

Vertical Speed

This article describes the use of vertical speed (rates of climb and descend) by air traffic controllers to control the traffic flow and solve conflicts. It describes the general procedures, typical applications and associated risks. It also gives some advice on the use of this method by air traffic controllers. Note that any part of this article is not intended to act as or replace any existing local procedures.

Description

In order to facilitate a safe and orderly flow of traffic, aircraft may be instructed to adjust rate of climb or rate of descent. Vertical speed adjustments should be limited to those necessary to establish and/or maintain a desired separation minimum. Instructions involving frequent changes of climb/descent rates should be avoided.

Climbing/descending aircraft may be instructed to maintain a specified rate of climb/descent, a rate of climb/descent equal to or greater than a specified value or a rate of climb/descent equal to or less than a specified value.

An aircraft may be instructed to expedite climb or descent as appropriate to or through a specified level, or may be instructed to reduce its rate of climb or rate of descent.

Aircraft must be advised when a rate of climb/descent restriction is no longer required. The flight crew must inform the ATC unit concerned if unable, at any time, to comply with a specified rate of climb or descent.

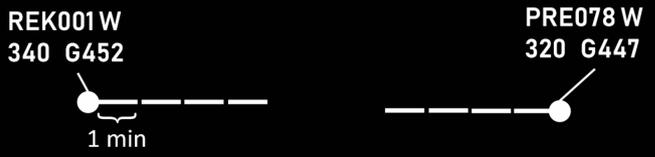
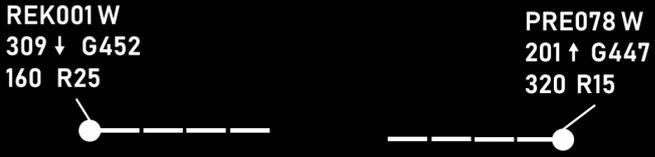
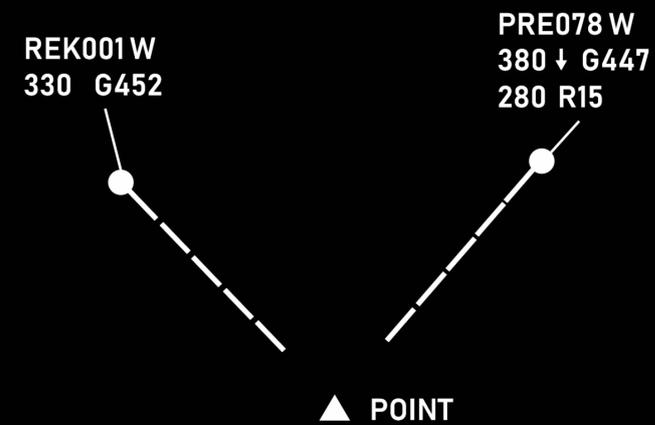
Phraseology

The vertical speed clearance may be a part of a vertical clearance or a separate one. It specifies the required rate of climb/descent, usually in feet per minute and may also contain:

- upper or lower limit of the vertical speed, if applicable. The phrases "*or greater*" and "*or less*" are used in this case. If no limit is specified, then the aircraft is expected to maintain an exact vertical speed.
- a condition, if applicable (e.g. until passing a level or a point)
- further information (e.g. reason for the restriction, e.g. traffic, special use area, etc.)

“ PRE078 climb FL 370 at 1000 feet per minute or greater until passing FL 360 due crossing traffic.

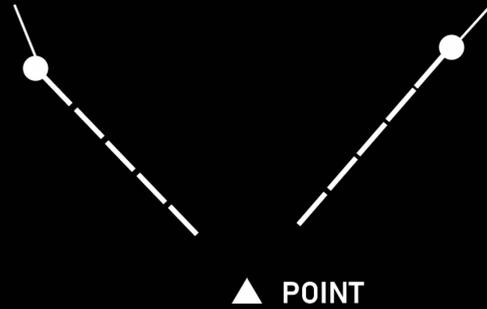
Typical Uses

<p>Accommodation of climb requests</p>	 <p>REK001 W 340 G452</p> <p>PRE078 W 320 G447</p> <p>1 min</p> <p>Pilot: PRE078, request FL 380</p> <p>ATC: PRE078, climb to FL 380 at 1000 feet per minute or greater due opposite traffic</p>
<p>Separation of departing and arriving traffic</p>	 <p>REK001 W 309 ↓ G452 160 R25</p> <p>PRE078 W 201 ↑ G447 320 R15</p> <p>ATC: PRE078, climb at 1500 feet per minute or greater due opposite traffic, advise if unable</p> <p>[readback from PRE078]</p> <p>ATC: REK001, descent at 2500 feet per minute or greater due opposite traffic</p> <p>[readback from PRE078]</p>
<p>Descending arriving aircraft below the overflying traffic</p>	 <p>REK001 W 330 G452</p> <p>PRE078 W 380 ↓ G447 280 R15</p> <p>▲ POINT</p> <p>ATC: PRE078, descend to FL 200 at 1500 feet per minute or greater until passing FL 320</p>

Vertical sequencing, i.e. establishing and maintaining vertical separation between two (or more) climbing or two (or more) descending aircraft

REK001 W
330 ↓ G452
210 R15

PRE078 W
350 ↓ G447
230 R15



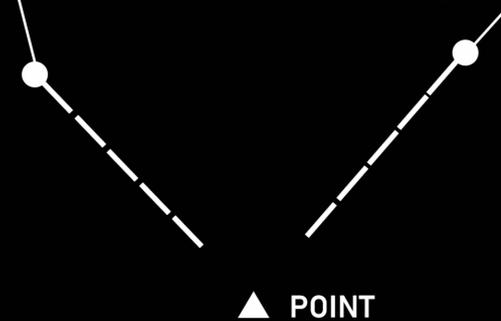
ATC: REK001, descend to FL 210 at 1500 feet per minute or greater

ATC: PRE078, descend to FL 230 at 1500 feet per minute or less

Corrective action (e.g. when the unrestricted vertical speed is considered insufficient)

REK001 W
330 G452

PRE078 W
380 ↓ G447
280 R05



ATC: PRE078, descent at 1500 feet per minute or greater until passing FL 320

Benefits

When properly used, vertical speed control helps to achieve

- continuous climb/descent (fewer level offs), therefore better efficiency
- descents starting close to the top-of-descent
- timely accommodation of climb (mostly) and (sometimes) descent requests
- reduced workload due to reduced need for vectoring. A proper vertical speed ensures that horizontal separation will be preserved at least until vertical separation is achieved.

Associated Risks

- The margin for error is often reduced. This method relies mostly on maintaining vertical separation, which is much smaller than the horizontal one (e.g. 1000 ft as opposed to 5

NM). Therefore, any misunderstanding or non-compliance can easily result in loss of separation.

- Harder to monitor aircraft compliance (as opposed to e.g. vectoring). While the information for vertical speed is usually available, it may require some effort to present it. Furthermore, the interpretation of two (or more) numbers and the comparison of clearances versus performance takes more time than just having a look at the situational display (which is used to monitor horizontal separation).
- Aircraft may be unable to maintain the assigned rate of climb after certain level. If this happens, flight crew may or may not inform the controller.
- Wrong readback may easily ruin the plan (e.g. both aircraft descending with "or greater")

Things to Consider

- Rates of climb should be coordinated with the flight crew, especially:
 - when approaching the cruising level
 - when the climb is not desired by the flight crew
 - when temperatures are high
- Some aircraft types are generally unable to maintain a high rate of climb (e.g. AIRBUS A-321, AIRBUS A-340-300)
- In order to mitigate the risks for crossing or opposite traffic situations, a safety buffer of 1 or 2 minutes should be used. This can be done by e.g.
 - Issuing the clearance(s) a bit earlier
 - Assigning vertical speeds that are a little higher (e.g. 1500 instead of 1000)
- High rates of descent are generally incompatible with low speeds. A combined instruction to reduce speed and increase the RoD should be coordinated with the flight crew.
- The aircraft needs time to achieve higher rates (2000 ft/min or higher). The transition period should be considered when calculating the necessary vertical speed.
- During the final 1000 ft, the vertical speed is usually 1000 ft/min or less. This is done to avoid level busts. It is therefore impractical to assign a rate of 2000 ft/min or greater if the aircraft is to climb or descend some 2000-3000 ft.
- The phrases "**Expedite climb**" and "**Expedite descent**", while being standard ICAO phraseology do not prescribe specific vertical speeds and should be used with **caution**. The general expectation in such case would be that:
 - a climbing aircraft would climb at the highest rate possible (which may or may not be enough to achieve the desired result). It is therefore advisable that larger safety buffers are used or an alternative plan is ready for implementation.
 - a descending aircraft would increase the rate of descent to at least 2000 ft/min. It is therefore advisable that this method is used for the first few thousand feet (e.g. for an aircraft at FL 390 "Descend FL 290, expedite passing FL 370 due crossing traffic")
- There should always be an alternative plan to accommodate for an aircraft being unable to continue climb with the desired rate.

Rules of Thumb

- Vertical speed of 2000 ft/min gives 10 FLs in 5 minutes
- Vertical speed of 2500 ft/min gives 10 FLs in 4 minutes
- Combined vertical speed of 4000 ft/min (e.g. RoD 2500 and RoC 1500) gives 20 FLs in 5 minutes

Combined vertical speed is the sum of the vertical speeds of a climbing and a descending aircraft, e.g. if aircraft A is climbing at 1500 ft/min and aircraft B is descending at 2000 ft/min, then the combined vertical speed is 3500 ft/min.

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