LEVELS AND ALTITUDES

In aviation it is of the utmost importance that a pilot knows his height above ground level for safe landing and obstacle avoidance. For air traffic controllers its for obvious reasons absolutely necessary to know at which altitudes aircrafts are flying. For this reason, every aircraft is equipped with some sort of pressure altimeter.

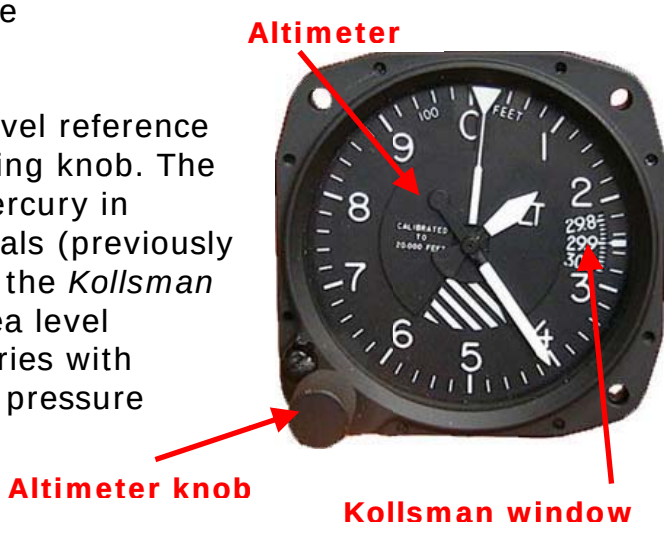
A pressure altimeter (also called barometric altimeter) is the altimeter found in most aircrafts. In it, an aneroid barometer measures the atmospheric pressure from a static port outside the aircraft.

Air pressure decreases with an increase of altitude approximately:

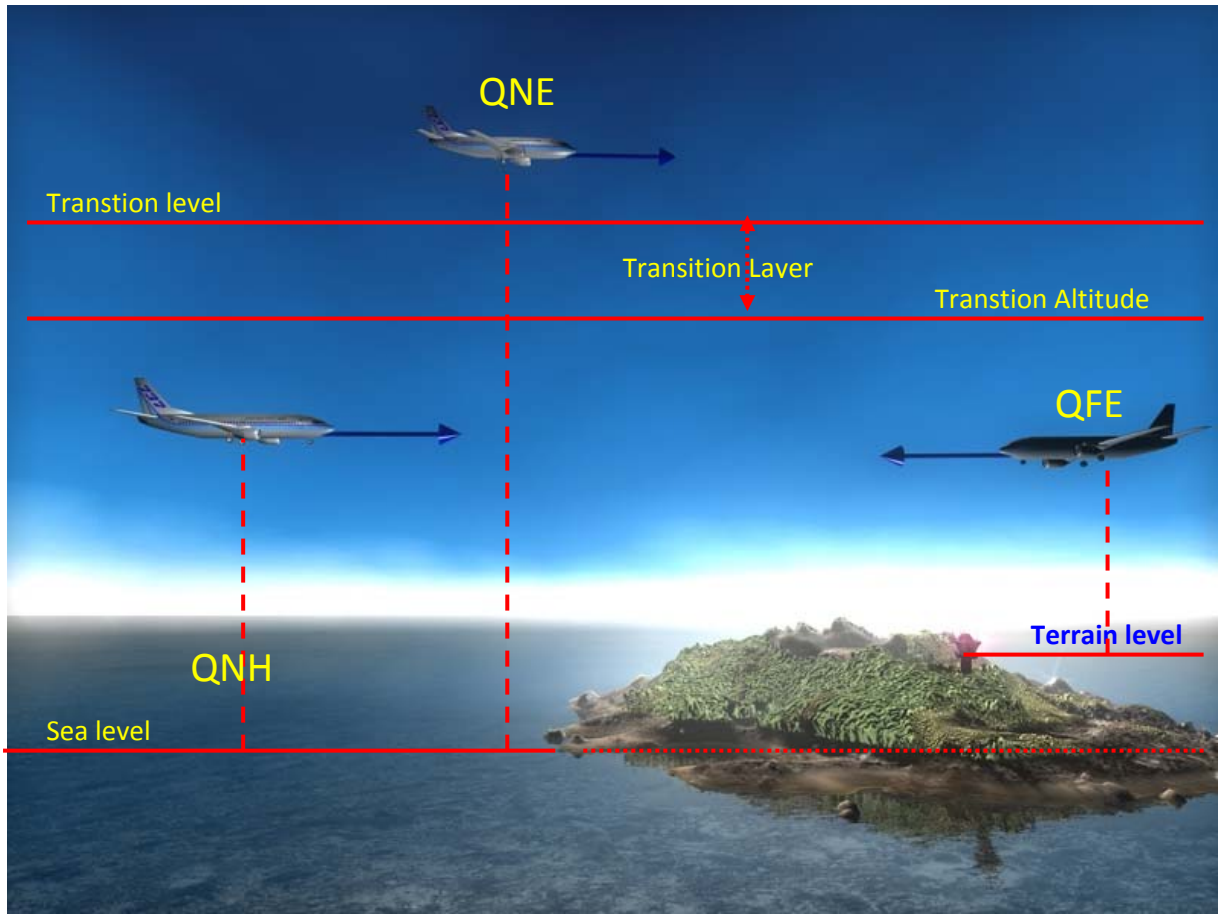
- 1Hpa (1mbar) for every 27ft (below FL180)
- 1Hpa (1mbar) for every 48ft (above FL180)

The altimeter is calibrated to show the pressure directly as an altitude above MSL (Mean Sea Level) , in accordance with a mathematical model defined by the ISA (International Standard Atmosphere) . Older aircraft used a simple ameroid barometer where the needle made less than one revolution around the face from zero to full scale. Modern aircraft use a "sensitive altimeter" which has a primary needle that makes multiple revolutions, and one or more secondary needles that show the number of revolutions, similar to a clock face. In other words, each needle points to a different digit of the current altitude measurement.

On a sensitive altimeter, the sea level reference pressure can be adjusted by a setting knob. The reference pressure, in inches of mercury in Canada amd the US and hectopascals (previously millibar) elsewhere, is displayed in the *Kollsman window.* This is necessary, since sea level reference atmospheric pressure varies with temperature and the movement of pressure systems in the atmosphere.



Reference pressure levels



Q-codes

The **Q code** is a standardized collection of three-letter message encodings, all starting with the letter "Q", initially developed for commercial radiotelegrapgh communication, and later adopted by other radio services, especially amateur radio. Although Q codes were created when radio used Mores code exclusively, they continued to be employed after the introduction of voice transmissions.

Although the majority of the Q codes have slipped out of common use, several remain part of the standard ICAO radiotelephony phraseology in aviation.

QNH: Atmospheric pressure at mean sea level (may be either a local, measured pressure or a regional forecast pressure)
QNE: Pressure altitude in the International Standard Atmosphere (1013.25 mbar at sea level)
QFE: Atmospehric pressure at airfield elevation
QFF: Baromettric pressure at a place, reduced to MSL (Mean Sea Level) using the actual temperature at the time of obeservation as the mean temperature

QNH

As reference pressure level the actual pressure at terrain level is reduced to sea level pressure (MSL) via the standard elapsed rate. The pressure altitude is referred to as “altitude in feet”. At low levels the QNH-setting is used to assure obstacle clearance based on MSL. Since the elapsed rate almost never equals the standard elapsed rate the terrain height will not be in accordance with the altitude reading based on the QNH.

QNE Standard Altimeter Setting (SAS = 1013,2 Hpa)

As reference pressure level the Standard Altimeter Setting (1013,2 Hpa) is used. This setting is one of the most used pressure settings. All air traffic flying above the transition altitude is required to use the SAS. In this manner it is possible to create safe altitude separation for all air traffic in controlled airspace. The Altitude based on the SAS is expressed in “Flight levels”(FL) in hundreds of feet. Thus 10000ft = FL100. Note that Flight level is not a true altitude but a relative altitude.

QFE

As reference pressure level the actual pressure at terrain level is used. The height readout from your barometric pressure altimeter will be the airport height above the earth surface. When entering the runway your barometric pressure altimeter should indicate 0 foot.

The readout from you barometric altimeter set to QFE is expressed in “heights in feet”. A country that frequently uses the QFE is the United Kingdom and Russia

What is Transition Altitude?:

Transition altitude is the maximum altitude where an aircraft is permitted to fly under the local barometric pressure (QNH) , this is where you would use your altimeter.

You should receive this barometric pressure in the relevant ATIS when you are parked at a gate, or the Departure or Tower controller may also inform you of this. This type of pressure is what's known as QNH.

Above the Transition Altitude (QFE) a pilot would need to change his altimeter to the standard barometric pressure of 1013,25 (1013 for short) Hpa or 29,92 inches of Mercury (Which equals the barometric pressure at sea level).

What is Transition Level?:

This is the minimum altitude at which you are permitted to fly under the standard barometric pressure of 1013,25 Hpa. To this point the altitude at which you are flying will be referred to as FL Flight Level.

In the diagram below we can clearly see the red line denoting the TRL Transition Level and below that we see the TA Transition Altitude.

What is Transition layer?:

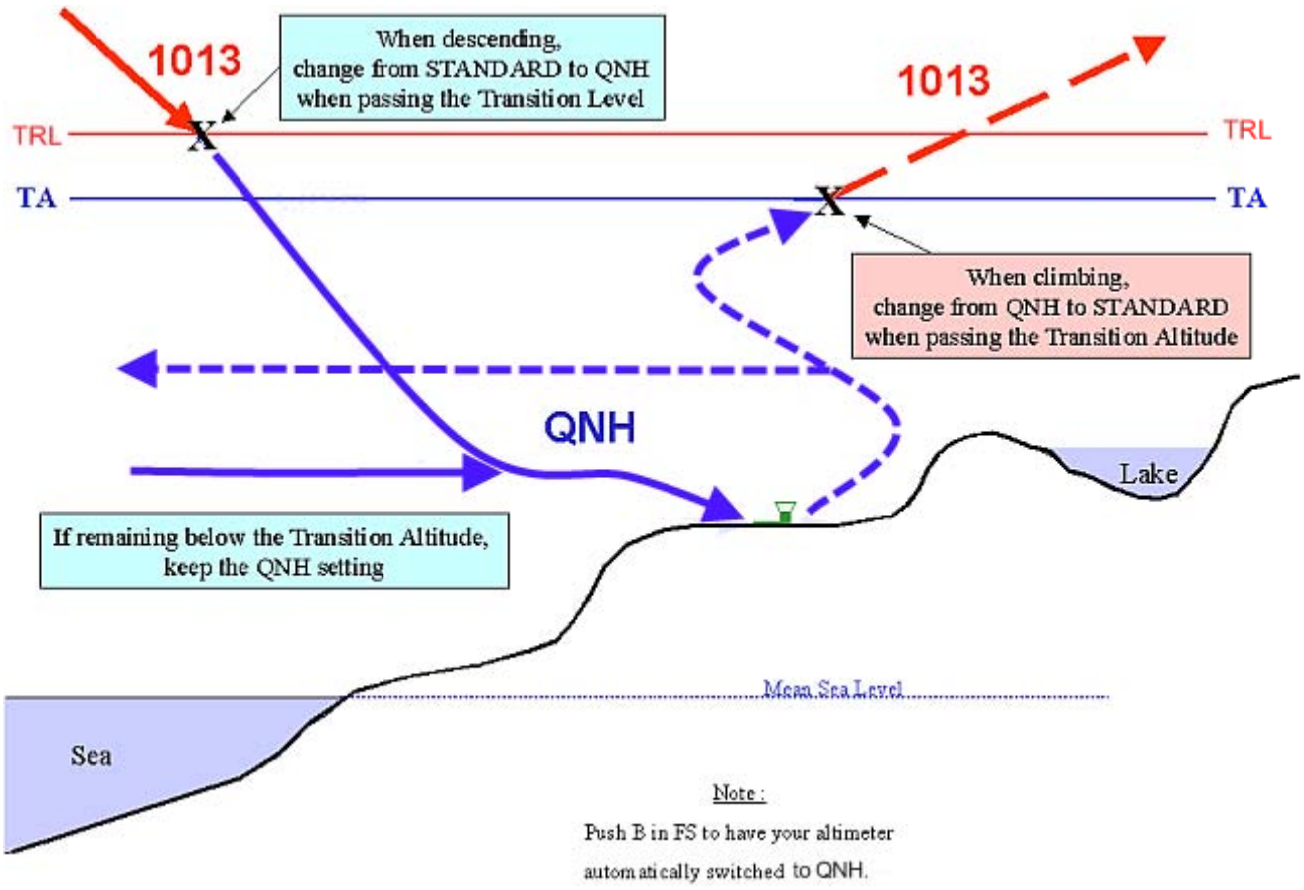
For safe transition from QNH-setting to QNE setting or vice versa a separation layer is needed. The This layer between the Transition altitude and Transition level is called the Transition Layer . width of this layer is determined by ATC

The reason for applying this separation layer is due to the fact that Pressure Altitude Variation (PAV) will occur.

Hence:

a:) The pressure at sea level usually deviates from 1013,2 Hpa

b:) The actual elapsed rate usually deviates from the standard elapsed rate.



As we can see there is a gap between the TRL and the TA. This gap is created by means of the current local QNH. For example let's imagine the local QNH at Schiphol Amsterdam EHAM was **1015**Hpa. The Transition altitude is fixed at **3000ft**, then the TL would be at **FL040**. The following table should clarify this in more detail.

QNH (hPa)	3000ft	4000ft	5000ft	6000ft	7000ft	Inch. of Merc *)
942 - 959	FL 060	FL 070	FL 080	FL 090	FL 100	27.82 - 28.33
960 - 977	FL 055	FL 065	FL 075	FL 085	FL 095	28.34 - 28.86
978 - 995	FL 050	FL 060	FL 070	FL 080	FL 090	28.87 - 29.39
996 - 1013	FL 045	FL 055	FL 065	FL 075	FL 085	29.40 - 29.92
1014 - 1031	FL 040	FL 050	FL 060	FL 070	FL 080	29.93 - 30.46
1032 - 1050	FL 035	FL 045	FL 055	FL 065	FL 075	30.47 - 31.03
1051 -	FL 030	FL 040	FL 050	FL 060	FL 070	31.04 -

It is therefore very important for a pilot to insert the correct barometric pressure in his altimeter. This could mean the difference between life and death.

Now Let's Recap:

When you are on the ground wanting to depart, you would work with Transition Altitude. Until climbing passed the TA you would use the local QNH setting.

If you are descending from the cruise you would work with Transition Level. Until you reach the TL you would have your altimeter set to 1013,25Hpa or 29,92 Inches of Mercury. When you descend through the TL you would change your altimeter to the local barometric setting (QNH) of the airport.

For every 27 feet you climb the barometric pressure changes by 1 Hpa.

Imagine you are at 600 feet with a barometric pressure of 1013,0 Hpa the calculation would be as follows:

600 ÷ 27 = 22,2 Hpa

1013,0 – 22,2 = 990.8 Hpa

Read this document carefully should you require it.

Make sure you know when to use Flight levels or Altitude in Feet.

QNH : Query Nautical Height (Regional Pressure Setting)
QFE : Query Field Elevation

Semi Circular Rules

To improve separation **during cruising flight**, pilots have to select a Level (Level means an Altitude or a Flight Level) according the direction of their flight. This is called the **semi-circular cruising level system**.

Pilots who fly more or less in the same direction select the same levels so aircraft from the opposite direction are passed above or below. This way, the risk of head-on collisions is reduced because there is slightly more time to see opposite traffic.

East-West configuration:

East	: heading 000 - 179 degrees	Choose ODD flightlevel
West	: heading 180 - 359 degrees	Choose EVEN flightlevel

North-South configuration:

North	: heading 270 - 089 degrees	Choose ODD flightlevel
South	: heading 090 - 269 degrees	Choose EVEN flightlevel

Countries like: France, Portugal, Spain, Italy, Egypt etc. use the North-South configuration.

- From Levels 3000ft and below, IFR and VFR is allowed to use any level
- VFR altitudes are limited to FL200 and fly 500ft above the odd and even flightlevels

RVSM airspace: (reduced vertical separation minimum)

The airspace between Flight level 290 and 410 are normally separated with 2000ft.

fl 290 - 330 - 370
fl 310 - 350 - 390

The airspace was limited to 6 levels only for safety reasons. As instrument accuracy improved and more commercial airlines started using these economical flight levels, aircrafts which comply to **MNPS** (minimum navigational performance specifications) are allowed to fly levels that are separated by 1000ft, thus doubling the capacity

fl 290 - 310 - 330 - 350 - 370 - 390
fl 300 - 320 - 340 - 360 - 380 - 400

For detailed information...CHECK : http://academy.ivao.aero/node/340

APENDIX A : Pressure conversion

Altimeter setting:

Non- US: QNH (Q –code Nautical height) in HectoPascal (hPa) / Millibar (mbar)
US: Altimeter in inches of mercury (inchHg) (kwikdruk)

QNH / ALTIMETER

950	951	952	953	954	955	956	957	958	959
28.05	28.08	28.11	28.14	28.17	28.2	28.23	28.26	28.29	28.32
960	961	962	963	964	965	966	967	968	969
28.35	28.38	28.41	28.44	28.47	28.5	28.53	28.56	28.59	28.61
970	971	972	973	974	975	976	977	978	979
28.64	28.67	28.7	28.73	28.76	28.79	28.82	28.85	28.88	28.91
980	981	982	983	984	985	986	987	988	989
28.94	28.97	29	29.03	29.06	29.09	29.12	29.15	29.18	29.21
990	991	992	993	994	995	996	997	998	999
29.23	29.26	29.29	29.32	29.35	29.38	29.41	29.44	29.47	29.5
1000	1001	1002	1003	1004	1005	1006	1007	1008	1009
29.53	29.56	29.59	29.62	29.65	29.68	29.71	29.74	29.77	29.8
1010	1011	1012	1013	1014	1015	1016	1017	1018	1019
29.83	29.85	29.88	29.91	29.94	29.97	30	30.03	30.06	30.09
1020	1021	1022	1023	1024	1025	1026	1027	1028	1029
30.12	30.15	30.18	30.21	30.24	30.27	30.3	30.33	30.36	30.39
1030	1031	1032	1033	1034	1035	1036	1037	1038	1039
30.42	30.45	30.47	30.5	30.53	30.56	30.59	30.62	30.65	30.68
1040	1041	1042	1043	1044	1045	1046	1047	1048	1049
30.71	30.74	30.77	30.8	30.83	30.86	30.89	30.92	30.95	30.98