

# Saab JA 37D Viggen

## FlightGear Flight Manual



*Model by*

Anders Lejczak, Justin Nicholson, Enrico Castaldi,  
Joshua Davidson, Nicola B. Bernardelli, Isaac Protiva,  
Colin Geniet, Nikolai V. Chr.

*Manual by*

Colin Geniet, Rick Gruber-Riemer

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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 (JA 37)

Wing span	10.60m
Length	16.40m
Height	5.93m
Main wing area	46.00m <sup>2</sup>
Max takeoff weight	ca. 20000kg
Max static thrust	66.6kN dry, 110.3kN 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<sup>1</sup>. 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 JA 37D.

**Compatibility Note** This manual was designed for version 4.319 of the Viggen model. Minimum supported FlightGear version is 2020.3.1. Using the latest stable FlightGear version is generally recommended.

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<sup>1</sup><https://github.com/NikolaiVChr/flightgear-saab-ja-37-viggen>

Part I

**Aircraft Description**

# 1. Cockpit Overview



- |                                       |  |
|---------------------------------------|--|
| 1. Thrust reverser status light       | 14. RPM indicator (N2)                         |
| 2. Thrust reverser handle             | 15. Engine pressure ratio indicator            |
| 3. Backup attitude indicator          | 16. HUD brightness knobs                       |
| 4. Altimeter                          | 17. Target display (MI)                        |
| 5. Backup altimeter                   | 18. Parking brake handle                       |
| 6. Autopilot pushbuttons/lights       | 19. Heading indicator                          |
| 7. G-meter                            | 20. Backup heading pushbutton/light            |
| 8. Master warning lights and button   | 21. Fast-reset pushbutton/light                |
| 9. Angle of attack indicator          | 22. Transonic / low speed reverse light        |
| 10. Autothrottle lights               | 23. Horizontal situation display (TI)          |
| 11. Airspeed/Mach indicator           | 24. Fuel gauge                                 |
| 12. Afterburner zone lights           | 25. Left warning lights panel (cf. fig. 2.1).  |
| 13. Attitude/director indicator (ADI) | 26. Right warning lights panel (cf. fig. 2.1). |

Figure 1.1: Cockpit—front panel



- |   |                                      |
|---|--------------------------------------|
| 1. Autothrottle lever                     | 14. Engine start switch              |
| 2. Landing gear lever                     | 15. Generator switch                 |
| 3. Cycle selected pylon button            | 16. Master power switch              |
| 4. Warning sounds volume                  | 17. Fuel cutoff switch               |
| 5. Air conditioning controls              | 18. Comm. radio channel selector KV1 |
| 6. Instruments light knob                 | 19. Datalink channel selector KV3    |
| 7. Panel light knob                       | 20. Warning lights test button       |
| 8. Backup trim controls                   | 21. Roll trim centered light         |
| 9. Yaw trim centered light                | 22. Pitch trim indicator             |
| 10. Trim reset button                     | 23. Brake pressure indicator         |
| 11. Radio control panel (not implemented) | 24. Cabin pressure indicator         |
| 12. Canopy jettison button                | 25. Taxi/landing lights switch       |
| 13. Radar control panel (not implemented) |                                      |

Figure 1.2: Cockpit—left panel





- |                                     |                                      |
|-------------------------------------|--------------------------------------|
| 1. Automatic fuel regulator switch  | 15. GPWS switch                      |
| 2. Afterburner cutoff switch        | 16. Windshield defogging knob        |
| 3. Emergency ram air turbine switch | 17. Test panel                       |
| 4. Pitch gearing switch             | 18. Nozzle position indicator        |
| 5. Fuses panel                      | 19. Exhaust temperature indicator    |
| 6. ILS switch                       | 20. Data panel                       |
| 7. Weapons panel                    | 21. RWR control panel                |
| 8. Countermeasures panel            | 22. Navigation radio panel           |
| 9. Manual fuel control switches     | 23. Transponder                      |
| 10. Ignition plug switch            | 24. Formation lights switch          |
| 11. Oxygen pressure indicator       | 25. Navigation lights switch         |
| 12. Oxygen cutoff switch            | 26. Anti-collision lights switch     |
| 13. Navigation panel                | 27. Identification transponder panel |
| 14. Radar altimeter switch          | 28. Formation lights intensity knob  |

Figure 1.3: Cockpit—right panel

## 2. Instrumentation and Indicators

### 2.1 Flight Instruments

**Altitude Indicator (fig 1.1:4)** 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 1.1:11)** The airspeed indicator is graduated in km/h on a pseudo-logarithmic scale, up to 1500km/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).

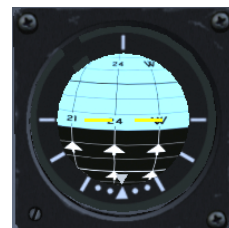


**Heading Indicator (fig 1.1:19)** The heading scale itself rotates to indicate aircraft heading, read against a fixed index. The thin pointer indicates commanded heading, or bearing to the destination. The wide pointer indicates track angle to the target, or runway direction (at landing). The heading indicator requires AC power. A red-white flag indicates power failure.

The heading indicator can also display the output of the backup gyrocompass, cf. section 2.2.



**Attitude/Director Indicator (fig 1.1:13)** 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 1.1:9)** The AoA indicator is graduated in degrees, from  $-4^{\circ}$  to  $30^{\circ}$ . 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  $-4^{\circ}$  position.





**Accelerometer (fig 1.1:7)** 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.



## 2.2 Backup Instruments

**Backup Altimeter (fig 1.1:5)** 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 Heading Indicator (fig 1.1:20)** The JA 37 does not have a separate backup heading indicator. Instead the main heading indicator can display the output of the backup gyrocompass. The button BACKUP HEADING (RESERVKURS) toggles this functionality. When the button light is lit, backup heading is displayed. The backup gyrocompass requires AC power.

**Backup Attitude Indicator (fig 1.1:3)** 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 1.1:14)** The RPM indicator shows high pressure compressor speed (N2), on a scale graduated up to 110%. It requires AC power.



**Engine Pressure Ratio Indicator (fig 1.1:15)** 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 1.3:19)** The EGT gauge indicates gas temperature after the turbine (before the afterburner stage) in °C. It requires DC power.



**Nozzle Position Indicator (fig 1.3:18)** The nozzle indicator shows the position of the engine exhaust nozzle and the current afterburner zone. It requires DC power.



**Afterburner Zone Indicator (fig 1.1:12)** 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 1.1:24)** The fuel gauge indicates fuel quantity as a percentage. Under standard conditions, the gauge indicates 112% with full internal tanks, and 136% 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 1.1:25 and 26)

**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 to off (up) position to reset.

**No reverse** Failure of thrust reverse of 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 1.1:6)** 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 1.1:10)** 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 1.1:22)** Yellow light, indicates that the aircraft is in the transonic regime.

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

## 3. Control Panels

### 3.1 Identification Friend or Foe (IFF)

IFF is a radar system designed to identify friendly aircrafts<sup>1</sup>. 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, agreed upon before a mission. In FlightGear, other aircrafts with a compatible IFF system include the F-16 and the MiG-21.

**Control Panel** The IFF control panel fig 1.3:27 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.

**Identification of Contacts** When a radar contact is selected, an IFF interrogation is automatically performed. If the aircraft is identified as friendly, it is displayed with a cross on the MI and the HUD, and with a green symbol on the TI.

Additionally, pressing **Ctrl**+**F** sends an IFF interrogation to the radar contact on which the MI cursor is pointing. If it is identified as friendly, a cross is displayed over this contact on the MI (such manual IFF interrogation are not displayed on the HUD or the TI).

**Friendly Callsigns** The menu **JA-37Di >> Friends (IFF)** allows to set a list of friendly callsigns. Aircrafts with these callsigns will always be identified as friendly by IFF, even if they do not have the same IFF query code. This allows to operate with other aircrafts which do not have a compatible IFF system.

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<sup>1</sup>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.

# 4. Displays

## 4.1 Generalities

All primary displays use electrical power from the secondary AC bus. The displays are turned on by the yellow top-left button on the TI (fig 1.1:23). In addition, displays are turned on at takeoff when RPM exceeds 90%.

The HUD requires 40 seconds of preheating after AC power is available, before turning on.



# 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

- ← Toggle thrust reverser
- ↑ + R Set reference altitude (goal altitude displayed on HUD).
- ↑ + H Cycle HUD brightness.
- I Display target type/callsign on ML.
- ↑ + I Toggle between english/imperial and swedish/metrics display modes.
- ↑ + PageUp / ↑ + PageDown Raise/lower seat position.
- O Open/close canopy.
- Ctrl + E ×3 Eject
- J Jettison drop tank (in flight only).
- ↑ + S Acrobatic smoke.
- ↑ + Y Engage landing mode.
- 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.
- Y** Use flight controls to controls radar cursor.
- [** / **]** Decrease/increase radar range (positions: 15km, 30km, 60km, 120km).
- ↑** + **N** Select center-most radar track.
- Ctrl** + **N** Set next waypoint as radar target.
- ↑** + **F** Unlock radar track.
- Ctrl** + **F** IFF contact under MI cursor.

### Combat

- H** Toggle HUD aiming mode.
- C** Cycle weapons.
- ↑** + **C** Cannon quick select.
- U** Missile quick select.
- ↑** + **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 MI and TI. There are three ways to control it:

- Enable the option **JA-37Di** » **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, and the trigger **E** is used to click. 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.

## 5.2 JA 37D Menu

The menu **JA-37Di** contains Viggen-specific dialogs and menus. The following entries are present.

**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).

**Friends (IFF)** Allows to set a list of friendly callsigns for IFF (cf. section 3.1).

**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 JA 37D Options



The dialog **JA-37Di** **Options** contains the following configuration options.

**HUD line width** Allows to improve HUD visibility if necessary.

**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.)

This option is for *physical labels* only, and should not be confused with the next one which affects displays.

**HUD/TI in metric units and Swedish** Change the unit system and language used in displays. Short-cut: +.


This option is for *displays* only, and should not be confused with the previous one which affects physical labels.


**TI Display: show non-functional menu items** On the TI display (HSD), show non-implemented menus.

**TI Display: use Internet to fetch map** Enable download of the world map displayed on the TI (HSD).

**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 through the TI display, or with **↑**+**C** / **U** to quick-select the cannon and A/A missiles respectively.
2. Engage aiming mode with **H**. (If quick select keys **↑**+**C** / **U** are used, aiming mode is automatically engaged).
3. Open trigger safety with **↑**+**E** to arm the selected weapon.
4. For missiles, lock onto the target.
5. Fire the weapon with **E**.
6. Secure the trigger with **↑**+**E**.

Remarks:

- Upon switching to aiming mode, the HUD changes to a weapon-specific aiming presentation.
- It is possible to fire without using the aiming mode. In this case, a simplified 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.

# A. Vigen 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