

Cold Temperature Corrections

Flying in temperatures below ISA can seriously erode your terrain/obstacle clearance!

Altimeters (even on the most advanced aircraft) indicate correctly only if the temperature of the atmosphere is equal to the values of the International Standard Atmosphere (ISA).

When the temperature is lower than ISA, then your true altitude is lower than the indicated altitude!

ICAO has therefore created provisions that require pilots (and in some specific cases air traffic controllers) to apply appropriate corrections, so that the altitudes flown achieve the required clearance above terrain and obstacles.

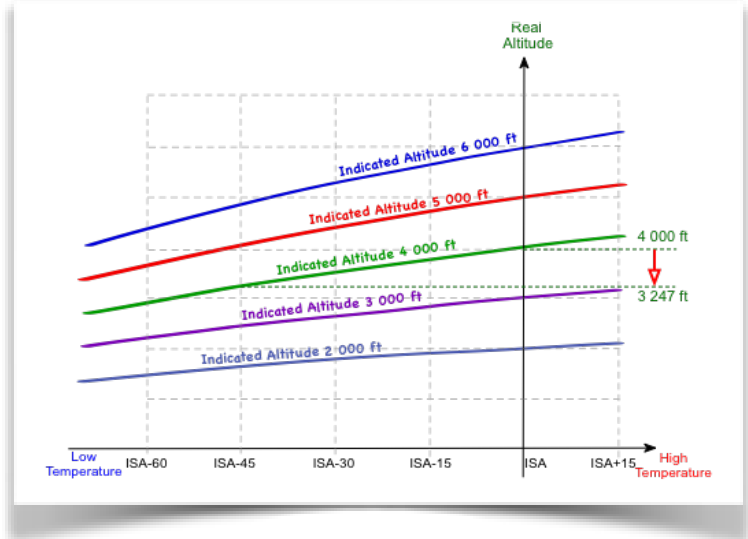
Experience shows, that many pilots operating in winter conditions are either not aware of these safety-relevant provisions or simply forget to apply them consistently. There is also no guarantee that the Air Traffic Services always apply the relevant provisions. If controllers are not aware of altitude corrections applied by pilots, a reduction of the required separation could occur.

IFALPA Policy developed by the ATS Committee aims to achieve improvements of the ICAO provisions (contained in PANS-OPS and PANS-ATM). IFALPA believes for instance that the 20 % cut-off before a cold temperature correction needs to be applied is excessive. If you start your missed approach from a (non-precision final approach) minimum that provides only 246 ft obstacle clearance and have not applied 20 % altitude correction, your obstacle clearance in the intermediate part of the Missed Approach Segment is halved to 49 ft! Starting the missed approach just 20 seconds too late could easily deplete the remaining obstacle clearance. Furthermore, if you level off at the missed approach altitude without appropriate altitude correction, you might even be below the critical obstacle in the final part of the missed approach segment, where the minimum obstacle clearance according to ICAO PANS-OPS is only 164 ft.

The following pages reproduce an Ops Bulletin issued by ICAO's European Air Navigation Planning Group that provides more detail on the problem and is intended to improve the awareness of both pilots and air traffic controllers of their responsibilities concerning cold temperature corrections.

The European Air Navigation Planning Group (EANPG) is concerned that incorrect application of (or failure to apply) the necessary altitude corrections for low temperature – as prescribed in the Procedures for Air Navigation Services (PANS; Doc 4444 PANS-ATM and Doc 8168 PANS-OPS), or their uncoordinated application might lead to either the risk of collision with terrain/obstacles or of loss of separation. While improvements to the current ICAO provisions are discussed, the following guidance is offered for pilots, ATS authorities, air navigation service providers and air traffic controllers.

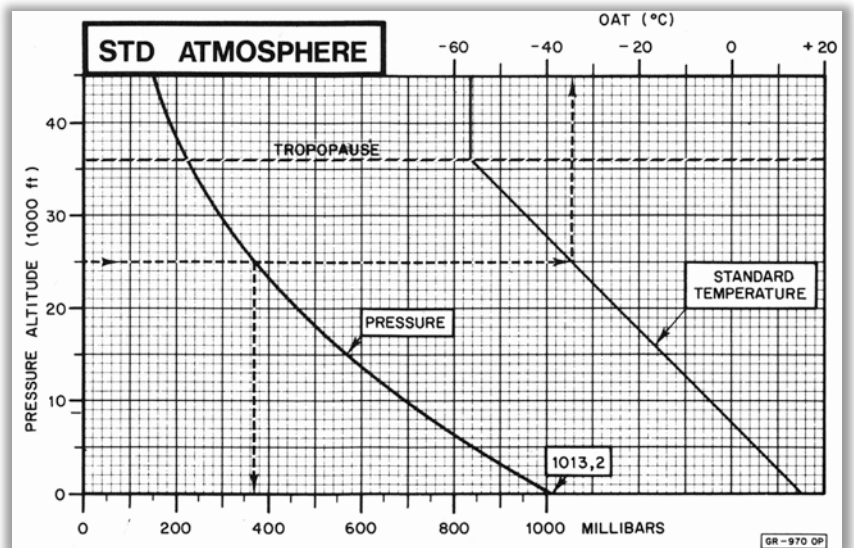
Barometric altimeters measure the air pressure and are calibrated according to the variation of the pressure with height, as specified for the international standard atmosphere (ISA). In conditions identical to ISA, the indication on the device will indicate the altitude above mean sea level when the reference datum is the local QNH.



It is part of the physics of the atmosphere that in case of a temperature deviation from ISA, the true altitude of a certain pressure value does no longer correspond to the altitude indicated on an altimeter that is calibrated to ISA.

In temperatures below ISA, the density of the air is higher and consequently the pressure values representing flight levels are closer together and the true altitude will be lower than the indicated altitude. Therefore corrections have to be applied to ensure terrain/obstacle clearance when the temperature is below ISA.

Weather patterns create areas of high and low pressure on the surface of the earth. These variations from the pressure expected according to the International Standard Atmosphere are compensated in the vicinity of airports by setting the appropriate pressure value (QNH) on altimeters, so that they show the correct altitude (airport elevation when on the ground; altitude above mean sea level when airborne).



Local air pressure and the deviation from ISA need to be taken into account to determine the lowest useable flight level.

ICAO provides in Doc 8168, PANS OPS, Volume I, a number of correction methods that can be used for determining the necessary altimetry correction to compensate the effect of cold temperature. Two of them are suitable for practical application, while the other two are more complex and normally used in case of calculating climb gradients or when the conditions are extremely different from ISA (temperatures below -50° C).

The practical methods that can be used easily in flight operations are:

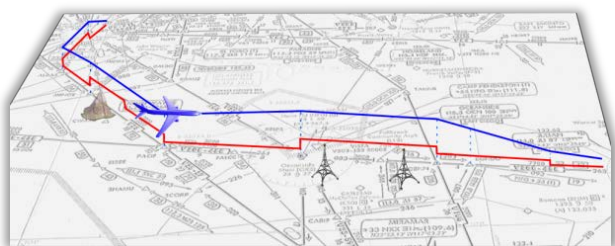
- **simple formula (very limited applicability range)**: add 4% of the height for each 10° C below ISA; valid for temperatures above -15°C at the altimeter setting source.
- **table based on a linear approximation formula**: applicable for heights up to 5000 ft above altimeter setting source and temperatures above -50°C

Table III-1-4-1 b). Values to be added by the pilot to minimum promulgated heights/altitudes (ft)

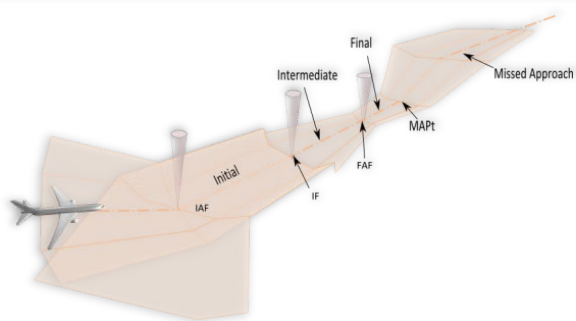
Aerodrome temperature (°C)	Height above the elevation of the altimeter setting source (feet)													
	200	300	400	500	600	700	800	900	1 000	1 500	2 000	3 000	4 000	5 000
0	20	20	30	30	40	40	50	50	60	90	120	170	230	280
-10	20	30	40	50	60	70	80	90	100	150	200	290	390	490
-20	30	50	60	70	90	100	120	130	140	210	280	420	570	710
-30	40	60	80	100	120	140	150	170	190	280	380	570	760	950
-40	50	80	100	120	150	170	190	220	240	360	480	720	970	1 210
-50	60	90	120	150	180	210	240	270	300	450	590	890	1 190	1 500

Who is responsible for altimetry correction?

Pilots are always responsible to ensure that levels flown (i.e. heights, altitudes, flight levels) are safe with respect to terrain and obstacle clearance. In addition to the pressure and temperature corrections PANS-OPS specifies corrections due to wind effect in mountainous terrain. States have to determine the useable minimum altitudes, including minimum flight levels and minimum vectoring altitudes.



When receiving a level clearance, the flight crew must ascertain that the cleared level will ensure the necessary obstacle clearance, and in case that an altimetry correction must be done, advise ATC that the cleared level cannot be accepted and demand a revised level clearance.



When flying at the minimum altitudes of an instrument approach procedure, or when checking the minimum altitudes along the instrument approach procedure, the flight crew must consider and apply the altimetry corrections, as necessary. It is recommended as best practice to advise ATC of the correction applied during the initial, intermediate and missed approach segments, as such corrections could bring the aircraft into conflict with traffic operating above.

Equally, when flying in uncontrolled airspace, a pilot must apply the necessary altimetry corrections and, when such correction would lead the aircraft into controlled airspace, a pilot shall obtain the necessary clearance from the responsible ATC unit.

There are some specific situations when the flight crew may be unable to determine the aircraft's exact position in respect to terrain/obstacles in the area and consequently the level, which provides the required obstacle clearance.

These situations are those when the aircraft is taken off its flight plan route or a published ATS route or instrument procedure (i.e. ATC issues vectors or direct routing instructions). In such cases, air traffic controllers must issue level instructions such that the prescribed obstacle clearance will exist at all times. It is the responsibility of the ATS authority to provide the controller with minimum altitudes corrected for temperature effect.

Salient points to remember:

Airspace Users

- Consider the surface temperature during the approach briefing;
- Plan appropriate cold temperature corrections for all altitudes where terrain/obstacle clearance could be affected;
- Compare the deviation from ISA at a suitable altitude during descent (e.g. 10000 feet above aerodrome level) with the deviation from ISA at the aerodrome to confirm the need for cold temperature corrections at lower altitudes;
- Apply cold temperature corrections according to PANS-OPS provisions when established and cleared on instrument approach procedure or in uncontrolled airspace;
- Determine if a level assigned by ATC is safe for reasons of terrain/obstacle clearance and when necessary request a higher level.

ATS Authorities

- Establish minimum flight and vectoring altitudes and publish in State's AIP how the correction for the cold temperature effect is addressed;
- Provide ATC with the values for minimum vectoring altitudes corrected for cold temperature effect, or a method to be used by the ATS provider to determine such values;
- Provide ATC with relevant provisions to follow when the temperature drop exceeds the range for which the values for minimum flight/vectoring altitudes have been established;
- Where deemed necessary to ensure the appropriate awareness of the flight crew on the cold temperature correction applied by ATS, complement the information in AIP with additional information on ATIS or to be issued by ATC

ATC

- Issue level instructions in compliance with the minimum flight/vectoring altitudes published in the State's AIP as means to ensure that the prescribed obstacle clearance will exist at all times;
- When vectoring for final approach, consider an extra distance so that, once established on IAP, the pilot could adjust to a more accurate temperature correction for the final approach fix altitude.