



DOCUMENT
GSM-G-CPL.022

DOCUMENT TITLE
**GENERAL OPERATIONS, FLIGHT PLANNING AND
PERFORMANCE**

**CHAPTER 19
TAKE-OFF CHARTS**

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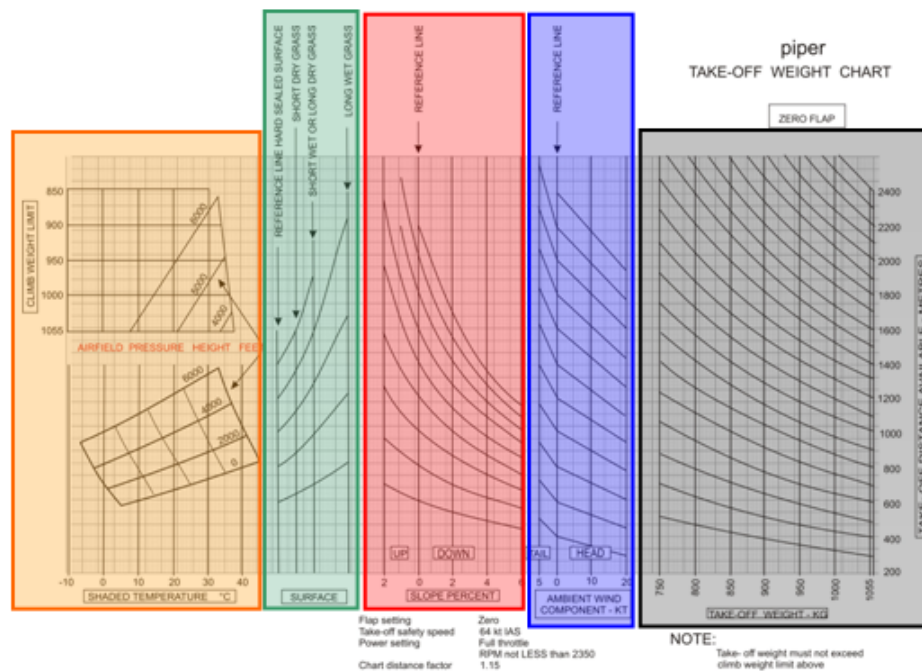
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CONTENTS	PAGE
TAKE-OFF CHARTS	3
BASIC TAKE-OFF CALCULATIONS	4
EXAMPLE	4
PIPER TYPE CHART	9
TAKE-OFF CLIMB WEIGHT LIMITS (CAO 20.7.4)	11
EXAMPLE 1	11
EXAMPLE 2	12

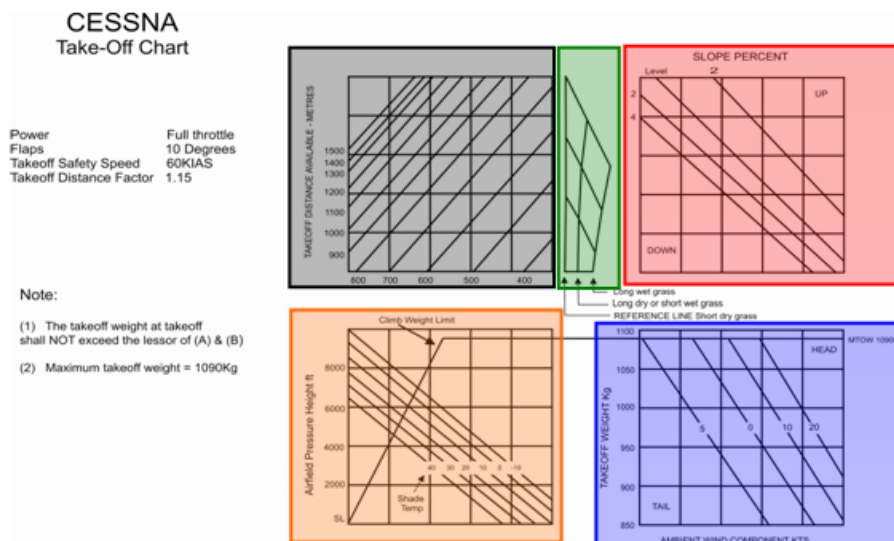
TAKE-OFF CHARTS

Take-off charts are typically provided in several forms. They allow a pilot to compute the take-off distance of the aircraft with no flaps or with a specific flap configuration. A pilot can also compute Take-off weight for a given distance. The take-off distance chart provides for various **pressures altitudes, temperatures, surface, slope, winds, and weight or distance.**

Most P charts are normally divided in to sections, though often not the same order



NOTE: you can see on this Cessna type chart, wind component and weight are in the same section



BASIC TAKE-OFF CALCULATIONS

EXAMPLE

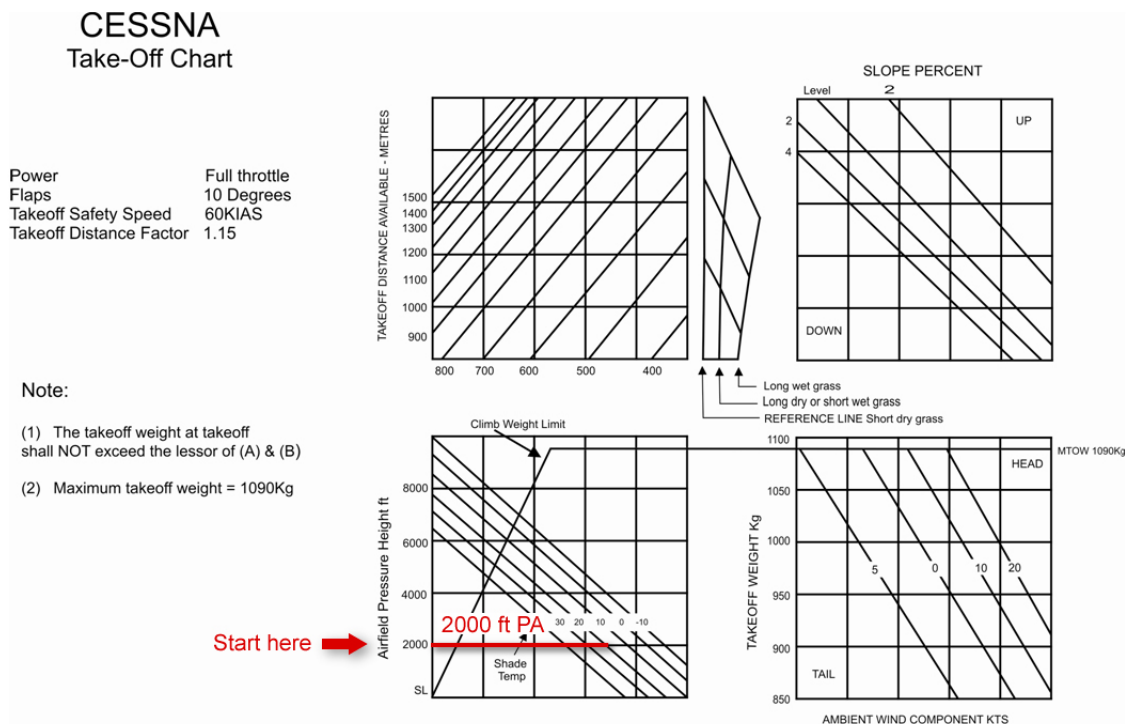
Let now look an example question for a Cessna type chart :

Elevation of the airfield	2300 ^{ft}	} Step 1
The area QNH	1023	
Temperature at airfield	+20°C	} Step 2
Runway length	800m	
Runway surface	Short wet grass	} Step 3
Runway	18/36	} Step 4
Runway slope	1.5% down to South	
Wind component	180°m/5kt	

The Entry point for this graph is with a pressure height/Altitude shown by the red arrow near the lower left box. So what is the pressure height ?

Step 1

Elevation with reference to 1013 hPa $(1023 - 1013) \times 30 = 300^{\text{ft}}$. As 1023 is a higher pressure than 1013, 300^{ft} needs to be subtracted from the elevation giving a pressure height of 2000^{ft}. This is what you enter the graph with.



Step 2

Temperature, Find the corresponding diagonal line representing +20°C in the same box as before. Once this is located, at that intersection draw a line vertically up into the box which displays the Take-off Available (TODA). Until the line reaches the TODA of the airfield.

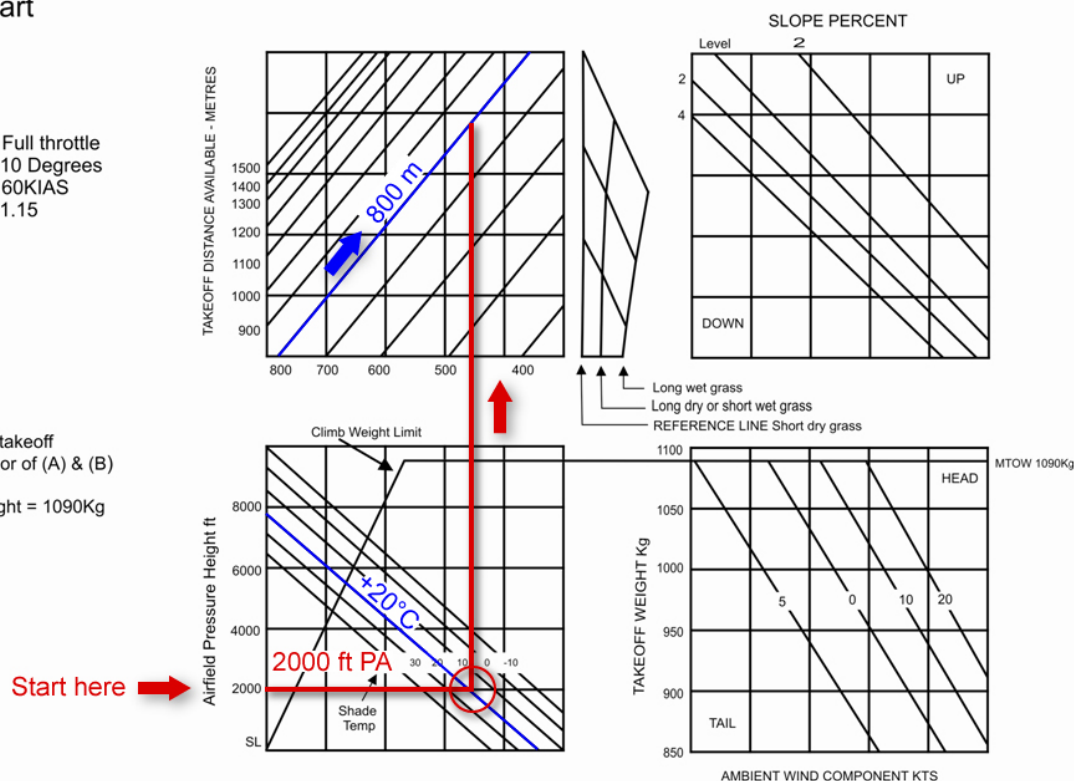
Temperature at airfield	+20°C	} Step
Runway length	800m	

CESSNA Take-Off Chart

Power Full throttle
Flaps 10 Degrees
Takeoff Safety Speed 60KIAS
Takeoff Distance Factor 1.15

Note:

- (1) The takeoff weight at takeoff shall NOT exceed the lessor of (A) & (B)
- (2) Maximum takeoff weight = 1090Kg



Step 3:

Runway surface, from the intersection of the temperature and the runway length line draw a new line horizontally to the REFERENCE line of the runway surface part of the chart, from this point travel diagonally down to the line which represents the type of the runway surface you are going to use, for our example "Short wet grass". From there continue the line the Runway slope box.

Runway surface

Short wet grass

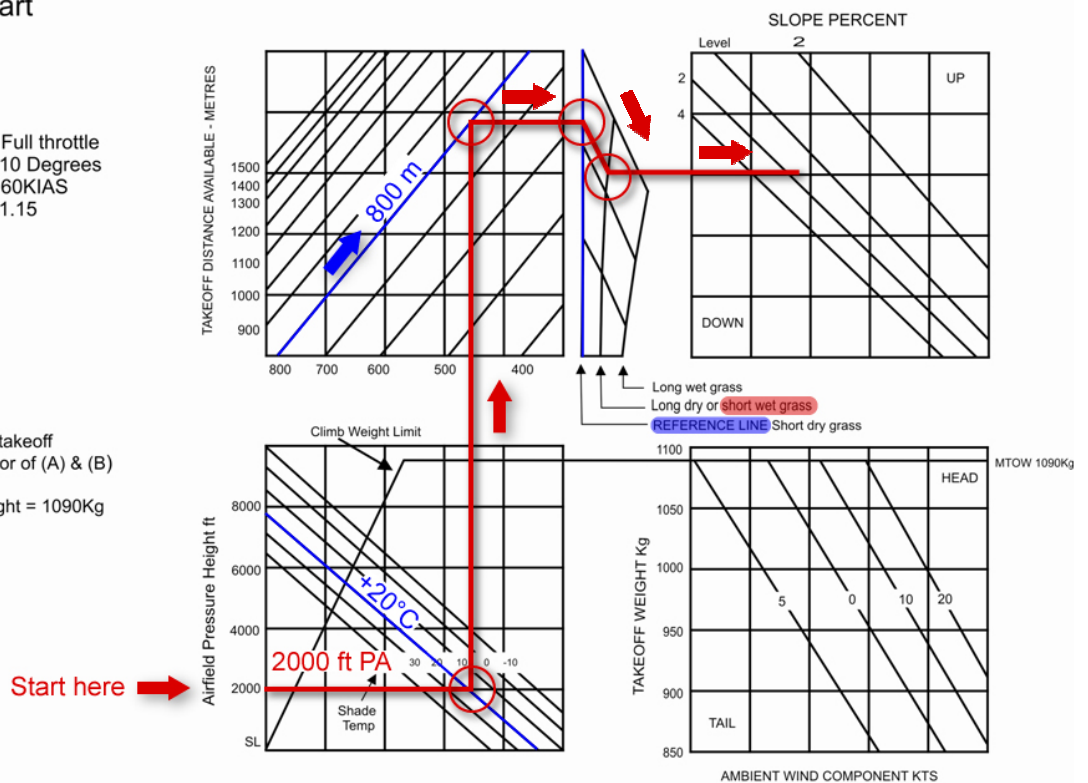
} **Step 3**

CESSNA
Take-Off Chart

Power Full throttle
Flaps 10 Degrees
Takeoff Safety Speed 60KIAS
Takeoff Distance Factor 1.15

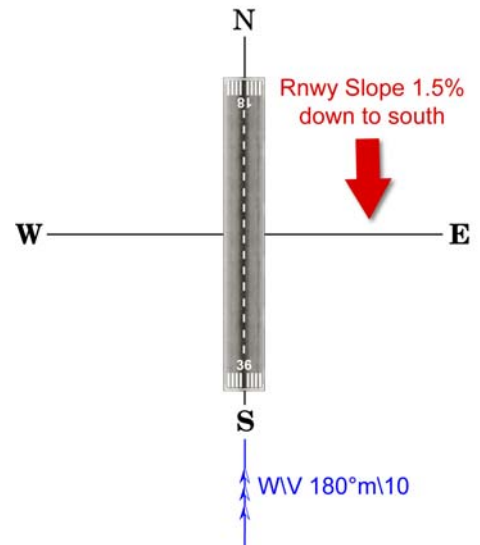
Note:

- (1) The takeoff weight at takeoff shall NOT exceed the lesser of (A) & (B)
- (2) Maximum takeoff weight = 1090Kg



Step 4

Runway slope, is the next step. The presses for finding how the slope will affect you (UP or DOWN), will take into account the wind strength and its affect on you. You may find it easier to draw a mud map to show runway directions, wind direction and slope direction.



Once you have established runway slope, draw a line vertically down from the intersection of Runway slope and the line from runway surface. Take care to get the correct slope direction UP / DOWN and enter the WIND part of the P Chart.

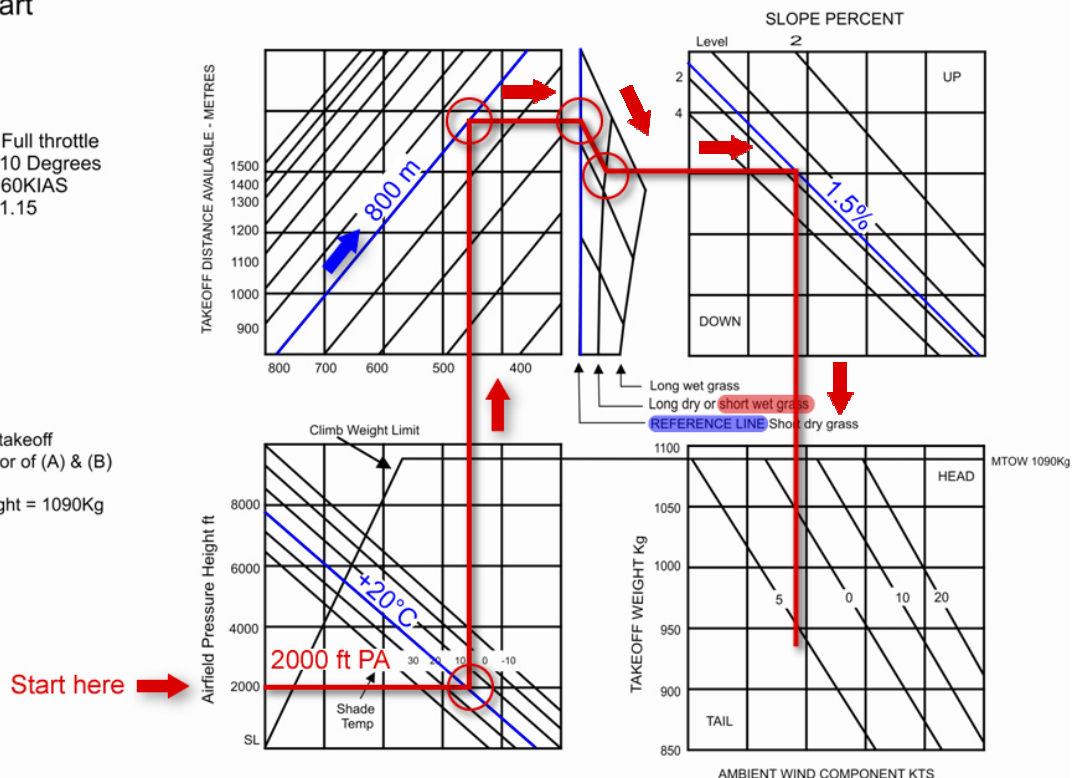
Runway	18/36	} Step 4
Runway slope	1.5% down to South	
Wind component	180°m/5kts	

CESSNA Take-Off Chart

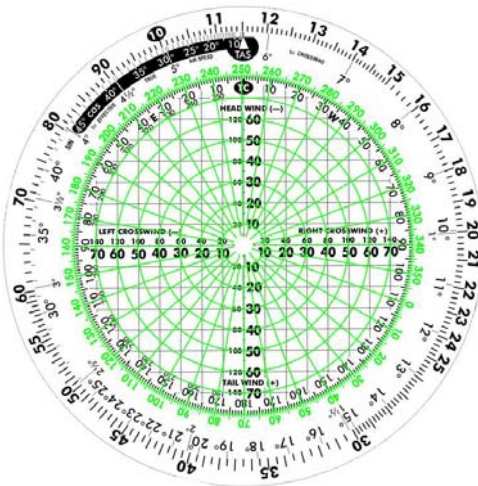
Power Full throttle
Flaps 10 Degrees
Takeoff Safety Speed 60KIAS
Takeoff Distance Factor 1.15

Note:

- (1) The takeoff weight at takeoff shall NOT exceed the lessor of (A) & (B)
- (2) Maximum takeoff weight = 1090Kg



Now for the wind component part of the P Chart, we can see that the head wind component (HWC) is 5kts directly along the runway. You may have to use your navigation computer or the wind component table in ERSA or Jeppesen to establish the head wind component if the wind is not directly down the runway.



CONVERSIONS - WIND COMPONENT

WIND COMPONENT TABLE

For crosswind component
Angle Between Wind Direction and Runway Heading

		10	20	30	40	50	60	70	80	90
W	5	1	2	3	4	5	6	7	8	9
i	10	2	3	5	6	7	8	9	10	11
n	15	3	5	7	9	11	13	14	15	16
d	20	3	7	10	13	15	17	18	19	20
	25	4	8	12	16	19	22	23	24	25
s	30	5	10	15	19	23	26	28	29	30
p	35	6	12	17	22	26	30	32	34	35
e	40	7	14	20	25	30	35	37	39	40
e	45	8	15	22	29	34	39	42	44	45
d	50	9	17	25	32	38	43	47	49	50
	55	10	19	27	35	42	48	52	54	55
k	60	10	20	30	38	46	52	56	59	60
n	65	11	22	32	42	50	56	61	64	65
o	70	12	24	35	45	54	60	66	69	70
t	75	13	26	37	48	57	64	70	73	75
s	80	14	27	40	51	60	69	75	78	80
	85	15	29	42	53	62	71	77	80	82
	90	16	30	44	55	64	73	79	81	83
	95	17	31	46	57	66	75	80	82	84
	100	18	32	48	59	68	77	81	83	85
	105	19	33	50	61	70	79	82	84	86
	110	20	34	52	63	72	81	83	85	87
	115	21	35	54	65	74	83	85	86	88
	120	22	36	56	67	76	84	86	87	89
	125	23	37	58	69	78	85	87	88	90
	130	24	38	60	71	80	86	88	89	91
	135	25	39	62	73	82	87	89	90	92
	140	26	40	64	75	84	88	90	91	93
	145	27	41	66	77	86	89	91	92	94
	150	28	42	68	79	88	91	92	93	95
	155	29	43	70	81	90	92	93	94	96
	160	30	44	72	83	92	93	94	95	97
	165	31	45	74	85	94	94	95	96	98
	170	32	46	76	87	96	95	96	97	99
	175	33	47	78	89	98	96	97	98	100
	180	34	48	80	91	100	97	98	99	101
	185	35	49	82	93	102	98	99	100	102
	190	36	50	84	95	104	99	100	101	103
	195	37	51	86	97	106	100	101	102	104
	200	38	52	88	99	108	101	102	103	105
	205	39	53	90	101	110	102	103	104	106
	210	40	54	92	103	112	103	104	105	107
	215	41	55	94	105	114	104	105	106	108
	220	42	56	96	107	116	105	106	107	109
	225	43	57	98	109	118	106	107	108	110
	230	44	58	100	111	120	107	108	109	111
	235	45	59	102	113	122	108	109	110	112
	240	46	60	104	115	124	109	110	111	113
	245	47	61	106	117	126	110	111	112	114
	250	48	62	108	119	128	111	112	113	115
	255	49	63	110	121	130	112	113	114	116
	260	50	64	112	123	132	113	114	115	117
	265	51	65	114	125	134	114	115	116	118
	270	52	66	116	127	136	115	116	117	119
	275	53	67	118	129	138	116	117	118	120
	280	54	68	120	131	140	117	118	119	121
	285	55	69	122	133	142	118	119	120	122
	290	56	70	124	135	144	119	120	121	123
	295	57	71	126	137	146	120	121	122	124
	300	58	72	128	139	148	121	122	123	125
	305	59	73	130	141	150	122	123	124	126
	310	60	74	132	143	152	123	124	125	127
	315	61	75	134	145	154	124	125	126	128
	320	62	76	136	147	156	125	126	127	129
	325	63	77	138	149	158	126	127	128	130
	330	64	78	140	151	160	127	128	129	131
	335	65	79	142	153	162	128	129	130	132
	340	66	80	144	155	164	129	130	131	133
	345	67	81	146	157	166	130	131	132	134
	350	68	82	148	159	168	131	132	133	135
	355	69	83	150	161	170	132	133	134	136
	360	70	84	152	163	172	133	134	135	137

For Headwind Component
Angle Between Wind Direction and Runway Heading

Locate 5 kts some where between 0 and 10kts on the lower right box which is the wind component section , draw your line so that it intersects the line you drew previously down from the SLOPE box, again one cannot emphasize enough **MAKE SURE YOU ARE USING THE CORRECT WIND COMPONENT HEAD/TAIL.**

From this point where the slope and HWC lines intersect, draw a line horizontally to the TAKE-OFF WEIGHT side and read directly from the vertical scale.

Answer: Though the Cessna aircraft used in this example has a structural Take-off weight limit of 1090kg. On this day (environmental conditions) at this airfield (physical characteristics').

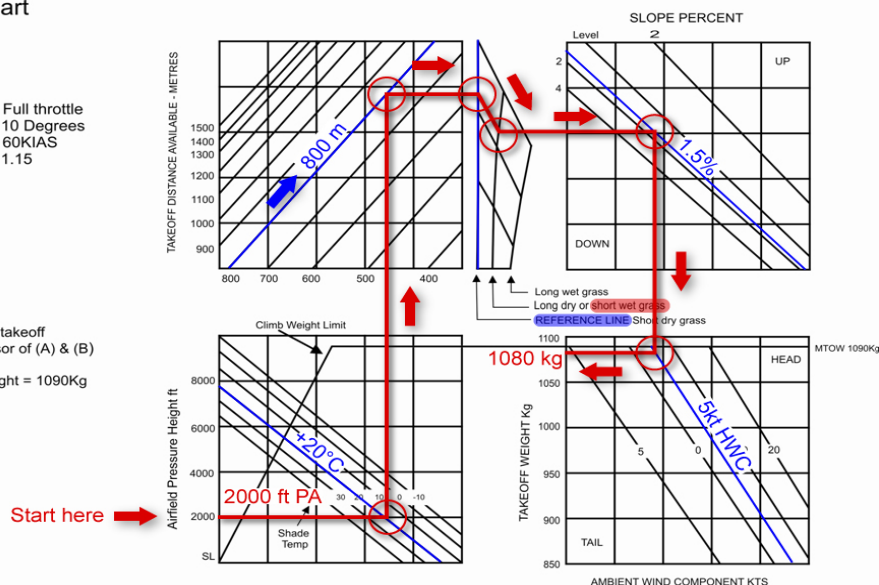
The Maximum Take-off weight is 1080kg

CESSNA Take-Off Chart

Power Full throttle
Flaps 10 Degrees
Takeoff Safety Speed 60KIAS
Takeoff Distance Factor 1.15

Note:

- (1) The takeoff weight at takeoff shall NOT exceed the lesser of (A) & (B)
- (2) Maximum takeoff weight = 1090Kg

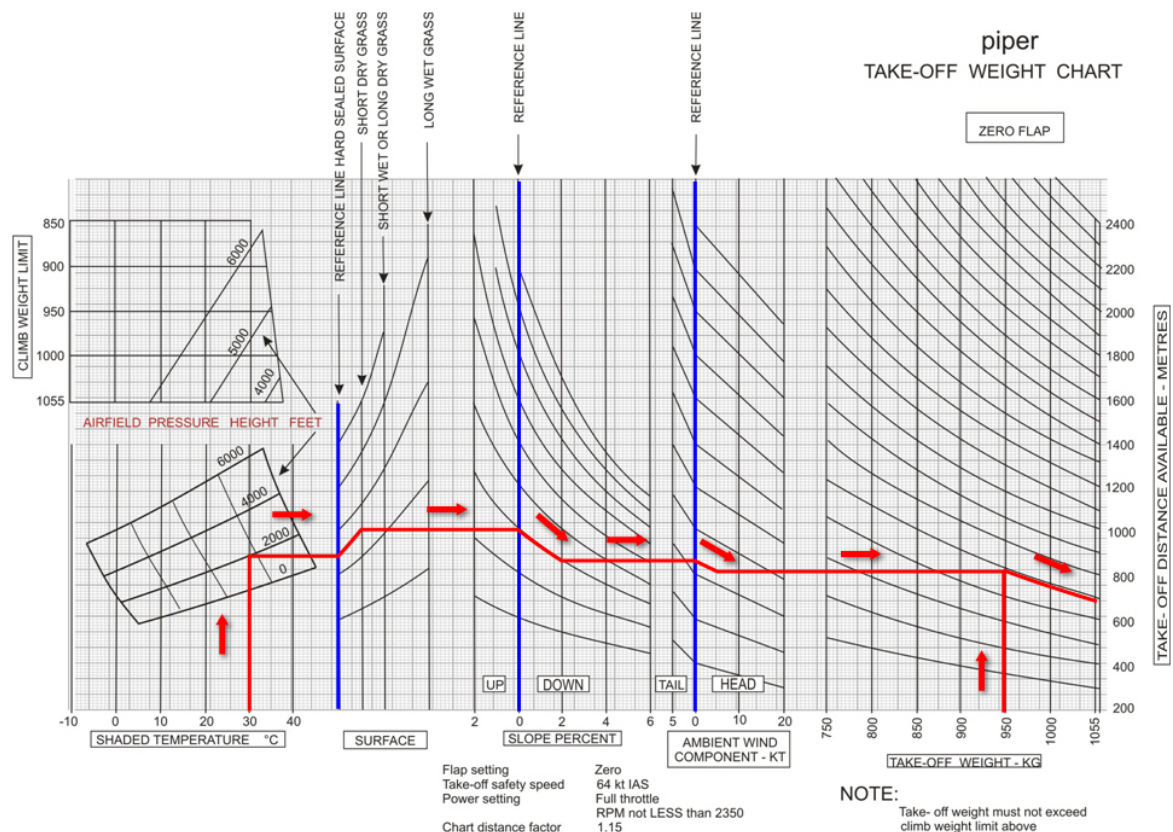


PIPER TYPE CHART

Example 1

Pressure Altitude = 2 000 ft
OAT = 30°C
Surface = Short dry grass
Runway slope = 2% down
Headwind = 5 kts
Take-off Weight = 950 kg

This chart is an example of a combined take-off distance graph. It takes into consideration pressure altitude, temperature, surface, slope, wind and Take-off weight or take-off distance available all on one chart.

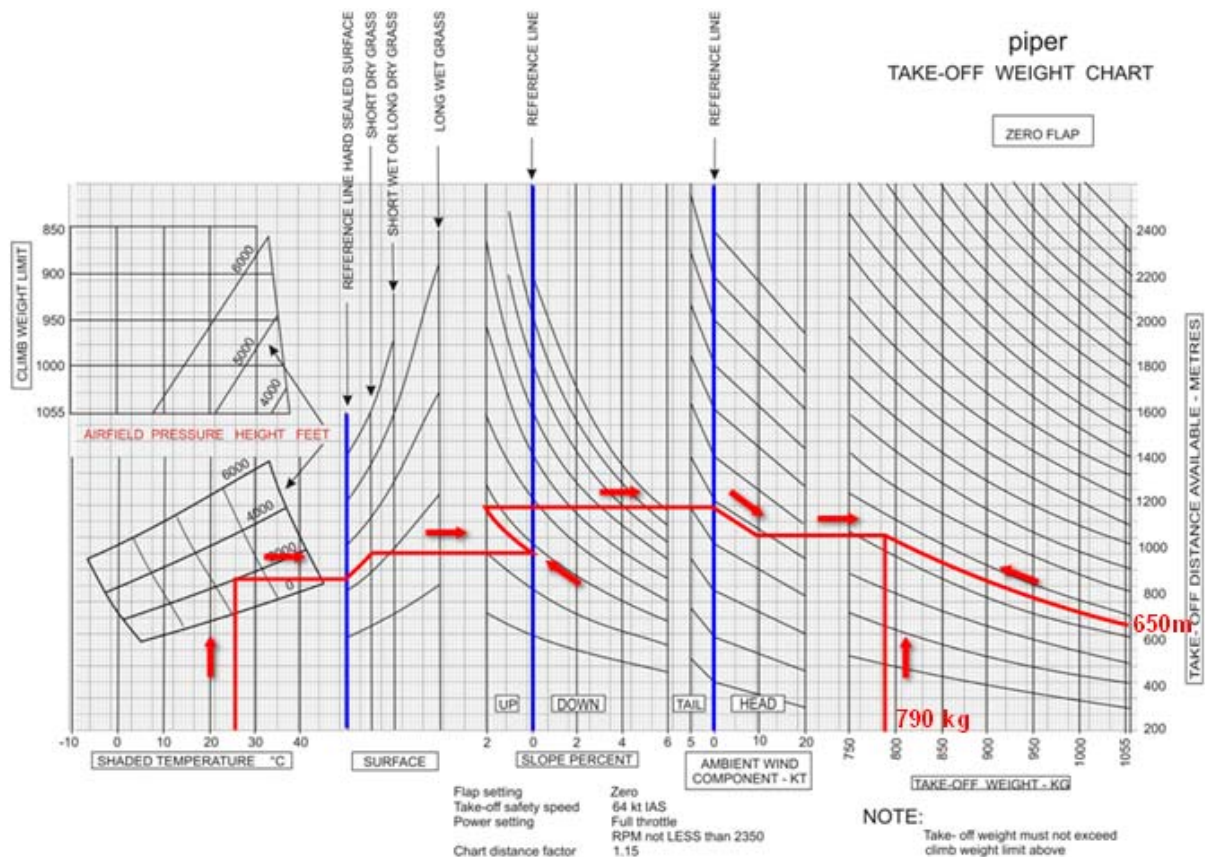


First, find the correct temperature on the bottom left-hand side of the graph. Follow the line from 30°C straight up until it intersects the 2 000 ft Pressure altitude line. From that point, draw a line straight across to the first dark **reference line**. Follow the upward guide lines until "Short dry grass" is reached. From there draw a straight line to the next reference line. Follow the downward guide line until 2° DOWN slope is reached, drawing a straight line to the next reference line. Follow the same procedure with the 5kt head wind. Continue this process following the RED line to the end of the chart, there read off the TODR for those environmental conditions and aircraft weight.

Example 2

Pressure Altitude = 2 000 ft
OAT = 25°C
Surface = Short dry grass
Runway slope = 2% up
Headwind = 10 kts
Take-off Distance Available = 650m

This chart is an example of a combined take-off distance graph. It takes into consideration pressure altitude, temperature, surface, slope, wind and Take-off weight or take-off distance available all on one chart.



First, find the correct temperature on the bottom left-hand side of the graph. Follow the line from 25°C straight up until it intersects the 2 000 ft Pressure altitude line. From that point, draw a line straight across to the first dark **reference line**. Follow the upward guide lines until "Short dry grass" is reached. From there draw a line to the next reference line. Follow the upward guide line until 2° UP slope is reached, drawing a straight line to the next reference line. Follow the same procedure with the 10kt head wind. Following the guidelines, draw a line from 650m until it intersects the line from the wind. Where these two intersect, draw a line straight down to read 790kg.

TAKE-OFF CLIMB WEIGHT LIMITS (CAO 20.7.4)

EXAMPLE 1

Pressure altitude	4000 ^{ft}
OAT	35°C
TODA	800m
Surface	Short wet grass
Slope	1.0% down <u>CAO 20.7.4 subsection 4.1(a)</u>
Ambient wind	15 HWC

CESSNA Take-Off Chart

Power Full throttle
Flaps 10 Degrees
Takeoff Safety Speed 60KIAS
Takeoff Distance Factor 1.15

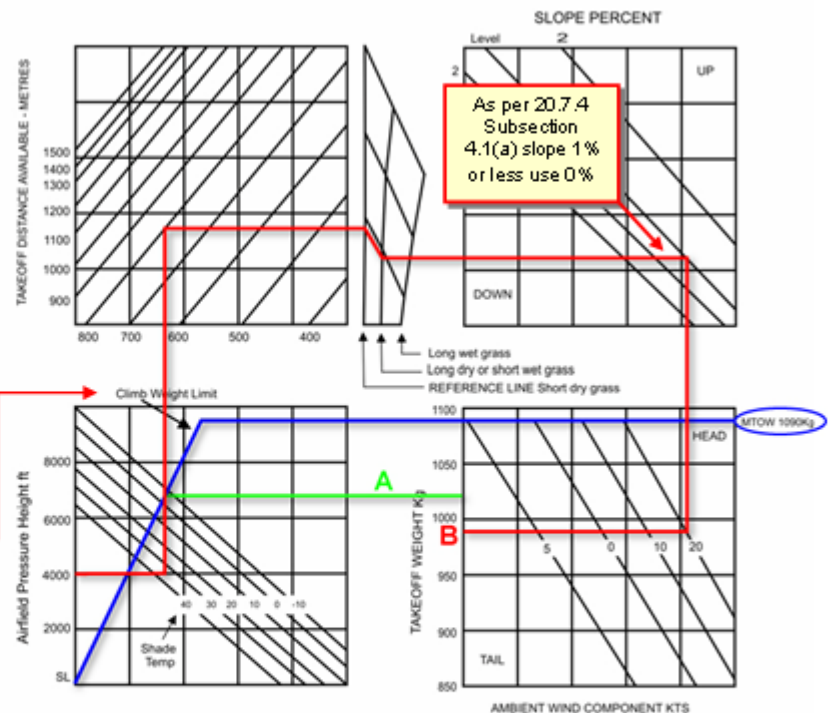
Note:

- (1) The takeoff weight at takeoff shall NOT exceed the lesser of (A) & (B)
- (2) Maximum takeoff weight = 1090Kg

Relates to climb weight limit
CAO 20.7.4 Subsection 7.1

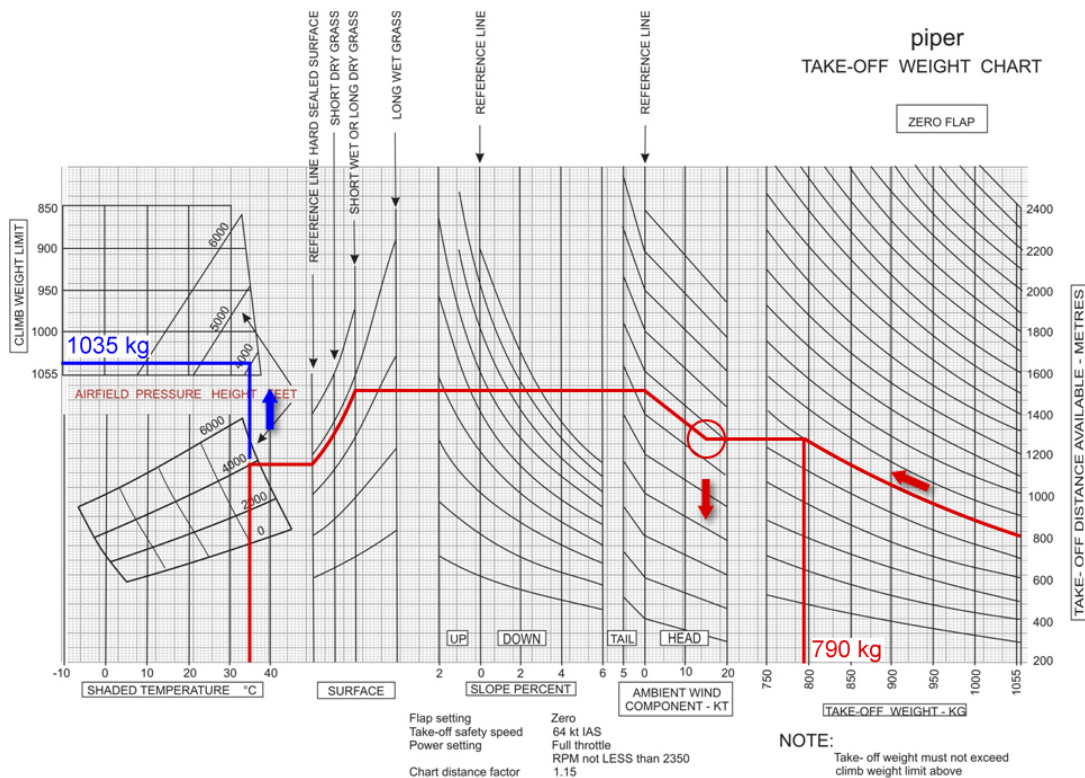
Where your vertical line from
Pressure and temp intersects the
blue line (Climb weight limit line)
Draw a line across to take off
weight (green line)
As the above Note says use the
Lesser of A & B for take off
weight

the climb weight limit guarantees
you will meet the 6% climb
gradient to 50ft



EXAMPLE 2

Pressure altitude 4000^{ft}
OAT 35°C
TODA 800m
Surface Short wet grass
Slope 1.0% down CAO 20.7.4 subsection 4.1(a)
Ambient wind 15 HWC



As we can see from the above PChart, the red line works through the graph to give a take-off weight of 790kg

The blue line continues up into the climb weight limit section of the PChart, giving a climb weight limit of 1035kg

Remember from the CAO 20.7.4 Climb weight limit guarantees a climb gradient of 6% to height 50^{ft} at take off safety speed which is shown on the PChart.

This said, we can only use the lesser of the two weights found, the climb weight limit of 1035kg will give the required 6% climb gradient, but we would need much more runway than is available, based on the environmental conditions at the airfield, the P Chart proves this with a maximum take-off weight of 780kg.

If we would meet our climb weight limit at 1035kg, we would most definitely achieve this at 780kg

Answer 790kg