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New VAPP Calculation process

A320/A330/A340 aircraft

AIRBUS

Content

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

Content

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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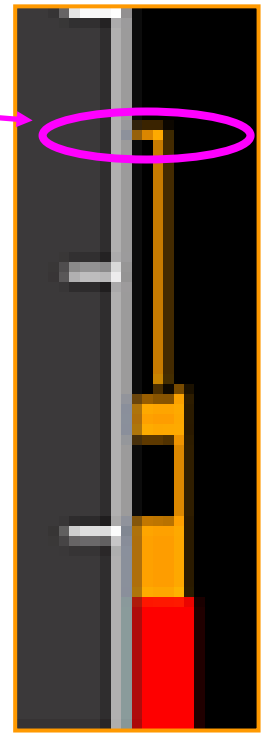
VAPP determination – No failure

- VAPP = VLS (Conf FULL or 3) + Delta

  - VLS = Lowest selectable speed
    - VLS = 1.23 x Vs1g (stall speed under 1g)
    - VLS depends on:
      - Aircraft weight
      - Slats/Flaps configuration
    - VLS Conf FULL = VREF



  - 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)

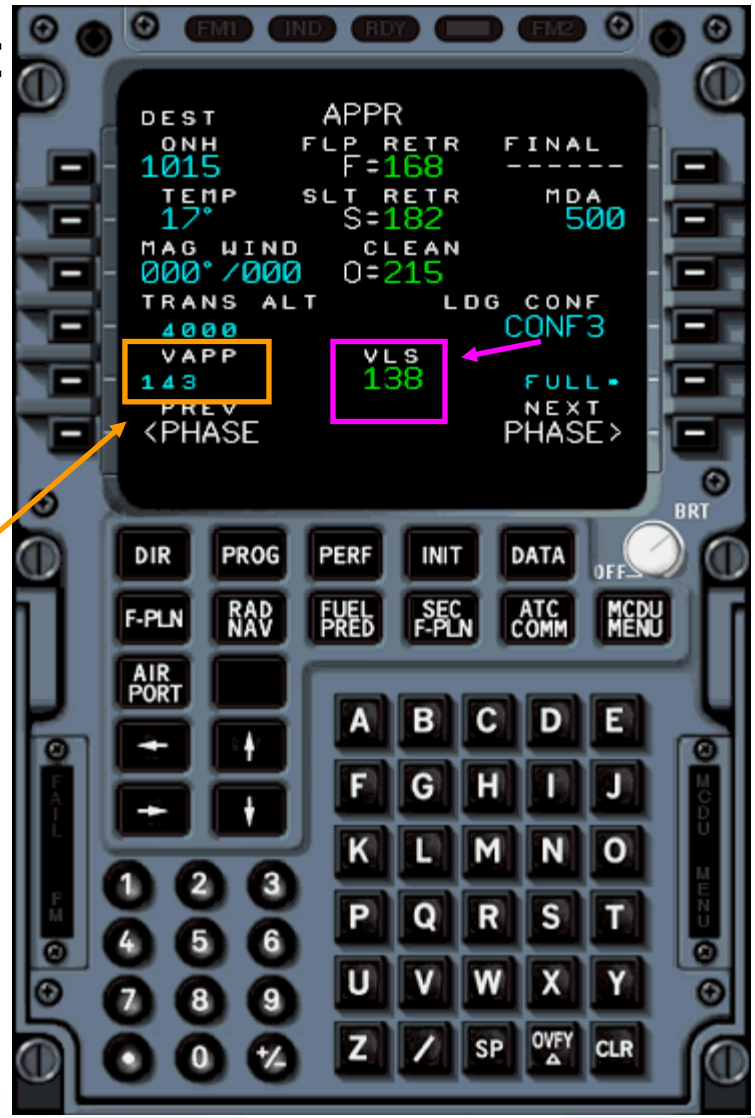
VAPP determination – No failure

- 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 knots

VLS Conf 3



VAPP determination – No failure

- Two landing configuration certified:
  - Conf FULL
  - Conf 3

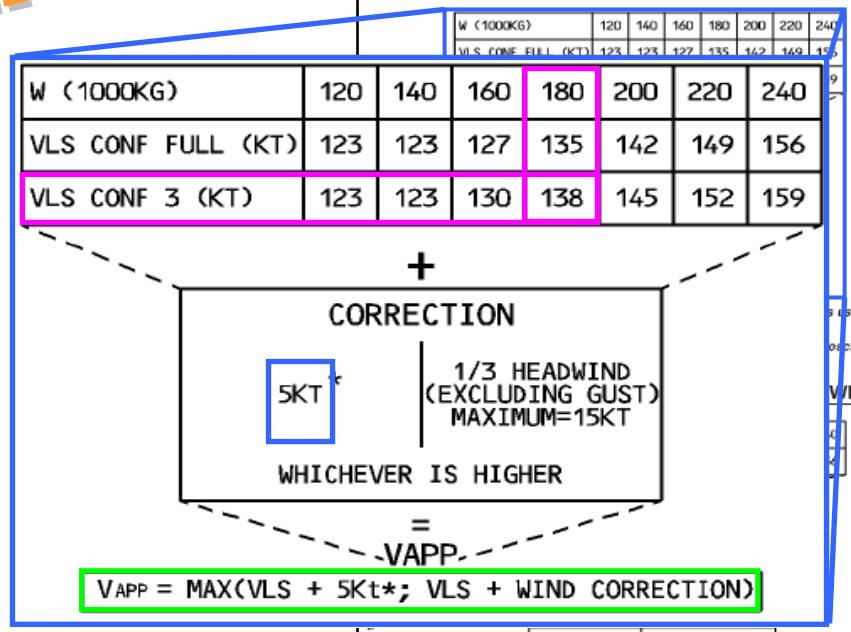
With QRH

- 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



Content

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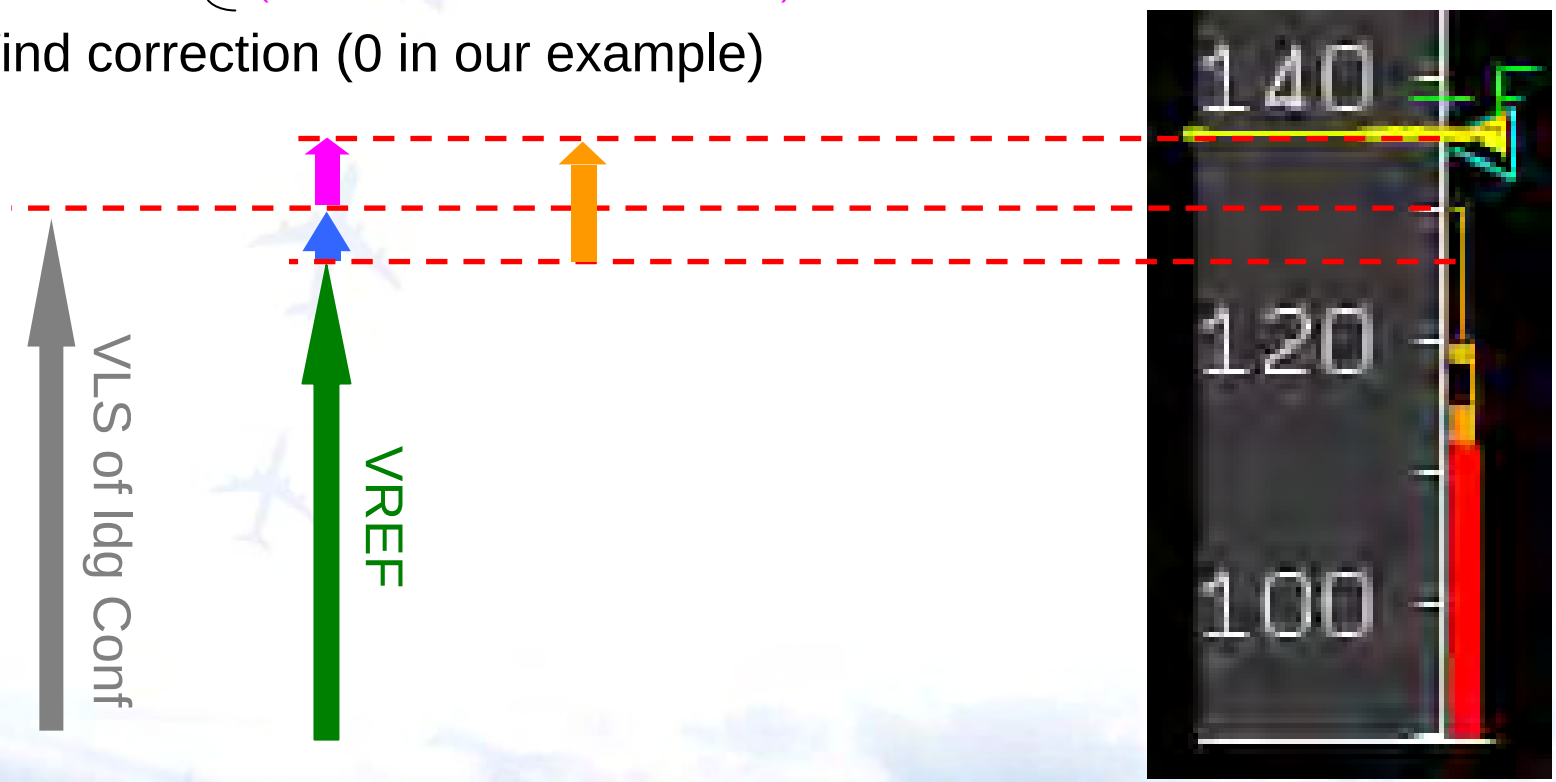
VAPP determination – With failure

VAPP = VREF (VLS Conf FULL) + ΔVREF + Wind Correction

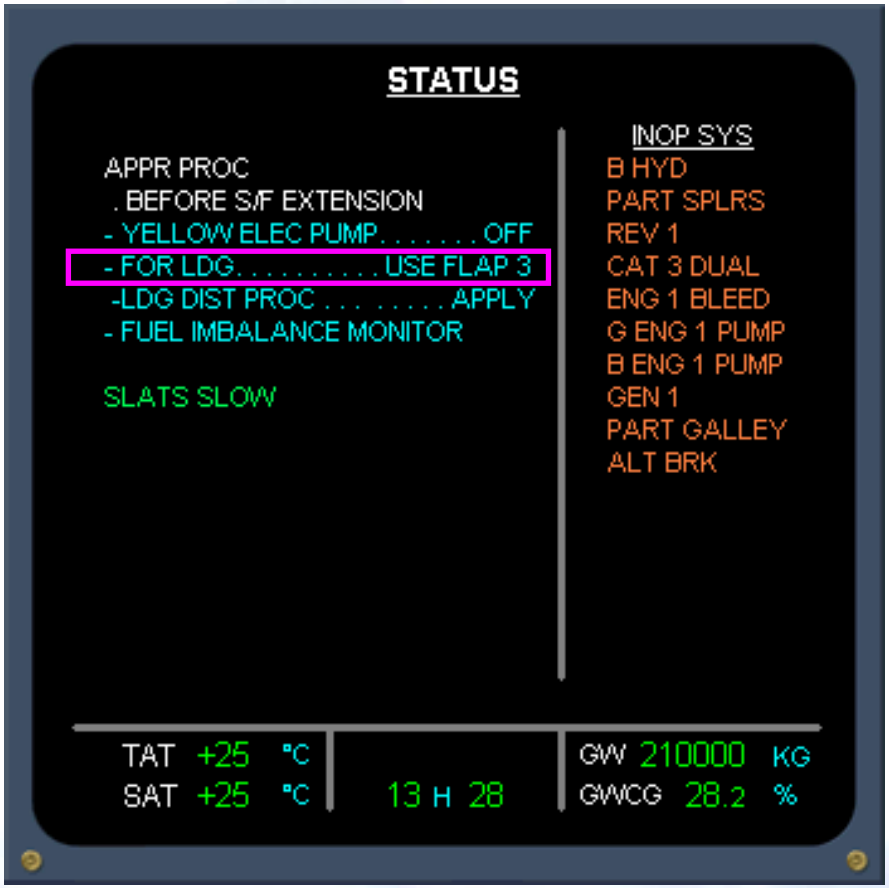
- VREF = VLS of Conf FULL
- ΔVREF =
  - VLS increase due to actual Slats/Flaps configuration
  - \+
  - Speed increase for handling qualities
  - (ΔVLS shown on LR ECAM STATUS)
- Wind correction (0 in our example)



VAPP determination – With failure

A330 engine 1 failure (1/3)

- After ECAM action completed the following STATUS is shown



VAPP determination – With failure

A330 engine 1 failure (2/3)

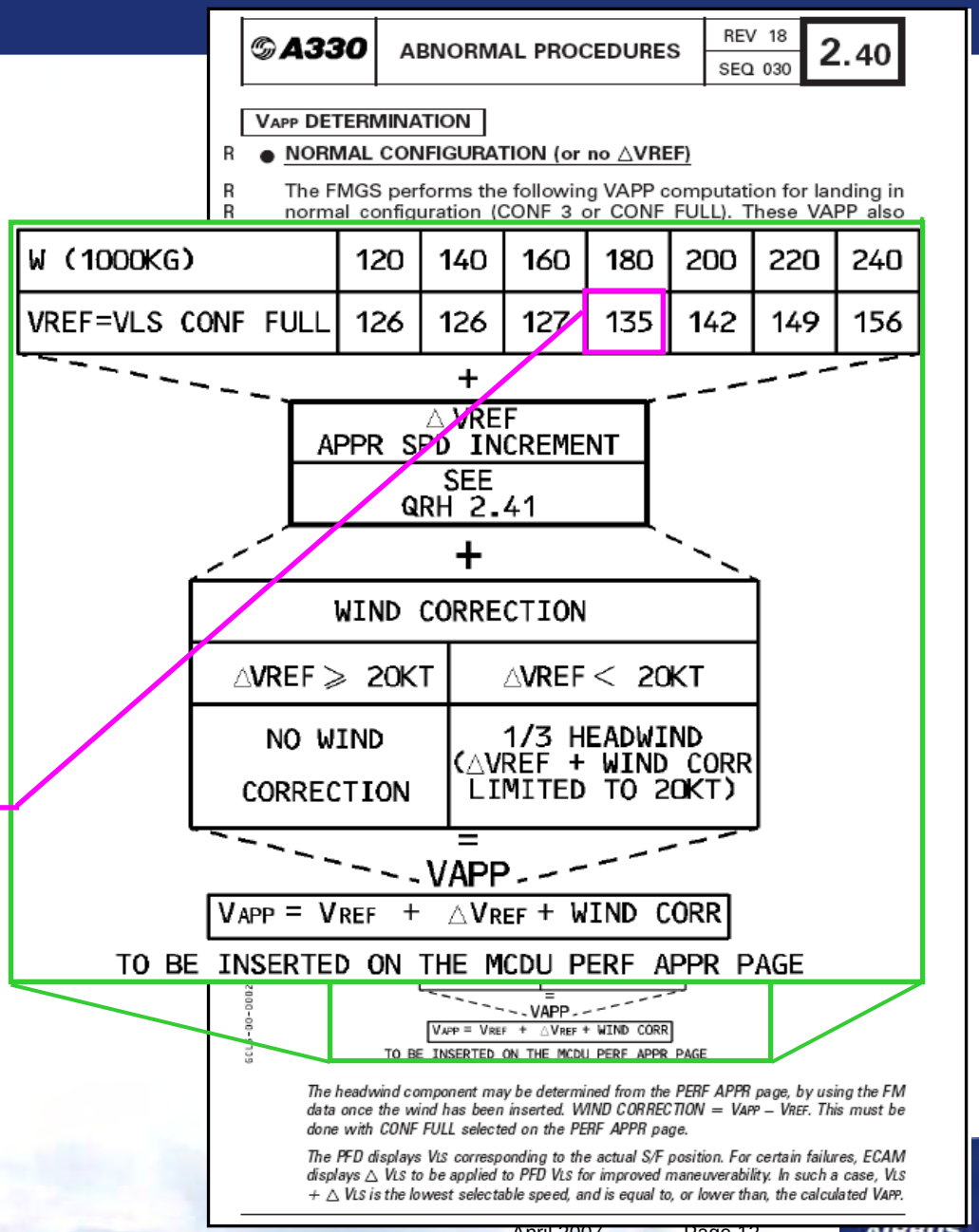
- Wind = 0 knots
- Weight = 180 tons

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

ΔVREF

- VAPP = 135 + 5 = 140 knots

VREF



VAPP determination – With failure

A330 engine 1 failure (3/3)

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

No failure

- VAPP = 138 + 5 = **143 knots**

VLS Conf 3 — A/THR use

With failure

- VAPP = 135 + 5 = **140 knots**

VREF — ΔVREF

- **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 ΔVREF
  - “Norm” Indicated

A318 A319 A320 A321 — ABNORMAL PROCEDURES — REV 41 — SEQ 102 — 2.32A

A320 FAMILY	FAILURE	FLAPS LEVER POSITION FOR LDG	△ 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	2.45	2.00	1.55
	UNRELIABLE SPEED INDICATION/ ADR CHECK PROC		15	1.45*	1.4*	1.3*
	DUAL IR FAULT/DUAL ADR FAULT ADR 1+2+3 FAULT		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)	2.15*	1.95*	1.95*
	REV UNLOCK with buffet		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

ding distance with

NF 3) is displayed

(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.

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)

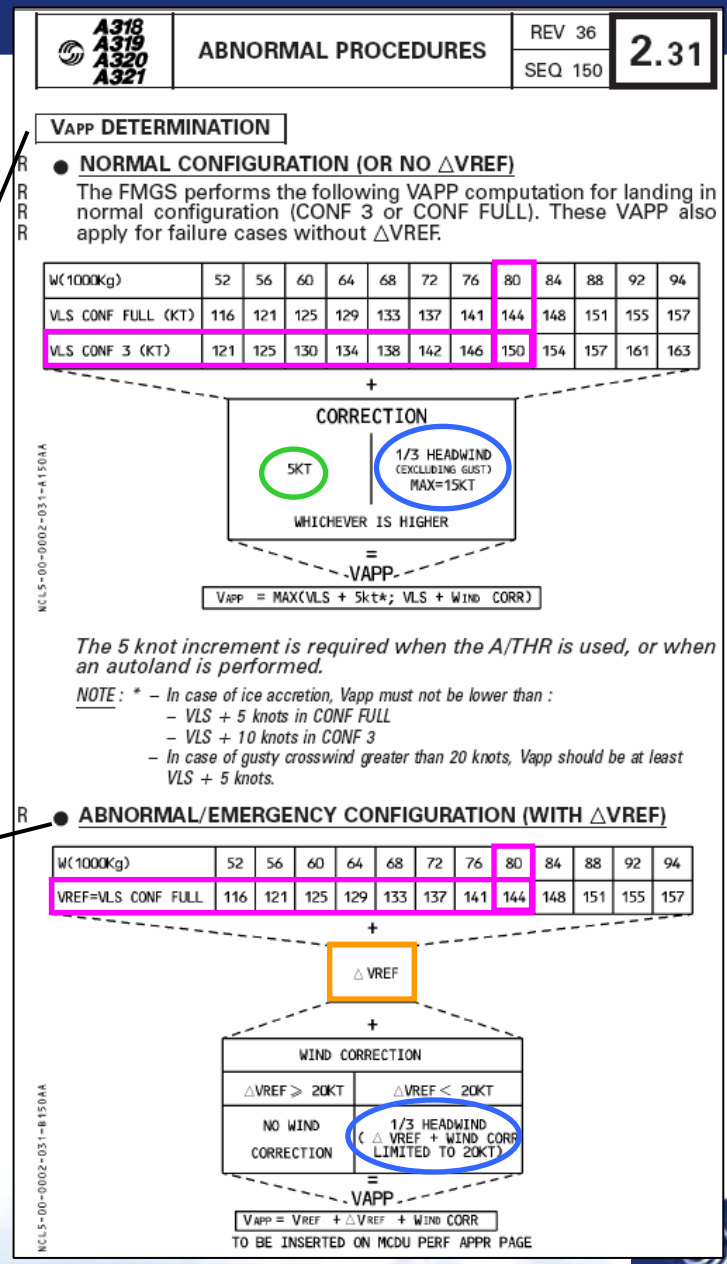
R ● **NORMAL CONFIGURATION (OR NO △VREF)**

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

} VAPP = **155 kt**

R ● **ABNORMAL/EMERGENCY CONFIGURATION (WITH △VREF)**

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



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 ΔVREF)” table:
    - VAPP = **155 kt**
  - VAPP “Abnormal/emergency configuration (with ΔVREF)” :
    - VAPP = **150 kt**

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

Content

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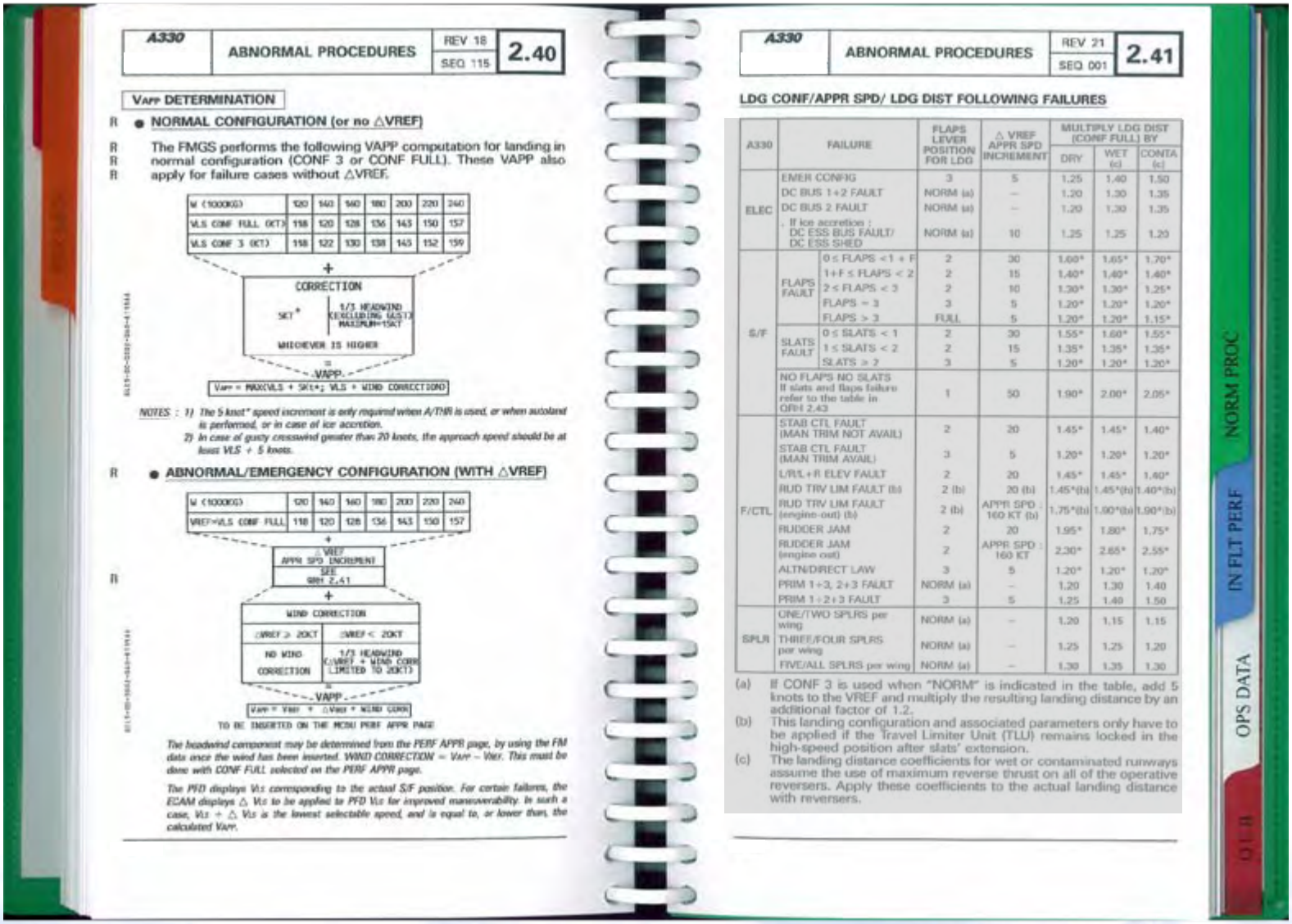
Enhanced VAPP calculation process

- 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

Clear and unambiguous method

Enhanced VAPP calculation process

A330 Current QRH 2.40



A330 | ABNORMAL PROCEDURES | REV 18 | SEQ 115 | 2.40

VAPP DETERMINATION

R ● NORMAL CONFIGURATION (or no △VREF)

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

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

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

WHICHEVER IS HIGHER

=

VAPP

VAPP = MAX(VLS + SET*; VLS + WIND CORRECTION)

NOTES : 1) The 5 knot* speed increment is only required when A/THR is used, or when autoland 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 △VREF)

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

+

△VREF APPR SPD INCREMENT SEE QRH 2.41

+

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

=

VAPP

VAPP = VREF + △VREF + 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 △ VLS to be applied to PFD VLS for improved manoeuvrability. In such a case, VLS + △ VLS is the lowest selectable speed, and is equal to, or lower than, the calculated VAPP.

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

LDG CONF/APPR SPD/ LDG DIST FOLLOWING FAILURES

A330	FAILURE		FLAPS LEVER POSITION FOR LDG	△ 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	FLAPS FAULT	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*
	SLATS FAULT	0 ≤ SLATS < 1	2	30	1.55*	1.60*	1.55*
		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 If slats and flaps failure refer to the table in QRH 2.43		1	50	1.90*	2.00*	2.05*
F/CTL	STAB CTL FAULT (MAN TRIM NOT AVAIL)		2	20	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
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 | QRH

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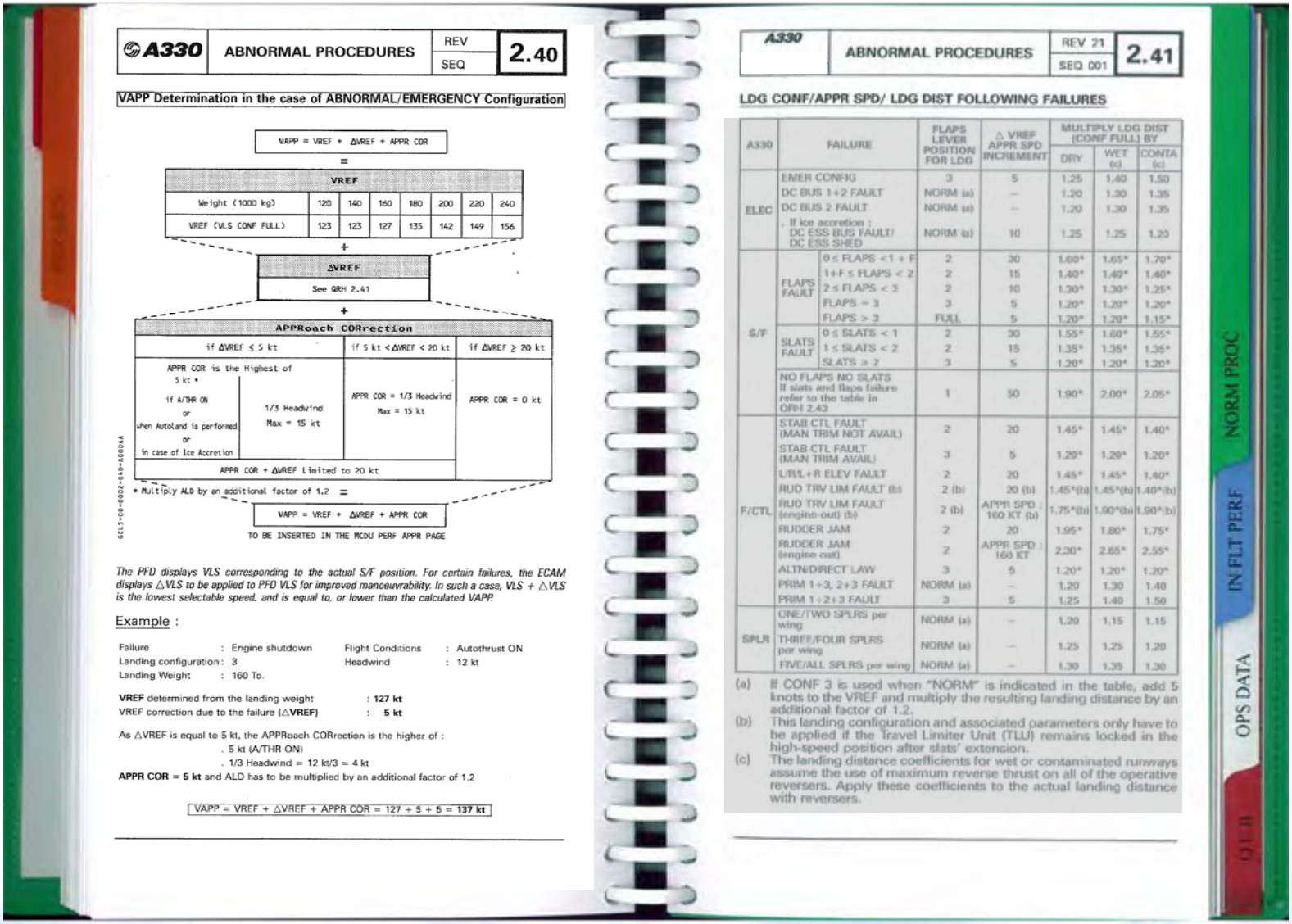
Enhanced VAPP calculation process

A330 Enhanced QRH 2.40



A330 | ABNORMAL PROCEDURES | REV | SEQ | 2.40

VAPP Determination in the case of ABNORMAL/EMERGENCY Configuration

VAPP = VREF + ΔVREF + APPR COR

=

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

+

ΔVREF

See QRH 2.41

+

APPRoach CORrection

if ΔVREF ≤ 5 kt		if 5 kt < ΔVREF < 20 kt	if ΔVREF ≥ 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 + ΔVREF limited to 20 kt			

* Multiply ALD by an additional factor of 1.2 =

VAPP = VREF + ΔVREF + 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 △VLS to be applied to PFD VLS for improved manoeuvrability. In such a case, VLS + △VLS is the lowest selectable speed, and is equal to, or lower than the calculated VAPP.

Example :

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

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

As ΔVREF 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 + ΔVREF + APPR COR = 127 + 5 + 5 = **137 kt**

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

LDG CONF/APPR SPD/ LDG DIST FOLLOWING FAILURES

A330	FAILURE		FLAPS LEVER POSITION FOR LDG	△ 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	FLAPS FAULT	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*
	SLATS FAULT	0 ≤ SLATS < 1	2	30	1.55*	1.60*	1.55*
		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 If slats and flaps failure refer to the table in QRH 2.43		1	50	1.90*	2.00*	2.05*
F/CTL	STAB CTL FAULT (MAN TRIM NOT AVAIL)		2	20	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
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.

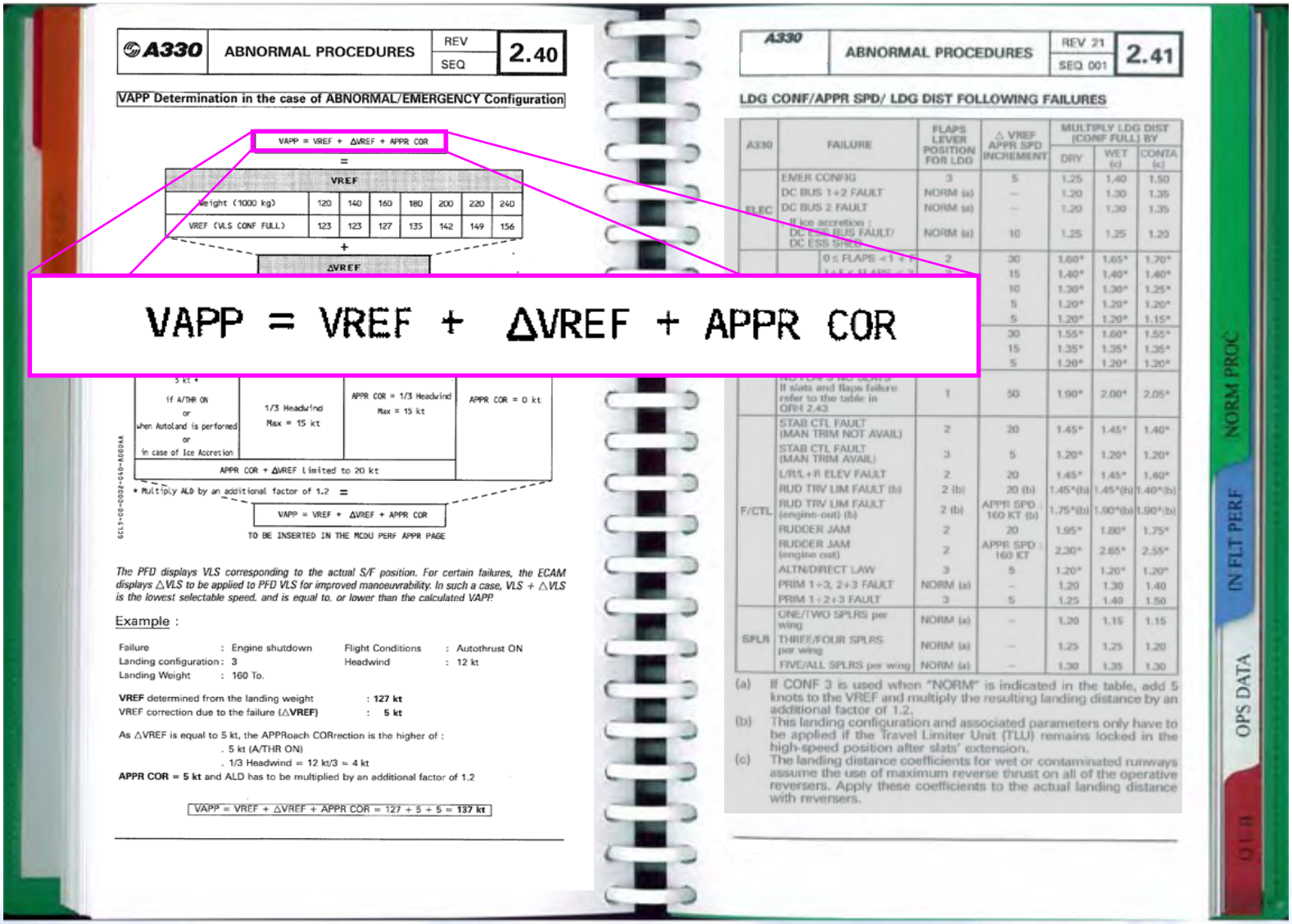
(b) This landing configuration and associated parameters only have to be applied if the Travel Limiter Unit (TLU) remains locked in the high-speed position after slats' extension.

(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 | QRH

Enhanced VAPP calculation process

A330 Enhanced QRH 2.40



A330 | ABNORMAL PROCEDURES | REV SEQ | 2.40

VAPP Determination in the case of ABNORMAL/EMERGENCY Configuration

VAPP = VREF + ΔVREF + APPR COR

=

VREF

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

+

ΔVREF

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 = ΔVREF limited to 20 kt			

* Multiply ALD by an additional factor of 1.2 =

VAPP = VREF + ΔVREF + APPR COR

TO BE INSERTED IN THE MCDU PERF APPR PAGE

VAPP = VREF + ΔVREF + APPR COR

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

Example :

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

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

As △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 + ΔVREF + APPR COR = 127 + 5 + 5 = **137 kt**

A330 | ABNORMAL PROCEDURES | REV 21 SEQ 001 | 2.41

LDG CONF/APPR SPD/ LDG DIST FOLLOWING FAILURES

A330	FAILURE	FLAPS LEVER POSITION FOR LDG	△ 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
	0 ≤ FLAPS < 1 + F	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*
	If slats and flaps failure refer to the table in OPH 2.43	1	50	1.90*	2.00*	2.05*
F/CTL	STAB CTL FAULT (MAN TRIM NOT AVAIL)	2	20	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
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.

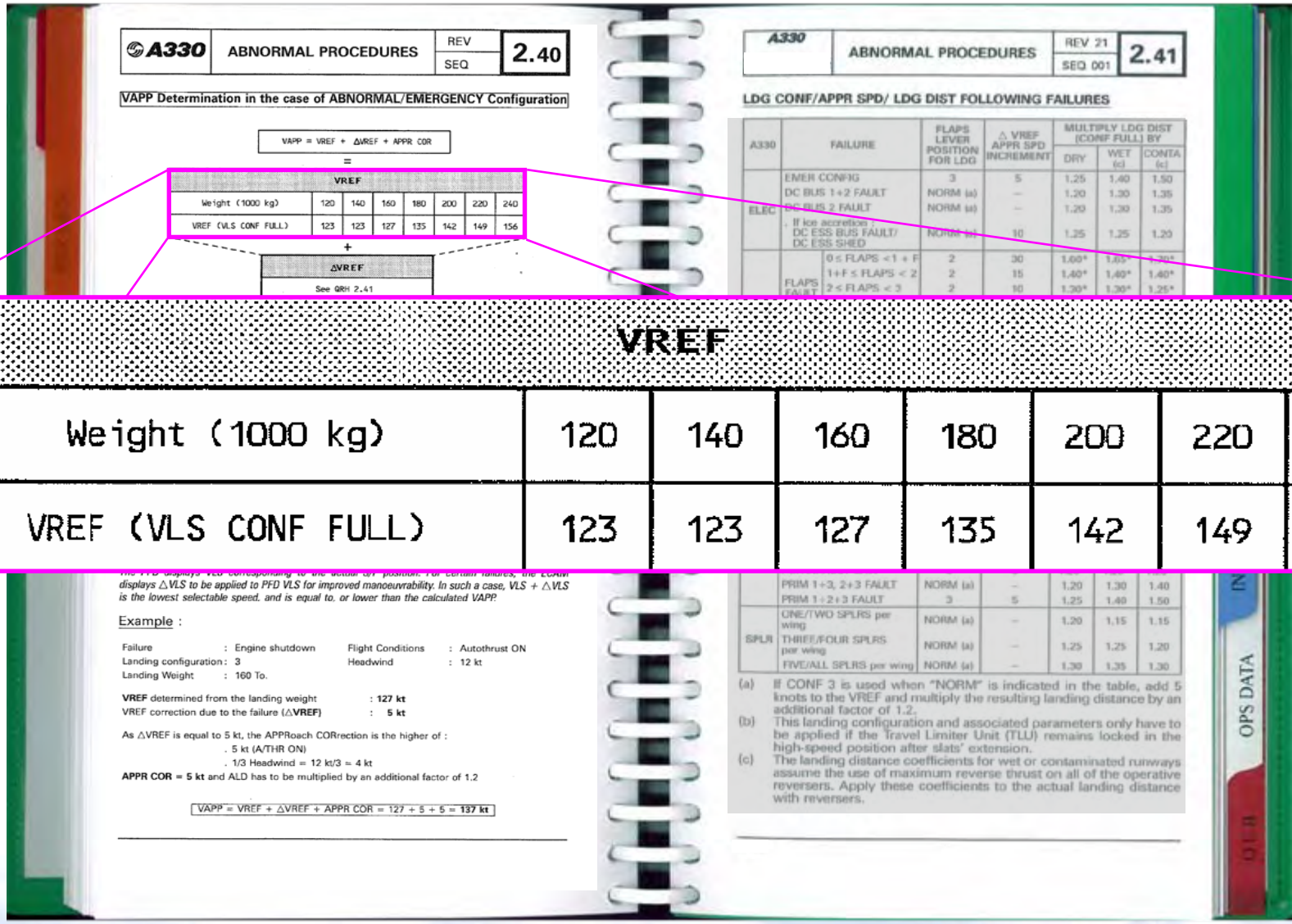
(b) This landing configuration and associated parameters only have to be applied if the Travel Limiter Unit (TLU) remains locked in the high-speed position after slats' extension.

(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 | QRH

Enhanced VAPP calculation process

A330 Enhanced QRH 2.40



A330 | ABNORMAL PROCEDURES | REV SEQ | 2.40

VAPP Determination in the case of ABNORMAL/EMERGENCY Configuration

VAPP = VREF + ΔVREF + APPR COR

=

VREF

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

+

ΔVREF

See QRH 2.41

displays △VLS to be applied to PFD VLS for improved manoeuvrability. In such a case, VLS + △VLS is the lowest selectable speed, and is equal to, or lower than the calculated VAPP.

Example :

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

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

As ΔVREF 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 + ΔVREF + APPR COR = 127 + 5 + 5 = **137 kt**

A330 | ABNORMAL PROCEDURES | REV 21 SEQ 001 | 2.41

LDG CONF/APPR SPD/ LDG DIST FOLLOWING FAILURES

A330	FAILURE	FLAPS LEVER POSITION FOR LDG	△ 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
FLAPS FAULT	0 ≤ FLAPS <1 + F	2	30	1.60*	1.85*	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*
	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.

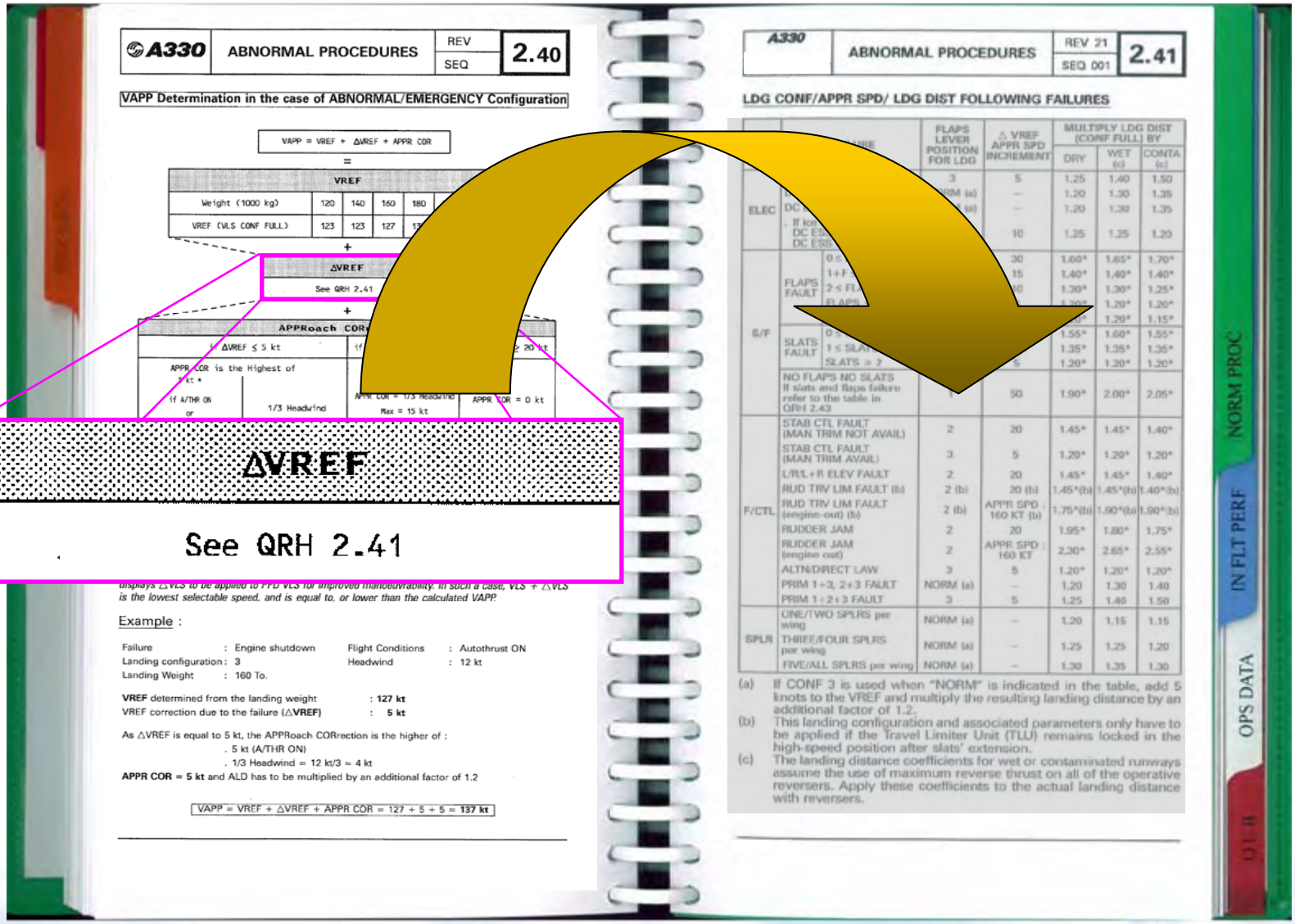
(b) This landing configuration and associated parameters only have to be applied if the Travel Limiter Unit (TLU) remains locked in the high-speed position after slats' extension.

(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

Enhanced VAPP calculation process

A330 Enhanced QRH 2.40



A330 | ABNORMAL PROCEDURES | REV | SEQ | 2.40

VAPP Determination in the case of ABNORMAL/EMERGENCY Configuration

VAPP = VREF + ΔVREF + APPR COR

=

VREF				
Weight (1000 kg)	120	140	160	180
VREF (VLS CONF FULL)	123	123	127	13

+

ΔVREF
See QRH 2.41

+

APPRoach COR	
If ΔVREF ≤ 5 kt	If ΔVREF > 5 kt
APPR COR is the Highest of 5 kt + If A/THR ON or 1/3 Headwind	APPR COR = 1/3 Headwind Max = 15 kt

ΔVREF

See QRH 2.41

displays △VLS to be applied to FPD VLS for improved manoeuvrability. In such a case, VLS + △VLS is the lowest selectable speed, and is equal to, or lower than the calculated VAPP.

Example :

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

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

As ΔVREF 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 + ΔVREF + APPR COR = 127 + 5 + 5 = **137 kt**

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

LDG CONF/APPR SPD/ LDG DIST FOLLOWING FAILURES

		FLAPS LEVER POSITION FOR LDG	Δ VREF APPR SPD INCREMENT	MULTIPLY LDG DIST (CONF FULL) BY DRY	WET (c)	CONTA (c)
ELEC	DC	3	5	1.25	1.40	1.50
	. If lost	RM (a)	–	1.20	1.30	1.35
	DC ES	(a)	–	1.20	1.30	1.35
	DC ESS		10	1.25	1.25	1.20
S/F	FLAPS FAULT	0 ≤	30	1.60*	1.65*	1.70*
		1+F	15	1.40*	1.40*	1.40*
		2 ≤ FL	10	1.30*	1.30*	1.25*
		FLAPS		1.20*	1.20*	1.20*
				1.20*	1.20*	1.15*
	SLATS FAULT	0 ≤		1.55*	1.60*	1.55*
		1 ≤ SLAT		1.35*	1.35*	1.35*
		SLATS ≥ 2	5	1.20*	1.20*	1.20*
	NO FLAPS NO SLATS If slats and flaps failure refer to the table in OPM 2.43	1	50	1.90*	2.00*	2.05*
F/CTL	STAB CTL FAULT (MAN TRIM NOT AVAIL)	2	20	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
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 | QRH

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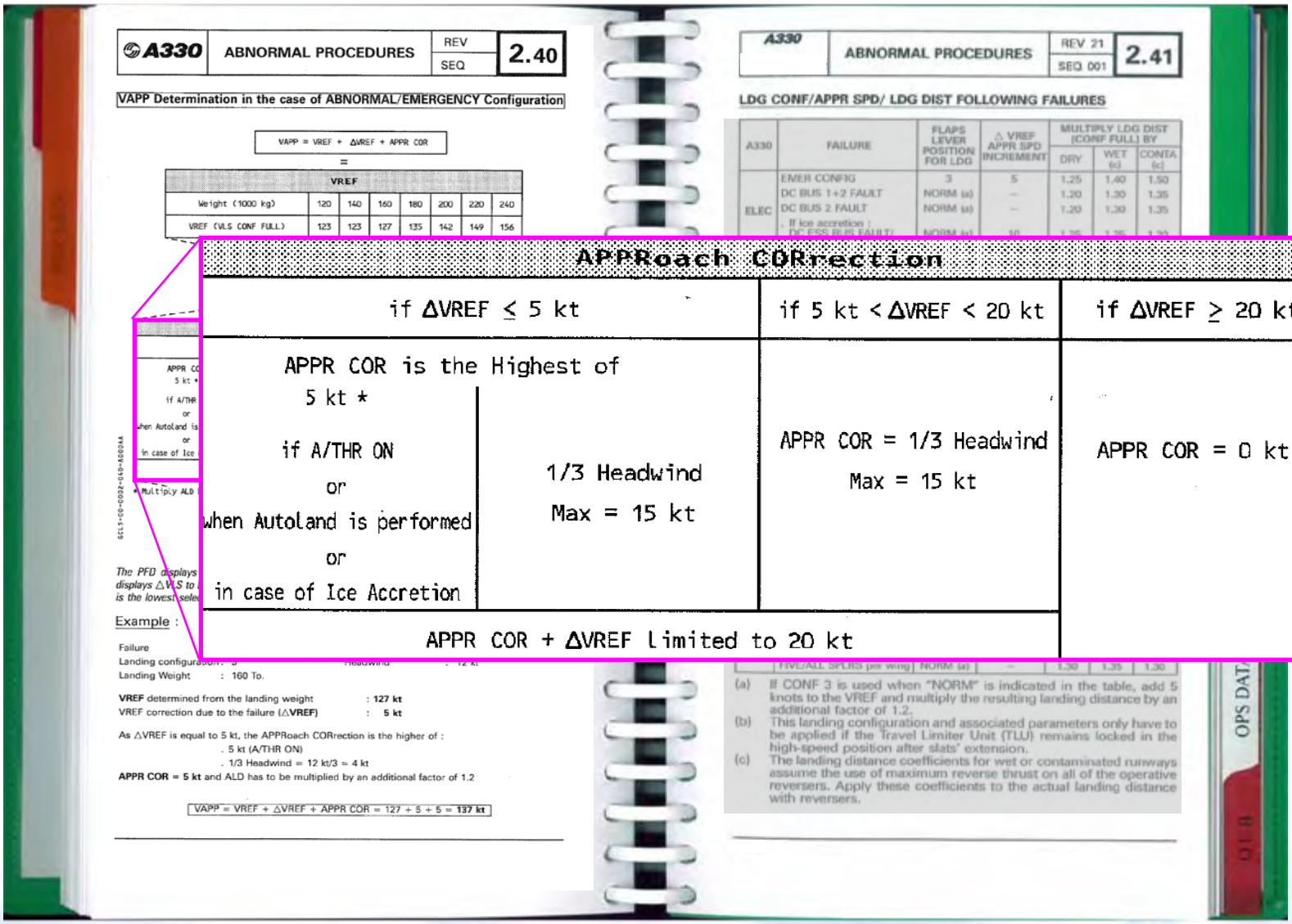
Enhanced VAPP calculation process

A330 Enhanced QRH 2.40



A330 | ABNORMAL PROCEDURES | REV / SEQ | 2.40

VAPP Determination in the case of ABNORMAL/EMERGENCY Configuration

VAPP = VREF + ΔVREF + APPR COR

=

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

APPRoach CORrection

if ΔVREF ≤ 5 kt		if 5 kt < ΔVREF < 20 kt	if ΔVREF ≥ 20 kt
APPR COR is the Highest of 5 kt *		APPR COR = 1/3 Headwind Max = 15 kt	APPR COR = 0 kt
if A/THR ON or when Autoland is performed or in case of Ice Accretion	1/3 Headwind Max = 15 kt		
APPR COR + ΔVREF limited to 20 kt			

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 (**ΔVREF**) : **5 kt**

As ΔVREF 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 + ΔVREF + APPR COR = 127 + 5 + 5 = **137 kt**

A330 | ABNORMAL PROCEDURES | REV 21 / SEQ 001 | 2.41

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
ELEC	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	NORM (a)	10			
	HYD/ALT 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

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**
- ΔVREF = **5 kt**

APPRoach CORrection		
if ΔVREF ≤ 5 kt	if 5 kt < ΔVREF < 20 kt	if ΔVREF ≥ 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 + ΔVREF limited to 20 kt		

→ APPR CORR = **5 kt**

VAPP = 135 + 5 + 5 = 145 knots

Enhanced VAPP calculation process

A330 Engine 1 failure

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

No failure

- VAPP = 138 + 5 = **143 knots**

VLS Conf 3 — A/THR use

With failure

- VAPP = 135 + 5 + 5 = **145 knots**

VREF — ΔVREF — A/THR use

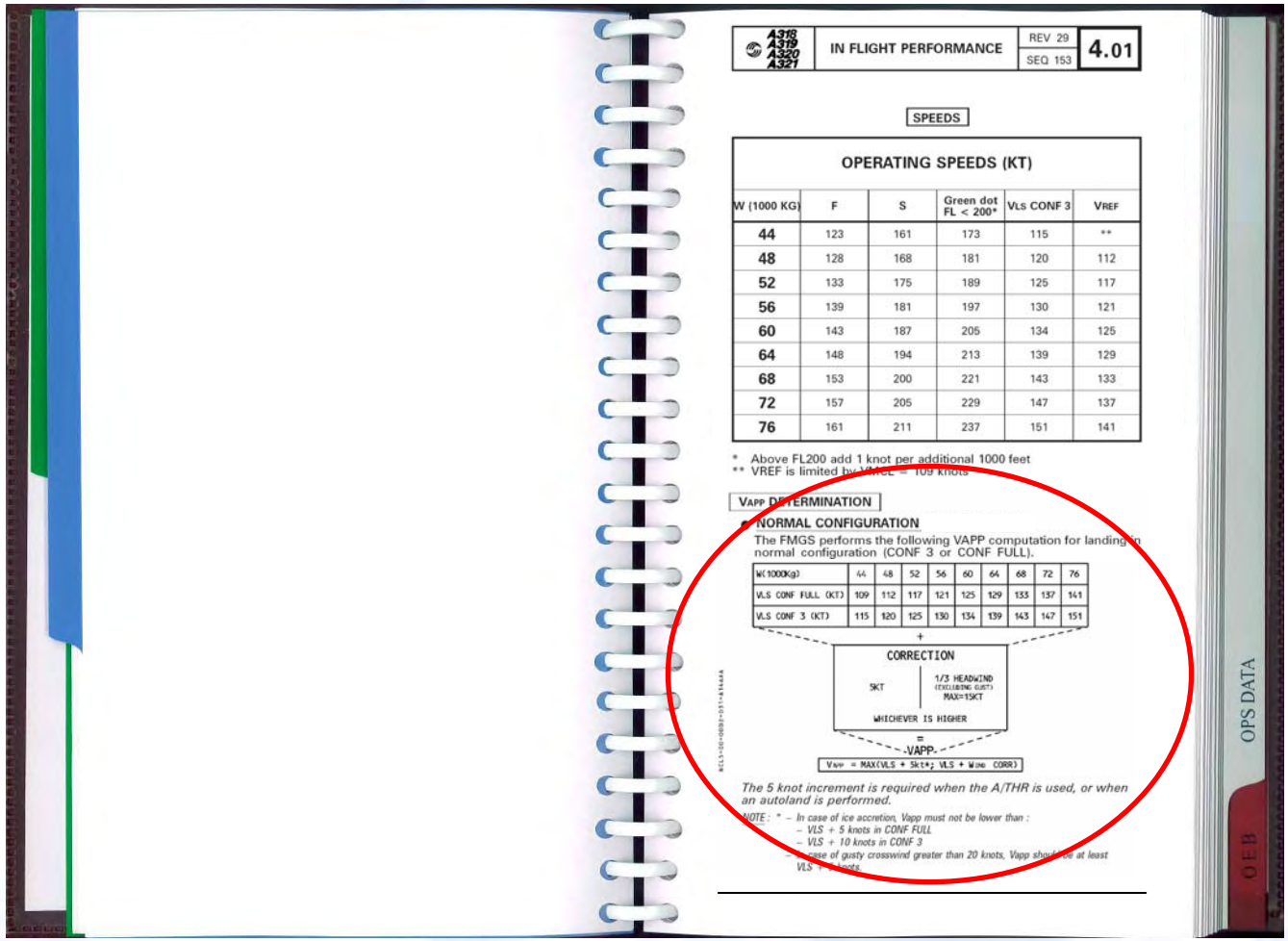
Autothrust effect now taken into account

VAPP with failure higher or equal to VAPP without failure

Enhanced VAPP calculation process

QRH additional modifications

- VAPP detemination without failure moved in QRH part 4



A318 A319 A320 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 VMCL = 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

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.

OPS DATA

OEB

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	△ 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	ΔVREF 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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