Flight Level Change (FLCH) for Dummies in the Boeing 757 and 767 - and I'm a Dummy!

Introduction

The purpose of this short précis is to summarise the operational application of Flight Level Change (FLCH) in the Boeing 757 and 767, in both the climb and the descent.

The précis assumes you have a basic understanding of automated flight through the MCP, and associated terminology.

FLCH in the Climb

In a VNAV climb the aircraft's speed is controlled through the elevators with the FMA pitch mode being VNAV SPD. The autothrottle maintains the programmed reference thrust with the FMA autothrottle mode being N1.

In a climb, when FLCH is selected on the MCP, the MCP speed window opens at the current airspeed and the aircraft's speed is still controlled through the elevators. The FMA pitch mode changes to SPD. The FMC considers the MCP altitude setting and commands the autothrottle to provide thrust as required to achieve the resulting altitude change in two minutes (120 seconds).

If a climb is commanded that exceeds the ability of the autothrottle to achieve the change in two minutes the thrust goes to the current thrust reference maximum setting (usually CLB).

When using FLCH the elevators control the speed and the autothrottle controls the rate of climb. Climbing in FLCH the FMA reads FLCH or THR HOLD / SPD / LNAV or HDG SEL.

Once the aircraft has reached the target MCP altitude the FMC reverts back to basic modes and the FMA changes to SPD / ALT HOLD. Now the elevators take control of altitude and the thrust levers take control of speed.

FLCH in the Descent

In a descent in VNAV PTH the elevators control the descent path and the aircraft's speed is controlled by the autothrottle. In a descent in VNAV SPD the elevators control the aircraft's speed and the autothrottle is usually in a manual mode (IDLE or THR HOLD).

In a descent, when FLCH is selected on the MCP, the MCP speed window opens at the current airspeed and the aircraft's speed is controlled through the elevators and the FMA pitch mode changes to SPD. The FMC considers the MCP altitude setting then commands the autothrottle to provide thrust (THR) as required to achieve the resulting altitude change in two minutes (120 seconds).

If a descent is commanded that exceeds the descent rate at flight idle thrust the FMA autothrottle mode changes from FLCH to THR HOLD. Speedbrake may be utilised to further increase the rate of descent.

When using FLCH the elevators control the speed and the autothrottle (and speedbrake if deployed) controls the rate of descent. Descending in FLCH the FMA reads FLCH or THR

HOLD / SPD / LNAV or HDG SEL.

Once the aircraft has reached the target MCP altitude the FMC reverts back to basic modes and the FMA changes to SPD and ALT HOLD. Now the elevators take control of altitude and the thrust levers take control of speed.

The essential point to understand about FLCH is that, in both the climb and the descent, airspeed is controlled by the elevators, not the autothrottle. The autothrottle controls the rate of climb or descent.

Speed Intervention

If a speed change is required, in either the climb or descent, this can be achieved by simply setting the MCP speed selector to the required airspeed. The aircraft will then accelerate or decelerate, through the elevators. The autothrottle will continue to provide thrust as required to achieve the altitude change in two minutes. Alternatively, the vertical speed can be modified by the PF manually manipulating the thrust levers (THR HOLD).

Changing airspeed will of course change the rate of climb or descent. This can be a great tool or a burden. If you want to slow down then be aware the rate of descent will decrease as the elevator will pitch the nose up, conversely if you want to speed up then the rate of descent will increase as the elevator will pitch the nose down.

A rule of thumb is to remember that it is hard to go down and slow down. You can either slow down early and maintain a stable rate of descent or you can descend with speed and use a level portion to assist in deceleration.

Thrust Intervention

If the PF manually moves the thrust levers they essentially negate the 120 second programmed altitude change and the PF takes over the vertical speed performance. The FMC effectively says “I had it all sorted out but if you want to interfere then by all means do so – but I give up.”

The FMA then changes from FLCH to THR HOLD, and the autothrottle is now completely dormant. The PF has taken autothrottle control away from the FMC and has overridden the programmed altitude change.

In essence the PF controls the vertical speed through the thrust levers and can set a vertical speed more or less than what the FMC had programmed. This is an excellent feature, particularly when working in a busy terminal area with a number of rapid changes required to comply with ATC instructions.

A Significant Trap in FLCH

While thrust intervention is an excellent feature, it does have a significant trap and it is essential that you understand just what that trap is. Remember that in FLCH airspeed is controlled by the elevators, not the autothrottle. The autothrottle controls the rate of climb or

descent.

Usually, the autothrottle, if armed, will provide stall protection even when it is not engaged. That is, if the airspeed decreases to near stick shaker activation, the autothrottle automatically re-engages ("wakes up") in the appropriate mode (SPD or N1) and advances thrust to maintain minimum manoeuvring speed (approximately the top of the amber band) or the speed set in the MCP speed window, whichever is greater.

However, when the MCP pitch mode is SPD and the autothrottle is in THR HOLD, the autothrottle will not automatically re-engage and will not support stall protection.

In FLCH with the autothrottle in THR HOLD, the ONLY way to get the thrust levers controlling speed again is to either reach the set MCP altitude OR select another mode – normally vert speed (V/S). If the PF does that then the autothrottle reverts back to normal operation. If you do not achieve the set MCP altitude or change mode out of FLCH, you have NO low speed or stall protection.

This trap is highly significant because with the autothrottle in THR HOLD, the autothrottle "wake up" mode does not work and it is therefore perfectly possible to stall the aircraft. This is especially so if the MCP altitude is above the current altitude and the Flight Director is indicating a climb.

The Asiana 777 crash at San Francisco is a classic example of this. During a visual approach to runway 28L the PF had initially allowed the aircraft to get high on the approach, so he activated FLCH to recover the approach but subsequently allowed the aircraft to descend below the glidepath. They disconnected the autopilot and raised the nose. The MCP altitude was set above their current altitude (for the missed approach).

They were now all set up for the low speed incident, as they had not appreciated that the autothrottle would not "wake up" and protect them from stalling the aircraft. The rest as they say, is history.

Summary

When in FLCH with the autopilot disengaged then change modes, for example to V/S – that will get the speed control back to normal and provide speed protection.

Alternatively, if the Flight Director is also selected off the autothrottle will revert to SPD and the autothrottle will again support stall protection.

Most advise against the use of FLCH at low level in terminal airspace. The Boeing Flight Crew Training Manual states that the use of FLCH is not recommended after the FAF.

However, if you choose to use FLCH with the autopilot disengaged in the terminal area then take care! It has a nasty surprise for the ignorant or unwary or those who do not diligently monitor the instruments and the FMAs.