BRITISH AIRWAYS

B747 Performance Manual

Revision Record

Revision	Date	Initials	Revision	Date	Initials
0	Nov 2015				
1	Dec 2017				

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Approved Signatory: 

1. This LEP is a complete re-issue showing individual page numbers.

2. Record this revision number on the Record Sheet in the front of this manual.

List of Effective Pages

Page	Rev	Date	Page	Rev	Date	Page	Rev	Date
LEP–1	1+	Nov 2017	2–31	1	Nov 2017	5–1	1	Nov 2017
LEP–2	1+	Nov 2017	2–32	1	Nov 2017	5–2	0	Nov 2015
SOC–1	1	Nov 2017	3–1	1	Nov 2017	5–3	0	Nov 2015
SOC–2	1	Nov 2017	3–2	1	Nov 2017	5–4	0	Nov 2015
TOC–1	1	Nov 2017	3–3	0	Nov 2015	5–5	0	Nov 2015
TOC–2	1+	Nov 2017	3–4	1	Nov 2017	5–6	0	Nov 2015
1–1	1	Nov 2017	3–5	1	Nov 2017	5–7	0	Nov 2015
1–2	0	Nov 2015	3–6	1	Nov 2017	5–8	1+	Nov 2017
1–3	0	Nov 2015	3–7	1	Nov 2017	5–9	1+	Nov 2017
1–4	0	Nov 2015	3–8	1	Nov 2017	5–10	1	Nov 2017
2–1	1	Nov 2017	3–9	1	Nov 2017			
2–2	1	Nov 2017	3–10	0	Nov 2015			
2–3	0	Nov 2015	3–11	1	Nov 2017			
2–4	1	Nov 2017	3–12	1	Nov 2017			
2–5	1	Nov 2017	3–13	1	Nov 2017			
2–6	1	Nov 2017	3–14	1	Nov 2017			
2–7	1	Nov 2017	3–15	1	Nov 2017			
2–8	1	Nov 2017	3–16	1	Nov 2017			
2–9	1	Nov 2017	3–17	1	Nov 2017			
2–10	1	Nov 2017	3–18	1	Nov 2017			
2–11	1	Nov 2017	3–19	1	Nov 2017			
2–12	1	Nov 2017	3–20	1	Nov 2017			
2–13	1	Nov 2017	3–21	0	Nov 2015			
2–14	1	Nov 2017	3–22	0	Nov 2015			
2–15	1	Nov 2017	4–1	1	Nov 2017			
2–16	1	Nov 2017	4–2	1	Nov 2017			
2–17	1	Nov 2017	4–3	0	Nov 2015			
2–18	1	Nov 2017	4–4	0	Nov 2015			
2–19	1	Nov 2017	4–5	0	Nov 2015			
2–20	1	Nov 2017	4–6	0	Nov 2015			
2–21	1	Nov 2017	4–7	1	Nov 2017			
2–22	1	Nov 2017	4–8	1	Nov 2017			
2–23	1	Nov 2017	4–9	1	Nov 2017			
2–24	1	Nov 2017	4–10	1	Nov 2017			
2–25	1	Nov 2017	4–11	0	Nov 2015			
2–26	1	Nov 2017	4–12	0	Nov 2015			
2–27	1	Nov 2017	4–13	1	Nov 2017			
2–28	1	Nov 2017	4–14	1	Nov 2017			
2–29	1	Nov 2017	4–15	0	Nov 2015			
2–30	1	Nov 2017	4–16	0	Nov 2015			

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SUMMARY OF CHANGES – REVISION 1

Ref	Reason for Change
1.1 Introduction	Editorial changes.
2.2 Take-off Weights	OM A reference added.
2.5.3 CARD ACARS Performance Request Page and Decode	Editorial changes.
3.1 Introduction	OM A reference added.
3.4 Landing on a Wet Runway	Clarification that exactly 3 mm of water is considered to be wet.
3.6 Generalised Landing Data	Quality of Landing field and climb limit charts improved.
4.4 Take-off from Contaminated Runways	Clarification that exactly 3 mm of water is considered to be wet.
5.1 Introduction and General Notes	References amended.

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Contents

1 INTRODUCTION AND AERODROME INFORMATION

1.1 Introduction

This manual comprises EASA OPS Part B, Chapter 4 of the BA Operations manual for the B747-400 (524G) rated aircraft. It includes tables, explanatory notes and examples of the necessary low speed data required to ensure a safe and efficient operation of the B747-400 (524G) rated aircraft to and from airfields covered by the current BA operational network.

The intent is to present this data in a clear and concise manner and to provide the relevant communication contact details as appropriate.

Airfield specific take-off data and landing performance data pages as well as a list of approved airfields for the B747 varient are published electronically in the B747-400G Dispatch Performance Data book.

1.2 Applicability

The data in the B747-400 (524G) Performance Manual is applicable to the following aircraft registrations.

G-CIVA to G-CIVZ

G-BNLA to G-BNLZ

G-BYGA to G-BYGG

1.3 Fire and Rescue

The ICAO Fire and Rescue Category for each aircraft is derived from the length and maximum width of the fuselage.

Refer to Part OM A for alleviations to the above requirements as well as the requirements for other alternate airfields.

The category for the B747-400 is **9** at destination airfields.

RAF, NATO and FAA airfields utilise a different standard of “Fire and Rescue” categorisation. Although no direct comparison can be made between these categories, the following table is an approximation of the relationship.

ICAO	NATO CRASH	RAF CRASH	FAA ARFF
4 and 5	5	3	B/C
6	6	4	C
7	7	5	D
8	8	7	D
9	N/A	N/A	E
10	N/A	N/A	E

1.4 Aerodrome Pavement Bearing Strength (ACN/PCN)

The ACN (Aircraft Classification Number) PCN (Pavement Classification Number) system provides a method of classifying pavement bearing strength from the standpoint of the stresses exerted by aircraft loads on pavements.

The ACN is a number expressing the relative effect of an aircraft load on a pavement for a specified subgrade (subsoil) strength.

The PCN is a number expressing the bearing strength of a pavement for unrestricted operations.

The following table gives ACNs for nine weights depending on type of pavement and subgrade. For normal operations the PCN should be equal to or more than the ACN. Linear interpolation may be made.

Aircraft Classification Numbers B747-400								
Weight kg	**Rigid Pavement Subgrades**				**Flexible Pavement Subgrades**			
	A	**B**	**C**	**D**	**A**	**B**	**C**	**D**
400000	52	62	74	85	58	64	80	102
380000	50	59	70	81	55	61	76	96
360000	47	56	66	76	51	57	70	90
340000	44	52	62	70	48	54	66	77
320000	41	48	57	65	45	50	60	77
300000	38	44	53	60	41	46	56	71
280000	35	41	48	56	38	42	51	65
260000	32	37	44	50	35	38	46	59
240000	29	33	39	45	32	34	41	52
220000	26	29	35	40	28	31	36	46

For example:

A pavement may be coded thus: PCN 80/R/B/W/T, where

80 is the PCN.
R for rigid (could be F for flexible).
B the column within rigid pavement (support strength category).
W maximum tyre pressure in PSI (W no limit, X-217, Y-145, Z-73).
T method of pavement evaluation (could be U).
(This code letter is only of interest to ground technical personnel.)

From the table it can be seen that operations would be unrestricted using this pavement, the highest ACN being 62.

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2 TAKE-OFF PERFORMANCE

2.1 Introduction

Take-off Performance data is obtained by using an electronic method (CARD) which is the primary source of take-off data, or manual (Take-off data pages) methods.

Electronic Data (CARD)

The CARD system is explained in Section 2.5, and provides details on how to request CARD take-off data via ACARS, output format interpretation and technical explanations.

Manual Data (Take-off Data Pages)

The Take-off data pages are held in the section labelled 'Take-off Performance', and Section 2.6 provides the format description and technical explanations.

2.2 Take-off Weights

The Maximum certified Take-Off Weight (MTOW) is the maximum take-off weight the operator has chosen for certification. See FCOM Limitations section for MTOW values, different MTOW values exist within the 747 fleet dependent on aircraft registration.

The Take-Off Performance Limit (**TOPL**) is the maximum permissible take-off weight at which the aircraft can attain the regulated performance requirements. OM A 8.28.A describes the methods used to calculate TOPL weights. This weight is purely a function of aircraft performance and as such can exceed the MTOW. However, in these circumstances the take-off weight permissible for operation must be reduced to the MTOW to comply with the regulations.

MEL performance corrections for operations with degraded/missing equipment are normally applied to the TOPL (unless otherwise specified).

A weight which meets both the regulated performance requirements and the operators chosen certification is called a Regulated Take-Off Weight (**RTOW**).

2.3 Take-off Speeds

Card Take-off Calculations

The V_1, V_R and V_2 speeds output on all CARD take-off performance calculations take account of the actual minimum take-off speed requirements.

Manual Take-off Calculations

For normal take-off operations use the V_1 speeds annotated on the applicable take-off data page in Section 4.5 of this Performance Manual.

If the V_1 entered into the FMC is below V_{MCG} then the FMC will advise the V_{MCG} value which can be confirmed for use using the tables on the following page.

The V_R and V_2 speeds calculated by the FMC using the actual take-off weight take account of the actual minimum take-off speed requirements.

Minimum V_{MCG} Tables

MAX TAKE-OFF RATING MINIMUM VMCG (KIAS)

G RATED A/C PRES ALT (ft)	ACTUAL OAT										
	°C	-55	10	15	20	25	30	35	40	45	50	55
	°F	-67	50	59	68	77	86	95	104	113	122	131
-2000		125	125	125	125	125	125	125	123	120	118	115
0		123	123	123	123	123	123	121	118	116	114	111
2000		121	121	121	121	120	119	117	114	112	110	107
4000		117	117	117	117	116	114	112	110	108	105	103
6000		114	114	113	113	112	110	108	106	104	102	99
8000		110	109	109	108	106	105	104	102	100	98	96
10000		105	105	104	103	102	101	99	98	96	94	93

TO1 TAKE-OFF RATING (10% THRUST REDUCTION) MINIMUM VMCG (KIAS)

G RATED A/C PRES ALT (ft)	ACTUAL OAT										
	°C	-55	10	15	20	25	30	35	40	45	50	55
	°F	-67	50	59	68	77	86	95	104	113	122	131
-2000		119	119	119	119	119	119	119	117	115	112	110
0		117	117	117	117	117	117	115	113	111	108	106
2000		115	115	115	115	115	113	111	109	107	105	102
4000		112	112	112	112	111	109	107	105	103	101	98
6000		109	109	108	108	107	105	103	101	99	97	95
8000		105	105	104	103	102	100	99	97	95	93	91
10000		101	100	99	98	97	96	95	93	91	90	88

TO2 TAKE-OFF RATING (20% THRUST REDUCTION) MINIMUM VMCG (KIAS)

G RATED A/C PRES ALT (ft)	ACTUAL OAT										
	°C	-55	10	15	20	25	30	35	40	45	50	55
	°F	-67	50	59	68	77	86	95	104	113	122	131
-2000		113	113	113	113	113	113	113	111	109	106	104
0		111	111	111	111	111	111	109	107	105	103	100
2000		109	109	109	109	109	107	105	103	101	99	97
4000		106	106	106	106	105	103	102	100	98	95	93
6000		103	103	103	102	101	100	98	96	94	92	90
8000		99	99	98	97	96	95	94	92	90	88	86
10000		95	95	94	93	92	91	90	88	87	85	83

2.4 General Take-off Information

Emergency Turn Procedures (ETPs)

Standard Instrument Departures (SIDs) at all the authorised airfields are assessed for terrain clearance. Where a SID has either not been assessed for terrain clearance or is not approved for use by BA this will be reflected in the ETP notes.

Terrain clearance is generally not assessed beyond the end of the SID. Crew must ensure that the relevant MSA is achieved if continuing beyond the end of the SID.

Except for detailed fleet specific runway analysis at limiting airfields where realistic gross weights are calculated, the standard ETP construction elsewhere assumes maximum take-off weight. An engine is assumed to fail at the most limiting point of the take-off. Other performance limiting failures (e.g. failure to retract landing gear or flaps) or combinations thereof are not considered.

ETP turn radii are generally based on turning at V_2 with 15 degrees angle of bank following an engine failure, or V_2 + 20 and 25 degrees angle of bank with all engines operating. Where the ETP follows the SID, speed and bank angle constraints published with the SID need to be complied with.

Although the close-in obstacle accountability area (“take-off cone”) only considers terrain from initially 90 m up to 900 m either side of track with the minimum required vertical clearance of 35 ft (net flight path), the ETP, where published, is based on significantly increased lateral and vertical obstacle or terrain clearance.

An ETP which deviates from the SID will be published when terrain clearance is not achieved on the SID track with one engine inoperative. The ETPs are runway specific and are available from CARD or, where published, on the relevant take-off data page.

ETPs will follow the SID track as far as possible to avoid unnecessary crew workload in the event of an early engine failure. Where a deviation from the SID is required, decision points will be published as ‘Engine Failure BEFORE’ and ‘Engine Failure AFTER’ a point on the SID track – usually an altitude, waypoint or DME distance. All engines performance prior to this point should ensure terrain clearance in the event of a subsequent engine failure although significant terrain may require more than one ‘BEFORE’ and ‘AFTER’ point to be used in the ETP. Strict adherence to the published ETP ground track is required to achieve the regulatory obstacle or terrain clearance (see Note).

ETPs are not generally shared with regulatory authorities across our network. Even where an ETP has been shared with the authority, this does neither guarantee that ATC are aware that an ETP is being flown nor the details of it so crews may need to advise ATC at the earliest opportunity.

An ETP will not be published when terrain clearance is achieved on the SID track with one engine inoperative. However this does not mean that the published ATC altitude constraints or minimum climb gradients on the SIDs will be achieved – in most cases these will not be met following an engine failure. In this case, crew must inform ATC.

Regardless of which procedure is flown, crew must ensure terrain clearance is achieved before accepting radar vectors that deviate from published SID and/or ETP guidance when below MSA.

Note: As the regulatory terrain clearance envelope is much less conservative than the EGPWS Warning/Caution envelope, an EGPWS Terrain Caution or Warning can be expected during a take-off following an engine failure at V_1 when operating in an obstacle or terrain constrained environment. Additionally, the EGPWS cannot anticipate turns and assesses threats only along a linear extrapolation of the instantaneous flight path vector. If the SID or ETP is designed to laterally avoid an obstacle or terrain by turning, an EGPWS Warning or Caution might be generated before or during this turn. Maximising the climb angle whilst accurately following the prescribed ETP ground track will ensure required regulatory obstacle clearance margins are met. Note that decelerating to speeds below V_2, while providing a short-term temporary benefit when speed is traded for altitude, invalidates certified climb performance which is based on a minimum speed of V_2.

Temperature Inversion

If a significant temperature inversion is forecast or there is reasonable evidence of its presence due to conditions (i.e. clear, calm conditions at night) and temperature is above ISA+15°C, the 3°C should be added to the reported tower temperature prior to calculating the TOPL weight and applicable reduced thrust.

Anti-icing

No allowance is necessary for nacelle anti-icing as the effect of this air bleed is offset by employing the normal EPR setting.

Operation of the wing anti-icing is not permitted for take-off. Therefore no performance adjustment has been given.

There are no performance effects or procedures associated with the application of de-icing/anti-icing fluid.

2.5 CARD Take-off Performance

2.5.1 Introduction

The CARD system provides direct access (via ACARS or SATCOM to a computer at LHR which runs an electronic version of the Airplane Flight Manual (AFM) in conjunction with an airfield database. Performance data is then calculated and sent back to the aircraft. CARD will produce performance data for dry, wet and contaminated runways, degraded braking action runway conditions and MEL items via performance correction codes.

Use CARD as the primary source of performance data on all flights. If CARD is not available use the tabulated data in the Performance Manual, but if payload limited contact Flight Technical Dispatch at LHR (FTD) who have access to the CARD system. Use SATCOM, ACARS (Shortcode .FCB), telephone (+44-(0)20-8513-0455) or SITA (LHRWYBA) to contact FTD and request that they run the data and send or read out the answers. The data can also be sent to a SITA printer at the station.

2.5.2 CARD ACARS Performance Request Details

Select **PERFORMANCE REQUEST** from the ACARS menu and complete the required fields and select SEND on page 2/2. Note the following:

- CARD will produce the optimum (highest TOPL weight) with flap 20 setting used for each start point as the default setting.
- CARD has four selectable fields (INTS, WET, ANTI-ICE and PACKS OFF) on page 1/2 of the ‘performance request’ screen.
- The adjacent keys toggle the <sel> prompt on and off.
- The default setting is with the <sel> prompt off (i.e. blank).
- When all fields have been completed on PAGE 1/2 and 2/2 of the ‘Performance Request’ screen, the request should be sent using the ‘SEND’ prompt on PAGE 2/2. If PAGE 1/2 is re-selected before this, then selectable fields on this page will revert to the preset defaults i.e. <sel> off.
- Careful checking of the up-linked ‘Performance Message’ will ensure that the correct selections have been used in the calculation.

2.5.3 CARD ACARS Performance Request Page and Decode

PAGE 1/2

```
                PERFORMANCE  REQ
                                        1/2
❶   DEP                               RUNWAY   ❷
    EGCC                                 23R
❸   *INTS      < sel >   < sel >   ANTI-ICE*   ❹
❺   *WET       < sel >   < sel >  PACKS  OFF*  ❻
❼   WIND                             QNH  HPA  ❽
    230/10                              1013
❾   TEMP  C
    21                                 SEND*
                                    ADVISORY
    <ACARS  MENU  xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                   scratchpad
```

```
PREV                    NEXT
PAGE  ——→ 2             PAGE  ——→ 2
```

PAGE 2/2

```
                PERFORMANCE  REQ
                                        2/2
❶   EST  TOW
    350.0                                23R
    EST
❷   MACTOW
    0
          PERFORMANCE  CORRECTION
❸   40                                    80   ❸


                                       SEND*   ❹
                                    ADVISORY
    <ACARS  MENU  xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
                   scratchpad
```

```
PREV                    NEXT
PAGE  ——→ 1             PAGE  ——→ 1
```

CARD ACARS Performance Request Page 1 Decode

❶ **DEP** — Is the departure station and will default to the DEP on the initialisation page. Manual entries of the four letter ICAO code will only be accepted, and will be copied to the initialisation page.

❷ **RUNWAY** — Is the designator of the runway to be used. Manual entries of 2-3 alpha/numeric characters only will be accepted. (Leading zero is required e.g. 01-09).

❸ ***INTS** — The “INTS” key toggles the <sel> prompt on and off adjacent to the selection. With <sel> prompt off just FULL LENGTH data will be run, with <sel> prompt selected FULL LENGTH and the most appropriate TAXIWAY or INTERSECTION start point(s) will be run. Default is not selected (i.e. FULL LENGTH data only).

❹ **ANTI-ICE*** — The “ANTI-ICE” key toggles the <sel> prompt on and off adjacent to the selection. With <sel> prompt off data will be run without ANTI-ICE, with the <sel> prompt selected data will be run with ANTI-ICE selected on. Default is not selected (i.e. ANTI-ICE off).

❺ ***WET** — The “WET” key toggles the <sel> prompt on and off adjacent to the selection. With <sel> prompt off data will be run for a DRY runway, with <sel> prompt selected data will be run for a WET runway. Default is not selected (i.e. DRY runway).

❻ **PACKS-OFF*** — The “PACKS-OFF” key toggles the <sel> prompt on and off adjacent to the selection. With <sel> prompt off data will be run for PACKS-ON take-off, with <sel> prompt selected data will be run for PACKS-OFF take-off. Default is not selected (i.e. PACKS-ON take-off).

❼ **WIND** — Is the wind direction and speed. Manual entries of 3 numeric characters (000-360) will be accepted for wind direction, and up to 2 numeric characters for wind speed. Default is 000/00 (i.e. still air).
Wind should be entered as reported, unless operational considerations require performance to be calculated with different wind direction/speed.

❽ **QNH hPa** — Is the barometric pressure at sea level (QNH) in hPa. Manual entries of 3-4 numeric characters (900-1100 only) will be accepted.

❾ **TEMP °C** Is the temperature (in degrees centigrade). Manual entries of up to 2 numeric characters will be accepted. (The minus sign will not be accepted, for negative temperatures use 0°C).

CARD ACARS Performance Request Page 2 Decode

❶ **EST TOW** Is the estimated take-off weight (in metric tonnes). This is the TOW from CIRRUS or the actual TOW from the Provisional loadsheet, or final loadsheet actual TOW. Manual entries of up to 4 numeric characters (e.g. 385.6) can be accepted. The EST TOW entry is required in order to provide assumed temperature data and V_1, V_R and V_2. If this field is left blank a Take-Off Performance Limit (TOPL) weight will be calculated for the given conditions only.
Those conditions that have a mandatory requirement for full power (e.g. contaminated runways or MEL corrections) will automatically calculate speeds relating to full power at the OAT. The EST TOW must be entered in the CARD request.
For those occasions when full power is required but not mandatory (e.g. flight tests or significant windshear), correction 56 “FULL POWER TAKE-OFF” and the EST TOW must be entered in the CARD request to obtain full power speeds at the OAT.

❷ **EST MACTOW** The Estimated MACTOW (percentage centre of gravity location) entry box is for future development of the system and is NOT USED.

❸ **PERFORMANCE CORRECTION** Are codes which may be entered to account for aircraft defects or performance conditions (e.g. anti-skid inoperative or contaminated runway – see para 2.5.4 for correction codes). Manual entries up to 2 numeric characters will be accepted.

❹ **SEND**

The SEND key queues the performance message (PEROI) for down link transmission. All entry fields and <sel> prompts will be cleared. The display will return to the Main Menu. The SEND key will be ignored if any boxed fields are empty.

Note: When all the fields have been completed on PAGE 1/2 and PAGE 2/2 of the 'Performance Request' screen, the request should be sent using the 'SEND' key on PAGE 2/2. If PAGE 1/2 is re-selected before this, then selectable fields on this page will revert to the preset defaults, i.e. <sel> off.

2.5.4 CARD Performance Correction Codes

Effect	Code	Description
Runway	04 (see Note 1 & 2)	3 mm – 6 mm (0.1 – 0.25 in) Standing Water – Full Power T/O
Condition	05 (see Note 1 & 2)	7 mm – 10 mm (0.25 – 0.4 in) Standing Water – Full Power T/O
	06 (see Note 1 & 2)	11 mm – 13 mm (0.4 – 0.5 in) Standing Water – Full Power T/O
	07 (see Note 1 & 2)	3 mm – 6 mm (0.1 – 0.25 in) Slush – Full Power T/O
	08 (see Note 1 & 2)	7 mm – 10 mm (0.25 – 0.4 in) Slush – Full Power T/O
	09 (see Note 1 & 2)	11 mm – 13 mm (0.4 – 0.5 in) Slush – Full Power T/O
	10 (see Note 1 & 2)	Compacted Snow – Full Power T/O
	11 (see Note 1 & 2)	10 mm – 20 mm (0.4 – 0.8 in) Dry Snow – Full Power T/O
	12 (see Note 1 & 2)	21 mm – 30 mm (0.8 – 1.2 in) Dry Snow – Full Power T/O
	13 (see Note 1 & 2)	31 mm – 40 mm (1.2 – 1.6 in) Dry Snow – Full Power T/O
	14 (see Note 1 & 2)	41 mm – 50 mm (1.6 – 2.0 in) Dry Snow – Full Power T/O
	20 (see Note 1 & 2)	Braking Action Medium – Full Power T/O
	21 (see Note 1 & 2)	Braking Action Medium to Poor – Full Power T/O
	22 (see Note 1 & 2)	Braking Action Poor or Unreliable – Full Power T/O
Air Conditioning	31	1 A/C Pack On
Pneumatic	36	FAM V Sys. Inop – Single Pack Operation
Flt Controls	40	Autospoilers Inop
Thrust	56	Full Power Take-Off
Landing Gear	61 (see Note 1 & 4)	Landing Gear Extended – Full Power T/O
	64	2 Brakes Inop – Deactivation Tool used
	65 (see Note 5)	2 Brakes Inop – Line Capped/Brake Removed
	66 (see Note 1)	Anti-Skid Inop – Full Power T/O
Hydraulic	67	Demand Hydraulic Pumps 1 or 4 Inoperative
Calc. Method	70 (see Note 7)	17 Percent Aft CG
	71 (see Note 7)	21 Percent Aft CG
Thrust	72	TO1 Thrust Rating
	73	TO2 Thrust Rating

Effect	Code	Description
APU	75	APU Inlet Door Inop in open position
Engine	76	Min Idle Sel Sys Inop (1 eng)
	77 (see Note 1)	EPR Indicating System Inop – Full Power T/O
	78 (see Note 1)	EEC System Inoperative – Full Power T/O
Thrust Rev	80 (see Note 3)	Thrust Reverser Inoperative (Wet Rwy only)
Flt Controls	81	Missing Folding Nose Assembly – CDL 27-81-1 Airfield Pressure Alt below 4000 ft
Adjustments	82 (see Note 8)	GoGo WiFi Antenna installed
Thrust	85	Spare Engine Carriage
	87 (see Note 1)	3 Engine Ferry (V_1 is VSTOP) – Derate 2 Full Power T/O
Adjustments	90 (see Note 6)	100 kg Weight Penalty
	91 (see Note 6)	200 kg Weight Penalty
	92 (see Note 6)	300 kg Weight Penalty
	93 (see Note 6)	400 kg Weight Penalty
	94 (see Note 6)	500 kg Weight Penalty
	95 (see Note 6)	1000 kg Weight Penalty
	96 (see Note 6)	1500 kg Weight Penalty
	97 (see Note 6)	2000 kg Weight Penalty
	98 (see Note 6)	3000 kg Weight Penalty
	99 (see Note 6)	5000 kg Weight Penalty

Note 1: These correction codes automatically calculate full power take-off at the OAT.

Note 2: **DO NOT** use Degraded Braking Action correction codes (20/21/22) in conjunction with Contaminated Runway correction codes (04 to 15).

Note 3: The ‘THRUST REVERSER INOPERATIVE’ correction code (80) is for use with take-off on a ‘WET’ runway only. Use of this correction code with take-off on a ‘DRY’ runway will have no effect as DRY runway calculations do not assume the use of Reverse Thrust.

Note 4: Code 61 restricts Maximum Takeoff Weight to 326,586 kg as per AFM.

Note 5: Code 65 calculates takeoff performance with 1 or 2 brakes deactivated by capping brake lines and considers L/G extended after takeoff as per MEL requirement. Do not additionally use code 61.

Note 6: Up to 4 of the corrections 90 through 99 can be combined to give cumulative weight penalties. However, only one of each number can be used per request.

Note 7: Alternate CG Correction codes 70 (17% Aft CG) and 71 (21% Aft CG) are provided for the ALTERNATE CG PROCEDURE, to allow for increased performance with an Aft CG. CARD speeds MUST be used.

Check MACTOW line on loadsheet to ensure aircraft is loaded correctly for Aft CG correction range used.

Use of the ALTERNATE CG PROCEDURE is **NOT** permitted for take-off on runways contaminated with standing water, ice, slush or snow.

Table showing Range of CG Limits & corresponding CARD Correction Code follows:

Range of CG	CARD Correction Code
Forward limit – 16.9% MAC	For Packs On or Off – No CARD correction required.
17% – 20.9% MAC	Use CARD correction code 70 – 17% Aft CG. (CARD speeds must be used.)
21% MAC – Aft limit	Use CARD correction code 71 – 21% Aft CG. (CARD speeds must be used.)

Note 8: This code MUST be run with the CARD request when the antenna is installed.

2.5.5 CARD Performance Uplink Message and Decode

A typical message is split into two parts (Part 1 – Performance Data and Part 2 – Notes/ETPs).

The uplinked data will be printed automatically. If the printer is unserviceable, data can be displayed on the screen.

The uplinked message will contain the input data upon which the calculation has been based. This should be thoroughly checked to ensure the correct details have been used for the performance calculation.

If any apparent anomaly appears on the printed CARD uplink message, request the CARD calculation again. If the anomaly still exists then contact FTD LHR.

The following are key points to remember when using the CARD uplink message:

1. FULL LENGTH will always be abbreviated to **F/L** and will only ever refer to either the physical Full Length of the runway where this is coincident with the declared TORA, or the maximum declared TORA where this is not coincident with the physical beginning of the runway.
2. **F/L** will be followed in brackets by the taxiway or hold designation by which the **F/L** is to be accessed (e.g. **TWY B1**), or (**BACKTRACK**) if this is required to access the **F/L**.
3. All other start points (taxiway intersections or hold points) other than **F/L** will be followed in brackets by the take-off shift from the **F/L** position rounded to the nearest 100 m, e.g. **TWY C3 (200 M)**.
4. When temporary runway data is available, this will be automatically generated and shown before the normal data and labelled ****TEMPORARY RWY DATA**** along with a brief description of the restriction. The normal data will be labelled ****PERMANENT RWY DATA**** in this case. The label precedes the data. A note will be added to the relevant NOTAM/item on the AIS briefing indicating that TEMPORARY RWY DATA is available from CARD.
5. Additional runway data will be automatically generated when necessary (e.g. varying heights of shipping, prefefred start points or arrester gear raised) and shown after the normal data and labelled ****ADDITIONAL RWY DATA**** along with a brief explanation for the data.
6. All CARD calculations will include the pertinent line-up allowance.

Note: It cannot be guaranteed with ACARS that the various parts of a message will arrive in order, so it is **IMPERATIVE** to verify that the four lines of data repeated at the beginning of each part of the message (FLT NO/DATE/TIME, REG/RTG/PACKS ON/OFF and AD/RWY) are appropriate, to ensure that all parts of the message have been received and correctly identified.

When multiple requests are made, the time stamp next to the date should be used to identify different messages.

A typical full format message is shown on the next page.

1. This example shows that, for an Actual Take-off Weight of between 350.0 (EST TOW) and 353.7 tonnes, an assumed temperature of 44°C and a V_1 of 134 kts should be used.

2. As shown in the example, note where the Take-off Weight (provisional or final) lies in relation to the weights in the ATOW column. Note the TEMP and V_1 corresponding to the higher weight. These are used as the Assumed Temperature for thrust reduction purposes and the corresponding V_1, V_R and V_2.
3. See FCOM 1, Normal Procedures – Pre-flight/Pushback/Start for thrust setting procedures.

CARD Uplink Message

```
1 OF 2
BA1234                  15AUG08     10:33
NLA
A/C PACKS OFF
EGCC/23R
W/C  10 HW              TEMP  21C
WET RWY                 ANTI-ICE OFF
QNH  1013               MACTOW  0
DAY    : CLG NIL
         VIS 150M
NIGHT  : CLG NIL
         VIS 150M
PERF CORRS
AUTOSPOILERS INOP                                    ❶
THRUST REVERSER INOP
— — — — — — — — — — — — — — — — — —
 350.0                        REQUESTED TOW          ❷
(    .  )                      FMC CALC TOW
— — — — — — — — — — — — — — — — — —
F/L (J1 HOLD)                    TOR  3048           ❸ ❹
□□□□□□□□□□□
□  FLAP 20  □                   TOPL:  392.7         ❺ ❻
□□□□□□□□□□□
ATOW        TEMP     V1      VR      V2              ❼ ❼
358.0        42      135     163     173
353.7        44      134     162     172
349.5        46      134     161     171
MIN ACCEL ALT 1750FT                                 ❽
— — — — — — — — — — — — — — — — — —
NOTES
SEE 2 OF 2
```

```
2 OF 2
BA1234                  15AUG08     10:33
NLA
A/C PACKS OFF
EGCC/23R
NOTES                                                ❾
PERFORMANCE RESTRICTIONS
EMERGENCY TURN PROCEDURE RWY 23R
NO RESTRICTIONS.  ENSURE MSA IS REACHED BEFORE
RETURN.

TERRAIN CLEARANCE HAS BEEN CHECKED ON SIDS
OUT TO MCT 20D.
END 2 OF 2
```

CARD Performance Uplink Message Decode

As stated before, the CARD input request details are shown at the top of the uplink message, and should be thoroughly checked to ensure the correct performance data has been calculated.

❶ **PERF CORRS**	Will display in words the details of any performance correction codes used in the request. If none used, will show NONE.
❷ **REQUESTED TOW** **FMC CALC TOW**	Shows the EST TOW entered in the CARD request. The FMC calculated TOW should be entered between the brackets. Any discrepancy between the FMC calculated TOW and the CARD request EST TOW must be explained.
❸ **F/L (J1 HOLD)**	Description of take-off position. In this case take-off is from the Full Length of the runway accessed from the J1 Hold.
❹ **TOR**	The available TOR for the take-off position in ❸ above.
❺ **FLAP**	The flap setting used for the performance calculation.
❻ **TOPL**	The Take-Off Performance Limit (TOPL) is the maximum performance take-off weight achievable for the conditions and configuration specified in the CARD request.
❼ **ATOW/TEMP** **$V_1/V_R/V_2$**	For Assumed Temperature take-offs CARD provides Actual Take-off Weight, Temperature and associated speed information for the EST TOW entered in the CARD request. **Note:** If EST TOW is NOT entered in the CARD request only the TOPL weight for the OAT will be provided.
❽ **MIN ACCEL ALT**	The all engines and engine out Minimum Acceleration Height will be shown here if above the minimum value of 1000 ft AAL. If different all engines and engine out Minimum Acceleration Heights are required they will be shown here.
❾ **NOTES**	Indicate any operational information relating to nonstandard performance – such as emergency turn procedures, runway bearing strength restrictions, arrester gear, etc.

2.5.6 Additional Notes on Uplink Message

EST TOW < TOPL at the MAX ASSUMED TEMP (i.e. not performance limited)

When the EST TOW is less than the TOPL at the MAX ASSUMED TEMPERATURE, CARD will produce speeds that relate to the EST TOW. However, in this case, the weight variation will not be displayed due to CARD artificially limiting the calculation to the EST TOW (see example below). In the case below, all three assumed temperatures and associated V speeds are valid for the ATOW displayed, and the highest TEMP and associated speeds should be entered into the FMC.

FLAP 20 TOPL: 426.8

ATOW	TEMP	V_1	V_R	V_2
260.0	70	136	136	145
260.0	72	137	137	145
260.0	74	137	137	145

ATOW > TOPL on performance limited take-offs

When CARD calculates ATOW data with a value ABOVE the TOPL for the ambient conditions, the data will be removed from the resulting output:

```
------------------------
 290.0      REQUESTED TOW
(    . )   FMC CALC GR WT
------------------------
F/L (A1 HOLD)    TOR 2329
***********
* FLAP 20 *   TOPL: 290.7
***********
ATOW   TEMP   V1  VR  V2
************************
290.7   50    132 143 155
287.0   52    132 142 154
------------------------
```

Note: If a request is made for a weight higher than TOPL for the ambient conditions then CARD will provide data based on the TOPL value as above.

Acceleration Height

CARD will calculate the acceleration height for the specific ‘on the day’ conditions (i.e. TEMP, WIND, QNH). This computation delays acceleration until the aircraft gradient provides the required clearance from obstacles with an engine failed. The CARD figure supersedes the take-off data page figure in the Performance Manual and should be used for both all engines and engine out departures unless otherwise specified. If different acceleration heights and thrust reduction altitudes are required, (normally for noise reasons), these will be shown on the CARD uplink message. The CARD calculation may result in a "MIN ACCEL HT" lower than the take-off data page figure in the Performance Manual. There is a minimum value of 1000 ft AAL.

Use of Assumed Temperature Reduced Thrust

Assumed Temperature Reduced Thrust should be used whenever conditions permit.

Assumed Temperature Reduced Thrust is NOT permitted if:

- The runway is defined as slippery (braking action is reported as poor), or is contaminated with snow, slush or standing water.
- Three or more anti-skid channels are inoperative.
- MEL requires full power.
- Particular windshear conditions exist – see FCOM 1.

Whenever Assumed Temperature Reduced take-off thrust is not permitted, those conditions that have a mandatory requirement for full power (e.g. contaminated runways or MEL corrections) will automatically calculate speeds relating to full power at the OAT. **The EST TOW must be entered in the CARD request**.

For those occasions when full power is required but not mandatory (e.g. flight tests or significant windshear), correction 56 **"FULL POWER TAKE-OFF"** and the **EST TOW** must be entered in the CARD request to obtain full power speeds at the OAT.

V_{MCG} Limited

CARD will indicate when a performance calculation becomes V_{MCG} limited. This will be displayed as the statement "V_{MCG} LIMITED" and will appear directly beneath the performance figures. In this case, use the highest assumed temperature displayed and associated speeds.

In contaminated conditions the use of TO power will often result in the take-off weight becoming V_{MCG} limited. If the V_{MCG} restricted take-off weight is insufficient for the operation, the use of a fixed derate TO1 or TO2 power (CARD correction codes 72 & 73, TO1 – 10% power reduction, TO2 – 20% power reduction) is approved for use and can result in a take-off weight improvement as the min V_{MCG} speed for TO1 and TO2 power settings are lower than that for TO power, and will normally eliminate the V_{MCG} restriction (see Contaminated section for full explanation and procedures to be used).

Note: During a fixed derate take-off (TO1/TO2), the take-off performance data at low gross weights may not provide a safe operating margin for V_{MCG} if thrust levers are advanced beyond the fixed derate limit. A thrust increase following an engine failure, especially near V_1, could result in a loss of directional control and should not be accomplished unless, in the opinion of the Captain, terrain contact is imminent.

TO power at very low take-off weights when assumed temperature reduced thrust can be used will often result in CARD returning a set of assumed temperatures, weights and associated speeds that are above the actual take-off weight requested, along with the message "V_{MCG} LIMITED". In this situation the natural V_1 associated with the low take-off weight is below the min V_{MCG} speed for TO power at the OAT, and CARD has no option other than to return weights and speeds that satisfy the min V_{MCG} requirement. A 5-10 T increase in the EST TOW entered into CARD will normally eliminate this V_{MCG} limitation.

2.5.7 CARD Datalink Error Messages

In the event of the CARD system not being able to calculate or supply the data requested, one of the following messages will be uplinked to the aircraft.

- **System Error Contact FTD**

  This message will be returned when a calculation has failed due to take-off not being possible with the requested conditions and runway. Check input conditions for any errors or try another runway.

- **Reduced Thrust not Calculated**

  This message will appear below the TOPL on the up-link message to indicate that reduced thrust data has not been calculated, normally because the EST TOW has not been entered in the CARD request.

- **Intersection Data Unavailable**

  This will appear at the bottom of the full up-link message if the intersection data was requested and has failed for whatever reason.

- **Airfield Code not Known**

  This will appear if the requested ICAO code is not in the airfield database.

- **Runway not Known**

  This will appear if the runway identifier requested is not in the airfield database.

- **Aircraft Type Excluded from Runway**

  This will appear if the aircraft is excluded from the runway within the airfield database for whatever reason.

- **Invalid Corrections**

  This will appear if requested correction(s) do not exist within the airfield database.

2.6 Take-off Data Pages

2.6.1 Introduction

Take-off data pages are provided in the B747-400G Dispatch Performance Data Book.

The pages are indexed by airfield ICAO code. In the page reference, further data on runway, aircraft configuration, runway status and further performance corrections is given as per examples below:

Page Name:	EGLL 27L-1 F5 ON COMB.
Decode:	EGLL, Rwy 27L – start point 1, Flap 5, Packs On, data valid for dry or wet runway.
Page Name:	KSAN 09-1 F15 OFF WET PerfCorrs (28).
Decode:	KSAN, Rwy 09 – start point 1, Flap 15, Packs Off, wet runway, Correction code 28 from CARD correction code table applied in calculation.

The data is published in a temperature verses wind format and page amendments will be provided through the normal distribution procedure.

Take-off data is tabulated for one runway or start position per page, using Flap 20 PACKS ON for all normal operations. Take-off data for PACKS OFF, DRY RWY or Alternate CG operations will be provided where operationally necessary. Runways and flap settings are published in ascending numerical order, with start positions in descending order by available length.

Take-off data pages are provided for the scheduled B747 destinations as a back-up for use when CARD is not available. Take-off data will be provided for one start-point on each runway. Check AIS briefing for information on any temporary data or technical handouts that are available.

In the event that a departure is required from any other destination or following a diversion to an alternate, then obtain take-off data by using CARD.

If both CARD and take-off data pages are not available then contact Flight Technical Dispatch at LHR (FTD) to obtain take-off data. Use ACARS (Shortcode .FCB), telephone (+44-(0)20-8513-0455) or SITA (LHRWYBA) to contact FTD and request that they run the data and send or read out the answers.

2.6.2 Take-off Weights, Tabulated Data and Decode

Take-off data pages enable the crew to determine for the corresponding runway, the maximum permissible take-off weight for the ambient pressure, temperature and surface wind conditions.

Note: The published weights are Take-Off Performance Limited weights (TOPL), and must be restricted to the Maximum Take-Off Weight the operator has chosen for certification (MTOW) upon completion of any performance calculation. This restriction establishes the certified Regulated Take-Off Weight (RTOW).

or:

For a given aircraft weight, the maximum temperature at which take-off would be permitted. This temperature (corrected for QNH and air conditioning packs) is called the Assumed Temperature.

The assumed temperature is entered on the FMC on the PERF take-off page. This reduced power setting provides performance in compliance with regulations in the event of an engine failure at V_1.

Specific data is established for each runway. It is based on standard atmospheric pressure and takes account of the significant obstacles in the Net Take-Off Flight Path. When the TOPL data is based on an Emergency Turn Procedure, details will be published at the bottom of the data or on a separate Performance Restrictions page.

Aircraft Configuration

The performance has been established in the following configuration.

Take-Off Thrust, Air Conditioning ON or OFF and anti-skid ON. In the event of a rejected take-off, maximum wheel braking, the use of speed brakes and maximum reverse thrust on the operating engine(s) is assumed for wet runways. The use of reverse thrust is not assumed on dry runways.

Air Conditioning Packs

The published take-off data pages will normally be calculated assuming all PACKS are on. However, an increment can be applied to the TOPL weight if the PACKS are off for take-off, and the correction for PACKS OFF can be found towards the bottom of the PACKS ON take-off data page.

When the actual take-off weight is 300, 000 kg or below a PACKS ON take-off should be carried out. When actual take-off weight is over 300, 000 kg a PACKS OFF take-off should be carried out.

GoGo WiFi Antenna Installed

The TOPL obtained from the take-off data page must be reduced by 87 kg.

Alternate CG

Alternate CG take-off data pages are provided where necessary (e.g. Johannesburg, Mexico and Sao Paulo) for 17% and 21% Aft CG, to allow for increased performance with an aft centre of gravity.

Check MACTOW line on loadsheet to ensure aircraft is loaded correctly for Aft CG correction range used.

Note: Use of Alternate CG is not permitted for take-off from contaminated or degraded braking action runways.

Range of CG Limits

Range of CG	Performance Pages
Forward limit – 16.9% MAC	For Packs On or Off – Use the normal performance pages.
17% – 20.9% MAC	Use 17% Aft CG performance pages.
21% MAC – Aft limit	Use 21% Aft CG performance pages.

Note: To obtain the correct V_R and V_2 speeds REDUCE the FMC speeds by 1 kt.

Minimum Acceleration Height (HAA)

The minimum all engines and engine out acceleration height is assumed to be 1000 ft above the airfield elevation. If greater, it will be shown as a note on both the take-off data page and CARD printout as “MIN ACCEL HT” and this is the figure that should be entered into the FMS take-off page. If different all engines and engine out acceleration heights are required, this will be indicated in the note on both the take-off data page and CARD printout.

Note: CARD acceleration heights are calculated for one set of conditions, which will normally produce a lower Accel Ht than the Performance Manual figure, which has to consider a range of temperatures and winds when calculating the Accel Ht.

B747-400G Take-off Data Page (Example)

BRITISH AIRWAYS **B747-400G** TAKE OFF DATA **NEW YORK**

A/D Elev **13ft** **J F KENNEDY (KJFK)**

❶ **F/L (TWY K)** **RWY 04L** ❶

❷ **DAY CLG** NIL **DAY VIS** 600ft **PVD** ❷
NIGHT CLG NIL **NIGHT VIS** 600ft **SLOPE** 0% UP

❸ **TOR** 3460m (11351ft) **ED** 3460m (11351ft) **TOD** 3460m (11351ft) ❸

❹ **FLAP 20** **RB211-524G/PACKS ON/DRY or WET RWY** **FLAP 20** ❹

	Temp °C	10kt Tail	V1 D/W	Inc /kt	5kt Tail	V1 D/W	Inc /kt	ZERO WIND	V1 D/W	Inc /kt	10kt Head	V1 D/W	Inc /kt	20kt Head	V1 D/W	
	70	269.5	35/25	1.5	276.9	41/31	1.4	**284.0**	**46/37**	**0.4**	288.1	47/40	0.4	292.2	48/43	
	66	280.5	37/26	1.6	288.4	42/32	1.5	**296.0**	**48/38**	**0.4**	300.3	50/41	0.4	304.7	51/44	
	62	292.5	40/28	1.7	300.9	45/34	1.6	**308.7**	**50/40**	**0.5**	313.3	53/43	0.5	317.9	55/46	
❺	**58**	303.8	40/30	1.7	312.5	45/36	1.6	**320.7**	**51/42**	**0.5**	325.5	53/45	0.5	330.4	55/49	❺
	54	313.0	41/32	1.9	322.6	46/38	1.7	**331.1**	**51/44**	**0.5**	336.0	54/47	0.5	341.0	56/51	
	52	317.4	41/31	2.0	327.2	47/37	1.7	**335.8**	**52/43**	**0.5**	340.8	54/46	0.5	345.8	57/50	
	50	321.4	41/32	2.0	331.5	46/38	1.8	**340.6**	**51/44**	**0.5**	345.6	54/47	0.5	350.8	56/51	
	48	325.7	42/33	2.0	335.9	47/39	1.9	**345.3**	**52/45**	**0.5**	350.4	54/48	0.5	355.8	57/51	
	46	330.1	42/34	2.0	340.3	47/40	1.9	**349.9**	**53/46**	**0.5**	355.1	55/49	0.6	360.7	58/52	
	44	334.2	43/34	2.1	344.6	48/40	2.0	**354.5**	**54/46**	**0.5**	359.8	56/50	0.6	365.6	58/53	
	42	338.2	42/35	2.1	348.9	47/41	2.1	**359.2**	**52/47**	**0.6**	364.8	55/50	0.6	370.6	57/54	
	40	342.6	43/36	2.2	353.4	48/42	2.1	**364.1**	**53/48**	**0.6**	369.8	56/51	0.6	375.8	58/54	
	38	347.0	44/37	2.2	358.1	49/43	2.2	**369.2**	**54/49**	**0.6**	375.1	56/52	0.6	381.3	59/55	
	36	351.6	44/37	2.3	362.9	49/43	2.3	**374.5**	**55/49**	**0.6**	380.5	57/53	0.6	386.6	59/56	
	34	356.0	43/38	2.3	367.6	49/44	2.4	**379.5**	**54/50**	**0.6**	385.5	56/53	0.8	393.4	58/56	❻
❻	32	360.0	44/39	2.4	372.0	49/45	2.4	**384.1**	**55/51**	**0.7**	391.4	57/54	0.7	398.8	59/57	
	30	364.4	45/40	2.5	376.9	50/45	2.6	**390.1**	**55/51**	**0.8**	397.7	57/54	0.6	403.8	59/58	
	28	365.4	45/40	2.5	377.8	50/46	2.7	**391.3**	**55/52**	**0.7**	398.5	57/55	0.6	404.7	60/58	
	26	366.4	46/40	2.5	378.7	51/46	2.7	**392.4**	**56/52**	**0.7**	399.3	58/55	0.6	405.4	60/58	
	24	367.3	46/40	2.5	379.6	51/46	2.8	**393.5**	**56/52**	**0.7**	400.1	58/55	0.6	406.2	60/59	
	22	368.2	46/41	2.5	380.5	51/47	2.8	**394.6**	**56/52**	**0.6**	400.9	58/55	0.6	407.0	61/59	
	20	369.0	46/41	2.5	381.4	52/47	2.9	**395.8**	**56/53**	**0.6**	401.7	59/56	0.6	407.8	61/59	
	18	369.9	47/41	2.5	382.3	52/47	2.9	**396.7**	**57/53**	**0.6**	402.5	59/56	0.6	408.6	61/59	
	16	370.8	47/41	2.5	383.2	52/47	2.8	**397.4**	**57/53**	**0.6**	403.3	59/56	0.6	409.5	62/60	
	14	371.7	47/42	2.5	384.1	52/48	2.8	**398.2**	**57/53**	**0.6**	404.1	60/57	0.6	410.3	62/60	
	12	372.6	48/42	2.5	385.0	53/48	2.8	**399.0**	**58/54**	**0.6**	404.9	60/57	0.6	411.1	62/60	
	10	373.5	48/42	2.5	385.9	53/48	2.8	**399.9**	**58/54**	**0.6**	405.7	60/57	0.6	411.9	63/61	
	8	374.5	48/43	2.5	386.8	53/49	2.8	**400.7**	**58/54**	**0.6**	406.6	61/58	0.6	412.7	63/61	
	6	375.4	49/43	2.6	388.2	54/49	2.7	**401.5**	**59/55**	**0.6**	407.4	61/58	0.6	413.5	63/61	
	4	376.4	49/43	2.6	389.5	54/49	2.6	**402.4**	**59/55**	**0.6**	408.3	61/58	0.6	414.4	64/62	
	2	377.3	49/43	2.7	390.8	54/49	2.5	**403.2**	**59/55**	**0.6**	409.1	62/59	0.6	415.2	64/62	
	0	378.3	49/44	2.8	392.2	54/50	2.4	**404.1**	**60/56**	**0.6**	410.0	62/59	0.6	416.1	65/62	

❼ P/C above 1013 + 0.2
P/C below 1013 - 0.6 PACKS OFF +2.0 ❽

PERFORMANCE RESTRICTIONS

❾ **ALL ENGINES** ❾
INITIATE TURN AT 300FT RA. CLIMB AT V2 PLUS 10KT TO 1510FT QNH (1500FT HAA). SET CLB1 THRUST AT 1510FT QNH (1500FT HAA).

Take-off Data Page Decode

❶ **RWY 04L F/L (TWY K)**	Description of take-off position. In this case take-off is from Full Length position entering the runway from Taxiway K.
❷ **CLG and VIS Day/Night**	Day/Night take-off minima.
❸ **TOR/ED/TOD**	Take-off distances on which performance data is based.
❹ **Flap 20**	Flap setting used to calculate performance data.
PACKS ON/DRY or WET RWY	Performance data calculated with Packs On and is valid for a Dry or Wet runway.
❺ **Environmental Envelope**	The line across the page denotes the top of the environmental envelope for this aircraft. Operations above this temperature are not permitted except for the use of assumed temperature reduced thrust take-offs.
❻ **Temp/Wind – TOPL/ Speeds**	For each temperature and wind case the TOPL weight is displayed along with the associated Dry and Wet V_1 speeds (note the format omits the leading one hundred integer).
Inc/kt	TOPL weight increment per kt of extra wind between wind columns.
❼ **P/C above 1013** **P/C below 1013**	Pressure correction to Zero Wind TOPL wt in kg/mb for pressures above 1013 mb (an increment) or below 1013 mb (a decrement).
❽ **Packs-Off**	Weight correction for operation with Packs-Off.
❾ **Notes**	Indicate any operational information relating to non-standard performance – such as emergency turn procedures, noise abatement procedures, acceleration heights (HAA), runway bearing strength restrictions, arrester gear etc.

2.6.3 Calculation Method

The take-off data pages use a temperature entry method. Interpolation can be conducted between consecutive lines for weight, temperature and speed. Interpolation for weight and speeds can also be conducted between columns of wind.

Determination of Maximum Regulated Take-off Weight (RTOW)

1. Enter the take-off data page with actual OAT and wind to derive the TOPL weight and V_1 (as necessary, interpolate between temperature rows and use increment per kt values between wind columns).
2. Apply corrections for Pressure (P/C) and MEL items as appropriate. This is the Take-Off Performance Limit (TOPL).
3. The Regulated Take-off weight (RTOW) is the more restrictive of the Take-off Performance Limit (TOPL), and the Maximum Certified Take-off Weight (MTOW). The actual TOW must not exceed RTOW.
4. Obtain V_R and V_2 from FMC for the actual TOW.

Assumed Temperature Reduced Thrust

Assumed temperature reduced thrust take-offs should be performed whenever the actual take-off weight is less than the Take-off Performance Limited weight (TOPL) for the actual OAT unless any of the following conditions exist.

Assumed temperature reduced thrust take-off is NOT permitted if:

1. The runway has degraded braking action or is contaminated with standing water, slush or snow.
2. The performance page in this manual, or MEL item is so annotated.
3. If particular wind shear conditions exist – see FCOM 1.
4. Operating a Gear Down Ferry flight.
5. Three or more anti-skid channels are inoperative.

Determination of Assumed Temperature Reduced Thrust

1. Extract the Take-Off Performance Limited weight (TOPL) for the OAT from the take-off data page, correcting for wind, P/C and any MEL items in the normal manner.

2. If the actual take-off weight is less than TOPL, then assumed temperature reduced thrust may be used.

3. Correct the actual take-off weight for any negative correction in the reverse sense at the OAT to produce an assumed take-off weight.

4. Scan up the wind component column used of the take-off data page until the assumed take-off weight matches or is just less than the weight in the identified wind component column. The temperature for this weight is the assumed temperature. Extract V_1 figure for this temperature. If V_1 at the assumed temperature is less than V_{MCG} at the actual OAT, then a lower assumed temperature must be used such that the V_1 associated with this lower temperature is equal to V_{MCG} at the OAT. (V_{MCG} tables available from Section 2.3.)

5. The Assumed temperature and V_1 established in 4 above is inserted into the FMC.

6. If a Reduced Thrust take-off cannot be made, extract V_1 for the OAT from the appropriate wind component column.

7. Once the required information has been inserted into the FMC, V_R and V_2 speeds (protected for absolute minimum values) will appear, and can be confirmed with the use of appropriate LSKs. V_1 from 4 above must be inserted. If this V_1 is below V_{MCG} the FMC will advise the V_{MCG} value which can then be confirmed for use; however, in this circumstance the criteria in 4 above must be taken into account. If the V_1 exceeds V_R reduce V_1 to the V_R value and enter.

2.6.4 Example Take-off Performance Calculation

2.6.4.1 Example Manual Calculation – Full Power Take-off

What are the conditions?

- Take-off from New York John F. Kennedy (JFK/KJFK) Rwy 04L (use example page from 2.6.2).
- Actual Take-off Weight (ATOW) 290 tons.
- Wind 220/7 kts.
- Temperature 25°C.
- WET Rwy.
- QNH 1005.
- Significant windshear in vicinity – Full Power Tkof required as per PM.

What are we looking for?

- Confirmation that we can lift the Actual Take-off Weight.
- V_1 speed for Take-off Weight at Full Power.

How do we get there?

1. Enter the take-off data page with actual OAT and wind to derive the TOPL weight and V_1 (as necessary, interpolate between temperature rows and use increment per kt values between wind columns). Apply corrections for Pressure (P/C) and MEL items as appropriate. This is the Take-off Performance Limit (TOPL).

   Ambient temperature 25°C, Wind 7 kts TW: 374.3 t interpolated from table.
   Correction -4.8 t for QNH (8 × -0.6 t).
   TOPL = 369.8 t.
   ATOW < TOPL: **Take-off with Actual Take-off Weight is permitted**.

2. Extract V_1 figure for this temperature and appropriate runway condition condition.
   WET V_1 = 144 kts interpolated.

2.6.4.2 Example Manual Calculation – Reduced Thrust Take-off

What are the conditions?

- Take-off from New York John F. Kennedy (JFK/KJFK) Rwy 04L (use example page from 2.6.2).
- Actual Take-off Weight (ATOW) 290 tons.

- Wind 040/12 kts.
- Temperature 25°C.
- DRY Rwy.
- QNH 1005.
- One missing Winglet Fairing MEL/CDL 57-23-1.

What are we looking for?

- Confirmation that we can lift the Actual Take-off Weight.
- Take-off speeds for Take-off Weight.
- Assumed Temperature value for reduced thrust, if possible.

How do we get there?

1. Ambient temperature 25°C, Wind 12 kts HW: 400.9 t interpolated from table.
   Corrections -4.8 t for QNH (8 × -0.6 t) and -9435 kg for CDL 57-23-1.
   TOPL = 386.665 t.
2. ATOW < TOPL: **Assumed Temperature reduced thrust may be used**.
3. Assumed tkof weight = ATOW + (value of negative corrections)
   Assumed tkof weight = 290 t + 4.8 t (QNH) + 9.435 t (CDL) = **304.3 t**.
4. Extract **62°C as Assumed Temperature** (find 313.3 as uppermost value that is higher than 304.3 in the 10 kts HW column). **Associated DRY V_1 = 153 kts**. Note that interpolation would be allowed to find an Assumed Temperature value for which the weight is closer to 304.3 t.
5. **V_{MCG}** for ambient temperature is **122 kts**.
6. As V_1 > V_{MCG}, **Reduced Thrust may be used**.

Conclusion

We can lift the Actual Take-off Weight using **V_1 = 153 kts** with **Reduced Thrust at Assumed Temp 62°C** in the conditions listed above.

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3 LANDING PERFORMANCE DATA

3.1 Introduction

OM A 8.28.B describes the methods used to calculate Landing Performance data. Landing data pages are provided for all normal operations, and are presented in the B747-400G Dispatch Performance Data Book. Data pages can be provided for temporary situations, and will be included as handouts via the Cirrus Briefing Web Server.

Note: Absence of landing data for a particular runway at an airfield where other runways are covered implies it is **NOT APPROVED** for landing.

If data is required for an airfield for which a landing page is not available or when a change to the published data arises at short notice, either:

1. Ensure information not available in Briefing or at Crew Report.
2. Contact Flight Technical Dispatch at LHR (FTD) who can obtain data from Flight Technical Services (FTS). Use ACARS (FCB), telephone (+44-(0)20-8513-0455) or SITA (LHRWYBA).
3. Use generalised landing performance data.
4. AOM is provided on approach charts.

3.2 Landing Weights

The landing weight should be calculated by taking into account reported braking action and ambient conditions. Before using the tables, ensure that the landing distances published are valid, e.g. threshold not inset due WIP. If a restriction is in force it will be noted on Nubrief and revised landing figures provided.

3.2.1 Maximum Weight Permitted for Pre-Flt Planning

The Maximum Landing Weight permitted, for an airfield, for use at the flight planning stage. It is the maximum weight for which dispatch landing performance requirements can be satisfied at the airfield, taking into account all authorised runways, wind up to the tailwind limit, and assuming a manual landing on a wet runway using maximum landing flaps with all retardation/stopping devices fully serviceable.

If any of these assumptions are not valid for a given flight, the Maximum Weight permitted figure cannot be used for that flight, and the actual Maximum Landing Weight data tables will need to be entered.

As different Maximum Certified Landing Weights exist within the British Airways 747 fleet and one set of Landing Data Pages are created for this fleet, one Maximum Landing Weight for Pre-Flt Planning is given for an airfield, up to 285,760 kg. Therefore, the FCOM Limitations must be checked to ensure the aircraft is operated within its Maximum Certified Landing Weight, which may be lower than 285,760 kg.

3.2.2 Maximum Landing Weight

Weights or allowable tailwinds are published for Manual and Automatic (AUTOLAND) landings, where approved, for both Flap 25 and 30. These assume use of maximum wheel brakes and no reverse thrust for normal landings (both DRY and WET) and full reverse thrust on all engines for slippery runways.

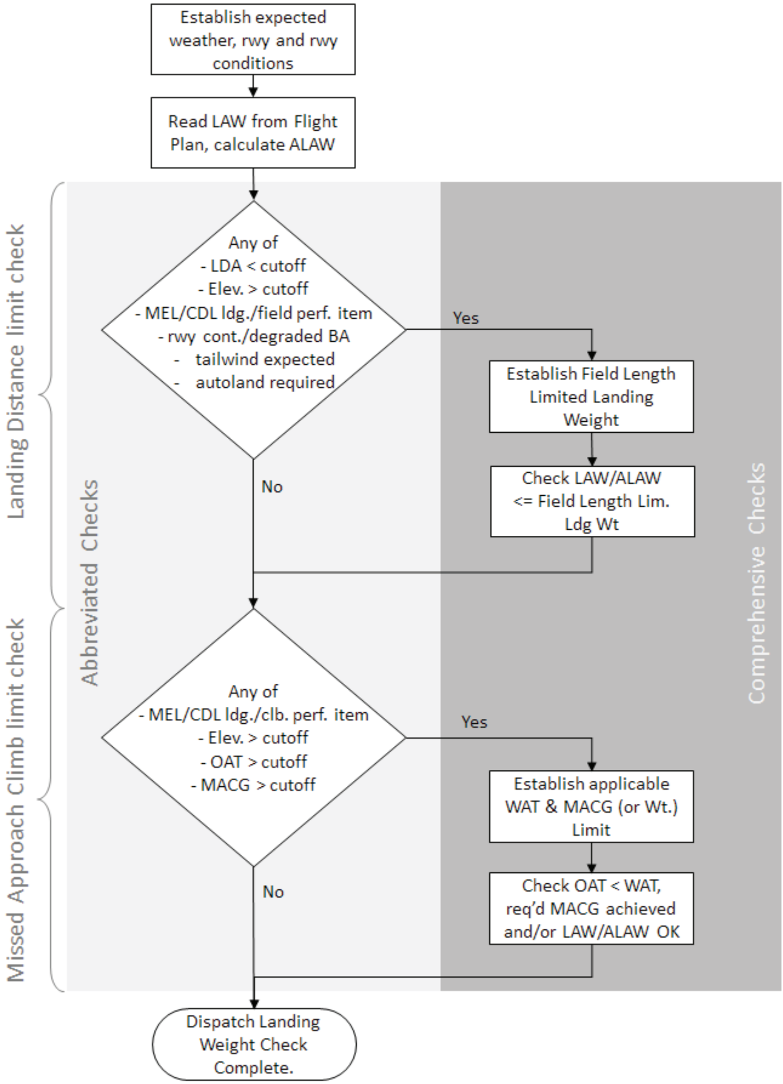
3.2.3 Dispatch Landing Weight Check

For the destination aerodrome and the destination alternate aerodrome on which fuel calculation is based, perform the following steps using the landing data pages in the Performance Manual. The flowchart given below provides a graphical representation of these.

A comprehensive Dispatch Landing Weight Check is only required when the cutoff values applicable to the B747 given below are violated, or when the conditions in which they apply are not met – see procedure and flowchart below. These values have been calculated assuming Flap 30 landing on a wet runway in zero wind at a Landing Weight of 285,763 kg with all brakes and spoilers serviceable and no reverse thrust used. The Missed Approach Climb Gradient and OAT have been calculated assuming an engine failure on application of Go-Around thrust for a Flap 20 go-around following a Flap 30 approach at Maximum Certified Landing Weight. All cutoff values assume Packs ON and Anti-Ice OFF.

Variant	Airfield Elev [ft]	LDA [m]	MACG [%]	OAT [°C]
B747-400 RB211-524G	2000	2600	6.5	48

3.2.3.1 Dispatch Landing Weight Check – Procedure



1. Establish expected weather, runway and runway surface conditions (*see Note 1*).

2. Read Planned Landing Weight LAW from Flight Plan; subtract diversion fuel weight to receive Planned Alternate Landing Weight ALAW when checking landing weight for alternate aerodrome.

3. Perform Abbreviated Landing Distance Limit check by establishing whether any of the following applies:

    a. Airfield elevation higher than cutoff value from table

    b. LDA of expected runway lower than cutoff value from table

    c. Runway surface contamination or degraded braking action expected

    d. Tailwind landing expected

    e. Autoland required

    f. MEL/CDL item applicable affecting landing performance

    If none of the above, available Landing Distance allows landing with a Landing Weight of 285,763 kg – continue to Missed Approach Climb limit check step 6; otherwise perform Comprehensive Landing Distance Limit Check from step 4.

4. Using the airfield specific Landing Data Pages and any MEL/CDL correction, establish Field Length Limited Landing Weight which is more restrictive of:

    a. Maximum Landing Weight for longest authorised and available runway, assuming still air and expected runway surface conditions (*see Note 2*)

    b. Maximum Landing Weight for runway most likely to be used, assuming expected wind and runway surface conditions (*see Note 2*)

5. Check that LAW/ALAW is less or equal Field Length Limited Landing Weight, considering MEL/CDL items as required.

6. Perform Abbreviated Missed Approach Climb Limit check by establishing whether any of the following applies:

    a. Airfield elevation higher than cutoff value from table

    b. MACG of planned approach higher than cutoff value from table

    c. Expected OAT higher than cutoff value from table

    d. MEL/CDL item applicable affecting missed approach climb performance

    If none of the above, planned Missed Approach allows go-around with a Landing Weight of 285,763 kg – Dispatch Landing Weight Check is complete; otherwise perform Comprehensive Missed Approach Climb Limit Check from step 7.

7. Using the applicable approach charts and the airfield specific Landing Data Pages, establish the applicable WAT limit. Consider, if present, any non-standard MACG requirement and associated WAT or weight limits given in the Landing Data Page notes (*see Note 3*).

8. Check that the expected OAT is equal to or below WAT limit and that LAW/ALAW are equal or less than any additional weight limit published in Missed Approach Notes on the Landing Data Page.

9. Dispatch Landing Weight Check complete (*see Note 4 and 5*).

Note:

1. Crews should use normal briefing material and reasonable estimates about likely conditions at time of landing to derive expected conditions. This represents a best endeavours approach to fulfilling the intent of the regulations.

2. Use the Runway Condition Assessment Matrix in Section 4.2 to correlate runway condition to stopping performance. Apply dry or wet runway data for any condition listed against braking actions DRY or GOOD, respectively. Apply slippery runway data for any condition listed against braking actions which are worse than GOOD.

3. For non-standard situations or to supplement Landing Data Page notes, the Go-Around Climb Gradient table in the QRH can be used.

4. If LAW/ALAW is greater than any applicable limit weight established above, dispatch requirements regarding landing performance are not met. In this case, available options might be (but are not limited to) using a different alternate, requesting a different flight plan if it facilitates reduction of fuel, or offloading weight.

5. The Dispatch Landing Weight Check satisfies dispatch landing performance calculation requirements including the regulatory margins. For inflight landing performance assessment, QRH data should be used instead of the Performance Manual landing data pages, as these conservative margins do not need to be applied for inflight calculations.

3.2.3.2 Dispatch Landing Weight Check – Worked Example for Comprehensive Check

Assumptions:

- Destination JNB
- LAW 252.1t
- Wind 210/10, 45°C, dry or wet runways
- No OPDEFs

BRITISH AIRWAYS **B747-400** LANDING DATA **JOHANNESBURG (FAOR)**

A/D Elev **5558ft** Max wt Permitted (For pre flt planning) **285,760kg** Briefing Cat A

RUNWAY (STATUS)	03L (E)	03R (E)	21L (LR)	21R (E)
Landing Distance Available	4418m / 14495ft	3400m / 11155ft	3400m / 11155ft	3968m / 13015ft
Slope	.39DN	.14DN	.14UP	.39UP
Notes	Note 1	Notes 1,2	Notes 1,3	Note 1
WAT LIMIT °C : Man / Auto Reduce MLW by 3000kg/ ° above Max Temp	42°/42°	36°	42°/42°	42°
25F Zero HW wt or TW (Manual)	14kt (8kt)	6kt (0kt)	6kt (0kt)	14kt (8kt)
25F Zero HW wt or TW (Autoland)	14kt (8kt)	6kt(0kt)	6kt (0kt)	
25F Slippery Zero HW wt or TW (Manual)	5kt	245.0	245.0	5kt
25F Slippery Zero HW wt or TW (Autoland)	5kt	245.0	245.0	
30F Zero HW wt or TW (Manual)	14kt (8kt)	6kt (0kt)	6kt (0kt)	14kt (8kt)
30F Zero HW wt or TW (Autoland)	14kt (8kt)	6kt(0kt)	6kt (0kt)	
30F Slippery Zero HW wt or TW (Manual)	5kt	269.0	269.0	5kt
30F Slippery Zero HW wt or TW (Autoland)	5kt	269.0	269.0	
Red'n per extra kt TW kg	5300kg	5300kg	5300kg	5300kg
Inc per kt HW kg		750kg	750kg	
Missed Approach Min Accel Alt	6600ft	6600ft	6600ft	6600ft

Brakes de-activated or Auto-Spoilers U/S. Information in brackets where different.
Slippery Rwy. No further correction needed if brakes de-activated.

1. **MACG and Minima**: WAT Limit ensures that all missed approach climb gradients can be met and therefore the lowest minima can be used. If Rwy 03R WAT limit restrictive, the 2.5% MACG minima may be used up to a WAT Limit of 42°C.
2. **ILS Cat 2 Rwy 03R:** Caution radio altimeter on Rwy 03R will ramp down approx 50ft just prior to Cat 2 DH, reducing time between 50 above call and DH.
3. **ILS Cat 2 Rwy 21L** : Caution radio altimeter on Rwy 21L will ramp down approx 50ft just prior to Cat 2 DH, reducing time betwen 50 above call and DH.

1. Establish expected weather, runway and runway surface conditions.

   Wind 210/10, 45°C, dry or wet runways, Rwy 21L expected

2. Read Planned Landing Weight LAW from Flight Plan; subtract diversion fuel weight to receive Planned Alternate Landing Weight ALAW when checking landing weight for alternate aerodrome.

   LAW is 252.1t

3. Perform Abbreviated Landing Distance Limit check by establishing whether any of the following applies:

   a. Airfield elevation higher than cutoff value from table **– Yes**

   b. LDA of expected runway lower than cutoff value from table **– No**

c. Runway surface contamination or degraded braking action expected **– No**

d. Tailwind landing expected **– No**

e. Autoland required **– No**

f. MEL/CDL item applicable affecting landing performance **– No**

If none of the above, available Landing Distance allows landing with a Landing Weight of 285,763 kg – continue to Missed Approach Climb limit check step 6; otherwise perform Comprehensive Landing Distance Limit Check from step 4.

4. Using the airfield specific Landing Data Pages and any MEL/CDL correction, establish Field Length Limited Landing Weight which is more restrictive of:

   a. Maximum Landing Weight for longest authorised and available runway, assuming still air and expected runway surface conditions

      285.8t (03L F30 Manual)

   b. Maximum Landing Weight for runway most likely to be used, assuming expected wind and runway surface conditions

      285.8t (21L F30 Manual)

      Field Length Limited Landing Weight is 285.8t.

5. Check that LAW/ALAW is less or equal Field Length Limited Landing Weight, considering MEL/CDL items as required.

   LAW is 252.1 < MLW => OK

6. Perform Abbreviated Missed Approach Climb Limit check by establishing whether any of the following applies:

   a. Airfield elevation higher than cutoff value from table **– Yes**

   b. MACG of planned approach higher than cutoff value from table **– No**

   c. Expected OAT higher than cutoff value from table **– No**

   d. MEL/CDL item applicable affecting missed approach climb performance **– No**

If none of the above, planned Missed Approach allows go-around with a Landing Weight of 285,763 kg – Dispatch Landing Weight Check is complete; otherwise perform Comprehensive Missed Approach Climb Limit Check from step 7.

7. Using the applicable approach charts and the airfield specific Landing Data Pages, establish the applicable WAT limit. Consider, if present, any non-standard MACG requirement and associated WAT or weight limits given in the Landing Data Page notes.

   Standard WAT limit is 42°C – OAT is 45°C so adjustment required:

   Adjusted WAT to be 45°C => Weight limit is MLW - (45°C -42°C) × 3000 kg = 276.8t

8. Check that the expected OAT is equal to or below WAT limit and that LAW/ALAW are equal or less than any additional weight limit published in Missed Approach Notes on the Landing Data Page.

   OAT = Adjusted WAT = 45°C, LAW is 252.1t < 276.8t => OK

9. Dispatch Landing Weight Check complete.

3.3 Reverse Thrust

The Standard Operating Procedure is to always use Reverse Thrust on landing. The use of Reverse Thrust is restricted at certain aerodromes at night (see relevant Aerodrome Charts). On these occasions Idle Reverse should always be selected as a minimum. Full Reverse Thrust techniques should be used whenever:

1. The runway is covered by standing water, snow, slush or ice.
2. The Target Threshold Speed has been increased for a deficiency.
3. There is any unserviceability of speed brakes, wheel brakes or anti-skid.

3.4 Landing on a Wet Runway

The presence of water on a runway will be reported as damp, wet, water patches or flooded.

A wet runway is defined as having up to and including 3 mm of water on the surface and a friction coefficient of approximately one half of that of a dry runway but with 'braking action good'. The landing weights are based on a wet runway.

Flooded runways must be considered as slippery.

For landings on a contaminated or degraded braking action runway, refer to Section 4 of this performance manual.

3.5 Landing Data Pages and Decode

Landing data pages are published in the B747-400G Performance Data book. For those airfields which are planned destinations or destination alternates for that B747, the landing pages give data to be used for the dispatch landing weight check with up to four runway weight tables on each page. For those airfields only used as enroute alternates, the landing pages only list the runways authorised for landing operations for the B747.

The landing pages are indexed by airfield ICAO code and followed by the letter “L” and a page number, e.g. EGLL-L-1.

BRITISH AIRWAYS	Boeing 747-400 RB211-524G	DISPATCH LANDING PAGE		Airport A	
A/D Elev **171ft**	Max wt permitted (pre flt planning): **285,760kg**			**(AAAA)**	1
RUNWAY Landing Distance Available	**02** 3054m / 10019ft	**11** 3065m / 10055ft	**20** 3054m / 10019ft	**29** 3065m / 10055ft	2
Notes					
WAT LIMIT °C : Man / Auto	54°C / -	54°C / 54°C	54°C / 54°C	54°C / -	3
25F Zero HW wt or TW - Manual	13kt (3kt)	13kt (3kt)	13kt (3kt)	13kt (3kt)	
25F Zero HW wt or TW - Autoland		13kt (3kt)	13kt (3kt)		
25F Slippery Zero HW wt or TW - Manual	256.9	257.9	256.9	257.9	
25F Slippery Zero HW wt or TW - Autoland		257.9	256.9		
30F Zero HW wt or TW - Manual	15kt (14kt)	15kt (14kt)	15kt (14kt)	15kt (14kt)	4
30F Zero HW wt or TW - Autoland		15kt (14kt)	15kt (14kt)		
30F Slippery Zero HW wt or TW - Manual	280	281	280	281	
30F Slippery Zero HW wt or TW - Autoland		281	280		
Red'n per extra kt TW kg	5300	5300	5300	5300	5
Inc per kt HW kg	750	750	750	750	

Brakes de-activated or Auto-Spoilers U/S. Data in brackets. No adjustment for Brakes de-activated or Auto-Spoilers U/S required for **Slippery Runway** data. 6

PERFORMANCE RESTRICTIONS
MACG: 5.8% minima can be used up to 36°C OAT and up to 285760kg.

Landing Data Page Decode

❶ **Airfield Name, Elevation and Max Wt Permitted**

The airfield name, the field elevation and the maximum landing weight permitted for use at the flight planning stage. It is valid for both dry and wet runways.

Note: Max Wt Permitted data given up to 285,760 kg which maybe greater than the Maximum Certified Landing Weight aircraft of the aircraft being operated. The FCOM Limitations section must be checked to ensure the Maximum Certified Landing Weight of the aircraft being operated is not exceeded.

❷ **Runway Data and Notes**

The runway designator and published LDA at time of landing page calculation. The Notes line references those notes applicable to the particular runway, if any.

❸ **WAT Limit**

The maximum landing OAT at which the required approach climb gradient is satisfied at the Landing Weight of 285,763 kg. Two values are presented, both of which are valid for Flap 25 or Flap 30 landings. The Manual (Man) figure should be applied for all manual approaches and the Autoland (Auto) figure should be applied for all automatic approaches. If OAT at the Arrival Airfield exceeds the published Max Temp, the Max Weight Permitted must be reduced by 3000 kg/ºC.

Different Maximum Certified Landing Weights exist within the British Airways 747 fleet. The FCOM Limitations section shows the different Maximum Certified Landing Weight values for each aircraft registration. Despite this, one set of Landing Data Pages are created for the 747 fleet and show the maximum landing weight achievable for each runway up to 285,760 kg. Therefore, when using the Landing Data Pages, the FCOM Limitations must always be checked to ensure the aircraft is operated within its Maximum Certified Landing Weight, which may be lower than 285,760 kg.

For aircraft registrations which have a Maximum Certified Landing Weight of less than 285,760 kg, performance data provided by the Landing Data Pages is valid. When tailwind information is shown, this data will be conservative as tailwind limits are based on a Landing Weight of 285,760 kg, as described below.

❹ **Maximum Landing Weights**

25F and 30F Manual/Autoland

The maximum permitted landing weight published for each runway approved for Flap 25 and Flap 30 Manual or Automatic landings with 0 kt tail wind component.

If only a tailwind figure is published, landing is permitted up to 285,760 kg and up to the number of knots of tailwind component listed.

The maximum tailwind component permitted for Manual landing is 15 kt.

30F Slippery Manual/Autoland

The maximum permitted slippery runway landing weight, using Flap 25 or 30 is for each approved runway, and should be used if the runway is reported as slippery, e.g. due to ice or standing water.

It can be used for both Manual and Autoland landings and assumes the use of full reverse thrust on all engines.

DURING FLIGHT PLANNING FOR LANDING AT AIRFIELDS WITH CONTAMINATED OR SLIPPERY CONDITIONS THE RUNWAY SHOULD NOT BE USED IF FULL REVERSE CANNOT BE OBTAINED FROM ALL ENGINES.

Note: However, following an engine failure an aircraft can return/continue to a contaminated or slippery runway using QRH PI Section, Non Normal Config Ldg Eng Shutdown tables to check adequate runway length available.

The maximum permitted tailwind component for landing on Slippery runways is 5 kt.

The Slippery landing weights assume the same procedures and threshold speeds as in normal landing, maximum reverse thrust on all engines, braking action poor, the normal 30% safety margin (see Section 4.2 – Braking Action Correlation with Runway Surface Conditions for relationship of braking coefficient to braking action), and no deficiency in the normal braking systems, i.e. Auto Speed Brakes, Wheel Brakes and Antiskid. Such surface conditions are encountered infrequently and rarely apply uniformly to the entire runway.

This level of performance is the best advice available in view of the difficulty in predicting the precise effect on an aircraft in these conditions. None of the assumptions constitute a mandatory limitation and are detailed to assist judgement of the related variables. The nature of the overrun area, the potential consequences of an overrun and possible weather changes since the last measurement or report, must also be considered.

One or Two Brakes De-activated

Operations with one or two brakes de-activated are permitted. The landing weights or obtainable tailwind for this operation are shown in brackets after the normal landing weights or tailwind if different.

Auto Spoilers Inoperative

Operations with auto-spoilers inoperative are approved provided all brakes are operational. In this situation the ‘Brakes De-Activated Weights’ apply.

❺ **Red’n Per Extra KT TW KG Manual/Autoland**

If the maximum tailwind listed is less than 15 kt (Manual or Autoland) and/or 5 kt (Slippery), the Maximum Landing Weight should be reduced by the tabulated value of ‘Red’n per extra kt TW kg’ for tailwinds greater than the figure listed, but not exceeding 15 kt (Manual or Autoland) and/or 5 kt (Slippery).

Inc Per Extra KT HW KG Manual/Autoland

If the Maximum Landing Weight in zero wind is less than the Maximum Landing Weight for Pre-flight Planning, an ‘Inc per kt HW kg’ is given, to be added to the weight, up to Maximum Landing Weight of 285,760 kg.

❻ **Missed Approach Climb Gradient Notes**

Missed Approach Climb Gradient (MACG) notes are published on the Dispatch Landing Data Pages for those Missed Approach procedures where a gradient higher than standard is specified for the procedure and which therefore are not covered by the WAT limit.

Aircraft performance for MACG notes is based on the scenario of a one-engine inoperative Go-Around, with the engine having failed at the point of Go-Around initiation following an all engines approach to the applicable minimum. Consequently, aircraft state for the MACG notes is assumed to be one engine inoperative, Flap 20, gear up, Bleeds on, Anti-Ice off at a speed of VREF30+5. Exceptions from this, if present, are given with the MACG notes.

For different configurations, non-standard situations, e.g. operating in icing conditions, or to supplement Landing Data Page notes, the Go-Around Climb Gradient table in the QRH can be used.

Airframe Icing Conditions

If operating in airframe icing conditions during any part of the flight, with forecast landing temperatures below **10ºC**, reduce Max Temp by **3ºC**.

3.6 Generalised Landing Data

Introduction

This section provides generalised landing data required to schedule landings at the flight planning stage.

The data may be used when no runway specific landing data is available, such as when ANTI-SKID or AUTO-SPOILER is inoperative.

Dry or Wet

The DRY OR WET landing distances are from a threshold height of 50 ft and a speed of V_{REF} with the actual dry runway landing distance multiplied by a factor of **1.67**.

Deceleration is by means of maximum braking applied immediately after touchdown, reverse thrust on operative engine(s) with anti-skid and auto-spoiler operative.

Anti-skid Inoperative

The anti-skid inoperative landing distances should be used at the flight planning stage (when factored) when the anti-skid system is selected OFF, is inoperative or is rendered inoperative as a result of some other system failure.

The data is valid for dry or wet runways with automatic, manual or (with reduced margins) no spoiler operation.

Auto-spoiler Inoperative

The auto-spoiler inoperative landing distances should be used at the flight planning stage (when factored) when the auto-spoiler system is inoperative or unarmed and the spoilers are deployed manually 2 seconds or less after touchdown. The data is valid for dry or wet runways and is also valid (with reduced margins) for landings in abnormal configurations, which render the spoiler system partially or totally inoperative.

Thrust Reverser Inoperative

The thrust reverser inoperative landing distance should be used at the flight planning stage (when factored) when one or more thrust reversers are placarded inoperative. The data is valid for dry or wet runways with automatic spoiler operation and anti-skid operative.

Tables are provided for determining the maximum landing weight as limited by field length or climb requirements for flaps 30. Maximum landing weight is the lesser of the field length limit weight and landing climb limit weight; do not exceed maximum structural landing weight.

Landing Field Limit Weight

Obtain wind corrected field length by entering upper table with field length available and wind component along the runway. Now enter lower table with wind corrected field length and pressure altitude to read field limit weight for the expected runway condition.

Landing Climb Limit Weight

Enter table with airport OAT and pressure altitude to read landing climb limit weight. Apply the noted corrections as required.

Quick Turnaround Limit Weight

Enter table with airport pressure altitude and OAT to read maximum quick turnaround weight. Apply the noted corrections as required.

If the landing weight exceeds the maximum quick turnaround weight, wait the specified time and then check that the wheel thermal plugs have not melted before executing a subsequent take-off.

Generalised Landing Data

The Maximum Performance Landing Weight is the smaller of the Field Length Limit Weight and Climb Limit Weight. (Do not exceed Maximum Structural Landing Weight). This data is valid for Manual Landing ONLY. Autoland is NOT APPROVED.

See charts on the following pages.

a. **Field Length Limit**

   To determine Field Length Limit Landing Weight:

   > Enter the appropriate Field Length Limit Chart with Field Length Available (LDA), correct for wind, runway condition and brake configuration (Antiskid Operative Chart only), proceed vertically to the Airport Pressure Altitude and read Field Length Limited Weight to the RIGHT.

b. **Climb Limit**

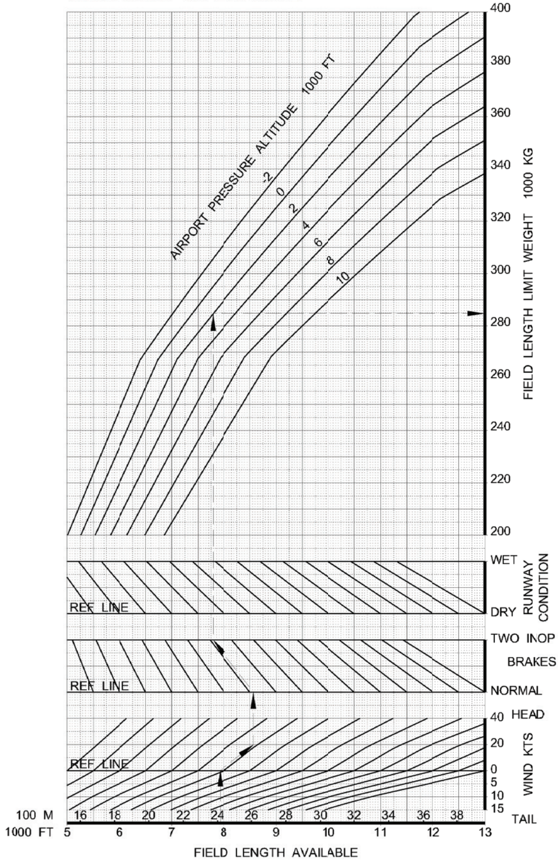
   To determine Climb Limited Weight:

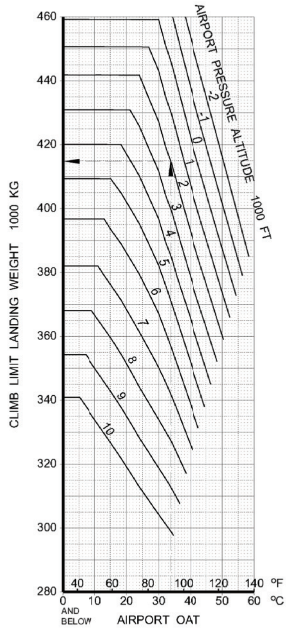
   > Enter Climb Limit Chart with Airport OAT, move vertically to Airport Pressure Altitude and read the Climb Limited Weight to the LEFT.

Landing Field and Climb Limit
Flaps 25

Landing Field & Climb Limit
Flaps 25

ANTI-SKID OPERATIVE





VALID FOR AUTOMATIC SPOILERS.

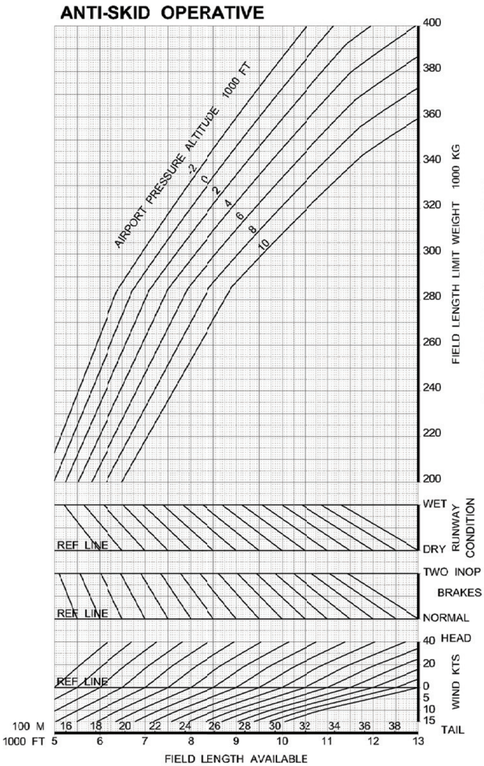
FOR MANUAL SPOILERS REDUCE FIELD LENGTH AVAILABLE BY 520 FT. ANTI-SKID MUST BE OPERATIVE FOR TWO BRAKES INOPERATIVE.

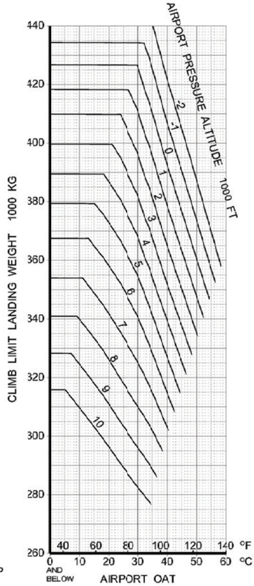
CLIMB LIMIT BASED ON 3 PACKS. FOR 1 A/C PACK OPERATION, INCREASE CLIMB WEIGHT 4800 KG. FOR OPERATION WITH NO PACKS, INCREASE CLIMB WEIGHT 7000 KG.

REDUCE LANDING CLIMB LIMIT WEIGHT BY 23500 KG FOR ICE ACCUMULATION WHEN OPERATING IN ICING CONDITIONS DURING ANY PART OF THE FLIGHT WITH FORECAST LANDING TEMPERATURE BELOW 8°C (46°F).

Landing Field and Climb Limit
Flaps 30

Landing Field & Climb Limit
Flaps 30





VALID FOR AUTOMATIC SPOILERS.

FOR MANUAL SPOILERS REDUCE FIELD LENGTH AVAILABLE BY 510 FT. ANTI-SKID MUST BE OPERATIVE FOR TWO BRAKES INOPERATIVE.

WHEN THE ANTICIPATED FLAPS 30 APPROACH SPEED (V_{REF} PLUS ADDITIVES FOR WIND AND GUST) IS GREATER THAN 167 KIAS, SCHEDULE FLAPS 25 LANDING SPEED AND FLAPS 25 LANDING DISTANCE.

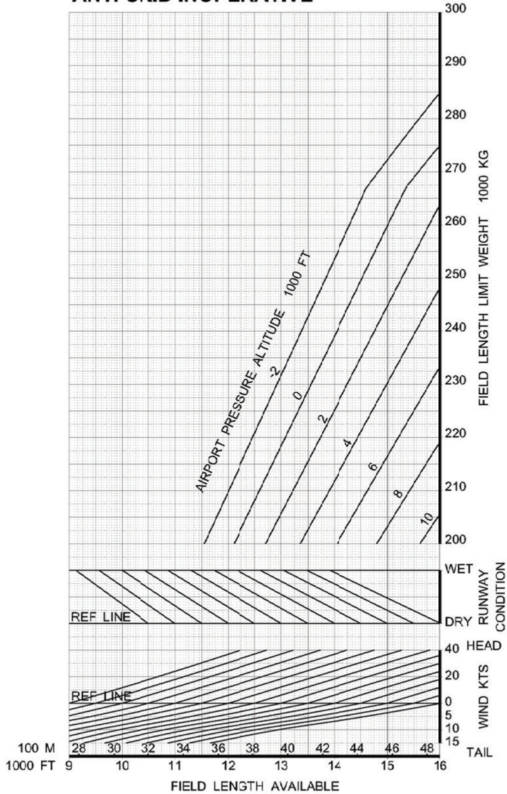
CLIMB LIMIT BASED ON 3 PACKS. FOR 1 A/C PACK OPERATION, INCREASE CLIMB WEIGHT 3250 KG. FOR OPERATION WITH NO PACKS, INCREASE CLIMB WEIGHT 5000 KG.

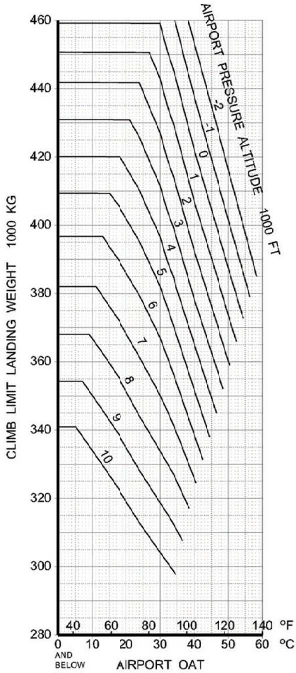
REDUCE LANDING CLIMB LIMIT WEIGHT BY 11100 KG FOR ICE ACCUMULATION WHEN OPERATING IN ICING CONDITIONS DURING ANY PART OF THE FLIGHT WITH FORECAST LANDING TEMPERATURE BELOW 8°C (46°F).

Landing Field and Climb Limit
Flaps 25

Landing Field & Climb Limit
Flaps 25

ANTI-SKID INOPERATIVE





VALID FOR AUTOMATIC OR MANUAL SPOILERS.

ANTI-SKID MUST BE OPERATIVE FOR TWO BRAKES INOPERATIVE.

CLIMB LIMIT BASED ON 3 PACKS. FOR 1 A/C PACK OPERATION, INCREASE CLIMB WEIGHT 4800 KG. FOR OPERATION WITH NO PACKS, INCREASE CLIMB WEIGHT 7000 KG.

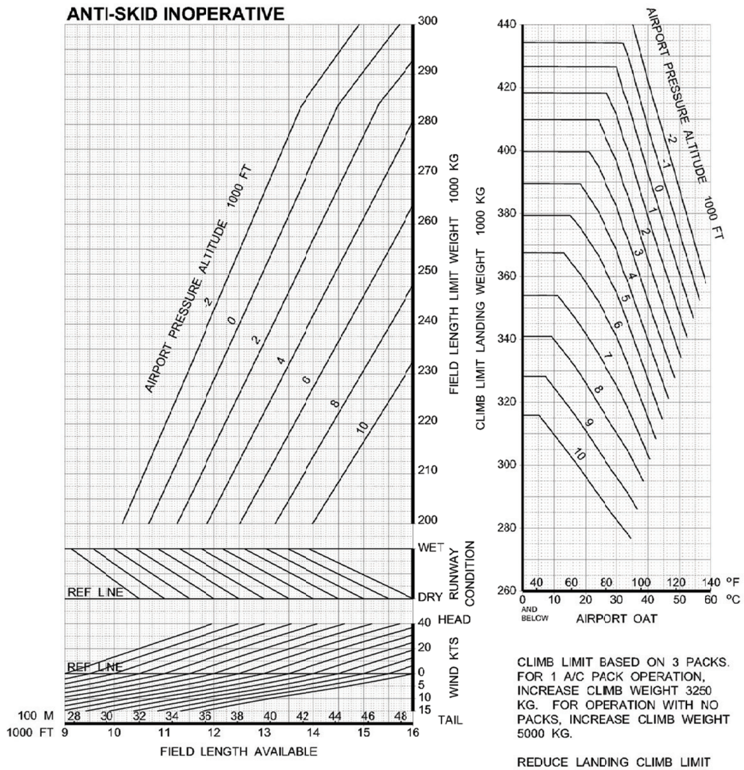
REDUCE LANDING CLIMB LIMIT WEIGHT BY 23500 KG FOR ICE ACCUMULATION WHEN OPERATING IN ICING CONDITIONS DURING ANY PART OF THE FLIGHT WITH FORECAST LANDING TEMPERATURE BELOW 8°C (46°F).

Landing Field and Climb Limit

Flaps 30

Landing Field & Climb Limit

Flaps 30



VALID FOR AUTOMATIC SPOILERS.

FOR MANUAL SPOILERS REDUCE FIELD LENGTH AVAILABLE BY 60 FT. ANTI-SKID MUST BE OPERATIVE FOR TWO BRAKES INOPERATIVE.

WHEN THE ANTICIPATED FLAPS 30 APPROACH SPEED (V_{REF} PLUS ADDITIVES FOR WIND AND GUST) IS GREATER THAN 167 KIAS, SCHEDULE FLAPS 25 LANDING SPEED AND FLAPS 25 LANDING DISTANCE.

CLIMB LIMIT BASED ON 3 PACKS. FOR 1 A/C PACK OPERATION, INCREASE CLIMB WEIGHT 3250 KG. FOR OPERATION WITH NO PACKS, INCREASE CLIMB WEIGHT 5000 KG.

REDUCE LANDING CLIMB LIMIT WEIGHT BY 11100 KG FOR ICE ACCUMULATION WHEN OPERATING IN ICING CONDITIONS DURING ANY PART OF THE FLIGHT WITH FORECAST LANDING TEMPERATURE BELOW 8°C (46°F).

Quick Turnaround Limit

Flaps 30
Limit Weight (1000 KG)

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)												
°C	°F	-2000	-1000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
50	122	312	306	300	294	288	283							
40	104	317	311	305	299	293	287	282	276	271	266	260		
30	86	323	317	310	304	298	292	286	281	275	270	265	259	254
20	68	329	322	316	310	303	297	291	285	280	274	269	264	258
10	50	335	328	322	316	309	303	297	291	285	279	273	268	262
0	32	341	335	328	321	315	309	302	296	290	284	279	273	268
-10	14	348	342	335	328	321	315	308	302	296	290	284	278	272
-20	-4	356	349	342	335	328	322	315	308	302	296	290	284	278
-30	-22	364	357	349	342	335	328	322	315	308	302	296	290	284
-40	-40	372	365	357	350	343	336	329	322	315	309	302	296	290
-50	-58	381	374	366	359	351	344	337	330	323	316	309	303	297

Flaps 25
Limit Weight (1000 KG)

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)												
°C	°F	-2000	-1000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
50	122	294	288	282	277	271	266							
40	104	299	293	287	281	276	271	265	260	255	250			
30	86	304	298	292	286	281	275	270	263	259	254	249	244	239
20	68	309	303	297	291	286	280	274	269	263	258	253	248	243
10	50	315	309	303	297	291	285	279	274	268	263	258	252	248
0	32	321	315	308	302	296	290	284	279	273	268	262	257	252
-10	14	327	321	315	308	302	296	290	284	278	273	267	262	256
-20	-4	334	328	321	315	309	302	296	290	284	278	272	267	261
-30	-22	341	335	328	322	315	309	303	296	290	284	278	273	267
-40	-40	349	342	335	329	322	316	309	303	297	290	284	278	273
-50	-58	357	350	343	336	330	323	317	310	304	297	291	285	279

Increase weight by 2800 kg per 1% uphill slope. Decrease weight by 7000 kg per 1% downhill slope.
Increase weight by 6000 kg per 10 knots headwind. Decrease weight by 41300 kg per 10 knots tailwind.
Decrease weight by 22200 kg when two brakes are deactivated.

After landing, at weights exceeding those shown above, adjusted for slope and wind, wait at least 70 minutes and check that wheel thermal plugs have not melted before executing a takeoff.

3.7 Circling/Visual Minima

For more information read OM A “Visual Flight Manoeuvres”.

4 CONTAMINATED OR DEGRADED BRAKING RUNWAYS

4.1 Introduction

Take-off or landing on a runway which is contaminated or has a degraded braking action requires careful consideration of all known factors before deciding if the conditions permit operations and what level of performance data should be used.

It must be remembered that when using any of the flow charts or comparison tables provided in this section, that they are not intended as an absolute guide, but to provide a reasonable estimation of the conditions that can be expected. Such guidance cannot and is not intended to cover all situations and combinations of contamination and degraded braking action. Therefore, crews must use their experience and judgement of observed conditions, together with airfield and other crew reports to make an assessment of the conditions most likely to apply at the actual time of operation.

DO NOT base assessments solely on a reported braking coefficient or reported braking action, these should be considered along with all other available information when assessing what level of performance should be used.

SNOWTAM Proforma

A specimen SNOWTAM proforma and decode is available in the MET section of each AERAD Supplement.

Runways NOTAMed as "May be Slippery When Wet"

Runway surface deterioration due to wear and age, rubber deposits and newly laid resurfaced runways prior to grooving could all produce reduced friction characteristics when wet. Aerodrome operators carry out periodic runway surface friction assessments on runways as part of a maintenance programme, and conduct additional measurements on newly resurfaced runways or runways suspected to be slippery under unusual conditions.

When the friction level of a significant portion of the runway (100 m or more in the UK) falls below a specified minimum friction level, the aerodrome operator will issue a notam stating that the runway "**may be slippery when wet**". This statement taken on its own would suggest that slippery take-off or landing performance data should be used, a situation that is probably far removed from the truth, especially if only a 100 m portion of the runway has a friction value below the specified level, while the rest of the runway may well have a braking action of good. When such notams are issued the affected area and its position on the runway will normally be identified, so crews can assess what impact on performance this should have if any. If necessary, advice on what level of performance data to use will be added to the notam on the AIS briefing.

Runway Friction Reports

Runway friction reports from measuring devices (e.g. Grip tester, Mu Meter, Saab Friction Tester) will NOT normally be provided when the runway is contaminated with standing water, slush or wet snow owing to the unreliability of these readings. However, a runway surface condition report will normally be provided stating the type and depth of contaminant, which may also be accompanied by an estimated braking action report using the terms “GOOD, MEDIUM/FAIR, POOR or NIL”.

It must be remembered that estimated braking action reports are purely subjective, and can be influenced by a variety of factors such as weight, technique, experience and expectations. Flight crews must be extremely cautious in making assumptions about the stopping capability of their aeroplane based solely on such reports. Flight crews should be aware that on runways contaminated with standing water, slush or wet snow, braking actions as low as poor may be experienced for take-off accelerate stop or landing.

4.2 Braking Action Correlation with Runway Surface Conditions

The following table (see next page) shows an estimate of what braking action may reasonably be expected for different types of contamination but be aware that many factors could change the relationships shown in the table. Also included is a column which provides corresponding runway friction measurements derived from ICAOs Compacted Snow and/or Ice covered runways table. This is not an exact science therefore totally reliable correlation does not exist; runway measured friction values can vary significantly for the same contaminant condition due to measuring techniques, equipment calibration, the effects of contamination on the friction measuring device and time passage since the measurement. *This table is not intended as an absolute guide to the correlation of braking actions, runway conditions and measured friction* since no reliable correlation of these factors exist. Assessments of braking action should not be based solely on runway friction reports alone; all other available information should be used in conjunction with friction reports to assess the braking action.

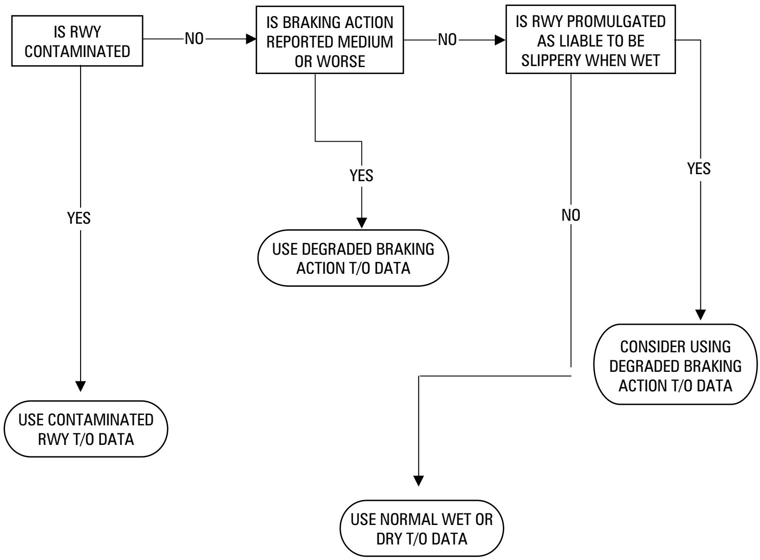
ICAO Code	Runway Contaminant	Reported Mu	Declaration and Directional Control	PIREP
6	• **Dry**	—	—	Dry
5	• **Wet** (Smooth, Grooved or PFC) • **Frost** • **Water, Slush, Dry or Wet Snow** – Up to 1/8" or 3 mm	.40 or higher	Braking deceleration is normal for the wheel braking effort applied. Directional control is normal.	Good
4	• **Compacted Snow** (Temperature at or below -13°C)	.39 -.35	Braking deceleration and controllability is between Good and Medium.	Good to Medium
3	• **Wet** (Slippery) • **Dry or Wet Snow** – Greater than 1/8" or 3 mm. (Temperature at or below -3°C) • **Compacted Snow** (Temperature at or below -3°C and above -13°C)	.34 -.30	Braking deceleration is noticeably reduced for the wheel braking effort applied. Direction control may be slightly reduced.	Medium
2	• **Water or Slush** – Greater than 1/8" or 3 mm. • **Dry or Wet Snow** – Greater than 1/8" or 3 mm. (Temperature above -3°C) • **Compacted Snow** (Temperature above -3°C)	.29 -.25	Braking deceleration and controllability is between Medium and Poor. Potential for hydroplaning exists.	Medium to Poor
1	• **Ice** (Temperature at or below -3°C)	.24 -.21	Braking deceleration is significantly reduced for wheel braking effort applied. Directional control may be significantly reduced.	Poor
0	• **Water over Compacted Snow** • **Dry or Wet Snow over Ice, Wet Ice** • **Ice** (Temperature above -3°C)	.20 or lower	Braking deceleration is minimal to non-existent for the wheel braking effort applied. Directional control may be uncertain.	Nil

4.3 Take-off from Contaminated or Degraded Braking Action Runways Flow Chart

The following flow chart is provided for guidance as to which data is the most appropriate to use when taking-off from a runway for which the normal dry or wet performance data would not be appropriate (i.e. contaminated or degraded braking action runways).

This guide is not intended to cover all situations and combinations of contamination and degraded braking action. Crews must use their experience, judgement of the observed conditions, as well as other crew and airfield reports in making an assessment of the conditions most likely to apply at the actual time off take-off.

Note: CARD must be used for all contaminated or degraded braking action take-off calculations. If ACARS is unavailable or the aircraft not equipped, contact FTD for CARD calculation.



Flight crews should be aware that in changing winter conditions the performance calculation carried out at the planning stage may no longer be appropriate at the time of take-off. A further calculation, based on the latest prevailing conditions, may be needed.

4.4 Take-off from Contaminated Runways

All take-off performance for contaminated runways should be obtained from CARD.

Performance data for contaminated runways assumes a uniform depth of contaminant along the entire length and width of the runway, which is an unlikely situation.

The contaminated data available from CARD assumes varying levels of braking for each contaminant type, which should be sufficient to cover most contaminated conditions and braking actions, resulting in only having to run the contaminated calculation on CARD.

The use of TO1 and TO2 take-off power settings is permitted for contaminated take-offs. TO1 and TO2 can be selected on the THRUST LIM page to provide fix derate take-off power settings (B747 FCOM Vol 2 page 11.32.2 provides further information). Of particular note are two statements:

1. The thrust setting parameter is considered a limitation for take-off. *This means that in the CARD performance calculation a lower value of V_{MCG} is used.*
2. Thrust levers should not be advanced further (except in a emergency) *e.g. windshear or blocked runway.* ***A further increase in thrust following an engine failure could result in a loss of directional control***.

The bold sentence at item 2 above is crucial. When using TO1 or TO2, the performance is calculated on the assumption of a lower V_{MCG} associated with the reduced maximum thrust setting, which can potentially increase the TOPL on contaminated or shorter runways where the aircraft's lower weight results in V_{MCG} becoming the limiting factor. However, more thrust is still available if the thrust levers are advanced. If more thrust is applied on the ground the V_{MCG} is re-set to a higher value, and if an engine has failed the aircraft could be below the reset V_{MCG} value resulting in insufficient rudder authority to control the swing.

Using TO1 or TO2 for Card Contaminated Take-off Calculations

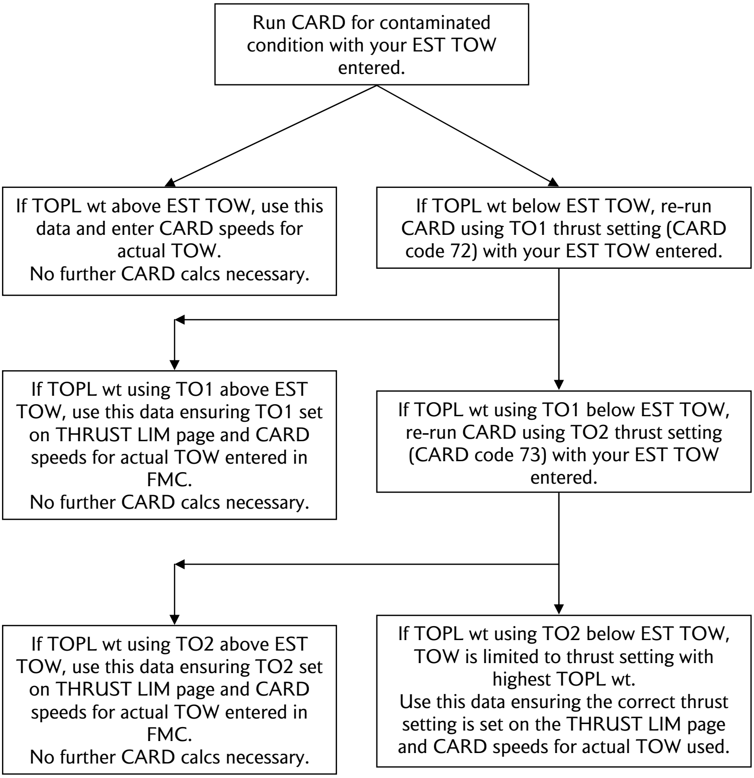
On page 7 a flow diagram illustrates the iterative process required when doing this complex calculation.

Notes:

1. The use of fixed derates (TO1 or TO2) will generally produce an improved TOPL only on runways of less than about 3000 m in contaminated conditions.
2. The contaminant codes calculate a full power take-off. When used with code 72 (TO1) or 73 (TO2) CARD calculates the performance using the respective power setting and its associated reduced V_{MCG}. It is the reduction in the V_{MCG} value that allows the increase in TOPL. This is an approved means of compliance with the requirement of a full power take-off in these conditions. **It is vital that the correct thrust setting (TO, TO1 or TO2) is selected on the Thrust Limit page.**
3. Contaminated performance data for liquid contaminants e.g. standing water/slush/wet snow, assumes a braking action on a predetermined incremental scale from below poor braking action at high speeds to medium – good braking action at very low speeds (as the aircraft decelerates from a rejected take-off).
4. It is not permissible to send contaminant correction code and degraded braking action correction code on the same request.
5. **Ensure the correct trust setting for the performance data used is entered in the THRUST LIM page.**
6. **Use CARD speeds for the actual TOW not FMC generated speeds. This may be in conflict with information in FCOM Vol 2 page 11.32.2 as this refers to non-contaminated operations.**

Flow Diagram for Calculating TOPL on a Contaminated Runway

This flow diagram should be used whenever the runway is contaminated.



TOPL = Take-off Performance Limit
EST TOW = Estimated Take-off Weight
TOW = Take-off Weight

Applicability of Contaminated Runway Data

A runway is considered to be contaminated when more than 25 % of the runway surface area (whether in isolated areas or not) within the required length and width being used is covered by contaminant of more than 3 mm of standing water or slush/wet snow, 10 mm of dry snow or when compacted snow is present.

The contaminated runway limitations on the following pages must be observed in these conditions.

For contaminant depths of up to and including 3 mm standing water or slush/wet snow, and 10 mm dry snow, the runway is NOT considered to be contaminated and WET runway data should be used. The contaminated runway limitations on the following pages do NOT apply in these conditions.

Definitions of Contaminated Runway Data Available from CARD

The following take-off performance data for contaminated runways is available from CARD:

Standing Water (CARD Correction Codes 04/05/06)

Caused by heavy rainfall or as a result of melting contaminant in which there are no visible traces of slush or ice crystals *(assumed specific gravity 1.0)*.

Performance data is provided for varying depths of standing water. Braking action assumed is on a predetermined incremental scale from below poor braking action at high speeds, to good to medium braking action at very low speeds.

Slush (Wet Snow) (CARD Correction Codes 07/08/09)

Water saturated snow, which with a heel and toe slap down action with the foot against the ground, will be displaced with a splatter (*assumed specific gravity 0.50 to 0.80*).

Wet snow is a composition which, if compacted by hand, will stick together and tend to, or does form a snowball, should be treated as Slush for performance calculations (*assumed specific gravity 0.50*).

Performance data is provided for varying depths of slush. Braking action assumed is on a predetermined incremental scale from below poor braking action at high speeds, to good to medium braking action at very low speeds.

Compacted Snow (CARD Correction Code 10)

Snow that has been compressed into a solid mass that resists further compression and will hold together or break up into chunks if picked up *(assumed specific gravity 0.35 to 0.50).*

Performance data for compacted snow assumes a braking action of good. *(If braking action is reported as good, conditions should not be expected to be as good as on clean, dry runways. The value "good" is comparative and is intended to mean that airplanes should not experience braking or* *directional control difficulties when stopping. The performance level used to calculate the "good" data is consistent with wet runway testing done on early Boeing jets).*

Dry Snow (CARD Correction Codes 11/12/13/14)

A condition where snow can be blown loose, or if compacted by hand, will fall apart upon release (*assumed specific gravity less than 0.35*). Dry snow only occurs below temperatures of about -5°C, and if there is any doubt as to the condition of the snow it should be treated as slush. A mixture of snow and slush must be treated as slush.

Performance data is provided for varying depths of dry snow. Braking action assumed is on a predetermined incremental scale from below poor braking action at high speeds, to good to medium braking action at very low speeds.

Observe the Following Limitations

- If there is any doubt about the condition of the snow especially when **OAT is above -5°C treat it as slush**.
- A mixture of snow and slush **must be treated as slush**.
- Use Flap 20 for take-off.
- Refer to QRH for max crosswind component.
- Full thrust take-off TO TO1 and TO2 are permitted. See flow charts and example for assistance in determining which take-off thrust setting to use.
- Take-off with Reduced Thrust using the assumed temperature method is NOT permitted.
- Engine anti-ice ON for take-off (except in standing water with OAT above 10°C). Airframe anti-ice ON as required after flap retraction.
- There are no deficiencies in braking systems i.e. Auto Speedbrake, Reverse Thrust, Wheel brakes and Anti-skid.
- Packs may be ON or OFF.
- Use the maximum runway distance available.
- The nature of the overrun area, the potential consequences of an overrun and possible weather changes since the last measurement report must be considered.
- Visual guidance for take-off must be available from any of the following:
  - Runway centreline lighting/paint markings.

  - Runway edge lighting or markers/markings.
- Minimum cleared width 45 m and symmetrical about centreline.
- Snow banks:

Cleared Width of	Max Height of Snow Bank
46 m (150 ft) or less	45 cm (1.5 ft)
46 – 60 m (150 – 195 ft)	Linear increase from 45 – 75 cm (1.5 – 2.5 ft)
60 – 66 m (195 – 220 ft)	Linear increase from 75 – 150 cm (2.5 –5 ft)
66 – 90 m (220 – 300 ft)	150 cm (5 ft)

Note: Take-off with tailwind greater than 5 kt is NOT recommended due to the adverse impact on performance weights.

4.5 Take-off from Degraded Braking Action Runways

All take-off performance for degraded braking runways should be obtained from CARD. Performance data for degraded braking action runways assumes the runway is **NOT** contaminated with water, slush or snow, and has a uniform braking action along the entire length and width of the runway, which is an unlikely situation.

The degraded braking data available from CARD provides three levels of braking action Medium, Medium to Poor and Poor or Unreliable.

The use of TO1 and TO2 take-off power settings is permitted for degraded braking action take-offs. TO1 and TO2 can be selected on the THRUST LIM page to provide fix derate take-off power settings (B747 FCOM Vol 2 page 11.32.2 provides further information). Of particular note are two statements:

1. The thrust setting parameter is considered a limitation for take-off. *This means that in the CARD performance calculation a lower value of V_{MCG} is used*.
2. Thrust levers should not be advanced further (except in an emergency) *e.g. windshear or blocked runway.* ***A further increase in thrust following an engine failure could result in a loss of directional control.***

   The bold sentence at item 2 above is crucial. When using TO1 or TO2, the performance is calculated on the assumption of a lower V_{MCG} associated with the reduced maximum thrust setting, which can potentially increase the TOPL on contaminated or shorter runways where the aircraft's lower weight results in V_{MCG} becoming the limiting factor. However, more thrust is still available if the thrust levers are advanced. If more thrust is applied on the ground the V_{MCG} is re-set to a higher value, and if an engine has failed the aircraft could be below the re-set V_{MCG} value resulting in insufficient rudder authority to control the swing.

Using TO1 or TO2 for Card Degraded Braking Action Take-off Calculations

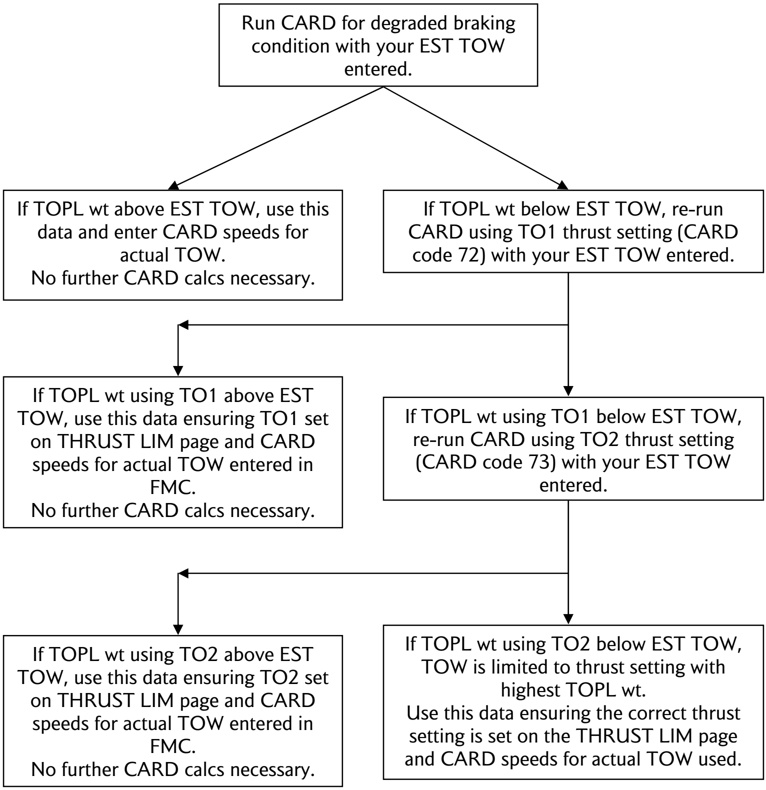
On page 13 a flow diagram illustrates the iterative process required when doing this complex calculation.

Notes

1. The use of fixed derates (TO1 or TO2) will generally produce an improved TOPL only on runways of less than about 3000 m in degraded braking conditions.
2. The contaminant codes calculate a full power take-off. When used with code 72 (TO1) or 73 (TO2) CARD calculates the performance using the respective power setting and its associated reduced V_{MCG}. It is the reduction in the V_{MCG} value that allows the increase in TOPL. This is an approved means of compliance with the requirement of a full power take-off in these conditions. **It is vital that the correct thrust setting (TO, TO1 or TO2) is selected on the Thrust Limit page.**
3. Degraded braking action performance data assumes a uniform level of braking action for the entire length and width of the runway, and that the runway is **NOT** contaminated, this is an unlikely situation.
4. It is not permissible to send degraded braking action correction code and contaminated correction code on the same request.
5. **Ensure the correct trust setting for the performance data used is entered in the THRUST LIM page.**
6. **Use CARD speeds for the actual TOW not FMC generated speeds. This may be in conflict with information in FCOM Vol 2 page 11.32.2 as this refers to non-contaminated operations**.

Flow Diagram for Calculating TOPL on a Degraded Braking Action Runway

This flow diagram should be used whenever the runway has a degraded braking action.



TOPL = Take-off Performance Limit
EST TOW = Estimated Take-off Weight
TOW = Take-off Weight

Definitions of Braking Action Data Available from CARD

The following take-off performance data for degraded braking action runways is available from CARD.

Medium Braking Action – ICAO Code 3 (CARD Correction Code 20)

Performance data assumes a uniform level of medium braking action for the entire length and width of the runway and the runway is not contaminated. Expect noticeably degraded braking conditions, and plan for a longer stopping distance such as might be expected on a compacted snow covered runway. Directional control may be slightly reduced.

Medium to Poor Braking Action – ICAO Code 2 (CARD Correction Code 21)

Performance data assumes a uniform level of medium to poor braking action for the entire length and width of the runway and the runway is not contaminated. Expect degraded braking conditions such that a substantially longer stopping distance should be expected and planned for. Directional control may be reduced.

Poor or Unreliable Braking Action – ICAO Code 1 (CARD Correction Code 22)

Performance data assumes a uniform level of poor or unreliable braking action for the entire length and width of the runway and the runway is not contaminated. Very degraded braking conditions, expect and plan for significantly longer stopping distance such as might be expected on an ice covered runway. Directional control may be significantly reduced.

Nil Braking Action – ICAO Code 0

No braking action and very poor directional control. **DO NOT TAKE-OFF IN THESE CONDITIONS**.

Observe the Following Limitations

- Use Flap 20 for take-off.
- Refer to QRH for max crosswind component.
- Full thrust take-off TO TO1 and TO2 are permitted. See flow charts and example for assistance in determining which take-off thrust setting to use.
- Take-off with Reduced Thrust using the assumed temperature method is NOT permitted.
- There are no deficiencies in braking systems i.e. Auto Speedbrake, Reverse Thrust, Wheel brakes and Anti-skid.
- Packs may be ON or OFF.
- Use the maximum runway distance available.
- The nature of the overrun area, the potential consequences of an overrun and possible weather changes since the last measurement report must be considered.

Note: Take-off with tailwind greater than 5 kt is NOT recommended due to the adverse impact on performance weights.

4.6 Landing on Contaminated or Degraded Braking Action Runways

The definitions of contaminated and degraded braking action runways remain the same as those used for take-off earlier in this section. The landing data is provided in two different manuals.

Performance Manual (Planning/Dispatch)

The landing data provided in the Performance manual meets the specific JAR certification requirements, and is factored according to the certification requirements.

Slippery Runway

Landing data published in the Performance manual is the actual demonstrated data plus a factor of 1.15 added for JAR certification requirements, and the runway is NOT contaminated, which Boeing have chosen to equate to a runway covered in wet ice.

QRH/FCOM (Advisory)

The landing data provided in the QRH is actual demonstrated landing performance data (unfactored) for various configurations and conditions. Boeing have chosen to equate their data to braking actions GOOD, MEDIUM and POOR and therefore takes no account of contaminant drag, and give this explanation as to the correlation of data:

"Airplane braking action is reported as good, medium or poor, depending on existing runway conditions. If braking action is reported as good, conditions should not be expected to be as good as on clean dry runways. The value "good" is comparative and is intended to mean that airplanes should not experience braking or directional control difficulties when stopping. The performance level used to calculate the "good" data is consistent with wet runway testing done on early Boeing jets. The performance level used to calculate the "poor" data reflects a runway covered with wet ice."

It is left to the Captain to assess the conditions expected at the time of landing to determine an appropriate factor to apply to this data.

Boeing recommends the use of the data labelled poor for calculating performance when landing on runways with reported standing water and slush.

Landing in Snow and Slush

Landing is permitted in up 10 cm (4 inches) of dry snow using Normal landing weights. Wet snow should be treated as slush and compacted snow as ice.

Minimum acceptable width of cleared runway is 45 m (150 ft).

Maximum height of snow banks for given cleared widths are given below:

Cleared Width	Max Height of Snow Bank
45 m (150 ft)	45 cm (1.5 ft)
58 m (190 ft)	76 cm (2.5 ft)
67 m (220 ft)	1.5 m (5 ft)

Above 67 m (220 ft) of cleared width, snow banks should not greatly exceed 1.5 m (5 ft). A uniform increase in the height of snow banks from 45 cm (1.5 ft) to 76 cm (2.5 ft) and 76 cm (2.5 ft) to 1.5 m (5 ft) may be used.

Snow banks must not exceed 76 cm (2.5 ft) adjacent to the runway edge.

Landing in slush or excessive water deeper than 1.3 cm (0.5 inches) or snow deeper than 10 cm (4 inches) should be avoided where possible, as airframe damage may result if these limitations are exceeded.

Landing distance should be calculated taking into account reported braking action and ambient conditions.

5 DRIFTDOWN AND DEPRESSURISATION

5.1 Introduction and General Notes

Introduction

This section provides route specific drift-down and de-pressurisation procedures for areas of high terrain. FCTM sections 7.6 and 4.13 discuss En-route Terrain – Drift Down and Oxygen analysis.

Fuel Jettison

On some sectors the high terrain is early in the flight and the fuel remaining will permit fuel jettison in the event of an IFSD. The analysis has shown that the terrain will be cleared without using fuel jettison. However, it is recommended that fuel jettison is selected as soon as workload permits. Further fuel jettison may be necessary to reduce weight below MLDW.

Escape Route

If the procedure includes the requirement for an escape route, then this **must** be inserted in Non-active Route (usually route 2) of the FMS at a time of low workload. This will ensure the aircraft can be safely navigated away from high terrain without delay in the event of an emergency.

MSA Band Width

The normal flight plan MSA bandwidth is 20 nm either side of track. For RNP 5 aircraft the bandwidth may be reduced to 5 nm. This is considered a sufficient margin, given the accuracy of GPS, and complies with the JAR-OPS requirement. In all cases sufficient lateral distance will be included in the terrain assessment to allow for turns and offsets.

MSAs and Terrain Clearance

The procedures will ensure that the aircraft will clear all terrain by at least 2000 ft under the most restrictive weight and met conditions.

Turns

The route specific procedure will specify the turn direction and offset to maximise terrain clearance. Terrain clearance is checked assuming a 15 degree banked turn. The mean turn radius will be close to 10 nm. For a drift down turn back, a 20 to 25 degree bank angle will reduce the height loss (allowing for extra gradient loss).

5.2 Specific Route Driftdown Procedures

5.2.1 Driftdown/Oxygen Procedure for Operation on Airways A368/B215 Through China En-route to HKG

(Eastbound)

B747-400	LHR – HKG Via Route A368/B215

Critical Points

YABRAI (YBL) (N39 25.7 E102 46.3) for engine failure.
OXY1 (N43 38.1 E090 25.1) 152 nm North of HMI, 110 nm South of FKG for decompression.
OXY2 (N34 30.3 E104 13.4) 69 nm North of OMBON, 162 nm South of JTA for decompression.

Actions Following in Flight Shut Down

Dependent on position as follows:
Once established at driftdown altitude, establish Two engine inoperative level-off height. Compare with MSAs on route ahead, and if adequate clearance is not available, divert as appropriate.

1. **Before YABRAI (YBL):** Proceed to YBL and route via A596 or B330 to ZBAA or ZBHH dependant on fuel.
2. **After YABRAI (YBL):** Proceed to destination.

Actions Following Depressurisation

1. **Before OXY1 (after Fukang):** Return to Urumqi area. Either land at Urumqi or divert back to CIS on A368 via SARIN.
2. **Between OXY1 (after Fukang) and OXY 2 (after JTA):** Proceed/return to Yabrai (YBL) as appropriate and route A596 to Beijing or destination dependant on fuel.
3. **After OXY 2 (after JTA):** Proceed to destination.

Note: Sufficient oxygen capacity is available to cover a decompression at OXY1 and divert to Urumqi or if this is not available, diversion by A368 via SARIN to the CIS. If routing via A368 – SARIN no special oxygen handling procedures are required. (MSAs to the West of SARIN are low enough that oxygen is not required.)

Escape Route

Escape route available via A596 towards Beijing ZBAA or Hohhot ZBHH dependant on fuel.

MSAs and Turns

Turns are permitted in either direction.

5.2.2 Driftdown/Oxygen Procedure for Operation on Airways B215/A368 Through China En-route from HKG (Westbound)

B747-400	HKG – LHR Via Route B215/A368

Critical Points

OXY1 (N43 38.1 E090 25.1) 152 nm North of HMI, 110 nm South of FKG for decompression.

Actions Following in Flight Shut Down

Dependent on position as follows:
Once established at driftdown altitude, establish Two engine inoperative level off height. Compare with MSAs on route ahead, and if adequate clearance is not available, divert as appropriate.

Actions Following Depressurisation

1. **Before OXY1 (between Hami HMI and Fukang FKG):** Proceed/return to Yabrai (YBL) as appropriate and route A596 towards Beijing ZBAA or Hohhot ZBHH dependant on fuel.
2. **After OXY1:** Route to CIS or divert to Urumqi.

Note: Sufficient oxygen capacity is available to cover a decompression at OXY1 and divert to Urumqi or if this is not available, diversion by A368 via SARIN to the CIS. If routing via A368 – SARIN no special oxygen handling procedures are required. (MSAs to the West of SARIN are low enough that oxygen is not required.)

Escape Route

Escape route available via A596 towards Beijing ZBAA or Hohhot ZBHH dependant on fuel.

MSAs and Turns

Turns are permitted in either direction.

5.2.3 Driftdown/Oxygen Procedure for Operation on Airway B330 Through China En-route to HKG

(Eastbound)

B747-400	**LHR – HKG Via Route B330 MORIT**

Critical Points

OXY2 (N34 30.3 E104 13.4) 69 nm North of OMBON, 162 nm South of JTA for decompression.

Actions Following in Flight Shut Down

Dependent on position as follows:
Once established at driftdown altitude, establish Two engine inoperative level off height. Compare with MSAs on route ahead, and if adequate clearance is not available, divert as appropriate.

Actions Following Depressurisation

1. **Before OXY2:** Proceed on airway A596 towards Beijing ZBAA or Hohhot ZBHH dependant on fuel or turnback and proceed to Novosibirsk (UNNT/OVB) on airway B330.

   Continuation past OXY2 on routing or a return to Urumqi/Kazakhstan past OXY1 is **not** permitted due to terrain critical oxygen requirements.
2. **After OXY2:** Continue to HKG.

Escape Route

Escape route available via A596 towards Beijing ZBAA or Hohhot ZBHH dependant on fuel.

MSAs and Turns

Turns are permitted in either direction.

5.2.4 Driftdown/Oxygen Procedure for Operation on Airways B330 Through China En-route from HKG

(Westbound)

B747-400	HKG – LHR Via Route B330 MORIT

Critical Points

OXY2 (N34 30.3 E104 13.4) 69 nm North of OMBON, 162 nm South of JTA for decompression.

Actions Following in Flight Shut Down

Dependent on position as follows:
Once established at driftdown altitude, establish Two engine inoperative level off height. Compare with MSAs on route ahead, and if adequate clearance is not available, divert as appropriate.

Actions Following Depressurisation

1. **Prior to OXY2:** Turn back and return to HKG.
2. **After OXY2:** Continue to Novosibrsk (UNNT/OVB) on airway B330 or proceed on airway A596 towards Beijing ZBAA or Hohhot ZBHH dependant on fuel.

Escape Route

Escape route available via A596 towards Beijing ZBAA or Hohhot ZBHH dependant on fuel.

MSAs and Turns

Turns are permitted in either direction.

5.2.5 Driftdown/Oxygen Procedure for Operation on Airway UB612 through Eastern Africa enroute to NBO

(Southbound)

B747-400	LHR – NBO via route UB612 MLK

Critical Points

TAPOS

Actions Following in Flight Shut Down

Dependent on position as follows:
Once established at driftdown altitude, establish Two Engine Inoperative level off height. Compare with MSAs on route ahead, and if adequate clearance is not available, divert as appropriate.

Actions Following Depressurisation

1. **Before TAPOS:** Follow route to PATAR. Right onto UA408/UM216. Divert to Entebbe (EBB/HUEN).

   Continuation past PATAR on routing following a depressurisation before TAPOS is not permitted due to terrain critical oxygen requirements.
2. **After TAPOS:** Continue on route to Nairobi (NBO/HKJK).

Escape Route

Escape route available via UA408/UM216 to Entebbe (EBB/HUEN).

MSAs and Turns

Turns are permitted in either direction.

5.2.6 Driftdown/Oxygen Procedure for Operation on Airway UN556 through Eastern Africa enroute to NBO (Southbound)

B747-400	LHR – NBO via route UN556 OVGAT

Critical Points

NABRO

Actions Following in Flight Shut Down

Dependent on position as follows:
Once established at driftdown altitude, establish Two Engine Inoperative level off height. Compare with MSAs on route ahead, and if adequate clearance is not available, divert as appropriate.

Actions Following Depressurisation

1. **Before NABRO:** Follow route to NABRO. Right onto UA408/UM216. Divert to Entebbe (EBB/HUEN).

   Continuation past NABRO on routing is not permitted due to terrain critical oxygen requirements.
2. **After NABRO:** Continue on route to Nairobi (NBO/HKJK).

Escape Route

Escape route available via UA408/UM216 to Entebbe (EBB/HUEN).

MSAs and Turns

Turns are permitted in either direction.

5.2.7 Decompression/Engine Failure Procedure for Operation on Airway UP975/UG8/UM688 Eastbound

B747-400	UP975/UG8/UM688 Eastbound

Critical Points

SIVAS (N39 47'22.90 E036 53'36.20) for driftdown and decompression.
SORAR (N38 37'27.00 E039 30'45.00) for driftdown and decompression.
OTKEP (N37 51'33.00 E042 39'36.00) for driftdown and decompression.

Actions Following Decompression/Engine Failure

1. **Before SIVAS/SIV** – divert as appropriate ***OR*** continue to SIVAS/SIV, turn right onto UL615 and divert to Ankara (LTAC/ESB).
2. **Between SIVAS/SIV and SORAR** – turn right and backtrack, offsetting the airway to SIVAS/SIV, turn left onto UL615 and divert to Ankara (LTAC/ESB).
3. **Between SORAR and OTKEP** – continue to OTKEP, continue onto UG8 to ALRAM, G208 to UMH, A422 to TBZ and divert to Tabriz (OITT/TBZ). If Tabriz is not available, turn North from TBZ on R661 to DULAV, L125 to NEGAN and divert to Yerevan (UDYZ/EVN).
4. **After OTKEP** – continue on planned route and divert as appropriate.

MSAs and Turns

Turn direction is unrestricted.

Notes – see Figure 1 (new figure).

Figure 1 Decompression Procedure UP975/UG8/UM688 Eastbound

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