A						
H	B		**3.0**	4.0	5.0	5.0	**7.0**
	C		**2.5**	**2.5**	**3.5**	**3.5**	6.0
M	D		2.5	2.5	2.5	2.5	5.0
	E		2.5	2.5	2.5	2.5	4.0
L	F		2.5	2.5	2.5	2.5	2.5

RECAT amendment safety assessment

RECAT B.1 - Heavy-Medium pairs

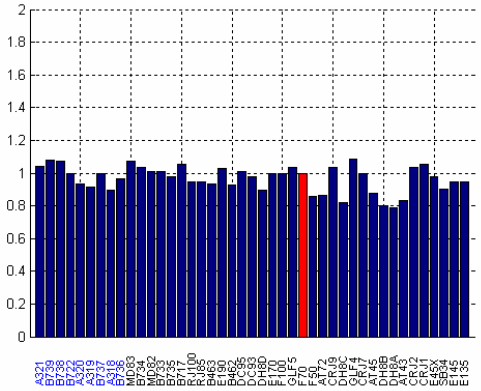
		S	H		M		L
		A	B	C	D	E	F
S	A						
H	B		**3.0**	4.0	**4.0**	5.0	**7.0**
	C		**2.5**	**2.5**	**3.5**	**3.5**	6.0
M	D		2.5	2.5	2.5	2.5	5.0
	E		2.5	2.5	2.5	2.5	4.0
L	F		2.5	2.5	2.5	2.5	2.5

RECAT amendment safety assessment

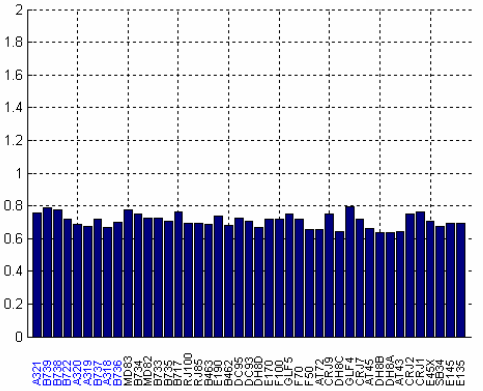
ICAO - Heavy-Medium pairs

ICAO		S	H		M		L
		A	B	C	D	E	F
S	A						
H	B		4.0	4.0	5.0	5.0	6.0
	C		4.0	4.0	5.0	5.0	6.0
M	D		2.5	2.5	2.5	2.5	5.0
	E		2.5	2.5	2.5	2.5	5.0
L	F		2.5	2.5	2.5	2.5	2.5

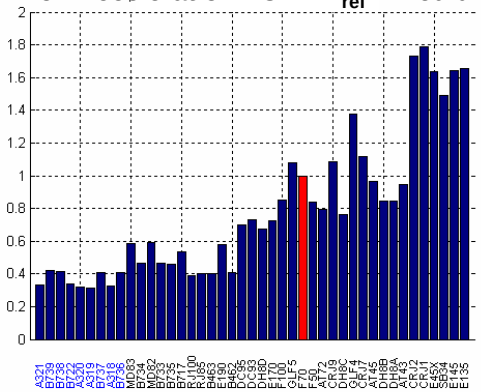
Circulation : CAT B_{ref} – Medium



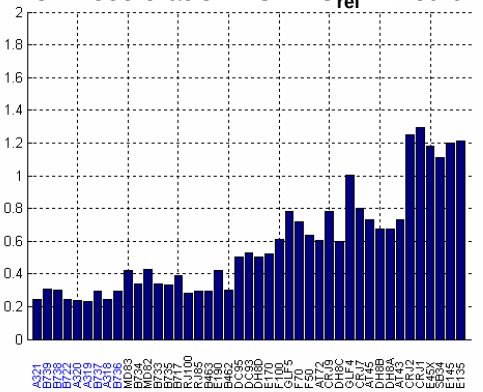
Circulation : CAT C_{ref} – Medium



Roll Acceleration : CAT B_{ref} – Medium



Roll Acceleration : CAT C_{ref} – Medium



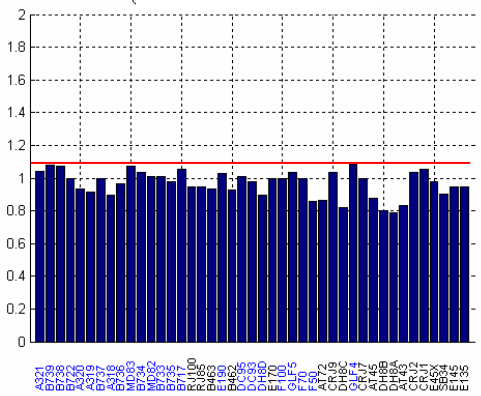
Roll Acceleration

RECAT amendment safety assessment

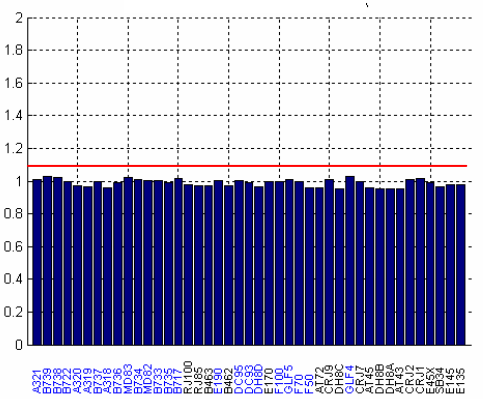
RECAT A - Heavy-Medium pairs

RECAT A		S	H		M		L
		A	B	C	D	E	F
S	A						
H	B		3.0	4.0	5.0	5.0	7.0
	C		2.5	2.5	**3.5**	**3.5**	6.0
M	D		2.5	2.5	2.5	2.5	5.0
	E		2.5	2.5	2.5	2.5	4.0
L	F		2.5	2.5	2.5	2.5	2.5

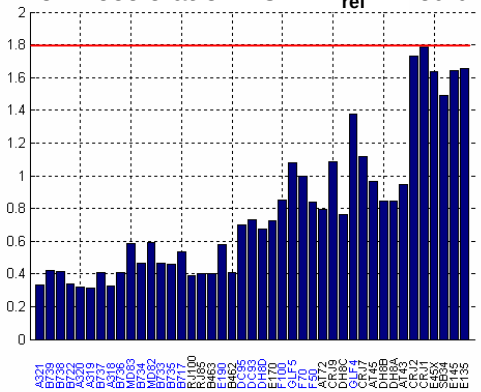
Circulation : CAT B_{ref} – Medium



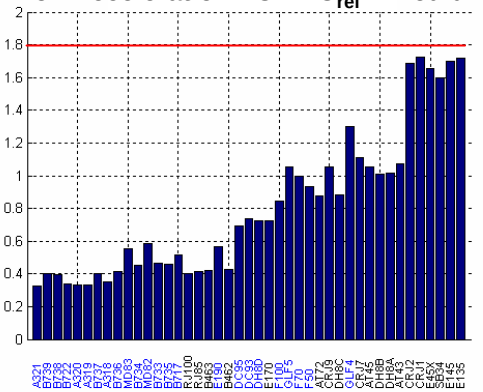
Circulation : CAT C_{ref} – Medium



Roll Acceleration : CAT B_{ref} – Medium



Roll Acceleration : CAT C_{ref} – Medium



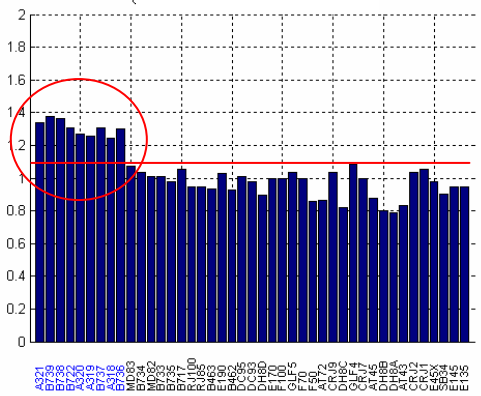
Roll Acceleration

RECAT amendment safety assessment

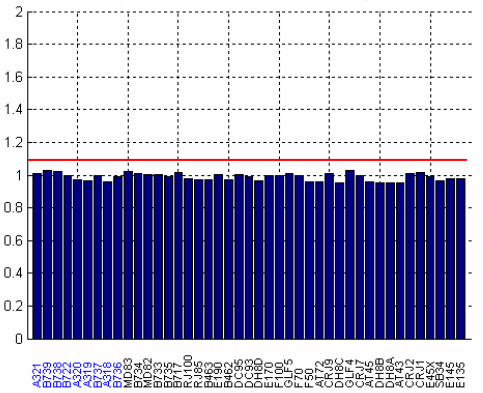
RECAT B.1 - Heavy-Medium

RECAT B		S	H		M		L
		A	B	C	D	E	F
S	A						
H	B		3.0	4.0	**4.0**	5.0	7.0
	C		2.5	2.5	**3.5**	**3.5**	6.0
M	D		2.5	2.5	2.5	2.5	5.0
	E		2.5	2.5	2.5	2.5	4.0
L	F		2.5	2.5	2.5	2.5	2.5

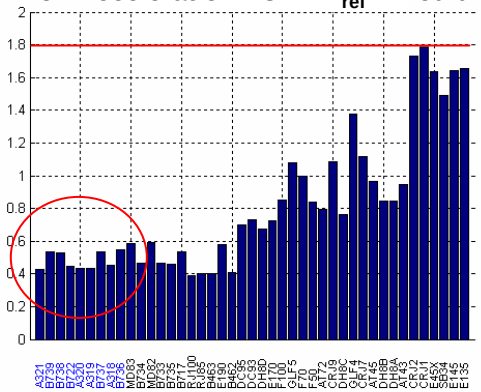
Circulation : CAT B_{ref} – Medium



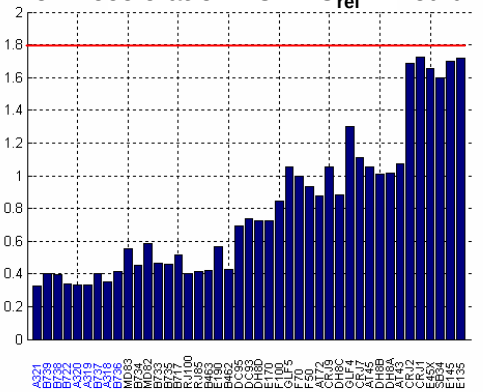
Circulation : CAT C_{ref} – Medium



Roll Acceleration : CAT B_{ref} – Medium



Roll Acceleration : CAT C_{ref} – Medium



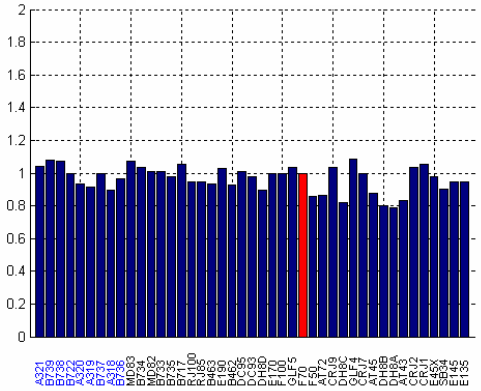
Roll Acceleration

RECAT amendment safety assessment

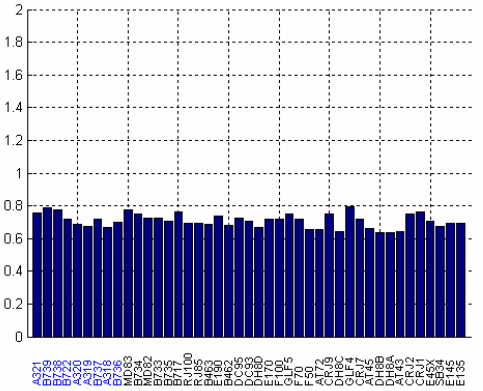
ICAO - Heavy-Medium pairs

ICAO		S	H		M		L
		A	B	C	D	E	F
S	A						
H	B		4.0	4.0	5.0	5.0	6.0
	C		4.0	4.0	5.0	5.0	6.0
M	D		2.5	2.5	2.5	2.5	5.0
	E		2.5	2.5	2.5	2.5	5.0
L	F		2.5	2.5	2.5	2.5	2.5

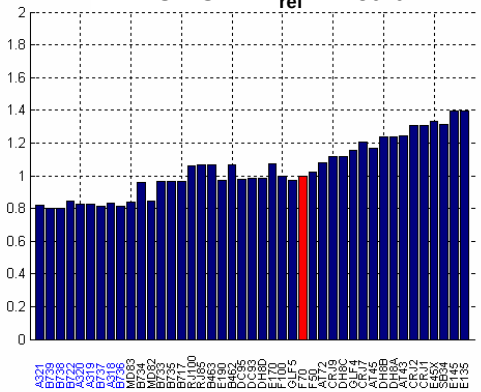
Circulation : CAT B_{ref} – Medium



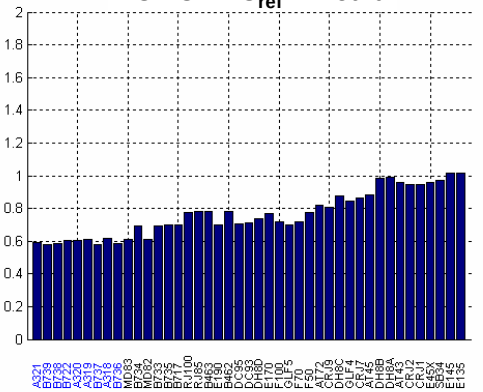
Circulation : CAT C_{ref} – Medium



RMC : CAT B_{ref} – Medium



RMC : CAT C_{ref} – Medium



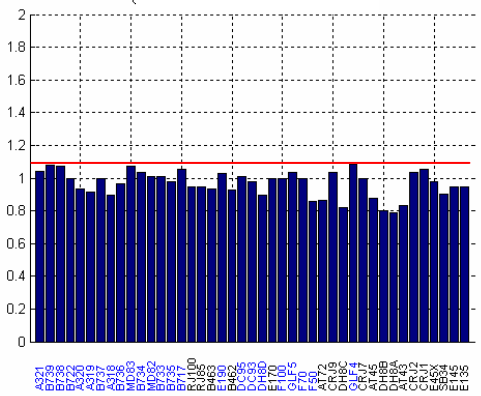
Rolling Moment Coefficient

RECAT amendment safety assessment

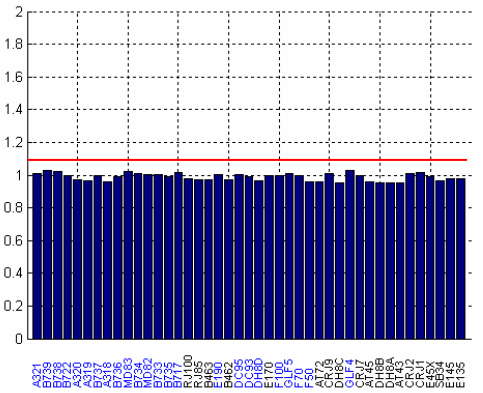
RECAT A - Heavy-Medium pairs

RECAT A		S	H		M		L
		A	B	C	D	E	F
S	A						
H	B		3.0	4.0	5.0	5.0	7.0
	C		2.5	2.5	**3.5**	**3.5**	6.0
M	D		2.5	2.5	2.5	2.5	5.0
	E		2.5	2.5	2.5	2.5	4.0
L	F		2.5	2.5	2.5	2.5	2.5

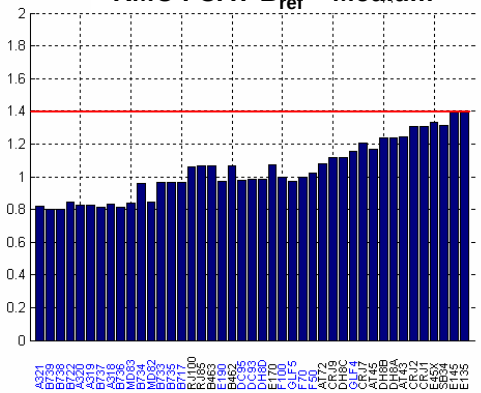
Circulation : CAT B_{ref} – Medium



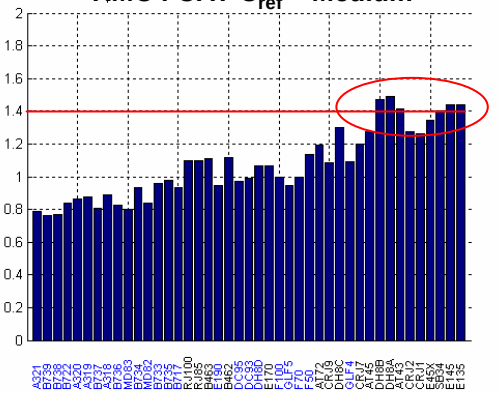
Circulation : CAT C_{ref} – Medium



RMC : CAT B_{ref} – Medium



RMC : CAT C_{ref} – Medium



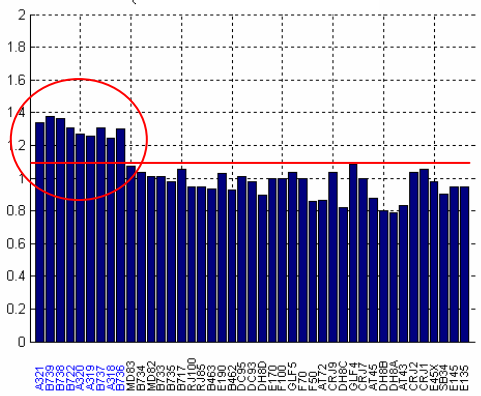
Rolling Moment Coefficient

RECAT amendment safety assessment

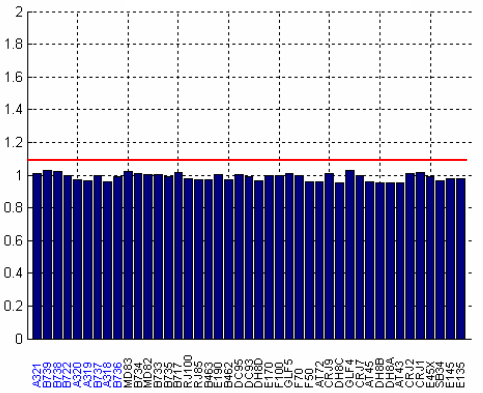
RECAT B.1 - Heavy-Medium pairs

RECAT B		S	H		M		L
		A	B	C	D	E	F
S	A						
H	B		3.0	4.0	**4.0**	5.0	7.0
	C		2.5	2.5	**3.5**	**3.5**	6.0
M	D		2.5	2.5	2.5	2.5	5.0
	E		2.5	2.5	2.5	2.5	4.0
L	F		2.5	2.5	2.5	2.5	2.5

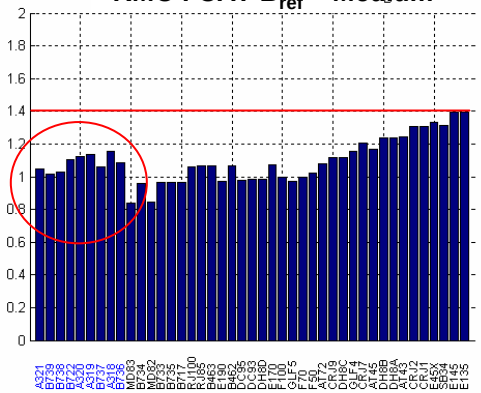
Circulation : CAT B_{ref} – Medium



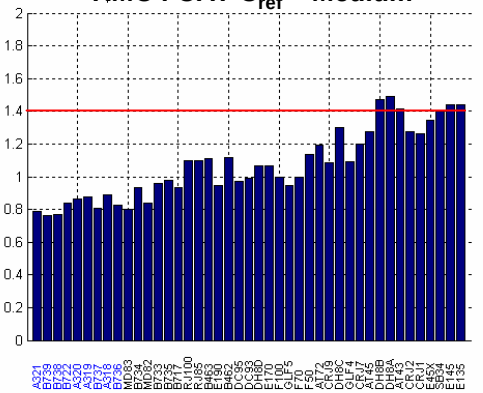
Circulation : CAT C_{ref} – Medium



RMC : CAT B_{ref} – Medium



RMC : CAT C_{ref} – Medium



Rolling Moment Coefficient

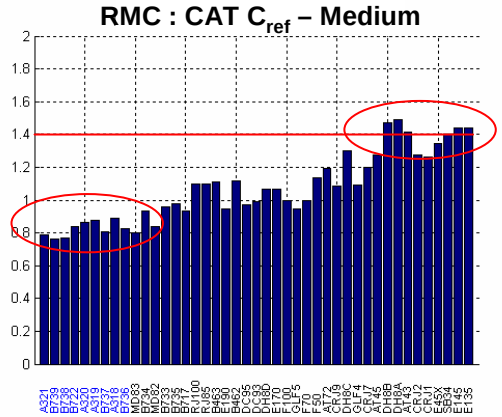
RECAT amendment safety assessment

RECAT B.1 - Heavy-Medium pairs

$$Rolling\ Moment\ Coefficient \propto \frac{\Gamma_i}{V_{f_j}.b_{f_j}}$$

Ac Type	Span [m]	App. Speed [kt]
DH8A	25.9	86
DH8B	25.9	87
AT43	24.6	95

CRJ2	21.2	130
AT72	27.1	103



Rolling Moment Coefficient

RECAT amendment safety assessment

RECAT B.1 - Heavy-Medium pairs

		S	H		M		L
		A	B	C	D	E	F
S	A						
H	B		**3.0**	4.0	**4.0**	5.0	**7.0**
	C		**2.5**	**2.5**	**3.5**	**3.5**	6.0
M	D		2.5	2.5	2.5	2.5	5.0
	E		2.5	2.5	2.5	2.5	4.0
L	F		2.5	2.5	2.5	2.5	2.5

RECAT amendment safety assessment

RECAT B.2 - Heavy-Medium pairs

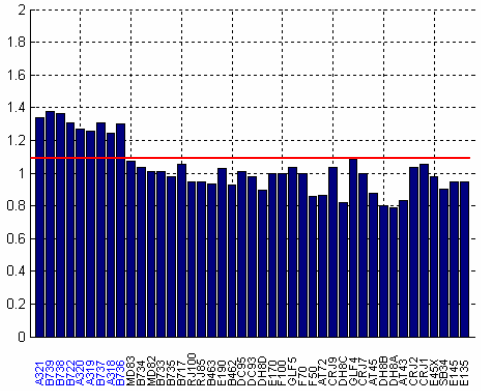
		S	H		M		L
		A	B	C	D	E	F
S	A						
H	B		**3.0**	4.0	**4.0**	5.0	**7.0**
	C		**2.5**	**2.5**	**3.0**	**4.0**	6.0
M	D		2.5	2.5	2.5	2.5	5.0
	E		2.5	2.5	2.5	2.5	4.0
L	F		2.5	2.5	2.5	2.5	2.5

RECAT amendment safety assessment

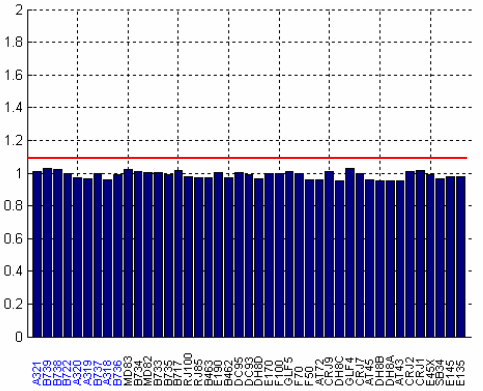
RECAT B.1 - Heavy-Medium

RECAT B		S	H		M		L
		A	B	C	D	E	F
S	A						
H	B		3.0	4.0	**4.0**	5.0	7.0
	C		2.5	2.5	**3.5**	**3.5**	6.0
M	D		2.5	2.5	2.5	2.5	5.0
	E		2.5	2.5	2.5	2.5	4.0
L	F		2.5	2.5	2.5	2.5	2.5

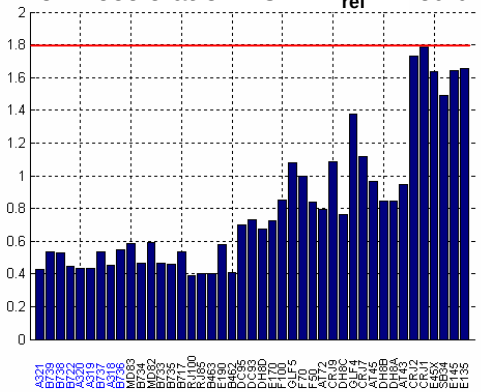
Circulation : CAT B_{ref} – Medium



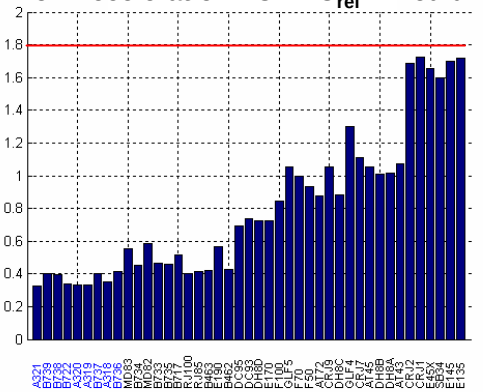
Circulation : CAT C_{ref} – Medium



Roll Acceleration : CAT B_{ref} – Medium



Roll Acceleration : CAT C_{ref} – Medium



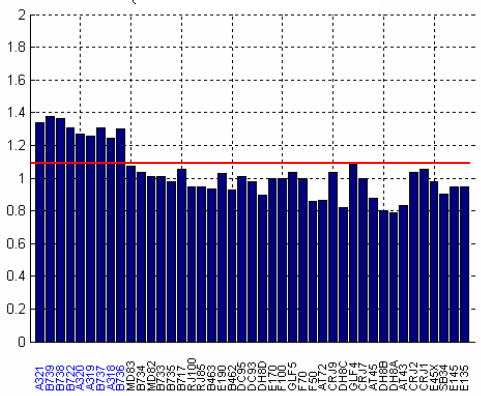
Roll Acceleration

RECAT amendment safety assessment

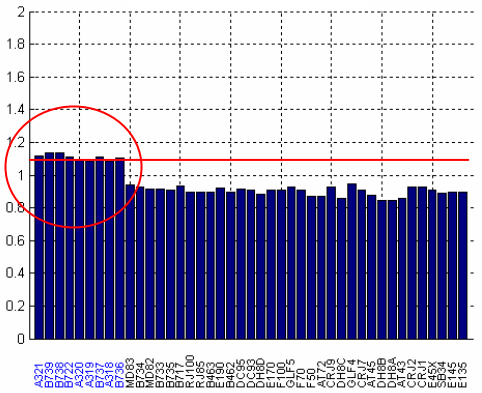
RECAT B.2 - Heavy-Medium

RECAT B		S	H		M		L
		A	B	C	D	E	F
S	A						
H	B		3.0	4.0	**4.0**	5.0	7.0
	C		2.5	2.5	**3.0**	**4.0**	6.0
M	D		2.5	2.5	2.5	2.5	5.0
	E		2.5	2.5	2.5	2.5	4.0
L	F		2.5	2.5	2.5	2.5	2.5

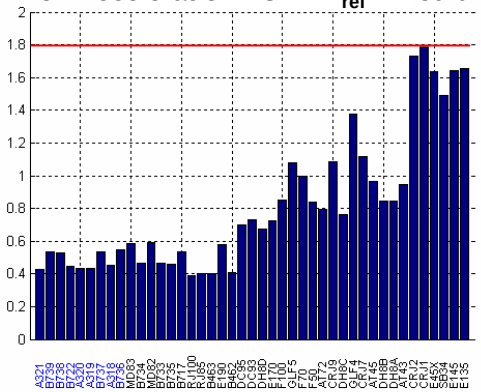
Circulation : CAT B_{ref} – Medium



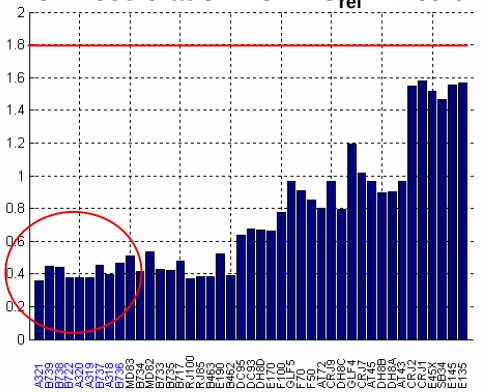
Circulation : CAT C_{ref} – Medium



Roll Acceleration : CAT B_{ref} – Medium



Roll Acceleration : CAT C_{ref} – Medium



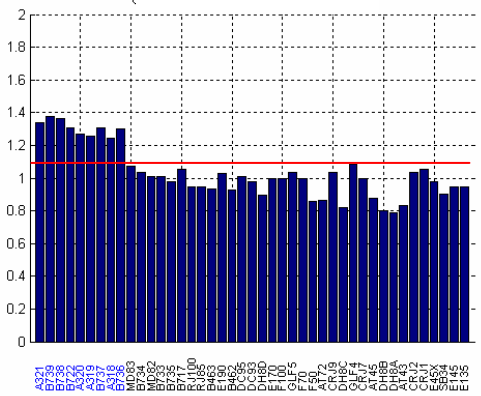
Roll Acceleration

RECAT amendment safety assessment

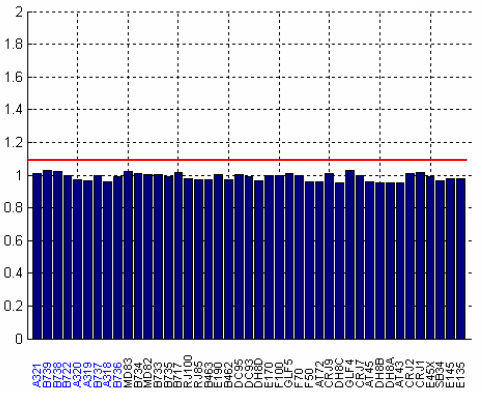
RECAT B.1 - Heavy-Medium pairs

RECAT B		S	H		M		L
		A	B	C	D	E	F
S	A						
H	B		3.0	4.0	**4.0**	5.0	7.0
	C		2.5	2.5	**3.5**	**3.5**	6.0
M	D		2.5	2.5	2.5	2.5	5.0
	E		2.5	2.5	2.5	2.5	4.0
L	F		2.5	2.5	2.5	2.5	2.5

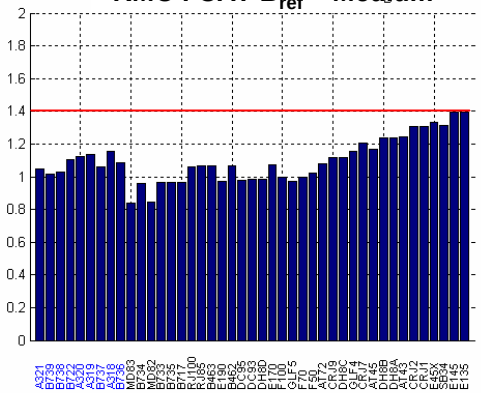
Circulation : CAT B_{ref} – Medium



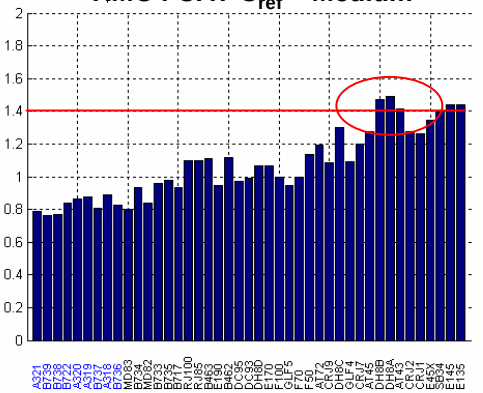
Circulation : CAT C_{ref} – Medium



RMC : CAT B_{ref} – Medium



RMC : CAT C_{ref} – Medium



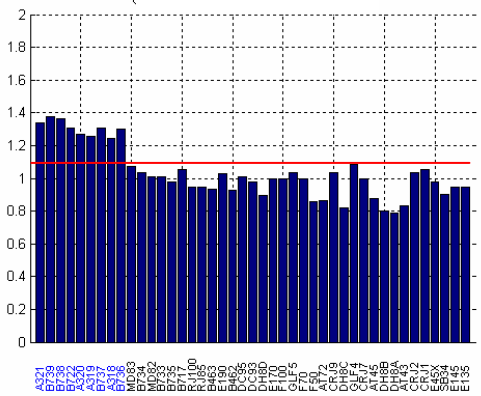
Rolling Moment Coefficient

RECAT amendment safety assessment

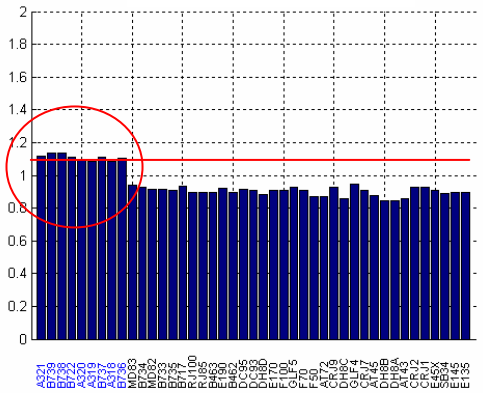
RECAT B.2 - Heavy-Medium pairs

RECAT B		S	H		M		L
		A	B	C	D	E	F
S	A						
H	B		3.0	4.0	**4.0**	5.0	7.0
	C		2.5	2.5	**3.0**	**4.0**	6.0
M	D		2.5	2.5	2.5	2.5	5.0
	E		2.5	2.5	2.5	2.5	4.0
L	F		2.5	2.5	2.5	2.5	2.5

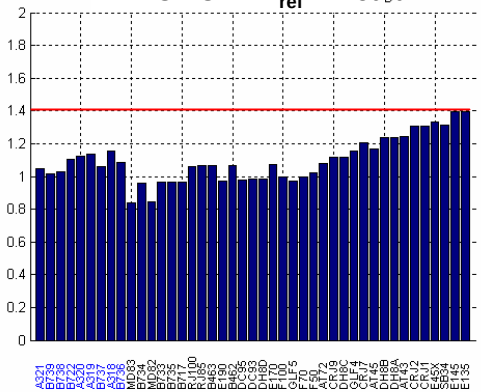
Circulation : CAT B_{ref} – Medium



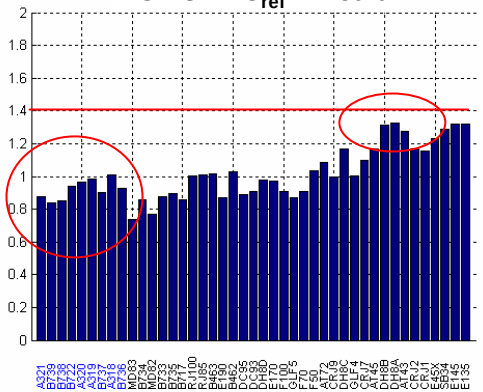
Circulation : CAT C_{ref} – Medium



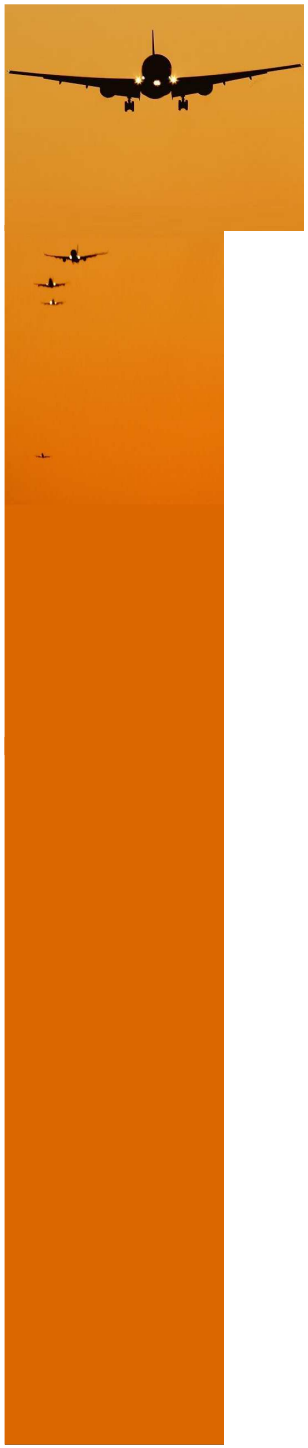
RMC : CAT B_{ref} – Medium



RMC : CAT C_{ref} – Medium



Rolling Moment Coefficient



RECAT amendment safety assessment

Preliminary Conclusion

Heavy – Medium

RECAT B proposal confirmed
to be acceptably safe

- Reduction of CAT B – CAT D
- Slight reduction of CAT C – CAT D
- Slight increase of CAT C – CAT E

RECAT amendment proposal

RECAT A

		S	H		M		L
		A	B	C	D	E	F
S	A						
H	B		**3.0**	4.0	5.0	5.0	**7.0**
	C		**2.5**	**2.5**	**3.5**	**3.5**	6.0
M	D		2.5	2.5	2.5	2.5	5.0
	E		2.5	2.5	2.5	2.5	4.0
L	F		2.5	2.5	2.5	2.5	2.5

RECAT amendment proposal

RECAT B

		S	H		M		L
		A	B	C	D	E	F
S	A						
H	B		**3.0**	4.0	**4.0**	5.0	**7.0**
	C		**2.5**	**2.5**	**3.0**	**4.0**	6.0
M	D		2.5	2.5	2.5	2.5	5.0
	E		2.5	2.5	2.5	2.5	4.0
L	F		2.5	2.5	2.5	2.5	2.5

ICAO separation

RECAT A separation reduction

RECAT B separation reduction

RECAT B limited separation reduction compared to RECAT A

RECAT A separation increase

RECAT amendment capacity assessment

Basic impact assessment based on real traffic (landing time) and conducted by EUROCONTROL for:

- LFPG
- EGLL
- EDDF

Very similar results for all 3 airports in terms of capacity

RECAT amendment capacity assessment

Logic of the impact assessment:

Only pairs with separation < ICAO separation + 1Nm are reduced

- B744 – A320 @ 6.5Nm is not reduced by RECAT
- B744 – A320 @ 5.5Nm is reduced

Reduction applied on the real separation

- B744 – A320 @ 5.5Nm is reduced to 4.5Nm

Reduction not allowed below RECAT separation

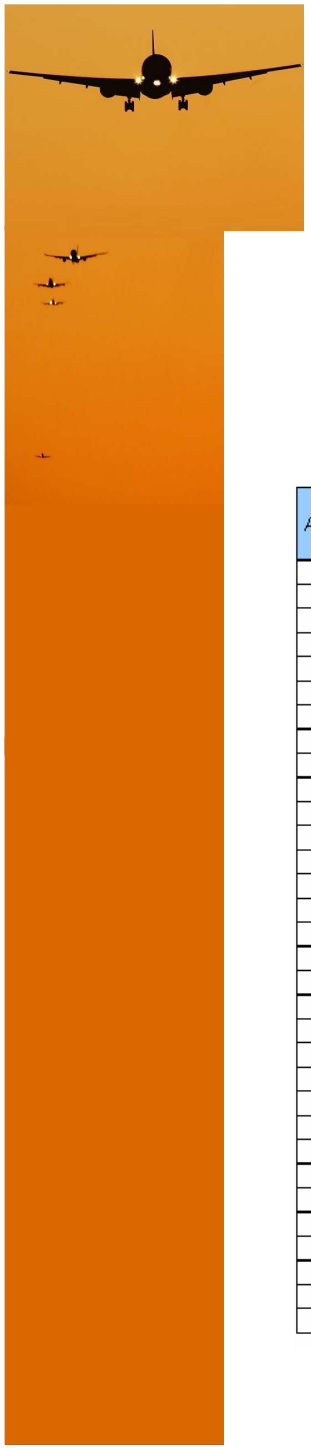
- B744 – A320 @ 4.8Nm is not reduced to 3.8Nm
- B744 – A320 @ 4.8Nm is reduced to 4.0Nm

Number of Nm saved per day are summed

- B744 – A320 @ 4.8Nm reduced @ 4.0Nm contribute to save 0.8Nm

Number of additional slots is derived considering one slot = 3Nm

- If 30Nm are saved along a day, number of potential additional slot = 10

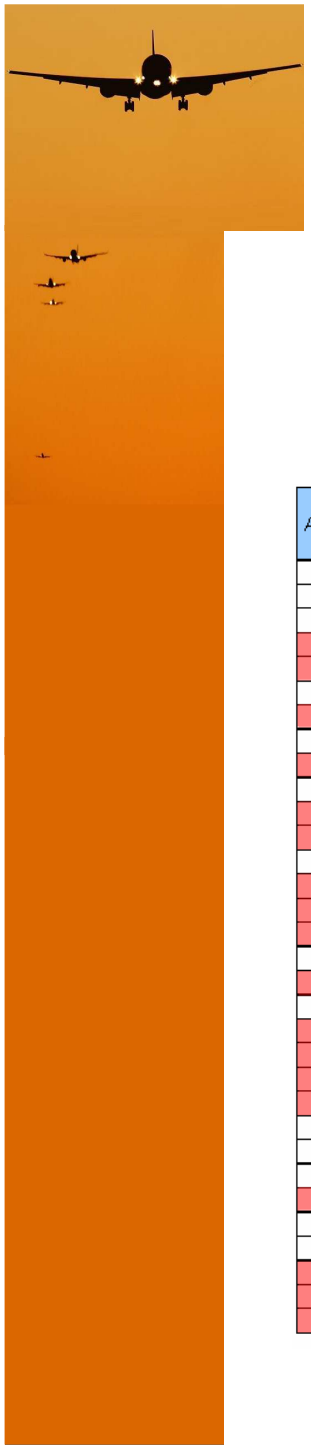


RECAT amendment capacity assessment

LFPG – Capacity assessment on a particular day

Ac type leader	Ac type follower	Theoretical ICAO separation	Proposed RECAT 1 separation
A343	B744	4	3
B762	A320	5	3.5
A332	A332	4	3
B772	B772	4	3
B772	A332	4	3
B763	A321	5	3.5
B772	A343	4	3
B772	A321	5	5
B752	B773	4	2.5
B773	A321	5	5
B752	B737	5	2.5
A332	A332	4	3
A343	B772	4	3
B772	A343	4	3
A332	B772	4	3
B773	A343	4	3

Ac type leader	Ac type follower	Theoretical ICAO separation	Proposed RECAT 1 separation
B763	CRJ7	5	3.5
B772	B773	4	3
B752	CRJ7	5	2.5
A343	B772	4	3
B753	A320	5	2.5
A332	A332	4	3
B772	A343	4	3
B772	B744	4	3
A332	B744	4	3
B763	CRJ7	5	3.5
B752	A320	5	2.5
B762	A320	5	3.5
A30B	A318	5	3.5
B753	E190	5	2.5
MD11	B733	5	3.5
B762	A321	5	3.5



RECAT amendment capacity assessment

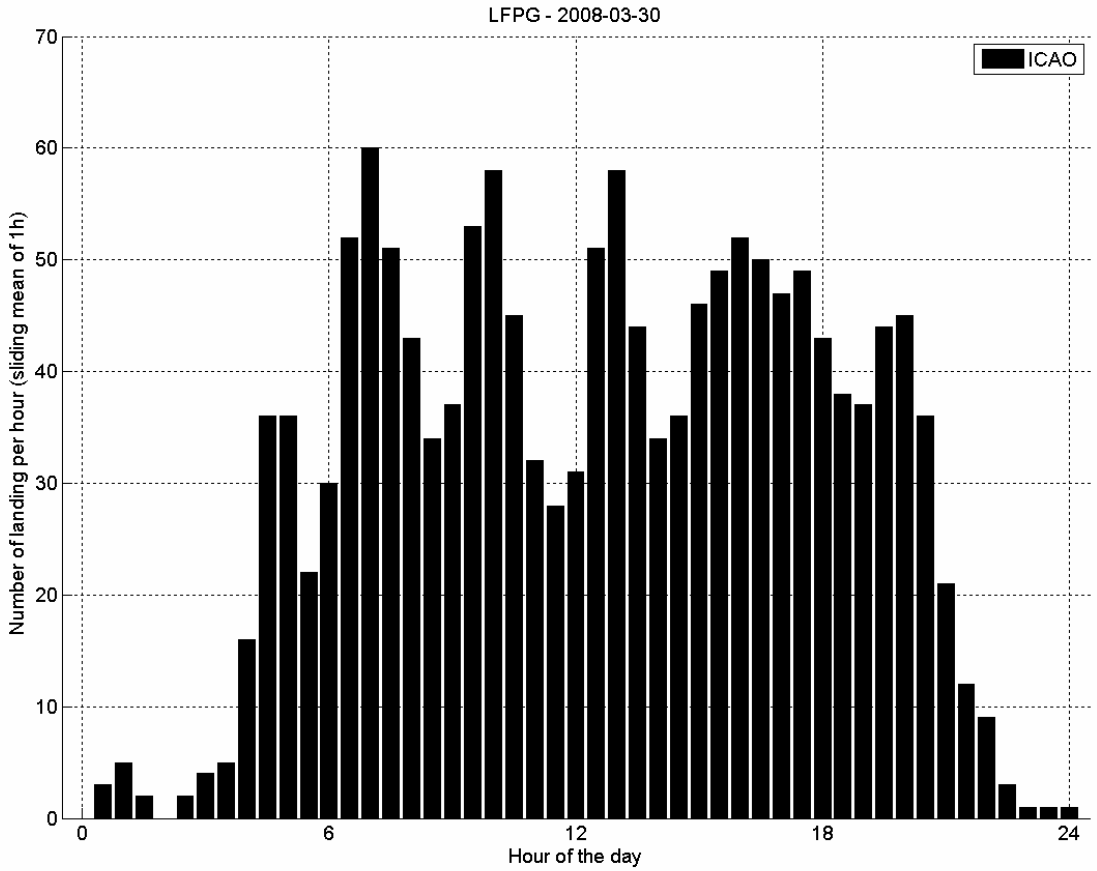
LFPG – Capacity assessment on a particular day

Ac type leader	Ac type follower	Theoretical ICAO separation	Proposed RECAT 1 separation	Proposed RECAT 2 separation
A343	B744	4	3	3
B762	A320	5	3.5	3.5
A332	A332	4	3	3
B772	A319	5	5	4
B772	B739	5	5	4
B772	B772	4	3	3
B772	A320	5	5	4
B772	A332	4	3	3
A343	A320	5	5	4
B763	A321	5	3.5	3.5
B744	A321	5	5	4
A332	A319	5	5	4
B772	A343	4	3	3
A343	A318	5	5	4
A343	A320	5	5	4
B772	A321	5	5	4
B752	B773	4	2.5	2.5
B773	A321	5	5	4
B752	B737	5	2.5	2.5
B773	A321	5	5	4
A343	B738	5	5	4
B744	A319	5	5	4
A332	A320	5	5	4
A332	A332	4	3	3
A343	B772	4	3	3
B772	A343	4	3	3
A343	A320	5	5	4
A332	B772	4	3	3
B773	A343	4	3	3
A343	A320	5	5	4
A343	A320	5	5	4
B744	A319	5	5	4

Ac type leader	Ac type follower	Theoretical ICAO separation	Proposed RECAT 1 separation	Proposed RECAT 2 separation
B763	CRJ7	5	3.5	3.5
B772	B773	4	3	3
B752	CRJ7	5	2.5	2.5
B744	A321	5	5	4
A343	B772	4	3	3
B772	A319	5	5	4
B753	A320	5	2.5	3.5
B773	A320	5	5	4
B744	A318	5	5	4
B773	A320	5	5	4
A343	A320	5	5	4
A343	A320	5	5	4
B744	A320	5	5	4
A332	A332	4	3	3
A332	A318	5	5	4
A332	A319	5	5	4
B744	A319	5	5	4
B772	A343	4	3	3
A343	A318	5	5	4
B772	A321	5	5	4
A332	A321	5	5	4
B772	B744	4	3	3
A332	B744	4	3	3
B763	CRJ7	5	3.5	3.5
B752	A320	5	2.5	3.5
B762	A320	5	3.5	3.5
A30B	A318	5	3.5	3.5
B753	E190	5	2.5	3.5
B772	A318	5	5	4
MD11	B733	5	3.5	3.5
B762	A321	5	3.5	3.5

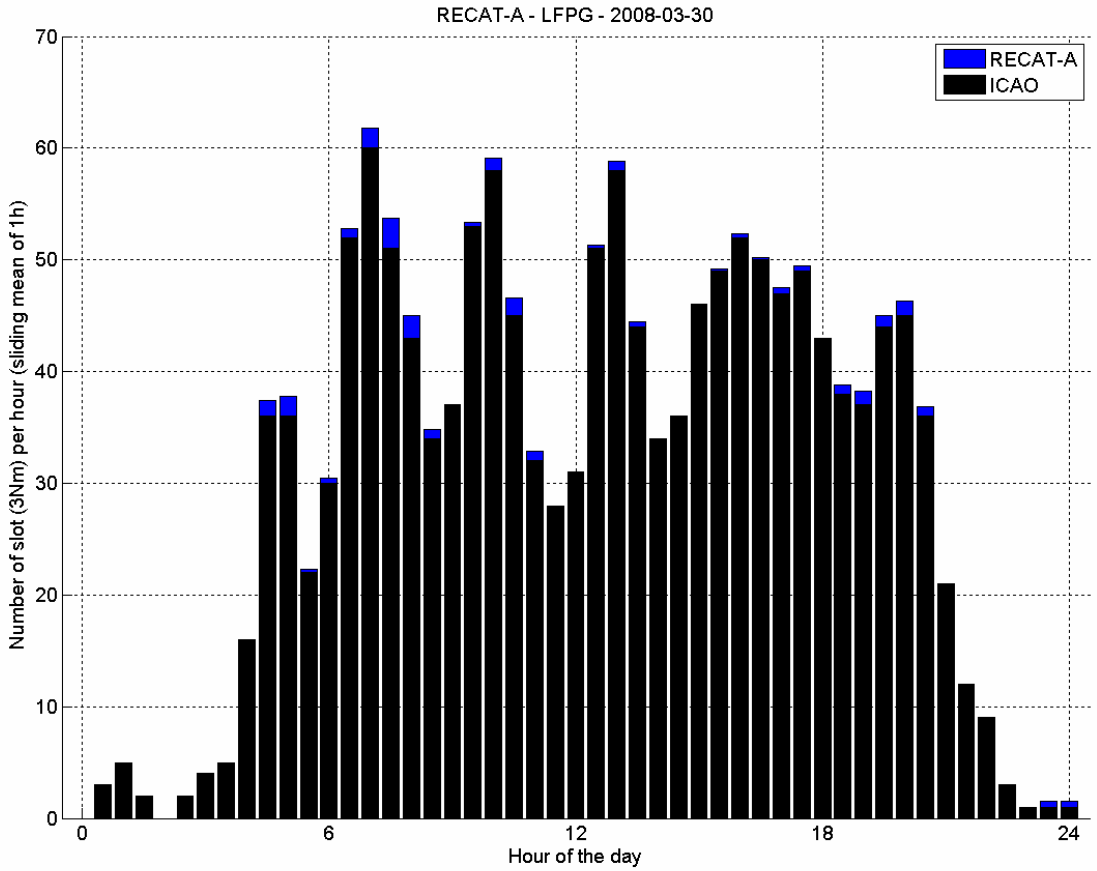
RECAT amendment capacity assessment

LFPG – ICAO



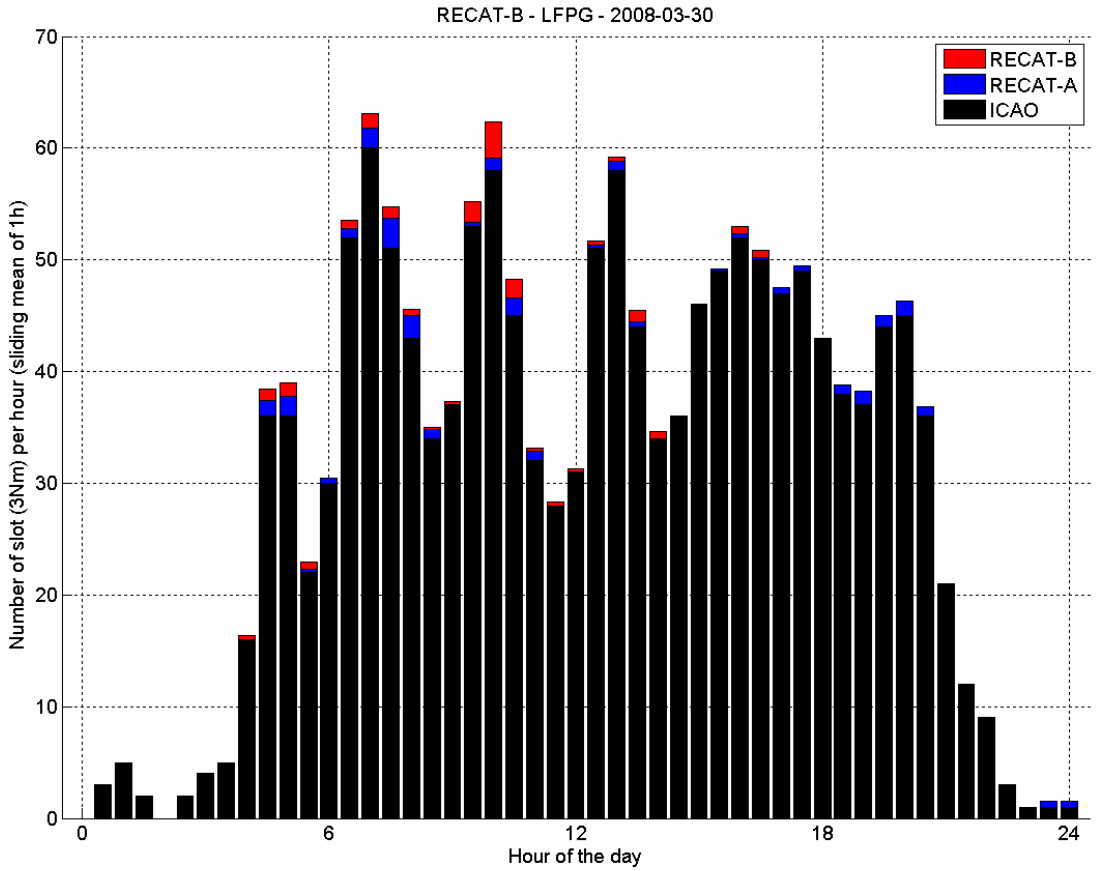
RECAT amendment capacity assessment

LFPG – RECAT A



RECAT amendment capacity assessment

LFPG – RECAT B.1



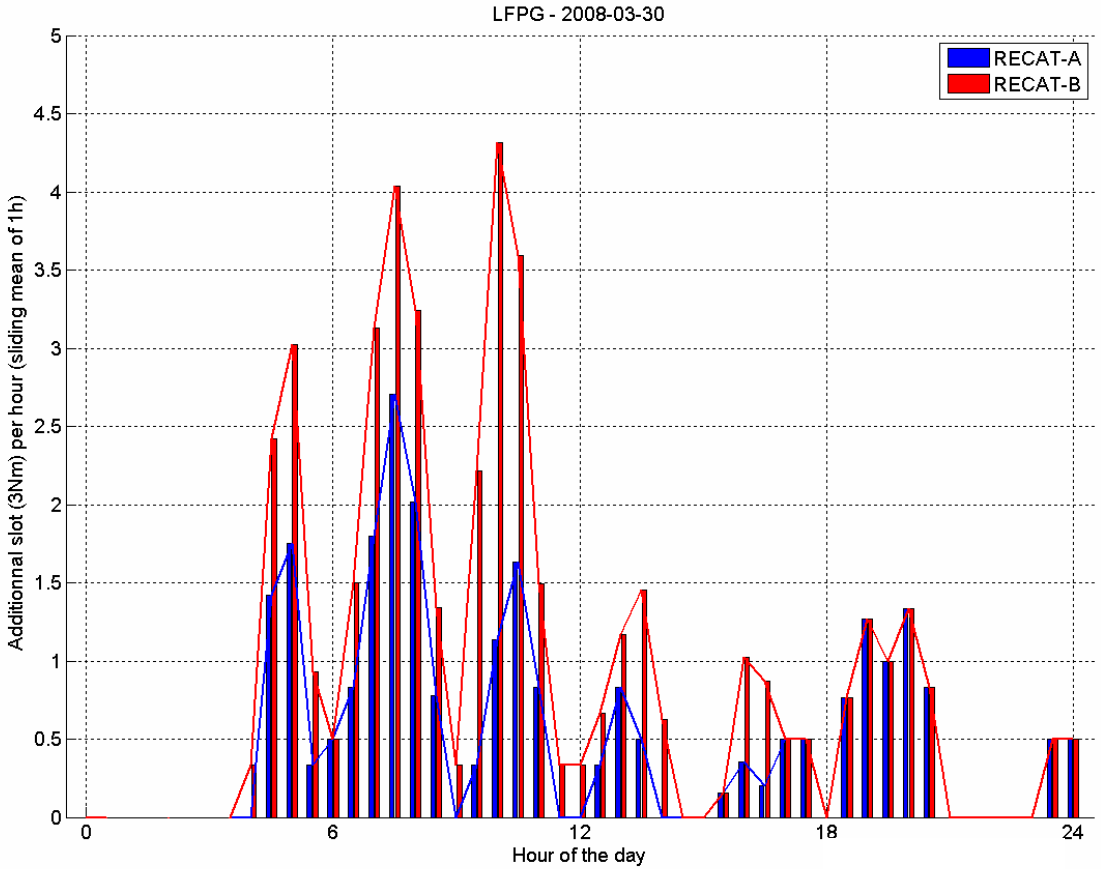
RECAT amendment capacity assessment

LFPG – RECAT B.1

Capacity benefit:

RECAT A : 1.5% (11 slots)
RECAT B.1 : 2.9% (21 slots)

RECAT B		S	H		M		L
		A	B	C	D	E	F
S	A						
H	B		3.0	4.0	**4.0**	5.0	7.0
	C		2.5	2.5	**3.5**	**3.5**	6.0
M	D		2.5	2.5	2.5	2.5	5.0
	E		2.5	2.5	2.5	2.5	4.0
L	F		2.5	2.5	2.5	2.5	2.5



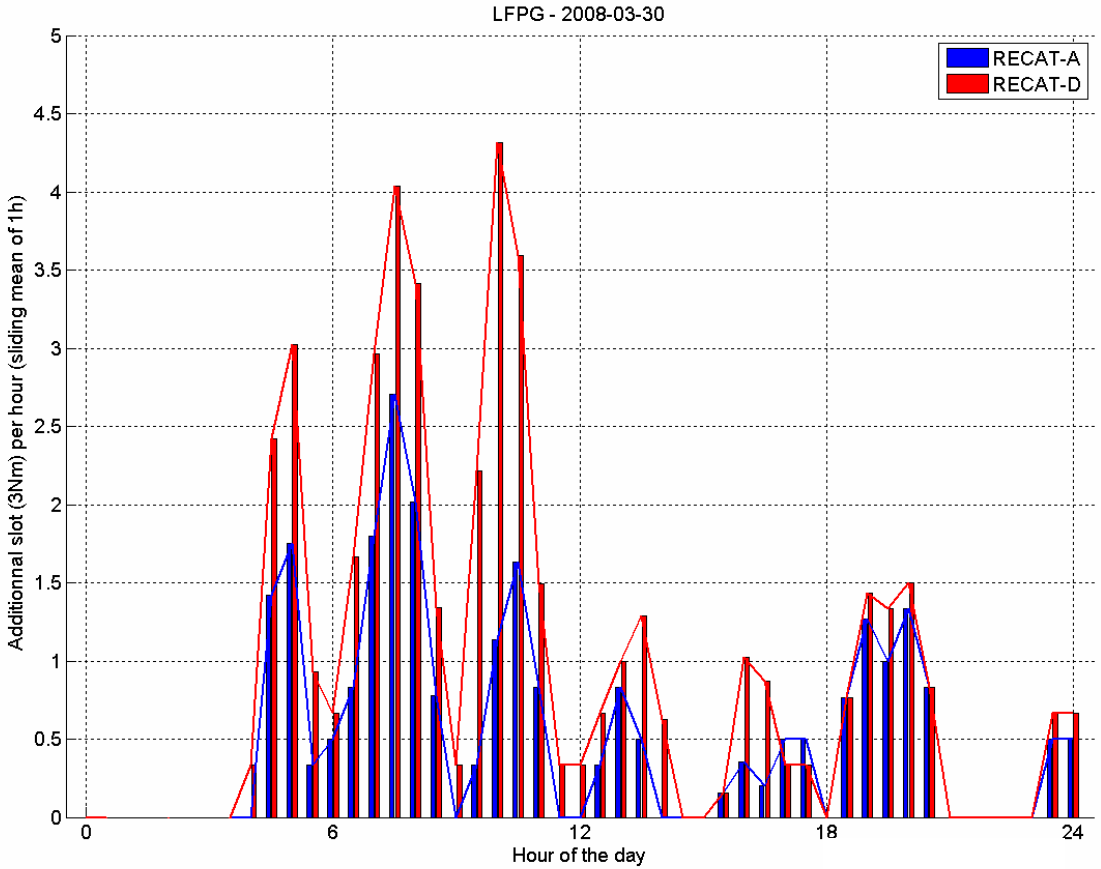
RECAT amendment capacity assessment

LFPG – RECAT B.2

Capacity benefit:

RECAT A : 1.5% (11 slots)
RECAT B.1 : 2.9% (21 slots)
RECAT B.2 : 2.9% (22 slots)

RECAT B		S	H		M		L
		A	B	C	D	E	F
S	A						
H	B		3.0	4.0	**4.0**	5.0	7.0
	C		2.5	2.5	**3.0**	**4.0**	6.0
M	D		2.5	2.5	2.5	2.5	5.0
	E		2.5	2.5	2.5	2.5	4.0
L	F		2.5	2.5	2.5	2.5	2.5



RECAT amendment capacity assessment

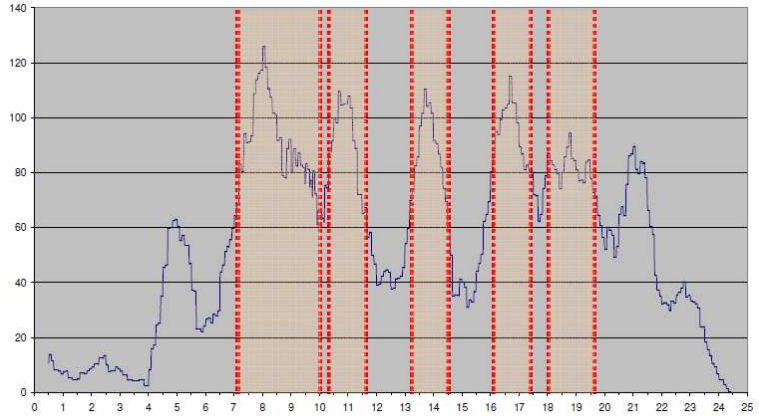
Detailed impact assessment based on local capacity assessment tools and conducted by ANSP:

- Ongoing NATS analysis for EGLL
- Available from DGAC for LFPG

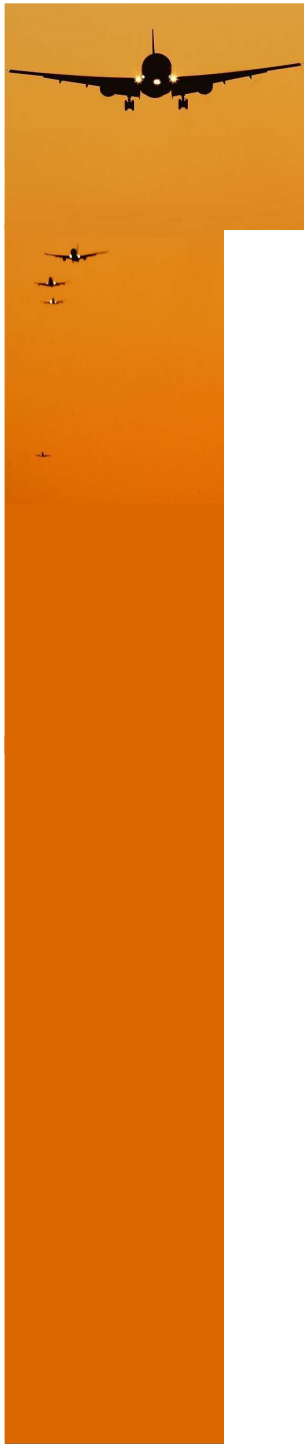
Capacity benefit:

RECAT A : 1.5% (11 slots)
RECAT B.1 : 2.9% (21 slots)

	Plage 1	Plage 2	Plage 3	Plage 4	Plage 5
Debut	7h00	10h20	13h20	16h00	18h00
Fin	10h00	11h20	14h20	17h30	19h30



Peak Hour	RECAT A	RECAT A (future)	RECAT B.1
1	1.26%	0.8%	5.5%
2	1.23%	0.4%	2.9%
3	0.06%	0.4%	1.3%
4	3.34%	1.4%	5.7%
5	0.61%	0.1%	1.4%
Mean	**1.26%**	**0.6%**	**3.3%**



Next steps

1. Kick-off meeting with the key European partners
2. Agreement on a planning for
   - preparing a new RECAT proposal
   - preparing the associated safety case
   - Conduct the capacity assessment
3. Significant EUROCONTROL effort will be dedicated to the European RECAT amendment during the next 6 months
4. Time horizon for completion : September 2012

Question?

WakeNet3-Europe

A network on Aircraft Wake Turbulence