What the Pilot Knows

Tips for Airport Operators

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CBR Technology Inc.

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Outline

Introduction

Clients • Customers • Facility Users

IFR Rates of Climb

Aircraft Performance Factors

Closing Remarks

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INTRODUCTION

DND Audits

- TP312 Aerodrome Standards and Recommended Practices
- Vs FAR 25 Take-off Profile

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EXCEPTIONAL PILOT

- *One day a long, long, long time ago, there was this pilot who, surprisingly, was not an arrogant 'know-it-all'…*
- *But it was just one pilot…*
- *And it was a long, long. long time ago…*
- *And it was just for that one day…*

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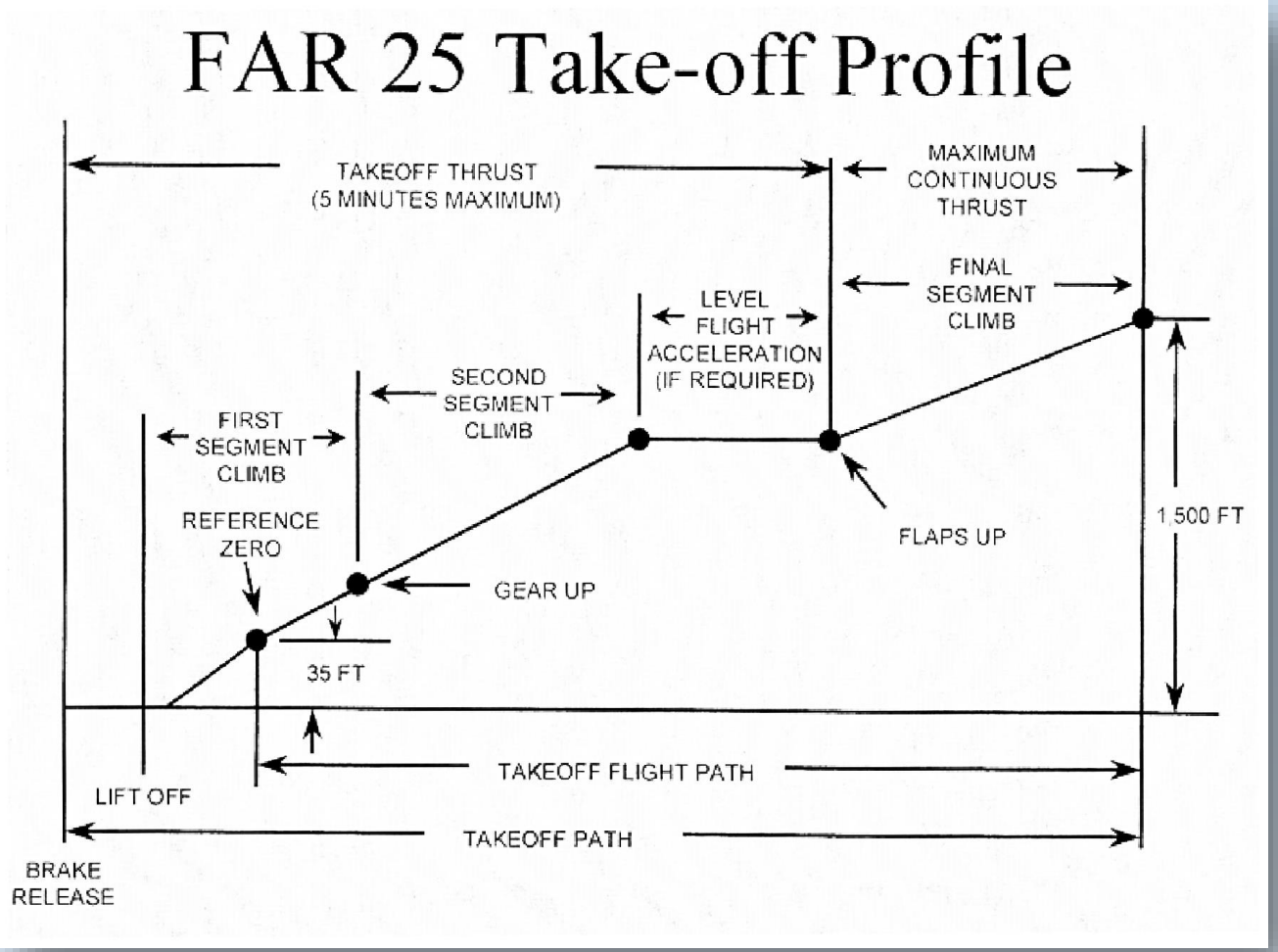
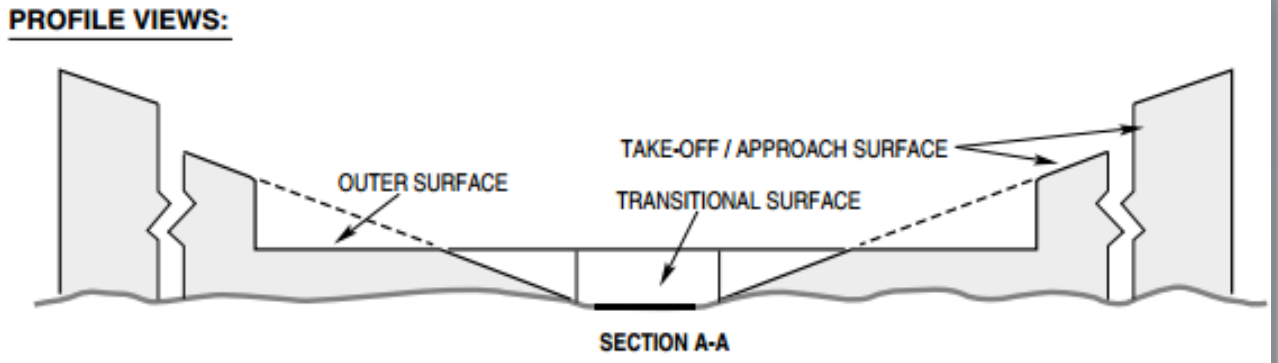
Runway Profiles

FAR 25 Take-off Profile





TP-312
Aerodrome Standards & Recommended Practices

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Clients • Customers • Facility Users

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Getting Maximum Benefit from Airfields

Airfields should provide maximum benefit to the end user *safely, legally and economically.*

- **Safe** (complying with aircraft certification flight manual)
- **Legal** (safety and economy come first!)
  - *Airfield facilities and exemptions*
  - *Declare available facilities*
  - *Minimize reductions to performance*
- **Economical** (cost effective for both airfield & aircraft operators)

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IFR Rates of Climb

King Air A-100

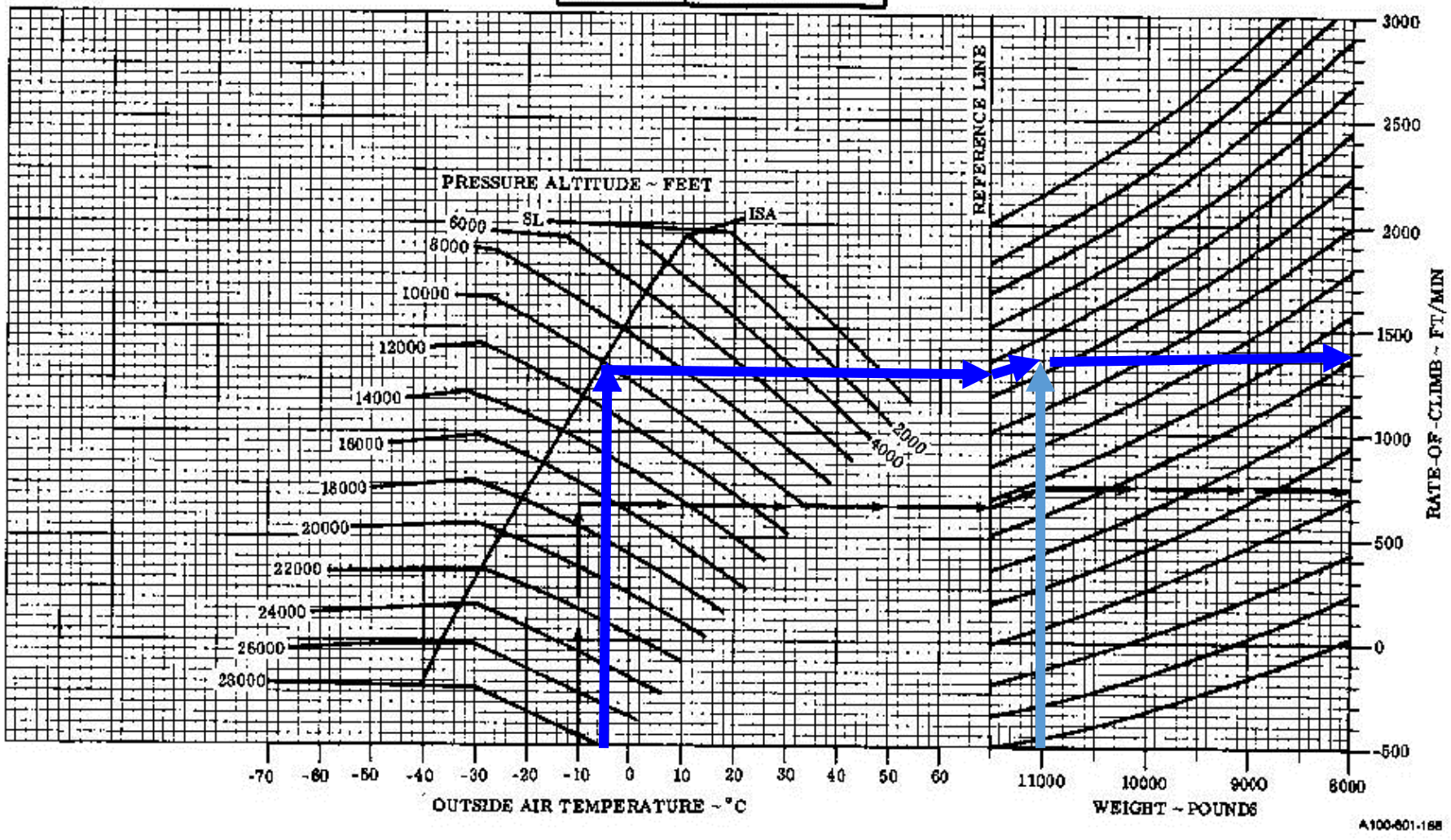
TWO ENGINE CLIMB

ASSOCIATED CONDITIONS:

POWER	MAXIMUM CONTINUOUS
FLAPS	0%
GEAR	UP

WEIGHT POUNDS	CLIMB SPEED ~ KNOTS IAS (ASSUMES ZERO INST. ERROR)
11500	119
11000	118
10000	115
9000	112
8000	109

Note:
FOR A WEIGHT OF 11000lbs
IAS = 118 Knots
However 118 IAS
= 138TAS at 10000 ft @ -5C



RATE OF CLIMB
1380 FT/MIN

King Air A-100 Flight Manual

- -5°C
- Pressure altitude 10000 feet
- Weight 11000 lbs

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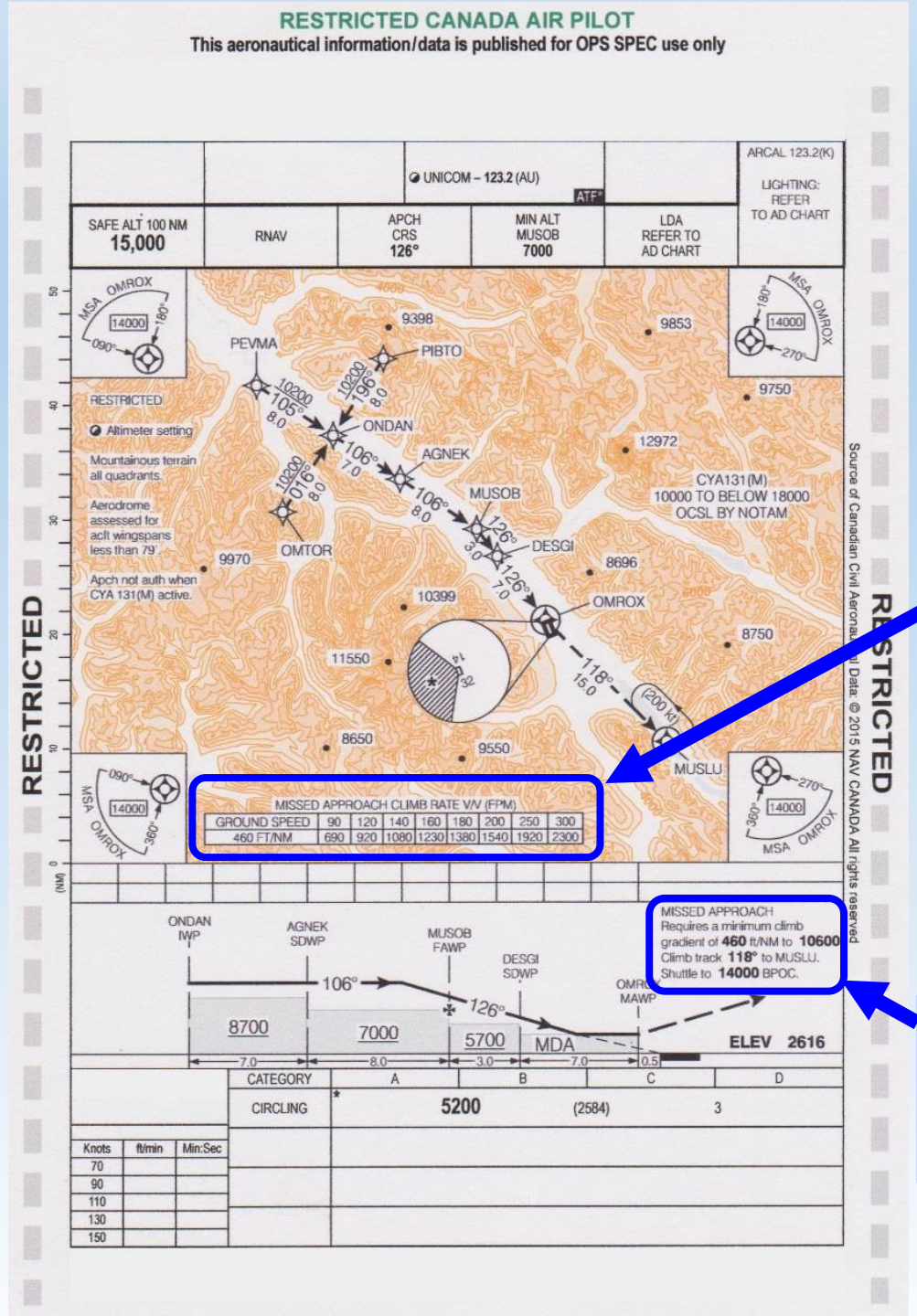

Rates of Climb *(Restricted Canada Air Pilot)*

Factors from previous slide include:

- -5°C
- Pressure altitude 10000 feet
- Weight 11000 lbs
- Rate of climb 1380 feet/minute

MISSED APPROACH CLIMB RATE V/V (FPM)								
GROUND SPEED (Knots)	90	120	140	160	180	200	250	300
460 FT/NM (ft/min)	690	920	1080	1230	1380	1540	1920	2300

MISSED APPROACH
Requires a minimum climb gradient of 460 ft/NM to 10600

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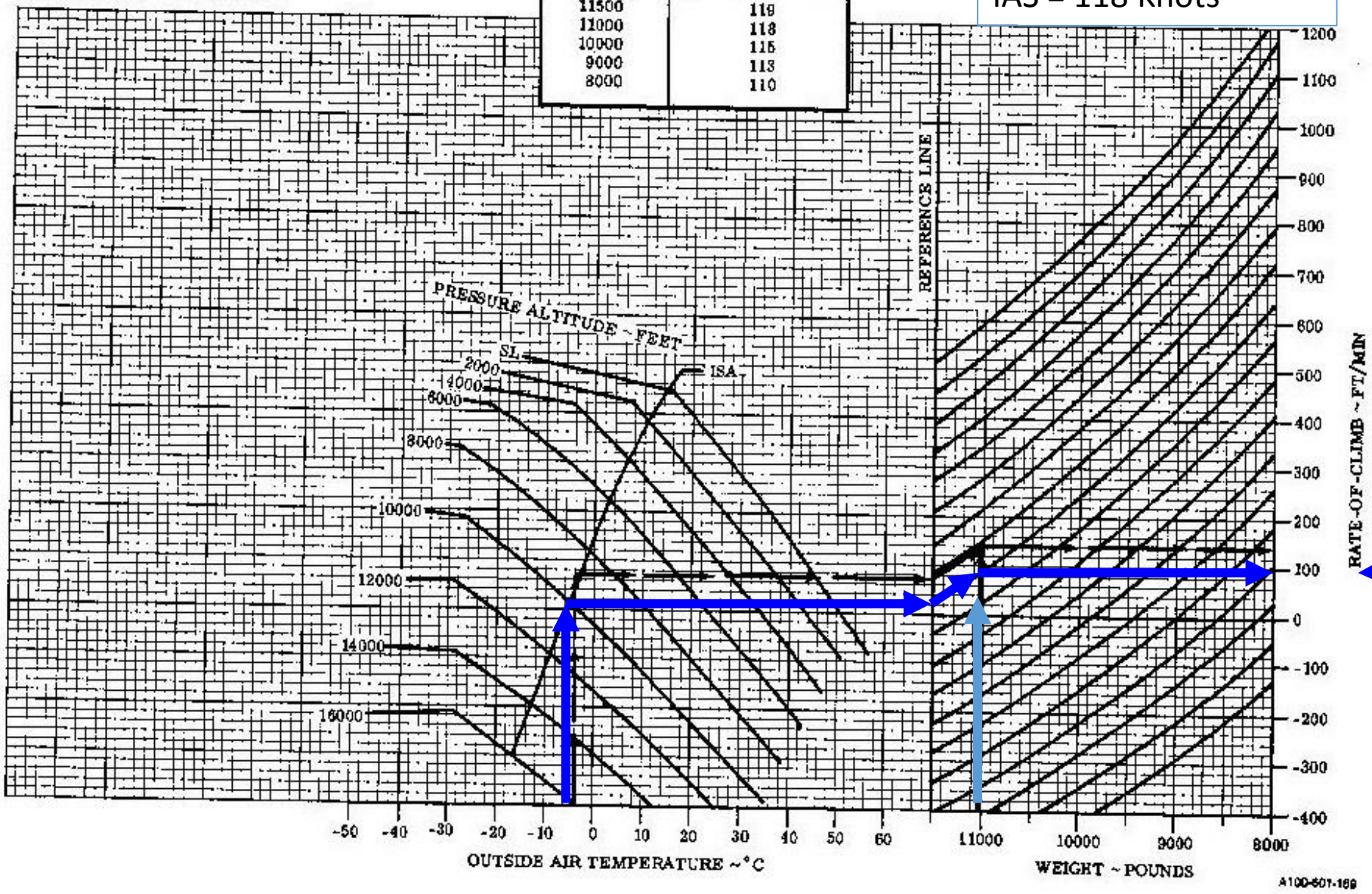
SINGLE ENGINE CLIMB

ASSOCIATED CONDITIONS:

POWER	MAXIMUM CONTINUOUS
FLAPS	0%
GEAR	UP
INOPERATIVE PROPELLER	FEATHERED

WEIGHT POUNDS	CLIMB SPEED ~KNOTS IAS (ASSUMES ZERO INST. ERROR)
11500	119
11000	118
10000	115
9000	113
8000	110



Note:
Weight / climb speed remains the same.
IAS = 118 Knots

King Air A-100 Flight Manual

- - 5°C
- Pressure altitude 10000 feet
- Weight 11000 lbs

RATE OF CLIMB
100 FT/MIN

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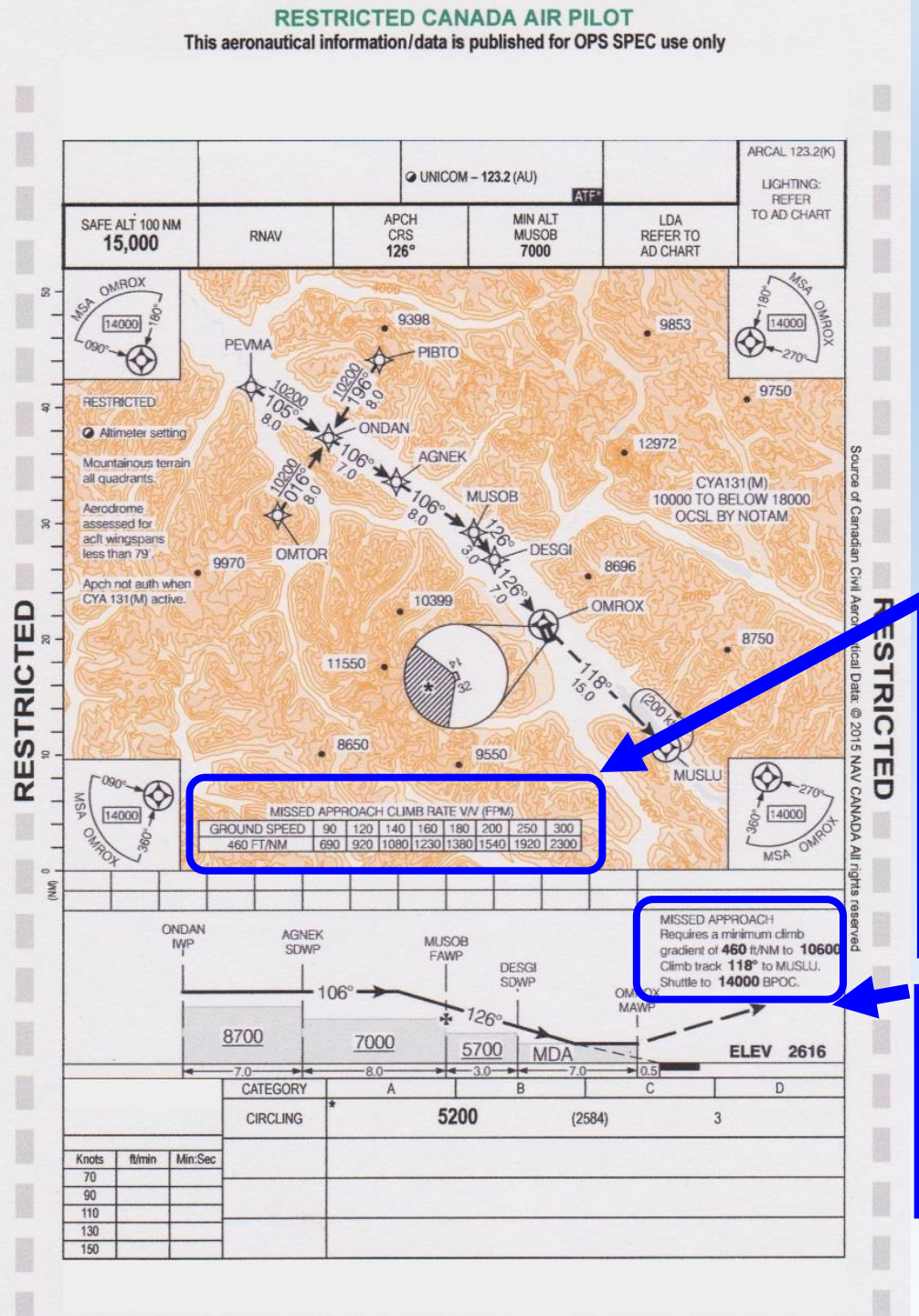

Rates of Climb *(Restricted Canada Air Pilot)*

Factors from previous slide include:

- - 5°C
- Pressure altitude 10000 feet
- Weight 11000 lbs
- Rate of climb 100 feet/minute

MISSED APPROACH CLIMB RATE V/V (FPM)								
GROUND SPEED (Knots)	90	120	140	160	180	200	250	300
460 FT/NM (ft/min)	690	920	1080	1230	1380	1540	1920	2300

MISSED APPROACH
Requires a minimum climb gradient of 460 ft/NM to 10600

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Aircraft Performance Factors

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Conditions Affecting Aircraft Performance
(Maximum Take-of/ Landing Weight)

Environmental (METAR)

Wind speed and direction

Barometric pressure (air density)

Temperature

Cloud ceiling

Precipitation

Visibility

Dew Point

Lightning Direction

Physical Conditions

Runway length (stopways and clearways can increase aircraft performance)

Runway contamination

Runway slope

Obstacles

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Environmental Condition:

Wind speed and direction

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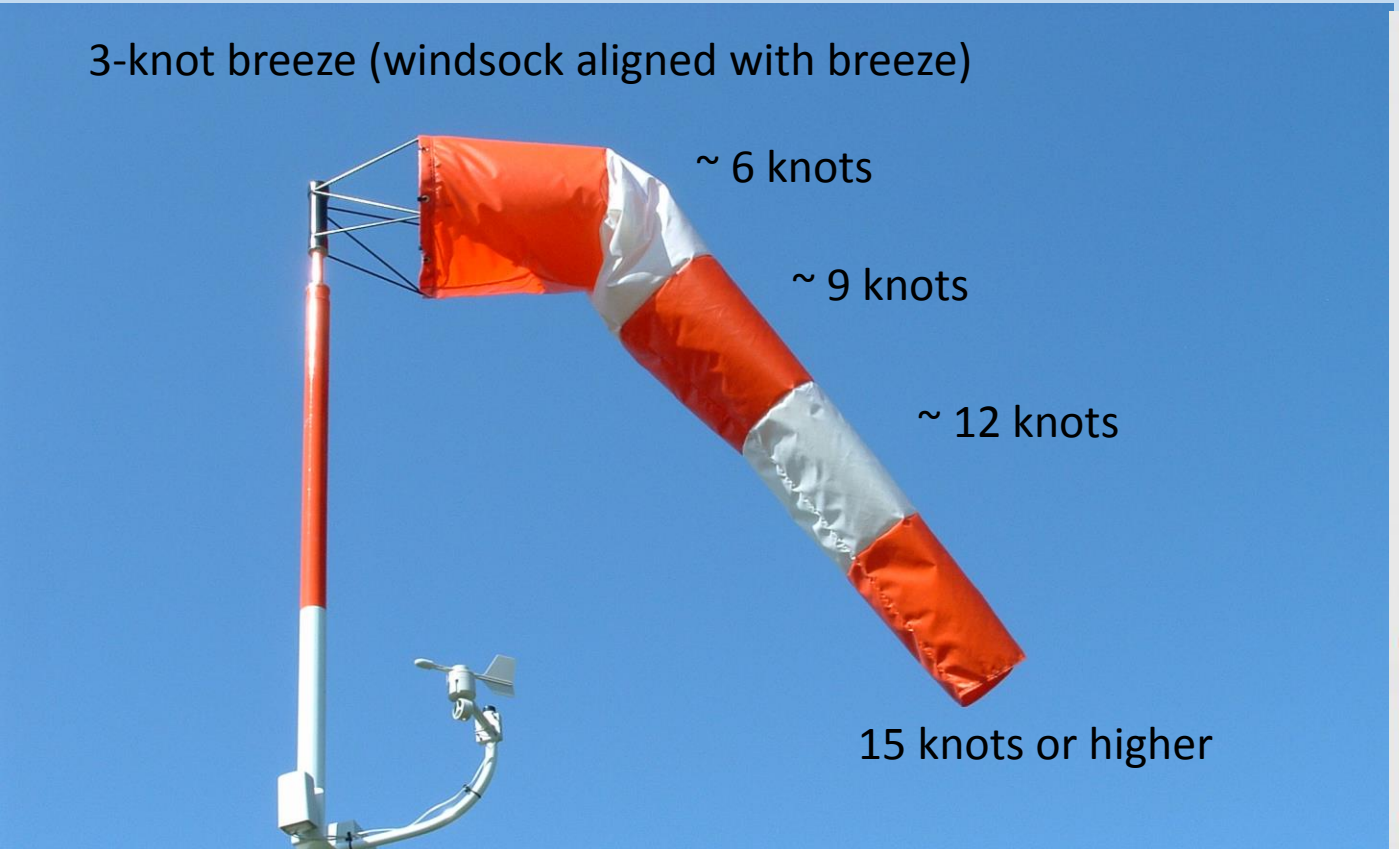
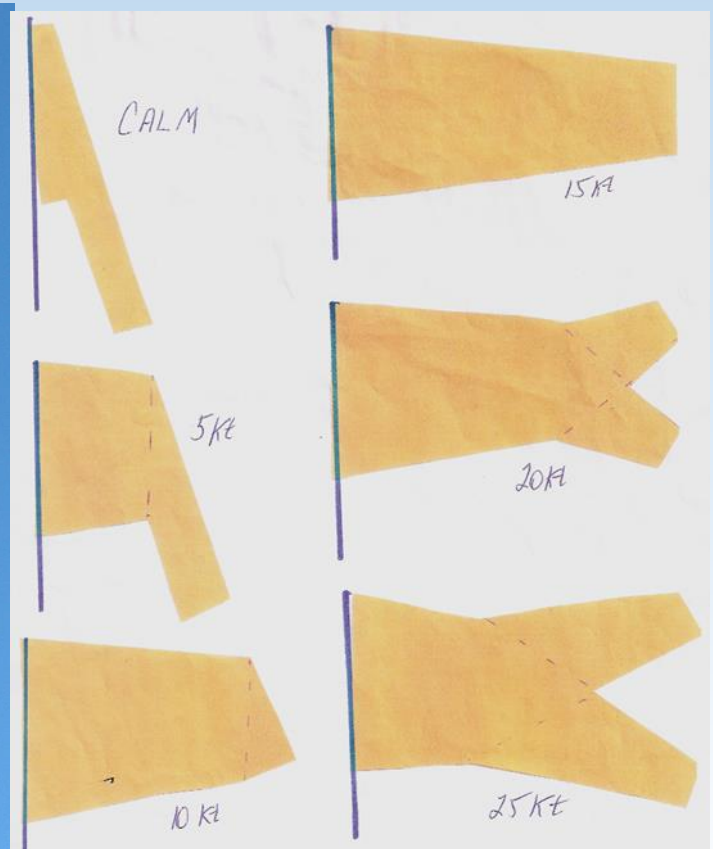
Wind Sock

Often the first segment is held open by the frame.

If the windsock is missing, you probably shouldn't be at the airport.

If the pole is missing, you're probably on your way to Oz.





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Beaufort Scale (Wind)

Beaufort number	Wind (km/h)	Wind (mph)	Wind Classification	Wind effects on land	Wind effects on water
1	1–5	1–3	Light air	Smoke drift indicates wind direction; still wind vanes	Scalelike ripples with no foam crests
2	6–11	4–7	Light breeze	Leaves rustle; wind felt on face; wind vanes moved by wind	Small wavelets; crests have a glassy appearance and do not break
3	12–19	8–12	Gentle breeze	Leaves and twigs constantly moving; light flags extended	Large wavelets; crests begin to break; scattered whitecaps
4	20–29	13–18	Moderate breeze	Dust and loose paper raised; small branches move	Small waves 1–4' becoming longer; many whitecaps
5	30–38	19–24	Fresh breeze	Small trees with leaves begin to sway	Moderate, longer waves 4–8'; whitecaps common; some spray
6	39–50	25–31	Strong breeze	Larger tree branches moving; phone lines whistle	Larger waves 8–13'; whitecaps common; more spray
10	87–101	55–63	Storm	Trees uprooted; considerable structural damage to buildings	Very high waves, 20–30', with overhanging crests; sea white with blown foam
11	102–115	64–72	Violent storm	Widespread damage	Huge waves, 30–45'; foam patches cover sea; air filled with spray; visibility reduced
12	>115	>72	Hurricane	Widespread damage	Huge waves, over 45'; air filled with foam; sea all white with driving spray; little visibility

6	39-50	25-31	Strong Breeze	Large tree branches moving; phone lines whistle	Larger waves 8-13'; whitecaps common; more spray

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Effects of Temperature and Pressure on Aircraft

Two basic scenarios:

1. The **PRESSURE** varies from ISA standard.

If the pressure is higher than ISA, then the altimeter reading in the aircraft will provide an elevation higher than the actual flight elevation.

2. The **TEMPERATURE** varies from ISA standard.

If the temperature is lower than ISA, then the altimeter reading in the aircraft will provide an elevation higher than the actual flight elevation.

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Environmental Condition:

Barometric Pressure (air density)

If the pressure is higher than ISA, then the altimeter reading in the aircraft will provide an elevation higher than the actual flight elevation.

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Theory of Barometric Pressure

Aircraft altimeter displaying an altitude of 10,180 feet.

Aircraft altitude is provided by an aneroid barometer.

- Pressure decreases with height.
- Aircraft goes up, pressure goes down.
  The altimeter is reading a height.

Altitude is recorded as height above Mean Sea Level (MSL).

- Reading a pressure value, not a place.
- Local air pressure at MSL is called the QNH or altimeter setting.

Subscale (Kolsman) sets the pressure at which the altimeter will set as the airport elevation, or QNH.

The greater the altitude the lower the pressure (approximately 1” of mercury per 1000’ near sea level.

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More about Barometric Pressure

International Standard Atmosphere (ISA) is a model used for the standardization of aircraft instruments.

- North America – Pressure range measure is 29.1 to 31 In Hg (**Stnd A.S.L. pressure is 29.92**)
- International – Corresponding values are 985.72 to 1050.08 millibars (**Stnd A.S.L. pressure is 1013.25 mbar)**
- Standard temperature is 15^{o}C.

It was established to provide a common reference for temperature and pressure. ISA uses tables of values over a range of altitudes.

Flying in ISA-plus temperatures will hamper aircraft performance. If ISA-plus temperatures are excessive, aircraft may be unable to maintain altitude, or climb at the anticipated rate.

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Barometric Pressure & Altimeters

At small airports:

- Two altimeters are used to ensure a correct reading.
- If a difference of more than 5/100” Hg exists, then both are considered inoperable.
- The elevation of the airfield is set on the altimeter at the site and the corresponding barometric pressure is read.
- The reading is transmitted to the pilot for flight elevation purposes.

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Dual Altimeters Used at Small or Remote Sites

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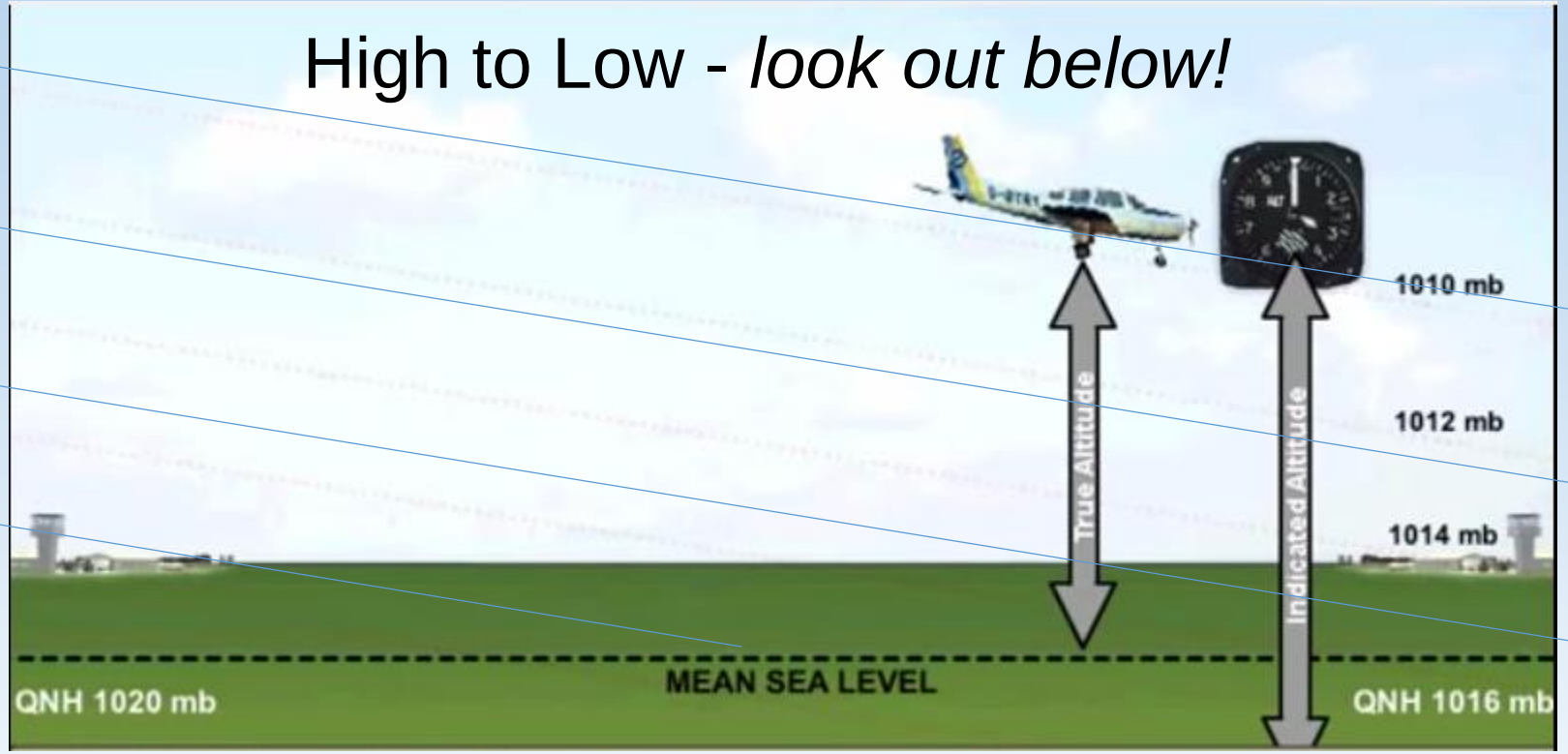
Pressure Change (high to low)



Recall normal range (International) is 985.72 to 1050.08 mbar

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Environmental Condition:

Temperature

If the temperature is lower than ISA, then the altimeter reading in the aircraft will provide an elevation higher than the actual flight elevation.

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Cold Temperature Corrections

- Pressure altimeters are calibrated to indicate true altitude under International Standard Atmosphere (ISA) conditions.
- Any deviation from ISA will result in an erroneous reading on the altimeter.
- In the case when the temperature is higher than ISA, the true altitude will be higher than the figure indicated by the altimeter, and the true altitude will be lower when the temperature is lower than ISA.
- The altimeter error may be significant and becomes extremely important when considering obstacle clearances in very cold temperatures.
- Unless otherwise specified, the destination aerodrome elevation is used as the elevation of the altimeter source.

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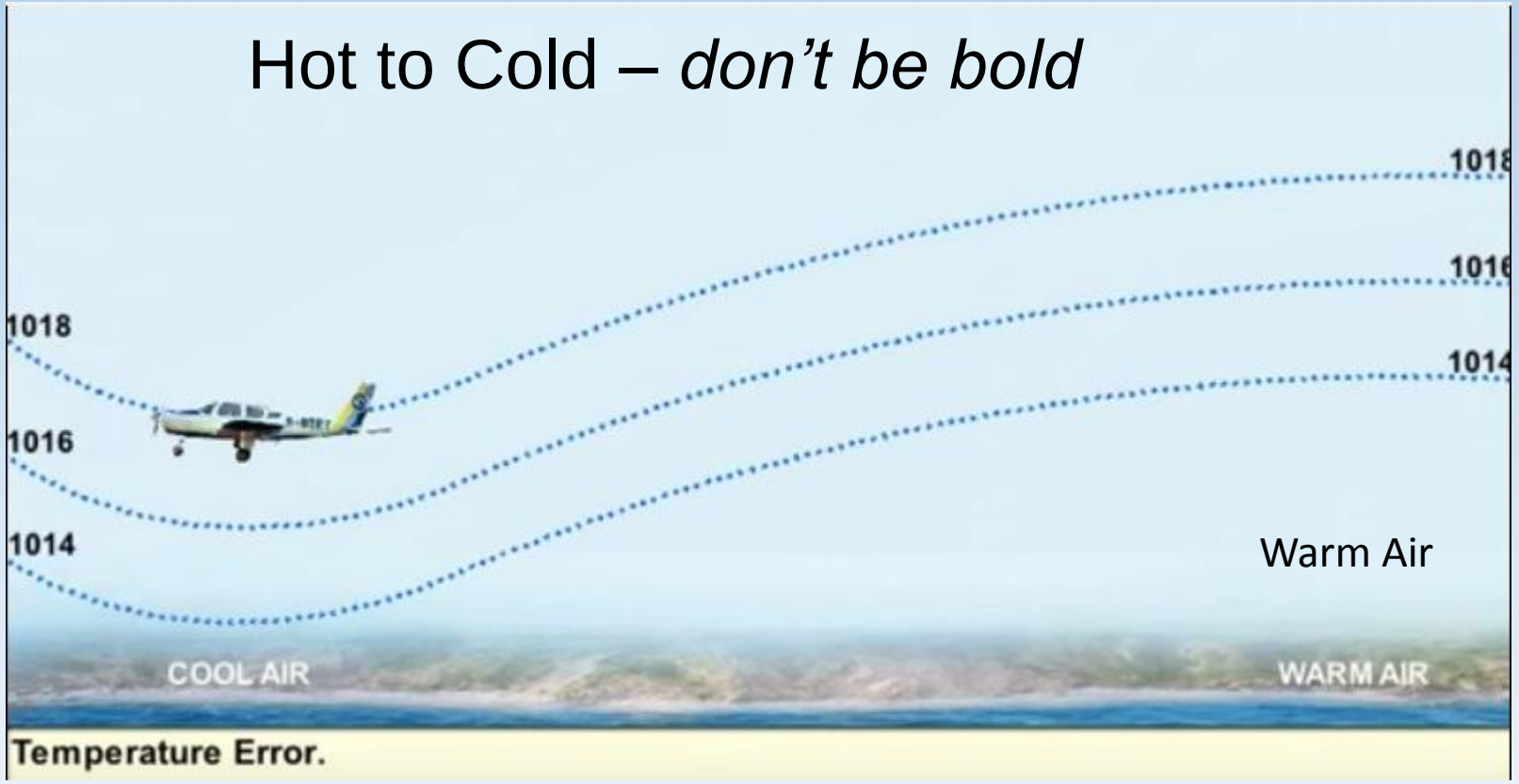
Temperature Change



Cool Air

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Temperature Altitude Correction Chart

Altitue Correction Chart

A/D Temp °C	HEIGHT ABOVE THE ELEVATION OF THE ALTIMETER SETTING SOURCE (feet)													
	200	300	400	500	600	700	800	900	1000	1500	2000	3000	4000	5000
0	20	20	30	30	40	40	50	50	60	90	120	170	230	290
-10	20	30	40	50	60	70	80	90	100	150	200	290	390	490
-20	30	50	60	70	90	100	120	130	140	210	280	430	570	710
-30	40	60	80	100	120	130	150	170	190	280	380	570	760	950
-40	50	80	100	120	150	170	190	220	240	360	480	720	970	1210
-50	60	90	120	150	180	210	240	270	300	450	600	890	1190	1500

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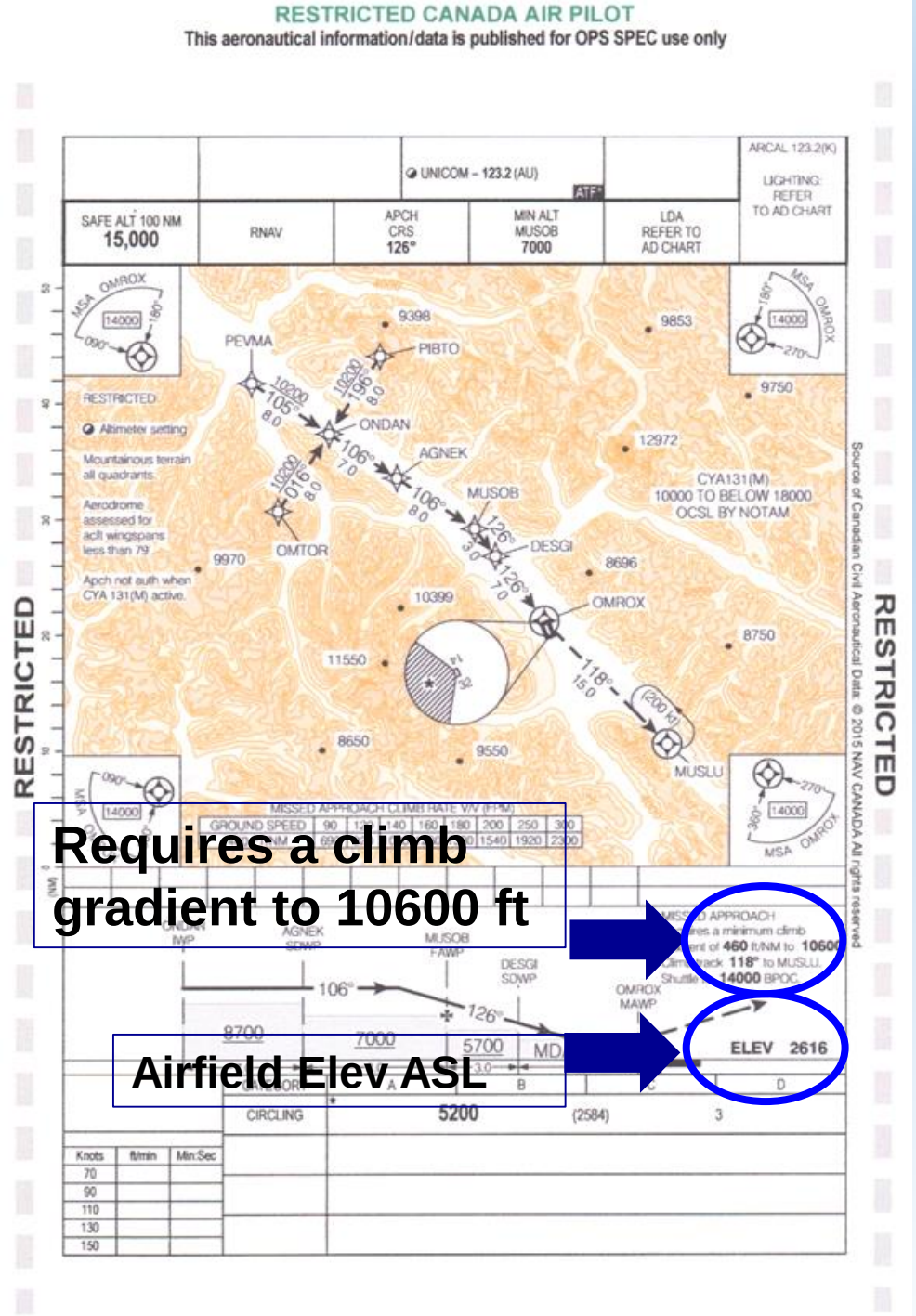

Example

Referring back to our IFR chart, the airfield is at 2,600’ ASL. The aircraft must climb to 10,600’ASL (8,000 feet above the airfield elevation).

If the ground temp is – 40°C, the altitude correction would be 1940 feet (970 X 2].

The pilot must climb to 12,540’ (10600 + 1940) on the aircraft altimeter to have obstacle clearance.

All of the arrival step-down altitudes must have the cold temperature correction applied.

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Physical Conditions

Declared Distance (Runway Length)
Runway End Safety Area (RESA)
Line-up Allowances
Runway Slope
Runway Contamination
Obstacles

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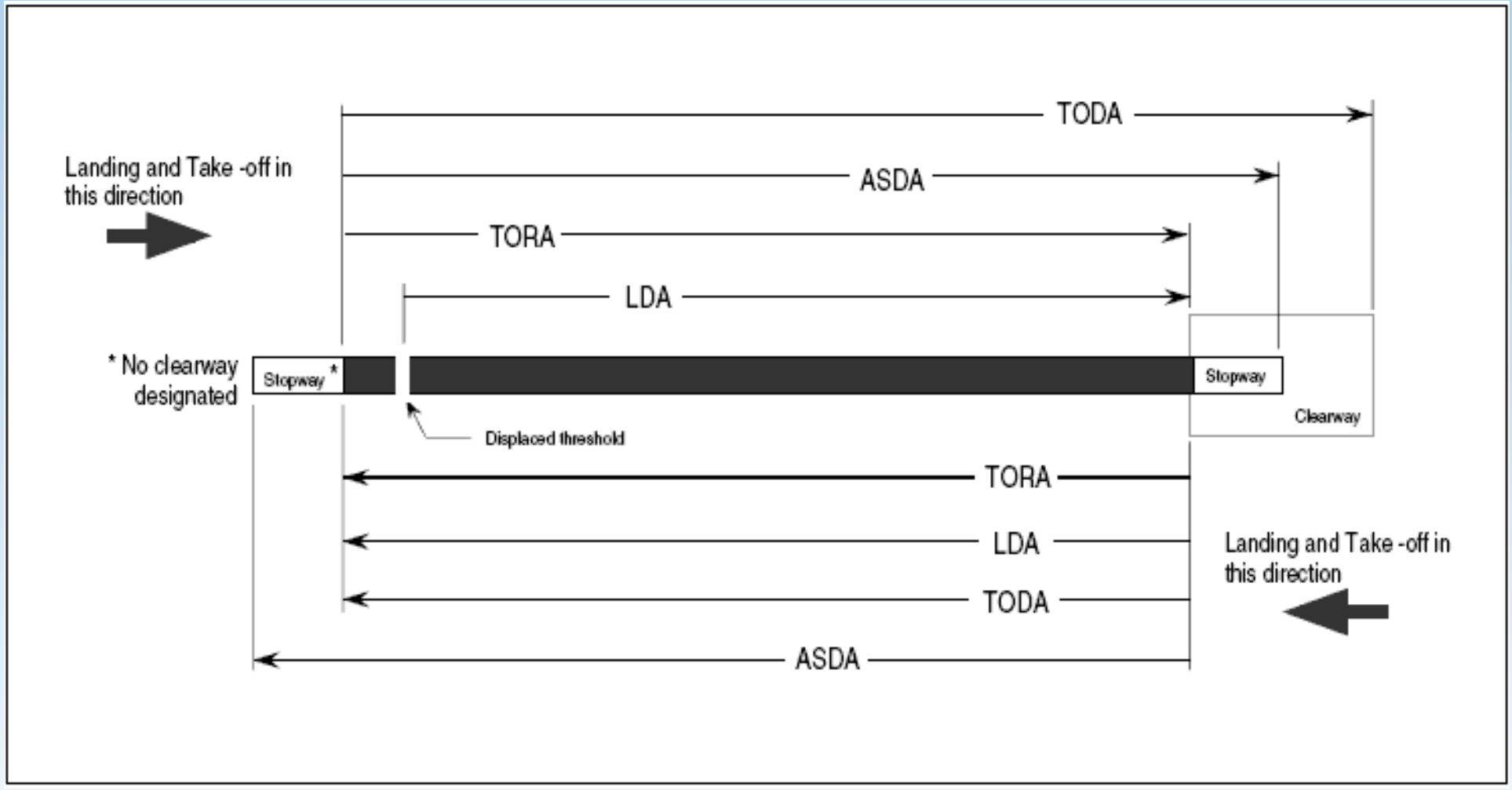
Declared Distance



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About RESA

Runway End Safety Area (RESA)

- Defined in Annex 14 & Explained (3.4)
- At each end of runway strip
- Purpose: to reduce the risk of damage to an aeroplane undershooting or overrunning the runway
- Not included in declared distances
- Minimum length: 90 m
- Width: twice that of runway

For small airports, why not?

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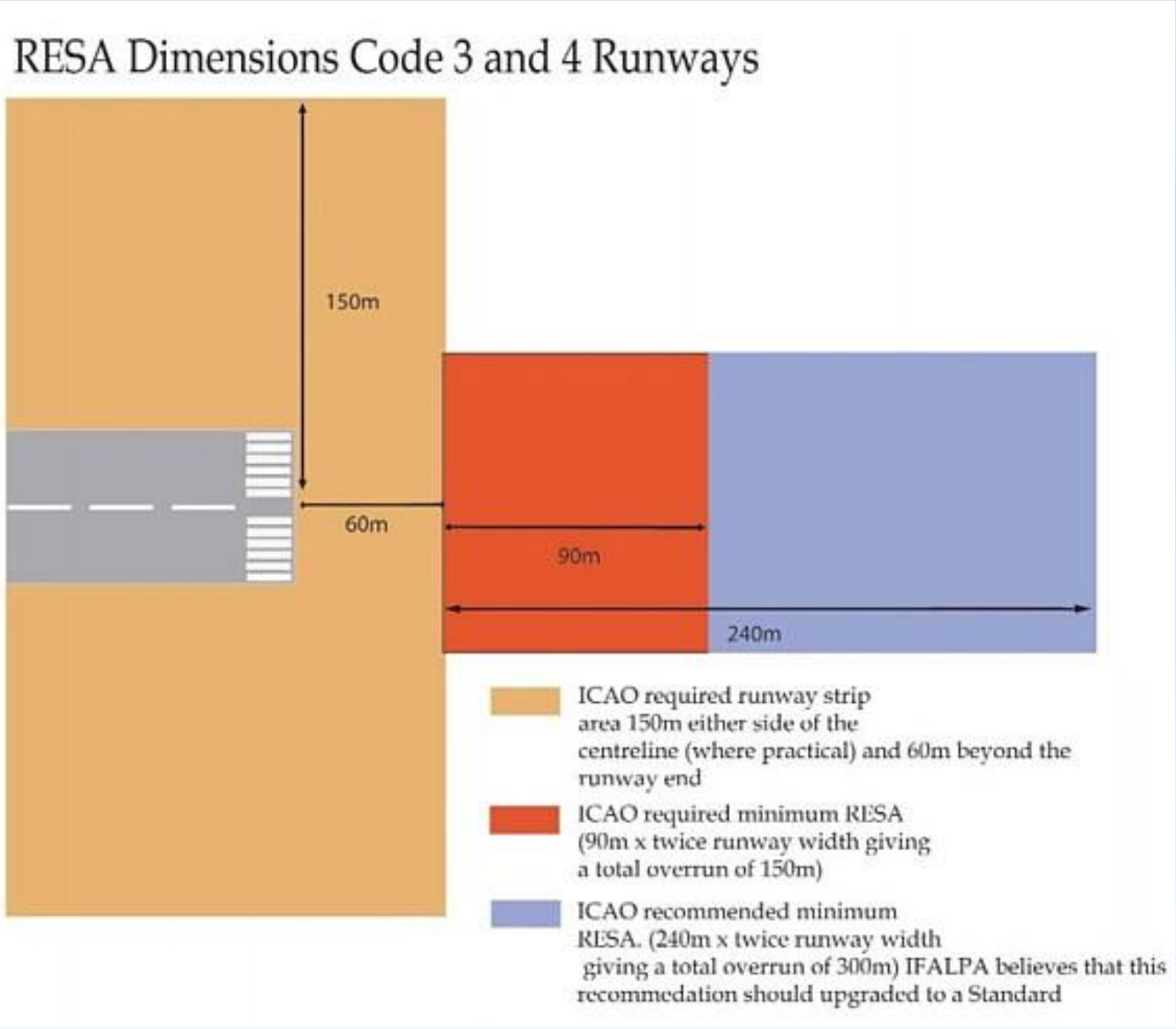

RESA Dimensions (Code 3 and 4 Runways)

ICAO Recommendations

- 60m Runway Strip
- 90m Required minimum beyond
- 240 m Recommended minimum Strip

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The Reason for RESA

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Line-up Allowance (200' aircraft)

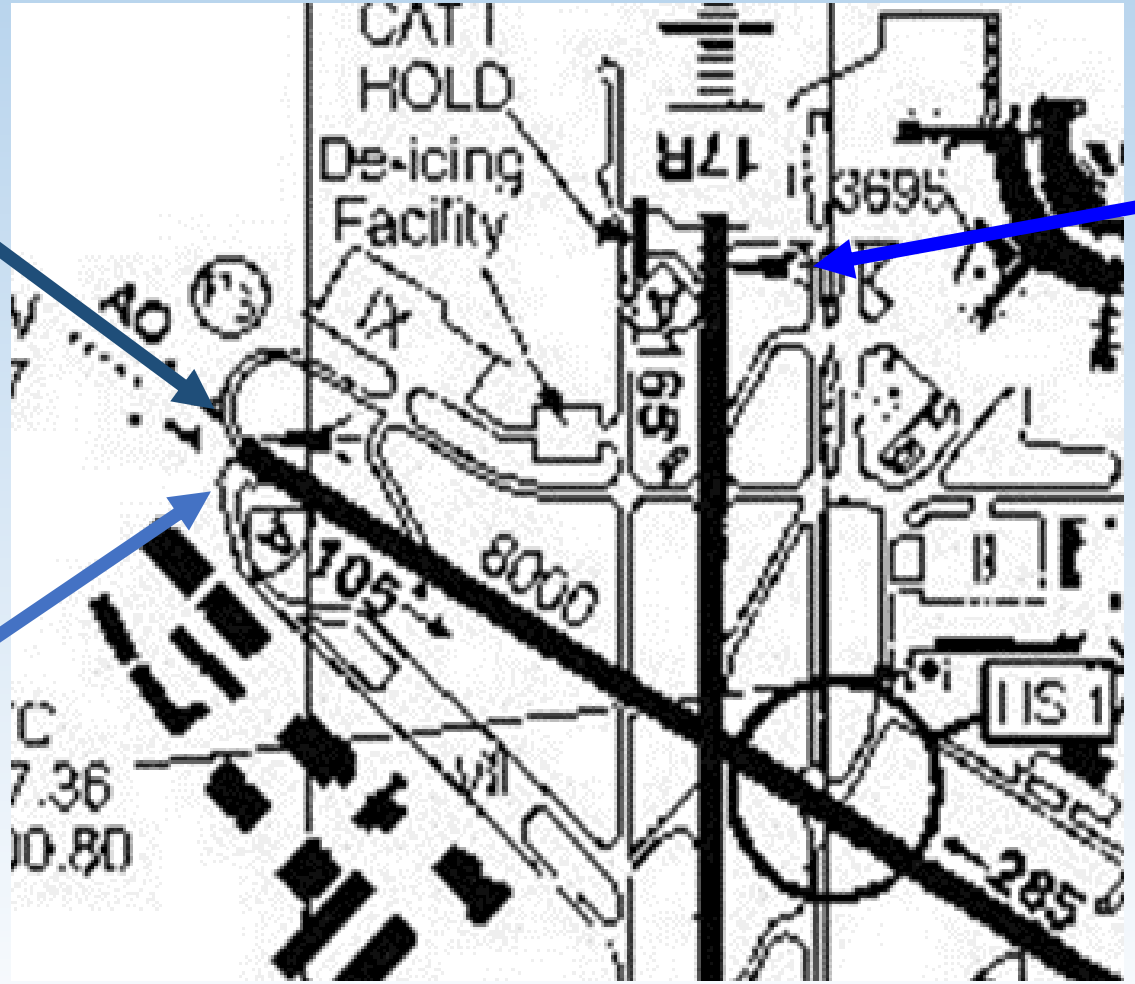
Runway 11
from taxiway AO.

No line-up
allowance

Runway 11
from taxiway A

90º turn = 1.4x200' =
280' line-up
allowance

CALGARY INTERNATIONAL AIRPORT



Runway 17R from
either taxiway

180º turn = 1.7x200' =
340' line-up allowance

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Line-up Allowances

- A distance penalty is incurred when an aircraft leaves the taxiway and lines up on the runway before beginning take-off roll.

- It is most economical to allow aircraft to taxi onto the runway end.

- One foot of taxiway costs less to build and maintain than one foot of runway.

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Runway Slope

To determine take-off performance, ***aircraft operators*** use the runway slope determined by the difference in threshold elevations divided by the total runway length.

***EXAMPLE:* Sanikiluaq, Nunavut**

- Runway center portion is significantly lower than both thresholds.
- The threshold elevation difference is only 4 feet (over 3800 feet = 0.1% slope).
- However, if you refer to the CFS, the slope shown is Rwy 09 down 0.9% and Rwy 27 down 1.2%.

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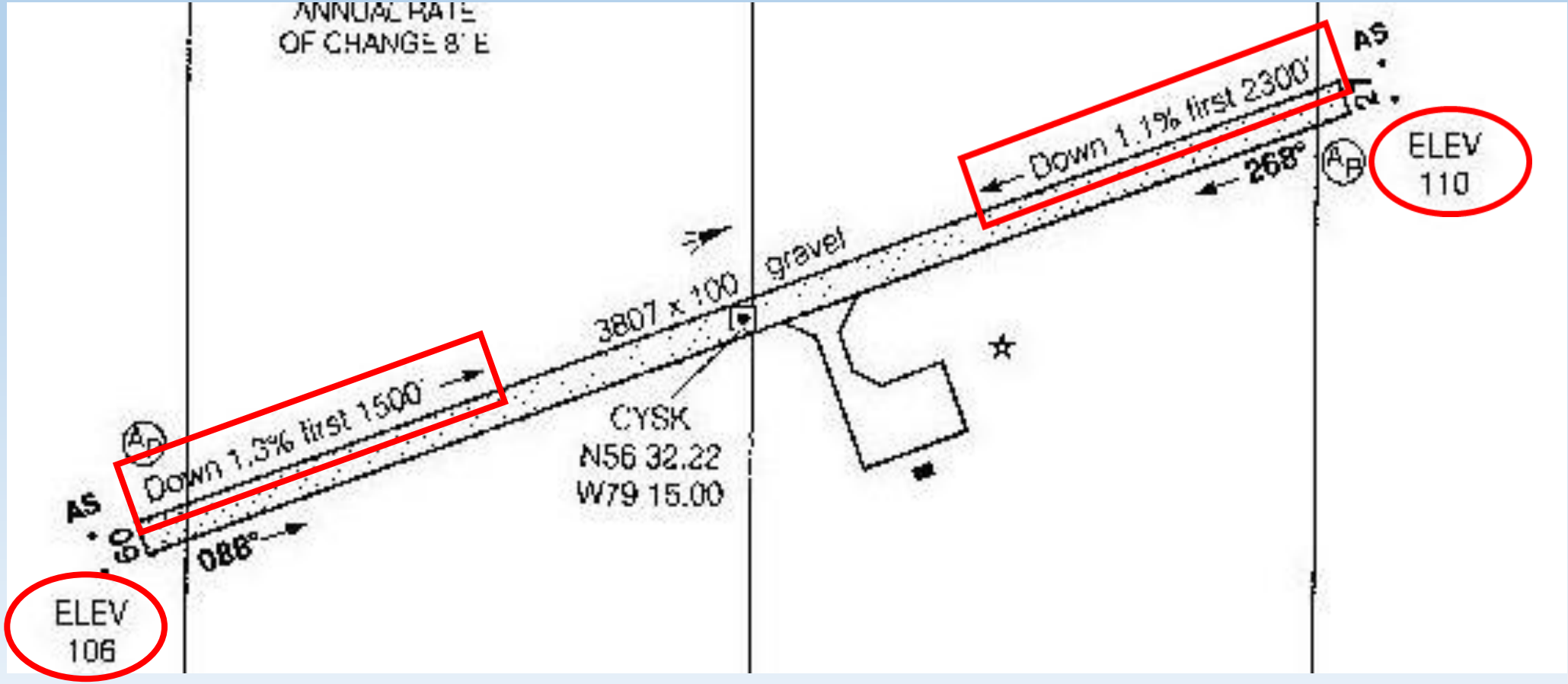
Sanikiluaq, Nunavut



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Closing Remarks

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Fokker F-28
Gravel Runway

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--KAAA--
ELEV. 0 FT
MAX TEMP 50C
RB183 MK555-15 ENG

FLAPS 18

FOKKER F-28
TAKE OFF PERFORMANCE
GRAVEL

--AAA--
ANY AIRPORT
ANYWHERE, USA
VAR 0

RUNWAY NO 01 02 03 04 05 06

WEIGHT

TEMPERATURE

C	CLIMB LIMIT						THRUST INDEX ENG ANTI-ICE OFF	ON	F
-14	66500	56240F	59470F	62300F	65120F	67950F	70000F	162	166	7
-12	66500	56120F	59330F	62160F	64970F	67790F	70000F	162	166	10
-10	66500	55990F	59200F	62020F	64830F	67640F	70000F	162	166	14
-8	66500	55870F	59070F	61890F	64680F	67480F	70000F	162	166	18
-6	66500	55740F	58930F	61750F	64540F	67330F	70000F	162	166	21
-4	66500	55610F	58800F	61610F	64390F	67170F	69960F	162	166	25
-2	66500	55490F	58670F	61480F	64250F	67020F	69790F	162	166	28
0	66500	55360F	58540F	61340F	64100F	66860F	69620F	162	166	32
2	66500	55230F	58400F	61200F	63950F	66710F	69460F	162	166	36
4	66500	55110F	58270F	61070F	63810F	66550F	69290F	162	166	39
6	66500	54980F	58140F	60930F	63660F	66390F	69120F	162	166	43
8	66500	54850F	58000F	60790F	63520F	66240F	68950F	162	166	46
10	66500	54730F	57870F	60660F	63370F	66080F	68790F	162	166	50
12	66500	54600F	57740F	60520F	63230F	65930F	68620F	162	NA	54
14	66500	54480F	57600F	60380F	63080F	65770F	68450F	162	NA	57
16	66500	54350F	57470F	60250F	62930F	65620F	68290F	162	NA	61
18	66500	54220F	57340F	60110F	62790F	65460F	68120F	162	NA	64
20	66500	54100F	57210F	59970F	62640F	65310F	67950F	158	NA	68
22	66500	53970F	57070F	59840F	62500F	65150F	67790F	153	NA	72
24	66500	53490F	56570F	59320F	61950F	64560F	67150F	148	NA	75
26	66500	53010F	56070F	58810F	61390F	63980F	66520F	143	NA	79
28	66500	52540F	55560F	58290F	60840F	63390F	65890F	138	NA	82
30	66500	52060F	55060F	57770F	60290F	62800F	65260F	132	NA	86
32	66500	51410F	54380F	57070F	59540F	62000F	64400F	128	NA	90
34	66500	50760F	53690F	56370F	58790F	61200F	63540F	122	NA	93
36	65700	50110F	53010F	55670F	58050F	60400F	62680F	117	NA	97
38	64750	49460F	52330F	54970F	57300F	59610F	61820F	111	NA	100
40	63800	48810F	51640F	54260F	56550F	58810F	60960F	105	NA	104
42	62750	48160F	50960F	53560F	55800F	58010F	60110F	99	NA	108
44	61700	47570F	50330F	52900F	55140F	57320F	59390F	93	NA	111
46	60550	46970F	49710F	52250F	54480F	56640F	58670F	87	NA	115
48	59400	46380F	49090F	51590F	53820F	55950F	57950F	80	NA	118
50	58250	45780F	48460F	50930F	53170F	55260F	57240F	72	NA	122

RUNWAY LENGTH	4000	4500	5000	5500	6000	6500
RUNWAY SLOPE	0.0	0.0	0.0	0.0	0.0	0.0
ADD LBS/KT HW	115	115	110	110	115	120
SUB LBS/KT TW	410	430	430	435	460	480
LEVEL OFF HT	600	600	600	600	600	600

LOW QNH: SUBTRACT 70 LB PER MB HIGH QNH: NO CORRECTION

APPLY PERFORMANCE CORRECTION AS REQUIRED *** OBSERVE STRUCTURAL LIMITS ***

PERFORMANCE DATA BASED ON NO SLOPE, NO OBSTRUCTIONS, GRAVEL SURFACE RUNWAY.

1. FOR ENGINE FAILURE USE SPECIAL ENGINE INOPERATIVE PROCEDURE.
   IF NO SPECIAL PROCEDURE IS PUBLISHED, CLIMB STRAIGHT OUT.
2. FOR "ALL ENGINES" DEPARTURE CHECK FOR NORMAL DEPARTURE PROCEDURE OR SID.

ISSUED: 24 FEB '92

Fokker F-28 Take-Off Performance (Gravel)

LOAD LIMITS BASED ON RUNWAY LENGTH & TEMPERATURE						
	Runway Length (ft)					
	4000	4500	5000	5500	6000	6500 ft
Temp	Weight					
-14	56240	59470	62300	65120	67950	70000
50	45780	48460	50930	53170	55260	57240
EFFECT OF WIND ON LOAD						
Add Lbs/Kt HW	115	115	110	110	115	120
Sub Lbs/Kt TW	410	430	430	435	460	480
* Performance data based on no slope, no obstructions, gravel surface runway.						

EFFECT OF LOW PRESSURE

Low QNH: Subtract 70 Lb per MB

985 to 1050 diff. is 65 mbar
Therefore 60 x 70 lbs = 4200 lbs

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Why Care about Airfield Safety?

- Passenger safety depends on it.
- Personal and corporate livelihoods are at stake.
- No agency, whether public or private, should focus on shutting down an airfield for non-compliance of a single non-compliant event.
- Rather, the onus is on all stakeholders to correct deficiencies and ensure airfields are safe, legal and economical.

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