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Flight Operations *REVIEW*

A MESSAGE TO FLIGHT CREWS FROM THE BOEING COMMERCIAL AIRPLANE GROUP

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Vmo/Mmo LIMITATIONS REVIEW

From time to time, we have received inquiries from pilots on what defines Vmo/Mmo on a jet transport, how it is displayed on the Mach/Airspeed Indicator, and its behavior with changing altitude. We will devote this issue to a review of Vmo/Mmo, from the pilot's perspective.

As defined by FAR 25.1505, Vmo/Mmo is the "Maximum Operating Limit Speed that may not be deliberately exceeded in any regime of flight (climb, cruise, or descent) except where a higher speed is authorized for flight test or pilot training operations."

All Boeing airplanes are certified to this rule. Therefore, intentional exceedance of Vmo/Mmo is not permitted in normal operations. Exceeding Vmo/Mmo can pose a threat to exceeding design structural integrity and design stability & control criteria of the airplane. At speeds less than Vmo/Mmo the airplane's flight characteristics have been confirmed by flight testing to meet FAR requirements. At speeds in excess of Vmo/Mmo, however, normal airplane handling characteristics are not assured.

Vmo/Mmo is displayed by the Vmo pointer on the conventional round dial Mach/Airspeed Indicator, and by the lower boundary of a red/black striped barber pole on vertical tape airspeed indicators. There is no separate pointer for Mmo. Mmo information is combined electronically into the Vmo pointer such that the pointer will always point to either the Vmo speed or the Mmo speed, whichever is slower, to protect the airplane from speed exceedance. Vmo/Mmo on the vertical tape airspeed indicators uses the same computational logic as that used by the Vmo pointer. Exceeding either Vmo or Mmo will result in the activation of an aural warning (clacker).

As an example, Figure 1 shows the flight envelope for the 757-200. Notice that below approximately FL270, the airplane is Vmo

restricted to 350 KIAS. Above approximately FL270, the airplane is Mmo restricted to 0.86 Mach. Therefore, 350 KIAS/.86M defines Vmo/Mmo for this airplane respectively. Other Boeing models have different Vmo/Mmo values, but the shape of the basic flight envelope remains unchanged from model to model.

FMC speed schedules are pre-programmed (as a function of Cost Index) to follow the shape of the flight envelope during climb/cruise/descent while staying a fixed speed margin away from the Vmo/Mmo envelope boundary.

The corresponding Mach/Airspeed Indicator display for a typical climb to altitude is shown in Figure 1. As the airplane climbs, the Vmo pointer will essentially trace the Vmo/Mmo boundary as a function of airplane altitude. This is the reason the Vmo pointer (or the barber pole boundary) will remain fixed at Vmo (350 KIAS for the 757) while climbing from Sea Level to FL270. At approximately FL270, the Vmo pointer will begin to move off 350 KIAS to restrict maximum IAS to a lower speed corresponding to the slanted "constant Mach" portion of the flight envelope. By FL390, the Vmo pointer will be pointing at 269 KIAS, an 81 kt reduction in "permissible" indicated airspeed from 350 KIAS. During descent, the Vmo pointer will move in reverse of the climb, arriving back at 350 KIAS at approximately FL270 and staying there for the remainder of the descent.

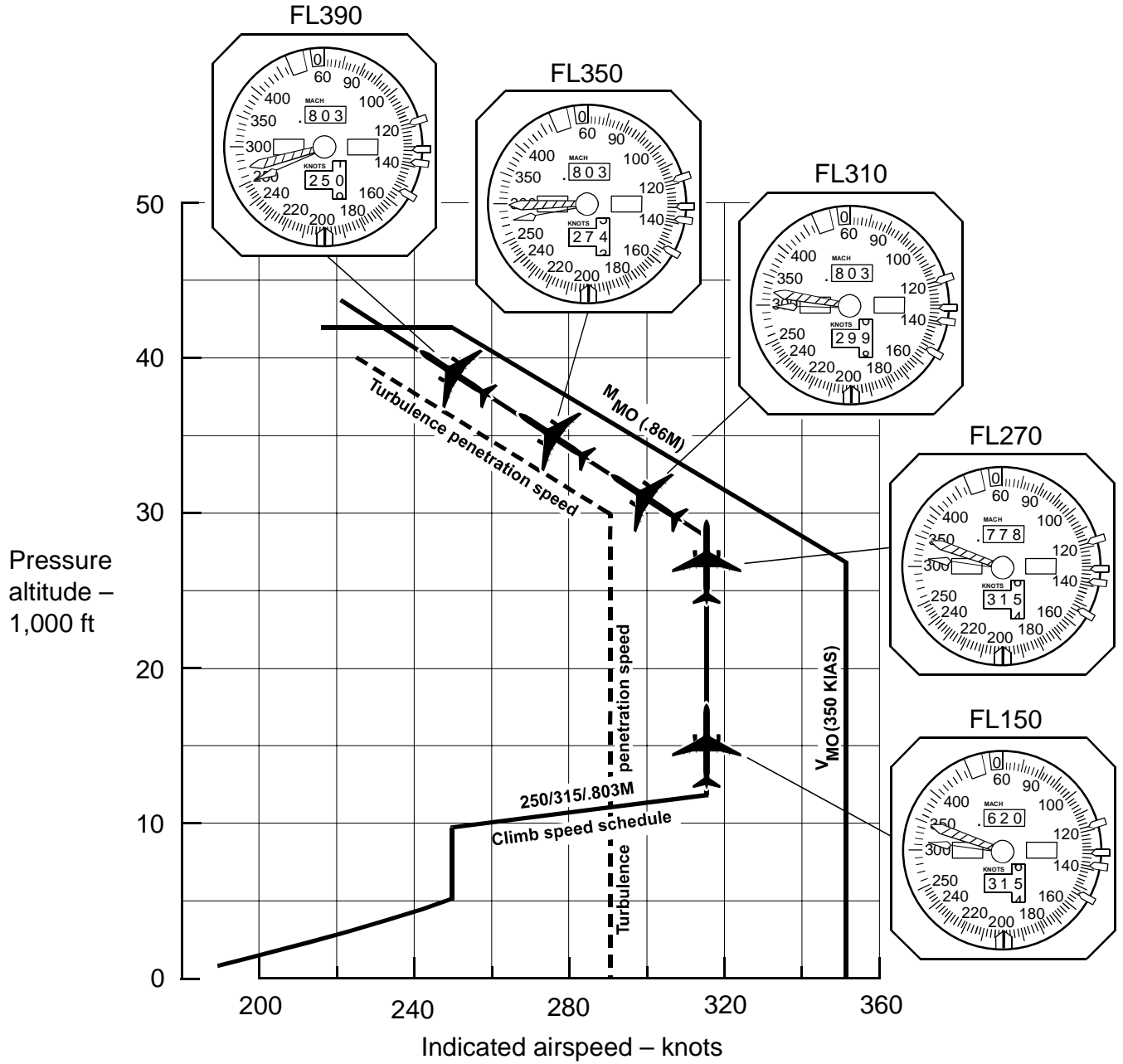


Figure 1. Vmo/Mmo Pointer movement during typical climb/descent

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