TAKEOFF

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TAKEOFF SPEED CALCULATION (B747-400 – All Engine Types)

Overview: The FMC-CDU, when initialized for correct aircraft weight, will provide base V1/Vr/V2 speeds for Dry/Clean runway conditions and Wet/Cluttered runway conditions. Speeds may be manually calculated using the charts and tables on the following pages.

To determine the correct V1, Vr, V2 speeds and the correct Engine-Out Pitch Attitude:

1) Find departure airport Elevation (Mean Sea Level) and Temperature.
2) Enter the ***Temperature – Altitude Region*** chart using the departure field elevation and current airport temperature. (Altitude from left and temperature from the bottom.)
3) Determine the letter region (A-L) where these two figures intersect on the chart. (If in the non lettered region to the right of the chart, takeoff is not advised.)
4) Determine the desired thrust setting (Full, 5%, 15% derate) and flap setting (10/20) for takeoff.
5) Using the ***V1,Vr,V2*** table appropriate for your takeoff thrust and flap setting, read your takeoff speeds from the appropriate letter region column based upon aircraft weight.
6) On the same chart, record the pitch angle that appears in column A based upon your aircraft weight.
7) Return to this page, and adjust your calculated speeds to account for runway slope (always 0 in MSFS) and headwind/tailwind component using the ***Slope / Wind Adjustment for V1*** below. (Negative number indicates a tail wind, positive indicates a headwind.)
8) Using the ***Engine Out Pitch Adjustment*** chart, modify the target Engine Out pitch attitude based on the Region Letter from step three.
9) Read the CG position from the TAKEOFF REF page of the FMC-CDU. Press the associated LSK on the CDU to have FMC-CDU calculate correct elevator trim setting, or use the table on page 1-15.

Example: Use the following GE engine example as an exercise for manually calculating takeoff speeds:

Departure Airport Altitude / Temp:	5,000 MSL / 20C
Aircraft Weight:	350,000kgs (770,000lbs)
Flap and Thrust setting for takeoff:	Flaps 20 / Max Thrust
Runway Slope / Wind Component	0.0 slope / 10 knot headwind
CG position as reported by FMC	23%

Results from above steps:

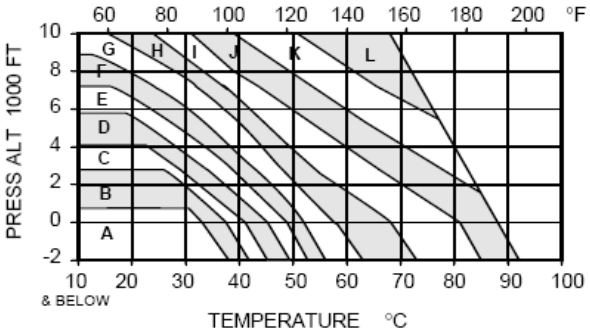
Letter Region from *Temperature – Altitude* Chart	D
Speeds from *Flaps 20 – Max Thrust* Chart	V1 – 147, Vr – 160, V2 – 171
Adjustment for Headwind:	+1 knot to V1/Vr
Final Takeoff Speeds:	V1 – 148, Vr – 160, V2 – 171
Engine Out Pitch Attitude for takeoff:	14 – 1 = 13 degrees
Stabilizer Trim Setting:	6 degrees*

*Interpolate trim setting if required figures are between positions on the chart.

TAKEOFF SPEEDS – Dry Runway: GE CF6 Engines

Maximum Rated Thrust / Flaps 10

TEMPERATURE - ALTITUDE REGION



SLOPE/WIND V_1 ADJUSTMENT

WEIGHT	SLOPE %					WIND KTS							
1000 KG	-2	-1	0	1	2	-15	-10	-5	0	10	20	30	40
400	-4	-2	0	2	3	-6	-4	-2	0	1	1	1	2
350	-3	-2	0	1	3	-5	-4	-2	0	1	1	2	2
300	-3	-1	0	1	2	-5	-4	-2	0	1	1	2	2
250	-2	-1	0	1	2	-5	-4	-2	0	1	1	2	3
200	-2	-1	0	1	2	-5	-4	-2	0	1	1	2	3

V_1, V_R, V_2 KIAS

CLIMB ATTITUDE (ATT) 3 ENGINES - DEGREES

WEIGHT	TEMPERATURE - ALTITUDE REGION																			
	A				B				C				D				E				F			
1000 KG	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT
400	160	178	189	15	161	179	189	14	162	180	189	14	163	180	189	14	165	181	189	14	167	182	189	13
390	158	176	187	15	159	177	187	14	160	177	187	14	161	178	187	14	163	179	187	14	165	180	187	13
380	156	173	185	15	157	174	185	15	158	175	185	14	159	176	185	14	161	176	185	14	163	177	185	14
370	154	170	183	15	155	171	183	15	156	172	183	15	157	173	183	14	158	174	183	14	160	175	183	14
360	151	167	180	15	152	168	180	15	153	169	180	15	154	170	180	14	156	171	180	14	158	172	180	14
350	148	164	177	15	149	165	177	15	150	166	177	15	152	167	177	15	153	167	177	14	155	168	177	14
340	145	160	175	16	147	162	175	16	148	162	175	15	149	163	175	15	150	164	175	15	152	165	175	14
330	142	157	172	16	144	158	172	16	145	159	172	16	146	160	172	15	148	161	172	15	149	162	172	15
320	139	154	169	16	141	155	169	16	142	156	169	16	143	157	169	16	145	157	169	15	146	159	169	15
310	136	150	166	17	137	151	166	17	139	152	166	16	140	153	166	16	142	154	166	16	143	155	166	15
300	133	147	164	17	134	148	164	17	135	149	164	17	137	150	164	16	138	151	164	16	140	152	164	16
290	129	143	161	18	131	144	161	17	132	145	161	17	134	146	161	17	135	147	161	16	137	148	161	16
280	126	139	158	18	128	141	158	18	129	141	158	17	130	142	158	17	132	143	158	17	134	144	158	16
270	123	136	155	18	124	137	155	18	125	138	155	18	127	139	155	17	128	140	155	17	130	141	155	17
260	120	132	153	19	121	133	153	19	122	134	152	18	123	135	152	18	125	136	152	17	127	137	152	17
250	116	129	150	19	117	130	150	19	118	131	150	19	119	131	150	18	121	132	150	18	123	133	149	17
240	112	125	147	20	113	126	147	20	114	127	147	19	115	128	147	19	117	129	147	18	118	130	147	18
230	108	121	145	20	109	123	144	20	110	123	144	20	111	124	144	19	113	125	144	19	114	126	144	18
220	104	117	142	21	105	119	142	21	106	120	141	20	107	120	141	20	109	121	141	19	110	122	141	19
210	100	114	139	21	101	115	139	21	102	116	139	21	103	116	138	20	104	117	138	20	106	118	138	20
200	95	110	136	22	96	111	136	22	98	112	136	21	99	113	135	21	100	113	135	21	102	114	135	20

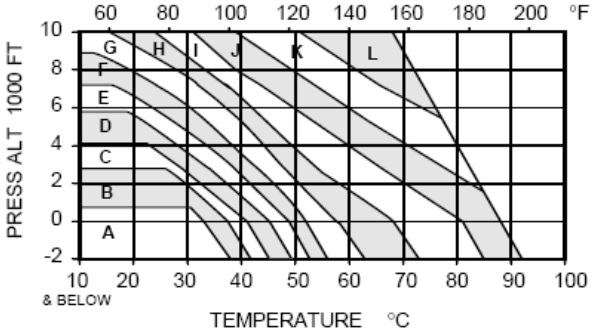
WEIGHT	TEMPERATURE - ALTITUDE REGION																			
	G				H				I				J				K				L			
1000 KG	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT
400	169	183	189	13	171	184	189	13	174	186	189	12												
390	167	181	187	13	169	182	187	13	172	183	187	12												
380	165	179	185	13	167	180	185	13	170	181	185	12	173	182	185	12								
370	163	176	183	13	165	177	183	13	168	178	183	12	171	180	183	12								
360	160	173	180	13	162	174	180	13	165	175	180	13	168	177	180	12								
350	157	170	177	14	160	171	177	13	163	172	177	13	166	174	177	12								
340	154	166	175	14	157	168	175	13	160	169	175	13	163	171	175	12	166	172	175	12				
330	152	163	172	14	154	165	172	14	157	166	172	13	160	167	172	13	162	169	172	12				
320	149	160	169	14	151	161	169	14	154	163	169	13	156	164	169	13	159	166	169	12				
310	146	156	166	15	148	158	166	14	151	159	166	14	153	161	166	13	156	162	166	13				
300	143	153	164	15	145	154	164	15	148	156	164	14	150	157	164	14	153	159	164	13	155	161	164	12
290	139	150	161	15	142	151	161	15	145	152	161	14	147	154	161	14	149	156	161	13	152	157	161	13
280	136	146	158	16	139	147	158	15	141	149	158	15	144	151	158	14	146	152	158	13	149	154	158	13
270	133	142	155	16	135	144	155	15	138	145	155	15	140	147	155	14	143	149	155	14	145	150	155	13
260	129	139	152	16	132	140	152	16	134	142	152	15	137	143	152	15	139	145	152	14	142	147	153	13
250	125	135	149	17	128	136	149	16	130	138	149	16	133	140	149	15	136	141	149	14	138	143	150	13
240	121	131	146	17	123	133	146	17	126	134	146	16	129	136	146	15	132	138	146	15	134	139	147	14
230	117	127	143	18	119	129	143	17	122	130	143	16	125	132	143	16	128	134	143	15	131	136	144	14
220	112	123	140	18	115	125	140	18	118	126	140	17	120	128	140	16	123	130	140	15	126	132	141	14
210	108	119	137	19	111	121	137	18	113	122	137	18	116	124	137	17	119	126	137	16	122	128	137	15
200	104	116	134	19	106	117	134	19	109	118	134	18	112	120	133	17	115	122	134	16	118	124	134	15

For speeds located in the shaded areas of this table, please ensure V1 is equal to or greater than the VMCG/Minimum V1 speed found on page 1-14.

TAKEOFF SPEEDS – Dry Runway: GE CF6 Engines

Maximum Rated Thrust / Flaps 20

TEMPERATURE - ALTITUDE REGION



SLOPE/WIND V_1 ADJUSTMENT

WEIGHT 1000 KG	SLOPE %					WIND KTS						
	-2	-1	0	1	2	-15	-10	-5	0	10	20	30	40
400	-4	-2	0	2	3	-6	-4	-2	0	1	1	1	2
350	-3	-2	0	1	3	-5	-4	-2	0	1	1	2	2
300	-3	-1	0	1	2	-5	-4	-2	0	1	1	2	2
250	-2	-1	0	1	2	-5	-4	-2	0	1	1	2	3
200	-2	-1	0	1	2	-5	-4	-2	0	1	1	2	3

V_1, V_R, V_2 KIAS

CLIMB ATTITUDE (ATT) 3 ENGINES - DEGREES

WEIGHT 1000 KG	TEMPERATURE - ALTITUDE REGION																							
	A				B				C				D				E				F			
	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT
400	155	171	182	13	156	172	182	13	157	173	182	12	157	174	182	12	159	174	182	12	160	175	182	12
390	153	169	180	13	154	170	180	13	155	171	180	12	156	172	180	12	157	172	180	12	159	173	180	11
380	151	167	178	13	152	168	178	13	153	168	178	12	154	169	178	12	155	170	178	12	157	171	178	11
370	149	164	176	13	149	165	176	13	150	166	176	13	152	166	176	12	153	167	176	12	155	168	176	12
360	146	161	174	13	147	162	174	13	148	163	174	13	149	164	174	13	151	164	174	12	152	165	174	12
350	143	158	171	14	144	159	171	13	145	160	171	13	147	160	171	13	148	161	171	12	149	162	171	12
340	140	155	169	14	141	156	169	14	143	156	169	13	144	157	169	13	145	158	169	13	147	159	169	12
330	137	151	166	14	138	152	166	14	140	153	166	14	141	154	166	13	142	155	166	13	144	156	166	13
320	134	148	163	14	135	149	163	14	137	150	163	14	138	151	163	14	140	152	163	13	141	153	163	13
310	131	145	160	15	132	146	160	15	134	147	160	14	135	147	160	14	136	148	160	14	138	149	160	13
300	128	141	158	15	129	142	158	15	131	143	158	15	132	144	158	14	133	145	158	14	135	146	158	14
290	125	138	155	16	126	139	155	15	127	140	155	15	129	141	155	15	130	142	155	14	132	143	155	14
280	122	134	152	16	123	135	152	16	124	136	152	16	126	137	152	15	127	138	152	15	129	139	152	15
270	118	130	149	17	119	132	149	16	121	132	149	16	122	133	149	16	123	134	149	15	125	135	149	15
260	114	126	146	17	115	127	146	17	116	128	146	17	118	129	146	16	119	130	146	16	121	131	146	15
250	110	123	144	18	111	124	143	17	112	125	143	17	114	125	143	17	115	126	143	16	117	127	143	16
240	106	119	141	18	107	121	141	18	108	121	141	17	110	122	140	17	111	123	140	17	113	124	140	16
230	103	116	138	18	104	117	138	18	105	118	138	18	106	119	138	18	107	119	138	17	109	120	137	17
220	99	112	136	19	100	113	136	19	101	114	135	18	102	115	135	18	103	116	135	18	105	117	134	17
210	95	108	133	20	96	110	133	19	97	110	133	19	98	111	132	19	99	112	132	18	101	113	132	18
200	90	105	130	20	92	106	130	20	93	107	130	20	94	107	129	19	95	108	129	19	97	109	129	18

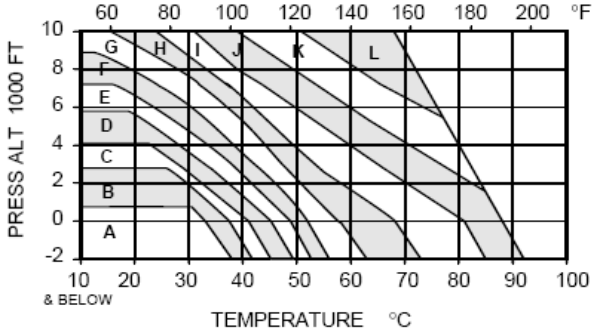
WEIGHT 1000 KG	TEMPERATURE - ALTITUDE REGION																							
	G				H				I				J				K				L			
	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT
400	163	176	182	11	165	177	182	11	168	178	182	11												
390	161	174	180	11	163	175	180	11	166	177	180	10												
380	159	172	178	11	161	173	178	11	164	174	178	10												
370	157	169	176	11	159	171	176	11	162	172	176	11	165	173	176	10								
360	154	166	174	12	157	168	174	11	159	169	174	11	162	170	174	10								
350	152	163	171	12	154	165	171	11	157	166	171	11	160	167	171	10								
340	149	160	169	12	152	162	169	12	155	163	169	11	158	164	169	11	161	166	169	10				
330	146	157	166	12	149	158	166	12	151	160	166	11	154	161	166	11	157	163	166	10				
320	144	154	163	12	146	155	163	12	148	157	163	11	151	158	163	11	153	160	163	10				
310	141	151	160	13	143	152	160	12	145	153	160	12	148	155	160	11	150	156	160	11				
300	138	147	158	13	140	149	158	13	142	150	158	12	145	152	158	11	147	153	158	11	150	155	158	10
290	134	144	155	14	137	145	155	13	139	147	155	12	142	148	155	12	144	150	155	11	147	151	155	11
280	131	140	152	14	134	142	152	13	136	143	152	13	138	145	152	12	141	147	152	12	143	148	152	11
270	128	137	149	14	130	138	149	14	132	140	149	13	135	141	149	12	137	143	149	12	140	145	149	11
260	123	133	146	15	126	134	146	14	128	136	146	14	131	137	146	13	133	139	146	12	136	141	146	12
250	119	129	143	15	122	130	143	15	124	132	143	14	127	134	143	13	129	135	143	13	132	137	143	12
240	115	125	140	16	117	127	140	15	120	128	140	15	123	130	140	14	125	132	140	13	128	133	140	12
230	111	121	137	16	113	123	137	16	116	124	137	15	119	126	137	14	121	128	137	13	124	130	137	12
220	107	118	134	17	109	119	134	16	112	121	134	15	114	122	134	15	117	124	134	14	120	126	134	13
210	103	114	131	17	105	115	131	16	107	117	131	16	110	119	131	15	113	120	131	14	116	122	131	13
200	99	110	128	18	101	112	128	17	103	113	128	16	106	115	128	15	109	117	128	14	112	118	128	14

For speeds located in the shaded areas of this table, please ensure V1 is equal to or greater than the VMCG/Minimum V1 speed found on page 1-14.

TAKEOFF SPEEDS – Wet Runway: GE CF6 Engines

Maximum Rated Thrust / Flaps 10

TEMPERATURE - ALTITUDE REGION



SLOPE/WIND V_1 ADJUSTMENT

WEIGHT 1000 KG	SLOPE %					WIND KTS							
	-2	-1	0	1	2	-15	-10	-5	0	10	20	30	40
400	-9	-5	0	4	7	-6	-4	-2	0	1	2	3	4
350	-7	-4	0	3	6	-6	-4	-2	0	1	2	3	4
300	-6	-3	0	2	4	-5	-4	-2	0	1	2	3	4
250	-5	-2	0	2	4	-5	-3	-2	0	1	2	3	4
200	-5	-2	0	2	4	-5	-3	-2	0	1	2	3	4

V_1, V_R, V_2 KIAS

CLIMB ATTITUDE (ATT) 3 ENGINES - DEGREES

WEIGHT 1000 KG	TEMPERATURE - ALTITUDE REGION																			
	A				B				C				D				E				F			
	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT
400	146	178	189	15	148	179	189	14	150	180	189	14	153	180	189	14	154	181	189	14	156	182	189	13
390	144	176	187	15	146	177	187	14	148	177	187	14	150	178	187	14	152	179	187	14	154	180	187	13
380	142	173	185	15	144	174	185	15	145	175	185	14	148	176	185	14	150	176	185	14	152	177	185	14
370	139	170	183	15	141	171	183	15	142	172	183	15	145	173	183	14	147	174	183	14	149	175	183	14
360	136	167	180	15	138	168	180	15	139	169	180	15	142	170	180	14	144	171	180	14	146	172	180	14
350	132	164	177	15	135	165	177	15	136	166	177	15	138	167	177	15	140	167	177	14	143	168	177	14
340	129	160	175	16	131	162	175	16	133	162	175	15	135	163	175	15	137	164	175	15	139	165	175	14
330	126	157	172	16	128	158	172	16	130	159	172	16	132	160	172	15	134	161	172	15	136	162	172	15
320	123	154	169	16	125	155	169	16	127	156	169	16	129	157	169	16	131	157	169	15	133	159	169	15
310	120	150	166	17	122	151	166	17	124	152	166	16	126	153	166	16	127	154	166	16	130	155	166	15
300	117	147	164	17	119	148	164	17	121	149	164	17	122	150	164	16	124	151	164	16	127	152	164	16
290	114	143	161	18	116	144	161	17	117	145	161	17	119	146	161	17	121	147	161	16	123	148	161	16
280	111	139	158	18	113	141	158	18	114	141	158	17	116	142	158	17	118	143	158	17	120	144	158	16
270	108	136	155	18	110	137	155	18	111	138	155	18	113	139	155	17	114	140	155	17	116	141	155	17
260	105	132	153	19	107	133	153	19	108	134	152	18	109	135	152	18	111	136	152	17	113	137	152	17
250	102	129	150	19	103	130	150	19	104	131	150	19	105	131	150	18	107	132	150	18	109	133	149	17
240	98	125	147	20	99	126	147	20	100	127	147	19	102	128	147	19	103	129	147	18	105	130	147	18
230	94	121	145	20	96	123	144	20	97	123	144	20	98	124	144	19	99	125	144	19	101	126	144	18
220	90	117	142	21	92	119	142	21	93	120	141	20	94	120	141	20	95	121	141	19	97	122	141	19
210	87	114	139	21	88	115	139	21	89	116	139	21	90	116	138	20	91	117	138	20	93	118	138	20
200	83	110	136	22	84	111	136	22	85	112	136	21	86	113	135	21	87	113	135	21	89	114	135	20

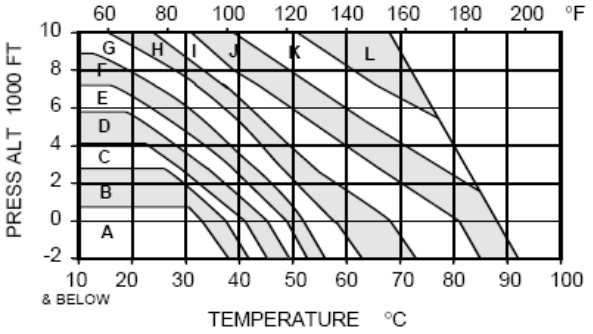
WEIGHT 1000 KG	TEMPERATURE - ALTITUDE REGION																			
	G				H				I				J				K				L			
	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT
400	160	183	189	13	163	184	189	13	166	186	189	12												
390	158	181	187	13	161	182	187	13	164	183	187	12												
380	156	179	185	13	159	180	185	13	162	181	185	12	165	182	185	12								
370	153	176	183	13	156	177	183	13	159	178	183	12	162	180	183	12								
360	150	173	180	13	153	174	180	13	156	175	180	13	159	177	180	12								
350	146	170	177	14	149	171	177	13	153	172	177	13	156	174	177	12								
340	143	166	175	14	146	168	175	13	149	169	175	13	153	171	175	12	156	172	175	12				
330	140	163	172	14	143	165	172	14	146	166	172	13	149	167	172	13	153	169	172	12				
320	136	160	169	14	139	161	169	14	143	163	169	13	146	164	169	13	149	166	169	12				
310	133	156	166	15	136	158	166	14	139	159	166	14	143	161	166	13	146	162	166	13				
300	130	153	164	15	133	154	164	15	136	156	164	14	139	157	164	14	143	159	164	13	146	161	164	12
290	126	150	161	15	129	151	161	15	133	152	161	14	136	154	161	14	140	156	161	13	143	157	161	13
280	123	146	158	16	126	147	158	15	129	149	158	15	133	151	158	14	136	152	158	13	140	154	158	13
270	119	142	155	16	122	144	155	15	126	145	155	15	129	147	155	14	133	149	155	14	136	150	155	13
260	116	139	152	16	119	140	152	16	122	142	152	15	126	143	152	15	129	145	152	14	133	147	153	13
250	111	135	149	17	115	136	149	16	118	138	149	16	121	140	149	15	125	141	149	14	129	143	150	13
240	107	131	146	17	110	133	146	17	114	134	146	16	117	136	146	15	120	138	146	15	124	139	147	14
230	103	127	143	18	106	129	143	17	109	130	143	16	113	132	143	16	116	134	143	15	119	136	144	14
220	99	123	140	18	102	125	140	18	105	126	140	17	108	128	140	16	111	130	140	15	115	132	141	14
210	95	119	137	19	98	121	137	18	101	122	137	18	104	124	137	17	107	126	137	16	110	128	137	15
200	91	116	134	19	94	117	134	19	96	118	134	18	99	120	133	17	102	122	134	16	105	124	134	15

For speeds located in the shaded areas of this table, please ensure V1 is equal to or greater than the VMCG/Minimum V1 speed found on page 1-14.

TAKEOFF SPEEDS – Wet Runway: GE CF6 Engines

Maximum Rated Thrust / Flaps 20

TEMPERATURE - ALTITUDE REGION



SLOPE/WIND V_1 ADJUSTMENT

WEIGHT	SLOPE %					WIND KTS							
1000 KG	-2	-1	0	1	2	-15	-10	-5	0	10	20	30	40
400	-9	-5	0	4	7	-6	-4	-2	0	1	2	3	4
350	-7	-4	0	3	6	-6	-4	-2	0	1	2	3	4
300	-6	-3	0	2	4	-5	-4	-2	0	1	2	3	4
250	-5	-2	0	2	4	-5	-3	-2	0	1	2	3	4
200	-5	-2	0	2	4	-5	-3	-2	0	1	2	3	4

V_1, V_R, V_2 KIAS

CLIMB ATTITUDE (ATT) 3 ENGINES - DEGREES

WEIGHT	TEMPERATURE - ALTITUDE REGION																			
	A				B				C				D				E			
1000 KG	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT
400	140	171	182	13	142	172	182	13	144	173	182	12	146	174	182	12	148	174	182	12
390	139	169	180	13	141	170	180	13	142	171	180	12	144	172	180	12	146	172	180	12
380	137	167	178	13	138	168	178	13	140	168	178	12	142	169	178	12	144	170	178	12
370	134	164	176	13	136	165	176	13	137	166	176	13	139	166	176	12	141	167	176	12
360	131	161	174	13	133	162	174	13	134	163	174	13	136	164	174	13	138	164	174	12
350	128	158	171	14	130	159	171	13	131	160	171	13	133	160	171	13	135	161	171	12
340	125	155	169	14	127	156	169	14	128	156	169	13	130	157	169	13	132	158	169	13
330	122	151	166	14	124	152	166	14	125	153	166	14	127	154	166	13	129	155	166	13
320	119	148	163	14	121	149	163	14	122	150	163	14	124	151	163	14	126	152	163	13
310	116	145	160	15	118	146	160	15	119	147	160	14	121	147	160	14	123	148	160	14
300	113	141	158	15	115	142	158	15	116	143	158	15	118	144	158	14	120	145	158	14
290	110	138	155	16	112	139	155	15	113	140	155	15	115	141	155	15	116	142	155	14
280	107	134	152	16	109	135	152	16	110	136	152	16	112	137	152	15	113	138	152	15
270	104	130	149	17	106	132	149	16	107	132	149	16	108	133	149	16	110	134	149	15
260	100	126	146	17	101	127	146	17	103	128	146	17	104	129	146	16	105	130	146	16
250	96	123	144	18	98	124	143	17	99	125	143	17	100	125	143	17	101	126	143	16
240	92	119	141	18	94	121	141	18	95	121	141	17	96	122	140	17	98	123	140	17
230	89	116	138	18	91	117	138	18	92	118	138	18	93	119	138	18	94	119	138	17
220	85	112	136	19	87	113	136	19	88	114	135	18	89	115	135	18	90	116	135	18
210	81	108	133	20	83	110	133	19	84	110	133	19	85	111	132	19	87	112	132	18
200	78	105	130	20	79	106	130	20	81	107	130	20	82	107	129	19	83	108	129	19

WEIGHT	TEMPERATURE - ALTITUDE REGION																			
	G				H				I				J				K			
1000 KG	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT	V_1	V_R	V_2	ATT
400	153	176	182	11	155	177	182	11	158	178	182	11								
390	151	174	180	11	154	175	180	11	157	177	180	10								
380	149	172	178	11	152	173	178	11	155	174	178	10								
370	146	169	176	11	149	171	176	11	152	172	176	11	155	173	176	10				
360	143	166	174	12	146	168	174	11	149	169	174	11	153	170	174	10				
350	140	163	171	12	143	165	171	11	146	166	171	11	149	167	171	10				
340	137	160	169	12	140	162	169	12	143	163	169	11	146	164	169	11	150	166	169	10
330	134	157	166	12	137	158	166	12	140	160	166	11	143	161	166	11	147	163	166	10
320	131	154	163	12	134	155	163	12	137	157	163	11	140	158	163	11	144	160	163	10
310	128	151	160	13	131	152	160	12	134	153	160	12	137	155	160	11	140	156	160	11
300	124	147	158	13	127	149	158	13	131	150	158	12	134	152	158	11	137	153	158	11
290	121	144	155	14	124	145	155	13	127	147	155	12	131	148	155	12	134	150	155	11
280	118	140	152	14	121	142	152	13	124	143	152	13	127	145	152	12	131	147	152	12
270	115	137	149	14	117	138	149	14	121	140	149	13	124	141	149	12	127	143	149	12
260	110	133	146	15	113	134	146	14	116	136	146	14	119	137	146	13	123	139	146	12
250	106	129	143	15	109	130	143	15	112	132	143	14	115	134	143	13	118	135	143	13
240	102	125	140	16	105	127	140	15	108	128	140	15	111	130	140	14	114	132	140	13
230	98	121	137	16	101	123	137	16	104	124	137	15	107	126	137	14	110	128	137	13
220	94	118	134	17	97	119	134	16	99	121	134	15	103	122	134	15	106	124	134	14
210	90	114	131	17	93	115	131	16	95	117	131	16	98	119	131	15	102	120	131	14
200	87	110	128	18	89	112	128	17	91	113	128	16	94	115	128	15	97	117	128	14

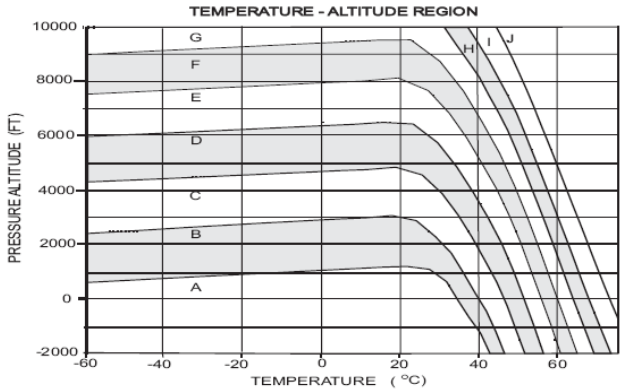
WEIGHT	TEMPERATURE - ALTITUDE REGION							
	L			
1000 KG	V_1	V_R	V_2	ATT
400				
390				
380				
370				
360				
350				
340				
330				
320				
310				
300	141	155	158	10
290	137	151	155	11
280	134	148	152	11
270	131	145	149	11
260	126	141	146	12
250	122	137	143	12
240	118	133	140	12
230	113	130	137	12
220	109	126	134	13
210	105	122	131	13
200	101	118	128	14

For speeds located in the shaded areas of this table, please ensure V1 is equal to or greater than the VMCG/Minimum V1 speed found on page 1-14.

TAKEOFF SPEEDS – Dry Runway: PW 4062 Engines

Maximum Rated Thrust / Flaps 10

(Wet Runway Adjustment Is On This Page)



SLOPE/WIND V_1 ADJUSTMENT

WEIGHT (1000 KG)	SLOPE (%)					WIND (KTS)							
	-2	-1	0	1	2	-15	-10	-5	0	10	20	30	40
420	-6	-3	0	3	6	-6	-4	-2	0	1	2	3	4
400	-6	-3	0	3	5	-6	-4	-2	0	1	2	3	4
380	-5	-3	0	2	5	-5	-3	-2	0	1	2	3	4
360	-5	-2	0	2	4	-5	-3	-1	0	1	2	3	3
340	-4	-2	0	2	4	-4	-3	-1	0	1	2	2	3
320	-4	-2	0	2	4	-4	-3	-1	0	1	2	2	3
300	-4	-2	0	2	3	-4	-2	-1	0	1	2	2	3
280	-3	-2	0	1	3	-4	-2	-1	0	1	2	2	3
260	-3	-1	0	1	3	-4	-3	-1	0	1	2	2	3
240	-3	-1	0	1	3	-4	-3	-1	0	1	2	3	4
220	-3	-1	0	1	2	-4	-3	-1	0	1	2	3	4
200	-2	-1	0	1	2	-5	-3	-2	0	1	2	3	4

V1, VR, V2 (KIAS)

WEIGHT (1000 KG)	TEMPERATURE - ALTITUDE REGION														
	A			B			C			D			E		
	V1	VR	V2	V1	VR	V2	V1	VR	V2	V1	VR	V2	V1	VR	V2
420	160	181	193	162	183	193	165	185	193	168	187	194			
400	155	175	188	157	177	188	160	179	188	164	181	189	165	182	189
380	151	170	184	153	172	184	156	174	185	160	176	185	162	178	185
360	145	163	179	148	166	179	151	168	180	154	170	180	157	172	180
340	140	157	174	142	159	174	146	161	174	149	163	175	152	165	175
320	134	150	168	136	152	169	140	154	169	143	156	169	146	158	170
300	128	143	163	130	145	163	133	147	163	137	149	163	140	151	164
280	123	137	158	124	138	158	127	140	158	131	142	158	133	144	158
260	117	130	153	118	131	152	121	133	152	124	134	152	126	137	152
240	109	122	147	111	123	147	113	125	146	116	127	146	118	129	146
220	101	115	142	103	116	141	105	118	141	108	119	140	110	121	140
200	93	107	136	94	108	136	97	110	135	99	111	135	102	113	134

For speeds located in the shaded areas of this table, please ensure V1 is equal to or greater than the VMCG/Minimum V1 speed found on page 1-14.

V1 Adjustment for Wet/Cluttered Runway

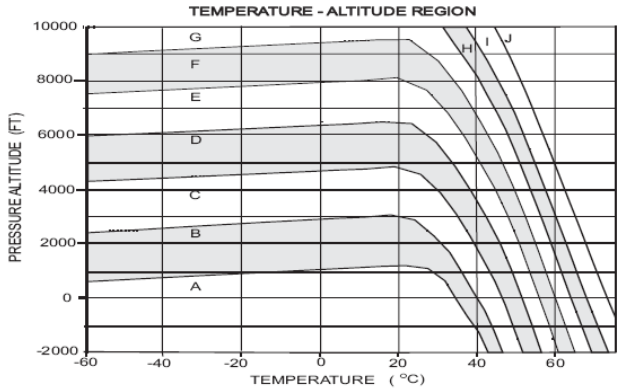
WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESSURE ALTITUDE (FT)			PRESSURE ALTITUDE (FT)			PRESSURE ALTITUDE (FT)		
	S.L.	5000	10000	S.L.	5000	10000	S.L.	5000	10000
460	0	0	0	-17	-13	-9	-37	-32	-27
440	-3	-1	0	-19	-15	-11	-40	-35	-30
420	-5	-3	-1	-22	-18	-14	-43	-38	-33
400	-7	-5	-3	-24	-20	-16	-46	-41	-36
380	-9	-7	-5	-27	-23	-19	-48	-43	-38
360	-10	-8	-6	-29	-25	-21	-50	-45	-40
340	-12	-10	-8	-31	-27	-23	-52	-47	-42
320	-13	-11	-9	-32	-28	-24	-54	-49	-44
300	-15	-13	-11	-34	-30	-26	-55	-50	-45
280	-16	-14	-12	-35	-31	-27	-56	-51	-46
260	-17	-15	-13	-36	-32	-28	-56	-51	-46
240	-17	-15	-13	-36	-32	-28	-56	-51	-46
220	-16	-14	-12	-35	-31	-27	-54	-49	-44
200	-15	-13	-11	-34	-30	-26	-52	-47	-42

Enter table with current braking action report, aircraft weight and departure field elevation. Adjust V1 by the amount indicated on the table.

TAKEOFF SPEEDS – Dry Runway: PW 4062 Engines

Maximum Rated Thrust / Flaps 20

(Wet Runway Adjustment Is On This Page)



SLOPE/WIND V_1 ADJUSTMENT

WEIGHT (1000 KG)	SLOPE (%)					WIND (KTS)							
	-2	-1	0	1	2	-15	-10	-5	0	10	20	30	40
420	-6	-3	0	3	6	-6	-4	-2	0	1	2	3	4
400	-6	-3	0	3	5	-6	-4	-2	0	1	2	3	4
380	-5	-3	0	2	5	-5	-3	-2	0	1	2	3	4
360	-5	-2	0	2	4	-5	-3	-1	0	1	2	3	3
340	-4	-2	0	2	4	-4	-3	-1	0	1	2	2	3
320	-4	-2	0	2	4	-4	-3	-1	0	1	2	2	3
300	-4	-2	0	2	3	-4	-2	-1	0	1	2	2	3
280	-3	-2	0	1	3	-4	-2	-1	0	1	2	2	3
260	-3	-1	0	1	3	-4	-3	-1	0	1	2	2	3
240	-3	-1	0	1	3	-4	-3	-1	0	1	2	3	4
220	-3	-1	0	1	2	-4	-3	-1	0	1	2	3	4
200	-2	-1	0	1	2	-5	-3	-2	0	1	2	3	4

V1, VR, V2 (KIAS)

WEIGHT (1000 KG)	TEMPERATURE - ALTITUDE REGION														
	A			B			C			D			E		
	V1	VR	V2	V1	VR	V2	V1	VR	V2	V1	VR	V2	V1	VR	V2
420	154	174	186	156	176	186	160	178	186	163	180	187			
400	149	169	181	151	171	181	155	172	182	158	174	182	159	175	182
380	145	164	178	148	166	178	151	168	178	154	170	178	156	172	179
360	140	158	173	143	160	173	146	162	173	149	164	173	152	166	174
340	134	151	168	137	153	168	140	155	168	144	157	168	146	159	169
320	129	145	162	131	147	163	134	149	163	138	151	163	141	153	163
300	123	138	157	125	140	157	128	142	157	132	144	157	135	146	158
280	118	131	151	119	132	152	122	135	152	126	137	152	128	139	152
260	111	124	146	113	125	146	115	127	146	118	130	146	121	132	146
240	104	117	141	105	118	141	107	120	140	110	121	140	113	124	140
220	96	109	136	97	111	135	100	112	135	102	114	134	105	116	134
200	88	102	130	90	103	130	92	105	129	95	106	129	97	108	128

For speeds located in the shaded areas of this table, please ensure V1 is equal to or greater than the VMCG/Minimum V1 speed found on page 1-14.

V1 Adjustment for Wet/Cluttered Runway

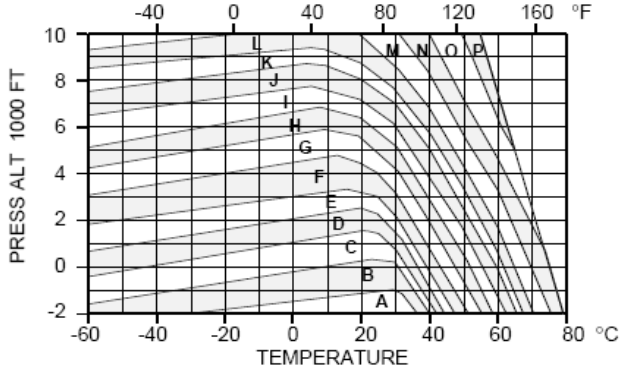
WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESSURE ALTITUDE (FT)			PRESSURE ALTITUDE (FT)			PRESSURE ALTITUDE (FT)		
	S.L.	5000	10000	S.L.	5000	10000	S.L.	5000	10000
460	0	0	0	-17	-13	-9	-37	-32	-27
440	-3	-1	0	-19	-15	-11	-40	-35	-30
420	-5	-3	-1	-22	-18	-14	-43	-38	-33
400	-7	-5	-3	-24	-20	-16	-46	-41	-36
380	-9	-7	-5	-27	-23	-19	-48	-43	-38
360	-10	-8	-6	-29	-25	-21	-50	-45	-40
340	-12	-10	-8	-31	-27	-23	-52	-47	-42
320	-13	-11	-9	-32	-28	-24	-54	-49	-44
300	-15	-13	-11	-34	-30	-26	-55	-50	-45
280	-16	-14	-12	-35	-31	-27	-56	-51	-46
260	-17	-15	-13	-36	-32	-28	-56	-51	-46
240	-17	-15	-13	-36	-32	-28	-56	-51	-46
220	-16	-14	-12	-35	-31	-27	-54	-49	-44
200	-15	-13	-11	-34	-30	-26	-52	-47	-42

Enter table with current braking action report, aircraft weight and departure field elevation. Adjust V1 by the amount indicated on the table.

TAKEOFF SPEEDS – Dry Runway: RR RB211 Engines

Maximum Rated Thrust / Flaps 10

Temperature / Altitude Region:



WEIGHT 1000 KG	SLOPE %					WIND KTS							
	-2	-1	0	1	2	-15	-10	-5	0	10	20	30	40
400	-5	-2	0	1	3	-6	-4	-2	0	1	1	2	2
350	-4	-2	0	1	2	-6	-4	-2	0	1	1	1	2
300	-3	-1	0	1	2	-5	-3	-2	0	0	1	1	2
250	-3	-1	0	1	2	-5	-3	-2	0	0	1	1	2
200	-3	-1	0	1	2	-5	-3	-2	0	0	1	1	2

V1, Vr, V2

WEIGHT (1000 KG)	TEMPERATURE - ALTITUDE REGION																											
	A				B				C				D				E				F				G				H			
	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT
400	156	171	182	13	156	172	182	12	157	172	182	12	158	173	182	12	159	173	182	12	159	174	182	12	161	175	182	11	162	175	182	11
390	154	169	180	13	154	169	180	12	155	170	180	12	156	170	180	12	157	171	180	12	157	172	180	12	159	173	180	11	160	173	180	11
380	152	166	178	13	152	167	178	13	153	167	178	12	154	168	178	12	155	169	178	12	155	169	178	12	156	170	178	11	158	171	178	11
370	149	163	176	13	150	164	176	13	150	164	176	12	151	165	176	12	152	166	176	12	153	167	176	12	154	167	176	11	156	168	176	11
360	147	160	174	13	147	161	174	13	148	162	174	13	149	162	174	12	150	163	174	12	150	164	174	12	151	164	174	12	153	165	174	12
350	144	157	171	14	145	158	171	13	145	158	171	13	146	159	171	13	147	160	171	12	148	161	171	12	149	161	171	12	151	162	171	12
340	141	154	169	14	142	155	169	14	142	155	169	13	143	156	169	13	145	157	169	13	145	157	169	13	146	158	169	12	148	159	169	12
330	138	151	166	14	139	151	166	14	139	152	166	14	140	153	166	13	142	153	166	13	142	154	166	13	143	155	166	13	145	156	166	12
320	135	148	163	14	136	148	163	14	136	149	163	14	137	149	163	14	139	150	163	13	140	151	163	13	140	152	163	13	142	153	163	12
310	132	144	160	15	133	145	160	15	133	145	160	14	134	146	160	14	136	147	160	14	137	148	160	13	137	148	160	13	139	149	160	13
300	129	141	158	15	130	141	158	15	130	142	158	15	131	143	158	14	132	143	158	14	134	144	158	14	134	145	158	13	136	146	158	13
290	125	137	155	16	126	138	155	15	127	139	155	15	128	139	155	15	129	140	155	14	130	141	155	14	131	142	155	14	133	142	155	13
280	122	134	152	16	123	134	152	16	123	135	152	15	125	136	152	15	126	136	152	15	127	137	152	15	128	138	152	14	129	139	152	14
270	118	130	149	17	119	131	149	16	120	131	149	16	121	132	149	16	122	133	149	15	123	133	149	15	124	134	149	15	126	135	149	14
260	115	126	146	17	116	127	146	17	117	127	146	16	117	128	146	16	118	129	146	16	119	130	146	15	121	130	146	15	122	131	146	15
250	111	122	144	17	112	123	143	17	113	124	143	17	114	124	143	17	115	125	143	16	116	126	143	16	117	126	143	16	118	127	143	15
240	108	119	141	18	109	120	141	18	110	120	141	17	110	121	141	17	111	121	141	17	112	122	140	16	113	123	140	16	115	123	140	16
230	104	115	138	18	105	116	138	18	106	117	138	18	107	117	138	18	107	118	138	17	108	118	138	17	110	119	138	16	111	120	138	16
220	101	112	136	19	101	112	136	19	102	113	136	18	103	114	135	18	104	114	135	18	105	115	135	17	106	115	135	17	107	116	135	17
210	97	108	133	20	98	109	133	19	98	109	133	19	99	110	133	19	100	110	133	18	101	111	132	18	102	112	132	18	103	112	132	17
200	93	104	131	20	94	105	130	20	95	105	130	20	95	106	130	19	96	107	130	19	97	107	130	18	98	108	130	18	99	109	129	18

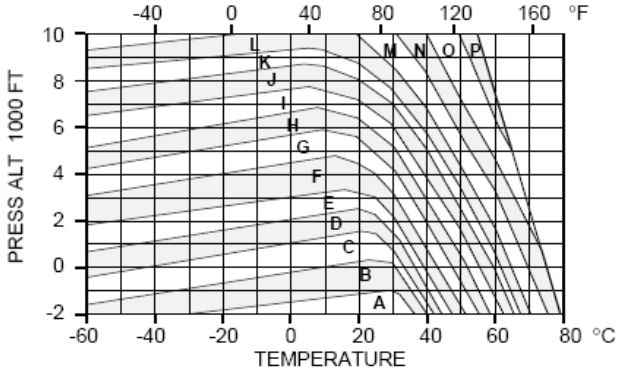
WEIGHT (1000 KG)	TEMPERATURE - ALTITUDE REGION																											
	I				J				K				L				M				N				O				P			
	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT
400	170	183	189	13	172	184	189	12	172	185	189	12	174	185	189	12	176	186	189	11												
390	168	180	187	13	169	181	187	12	170	182	187	12	171	183	187	12	173	183	187	11												
380	165	178	185	13	167	179	185	13	167	179	185	12	169	180	185	12	170	180	185	12	171	182	185	11								
370	163	175	183	13	164	176	183	13	165	177	183	12	166	177	183	12	168	178	183	12	169	180	183	11	169	180	183	11				
360	160	172	180	13	162	173	180	13	162	174	180	13	163	174	180	12	165	175	180	12	166	176	180	11	167	177	180	11				
350	157	169	177	13	159	170	177	13	159	171	177	13	161	171	177	12	162	172	177	12	163	173	177	12	165	174	177	11				
340	155	166	175	14	156	167	175	13	156	168	175	13	158	168	175	13	160	169	175	12	161	170	175	12	163	171	175	11	165	172	175	11
330	152	163	172	14	153	164	172	13	154	164	172	13	155	165	172	13	157	166	172	12	158	167	172	12	160	168	172	12	163	169	172	11
320	149	159	169	14	150	160	169	14	151	161	169	13	152	162	169	13	154	163	169	13	155	164	169	12	158	165	169	12	160	166	169	11
310	146	156	166	14	147	157	166	14	148	158	166	14	149	159	166	13	152	160	166	13	153	160	166	12	155	162	166	12	158	163	166	12
300	143	152	164	15	144	153	164	14	145	154	164	14	146	155	164	14	149	156	164	13	150	157	164	13	152	159	164	12	155	159	164	12
290	139	149	161	15	141	150	161	15	142	151	161	14	143	152	161	14	146	153	161	13	147	154	161	13	149	155	161	13	152	156	161	12
280	136	145	158	15	138	146	158	15	139	147	158	15	140	148	158	14	142	150	158	14	143	151	158	13	146	152	158	13	149	153	158	12
270	133	141	155	16	134	142	155	15	135	143	155	15	137	145	155	15	138	146	155	14	140	147	155	14	143	148	155	13	145	150	155	13
260	129	138	152	16	131	139	152	16	132	140	152	15	133	141	152	15	135	142	152	14	136	144	152	14	139	145	151	13	141	146	151	13
250	125	134	149	17	127	135	149	16	128	136	149	16	129	137	149	15	131	138	149	15	133	140	148	14	135	141	148	14	138	143	148	13
240	122	130	146	17	123	131	146	17	124	133	146	16	126	134	146	16	127	134	146	15	129	136	145	15	131	138	145	14	134	139	145	14
230	118	127	143	17	119	128	143	17	120	129	143	17	122	130	143	16	123	131	143	15	125	132	142	15	127	134	142	14	129	135	142	14
220	114	123	140	18	115	124	140	17	116	125	140	17	117	126	140	17	119	127	140	16	121	128	139	15	123	130	139	15	125	131	139	14
210	110	119	137	18	111	120	137	18	112	121	137	18	113	122	137	17	115	123	137	16	117	124	136	16	119	125	136	15	121	127	136	15
200	105	115	135	19	107	116	134	19	108	117	134	18	109	118	134	18	111	119	134	17	113	120	133	16	114	121	133	16	117	122	133	15

For speeds located in the shaded areas of this table, please ensure V1 is equal to or greater than the VMCG/Minimum V1 speed found on page 1-14.

TAKEOFF SPEEDS – Dry Runway: RR RB211 Engines

Maximum Rated Thrust / Flaps 20

Temperature / Altitude Region:



WEIGHT 1000 KG	SLOPE %					WIND KTS							
	-2	-1	0	1	2	-15	-10	-5	0	10	20	30	40
400	-5	-2	0	1	3	-6	-4	-2	0	1	1	2	2
350	-4	-2	0	1	2	-6	-4	-2	0	1	1	1	2
300	-3	-1	0	1	2	-5	-3	-2	0	0	1	1	2
250	-3	-1	0	1	2	-5	-3	-2	0	0	1	1	2
200	-3	-1	0	1	2	-5	-3	-2	0	0	1	1	2

V1, Vr, V2

WEIGHT (1000 KG)	TEMPERATURE - ALTITUDE REGION																											
	A				B				C				D				E				F				G				H			
	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT
400	156	171	182	13	156	172	182	12	157	172	182	12	158	173	182	12	159	173	182	12	159	174	182	12	161	175	182	11	162	175	182	11
390	154	169	180	13	154	169	180	12	155	170	180	12	156	170	180	12	157	171	180	12	157	172	180	12	159	173	180	11	160	173	180	11
380	152	166	178	13	152	167	178	13	153	167	178	12	154	168	178	12	155	169	178	12	155	169	178	12	156	170	178	11	158	171	178	11
370	149	163	176	13	150	164	176	13	150	164	176	12	151	165	176	12	152	166	176	12	153	167	176	12	154	167	176	11	156	168	176	11
360	147	160	174	13	147	161	174	13	148	162	174	13	149	162	174	12	150	163	174	12	150	164	174	12	151	164	174	12	153	165	174	12
350	144	157	171	14	145	158	171	13	145	158	171	13	146	159	171	13	147	160	171	12	148	161	171	12	149	161	171	12	151	162	171	12
340	141	154	169	14	142	155	169	14	142	155	169	13	143	156	169	13	145	157	169	13	145	157	169	13	146	158	169	12	148	159	169	12
330	138	151	166	14	139	151	166	14	139	152	166	14	140	153	166	13	142	153	166	13	142	154	166	13	143	155	166	13	145	156	166	12
320	135	148	163	14	136	148	163	14	136	149	163	14	137	149	163	14	139	150	163	13	140	151	163	13	140	152	163	13	142	153	163	12
310	132	144	160	15	133	145	160	15	133	145	160	14	134	146	160	14	136	147	160	14	137	148	160	13	137	148	160	13	139	149	160	13
300	129	141	158	15	130	141	158	15	130	142	158	15	131	143	158	14	132	143	158	14	134	144	158	14	134	145	158	13	136	146	158	13
290	125	137	155	16	126	138	155	15	127	139	155	15	128	139	155	15	129	140	155	14	130	141	155	14	131	142	155	14	133	142	155	13
280	122	134	152	16	123	134	152	16	123	135	152	15	125	136	152	15	126	136	152	15	127	137	152	15	128	138	152	14	129	139	152	14
270	118	130	149	17	119	131	149	16	120	131	149	16	121	132	149	16	122	133	149	15	123	133	149	15	124	134	149	15	126	135	149	14
260	115	126	146	17	116	127	146	17	117	127	146	16	117	128	146	16	118	129	146	16	119	130	146	15	121	130	146	15	122	131	146	15
250	111	122	144	17	112	123	143	17	113	124	143	17	114	124	143	17	115	125	143	16	116	126	143	16	117	126	143	16	118	127	143	15
240	108	119	141	18	109	120	141	18	110	120	141	17	110	121	141	17	111	121	141	17	112	122	140	16	113	123	140	16	115	123	140	16
230	104	115	138	18	105	116	138	18	106	117	138	18	107	117	138	18	107	118	138	17	108	118	138	17	110	119	138	16	111	120	138	16
220	101	112	136	19	101	112	136	19	102	113	136	18	103	114	135	18	104	114	135	18	105	115	135	17	106	115	135	17	107	116	135	17
210	97	108	133	20	98	109	133	19	98	109	133	19	99	110	133	19	100	110	133	18	101	111	132	18	102	112	132	18	103	112	132	17
200	93	104	131	20	94	105	130	20	95	105	130	20	95	106	130	19	96	107	130	19	97	107	130	18	98	108	130	18	99	109	129	18

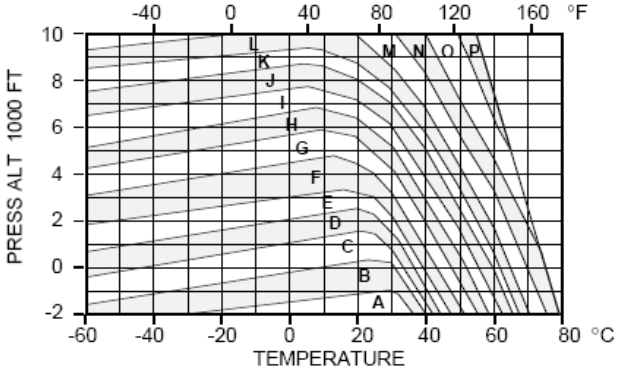
WEIGHT (1000 KG)	TEMPERATURE - ALTITUDE REGION																											
	I				J				K				L				M				N				O				P			
	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT
400	164	176	182	11	166	177	182	11	166	178	182	10	168	178	182	10	169	179	182	10												
390	162	174	180	11	164	175	180	11	164	176	180	10	166	176	180	10	167	177	180	10												
380	160	172	178	11	161	173	178	11	162	173	178	10	163	174	178	10	165	175	178	10	166	175	178	9								
370	157	169	176	11	159	170	176	11	159	170	176	10	161	171	176	10	162	172	176	10	163	173	176	9								
360	155	166	174	11	156	167	174	11	156	168	174	11	158	168	174	10	160	169	174	10	160	170	174	10	162	171	174	9				
350	152	163	171	11	153	164	171	11	154	165	171	11	155	165	171	11	157	166	171	10	158	167	171	10	159	168	171	9				
340	149	160	169	12	151	161	169	11	151	162	169	11	152	162	169	11	155	163	169	10	155	164	169	10	156	165	169	10	158	166	169	9
330	147	157	166	12	148	158	166	12	148	158	166	11	149	159	166	11	152	160	166	11	153	161	166	10	154	162	166	10	155	163	166	9
320	144	154	163	12	145	155	163	12	145	155	163	12	147	156	163	11	149	157	163	11	150	158	163	10	151	159	163	10	153	160	163	9
310	141	150	160	13	142	151	160	12	143	152	160	12	144	153	160	12	146	154	160	11	147	155	160	11	148	156	160	10	150	157	160	10
300	138	147	158	13	139	148	158	12	140	149	158	12	141	150	158	12	144	151	158	11	144	152	158	11	146	153	158	10	148	154	158	10
290	134	144	155	13	136	144	155	13	137	145	155	13	138	146	155	12	140	147	155	12	141	148	155	11	143	150	155	11	145	150	155	10
280	131	140	152	14	132	141	152	13	133	142	152	13	135	143	152	13	137	144	152	12	138	145	152	11	139	146	152	11	141	147	152	10
270	127	136	149	14	129	137	149	13	130	138	149	13	131	139	149	13	134	140	149	12	135	141	149	12	136	142	149	11	138	143	149	11
260	123	132	146	14	125	133	146	14	126	134	146	14	128	135	146	13	130	136	146	13	131	138	146	12	133	139	146	12	135	140	146	11
250	120	129	143	15	121	129	143	14	122	130	143	14	124	131	143	14	126	133	143	13	128	134	143	12	129	135	143	12	131	136	143	11
240	116	124	140	15	117	125	140	15	118	126	140	14	120	127	140	14	122	129	140	13	124	130	139	13	125	131	139	12	128	132	139	12
230	112	121	137	16	113	122	137	15	114	122	137	15	116	124	137	15	118	125	137	14	120	126	137	13	121	127	136	13	124	129	136	12
220	108	117	135	16	109	118	134	16	110	119	134	15	112	120	134	15	114	121	134	14	116	122	134	13	118	123	133	13	120	125	133	12
210	104	113	132	17	105	114	132	16	106	115	131	16	108	116	131	15	110	117	131	14	112	118	131	14	114	120	131	13	116	121	130	13
200	100	109	129	17	101	110	129	17	102	111	129	16	103	112	128	16	105	113	128	15	108	114	128	14	109	116	128	14	112	117	127	13

For speeds located in the shaded areas of this table, please ensure V1 is equal to or greater than the VMCG/Minimum V1 speed found on page 1-14.

TAKEOFF SPEEDS – Wet Runway: RR RB211 Engines

Maximum Rated Thrust / Flaps 10

Temperature / Altitude Region:



WEIGHT 1000 KG	SLOPE %					WIND KTS							
	-2	-1	0	1	2	-15	-10	-5	0	10	20	30	40
400	-6	-3	0	2	4	-5	-3	-2	0	1	1	2	3
350	-6	-3	0	2	4	-5	-4	-2	0	1	2	2	3
300	-5	-2	0	2	3	-5	-4	-2	0	1	2	3	3
250	-5	-2	0	2	3	-5	-4	-2	0	1	2	3	3
200	-5	-2	0	2	3	-5	-4	-2	0	1	2	3	3

V1, Vr, V2

WEIGHT (1000 KG)	TEMPERATURE - ALTITUDE REGION																											
	A				B				C				D				E				F				G				H			
	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT
400	145	178	189	15	146	179	189	14	147	179	189	14	149	180	189	14	151	180	189	13	153	181	189	13	155	182	189	13	157	182	189	13
390	143	175	187	15	144	176	187	14	145	176	187	14	147	177	187	14	149	178	187	14	151	178	187	13	153	179	187	13	154	180	187	13
380	140	172	185	15	142	173	185	14	143	174	185	14	144	174	185	14	146	175	185	14	149	176	185	14	151	177	185	13	152	177	185	13
370	137	170	183	15	139	170	183	15	140	171	183	14	141	171	183	14	143	172	183	14	146	173	183	14	148	174	183	13	149	175	183	13
360	134	167	180	15	136	167	180	15	137	168	180	15	138	168	180	14	140	169	180	14	143	170	180	14	144	171	180	14	146	172	180	13
350	131	163	177	15	133	164	177	15	134	165	177	15	135	165	177	15	137	166	177	14	139	167	177	14	141	168	177	14	143	169	177	14
340	128	160	175	16	130	161	175	15	131	161	175	15	132	162	175	15	134	163	175	15	136	163	175	14	138	164	175	14	140	165	175	14
330	125	157	172	16	127	157	172	16	128	158	172	15	129	159	172	15	130	159	172	15	133	160	172	15	135	161	172	14	136	162	172	14
320	123	153	169	16	124	154	169	16	125	154	169	16	126	155	169	15	128	156	169	15	130	157	169	15	132	158	169	15	133	159	169	14
310	120	150	166	17	121	150	166	16	122	151	166	16	123	152	166	16	124	152	166	16	126	153	166	15	128	154	166	15	130	155	166	15
300	117	146	164	17	118	147	164	17	119	147	164	16	120	148	164	16	121	149	164	16	123	150	164	16	125	151	164	15	126	152	164	15
290	114	143	161	17	115	143	161	17	116	144	161	17	117	144	161	17	118	145	161	16	120	146	161	16	122	147	161	16	123	148	161	15
280	111	139	158	18	112	140	158	18	113	140	158	17	115	141	158	17	115	141	158	17	117	142	158	16	119	143	158	16	120	144	158	16
270	108	135	156	18	109	136	155	18	110	136	155	18	112	137	155	17	112	138	155	17	114	139	155	17	116	139	155	16	117	140	155	16
260	105	132	153	19	106	132	153	18	107	133	153	18	108	134	153	18	109	134	152	18	111	135	152	17	112	136	152	17	114	137	152	16
250	102	128	150	19	102	129	150	19	103	129	150	19	105	130	150	18	105	131	150	18	107	131	149	18	108	132	149	17	110	133	149	17
240	98	125	147	20	99	125	147	19	100	126	147	19	101	126	147	19	101	127	147	18	103	128	147	18	104	128	146	18	106	129	146	17
230	94	121	145	20	95	121	144	20	96	122	144	20	97	123	144	19	98	123	144	19	99	124	144	19	100	125	144	18	102	126	143	18
220	90	117	142	21	91	118	142	21	92	118	141	20	93	119	141	20	94	119	141	20	95	120	141	19	96	121	141	19	98	122	141	18
210	87	113	139	21	87	114	139	21	88	114	139	21	89	115	138	20	90	116	138	20	91	116	138	20	92	117	138	19	94	118	138	19
200	83	109	136	22	84	110	136	22	84	110	136	21	85	111	136	21	86	112	135	21	87	112	135	20	88	113	135	20	90	114	135	19

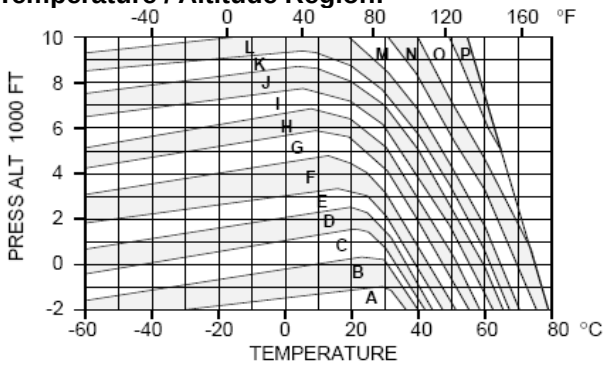
WEIGHT (1000 KG)	TEMPERATURE - ALTITUDE REGION																											
	I				J				K				L				M				N				O				P			
	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT
400	160	183	189	13	161	184	189	12	162	185	189	12	164	185	189	12	165	186	189	11												
390	158	180	187	13	159	181	187	12	160	182	187	12	161	183	187	12	162	183	187	11												
380	156	178	185	13	156	179	185	13	157	179	185	12	158	180	185	12	159	180	185	12	162	182	185	11								
370	153	175	183	13	153	176	183	13	154	177	183	12	155	177	183	12	156	178	183	12	160	180	183	11	161	180	183	11				
360	150	172	180	13	150	173	180	13	151	174	180	13	152	174	180	12	153	175	180	12	157	176	180	11	158	177	180	11				
350	146	169	177	13	147	170	177	13	149	171	177	13	149	171	177	12	151	172	177	12	154	173	177	12	155	174	177	11				
340	143	166	175	14	144	167	175	13	146	168	175	13	147	168	175	13	149	169	175	12	151	170	175	12	153	171	175	11	155	172	175	11
330	140	163	172	14	141	164	172	13	142	164	172	13	144	165	172	13	146	166	172	12	148	167	172	12	150	168	172	12	152	169	172	11
320	136	159	169	14	138	160	169	14	139	161	169	13	141	162	169	13	144	163	169	13	145	164	169	12	147	165	169	12	150	166	169	11
310	133	156	166	14	134	157	166	14	136	158	166	14	138	159	166	13	141	160	166	13	142	160	166	12	144	162	166	12	147	163	166	12
300	130	152	164	15	131	153	164	14	132	154	164	14	135	155	164	14	137	156	164	13	139	157	164	13	142	159	164	12	144	159	164	12
290	126	149	161	15	128	150	161	15	129	151	161	14	131	152	161	14	134	153	161	13	136	154	161	13	139	155	161	13	142	156	161	12
280	123	145	158	15	124	146	158	15	126	147	158	15	128	148	158	14	130	150	158	14	133	151	158	13	136	152	158	13	139	153	158	12
270	119	141	155	16	120	142	155	15	122	143	155	15	124	145	155	15	127	146	155	14	130	147	155	14	132	148	155	13	135	150	155	13
260	115	138	152	16	117	139	152	16	119	140	152	15	120	141	152	15	123	142	152	14	126	144	152	14	128	145	151	13	132	146	151	13
250	111	134	149	17	113	135	149	16	115	136	149	16	116	137	149	15	118	138	149	15	121	140	148	14	124	141	148	14	127	143	148	13
240	107	130	146	17	109	131	146	17	110	133	146	16	112	134	146	16	114	134	146	15	117	136	145	15	119	138	145	14	123	139	145	14
230	103	127	143	17	105	128	143	17	106	129	143	17	108	130	143	16	110	131	143	15	113	132	142	15	115	134	142	14	118	135	142	14
220	99	123	140	18	100	124	140	17	102	125	140	17	104	126	140	17	106	127	140	16	108	128	139	15	111	130	139	15	114	131	139	14
210	95	119	137	18	96	120	137	18	98	121	137	18	99	122	137	17	101	123	137	16	104	124	136	16	106	125	136	15	110	127	136	15
200	90	115	135	19	92	116	134	19	93	117	134	18	95	118	134	18	97	119	134	17	100	120	133	16	102	121	133	16	106	122	133	15

For speeds located in the shaded areas of this table, please ensure V1 is equal to or greater than the VMCG/Minimum V1 speed found on page 1-14.

TAKEOFF SPEEDS – Wet Runway: RR RB211 Engines

Maximum Rated Thrust / Flaps 20

Temperature / Altitude Region:



WEIGHT 1000 KG	SLOPE %					WIND KTS							
	-2	-1	0	1	2	-15	-10	-5	0	10	20	30	40
400	-6	-3	0	2	4	-5	-3	-2	0	1	1	2	3
350	-6	-3	0	2	4	-5	-4	-2	0	1	2	2	3
300	-5	-2	0	2	3	-5	-4	-2	0	1	2	3	3
250	-5	-2	0	2	3	-5	-4	-2	0	1	2	3	3
200	-5	-2	0	2	3	-5	-4	-2	0	1	2	3	3

V1, Vr, V2

WEIGHT (1000 KG)	TEMPERATURE - ALTITUDE REGION																											
	A				B				C				D				E				F				G				H			
	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT
400	139	171	182	13	140	172	182	12	142	172	182	12	143	173	182	12	145	173	182	12	147	174	182	12	149	175	182	11	151	175	182	11
390	137	169	180	13	139	169	180	12	140	170	180	12	141	170	180	12	143	171	180	12	145	172	180	12	147	173	180	11	149	173	180	11
380	135	166	178	13	136	167	178	13	137	167	178	12	139	168	178	12	141	169	178	12	143	169	178	12	145	170	178	11	146	171	178	11
370	132	163	176	13	133	164	176	13	134	164	176	12	136	165	176	12	138	166	176	12	140	167	176	12	142	167	176	11	144	168	176	11
360	130	160	174	13	131	161	174	13	131	162	174	13	133	162	174	12	135	163	174	12	138	164	174	12	139	164	174	12	140	165	174	12
350	127	157	171	14	128	158	171	13	129	158	171	13	130	159	171	13	132	160	171	12	135	161	171	12	136	161	171	12	137	162	171	12
340	124	154	169	14	125	155	169	14	126	155	169	13	127	156	169	13	129	157	169	13	131	157	169	13	133	158	169	12	134	159	169	12
330	121	151	166	14	122	151	166	14	123	152	166	14	124	153	166	13	126	153	166	13	128	154	166	13	130	155	166	13	131	156	166	12
320	118	148	163	14	119	148	163	14	120	149	163	14	121	149	163	14	123	150	163	13	125	151	163	13	127	152	163	13	128	153	163	12
310	115	144	160	15	117	145	160	15	117	145	160	14	119	146	160	14	120	147	160	14	122	148	160	13	124	148	160	13	125	149	160	13
300	112	141	158	15	114	141	158	15	115	142	158	15	116	143	158	14	117	143	158	14	119	144	158	14	121	145	158	13	122	146	158	13
290	109	137	155	16	111	138	155	15	112	139	155	15	114	139	155	15	114	140	155	14	116	141	155	14	118	142	155	14	119	142	155	13
280	106	134	152	16	108	134	152	16	110	135	152	15	111	136	152	15	111	136	152	15	113	137	152	15	115	138	152	14	116	139	152	14
270	103	130	149	17	105	131	149	16	107	131	149	16	108	132	149	16	108	133	149	15	110	133	149	15	111	134	149	15	112	135	149	14
260	100	126	146	17	102	127	146	17	103	127	146	16	104	128	146	16	105	129	146	16	106	130	146	15	108	130	146	15	108	131	146	15
250	96	122	144	17	98	123	143	17	99	124	143	17	101	124	143	17	101	125	143	16	102	126	143	16	104	126	143	16	104	127	143	15
240	93	119	141	18	94	120	141	18	95	120	141	17	97	121	141	17	97	121	141	17	98	122	140	16	100	123	140	16	101	123	140	16
230	89	115	138	18	90	116	138	18	92	117	138	18	93	117	138	18	93	118	138	17	94	118	138	17	96	119	138	16	97	120	138	16
220	86	112	136	19	87	112	136	19	88	113	136	18	89	114	135	18	89	114	135	18	90	115	135	17	92	115	135	17	93	116	135	17
210	83	108	133	20	83	109	133	19	84	109	133	19	85	110	133	19	86	110	133	18	87	111	132	18	88	112	132	18	89	112	132	17
200	79	104	131	20	80	105	130	20	80	105	130	20	81	106	130	19	82	107	130	19	83	107	130	18	84	108	130	18	85	109	129	18

WEIGHT (1000 KG)	TEMPERATURE - ALTITUDE REGION																											
	I				J				K				L				M				N				O				P			
	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT	V1	VR	V2	ATT
400	154	176	182	11	155	177	182	11	156	178	182	10	159	178	182	10	159	179	182	10												
390	152	174	180	11	153	175	180	11	154	176	180	10	157	176	180	10	158	177	180	10												
380	150	172	178	11	151	173	178	11	152	173	178	10	155	174	178	10	156	175	178	10	157	175	178	9								
370	147	169	176	11	148	170	176	11	149	170	176	10	151	171	176	10	153	172	176	10	155	173	176	9								
360	144	166	174	11	145	167	174	11	146	168	174	11	148	168	174	10	150	169	174	10	152	170	174	10	154	171	174	9				
350	141	163	171	11	142	164	171	11	143	165	171	11	145	165	171	11	147	166	171	10	149	167	171	10	151	168	171	9				
340	138	160	169	12	139	161	169	11	140	162	169	11	143	162	169	11	145	163	169	10	146	164	169	10	148	165	169	10	151	166	169	9
330	135	157	166	12	136	158	166	12	137	158	166	11	140	159	166	11	142	160	166	11	144	161	166	10	146	162	166	10	148	163	166	9
320	131	154	163	12	133	155	163	12	133	155	163	12	136	156	163	11	139	157	163	11	141	158	163	10	143	159	163	10	145	160	163	9
310	128	150	160	13	129	151	160	12	130	152	160	12	133	153	160	12	135	154	160	11	138	155	160	11	140	156	160	10	142	157	160	10
300	125	147	158	13	126	148	158	12	127	149	158	12	130	150	158	12	132	151	158	11	134	152	158	11	137	153	158	10	139	154	158	10
290	122	144	155	13	123	144	155	13	124	145	155	13	127	146	155	12	129	147	155	12	131	148	155	11	134	150	155	11	137	150	155	10
280	118	140	152	14	119	141	152	13	120	142	152	13	123	143	152	13	125	144	152	12	128	145	152	11	130	146	152	11	133	147	152	10
270	115	136	149	14	116	137	149	13	117	138	149	13	119	139	149	13	122	140	149	12	124	141	149	12	127	142	149	11	130	143	149	11
260	111	132	146	14	112	133	146	14	113	134	146	14	115	135	146	13	117	136	146	13	120	138	146	12	122	139	146	12	126	140	146	11
250	107	129	143	15	108	129	143	14	109	130	143	14	111	131	143	14	113	133	143	13	116	134	143	12	118	135	143	12	122	136	143	11
240	102	124	140	15	104	125	140	15	105	126	140	14	107	127	140	14	109	129	140	13	111	130	139	13	114	131	139	12	118	132	139	12
230	98	121	137	16	100	122	137	15	101	122	137	15	103	124	137	14	105	125	137	14	107	126	137	13	109	127	136	13	113	129	136	12
220	94	117	135	16	96	118	134	16	97	119	134	15	98	120	134	15	100	121	134	14	103	122	134	13	105	123	133	13	109	125	133	12
210	90	113	132	17	92	114	132	16	93	115	131	16	94	116	131	15	96	117	131	14	99	118	131	14	101	120	131	13	105	121	130	13
200	86	109	129	17	88	110	129	17	89	111	129	16	90	112	128	16	92	113	128	15	94	114	128	14	97	116	128	14	100	117	127	13

For speeds located in the shaded areas of this table, please ensure V1 is equal to or greater than the VMCG/Minimum V1 speed found on page 1-14.

MISCELANEOUS SETTINGS

Stabilizer Trim Setting:

WEIGHT	STAB TRIM SETTING UNITS						
	CG %MAC						
1000 KG	9	13	17	21	25	29	33
400	9 1/2	9	8	7	6	5	4
380	9 1/2	9	8	7	5 1/2	5	3 1/2
360	9 1/2	8 1/2	7 1/2	6 1/2	5 1/2	4 1/2	3 1/2
340	9 1/2	8 1/2	7 1/2	6 1/2	5 1/2	4 1/2	3 1/2
320	9 1/2	8 1/2	7 1/2	6 1/2	5 1/2	4	3
300	9	8	7	6	5	4	3
280	8 1/2	7 1/2	6 1/2	5 1/2	4 1/2	3 1/2	2 1/2
260	8	7	6	5	4	3	2
240		6	5	4 1/2	3 1/2	2 1/2	
220		5	4	3 1/2	3	2	
200		4	3 1/2	3	2 1/2		

Minimum Allowed Vmcg / Vr Speed

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE FT													
		-2000		0		2000		4000		6000		8000		10000	
°C	°F	V_{MCG}	$V_{R\,MIN}$	V_{MCG}	$V_{R\,MIN}$	V_{MCG}	$V_{R\,MIN}$	V_{MCG}	$V_{R\,MIN}$	V_{MCG}	$V_{R\,MIN}$	V_{MCG}	$V_{R\,MIN}$	V_{MCG}	$V_{R\,MIN}$
-55	-67	125	126	123	123	121	121	117	117	114	114	110	110	105	105
0	32	125	125	123	123	121	121	117	117	114	114	110	110	105	105
5	40	125	125	123	123	121	121	117	117	114	114	110	110	105	105
7	45	125	125	123	123	121	121	117	117	114	114	110	110	105	105
9	49	125	125	123	123	121	121	117	117	114	114	110	110	105	105
10	50	125	125	123	123	121	121	117	117	114	114	109	109	105	105
11	52	125	125	123	123	121	121	117	117	114	114	109	109	105	105
13	56	125	125	123	123	121	121	117	117	114	114	109	109	104	104
14	57	125	125	123	123	121	121	117	117	114	114	109	109	104	104
15	59	125	125	123	123	121	121	117	117	113	113	109	109	104	104
18	65	125	125	123	123	121	121	117	117	113	113	108	108	103	103
20	68	125	125	123	123	121	121	117	117	113	113	108	108	103	103
21	70	125	125	123	123	121	121	117	117	112	112	107	107	103	103
24	75	125	125	123	123	121	121	116	116	112	112	107	107	102	102
25	77	125	125	123	123	120	120	116	116	112	112	106	107	102	102
27	80	125	125	123	123	120	120	115	116	111	111	106	106	101	101
30	86	125	125	123	123	119	119	114	115	110	110	105	105	101	101
32	90	125	125	122	122	118	118	114	114	109	109	105	105	100	100
35	95	125	125	121	121	117	117	112	112	108	108	104	104	99	99
40	104	123	123	118	118	114	114	110	110	106	106	102	102	98	98
45	113	120	120	116	116	112	112	108	108	104	104	100	100	96	96
50	122	118	118	114	114	110	110	105	105	102	102	98	98	94	94
55	131	115	115	111	111	107	107	103	103	99	99	96	96	93	93
60	140	112	112	108	108	104	104	100	101	97	97	94	94	91	91

If in the shaded area of the **V1VrV2** table, cross reference the Vmcg and Minimum Vr values from this table. If this tables values are higher than V1/Vr, use the figures from this table in place of V1/Vr.

What is this?: In some specific takeoff configurations, it is possible for the airplane to be rotated below the “Minimum Controllable Ground Speed.” or Vmcg. This is the minimum speed at which the flight controls have enough aerodynamic effectiveness to control the aircraft in the event of an engine failure during the takeoff roll. Below Vmcg, control effectiveness will be insufficient to provide directional control the airplane.

TAKEOFF THRUST SETTINGS

TAKEOFF THRUST N1 (B747-400 GE-CF6 Engines)

Takeoff EPR: 3 packs on

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)												
°C	°F	-2000	-1000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
54	129	102.8	103.1	103.1	103.4	103.6	103.6	103.6	103.0	104.0	104.0	103.9	103.9	103.8
50	122	103.6	104.3	104.7	104.4	103.9	103.8	103.9	104.2	104.3	104.3	104.2	104.1	104.1
45	113	104.2	104.9	105.6	105.8	105.8	105.2	104.6	104.4	104.6	104.5	104.5	104.4	104.4
40	104	104.8	105.5	106.2	106.5	106.5	106.4	106.2	106.2	105.8	105.0	104.8	104.7	104.7
35	95	105.1	106.2	106.9	107.2	107.3	107.2	107.0	107.2	107.3	107.2	106.5	105.6	104.9
30	86	104.2	105.6	106.9	108.0	108.1	108.0	107.9	108.1	108.2	108.2	108.0	107.6	107.0
25	77	103.4	104.7	106.0	107.1	108.0	108.8	108.8	108.9	109.0	109.1	109.0	108.6	108.2
20	68	102.5	103.9	105.2	106.2	107.1	107.9	108.6	109.5	109.6	109.8	109.9	109.6	109.2
15	59	101.6	103.0	104.3	105.3	106.2	107.0	107.7	108.5	109.4	110.1	110.5	110.5	110.3
10	50	100.8	102.1	103.4	104.4	105.3	106.1	106.8	107.6	108.4	109.2	109.9	110.4	110.9
5	41	99.9	101.2	102.5	103.5	104.4	105.1	105.8	106.7	107.5	108.2	108.9	109.4	110.0
0	32	99.0	100.3	101.6	102.6	103.5	104.2	104.9	105.8	106.5	107.2	107.9	108.5	109.0
-10	14	97.2	98.5	99.7	100.7	101.6	102.3	103.0	103.9	104.7	105.3	106.0	106.5	107.0
-20	-4	95.4	96.6	97.8	98.8	99.7	100.4	101.1	101.9	102.7	103.4	104.1	104.6	105.1
-30	-22	93.5	94.7	95.9	96.9	97.8	98.5	99.2	100.0	100.8	101.4	102.1	102.6	103.0
-40	-40	91.6	92.8	93.9	94.9	95.8	96.5	97.2	98.0	98.7	99.4	100.0	100.5	101.0
-50	-58	89.6	90.8	91.9	92.9	93.7	94.5	95.1	95.9	96.7	97.3	97.9	98.4	98.9

When planning takeoff without all three packs operating, or with Engine Nacelle Anti Ice (NAI) ON, adjust N1 based on the table below:

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (FT)												
	-2000	-1000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
2 PACKS OFF	0.3	0.3	0.3	0.3	0.3	0.4	0.5	0.5	0.5	0.5	0.5	0.6	0.6
3 PACKS OFF	0.5	0.5	0.5	0.5	0.5	0.6	0.7	0.8	0.8	0.8	0.8	0.8	0.9
ENGINE ANTI-ICE ON*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.8	-0.8	-0.7	-0.7

*Note: No adjustment required for NAI operation below 7500 MSL.

TAKEOFF THRUST EPR (B747-400 PW-4062 Engines)

Takeoff EPR: 3 packs on

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)												
°C	°F	-2000	-1000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
70	158	1.27	1.27	1.27										
65	149	1.30	1.30	1.30	1.30									
60	140	1.34	1.34	1.34	1.34	1.34	1.34							
55	131	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38				
50	122	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.42	1.42
45	113	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47
40	104	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52
35	95	1.54	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56
30	86	1.54	1.56	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60
25	77	1.54	1.56	1.60	1.62	1.63	1.64	1.64	1.64	1.64	1.64	1.64	1.64	1.64
20	68	1.54	1.56	1.60	1.62	1.63	1.64	1.64	1.64	1.64	1.64	1.64	1.64	1.64
15	59	1.54	1.56	1.60	1.62	1.63	1.64	1.64	1.64	1.64	1.64	1.64	1.64	1.64
10 & BELOW	50 & BELOW	1.54	1.56	1.60	1.62	1.63	1.64	1.64	1.64	1.64	1.64	1.64	1.64	1.64

When planning takeoff without all three packs operating adjust N1 based on the following schedule:

2 Packs OFF add 0.01
3 Packs OFF add 0.02

TAKEOFF THRUST EPR (B747-400 RR-RB211 Engines)

Takeoff EPR: 3 packs on

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)												
°C	°F	-2000	-1000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
70	158	1.46	1.46	1.46	1.46	1.46								
65	149	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50					
60	140	1.53	1.53	1.53	1.53	1.53	1.53	1.53	1.53	1.53	1.53			
55	131	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56
50	122	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59
45	113	1.62	1.62	1.62	1.62	1.62	1.62	1.62	1.62	1.62	1.62	1.62	1.62	1.62
40	104	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.64	1.64
35	95	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.67	1.67	1.67	1.66
30	86	1.68	1.69	1.71	1.71	1.71	1.71	1.71	1.71	1.71	1.70	1.69	1.69	1.68
25	77	1.68	1.69	1.71	1.72	1.73	1.73	1.73	1.73	1.73	1.72	1.71	1.70	1.70
20	68	1.68	1.69	1.71	1.72	1.73	1.74	1.75	1.75	1.75	1.74	1.73	1.72	1.72
15	59	1.68	1.69	1.71	1.72	1.73	1.74	1.75	1.76	1.76	1.76	1.75	1.74	1.73
10	50	1.68	1.69	1.71	1.72	1.73	1.74	1.75	1.76	1.77	1.77	1.77	1.76	1.75
5 & BELOW	41 & BELOW	1.68	1.69	1.71	1.72	1.73	1.74	1.75	1.76	1.77	1.77	1.77	1.77	1.77

When planning takeoff without all three packs operating adjust N1 based on the following schedule:

2 Packs OFF add 0.01
3 Packs OFF add 0.01

Reduced N1 Takeoff Thrust Settings (B747-400)

Whenever possible, crews should conduct takeoffs using a derated takeoff N1/EPR thrust setting as selected via the THRUST LIM page in the FMC. This will result in reduced engine wear, reduced maintenance costs and reduced fuel burn. In addition, reduced thrust takeoffs normalize the takeoff acceleration rates giving the crew adequate time to asses takeoff conditions even when the aircraft is lightly loaded. When a derated N1/EPR thrust setting is selected via the FMC, it is to be considered the minimum thrust required under selected conditions.

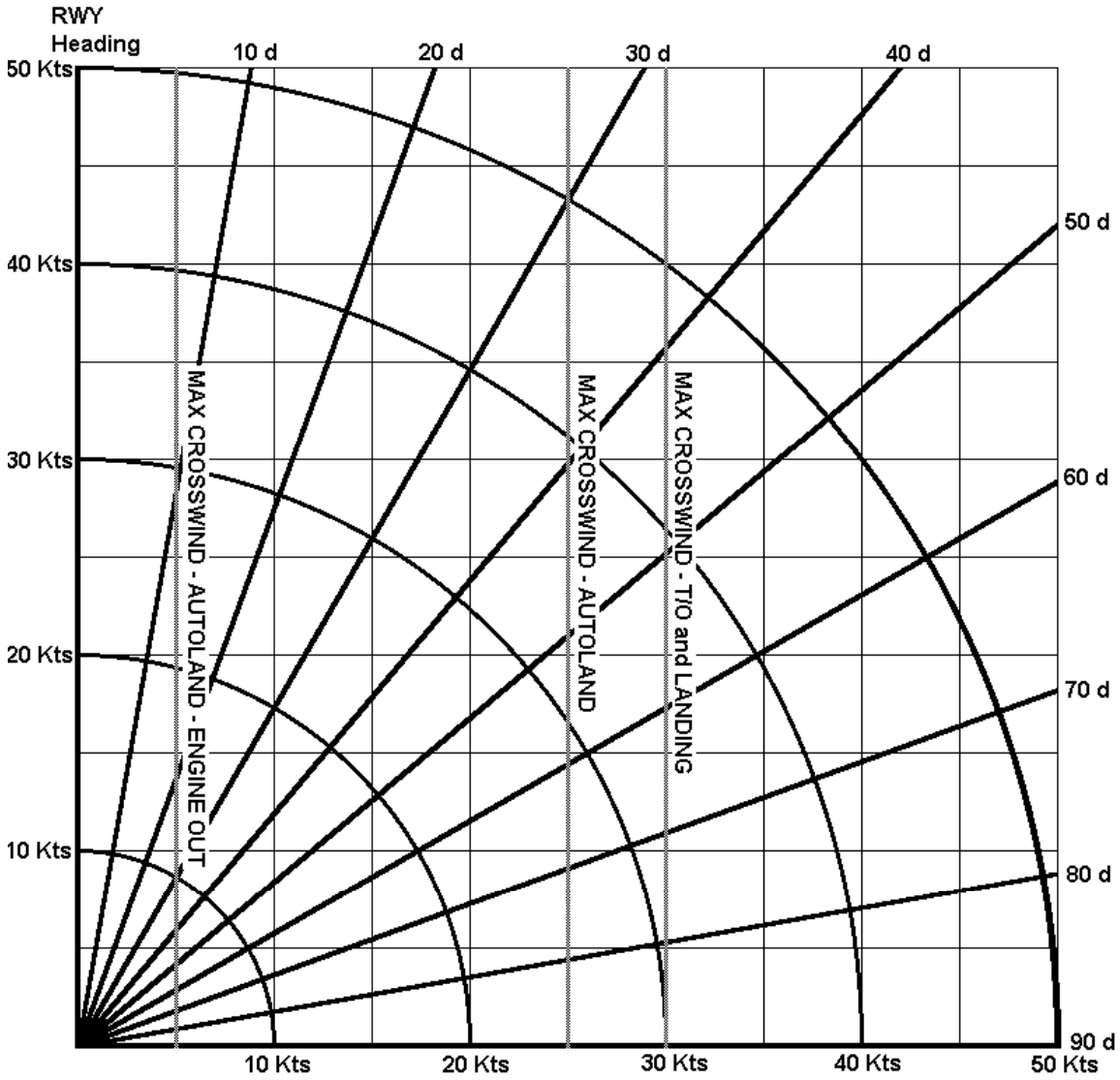
Reduced Takeoff N1 should <u>not</u> be used when:

- Braking action is reported to be less than 'Good.'
- The probability of windshear exists.
- Runway is wet or cluttered.
- Takeoff is to be made with a tailwind.
- Antiskid system is inoperative.
- Any brake is deactivated

In situations where the crew enters an **Assumed Temperature** into the THRUST LIM page and the crew-entered temperature exceeds the ambient temperature, the FMC will automatically compute the reduced takeoff thrust required.

Crews should always enter an assumed temperature to determine V speeds if derated takeoff N1/EPR settings are being used. *If the V speeds determined using the assumed temperature are less than the minimum V speeds according to the **V1 Minimum Speeds** Table, then use the minimum V speeds.*

MAX CROSSWIND COMPONENT (747-400)



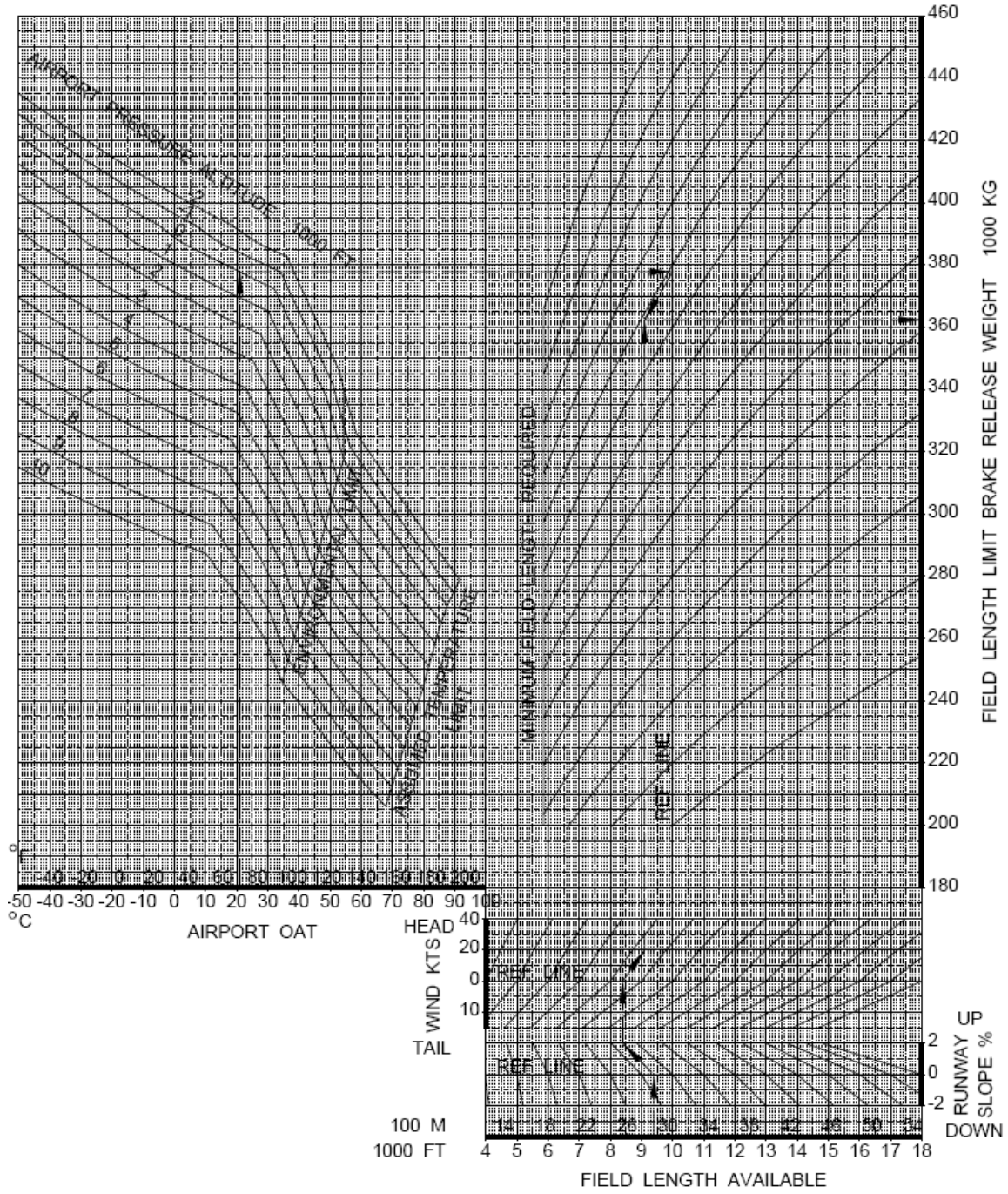
MAX AUTOLAND HEADWIND: 25kts
MAX AUTOLAND TAILWIND: 10kts

To Use: Determine **Runway Heading** of runway to be used. Obtain **Reported Wind Direction/Speed.** Calculate number of degrees difference between **Runway Heading** and **Wind Direction.** Result will be between 0 degrees (pure headwind) and 90 degrees (pure crosswind).

Enter grid on tangent line which represents difference between **Runway Heading** and **Wind Direction**, move inward toward lower left corner until reaching wind speed arc for **Reported Wind Speed.** From this point, read wind speed from left border to determine H**eadwind Component**, and read wind speed from bottom border to determine **Crosswind Component.** Labeled vertical lines represent demonstrated crosswind limitations of aircraft.

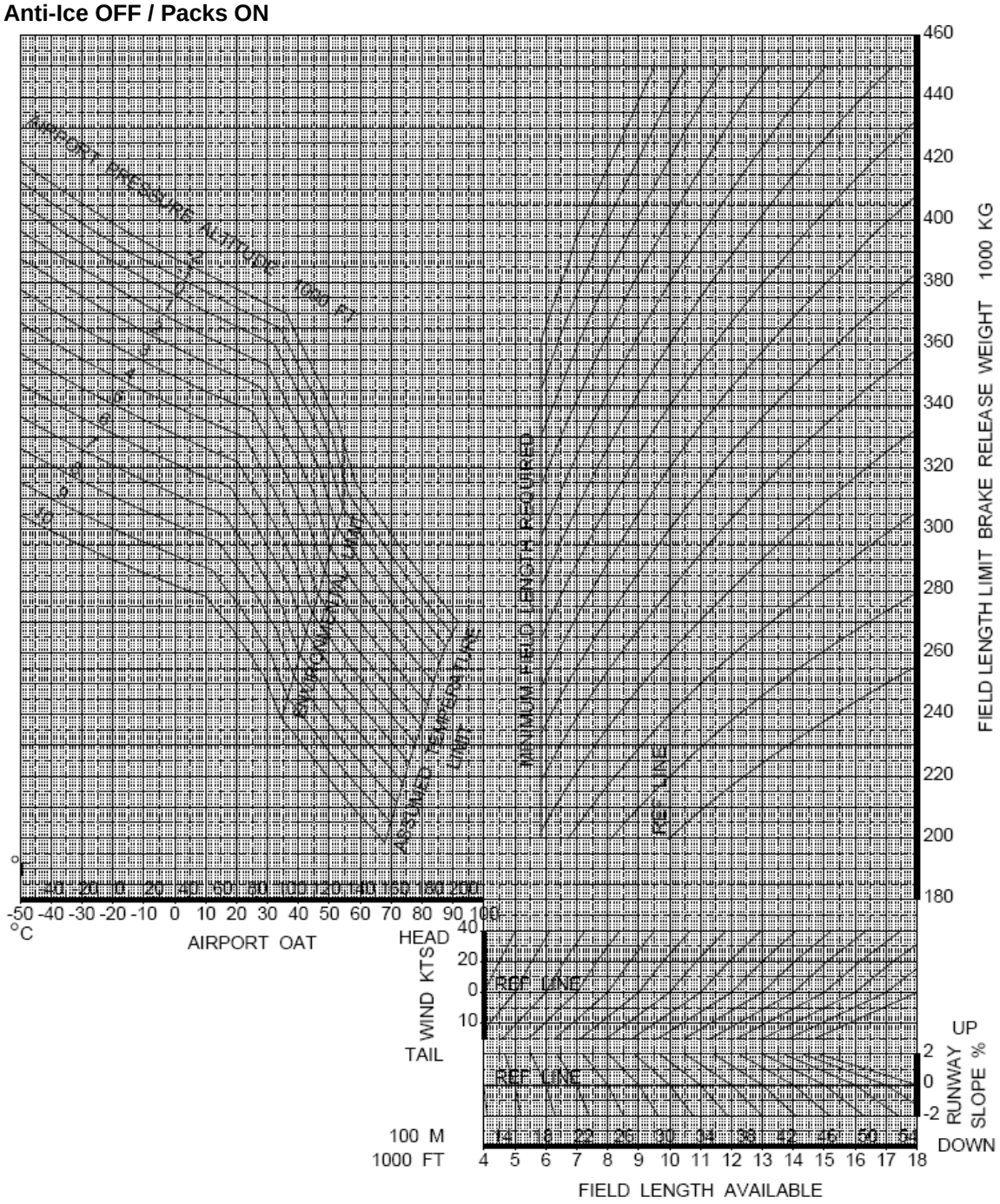
TAKEOFF RUNWAY LIMIT WEIGHT
(Instructions Follow Charts)

Flaps 20 – Dry Runway
Anti-Ice OFF / Packs ON



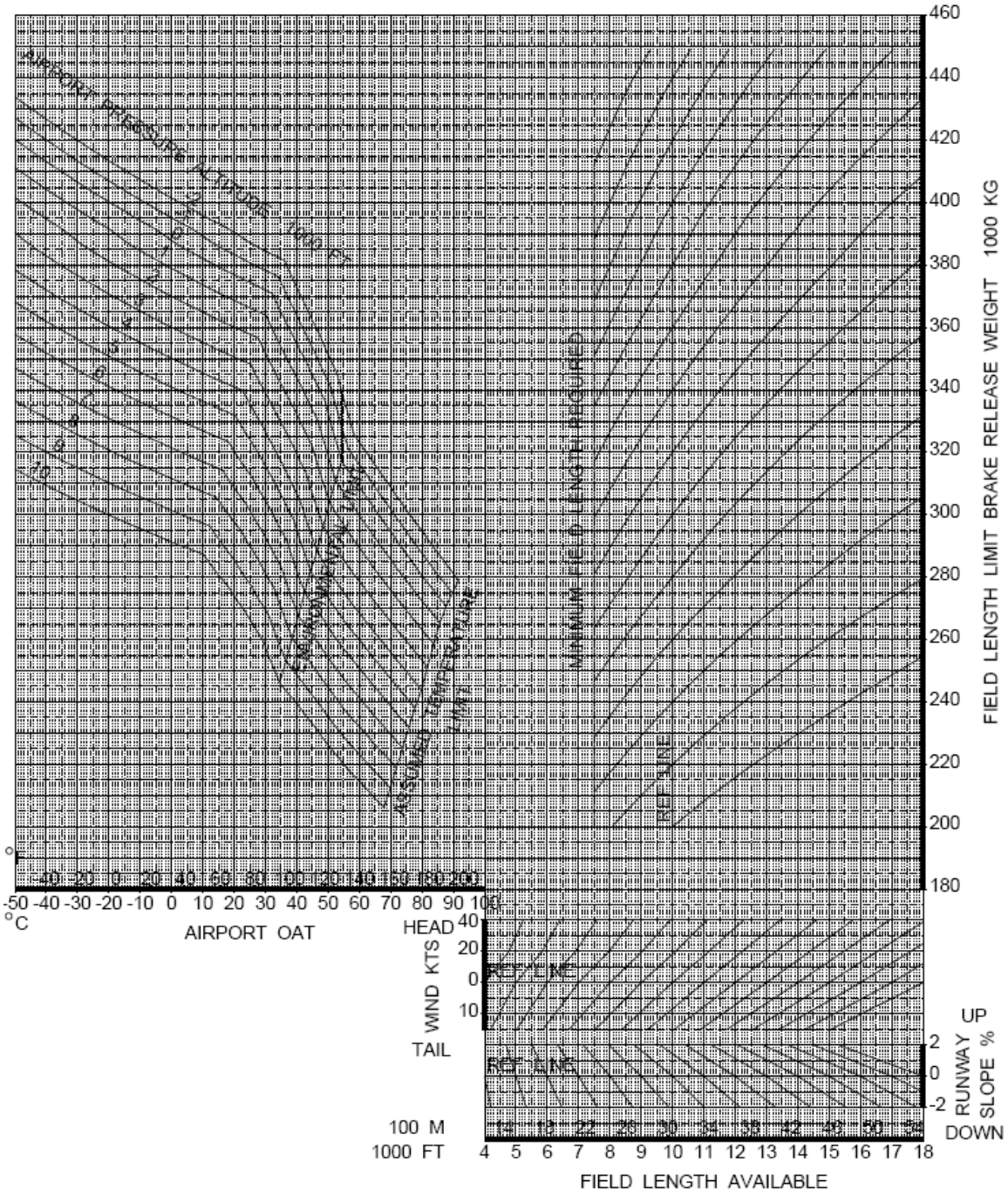
For all Packs OFF increase weight by 2000kg.
For 1 Pack ON increase weight by 1100kg.
For APU supplying 1 pack, increase weight by 1900kg
With engine anti-ice ON, decrease weight by 2400kg (below 7500MSL) or 5000kg (above 7500MSL)

Flaps 10 – Dry Runway
Anti-Ice OFF / Packs ON



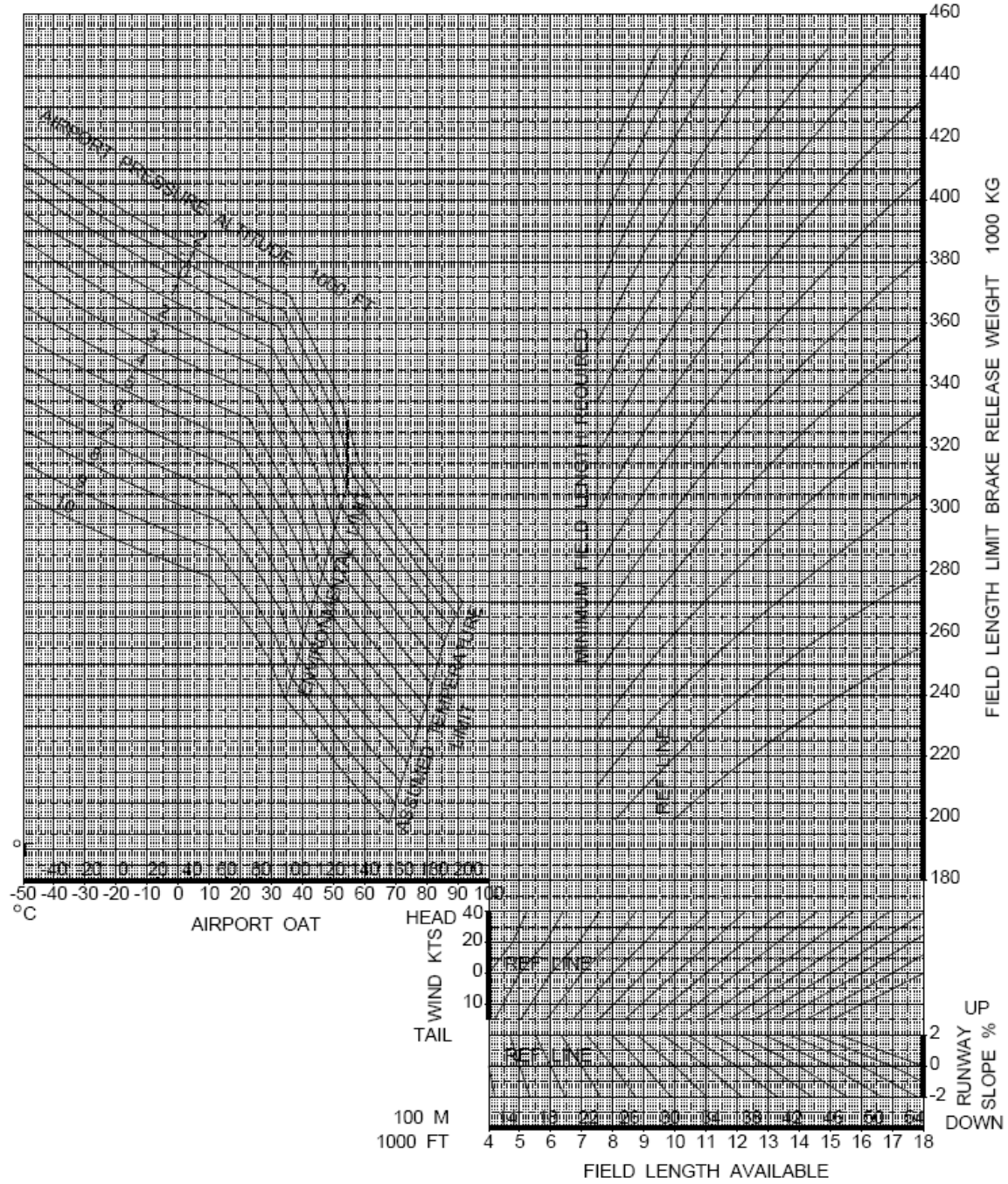
For all Packs OFF increase weight by 2000kg.
For 1 Pack ON increase weight by 1100kg.
For APU supplying 1 pack, increase weight by 1900kg
With engine anti-ice ON, decrease weight by 2400kg (below 7500MSL) or 5000kg (above 7500MSL)

Flaps 20 – Wet Runway
Anti-Ice ON or OFF / Packs ON



For all Packs OFF increase weight by 2000kg.
For 1 Pack ON increase weight by 1100kg.
For APU supplying 1 pack, increase weight by 1900kg
With engine anti-ice ON, decrease weight by 2400kg (below 7500MSL) or 5000kg (above 7500MSL)

Flaps 10 – Wet Runway
Anti-Ice ON or OFF / Packs ON



For all Packs OFF increase weight by 2000kg.
For 1 Pack ON increase weight by 1100kg.
For APU supplying 1 pack, increase weight by 1900kg
With engine anti-ice ON, decrease weight by 2400kg (below 7500MSL) or 5000kg (above 7500MSL)

TAKEOFF PERFORMANCE / SAFETY VERIFICATION

Limitations:

Maximum Zero Fuel Weight (MZFW):	535,000lbs	242,671kg
Maximum Zero Fuel Weight (MZFW) 400F:	635,000lbs	288,113kg
Maximum Takeoff Gross Weight (MTOG):	875,000lbs	396,893kg
Maximum Taxi Weight (MTW):	877,000lbs	397,800kg
Minimum Zero Fuel Weight: (ZFW)	397,000lbs	180,076kg
Maximum Crosswind Component:	See Table	

V Speed Determination:
Determine runway condition, N1 setting and flap setting to be used for takeoff. Use V speeds for associated Aircraft Takeoff Gross Weight (ATOG). These speeds will normally be displayed by the FMC after correct weights and runway conditions have been verified in the PERF INIT page.

In the event that standing water, slush and wet or dry snow is present on the usable portion of the runway, use the **Wet/Cluttered Runway** table speeds, and adjust the FMC calculated speeds if necessary. *When departing from a **Wet/Cluttered Runway** do not use a derated thrust for takeoff. All takeoffs from wet/cluttered runways will be made at the standard thrust setting for the aircraft weight and temperature conditions..*

Minimum V Speed Conditions:
For some high temperature, high altitude conditions or tailwind takeoffs, it may be necessary to adjust the V1/Vr speeds calculated by the FMC and V Speed Tables in order to ensure a proper safety margin. Use the **Minimum Vmcg / Vr Table** to make such adjustments. *Care should be taken not to adjust V1 below the values outlined in the minimum allowable V1 Table or control of the aircraft may be lost in the event of an engine failure after V1..*

Engine N1%/EPR Safety Check:
The FMC will normally provide the crew with accurate target N1/EPR settings for the takeoff regime of flight. Crews should exercise caution not to exceed the maximum allowable N1/EPR settings for the engines. Crews should cross reference the FMC calculated N1/EPR takeoff setting displayed on the THRUST LIM page against the **MAX Takeoff %N1/EPR** tables to ensure safe N1/EPR settings are used.

Takeoff Safety Considerations:
The “Eighty Knots” PNF callout is designed to alert the crew that they are entering the high speed phase of the takeoff roll. Once this has occurred, the Captain’s should only elect to reject a takeoff in a situation where the failure involved may prevent the aircraft from being safely flown. A minor, or non critical failure does not constitute a valid reason to reject a takeoff while in the high speed regime, as it may place the aircraft in greater danger than a continuance of the takeoff roll.

Conditions which warrant a decision to reject the takeoff include, but are not limited to, engine failures, engine or onboard fires, flight control failures or any other failure which calls into question the aircraft’s ability to fly. Crews should not assume that a ‘Go’ decision has been made upon passing 80 knots, however, as a decision relative to the nature of a failure and it’s proximity to V1 must still be made.

How to Calculate Takeoff Runway LIMIT WEIGHT

Overview: To determine the runway length required for takeoff, you need five pieces of data:

- Takeoff Flap Setting: (10 or 20)
- Length of Runway to be used:
- Outside Air Temperature:
- Airport Elevation:
- Head/Tailwind Component:

Normally we would also require runway slope information, but in the MSFS world, runway slope is always zero, so we can safely ignore this factor.

You can find these pieces of information simply. Flap setting to be used for takeoff is your choice. Flaps 10 is usually good, but at heavier weights and/or shorter runways, Flaps 20 is a better option.

Length of Runway to be used can be found in the MSFS airport information using the Map, or through various aviation publications.

Outside Air Temperature can be found by listening to the airport ATIS broadcast.

Airport pressure altitude is easily determined by setting the airplane altimeter to 29.92 In/Hg and reading the altitude reported by the altimeter.

Head/Tailwind component can be found entering the ATIS wind information into the chart on page 1-18.

Once you have this information, you can easily determine the limit weight for your runway of choice. This limit weight is the heaviest weight at which you may safely take off from this runway given your chosen flap setting and the other variables involved.

Example: Use the Flaps 20 DRY RUNWAY chart found on page 1-19, as this chart has index lines to help make this example clearer!

To calculate your limit weight, start at the bottom of the chart by entering into the chart using the Field Length Available. (assume 10,000 feet) Travel vertically until reaching the REF LINE for WIND KTS. Follow the arc to the right for a headwind, and down/left for a tailwind, using the scale on the left. (In this case, assume an 18knot headwind.) Mark the vertical line that you are located on, then shift your attention to the left side of the chart bottom.

Enter the chart again at AIRPORT OAT using the current airport temperature, and travel vertically until reaching the airport pressure altitude. (Assume 20C and Sea Level)

Now, travel horizontally from your pressure altitude intersection, and simultaneously also travel vertically from your headwind/tailwind intersection until both your horizontal line and your vertical line intersect the same curved arc in the upper right portion of the chart. Using the lower of the two intersection points, travel horizontally to the right to determine your takeoff weight limit. (in this case, 360,000KG.

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