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New VAPP Calculation process

A320/A330/A340 aircraft



Content

- VAPP definition
- VAPP determination – No failure
- VAPP determination – With failure
- Enhanced VAPP calculation process
- Conclusion

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VAPP definition

- VAPP is the **safest** approach and landing speed taking into account:

- ▶ Aircraft gross **weight**



- ▶ **Wind** conditions



- ▶ **Slaps/Flats** configuration

- ▶ Aircraft **status** (with or without failure)



- ▶ **Icing** conditions

- ▶ Use of **autothrust/autoland**



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VAPP determination – No failure

- $VAPP = VLS (\text{Conf FULL or 3}) + \text{Delta}$

- ▶ **VLS** = Lowest selectable speed

- $VLS = 1.23 \times V_{s1g}$ (stall speed under 1g)

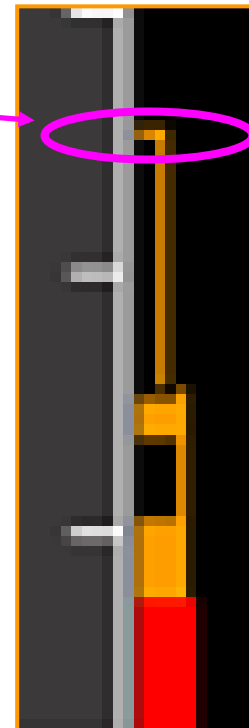
- VLS depends on:

- Aircraft weight
 - Slats/Flaps configuration

- $VLS \text{ Conf FULL} = V_{REF}$

- ▶ **Delta** taken as a margin (max of):

- 5 knots for the use of the autothrust
 - 1/3 of steady headwind = Wind Correction (limited to 15 knots)
 - 5 knots for severe icing conditions (A330 example)



VAPP determination – No failure

- Two landing configurations certified:

- ▶ Conf FULL
- ▶ Conf 3

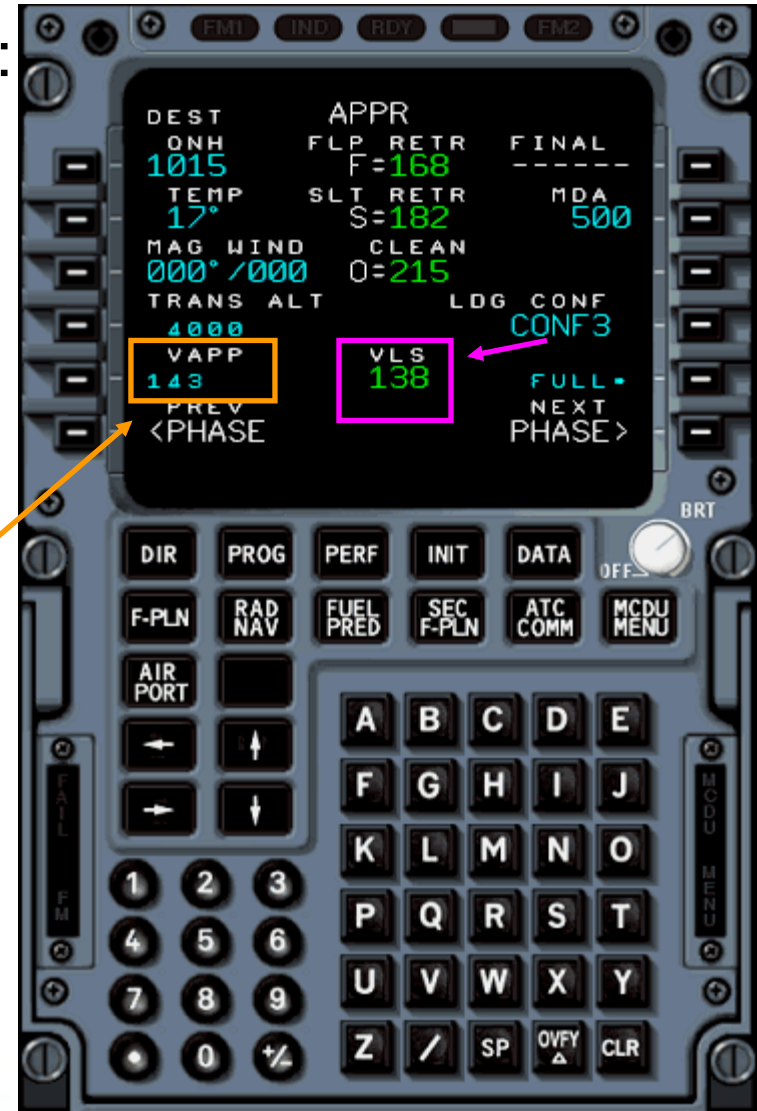
With FMS

- Example:

- A330 180 tons
- Conf 3 landing
- A/THR ON
- No Wind

▶ $VAPP = 138 + 5 = 143 \text{ knots}$

VLS Conf 3



VAPP determination – No failure

- Two landing configuration certified:

- ▶ Conf FULL
- ▶ Conf 3

With QRH

- Example:

- A330 180 tons
- Conf 3 landing
- A/THR ON
- No Wind



▶ $VAPP = 138 + 5 = 143$ knots

VLS Conf 3

A/THR use

FMS and QRH method consistent

A330	ABNORMAL PROCEDURES	REV 20	2.40
		SEQ 015	

VAPP DETERMINATION

- NORMAL CONFIGURATION (or no ΔVREF)**

The FMGS performs the following VAPP computation for landing in normal configuration (CONF 3 or CONF FULL). These VAPP also apply for failure cases without ΔVREF.

W (1000KG)	120	140	160	180	200	220	240
VLS CONF FULL (KT)	123	123	127	135	142	149	156
VLS CONF 3 (KT)	123	123	130	138	145	152	159

+

CORRECTION

5KT

1/3 HEADWIND
(EXCLUDING GUST)
MAXIMUM=15KT

WHICHEVER IS HIGHER

=

VAPP

$VAPP = \text{MAX}(VLS + 5Kt*; VLS + \text{WIND CORRECTION})$

NO WIND CORRECTION	1/3 HEADWIND (ΔVREF + WIND CORR LIMITED TO 20KT)
--------------------	--

- VAPP

VAPP = VREF + ΔVREF + WIND CORR

TO BE INSERTED ON THE MCDU PERF APPR PAGE

The headwind component may be determined from the PERF APPR page, by using the FM data once the wind has been inserted. WIND CORRECTION = VAPP - VREF. This must be done with CONF FULL selected on the PERF APPR page.

The PFD displays VLS corresponding to the actual S/F position. For certain failures, the ECAM displays Δ VLS to be applied to PFD VLS for improved manoeuvrability. In such a case, VLS + Δ VLS is the lowest selectable speed, and is equal to, or lower than, the calculated VAPP.

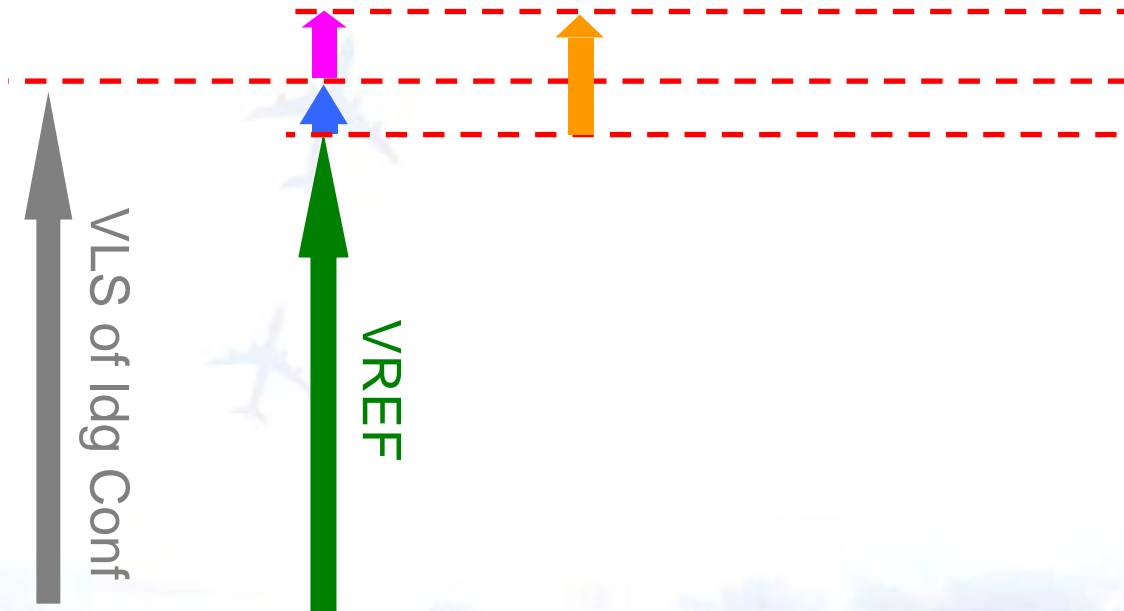
Content

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VAPP determination – With failure

$$VAPP = VREF (VLS \text{ Conf FULL}) + \Delta VREF + \text{Wind Correction}$$

$$\left\{ \begin{array}{l} VREF = VLS \text{ of Conf FULL} \\ \Delta VREF = \left\{ \begin{array}{l} VLS \text{ increase due to actual Slats/Flaps configuration} \\ + \\ \text{Speed increase for handling qualities} \\ (\Delta VLS \text{ shown on LR ECAM STATUS}) \end{array} \right. \\ \text{Wind correction (0 in our example)} \end{array} \right.$$



VAPP determination – With failure

A330 engine 1 failure (1/3)

- ▶ After ECAM action completed the following STATUS is shown

STATUS

APPR PROC
BEFORE S/F EXTENSION
- YELLOW ELEC PUMP OFF
- FOR LDG USE FLAP 3
- LDG DIST PROC APPLY
- FUEL IMBALANCE MONITOR

SLATS SLOW

INOP SYS
B HYD
PART SPLRS
REV 1
CAT 3 DUAL
ENG 1 BLEED
G ENG 1 PUMP
B ENG 1 PUMP
GEN 1
PART GALLEY
ALT BRK

TAT +25 °C		GW 210000 KG
SAT +25 °C	13 H 28	GWCG 28.2 %



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VAPP determination – With failure

A330 engine 1 failure (2/3)

- Wind = 0 knots
- Weight = 180 tons

	SHUTDOWN	3	5
	THR LEVER FAULT	3	5
ENG	REV UNLOCKED (WITH BUFFET)	2	25

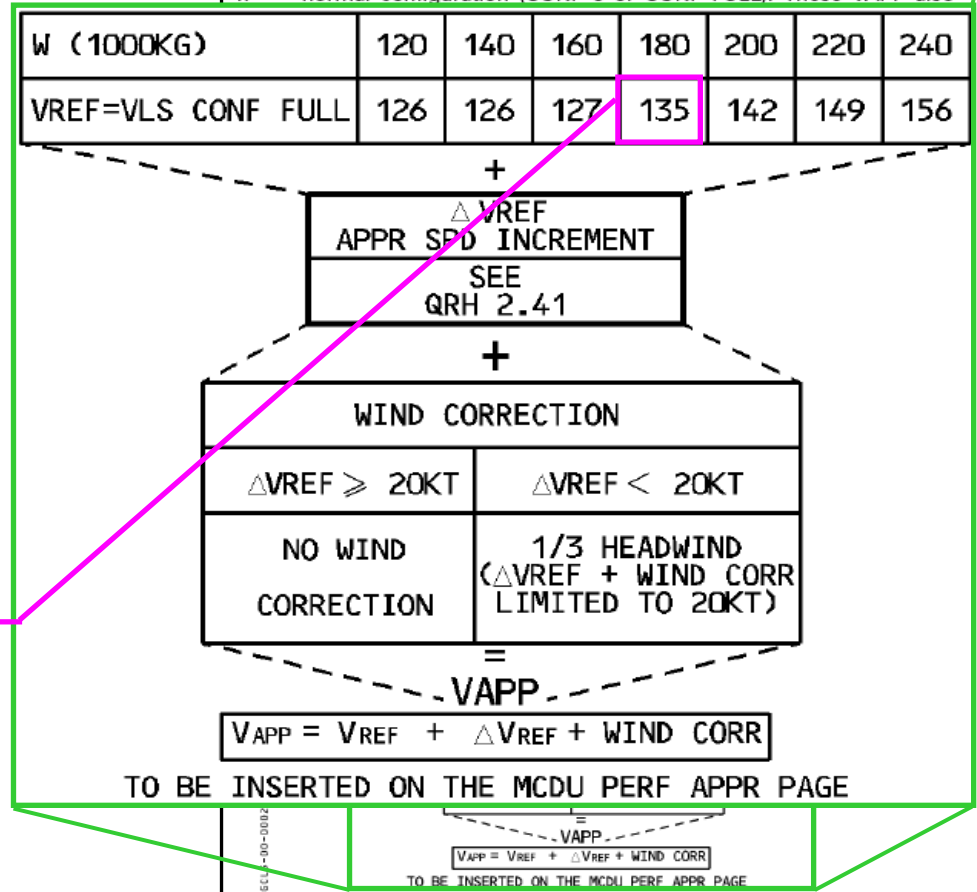
ΔV_{REF}

• $V_{APP} = 135 + 5 = 140$ knots

V_{REF} ←

VAPP DETERMINATION

- R ● **NORMAL CONFIGURATION (or no ΔV_{REF})**
- R The FMGS performs the following VAPP computation for landing in normal configuration (CONF 3 or CONF FULL). These VAPP also



The headwind component may be determined from the PERF APPR page, by using the FM data once the wind has been inserted. WIND CORRECTION = VAPP - VREF. This must be done with CONF FULL selected on the PERF APPR page.

The PFD displays Vls corresponding to the actual S/F position. For certain failures, ECAM displays ΔV_{LS} to be applied to PFD VLS for improved maneuverability. In such a case, Vls + ΔV_{LS} is the lowest selectable speed, and is equal to, or lower than, the calculated VAPP.

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VAPP determination – With failure

A330 engine 1 failure (3/3)

- ▶ Summary: A330 at 180 tons in Conf 3 without wind:

No failure

$$\text{VAPP} = 138 + 5 = 143 \text{ knots}$$

VLS Conf 3

A/THR
use

With failure

$$\text{VAPP} = 135 + 5 = 140 \text{ knots}$$

VREF

Δ VREF


- ▶ **Autothrust** use **not taken** into account in the failure case calculation

- ▶ **VAPP** Conf 3 with one engine inoperative **lower** than VAPP Conf 3 with no failure.

VAPP determination – With failure

Use of the QRH table when “NORM” is indicated (1/3)

- EX: Anti skid inoperative on A321 at 80 tons
 - ▶ No Δ VREF
 - ▶ “Norm” Indicated

 A318 A319 A320 A321		ABNORMAL PROCEDURES		REV 41	2.32A		
				SEQ 102			
A320 FAMILY	FAILURE	FLAPS LEVER POSITION FOR LDG	Δ VREF APPR SPD INCREMENT	MULTIPLY LDG DIST (CONF FULL) BY			
				DRY	WET (b)	CONTA (b)	
BRK	ANTI SKID	Norm (a)	–	1.60	1.30	1.10	
	AUTO BRK FAULT	Norm (a)	–	1.45	1.25	1.20	
NAV	IR 1+2+3 FAULT	10	10	2.45	2.00	1.55	
	UNRELIABLE SPEED INDICATION/ADR CHECK PROC	15	15	1.45*	1.4*	1.3*	
	DUAL IR FAULT/DUAL ADR FAULT ADR 1+2+3 FAULT	10	10	1.35*	1.30*	1.25*	
BLEED	WING ANTI ICE NOT AVAIL (if Ice accretion)	(a)	10	1.30	1.30	1.20	
ENG	REV UNLOCK with buffet	55 (APPR) 40 (THRESHOLD)	55 (APPR) 40 (THRESHOLD)	2.15*	1.95*	1.95*	
	REV UNLOCK with buffet	10	10	1.35*	1.35*	1.35*	

(a) If “CONF 3” is used when “NORM” is indicated in the table, add 6 knots to the VREF and multiply the resulting landing distance by an additional factor of 1.10.

(b) The landing distance coefficients for wet or contaminated runways assume the use of maximum reverse thrust on all of the operative landing distance with

(a) If “CONF 3” is used when “NORM” is indicated in the table, add 6 knots to the VREF and multiply the resulting landing distance by an additional factor of 1.10.

CONF 3) is displayed

VAPP determination – With failure

Use of the QRH table when “NORM” is indicated (2/3)

- Calcul of the VAPP
(Ldg Conf 3, A/THR ON, no wind)

R ● NORMAL CONFIGURATION (OR NO ΔVREF)

- ▶ VAPP = Max between
 - 150 + 5 = 155
 - 150 + 1/3*0 = 150
 } VAPP = **155 kt**

R ● ABNORMAL/EMERGENCY CONFIGURATION (WITH ΔVREF)

- ▶ Flight crew may interpret the note as a ΔVREF
- ▶ VAPP = 144 + 6 + 1/3*0 = **150 kt**

**A318
A319
A320
A321**

ABNORMAL PROCEDURES

REV 36
SEQ 150

2.31

VAPP DETERMINATION

● NORMAL CONFIGURATION (OR NO ΔVREF)
 The FMGS performs the following VAPP computation for landing in normal configuration (CONF 3 or CONF FULL). These VAPP also apply for failure cases without ΔVREF.

W(1000kg)	52	56	60	64	68	72	76	80	84	88	92	94
VLS CONF FULL (KT)	116	121	125	129	133	137	141	144	148	151	155	157
VLS CONF 3 (KT)	121	125	130	134	138	142	146	150	154	157	161	163

+

CORRECTION

5KT

1/3 HEADWIND
(EXCLUDING GUST)
MAX=15KT

WHICHEVER IS HIGHER

=

VAPP

+

VAPP = MAX(VLS + 5kt*; VLS + WIND CORR)

The 5 knot increment is required when the A/THR is used, or when an autoland is performed.
 NOTE: * – In case of ice accretion, Vapp must not be lower than :
 – VLS + 5 knots in CONF FULL
 – VLS + 10 knots in CONF 3
 – In case of gusty crosswind greater than 20 knots, Vapp should be at least VLS + 5 knots.

● ABNORMAL/EMERGENCY CONFIGURATION (WITH ΔVREF)

W(1000kg)	52	56	60	64	68	72	76	80	84	88	92	94
VREF=VLS CONF FULL	116	121	125	129	133	137	141	144	148	151	155	157

+

Δ VREF

+

WIND CORRECTION

ΔVREF ≥ 20KT	ΔVREF < 20KT
NO WIND CORRECTION	1/3 HEADWIND (Δ VREF + WIND CORR LIMITED TO 20KT)

=

VAPP

+

VAPP = VREF + ΔVREF + WIND CORR

TO BE INSERTED ON MCDU PERF APPR PAGE

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New VAPP Calculation process

April 2007

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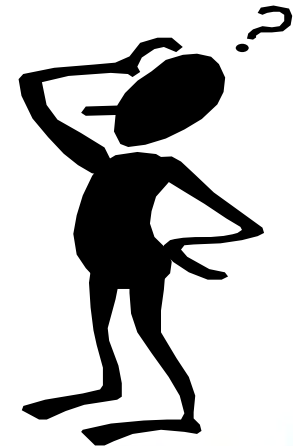
VAPP determination – With failure

Use of the QRH table when “NORM” is indicated (3/3)

- Summary

- ▶ A321, 80 tons: **VLS Conf 3 = 150 knots**
- ▶ VAPP using “Normal configuration (with no $\Delta VREF$)” table:
 - VAPP = **155 kt**
- ▶ VAPP “Abnormal/emergency configuration (with $\Delta VREF$)” :
 - VAPP = **150 kt**

Two methods may be used
to determine the VAPP
with **not the same result**



Content

- VAPP definition
- VAPP determination – No failure
- VAPP determination – With failure
- **Enhanced VAPP calculation process**
- Conclusion

Enhanced VAPP calculation process

- One **single method** whatever the type of failure
 - ▶ **No room for doubts** on the method to be used
 - Normal VAPP calculation removed from QRH Part 2
- VAPP with failure higher or equal to VAPP with no failure
 - ▶ **Autothrust** use taken into account



New VAPP Calculation process

**Clear and unambiguous
method**

Enhanced VAPP calculation process

A330 Current QRH 2.40

A330	ABNORMAL PROCEDURES	REV 18	2.40
		SEQ 115	

VAPP DETERMINATION

R ● NORMAL CONFIGURATION (or no ΔVREF)

R The FMGS performs the following VAPP computation for landing in normal configuration (CONF 3 or CONF FULL). These VAPP also apply for failure cases without ΔVREF.

W (1000KG)	120	140	160	180	200	220	240
VLS CONF FULL (KT)	118	120	128	136	143	150	157
VLS CONF 3 (KT)	118	122	130	138	145	152	159

+

CORRECTION

SKT* 1/3 HEADWIND EXCLUDING SLATS MAXIMUM+5KTS

WHICHEVER IS HIGHER

=

VAPP

Vapp = MAX(VLS + SKT*; VLS + WIND CORRECTED)

NOTES : 1) The 5 knot* speed increment is only required when A/THR is used, or when autobrake is performed, or in case of ice accretion.
2) In case of gusty crosswind greater than 20 knots, the approach speed should be at least VLS + 5 knots.

R ● ABNORMAL/EMERGENCY CONFIGURATION (WITH ΔVREF)

W (1000KG)	120	140	160	180	200	220	240
VREF=VLS CONF FULL	118	120	128	136	143	150	157

+

ΔVREF APPR SPD INCREMENT SEE QRH 2.41

+

WIND CORRECTION

ΔVREF ≥ 20KT	ΔVREF < 20KT
NO WIND CORRECTION	1/3 HEADWIND (ΔVREF + WIND CORR LIMITED TO 20KTS)

=

VAPP

VAPP = VREF + ΔVREF + WIND CORR

TO BE INSERTED ON THE MCDU PERF APPR PAGE

The headwind component may be determined from the PERF APPR page, by using the FM data once the wind has been inserted. WIND CORRECTION = Vapp - Vref. This must be done with CONF FULL selected on the PERF APPR page.
The PFD displays VLS corresponding to the actual S/F position. For certain failures, the ECAM displays Δ VLS to be applied to PFD VLS for improved maneuverability. In such a case, VLS + Δ VLS is the lowest selectable speed, and is equal to, or lower than, the calculated Vapp.

A330	ABNORMAL PROCEDURES	REV 21	2.41
		SEQ 001	

LDG CONF/APPR SPD/ LDG DIST FOLLOWING FAILURES

A330	FAILURE	FLAPS LEVER POSITION FOR LDG	Δ VREF APPR SPD INCREMENT	MULTIPLY LDG DIST (CONF FULL) BY		
				DRY	WET (c)	CONTA (c)
ELEC	EMER CONFIG	3	5	1.25	1.40	1.50
	DC BUS 1+2 FAULT	NORM (a)	—	1.20	1.30	1.35
	DC BUS 2 FAULT	NORM (a)	—	1.20	1.30	1.35
	. If ice accretion : DC ESS BUS FAULT/ DC ESS SHED		NORM (a)	10	1.25	1.25
S/F	0 ≤ FLAPS < 1 + F	2	30	1.60*	1.65*	1.70*
	1 + F ≤ FLAPS < 2	2	15	1.40*	1.40*	1.40*
	2 ≤ FLAPS < 3	2	10	1.30*	1.30*	1.25*
	FLAPS = 3	3	5	1.20*	1.20*	1.20*
	FLAPS > 3	FULL	5	1.20*	1.20*	1.15*
	0 ≤ SLATS < 1	2	30	1.55*	1.60*	1.55*
S/LTS FAULT	1 ≤ SLATS < 2	2	15	1.35*	1.35*	1.35*
	SLATS ≥ 2	3	5	1.20*	1.20*	1.20*
	NO FLAPS NO SLATS	1	50	1.90*	2.00*	2.05*
	<small>If slats and flaps failure refer to the table in QRH 2.43</small>					
F/CTL	STAB CTL FAULT (MAN TRIM NOT AVAIL)	2	30	1.45*	1.45*	1.40*
	STAB CTL FAULT (MAN TRIM AVAIL)	3	5	1.20*	1.20*	1.20*
	L/R/L + R ELEV FAULT	2	20	1.45*	1.45*	1.40*
	RUD TRV LIM FAULT (b)	2 (b)	20 (b)	1.45*(b)	1.45*(b)	1.40*(b)
	RUD TRV LIM FAULT (engine-out) (b)	2 (b)	APPR SPD : 160 KT (b)	1.75*(b)	1.90*(b)	1.90*(b)
	RUDDER JAM	2	20	1.95*	1.80*	1.75*
	RUDDER JAM (engine out)	2	APPR SPD : 160 KT	2.30*	2.65*	2.55*
	ALTN/DIRECT LAW	3	5	1.20*	1.20*	1.20*
	PRIM 1+3, 2+3 FAULT	NORM (a)	—	1.20	1.30	1.40
	PRIM 1+2+3 FAULT	3	5	1.25	1.40	1.50
SPLRS	ONE/TWO SPLRS per wing	NORM (a)	—	1.20	1.15	1.15
	THREE/FOUR SPLRS per wing	NORM (a)	—	1.25	1.25	1.20
	FIVE/ALL SPLRS per wing	NORM (a)	—	1.30	1.35	1.30

(a) If CONF 3 is used when "NORM" is indicated in the table, add 5 knots to the VREF and multiply the resulting landing distance by an additional factor of 1.2.

(b) This landing configuration and associated parameters only have to be applied if the Travel Limiter Unit (TLU) remains locked in the high-speed position after slats' extension.

(c) The landing distance coefficients for wet or contaminated runways assume the use of maximum reverse thrust on all of the operative reversers. Apply these coefficients to the actual landing distance with reversers.

NORM PROC
IN FLT PERF
OPS DATA

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New VAPP Calculation process

April 2007

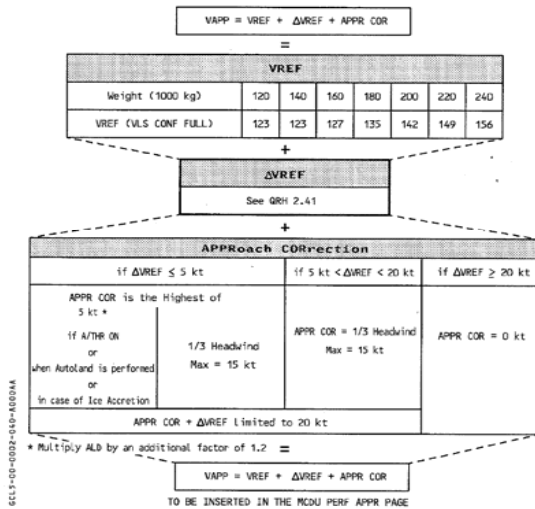
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Enhanced VAPP calculation process

A330 Enhanced QRH 2.40

A330	ABNORMAL PROCEDURES	REV	2.40
		SEQ	

VAPP Determination in the case of ABNORMAL/EMERGENCY Configuration



The PFD displays VLS corresponding to the actual S/F position. For certain failures, the ECAM displays ΔVLS to be applied to PFD VLS for improved manoeuvrability. In such a case, VLS + ΔVLS is the lowest selectable speed, and is equal to, or lower than the calculated VAPP.

Example :

Failure : Engine shutdown Flight Conditions : Autothrust ON
Landing configuration : 3 Headwind : 12 kt
Landing Weight : 160 To.

VREF determined from the landing weight : 127 kt
VREF correction due to the failure ($\Delta VREF$) : 5 kt

As $\Delta VREF$ is equal to 5 kt, the APPROACH CORrection is the higher of :
5 kt (A/THR ON)
1/3 Headwind = 12 kt/3 = 4 kt

APPR COR = 5 kt and ALD has to be multiplied by an additional factor of 1.2

$$VAPP = VREF + \Delta VREF + APPR COR = 127 + 5 + 5 = 137 \text{ kt}$$

A330	ABNORMAL PROCEDURES	REV 21	2.41
		SEQ 001	

LDG CONF/APPR SPD/ LDG DIST FOLLOWING FAILURES

A330	FAILURE	FLAPS LEVER POSITION FOR LDG	Δ VREF APPR SPD INCREMENT	MULTIPLY LDG DIST (CONF FULL) BY		
				DRY	WET (c)	CONTA (c)
ELEC	EMER CONFIG	3	5	1.25	1.40	1.50
	DC BUS 1+2 FAULT	NORM (a)	—	1.20	1.30	1.35
	DC BUS 2 FAULT	NORM (a)	—	1.20	1.30	1.35
	If ice accretion : DC ESS BUS FAULT/ DC ESS SHED	NORM (a)	10	1.25	1.25	1.20
S/F	0 \leq FLAPS < 1 + F	2	30	1.60*	1.65*	1.70*
	1 + F \leq FLAPS < 2	2	15	1.40*	1.40*	1.40*
	2 \leq FLAPS < 3	2	10	1.30*	1.30*	1.25*
	FLAPS = 3	3	5	1.20*	1.20*	1.20*
	FLAPS > 3	FULL	5	1.20*	1.20*	1.15*
	NO FLAPS NO SLATS If slats and flaps failure refer to the table in QRH 2.43		1	50	1.90*	2.00*
F/CTL	STAB CTL FAULT (MAN TRIM NOT AVAIL)	2	30	1.45*	1.45*	1.40*
	STAB CTL FAULT (MAN TRIM AVAIL)	3	5	1.20*	1.20*	1.20*
	L/R/L + R ELEV FAULT	2	20	1.45*	1.45*	1.40*
	RUD TRV LIM FAULT (b)	2 (b)	20 (b)	1.45*(b)	1.45*(b)	1.40*(b)
	RUD TRV LIM FAULT (engine-out) (b)	2 (b)	APPR SPD : 160 KT (b)	1.75*(b)	1.90*(b)	1.90*(b)
	RUDDER JAM	2	20	1.95*	1.80*	1.75*
	RUDDER JAM (engine out)	2	APPR SPD : 160 KT	2.30*	2.65*	2.55*
	ALTDIRECT LAW	3	5	1.20*	1.20*	1.20*
	PRIM 1+3, 2+3 FAULT	NORM (a)	—	1.20	1.30	1.40
	PRIM 1+2+3 FAULT	3	5	1.25	1.40	1.50
SPLR	ONE/TWO SPLRS per wing	NORM (a)	—	1.20	1.15	1.15
	THREE/FOUR SPLRS per wing	NORM (a)	—	1.25	1.25	1.20
	FIVE/ALL SPLRS per wing	NORM (a)	—	1.30	1.35	1.30

- (a) If CONF 3 is used when "NORM" is indicated in the table, add 5 knots to the VREF and multiply the resulting landing distance by an additional factor of 1.2.
- (b) This landing configuration and associated parameters only have to be applied if the Travel Limiter Unit (TLU) remains locked in the high-speed position after slats' extension.
- (c) The landing distance coefficients for wet or contaminated runways assume the use of maximum reverse thrust on all of the operative reversers. Apply these coefficients to the actual landing distance with reversers.

NORM PROC

IN FLT PERF

OPS DATA

D.U.B

Enhanced VAPP calculation process

A330 Enhanced QRH 2.40

A330 ABNORMAL PROCEDURES REV **2.40**
SEQ

VAPP Determination in the case of ABNORMAL/EMERGENCY Configuration

$$VAPP = VREF + \Delta VREF + APPR COR$$

VREF						
Weight (1000 kg)	120	140	160	180	200	240
VREF (VLS CONF FULL)	123	123	127	135	142	149

$$VAPP = VREF + \Delta VREF + APPR COR$$

Failure	5 kt +	1/3 Headwind	APPR COR = 1/3 Headwind	APPR COR = 0 kt
if A/THR ON or when Autoland is performed or in case of Ice Accretion	Max = 15 kt	Max = 15 kt	Max = 15 kt	

* Multiply ALD by an additional factor of 1.2 =

$$VAPP = VREF + \Delta VREF + APPR COR$$

TO BE INSERTED IN THE MCDU PERF APPR PAGE

The PFD displays VLS corresponding to the actual S/F position. For certain failures, the ECAM displays ΔVLS to be applied to PFD VLS for improved manoeuvrability. In such a case, $VLS + \Delta VLS$ is the lowest selectable speed, and is equal to, or lower than the calculated VAPP.

Example :

Failure : Engine shutdown Flight Conditions : Autothrust ON
Landing configuration : 3 Headwind : 12 kt
Landing Weight : 160 To.

VREF determined from the landing weight : **127 kt**
VREF correction due to the failure ($\Delta VREF$) : **5 kt**

As $\Delta VREF$ is equal to 5 kt, the APPR COR correction is the higher of :
5 kt (A/THR ON)
1/3 Headwind = 12 kt / 3 = 4 kt

APPR COR = 5 kt and ALD has to be multiplied by an additional factor of 1.2

$$VAPP = VREF + \Delta VREF + APPR COR = 127 + 5 + 5 = 137 \text{ kt}$$

A330 ABNORMAL PROCEDURES REV **2.41**
SEQ 001

LDG CONF/APPR SPD/ LDG DIST FOLLOWING FAILURES

A330	FAILURE	FLAPS LEVER POSITION FOR LDG	Δ VREF APPR SPD INCREMENT	MULTIPLY LDG DIST (CONF FULL) BY			
				DRY	WET (c)	CONTA (c)	
E/LEC	EMER CONFIG	3	5	1.25	1.40	1.50	
	DC BUS 1+2 FAULT	NORM (a)	—	1.20	1.30	1.35	
	DC BUS 2 FAULT	NORM (a)	—	1.20	1.30	1.35	
	If ice accretion : DC ESS BUS FAULT/ DC ESS SHING	NORM (a)	10	1.25	1.25	1.20	
F/CTL	0 ≤ FLAPS < 1 + 1 ≤ FLAPS < 2	2	30	1.60*	1.65*	1.70*	
			15	1.40*	1.40*	1.40*	
			10	1.30*	1.30*	1.25*	
			5	1.20*	1.20*	1.20*	
			5	1.20*	1.20*	1.15*	
			30	1.55*	1.60*	1.55*	
			15	1.35*	1.35*	1.35*	
			5	1.20*	1.20*	1.20*	
			1	50	1.90*	2.00*	2.05*
			2	30	1.45*	1.45*	1.40*
SPLR	ONE/TWO SPLRS per wing	NORM (a)	—	1.20	1.15	1.15	
	THREE/FOUR SPLRS per wing	NORM (a)	—	1.25	1.25	1.20	
	FIVE/ALL SPLRS per wing	NORM (a)	—	1.30	1.35	1.30	
			2	20	1.45*	1.45*	1.40*
			2	20	1.45*(b)	1.45*(b)	1.40*(b)
			2	20	1.75*(b)	1.90*(b)	1.90*(b)
			2	20	1.95*	1.80*	1.75*
			2	20	2.30*	2.65*	2.55*

(a) If CONF 3 is used when "NORM" is indicated in the table, add 5 knots to the VREF and multiply the resulting landing distance by an additional factor of 1.2.
(b) This landing configuration and associated parameters only have to be applied if the Travel Limiter Unit (TLU) remains locked in the high-speed position after slats' extension.
(c) The landing distance coefficients for wet or contaminated runways assume the use of maximum reverse thrust on all of the operative reversers. Apply these coefficients to the actual landing distance with reversers.

OPS DATA IN FLT PERF NORM PROC

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Enhanced VAPP calculation process

A330 Enhanced QRH 2.40

A330 ABNORMAL PROCEDURES REV **2.40**
SEQ

VAPP Determination in the case of ABNORMAL/EMERGENCY Configuration

$VAPP = VREF + \Delta VREF + APPR COR$

=

VREF	
Weight (1000 kg)	120 140 160 180 200 220 240
VREF (VLS CONF FULL)	123 123 127 135 142 149 156

+

$\Delta VREF$

See QRH 2.41

A330 ABNORMAL PROCEDURES REV 21 **2.41**
SEQ 001

LDG CONF/APPR SPD/ LDG DIST FOLLOWING FAILURES

A330	FAILURE	FLAPS LEVER POSITION FOR LDG	Δ VREF APPR SPD INCREMENT	MULTIPLY LDG DIST (CONF FULL) BY		
				DRY	WET (c)	CONTA (c)
	EMER CONFIG	3	5	1.25	1.40	1.50
	DC BUS 1+2 FAULT	NORM (a)	—	1.20	1.30	1.35
	DC BUS 2 FAULT	NORM (a)	—	1.20	1.30	1.35
	If ice accretion DC ESS BUS FAULT/ DC ESS SHED	NORM (a)	30	1.25	1.25	1.20
	0 ≤ FLAPS < 1 + F	2	30	1.60*	1.60*	1.60*
	1+F ≤ FLAPS < 2	2	15	1.40*	1.40*	1.40*
	2 ≤ FLAPS < 3	2	10	1.20*	1.20*	1.25*
	PRIM 1+3, 2+3 FAULT	NORM (a)	—	1.20	1.30	1.40
	PRIM 1+2+3 FAULT	3	5	1.25	1.40	1.50
	ONE/TWO SPLRS per wing	NORM (a)	—	1.20	1.15	1.15
	THREE/FOUR SPLRS per wing	NORM (a)	—	1.25	1.25	1.20
	FIVE/ALL SPLRS per wing	NORM (a)	—	1.30	1.35	1.30

(a) If CONF 3 is used when "NORM" is indicated in the table, add 5 knots to the VREF and multiply the resulting landing distance by an additional factor of 1.2.
 (b) This landing configuration and associated parameters only have to be applied if the Travel Limiter Unit (TLU) remains locked in the high-speed position after slats' extension.
 (c) The landing distance coefficients for wet or contaminated runways assume the use of maximum reverse thrust on all of the operative reversers. Apply these coefficients to the actual landing distance with reversers.

VREF

Weight (1000 kg)	120	140	160	180	200	220	240
VREF (VLS CONF FULL)	123	123	127	135	142	149	156

The PFD displays VREF corresponding to the selected position. For certain failures, the EICAS displays Δ VLS to be applied to PFD VLS for improved manoeuvrability. In such a case, VLS + Δ VLS is the lowest selectable speed, and is equal to, or lower than the calculated VAPP.

Example :

Failure : Engine shutdown Flight Conditions : Autothrust ON
 Landing configuration : 3 Headwind : 12 kt
 Landing Weight : 160 To.

VREF determined from the landing weight : **127 kt**
VREF correction due to the failure (Δ VREF) : **5 kt**

As Δ VREF is equal to 5 kt, the APPRoch CORrection is the higher of :
 . 5 kt (A/THR ON)
 . 1/3 Headwind = 12 kt/3 = 4 kt

APPR COR = 5 kt and ALD has to be multiplied by an additional factor of 1.2

$VAPP = VREF + \Delta VREF + APPR COR = 127 + 5 + 5 = 137 \text{ kt}$

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Enhanced VAPP calculation process

A330 Enhanced QRH 2.40

A330	ABNORMAL PROCEDURES	REV	2.40
		SEQ	

VAPP Determination in the case of ABNORMAL/EMERGENCY Configuration

$$VAPP = VREF + \Delta VREF + APPR COR$$

VREF				
Weight (1000 kg)	120	140	160	180
VREF (VLS CONF FULL)	123	123	127	131

+

Approach COR	
If $\Delta VREF \leq 5$ kt	If $\Delta VREF > 5$ kt
APPR COR is the Highest of kt + If A/THR ON or 1/3 Headwind	APPR COR = 1/3 Headwind Max = 15 kt APPR COR = 0 kt

$\Delta VREF$

See QRH 2.41

A330	ABNORMAL PROCEDURES	REV 21	2.41
		SEQ 001	

LDG CONF/APPR SPD/ LDG DIST FOLLOWING FAILURES

FAILURE	FLAPS LEVER POSITION FOR LDG	Δ VREF APPR SPD INCREMENT	MULTIPLY LDG DIST (CONF FULL) BY			
			DRY	WET (c)	CONTA (c)	
ELEC DC ESS BUS	3	5	1.25	1.40	1.50	
	2	—	1.20	1.30	1.35	
	1	10	1.20	1.30	1.35	
FLAPS FAULT	0 < FLAPS	30	1.60*	1.65*	1.70*	
	1 < FLAPS	15	1.40*	1.40*	1.40*	
	2 < FLAPS	10	1.30*	1.30*	1.25*	
S/F SLATS FAULT	0 < SLATS	30	1.55*	1.60*	1.55*	
	1 < SLATS	15	1.35*	1.35*	1.35*	
	2 < SLATS	5	1.20*	1.20*	1.20*	
NO FLAPS NO SLATS	1	50	1.90*	2.00*	2.05*	
F/CTL	STAB CTL FAULT (MAN TRIM NOT AVAIL)	2	30	1.45*	1.45*	1.40*
	STAB CTL FAULT (MAN TRIM AVAIL)	3	5	1.20*	1.20*	1.20*
	L/R/L + R ELEV FAULT	2	20	1.45*	1.45*	1.40*
	RUD TRV LIM FAULT (b)	2 (b)	20 (b)	1.45*(b)	1.45*(b)	1.40*(b)
	RUD TRV LIM FAULT (engine-out) (b)	2 (b)	APPR SPD : 160 KT (b)	1.75*(b)	1.90*(b)	1.90*(b)
	RUDDER JAM	2	20	1.95*	1.80*	1.75*
	RUDDER JAM (engine out)	2	APPR SPD : 160 KT	2.30*	2.65*	2.55*
	ALTDIRECT LAW	3	5	1.20*	1.20*	1.20*
	PRIM 1+3, 2+3 FAULT	NORM (a)	—	1.20	1.30	1.40
	PRIM 1+2+3 FAULT	3	5	1.25	1.40	1.50
SPLR	ONE/TWO SPLRS per wing	NORM (a)	—	1.20	1.15	1.15
	THREE/FOUR SPLRS per wing	NORM (a)	—	1.25	1.25	1.20
	FIVE/ALL SPLRS per wing	NORM (a)	—	1.30	1.35	1.30

(a) If CONF 3 is used when "NORM" is indicated in the table, add 5 knots to the VREF and multiply the resulting landing distance by an additional factor of 1.2.

(b) This landing configuration and associated parameters only have to be applied if the Travel Limiter Unit (TLU) remains locked in the high-speed position after slats' extension.

(c) The landing distance coefficients for wet or contaminated runways assume the use of maximum reverse thrust on all of the operative reversers. Apply these coefficients to the actual landing distance with reversers.

OPS DATA IN FLT PERF NORM PROC

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Enhanced VAPP calculation process

A330 Enhanced QRH 2.40

A330 ABNORMAL PROCEDURES REV **2.40**
SEQ

VAPP Determination in the case of ABNORMAL/EMERGENCY Configuration

$VAPP = VREF + \Delta VREF + APPR COR$

		VREF						
		120	140	160	180	200	220	240
Weight (1000 kg)		120	140	160	180	200	220	240
VREF (VLS CONF FULL)		123	123	127	135	142	149	156

A330 ABNORMAL PROCEDURES REV 21 **2.41**
SEQ 001

LDG CONF/APPR SPD/ LDG DIST FOLLOWING FAILURES

A330	FAILURE	FLAPS LEVER POSITION FOR LDG	Δ VREF APPR SPD INCREMENT	MULTIPLY LDG DIST (CONF FULL) BY		
				DRY	WET (c)	CONTA (c)
	EMER CONFIG	3	5	1.25	1.40	1.50
	DC BUS 1+2 FAULT	NORM (a)	—	1.20	1.30	1.35
ELEC	DC BUS 2 FAULT	NORM (a)	—	1.20	1.30	1.35
	If ice accretion : DC ESS BUS FAULT	NORM (a)	10	1.25	1.35	1.50

APPROACH CORRECTION

if $\Delta VREF \leq 5$ kt	if $5 \text{ kt} < \Delta VREF < 20$ kt	if $\Delta VREF \geq 20$ kt
<p>APPR COR is the Highest of</p> <ul style="list-style-type: none"> 5 kt * if A/THR ON or when Autoland is performed or in case of Ice Accretion 	<p>APPR COR = 1/3 Headwind Max = 15 kt</p>	<p>APPR COR = 0 kt</p>
<p>APPR COR + $\Delta VREF$ Limited to 20 kt</p>		

Example :

Failure Landing configuration : 3 headwind : 12 kt
Landing Weight : 160 To.

VREF determined from the landing weight : 127 kt
VREF correction due to the failure ($\Delta VREF$) : 5 kt

As $\Delta VREF$ is equal to 5 kt, the APPROACH CORrection is the higher of :
5 kt (A/THR ON)
1/3 Headwind = 12 kt/3 = 4 kt

APPR COR = 5 kt and ALD has to be multiplied by an additional factor of 1.2

$VAPP = VREF + \Delta VREF + APPR COR = 127 + 5 + 5 = 137 \text{ kt}$

OPS DATA

(a) If CONF 3 is used when "NORM" is indicated in the table, add 5 knots to the VREF and multiply the resulting landing distance by an additional factor of 1.2.

(b) This landing configuration and associated parameters only have to be applied if the Travel Limiter Unit (TLU) remains locked in the high-speed position after slats' extension.

(c) The landing distance coefficients for wet or contaminated runways assume the use of maximum reverse thrust on all of the operative reversers. Apply these coefficients to the actual landing distance with reversers.



Enhanced VAPP calculation process

A330 Engine 1 failure

- ▶ Weight = 180 tons, autothrust used, and no wind

$$VAPP = VREF + \Delta VREF + APPR COR$$

W (1000KG)	120	140	160	180	200	220	240
VREF=VLS CONF FULL	126	126	127	135	142	149	156

ENG	SHUTDOWN	3	5
	THR LEVER FAULT	3	5
	REV UNLOCKED (WITH BUFFET)	2	25

• VREF = 135 kt

• $\Delta VREF = 5$ kt

APPRoach CORrection		
if $\Delta VREF \leq 5$ kt	if $5 \text{ kt} < \Delta VREF < 20$ kt	if $\Delta VREF \geq 20$ kt
APPR COR is the Highest of 5 kt* if A/THR ON or when Autoland is performed or in case of Ice Accretion 1/3 Headwind Max = 15 kt	APPR COR = 1/3 Headwind Max = 15 kt	APPR COR = 0 kt
APPR COR + $\Delta VREF$ Limited to 20 kt		

→ APPR CORR = 5 kt



$$VAPP = 135 + 5 + 5 = 145 \text{ knots}$$

Enhanced VAPP calculation process

A330 Engine 1 failure

- ▶ Weight = 180 tons, autothrust used, and no wind

No failure

$$\bullet \text{ VAPP} = 138 + 5 = 143 \text{ knots}$$

VLS Conf 3

A/THR
use

With failure

$$\bullet \text{ VAPP} = 135 + 5 + 5 = 145 \text{ knots}$$

VREF

Δ VREF

A/THR
use

Autothrust effect now taken into account

VAPP with failure higher or equal to VAPP without failure

Enhanced VAPP calculation process

QRH additional modifications

- VAPP determination without failure moved in QRH part 4

A378
A379
A380
A321

IN FLIGHT PERFORMANCE

REV 29
 SEQ 153

4.01

SPEEDS

OPERATING SPEEDS (KT)

W (1000 KG)	F	S	Green dot FL < 200*	VLS CONF 3	VREF
44	123	161	173	115	**
48	128	168	181	120	112
52	133	175	189	125	117
56	139	181	197	130	121
60	143	187	205	134	125
64	148	194	213	139	129
68	153	200	221	143	133
72	157	205	229	147	137
76	161	211	237	151	141

* Above FL200 add 1 knot per additional 1000 feet
 ** VREF is limited by VREF = 109 knots

VAPP DETERMINATION

NORMAL CONFIGURATION
 The FMGS performs the following VAPP computation for landing in normal configuration (CONF 3 or CONF FULL).

W(1000kg)	44	48	52	56	60	64	68	72	76
VLS CONF FULL (KT)	109	112	117	121	125	129	133	137	141
VLS CONF 3 (KT)	115	120	125	130	134	139	143	147	151

+

CORRECTION
 SKT 1/3 HEADWIND
 (EXCLUDING GUST)
 MAX=15KT
 WHICHVER IS HIGHER

=

-VAPP

$V_{app} = \text{MAX}(VLS + SKT; VLS + WIND CORR)$

The 5 knot increment is required when the A/THR is used, or when an autoland is performed.

NOTE: * - In case of ice accretion, Vapp must not be lower than :
 - VLS + 5 knots in CONF FULL
 - VLS + 10 knots in CONF 3
 - In case of gusty crosswind greater than 20 knots, Vapp should be at least VLS + 10 knots.

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OPS DATA



Enhanced VAPP calculation process

Use of the QRH table when "NORM" is indicated

- ▶ LDG CONF / APPR SPD / LDG DIST FOLLOWING FAILURE tables modified

A320 FAMILY	FAILURE	FLAPS LEVER POSITION FOR LDG	Δ VREF APPR SPD INCREMENT	MULTIPLY LDG DIST (CONF FULL) BY		
				DRY	WET (b)	CONTA (b)
BRK	ANTI SKID	Norm (a)	—	1.60	1.30	1.10
	AUTO BRK FAULT	Norm (a)	—	1.45	1.25	1.20



A320 FAMILY	FAILURE	FLAP LEVER POSITION FOR LDG	Δ VREF APPR SPD INCREMENT	MULTIPLY LDG DIST (CONF FULL) BY		
				DRY	WET (b)	CONTA (b)
BRK	ANTI SKID	3	6	1.80	1.45	1.25
		FULL	-	1.60	1.30	1.10
	AUTO BRK FAULT	3	6	1.60	1.40	1.35
		FULL	-	1.45	1.25	1.20

Easier to use

Content

- VAPP definition
- VAPP determination – No failure
- VAPP determination – With failure
- Enhanced VAPP calculation process
- Conclusion

Conclusion

- One **single method** for VAPP computation, whatever the type of failure
 - ▶ VAPP determination method without failure is **moved** from QRH Part 2 to **QRH Part 4**
- With the **enhanced VAPP** calculation method (with failure)
 - ▶ **Autothrust** use can be taken **into account**
 - ▶ VAPP with failure is **higher or equal** to VAPP without failure
- “**NORM**” indication replaced by **two cases** (Conf 3 and FULL) in the QRH LDG CONF / APPR SPD / LDG DIST FOLLOWING FAILURE table.
- Enhancements **should be available** with the next QRH General Revisions planned for dispatch in **January 2008**

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