Saab AJS 37 Viggen

FlightGear Flight Manual

Model by

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Introduction

The Saab 37 Viggen

The Saab 37 Viggen is a Swedish, supersonic, single-seat military aircraft, notable for its short takeoff and landing capability offered by a thrust reverser. It was developed in the 1960's, entered service in 1971, and was retired in 2005. While the Viggen was intended as a multi-role aircraft, it never truly achieved that goal—unlike its successor the JAS 39 Gripen. Instead, the Viggen was developed into a multitude of versions for different roles: surface attack (AJ 37), reconnaissance (SF 37, SH 37), and fighter interceptor (JA 37).

Specification (AJS 37)

Wing span	10.60m
Length	16.30m
Height	5.81m
Main wing area	46.00m^2
Max takeoff weight	ca. 20000kg
Max static thrust	65.6kN dry, 115.6kN with afterburner

FlightGear Model

This flight manual is intended for the Saab 37 Viggen model for the FlightGear flight simulator. The model is available through FlightGear's official hangar FGAddon. Alternatively, development versions can be found in the Github repository[1]. Two variants of the Viggen have been developed in this model:

JA 37D A modernised fighter interceptor version from the 1990's. It notably features some of the glass instrument panels used in the JAS 39 Gripen.

AJS 37 Primarily a surface attack version, which resulted out of a modification programme providing some existing Viggens with limited multi-role (attack, fighter, and reconnaissance) capabilities.

This version of the manual is for the AJS 37.

Compatibility Note This manual was designed for version 5.0.0 of the Viggen model. Minimum supported FlightGear version is 2020.3.1. Using the latest stable FlightGear version is generally recommended.

[1] `https://github.com/NikolaiVChr/flightgear-saab-ja-37-viggen`

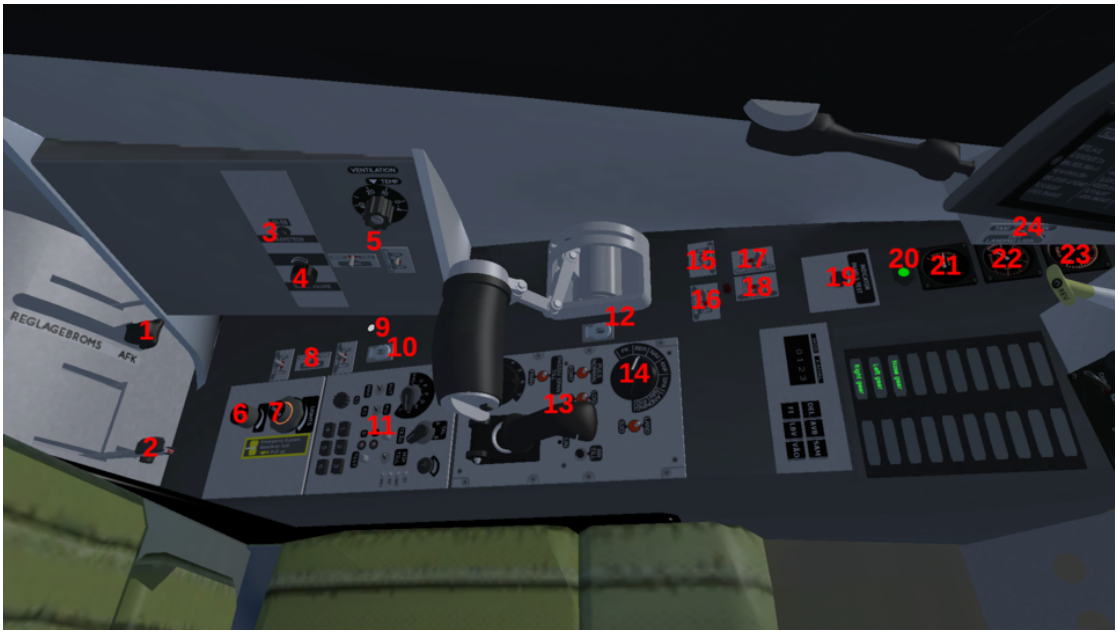
Part I

Aircraft Description

1. Cockpit Overview

1. Thrust reverser status light
2. Thrust reverser handle
3. Autopilot pushbuttons/lights
4. Autothrottle lights
5. Airspeed/Mach indicator
6. Radio frequency selector
7. Angle of attack indicator
8. Master warning lights and button
9. HUD brightness knobs
10. Attitude/director indicator (ADI)
11. Altimeter
12. Central indicator (CI)
13. Parking brake handle
14. Clock
15. HUD settings switches
16. Backup attitude indicator
17. Backup altimeter
18. Backup heading indicator
19. 'Weapon released' light
20. G-meter
21. Backup airspeed indicator
22. RPM indicator (N2)
23. Afterburner zone lights
24. Engine pressure ratio indicator
25. Transonic / low speed reverse light
26. Waypoint type / number indicator
27. Waypoint distance indicator
28. Fuel gauge
29. Left warning lights panel (cf. fig. 2.1).
30. Right warning lights panel (cf. fig. 2.1).

Figure 1.1: Cockpit—front panel



1. Autothrottle lever
2. Landing gear lever
3. Cycle selected pylon button
4. Warning sounds volume
5. Air conditioning controls
6. Instruments light knob
7. Panel light knob
8. Backup trim controls
9. Yaw trim centered light
10. Trim reset button
11. Radio control panel (not implemented)
12. Canopy jettison button
13. Radar control panel (not implemented)
14. Main mode selector knob
15. Engine start switch
16. Generator switch
17. Master power switch
18. Fuel cutoff switch
19. Warning lights test button
20. Roll trim centered light
21. Pitch trim indicator
22. Brake pressure indicator
23. Cabin pressure indicator
24. Taxi/landing lights switch

Figure 1.2: Cockpit—left panel

1. Automatic fuel regulator switch
2. Afterburner cutoff switch
3. Emergency ram air turbine switch
4. Pitch gearing switch
5. Fuses panel
6. ILS switch
7. Weapons panel
8. Countermeasures panel
9. Manual fuel control switches
10. Ignition plug switch
11. Nozzle position indicator
12. Exhaust temperature indicator
13. Oxygen pressure indicator
14. Oxygen cutoff switch
15. Radar altimeter switch
16. DME switch—no functionality
17. Navigation panel
18. TILS channel selection knob
19. TILS channel group switch
20. Windshield defogging knob
21. Test panel
22. Data panel (not implemented)
23. RWR control panel
24. Transponder
25. Formation lights switch
26. Navigation lights switch
27. Anti-collision lights switch
28. Identification transponder panel
29. Formation lights intensity knob

Figure 1.3: Cockpit—right panel

2. Instrumentation and Indicators

2.1 Flight Instruments

Altitude Indicator (fig 1.1:11) The long pointer is graduated in 100m, the short one in 1000m. The indicator can only display altitudes in the range 0–10km, after which it will cycle back to 0.

The knob is used to set reference pressure, which is displayed in hPa on a digital counter. Pulling the knob (click the center of the knob) sets the altimeter to the standard reference pressure 1013hPa. The pressure counter is covered with the text 'STD' in this case.

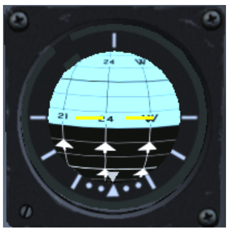
The altimeter requires AC power. A red-white flag indicates power failure.

Airspeed/Mach Indicator (fig 1.1:5) The airspeed indicator is graduated in km/h on a pseudo-logarithmic scale, up to 1400km/h. The airspeed indicator is fully mechanical.

The digital Mach indicator has a range of M 0–2.5. It is partially covered at M <0.4. The Mach indicator requires AC power. A red-white flag indicates power failure of the Mach indicator (but not of the airspeed indicator).

The knob controls an index on the airspeed scale, with no functionality.

Heading Indicator (fig 1.1:12) The heading indicator forms a ring around the radar display (CI). The heading scale ring itself rotates, and is read against a fixed index. A second yellow moving index indicates bearing to the next waypoint. The heading indicator requires AC power. A red-white flag indicates power failure.



Attitude/Director Indicator (fig 1.1:10) The ADI consists of a sphere which rotates in 3 axes, indicating pitch, roll, and course. The two flight director needles (horizontal and vertical) show ILS deviation for landing. The ADI requires AC power. A red flag indicates power failure.

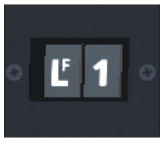
Angle-of-Attack Indicator (fig 1.1:7) The AoA indicator is graduated in degrees, from -4° to 30°. When on the ground, the indicator displays pitch angle instead of AoA. The AoA indicator requires DC power. In case of power failure, the pointer returns to the -4° position.

Accelerometer (fig 1.1:20) The accelerometer shows G-load (acceleration along the vertical axis), between -2g and +9g. A second pointer shows the maximum (positive) acceleration reached. The button resets the maximum acceleration pointer. The accelerometer is fully mechanical.

Clock (fig 1.1:14) The clock has two scales. The inner scale and the white pointers indicates time. The outer scale and the yellow pointers are used for the stopwatch. The lower-left knob is used to adjust time. The top-right button controls the stopwatch. The first push starts the stopwatch, the second push stops it, and the third push resets it.

Waypoint Distance Indicator (fig 1.1:27) Indicates the distance to the next waypoint. At distances <40km, the scale is graduated in km. At distances >40km, the scale is graduated in Nordic miles (1mil = 10km), and indicates distances up to 400km. A small screen indicates the unit in use, as either ‘km’ or ‘mil’.

Destination Indicator (fig 1.1:26) Indicates the type and number of the next waypoint. The first character indicates waypoint type: B for regular waypoints, L for departure and landing bases. The second character indicates the waypoint number, or S for the departure base.



2.2 Backup Instruments

Backup Altimeter (fig 1.1:17) The long pointer is graduated in 100m, the short one in 1000m. The indicator can only display altitudes in the range 0–10km, after which it will cycle back to 0. The knob is used to set reference pressure, which is displayed in hPa on a digital counter. The backup altimeter is fully mechanical.

Backup Airspeed Indicator (fig 1.1:21) The backup airspeed indicator is graduated in km/h on a pseudo-logarithmic scale, up to 800km/h. It is fully mechanical.

Backup Heading Indicator (fig 1.1:18) The backup heading pointer indicates aircraft heading on a fixed scale. The backup heading indicator requires AC power.

Backup Attitude Indicator (fig 1.1:16) The backup horizon indicates pitch and roll angles. The display is mechanical, but the gyro uses AC power. A red-white flag indicates power failure. The instrument will continue to function with reasonable accuracy for a few minutes after loss of AC power.

2.3 Engine Instruments

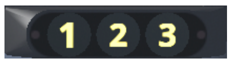
RPM Indicator (fig 1.1:22) The RPM indicator shows the high pressure compressor speed (N2), on a scale graduated up to 110%. It requires AC power.

Engine Pressure Ratio Indicator (fig 1.1:24) The EPR indicator shows the pressure ratio between the intake and the outlet of the turbine (before the afterburner stage). It requires AC power.

Exhaust Gas Temperature Indicator (fig 1.3:12) The EGT gauge indicates gas temperature after the turbine (before the afterburner stage) in °C. It requires DC power.

Nozzle Position Indicator (fig 1.3:11) The nozzle indicator shows the position of the engine exhaust nozzle and the current afterburner zone. It requires DC power.

Afterburner Zone Indicator (fig 1.1:23) The afterburner zone lights activate to indicate the afterburner zones (1 to 3) commanded by the throttle lever position. The lights are commanded purely by the throttle position, and not the afterburner zones which are actually lit: for instance moving the throttle in the afterburner zone during thrust reverse causes the lights to activate, despite afterburner being inhibited during reverse.



Fuel Gauge (fig 1.1:28) The fuel gauge indicates fuel quantity as a percentage. Under standard conditions, the gauge indicates 107% with full internal tanks, and 132% with the external tank in addition. A second black-white pointer indicates required fuel quantity (not implemented). The fuel gauge requires AC power.

2.4 Warning Lights Panels

Figure 2.1: Left and right warning panels (fig 1.1:29 and 30)

Fire (x2) Engine fire (blinking).

Fuel distrib Fuel distribution system failure (blinking, steady if hydraulics failure).

X-Tank fuel Blinking: external fuel tank pump failure. Steady: external fuel tank pump inactive due to low engine RPM.

Tank pump Fuel pump failure (blinking, steady if electrical failure).

Gear Blinking: gear up at low speed and altitude. Steady: landing gear extending/retracting.

Stuck in rev. Thrust reverser engaged and failed (blinking).

Nose/Left/Right gear Gear down and locked (steady).

Speedbrake Blinking: speedbrakes failure. Steady: speedbrakes extended.

Electrical Failure in electrical system (blinking).

Elec. Reserve Emergency ram air turbine failure, or abnormal engagement (blinking).

Hydraulic 1/2 Low pressure in hydraulic systems (blinking).

Auto throttle Steady: normal auto-throttle disengagement. Blinking: abnormal auto-throttle disengagement, or failure. Pull auto-throttle lever to off (up) position to reset.

No reverse Failure of thrust reverse or tertiary air intake (blinking).

Hydr. Reserve Low pressure in backup hydraulic system (blinking).

Oil pressure Low pressure in engine oil system (blinking).

Oil temp. High engine oil temperature (blinking).

Flightstick,Attitude,Altitude Abnormal disengagement of corresponding or higher autopilot mode (blinking). To reset, acknowledge master warning, then press any autopilot button.

Fire GTS Fire in engine start system (blinking).

Pitch gearing Failure in elevator reduction gearing (blinking).

Cabin alt. Low cabin pressure (blinking).

Canopy/Seat Failure of canopy or ejection seat (blinking).

Ignition sys Engine ignition active (blinking).

Start sys Engine start sequence in progress (steady).

Man. fuel reg Automatic fuel regulation disengaged (steady).

Central CPU Main computer failure (blinking).

Primary data Flight data computer failure (blinking).

Inertia nav. Inertia navigation central aligning (steady).

Radar Radar failure (blinking).

Transponder Identification transponder failure (steady).

Alpha Failure in angle of attack sensor (blinking).

Oxygen Oxygen supply closed, or low pressure (blinking).

Outlet temp High exhaust gas temperature (blinking).

Fuel amount Low fuel quantity (blinking).

Weapons Weapon systems failure (blinking).

2.5 Other Indicator Lights

Master Warning (fig 1.1:8) The master warning consists of two flashing red lights, together with a sound warning. It generally lights up together with a light on the warning panels. Pressing the button between the lights acknowledges the warning. Depending on the nature of the warning, the master warning lights may remain steady after acknowledgement.

Reverser (fig 1.1:1) Green light, indicates that the reverser handle (fig 1.1:2) is pulled, and the reverser is armed (but not necessarily active).

Autopilot (fig 1.1:3) Three green pushbuttons/lights. Used to select one of the autopilot modes: stability assist (STICK/SPAK), attitude hold (ATT), altitude hold (ALT/HÖJD). When an autopilot mode is active, the light for it and any lower mode are lit. The lights can blink to indicate special flight conditions under which the autopilot is not fully functional.

Autothrottle (fig 1.1:4) The orange A/T (AFK) light indicates that autothrottle is active. The pushbutton/light 15,5° is used to select the high-alpha landing mode (requires landing gear down).

Transonic / Low Speed Reverse(fig 1.1:25) Yellow light, indicates that the aircraft is in the transonic regime.

On the ground, it instead indicates that the reverser is active at low airspeed, causing a risk of hot air ingestion and engine fire. A low throttle setting (EPR<1.4) should be maintained in this case.

Weapon Released (fig 1.1:19) When using Rb 04, Rb 15, and m/71, a steady light indicates that the weapon release sequence is complete. The light goes off when securing the trigger safety.

A blinking light indicates that a weapon was not properly released.

3. Control Panels

3.1 Main Mode Selector

The main mode selector knob fig 1.2:14 is located on the radar panel, next to the throttle. It selects an aircraft main operation mode, corresponding to different phases of a flight. The knob can be rotated with the keybindings M / ⇧+M.

3.1.1 Main Modes

FK/TST Built-in test. Not implemented (does the same as BER/PRE).

BER/PRE Standby mode used for start-up and taxi. Displays (HUD and CI) are turned off.

NAV Navigation mode. Used during most of the flight, including takeoff.

ANF/CBT Combat mode. See chapter 7.

SPA/REC Reconnaissance mode. Not implemented (does the same as NAV).

LANDING NAV Instruments landing mode. Enables landing guidance using inertial navigation and ILS, provided the destination is set in the route manager.

LANDING P/O Visual landing mode.

3.1.2 Example of Use

A typical flight may use the following modes. Initially, the mode is BER/PRE. Shortly before takeoff (when entering the runway), the mode is switched to NAV. In order to use weapons, the mode is switched to ANF/CBT, then back to NAV when resuming normal flight.

LANDING mode is typically selected within 20km of the destination. LANDING NAV mode will give indications to follow a full approach pattern, and enables ILS guidance for final, if available. LANDING P/O simply gives indicates runway heading and nominal glide slope on the HUD, for visual landing. One can also begin the approach in LANDING NAV mode, and later switch to LANDING P/O to finish the approach visually.

3.1.3 Alternative Landing Approaches

For the LANDING NAV mode, the approach pattern can be changed by the following operations (called ‘flip-flop’).

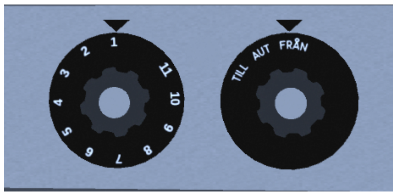
- Switching to LANDING P/O, then back to LANDING NAV select the short approach mode, with a 10km final instead of a 20km final.
- Switching to NAV, then back to LANDING NAV starts a new approach pattern, with a long (20km) final. (NAV can be replaced by any non-landing mode).

3.2 Identification Friend or Foe (IFF)

IFF is a radar system designed to identify friendly aircrafts.[1] Each aircraft can set a *query code* for its IFF system, and aircrafts with the same query code set will be identified as friendly. Thus, allied aircrafts can identify each other by using a shared code, chosen before the mission. In FlightGear, other aircrafts with a compatible IFF system include the F-16 and Justin Nicholson's MiG-21[2].

The AJS variant of the Viggen is only equipped with the transponder part of the IFF system: it can be identified by other aircrafts, but can not identify them.

Control Panel The IFF control panel fig 1.3:28 is located on the rear right side of the cockpit. The right knob is the power knob, with 3 positions: OFF/FRÅN, AUTO (on when airborne), ON/TILL. The left knob is used to set the query code, between 1 and 11.



[1] Despite the name, IFF can by no mean identify foes. An enemy aircraft is undistinguishable from e.g. a civilian aircraft, or an aircraft with a non-functioning IFF system.

[2] `https://github.com/l0k1/MiG-21bis`

4. Displays

4.1 Generalities

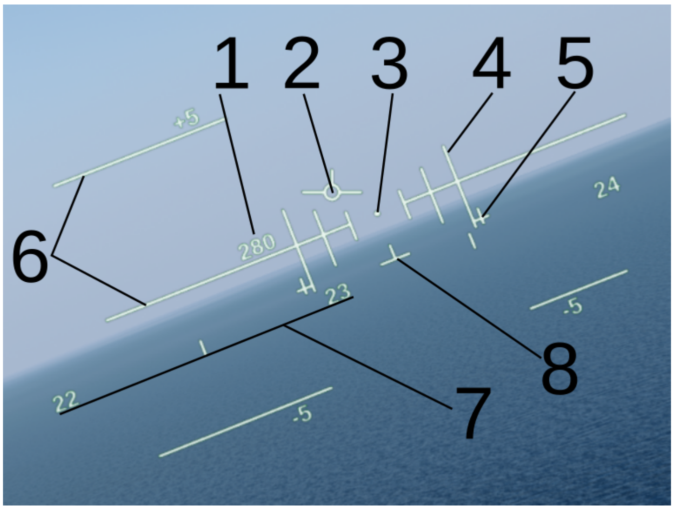
All primary displays use electrical power from the secondary AC bus. The displays are turned on when switching the main mode selector (fig 1.2:14) from BER/PRE to NAV.

Displays require some preheating before being functional:

- The HUD can turn on 30 seconds after AC power is available.
- The CI can turn on 30 seconds after switching to mode NAV.

4.2 Head Up Display (HUD)

4.2.1 Overview



1. Digital altitude
2. Flight path vector
3. Reference point
4. Altitude bars
5. Reference bars and radar altitude index
6. Artificial horizon and pitch lines
7. Heading scale
8. Time / distance scale

Figure 4.1: HUD overview

4.2.2 Controls

HUD brightness is adjusted with knob fig 1.1:9.

The following two switches located on the lower right of the HUD (fig 1.1:15) affect the HUD presentation.

SLAV SI (SLV HUD) In navigation mode, this switch enables a decluttered low-altitude mode when in position T (ON), see section 4.2.4.

During optical landing, when in position T (ON), the HUD reference point will be aligned with the flight path vector, instead of indicating runway heading.

HÖJD CI SI (ALT DISP) When in position RHM (RAD), the radar altimeter is used to compute a ground corrected altitude, which is displayed on the HUD. Otherwise, displayed altitude is the same as on the main altimeter.

The switch automatically goes back to position LD (BAR) at altitude >2450m and during landing final phase.

4.2.3 Navigation Mode

Artificial Horizon (fig 4.1:6) The artificial horizon and the $\pm 5°$ pitch lines provide an attitude reference. The HUD does not have a full pitch scale, only the horizon and the $\pm 5°$ lines.

Horizontally, the artificial horizon is pointing towards the current destination, indicated by the reference point (fig 4.1:3).

Flight Path Vector (fig 4.1:2) The FPV marker indicates the aircraft path direction relative to the ground. When on the horizon, the aircraft is in level flight. When covering the reference point, the aircraft track coincides with the destination.

Digital Altitude (fig 4.1:1) Displays the aircraft altitude. Below 1km the altitude is displayed in meters with a precision of 10m. Above 1km the altitude is displayed in kilometers with a precision of 100m. Above 10km, the digital altitude cycles back to 0, thus 1500m and 11500m are both displayed as '1,5'. Negative altitude down to -90m can be displayed.

Altitude Bars (fig 4.1:4) The 6 altitude bars indicate the aircraft altitude relative to the reference altitude (also called commanded altitude).

The top of the bars represents the reference altitude, and the bottom of the bars represent ground level (to be exact, indicated altitude 0m). The aircraft altitude is indicated by the horizon line. Thus, if the top of the bars is aligned with the horizon, the aircraft is at the commanded altitude, and if the bottom of the bars is aligned with the horizon, the aircraft is at ground level.

One can imagine the top, resp. bottom of the bars as forming a horizontal plane in a perspective drawing, located at reference altitude, resp. ground altitude. In this perspective drawing, the vanishing point is the reference point.

If the reference altitude is higher than 500m, the bottom of the bars represents the reference altitude minus 500m instead of ground level.

Reference Altitude The reference altitude displayed by the altitude bars is set as follows.

- During takeoff, reference altitude is fixed at 500m.
- During flight, the reference button (keybinding ⇧+R) sets it to the current altitude.
- If autopilot altitude hold mode is active, the reference altitude is the autopilot altitude.
- When entering landing mode, reference altitude is set to 500m. It can still be modified with the reference button or by engaging autopilot altitude hold.

If the difference between reference altitude and current altitude is too large, the displayed reference altitude will differ from the actual reference altitude.

Reference Altitude Bars (fig 4.1:5) The reference altitude bars are located just next to the outer altitude bars. The length of the reference altitude bars varies to indicate reference altitude: if the length of the outer altitude bars (which is fixed to 3°) represents the reference altitude, then the length of the reference altitude bars represents 100m.

For instance, in fig. 4.1, the length of the reference altitude bars is 0.6°, i.e. 1/5 of the outer altitude bars. Thus 100m is 1/5 of the reference altitude, i.e. the reference altitude is 500m.

At reference altitudes higher than 500m, the reference bars are hidden.

Radar Altitude Index (fig 4.1:5) When available, radar altitude is indicated by a horizontal index on the outer altitude bars, which can be read on the outer altitude bars or the reference altitude bars.

When the index is at the bottom of the altitude bars, radar altitude and indicated altitude coincide, which can be used to calibrate the altimeter in flight. However this method is only accurate when reference altitude is at most 500m (reference altitude bars are displayed).

Heading Scale (fig 4.1:7) Indicates current heading. Every 10° is indicated by a number, and every 5° between them by a vertical mark. The scale is 1:1, i.e. the bearing of a world object can be read directly on the scale.

Time and Distance Scale (fig 4.1:8) Indicate time or distance to an event or waypoint. The line shrinks and grows horizontally around the center to indicate time or distance to the event. A vertical center mark, and in some modes two side marks, represent the events.

- During takeoff roll, the line grows to indicate aircraft speed. The side marks indicate recommended rotation speed.
- In navigation mode, the line represents time to the next waypoint. It appears 60 seconds before the waypoint, and shrinks until reaching the waypoint.
- In cannon or rocket aiming modes, the line indicates distance to target, and the side marks indicate minimum firing distance.

4.2.4 Low Altitude Declutter

If the switch SLAV SI is in position T (TILL), a decluttered HUD is displayed at altitude <100m. In this decluttered mode, only the flight path vector, artificial horizon, and digital altitude are displayed. Pressing the reference button (keybinding ⇧+R) in decluttered mode toggles the heading scale.

4.2.5 Takeoff Mode

Takeoff mode is enabled is enabled when the nose gear is compressed, provided the master mode selector is not in mode LANDING.

During takeoff, the FPV is fixed 10° below the aircraft forward axis, and the FPV marker vertical fin is hidden. The artificial horizon reference point is aligned with the aircraft forward axis. Time line and heading scale are fixed 10° below the horizon. The time line indicates airspeed, with the side markers corresponding to rotation speed.

When the rotation angle reaches 5°, the time line is hidden and the heading scale moves to its normal position.

Takeoff mode stops once the airspeed exceeds M 0.35, when the climb angle is at least 3°, or at landing gear retraction.

4.2.6 Landing Mode

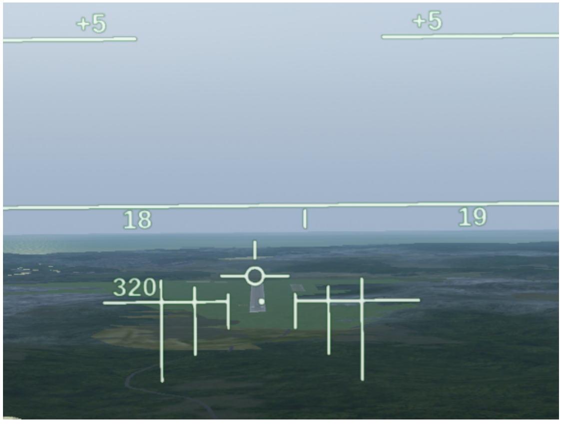


Figure 4.2: HUD during final

In landing mode, the HUD changes when starting the final. The -5° pitch lines are removed, and a glideslope line is added 2.86° below the horizon (corresponding to a slope of 5%). Altitude bars and digital altitude are moved from the horizon to the glideslope line, and the heading scale is moved under the horizon.

Speed / AoA Indicator In landing mode, the vertical fin ('tail') of the flight path vector symbol moves vertically to indicate deviation from the target speed or angle of attack.

The speed is correct when the bottom of the tail is on the FPV circle (default position in navigation mode). If the tail is higher than the circle, the aircraft speed is too high. If the tail is lower (inside the circle), the aircraft speed is too low.

While the landing gear is up, the target speed is 550km/h. Once the landing gear is down and locked, the target angle of attack is 12°. If the $\alpha 15, 5°$ button (fig 1.1:4) is pressed (light lit), the target angle of attack is 15.5° instead.

When the landing gear is down, the fin will blink if the angle of attack is critically high.

ILS Guidance If ILS guidance is used, the reference point indicates the heading to follow to align with the localizer, and the altitude bars indicate ILS glideslope deviation: if the top of the bars is above, resp. below the glideslope line, the aircraft is below, resp. above the ILS glideslope.

If ILS is not used (optical landing mode), the reference point indicates runway heading and the altitude bars are hidden.

Touchdown Below 30m, the HUD switches to optical landing display (ILS indications disappear). Below 15m radar altitude, the HUD switches to flare mode. The glideslope line moves up to indicate the descent angle which gives a vertical speed of 2.96m/s, the maximum for touchdown. If radar altitude is unavailable, transition to flare mode occurs at 30m.

4.2.7 Tactical Information

Some weapons have specific combat HUD presentations (aiming mode), enabled by switching to ANF/CBT mode or arming the weapon. See chapter 7 for details.

Part II

Operation

5. Generic FlightGear Operations

5.1 Key Bindings

A summary of the key bindings can also be found in Help » Aircraft Help.

General

M / ⇧+M Rotate main mode selector knob clockwise/counterclockwise.

K / J Extend/retract airbrakes (press for ca. 2s for full extension). When the landing gear is down, airbrakes retract as soon as K is released.

Ctrl+B Toggle airbrakes (simplified airbrakes control). When the landing gear is down, airbrakes retract as soon as Ctrl+B is released.

⟵ Toggle thrust reverser.

⇧+R Set reference altitude (cf. section 4.2.3).

⇧+H Cycle HUD brightness.

I Toggle HUD low altitude declutter (cf. section 4.2.2).

⇧+I Toggle radar or barometric altitude on HUD and CI (cf. section 4.2.2).

⇧+PageUp / ⇧+PageDown Raise/lower seat position.

O Open/close canopy.

Ctrl+E ×3 Eject

J Jettison drop tank (in flight only).

⇧+S Acrobatic smoke.

Ctrl+Y Display landing airport informations (requires runway selected in route manager).

View

Q Reset view.

Ctrl+Q Zoom on radar display.

Ctrl+⇧+Q Zoom on HUD.

Autopilot

Ctrl + T Autopilot stability assist mode.

Ctrl + W Autopilot attitude hold mode.

Ctrl + A Autopilot altitude hold mode.

Ctrl + D Disengage all autopilot modes.

Ctrl + S Toggle autothrottle lever.

Ctrl + G Autothrottle quick disengage.

Ctrl + ← / Ctrl + → Trim yaw, or adjust autopilot heading/bank angle.

Radar Controls See also section 5.1.1.

R Toggle radar.

[/] Decrease/increase radar range (positions: 15km, 30km, 60km, 120km).

Y Use flight controls to controls radar cursor.

L Cursor click.

Combat

C Cycle weapons.

U Gear down: disengage autothrottle. Gear up: select IR missile.

⇧ + U Uncage IR missile seeker (requires lock). Held: cage/reset IR missile seeker.

⇧ + E Toggle trigger safety.

E Fire weapon.

Q Release flare/chaff.

5.1.1 Radar Stick Controls

The radar stick is used to control the cursor on the CI. There are three ways to control it:

- Enable the option AJS-37 > Options > Arrow keys control radar cursor, and use the arrow keys to move the cursor, ↲ to click/select.
- Add joystick bindings to control the cursor. This can be done under File > Joystick Configuration, the controls are named Cursor Horizontal, Cursor Vertical, and Cursor Click. Alternatively, manually edit joystick configuration files to bind the properties

```
/controls/displays/cursor-slew-x
/controls/displays/cursor-slew-y
/controls/displays/cursor-click
```

- Press Y to use the main flight controls (joystick, mouse, arrow keys, whatever you use to control the aircraft) to instead control the cursor. In this mode, elevator and aileron controls are used to move the cursor. Normal flight controls are restored by pressing Y again. A ground collision warning will also immediately restore normal flight controls.

  Consider using autopilot when controlling the cursor in this way.

In all cases, L can also be used to click.

The same controls are used to move and lock the Rb 75 seeker, and to fly the Rb 05A remote controlled missile.

5.2 AJS 37 Menu

The menu AJS-37 contains Viggen-specific dialogs and menus. The following entries are present.

Manual (open in browser) Open this manual in a browser or PDF reader.

Select Livery There is a variety of liveries available, both historical and fictional.

Auto start/stop Lets you start and stop the plane without needing to switch switches etc. yourself. The progress is shown in the top centre of the screen in blue text. The final notification of the start-up sequence is 'Engine ready'. The shut-down sequence is done, when the aircraft is dark.

Repair Repairs system failures when on the ground. In case of a full crash, this option is mostly useless; one should restart instead, for instance with Location > Select Airport.

Fuel/Loadout The fuel slider allows quick selection of fuel quantity, while ensuring proper fuel balance. Fuel quantity is indicated as a percentage, which corresponds to the fuel gauge reading. A level of 100% corresponds slightly less than full internal tanks.

The loadout selection buttons in the rest of the screen allow fast selection of preset historical weapon loadouts. The button Clean loadout removes any loaded weapon. The button Reload ammo/flares reloads ammunition for guns, rocket pods and bomb racks, as well as flares.

Compared to the standard dialog Equipment > Fuel and Payload, this dialog is quicker and ensures some realism, but allows less choices.

Performance monitor Display aircraft performance (mostly for development).

Systems monitor Display internal status of some systems (mostly for development).

Combat log Multiplayer damage log (damage dealt and received).

Toggle external power External electrical power, normally used for startup. An electrical power truck is shown to the right of the aircraft when enabled. Only available when fully stopped.

Options Viggen specific configuration options, see section 5.3.

5.3 AJS 37 Options

The dialog AJS-37 » Options contains the following configuration options.

G-suit quality Changes resistance to blackout under high G-load.

Cockpit labels in Swedish Enable historical Swedish cockpit, instead of the English translation. (Cockpit translation is very incomplete.)

Rust on fuselage Purely visual. Only available when using the Atmospheric Light Scattering (ALS) FlightGear renderer.

Rust in cockpit Purely visual. Only available when using the Atmospheric Light Scattering (ALS) FlightGear renderer.

Arrow keys control radar cursor When enabled, the arrow keys will control the radar stick to move the cursor on the different displays, and ↲ is used to 'click' (select the target under the cursor, or other depending on context).

When disabled, the arrow keys are used for elevator and aileron, and ↲ is used for rudder (FlightGear default behaviour). Cf. section 5.1.1 for more details regarding cursor controls.

Enable multiplayer damage Allows to deal and receive damage from other compatible aircrafts (other Viggens, F-14, F-15, F-16, M-2000, MiG-21, etc.) in multiplayer. This requires *both* involved aircraft to enable damage.

For fairness, this option can only be toggled when stopped on the ground. It also enforces some realism options: blackout, normal simulation speed, no external views, and disabling fuel, payload, repair, and combat log menus while in flight.

6. Standard Procedures

To come! Please check FlightGear built-in checklists Help > Aircraft Checklists in the meantime.

7. Weapons Operation

7.1 Generalities

The generic weapon employment procedure is the following.

1. Select weapon type with C, or U to select A/A missiles.
2. Main mode selector to ANF/CBT (fig 1.2:14, shortcuts M/⇧+M).
3. Open trigger safety with ⇧+E to arm the selected weapon.
4. Depending on weapon type, lock onto the target.
5. Fire the weapon with E.
6. Secure the trigger with ⇧+E.

Remarks:

- Upon switching to mode ANF/CBT, the HUD changes to a weapon-specific aiming presentation. For the Rb 04, Rb 15, Rb 05, and m/90, this aiming mode is the same as the usual navigation HUD.
- It is possible to fire in mode NAV instead of ANF/CBT. In this case, the aiming presentation is engaged when opening the trigger safety.

7.1.1 Trigger Safety Usage

The trigger safety role is not merely to prevent unintentional fire. It is an import part of the fire control system as it arms the weapon. As a consequence, improper use of trigger safety will prevent weapon usage.

General guidelines are:

- Only open the trigger safety once the target is in sight / on radar, and the decision to engage it has been made.
- Only open the trigger safety after the desired weapon is selected. If a new weapon is selected while the trigger is unsafe, the new weapon will not be armed (until the trigger is safed and unsafed again).
- Secure the trigger shortly after firing.
- When firing several missiles in succession, it is necessary to secure the trigger between each weapon.

7.2 AKAN and ARAK

The m/55 AKAN cannon pods and m/70 ARAK rocket pods share the same sighting mechanisms and firing procedures.

The m/55 AKAN is a 30mm ADEN cannon pod, with 150 rounds. Two can be carried on the main wing pylons.

The m/70 ARAK consists of six 135mm rockets, which are all fired in a 0.6 seconds salvo. Four pods can be carried on the main wing and fuselage pylons.

7.2.1 Ranging

The AJS combines two methods to compute the distance to the target (i.e. the point on which the aiming reticle is located).

Ranging by Triangulation Triangulation computes the distance to the target based on aircraft altitude and the angle between the aiming reticle and the horizon. Ranging by triangulation assumes that the target altitude is 0, thus it is essential to properly calibrate indicated altitude by 1. setting the altimeter to the target QFE, or 2. using radar-altimeter corrected altitude (switch HÖJD CI SI in position RHM).

Ranging by triangulation is only available if the aiming reticle is at least 5° below the horizon.

Radar Ranging The aircraft main radar is used to compute the range to the ground. Radar ranging is only used when the following conditions are met.

- Triangulation ranging is active, and computed distance is at most 7km.
- Main mode selector is ANF/CBT.
- Roll angle is less than 45°, or trigger safety is open.

Remarks Because triangulation ranging is required before radar ranging can be enabled, it is essential to at least approximately calibrate the altimeter.

If triangulation ranging is unavailable (reticle is less than 5° below the horizon) a fixed distance of 1400m is used to compute reticle position.

7.2.2 HUD Aiming Mode

When AKAN or ARAK are selected, the HUD aiming mode (fig. 7.1) is enabled by switching to mode ANF/CBT, or arming the weapon (trigger unsafe) in mode NAV.

It comports an aiming reticle (fig 7.1:1), the digital altitude indicator, and a number of indicators and cues for target range, which appear in the following order:

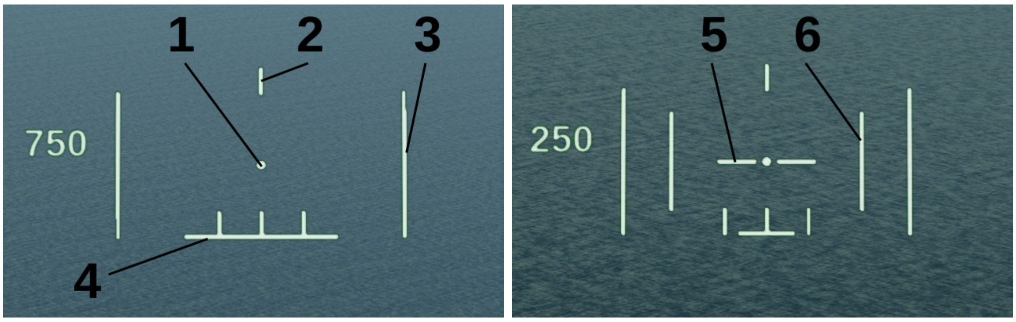
1. The distance line (fig 7.1:4) indicates range to the target up to 8km when triangulation ranging is active. The side marks indicate the computed firing distance (minimum firing distance giving sufficient time for safe evasion).

2. When radar ranging is active, a vertical bar is displayed above the reticle (fig 7.1:2).

3. 2 seconds before computed firing distance, the distance line blinks.

4. 0.5 seconds before computed firing distance, the firing command lines appear (fig 7.1:5).

5. When the minimum distance for safe evasion is passed, the evasion warning bars start blinking (fig 7.1:6). This indicates that the attack run should be aborted immediately.



1. Aiming reticle
2. Radar ranging mark.
3. Side bars, no functionality.
4. Distance line.
5. Firing command lines.
6. Evasion warning bars.

Figure 7.1: HUD aiming mode

Minimum distance for safe evasion is computed to keep the aircraft out of the explosion debris zone, and assumes a 5g pull, with some margin.

The position of the aiming reticle is correct starting 3 seconds before computed firing distance. The aiming reticle includes wind compensation.

7.3 Rb 75

The Rb 75 is a Swedish version of the AGM-65A television-guided missile. It is designed for use against ground targets. The pilot locks on the target by manually slewing the Rb 75 seeker head using the radar stick.

In the real Viggen, the EP-13 screen to the right of the HUD displayed the Rb 75 seeker image, and was used to lock on the target.

In FlightGear, the EP-13 screen is not functional. Instead, the seeker position is displayed as a small circle on the HUD. The seeker is controlled with the radar stick (see section 5.1.1). When the seeker is over the target, it can be locked using the radar stick click/select.

7.4 Rb 05A

The Rb 05A is a remote-controlled missile. It is primarily intended for use against ground and naval targets, but can also be used against slow-manoeuvring air targets thanks to a proximity fuse. The missile is guided visually by the pilot. A flare at the back of the missile helps the pilot to keep sight of it (fig. 7.2).

In FlightGear, the Rb 05A uses the same controls as the radar stick, cf. section 5.1.1.[1]

7.4.1 Procedure

1. Main mode selector to ANF/CBT. (fig 1.2:14, shortcuts M/⇧+M).

[1] In the real Viggen, a separate control stick on the right console was used.

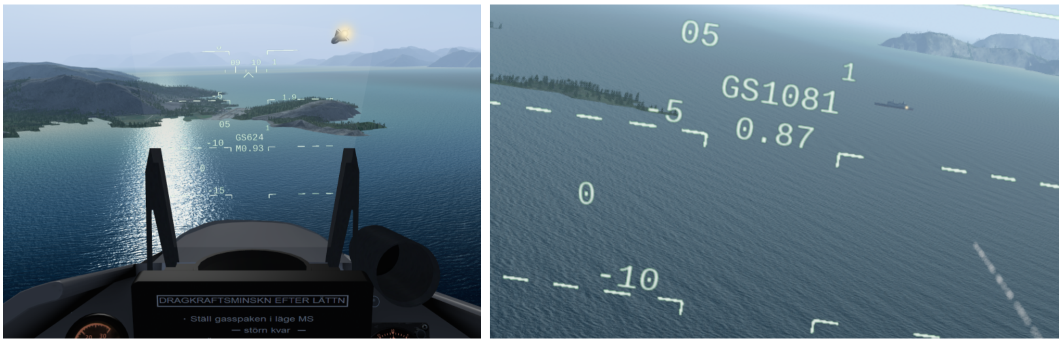


Figure 7.2: Rb 05A flare for visual guidance. On the left, the missile is entering the pilot's field of view just after launch. On the right, the missile is about to hit the target ship, and the missile flare is visible over the ship

2. Select the Rb 05A (cycle weapons with C).
3. Once in firing position, consider engaging autopilot in ATT or HÖJD/ALT mode to reduce pilot workload.
4. Identify the target visually.
5. Unsafe the trigger and fire within 9km of the target.
6. After 1.7s, missile controls are enabled (cf. section 5.1.1 for control methods). At this point, it should be well within the pilot field of view.
7. When the missile hits, take evasive manoeuvres, secure the trigger, and switch to NAV mode.

Remarks.

- Recommended speed is 700-1150 km/h.
- Recommended attitude is a level flight or slight dive, so as to not loose sight of the target and the missile.
- Recommended altitude is 300-400 meters above ground.
- The target do not need to be directly in front of the aircraft as the missile can be guided considerably to the side. However, doing so makes it harder to aim the missile, and reduces effective range.
- The missile flies for ca. 24 seconds, giving it a maximum effective range of ca. 9 km.
- It is easiest to aim the missile using the collimation principle: try to keep the missile flare covering the target at all time.

A. Viggen Swedish Dictionary

	Swedish	English
	TILL	ON
	FRÅN	OFF
Instruments:		
	Höjd	Altitude
	Fart	Speed
	Kurs	Course/Heading
	Varv	Revolution (RPM)
	Bränsle	Fuel
Autopilot:		
	SPAK	Stability assist mode (lit. Stick)
	ATT	Attitude hold
	HÖJD	Altitude hold
	AFK (Automatisk FartKontroll)	Auto-throttle
Displays:		
	SI (SiktlinjesIndicator)	HUD
	CI (CentralIndicator)	AJS radar screen
	MI (MålIndicator)	JA radar screen (lit. Target Display)
	TI (TaktiskIndicator)	JA Horizontal Situation Display