DOCUMENT
GSM-G-CPL.022

DOCUMENT TITLE

GENERAL OPERATIONS, FLIGHT PLANNING AND PERFORMANCE

CHAPTER 19
TAKE-OFF CHARTS

Version 1.0
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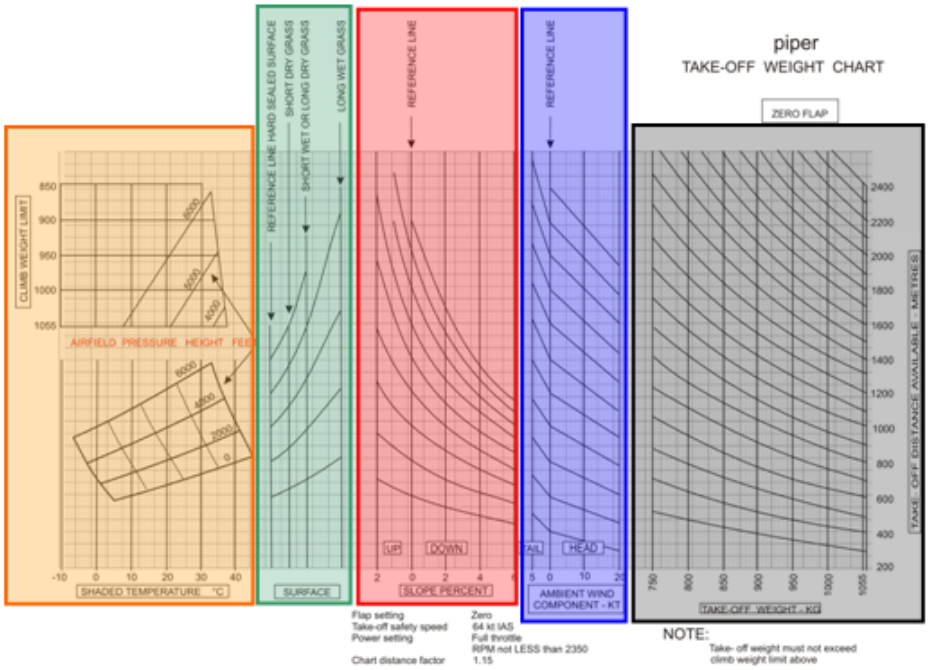
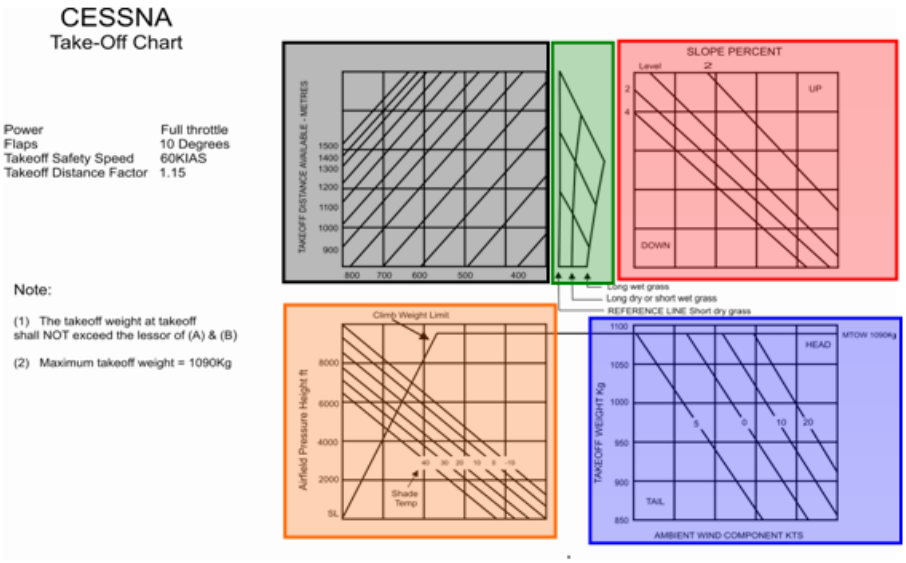
TAKE-OFF CHARTS

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

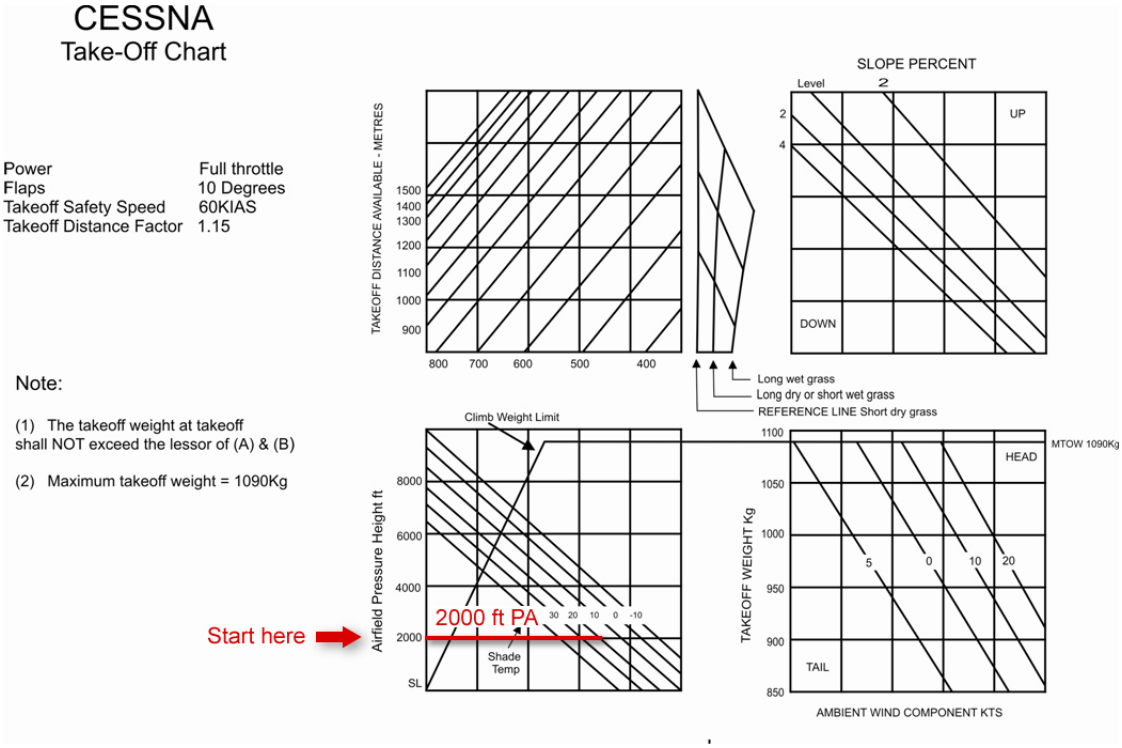
Let now look an example question for a Cessna type chart :

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

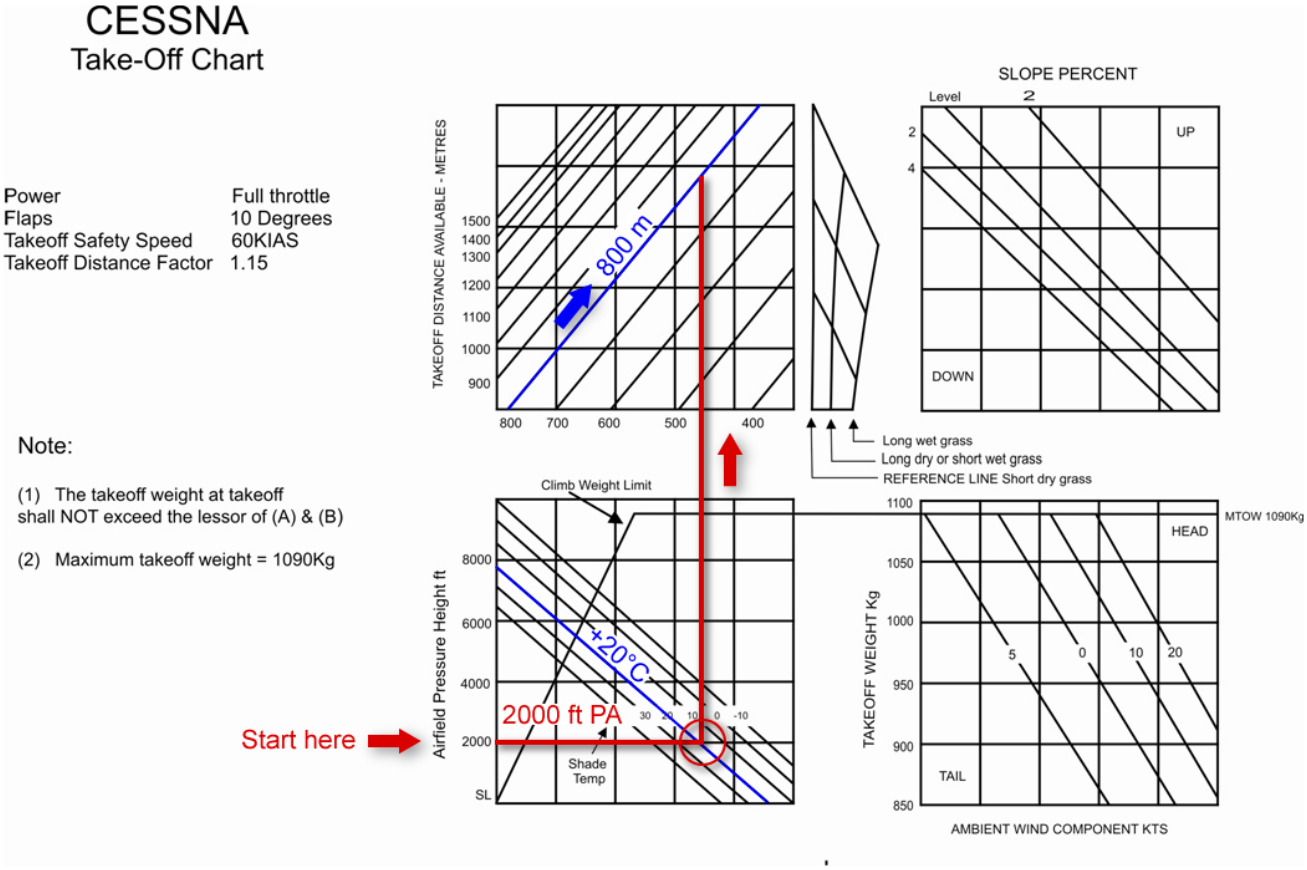
Elevation with reference to 1013 hPa (1023 - 1013) x 30 = 300$^{ft.}$ As 1023 is a higher pressure than 1013, 300^{ft} needs to be subtracted from the elevation giving a pressure height of 2000^{ft}. This is what you enter the graph with.



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.

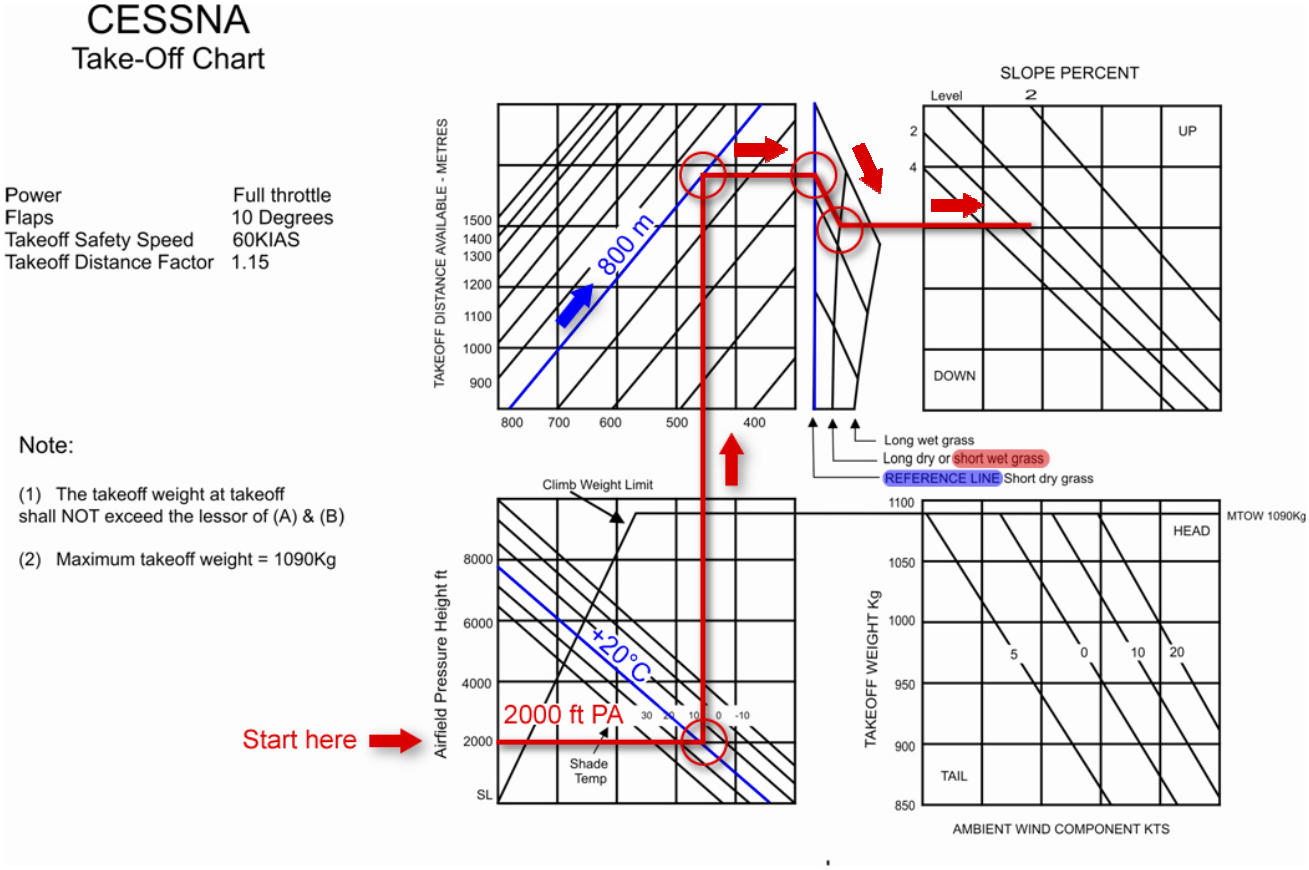
Temperature at airfield	+20°C	**Step**
Runway length	800m	



Step 3:

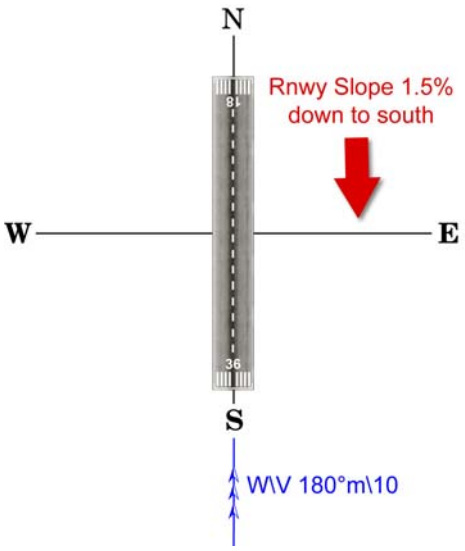
Runway surface, from the intersection of the temperature and the runway length line draw a new line horizontally to the REFERENCE line of the runway surface part of the chart, from this point travel diagonally down to the line which represents the type of the runway surface you are going to use, for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

Runway surface Short wet grass } **Step 3**



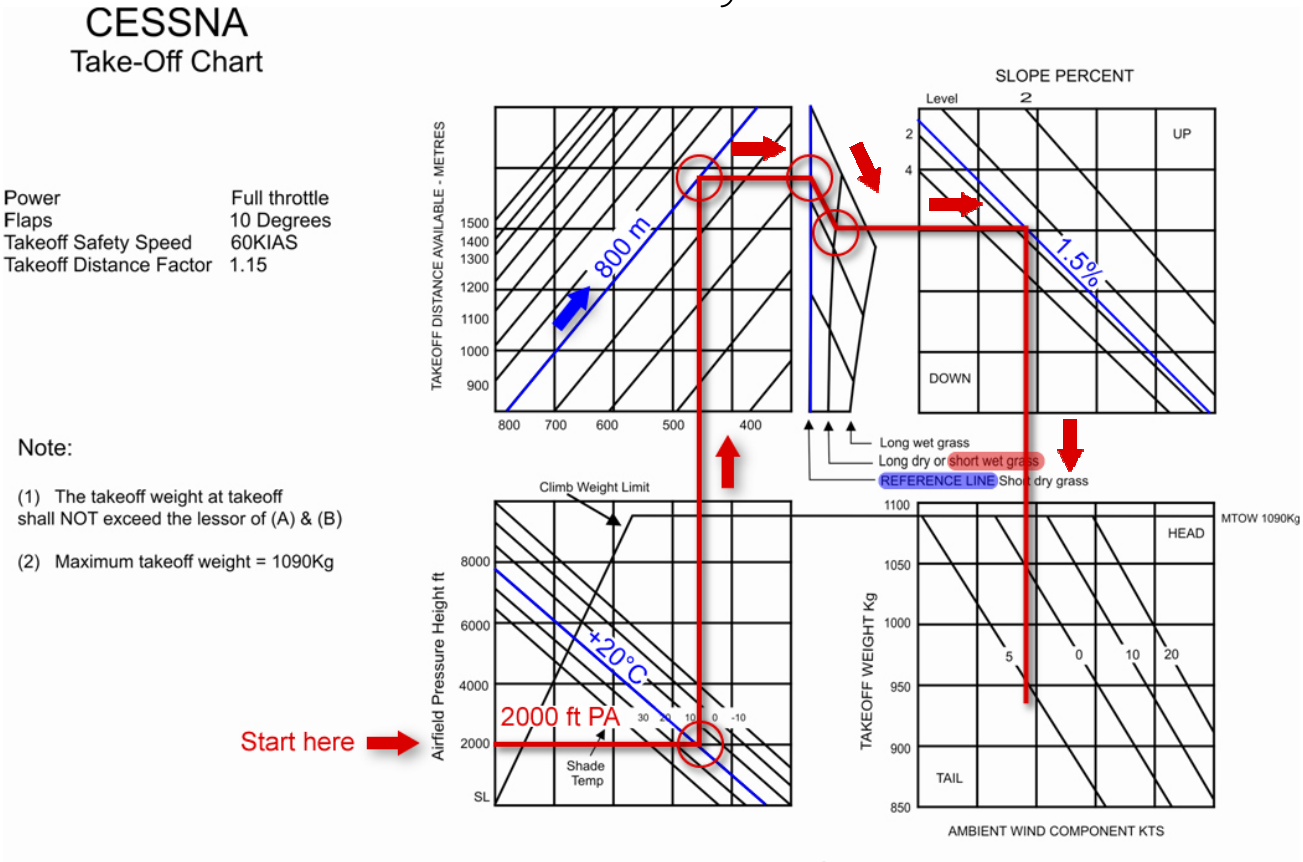
Step 4

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.

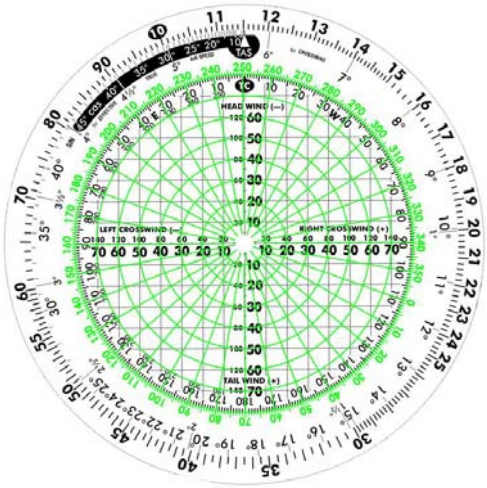


Once you have established runway slope, draw a line vertically down from the intersection of Runway slope and the line from runway surface. Take care to get the correct slope direction UP / DOWN and enter the WIND part of the P Chart.

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



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	2	3	4	4	4	5	5
i	10	2	3	5	6	7	8	9	9	10
n	15	3	5	7	9	11	13	14	14	15
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
		80	70	60	50	40	30	20	10	0

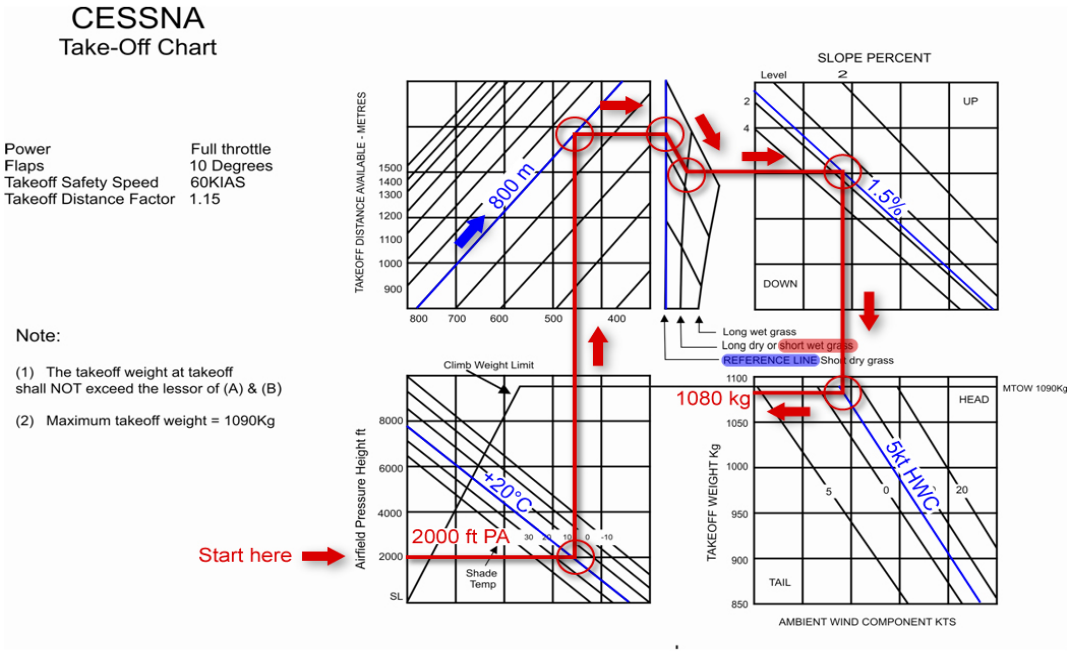
For Headwind Component
Angle Between Wind Direction and Runway Heading

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

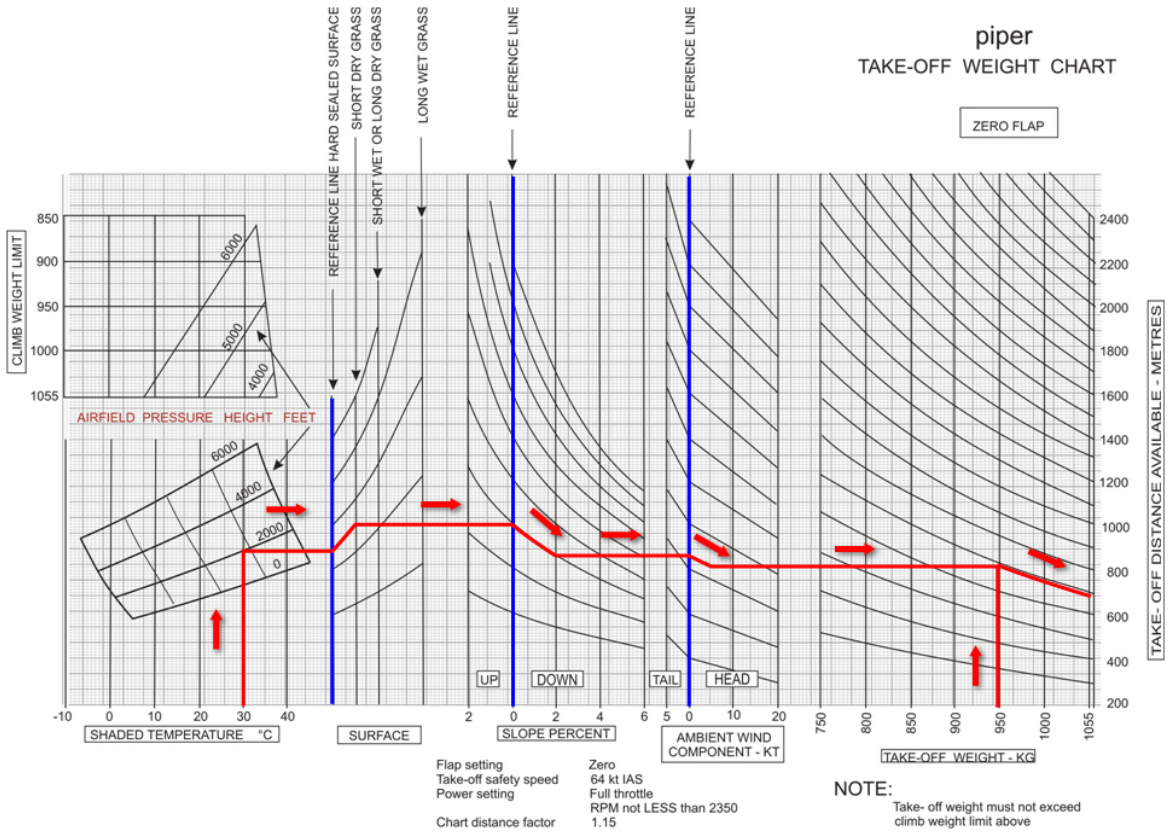


PIPER TYPE CHART

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.

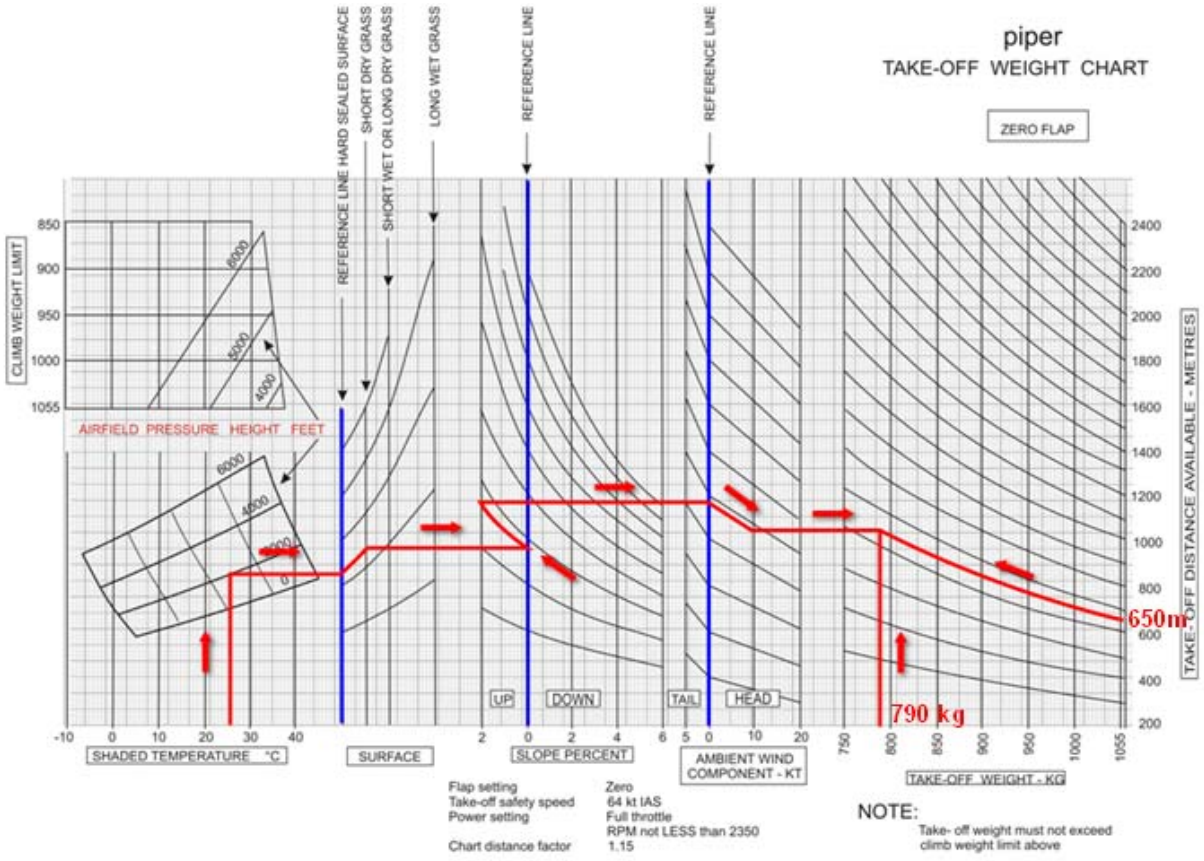


First, find the correct temperature on the bottom left-hand side of the graph. Follow the line from 30°C straight up until it intersects the 2 000 ft Pressure altitude line. From that point, draw a line straight across to the first dark **reference line**. Follow the upward guide lines until "Short dry 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.

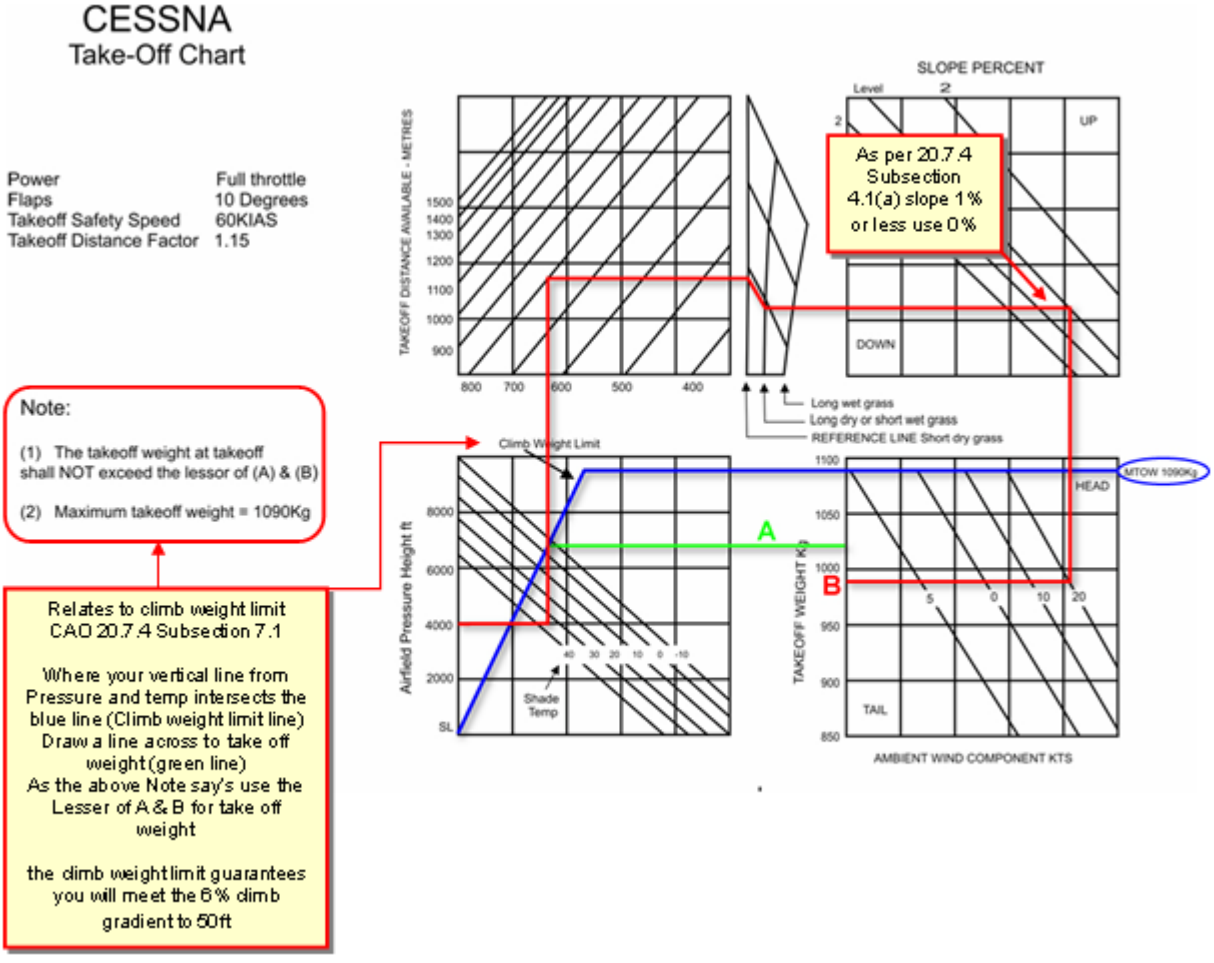


First, find the correct temperature on the bottom left-hand side of the graph. Follow the line from 25°C straight up until it intersects the 2 000 ft Pressure altitude line. From that point, draw a line straight across to the first dark **reference line**. Follow the upward guide lines until “Short dry 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 untill 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)

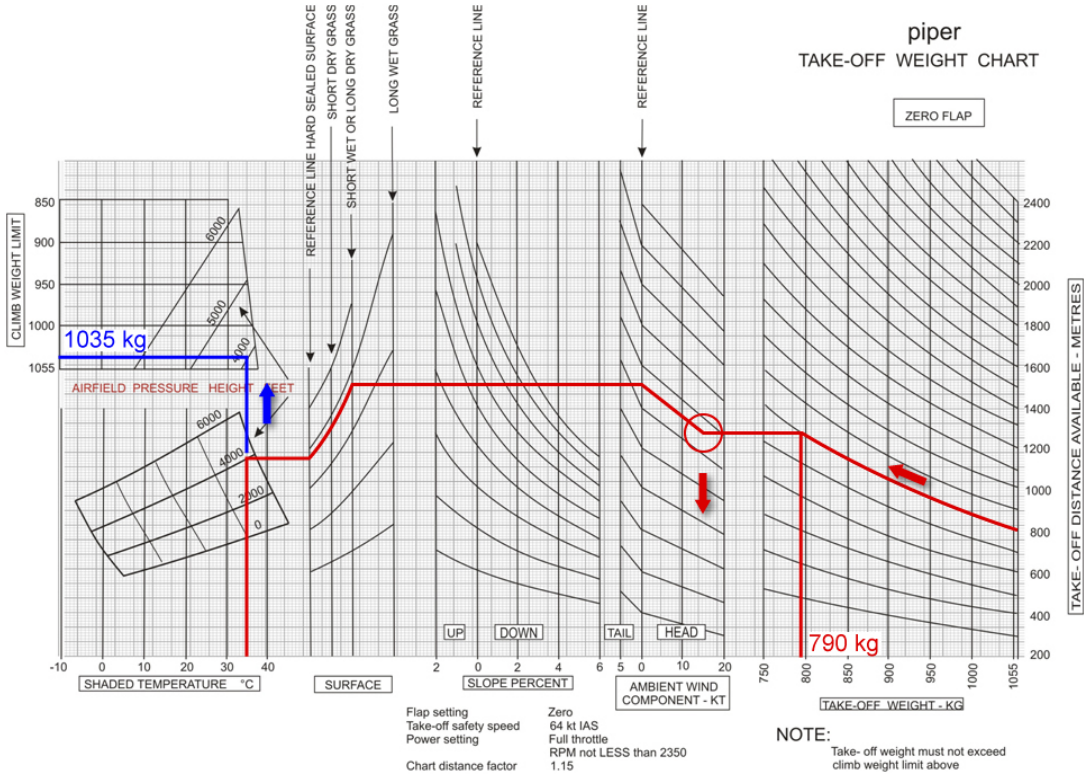
EXAMPLE 1

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



EXAMPLE 2

Pressure altitude	4000ft
OAT	35ºC
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 COA 20.7.4 Climb weight limit guarantees a climb gradient of 6% to height 50ft 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