ALTIMETRY FOR AIR TRAFFIC CONTROLLER

1. Introduction

This article's goal is to help the air traffic controller to use the correct altimetry in his airspace.
You will learn the different terms and how to use them.

2. Height, altitude, flight level

These definitions are already covered by another article. We just want to remind you of the differences of vertical measurement of an aircraft.

The **HEIGHT** is the vertical distance of an aircraft above whatever SURFACE (buildings, mountains, a lake, etc.). HEIGHT is expressed in feet AGL (or meter AGL where applicable) (Above Ground Level).

The **ALTITUDE** (ALT) is the vertical distance of an aircraft above the MEAN SEA LEVEL (MSL).
For objects, landmarks and obstacles, the word ELEVATION (ELEV) is used instead of altitude.
ALTITUDES and ELEVATIONS are expressed in feet (or meter) AMSL (Above Mean Sea Level).

A **FLIGHT LEVEL** (FL) is the vertical distance of an aircraft above the ISOBARIC SURFACE of 1013.25hPa (hecto Pascal) or 29.92 in Hg (inches of Mercury).

	Height	Altitude	Flight Level
Landmark reference	surface	mean sea level	/
Altimetry reference	QFE	QNH	isobar surface 1013,25hPa
Unit	Feet (ft) AGL/ASFC	Feet (ft) AMSL	Flight Level (FL)

3. Transition altitude and transition level

In their airspace, air traffic controllers must define the transition altitude and transition flight level. These data are available on airfield ATIS information or on charts.

3.1. QNH value and altitude clearances

In their airspace, air traffic controllers shall give clearances including altitude and flight level. The rule is:

- ATC gives clearance using altitude based upon local QNH at and below sector's transition altitude.
- ATC gives clearance using flight level based upon standard pressure at and above sector's transition level.

QNH shall be given with the first descend clearance to an altitude below the transition level by the air traffic controller.

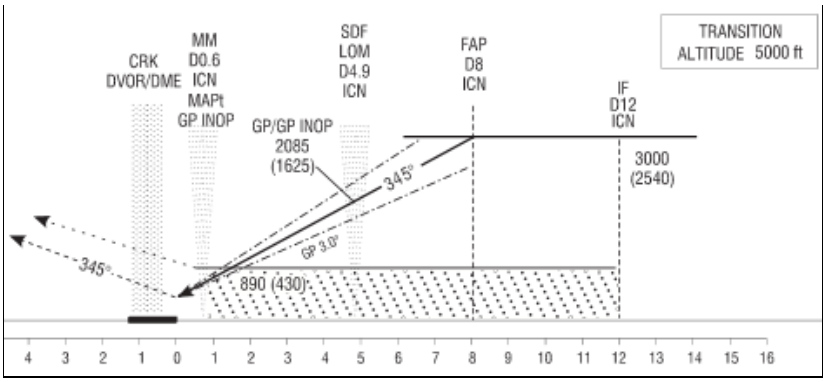
3.2. Transition altitude

The transition altitude is:

- The **upper limit from the surface to use local QNH altimeter setting** applicable to all aircraft.
- Published on charts (IAC, ARR, DEP)
- Broadcasted in the ATIS of air traffic controller.
- Defined inside the associated TMA (terminal area) where it is published.
- Usually given in feet but can be in meter in some countries.
- Transition altitude abbreviation defined by ICAO is **TA**.

Typical transition altitudes:

- In Europe, depends of the airfield (usually below 10000ft).
- In USA, there is one unique transition altitude at 18000ft.



Example: EICK IAC chart: TA=5000ft

3.3. Transition level

The transition level is:

- The **lower limit to use standard 1013hPa altimeter setting** applicable to all aircraft.
- Sometimes published on charts (IAC, ARR, DEP) but not often.
- Usually calculated by air traffic controller in function of transition altitude and QNH.
- Broadcasted in the ATIS of air traffic controller.
- Defined inside the associated TMA (terminal area) where transition altitude is published.
- Always given in flight level.
- Transition level abbreviation defined by ICAO is **TRL.**

Example: EIDW DEP Chart: Transition Level by ATC

Note that in some charts or documentation, you may find the use of TL abbreviation in place of TRL.

The altitude of the transition level shall always be greater or equal than the transition altitude.

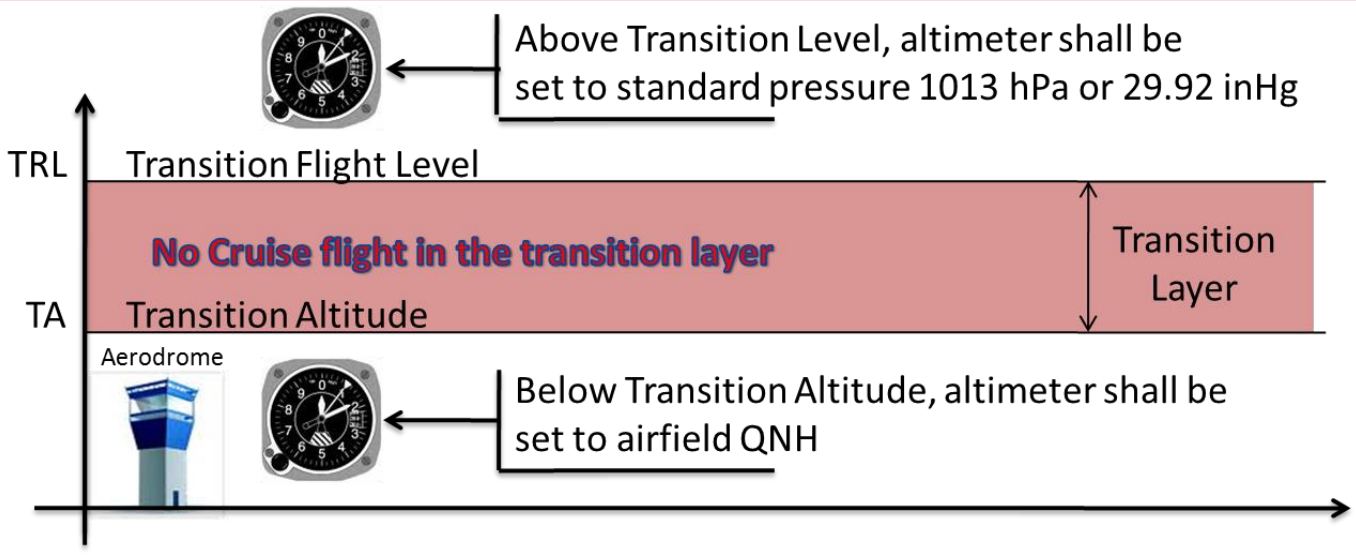
Consult documentation for transition level calculation in our training documentation offer.

3.4. Transition layer

The transition layer is the airspace located between the transition altitude and the transition level.

The transition layer is defined inside the associated TMA (terminal area) where the transition altitude is published.

No cruise flight in the transition layer is permitted. An aircraft can only cross the transition layer.



3.5. Transition layer thickness

The transition layer thickness is laid down in the country regulation and can be:

- Between 0ft and 999ft.
- Between 0ft and 499ft.
- Between 1000ft and 1999ft.
- Between 1000ft and 1499ft.

Consult your national regulation documentation or ask your training or ATC operation staff in order to have this value.

3.6. No transition altitude published

There are airfields outside TMA with no altitude transition published.

For these airfields, the default transition altitude should be 3000ft above the surface (height).
In this case there is no transition level.

4. Use of altimetry

A pilot can configure his aircraft with only three possible altimeter settings:

- Altimeter set on local QNH
- Altimeter set on standard pressure 1013hPa
- Altimeter set on local QFE (forbidden in some areas and airport but still used in some regions)

4.1. Q code definition

Q code	Definition
QFE	Atmospheric pressure at a specified datum such as airfield runway threshold.
QNH	Atmospheric pressure at mean sea level (may be either a local, measured pressure or a regional forecast pressure (RPS)).

4.2. Altitude separation problem

For a pilot the problem is that the QNH varies from one airport to another.

- If the local pressure is not known, the pilot has no choice but to keep the old value, even if it is the pilot's duty to find out the right value.
- When two aircraft fly at different altitudes with a different QNH, the vertical separation can be not guaranteed.

The same altimeter setting in all aircraft in one zone is the unique manner to guarantee that two close aircraft are properly separated vertically.

When using the standard altimeter setting, you must understand that a plane altitude will vary in function of the local atmospheric pressure of the crossed zones (see documentation altitude/height/flight level).

4.3. Altimeter setting change

The **standard altimeter setting** is mainly used and adapted for the **highest cruise altitude** in order to maintain separation of all aircraft whatever their origin and destination airfields. The altitude change at high flight level in function of local atmospheric pressure will be very slow and there will be very few influences.

The **local QNH altimeter setting** is mainly used and adapted for the **landing and take-off procedure**, **low altitude routes close to the landmark** and the **approach phase of the flight**. With taking the same local reference, all aircraft altitudes are constant with a constant air pressure value (QNH).

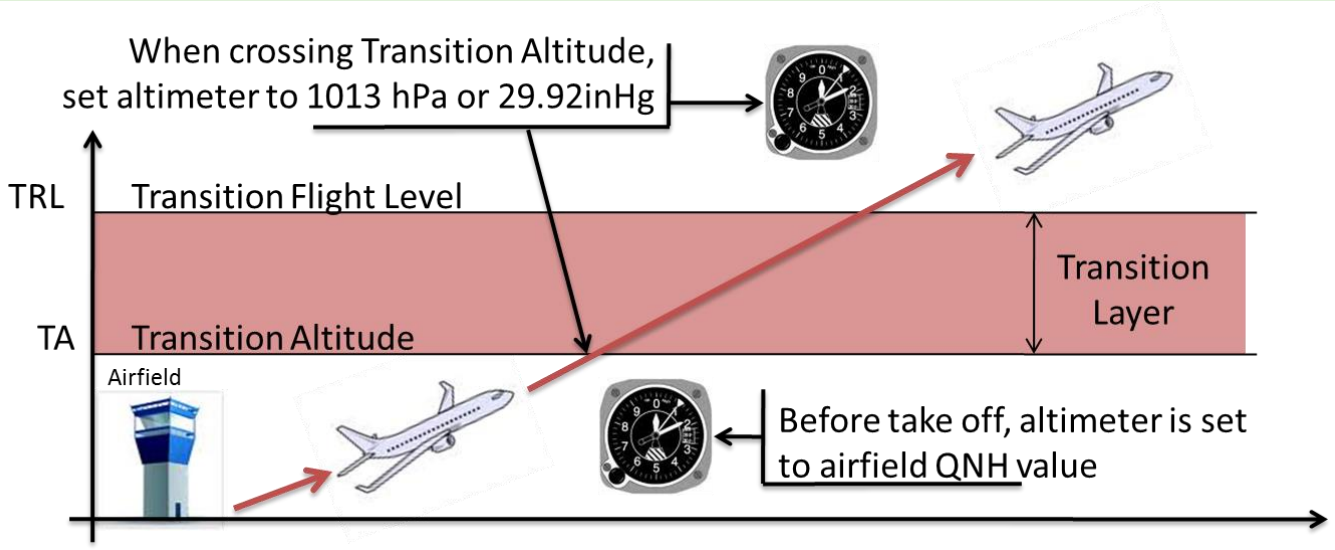
Those definitions can be translated for an ATC perspective.

Note that in some countries, the difference between TA and TRL or the transition layer thickness is less than 1000ft, and the dual assignation in clearance of TA and TRL may create vertical separation loss.

The first assignable flight level for IFR aircraft by ATC should be in that case the next IFR flight level above transition level which ensure a minimum of 1000ft separation.

4.3.1. Climbing phase

When in a climbing flight, passing through the transition altitude the altimeter setting will be changed from QNH to STD.
The transition altitude (TA) is the highest altitude that will be assigned to an aircraft.



4.3.2. Descending phase

When in a descending flight, passing through the transition level the altimeter setting will be changed from STD to QNH.
The transition level (TRL) is the lowest available FL, depending on the local pressure, that will be assigned to an aircraft.