Miltech Simulations U-2

High Altitude and the Cruise Climb

Most of a U-2 flight is spent above 60,000 ft in the cruise climb. Up there the aircraft is light on the controls, slow to answer and close to its limits on both sides of the speed band. This page explains how the cruise climb works, how to get into it, how to fly it with and without the autopilot, what warns you and what to do when something goes wrong. This page describes what the simulation does.

Note
Sim values. Performance values are measured in the sim. They may not accurately represent (nor do they intend to accurately represent) the performance of the real aircraft.

M .715Cruise MachHeld by the autopilot in MACH, at climb power.

~20 ktUsable speed bandBetween the stall and the red line at the top.

+800 ft/hThe climb never stopsThe aircraft rises as it burns fuel.

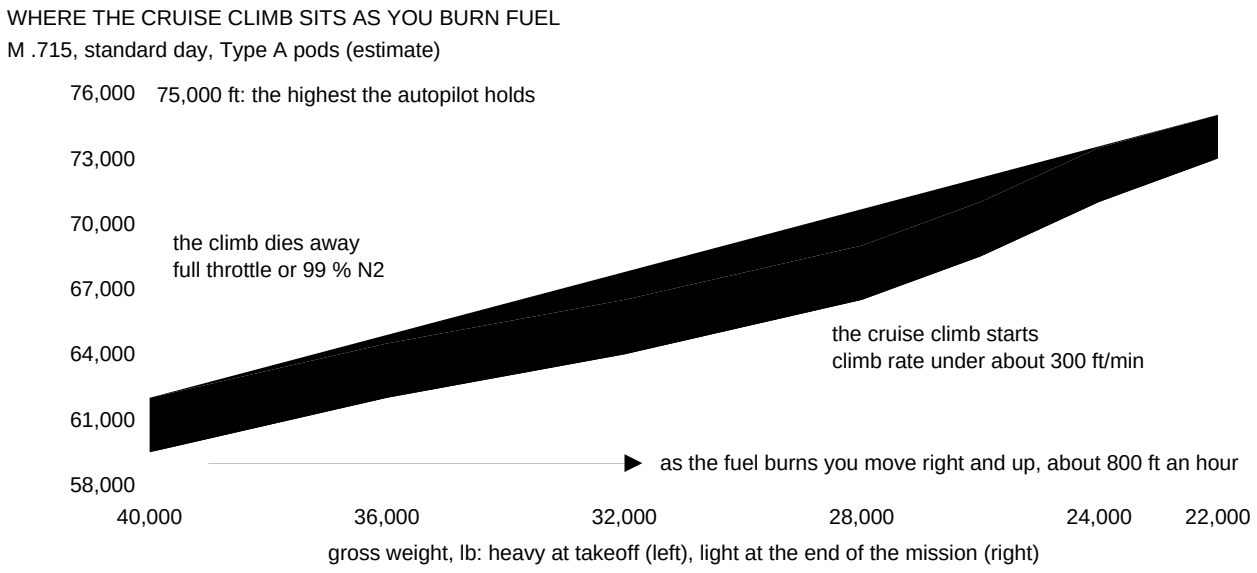
75,000 ftAutopilot ceilingThe highest the autopilot holds.

Note
About the numbers. Standard day, M .715, Type A pods fitted. Speeds are what the PFD shows. Heights, margins and fuel flows are worked out from the flight model and the engine tables. Your weight is on the EFB Aircraft tab (**Gross**).

How the Cruise Climb Works

The U-2 does not level off at a cruising altitude. You hold M .715 and climb power and let the aircraft find its own height. At a fixed Mach the engine's thrust and the airframe's drag both shrink as the air thins, so for each weight there is one height where the thrust just covers the drag and the climb dies away.

Burn fuel and that height moves up. Up there the engine burns roughly 1,000 - 1,450 lb of fuel an hour, and the aircraft gains about 750 - 850 ft in that hour. With the autopilot in MACH this happens by itself.



With the autopilot in MACH the aircraft stays in the blue band and creeps up as it burns fuel. At 94 % N2 (650 °C) every line is about 1,800 ft lower; a warm day puts them lower too.

Full throttle, or 99 % N2 on the vernier. At 94 % N2 every line is about 1,800 ft lower; a warm day puts them lower too. A heavy aircraft starts its cruise climb at about 60,000 ft and works its way up through the flight: from a 40,000 lb takeoff it reaches 70,000 ft only late in a long mission.

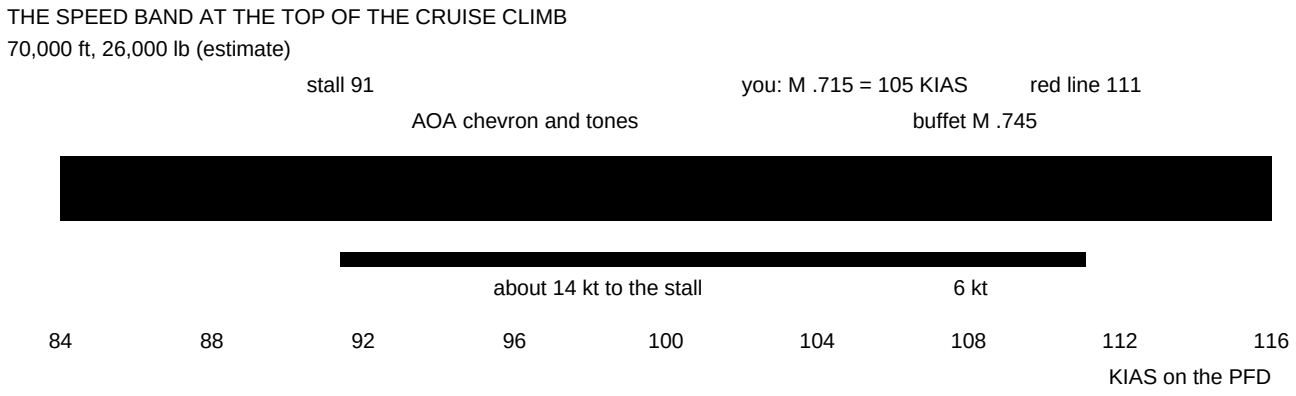
Getting There

1. **Climb at 160 KIAS.** Full throttle from brake release. From about 45,000 ft set climb power with the vernier: EGT 650 - 725 °C, 94 - 99 % N2.
2. **At about 52,000 ft change to Mach.** The Mach reaches .715 there: hold it from now on and let the needle fall by itself, to about 133 KIAS at 60,000 ft, 118 at 65,000 and 105 at 70,000. Run the 52,000 FT CLIMB CHECK.
3. **Engage MACH.** With the aircraft steady at M .715, press MACH on the AFCS panel (AFCS engaged first). MACH needs valid air data: with an IAS or ALT flag it drops to pitch hold. In rough air, wait for smooth air before you engage it.
4. **Let the climb rate die away.** From thousands of feet per minute at 50,000 ft it falls to a few hundred where your cruise climb starts - from about 59,500 ft heavy to about 71,000 ft at 24,000 lb. Nothing is wrong: that is the cruise climb.
5. **Set up for the long haul.** GUST CONTROL FAIRED, the sideslip centred with the YAW BAL knob, the ROLL sync bar centred (balance the fuel if it is not), and the CRUISE CLIMB checklist.

The Speed Band at the Top

At the top of the cruise climb the whole usable speed range is about 20 kt wide. Above you are the Mach buffet and the red line, about 5 and 6 kt away, at every weight. The stall below you is about 12 - 14 kt away when you are heavy and about 8 kt when you are light.

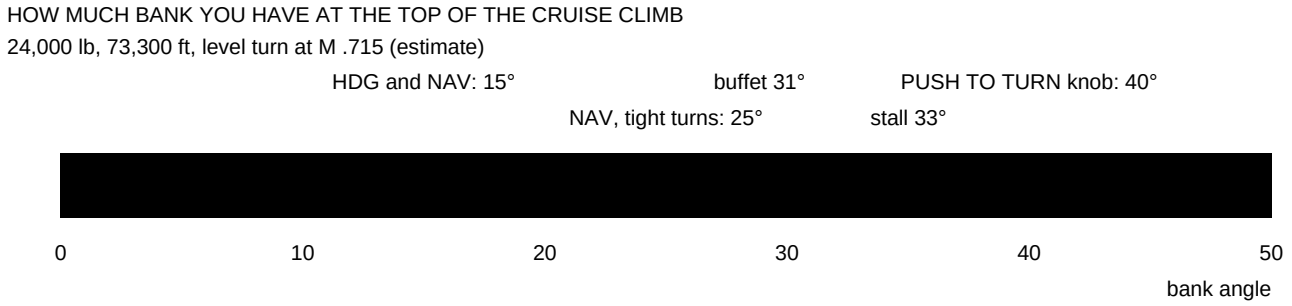
At the same weight that lower gap shrinks by about 3 kt for every 1,000 ft higher, so forcing the aircraft above its top, in a zoom or by slowing down, eats into it fast. Wait for the fuel to burn off.



Near the top of the cruise climb for this weight. Heavier, the stall gap is a little wider; lighter, it narrows to about 8 kt. The gap above you stays about 6 kt at every weight.

Turning up High

Every degree of bank asks the wing for more lift, and at the top of the climb it has little to spare. A level turn loads the wing about 4 % more at 15°, 10 % at 25° and 15 % at 30°, as if the aircraft were that much heavier.



A level turn asks the wing for more lift: about 4 % more at 15°, 10 % at 25° and 15 % at 30°. The PUSH TO TURN knob can bank you past the stall up here. A couple of thousand feet below your top there are a few degrees more on each line.

- **The autopilot keeps you clear.** HDG and NAV turn at 15°. NAV goes up to 25° only in a turn forced tighter between close destination points, and comes back to 15° as you near the stall.
- **Leave the PUSH TO TURN knob alone at the top.** It banks to 40°, past the buffet and the stall up here.
- **By hand, 15 - 20°, 25° at most.** A couple of thousand feet below your top you have a few degrees more.
- **Turns are wide.** At about 410 kt true airspeed, 15° of bank gives a radius of about 9 NM, and a U-turn takes about 4 minutes. At 25° it is about 5 NM and 2½ minutes. Each destination point's turn radius sets how wide NAV turns - see Navigation System.

Flying It with the Autopilot

MACH hold is the cruise climb: the autopilot pitches to hold the Mach, and the aircraft climbs as it gets lighter. See AFCS System.

- **Slow on purpose.** Above 60,000 ft the Mach wanders a few thousandths and corrections take minutes. A .010 change on PITCH MACH takes about 3 minutes. Do not chase it by hand.
- **Throttle is yours.** The autopilot does not move it.
- **Stall margin.** Near the stall, MACH lets the speed rise and ALT gives up height.
- **Trim.** With PITCH TRIM in AUTO the autopilot trims. At disconnect the trim runs back slowly, so expect a slow pitch change.
- **Knobs at 5.** If it hunts in rough air, set MACH/ALT towards 3 and PITCH RATE towards 7.
- **↔ Hunting below 60,000 ft:** switch MACH off and engage it again higher.
- **ALT hold** is for a level leg below your top (for example 45,000 ft), not the cruise climb. Do not use it heavy or near the stall.
- **Trips.** Large pitch, bank (over 45°) or yaw rates switch an axis off. Fly by hand, then cycle each tripped axis switch OFF and ON.

Flying It by Hand

- **Fly the attitude, then wait.** Change pitch by half a degree and give the Mach 10 - 20 seconds. Keep making small corrections.
- **Trim in blips.** A short blip is a lot.
- **Keep the yoke inside 38°.** Past that, a roll spoiler comes up on the low wing.

- **Keep the sideslip centred** with the rudder or YAW BAL.

Balance, Trim and the Long Haul

- **Heavy wing:** the ROLL sync bar beside the SFD moves off centre. Cross-transfer fuel until it is centred - CRUISE TRIM AND BALANCE. Do not use aileron trim up here.
- **Bank that stays:** ROLL off, balance the fuel, ROLL on again.
- **Once an hour:** check fuel (SYS → CNSUM and PERF), balance, N2, EGT, oxygen and cabin altitude (about 29,000 ft is normal).
- **Plan the end early:** you need about 150 NM to come down.

Turbulence up High

- **Light:** no problem for the autopilot.
- **Keep gust control FAIRED.** Gust UP narrows the speed band at the top. It is for rough air lower down.

Leaving the Cruise Climb

The first part of the way down is the slowest: up here idle is still a lot of thrust and the low indicated speed takes the bite out of the drag devices. Put everything out together.

- **Start about 150 NM out.** About 2.4 NM for every 1,000 ft, more with a tailwind. With everything out it takes about 20 minutes and 110 NM from 72,000 ft to 20,000 ft.
- **Gear down first** (it has no speed limit), throttle idle, speedbrakes OUT, SPOILER switch ARM with landing spoilers LET DN. The lift spoilers do the most up here. Gust control UP before you pass 180 KIAS.
- **M .715 down to 53,000 ft, then 160 KIAS.** The needle climbs back as you come down.
- The full descent is in Flying the U-2S and the Descent and Approach checklists.

Related pages: Cruise · AFCS System (Autopilot) · Specifications and Limitations

Miltech Simulations U-2. SIMULATION USE ONLY. This documentation describes the simulated aircraft as delivered in the add-on and must not be used for real-world aviation.