On SID-charts, the Transition Altitude [TA] usually is indicated. Normally, this is a fixed altitude *per country*. Throughout The Netherlands it is 3000 feet[1)], throughout Germany 5000' and throughout the United States 18.000'. In the UK however, TA changes. On the London SID's, it is 6000', but Manchester SID charts show 5000', East Midlands 3000' etc.

On a climb out of London, ATC would tell you – for instance – to level off at *altitude* 6000', with the next climb instruction to be: climb to *Flight Level* [FL] 90. So, as long as you are *at* or *below* TA, you will be flying altitude based on QNH (or: altimeter setting in the USA, where they do not use the abbreviation QNH). Above the TA, you will be cleared in Flight Levels based on the standard altimeter setting 1013,25 hPa or 29,92 inches.

So: where TA is a fixed value per – let's say: region – the Transition Level [TL] changes all the time. This change is due to the fact, that the QNH is an ever changing figure, and because of that: the point in "space" where the 1013 pressure level is, will change accordingly.

Suppose at EHAM the QNH is 1043 hPa. As the aircraft climbs out, the altimeter system will sense lower air pressure and indicate an increase in altitude. For every drop of 1 hPa in air pressure, the aircraft will have climbed – approximately – 30 feet. Therefore, at 900' QNH the aircraft will reach the level where the altimeter senses 1013 hPa: $(1043\text{-}1013) \times 30 \approx 900$'.
Now, with the QNH at EHAM being 983 hPa, and EHAM being already more or less at sea level, the 1013 hPa level could be found some 900 conceivable feet below this 983 hPa level: $(983\text{-}1013) \times 30 \approx -900$' (or 900' below sea level).

You can check this out with PS1, by positioning yourself at EHAM and change the WX situation accordingly: first with the QNH being 1043 hPa, secondly with the QNH being 983 hPa. If you change from QNH to standard, you will see an indication of some 900' in the 1043 scenario, and a negative indication of again some 900' in the 983 scenario.

So, as the 1013 level changes all the time, the Transition Level will have to change accordingly. The objective is to get a separation of *at least* 1000 feet between traffic flying at TA and traffic flying at TL. *High* QNH will result in a *low* TL, a *low* QNH results in a *high* TL.

In the 1043 scenario and flying at 3000' QNH, the altimeter would show 2100' with the subscale momentarily set at standard 1013. This 2100' is also called "pressure altitude" as it is based on the 1013 setting. An additional 1000' as a safety layer would result in 3100' pressure altitude or *FL 31*, which is not existing. Therefore, the lowest possible TL will be FL40.
For correct determination of the TL, temperature also is a factor. But in this case, traffic at TL 40 will always have sufficient separation with traffic at TA 3000'.

In the 983 scenario, 3000' QNH would read 3900' on the standard setting. An additional 1000' of buffer results in TL being at least FL50, temperature could even further raise this to FL 55. So, between TA 3000' and TL50, there is ***only*** a mere actual 1000 feet difference.

In a climb, you will fly - and speak of - altitude at or below TA. In descent you will fly – and speak of – Flight Levels until reaching the TL. Controllers in EHAM supply you with the following descent clearance: "descent to Transition Level 50". You're still flying 1013 hPa. The next descent clearance will then be: "down to altitude 3000', QNH 1039". This is where you start changing the altimeter setting to QNH.

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[1)] In The Netherlands: TA for IFR traffic is 3000', TA for VFR traffic is 3500'.

Flying across the North Atlantic – or elsewhere over long stretches of water – there will be a point in time, where flying onwards to the destination will take just as long as flying back to the point of departure. This point is called Point of Equal Time [PET].

Flying westwards to The USA mostly gives you a headwind and a resulting low GroundSpeed [GS], while flying the other way would give you tailwinds and higher GS.

Let’s take an example of flying from **A**(msterdam) to **B**(oston).

$D$ = distance from A to B
$PET_D$ = distance from A to Point of Equal Time
$PET_t$ = time from A to PET
$T$ = planned flying time from A to B
$GS_O$ = Groundspeed out, or GS from A to PET
$GS_R$ = GS return, or GS from PET back to A
$GS_A$ = GS ahead, or GS from PET to B

By definition (of PET), time from PET to B equals time from PET to A

$$\frac{D - PETd}{GSA} = \frac{PETd}{GSR}$$

of:

$$PETd = D \times \frac{GSR}{GSA + GSR}$$

Another way of looking at this, would be:

$PET_t \times GS_O = (T\text{-}PET_t) \times GS_R \Rightarrow$
$(T \times GS_R) - (PET_t \times GS_R) = PET_t \times GS_O \Rightarrow$
$PET_t \times GS_O + (PET_t \times GS_R) = (T \times GS_R) \Rightarrow$
$PET_t\ (GS_O + GS_R) = (T \times GS_R) \Rightarrow$

$$PETt = T \times \frac{GSr}{GSo + GSr}$$

$$PETd = T \times \frac{GSo \times GSr}{GSo + GSr}$$

There also is a Point of No Return [PNR]. This is the point en route, where the aircraft after departure from A can return to A (under same wind conditions), without landing somewhere en route for extra fuel. These points will be determined for normal operations and (one or more) engine-out operations.

Again, flying from A to B:

$PNR_d$ = distance to the Point of No Return
$PNR_t$ = Elapsed time from departure point to PNR
$T_{end}$ = expressed in time: total fuel quantity on board *without* required extra fuel for alternate, etc. (so basically: trip fuel only)
$GS_O$ = Groundspeed from A to PNR
$GR_S$ = GS from PNR to A

By definition, $PNR_t \times GS_o = (T_{end} - PNR_t) \times GS_R$ (actually: time multiplied by speed equals distance)

$$PNRt = Tend \times \frac{GSr}{GSo + GSr}$$

$$PNRd = PNRt \times GSo = Tend \times \frac{GSo \times GSR}{GSo + GSR} \Rightarrow PNRd = Tend \times \frac{GSo \times GSr}{GSo + GSr}$$

Suppose, a flight goes from A to B, where B is 1200 NM east of A. Forecasted winds are 240 degrees with 60 kts, TAS is 250 kts. Endurance is 05:30 hrs. Find PET (time and distance) and PNR (time and distance) for return to A.

First, find $GS_O$ and $GS_R$.

True track A to B = 090°, TAS = 250 kts, W/V = 240/60 ⇒ $GS_O$ = 300 kts[2)]
True track B to A = 270° ⇒ $GS_R$ = 196 kts.

$$PETd = D \times \frac{GSr}{GSo + GSr} = 1200 \times \frac{196}{300 + 196} = 474nm$$

$$PETt = \frac{474nm}{300kt} = 01{:}35$$

$$PNRt = Tend \times \frac{GSr}{GSo + GSr} = 05{:}30 \times \frac{196}{496} = 02{:}10$$

$$PNRd = PNRt * GSo = 650nm$$

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2) This can be found by computing TT, TAS and W/V; Crosswind component = sine of W/V; Trackcomponent = cos of W/V; In this case TC= $\cos 30^o \times 60 \approx 50$kts tailwind.