

D I G I T A L   C O M B A T   S I M U L A T O R

# F-5E

## *Flaming Cliffs*



### Quick Start Guide



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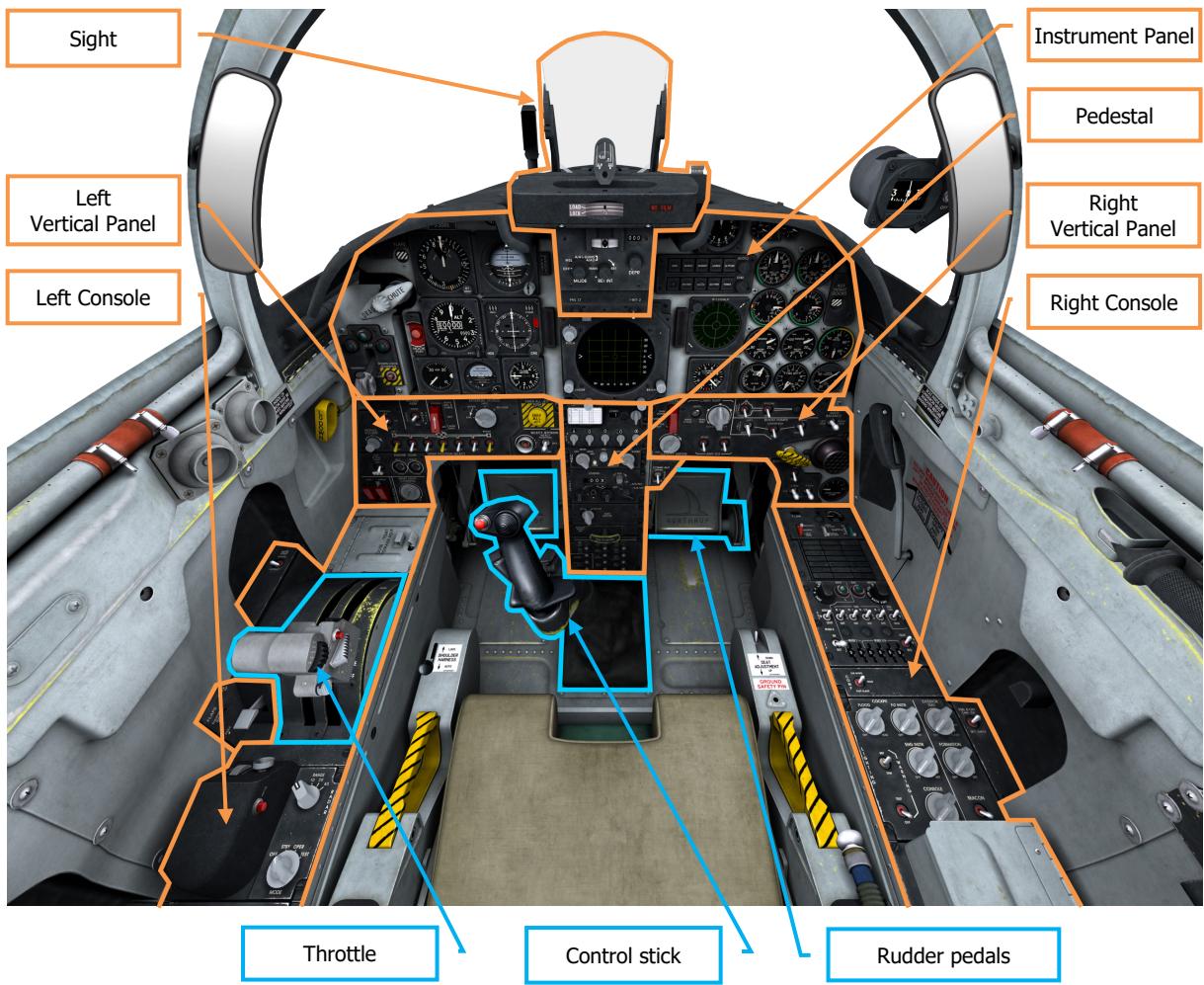
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# COCKPIT

The cockpit of the F-5E has a standard arrangement. It contains aircraft and armament controls, various instruments, control panels of aircraft systems, and the ejection seat.

Control stick is located in the center of the cockpit, throttle controls are to the left, and rudder pedals are under the instrument panel. The instrument panel and sight are in front of the pilot.



## Control stick

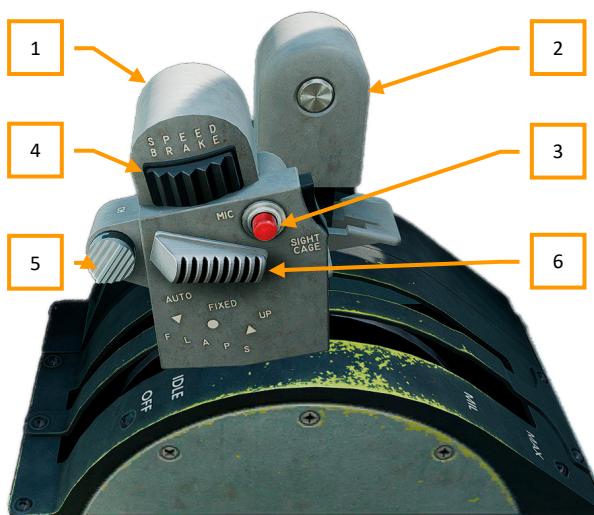
The control stick provides pitch and roll commands to maneuver the aircraft. Roll is used to turn the aircraft while pitch allows to control altitude.



1. Weapon Release Button **R.Alt + Space**
2. Trigger **Space**
3. Nosewheel Steering Button **Alt + Q**
4. Pitch and Aileron Trim Button  
**R.Ctrl + [** - nose-up trim;  
**R.Ctrl + ;** - nose-down trim;  
**R.Ctrl + ,** - trim left wing console down;  
**R.Ctrl + /** - trim right wing console down.

## Throttle

The throttle is used to control the engine thrust thus controlling the airspeed. Each throttle controls its respective engine and has several buttons that permit manipulation of aircraft systems.



1. Left Engine Throttle.
2. Right Engine Throttle.
3. Microphone Button.
4. Speed Brake Switch **B**.
5. Chaff/Flare Release Button.
6. Flap Thumb Switch **F**.

## Rudder pedals

The pedals are used in flight to yaw the airplane left and right using the rudder and, on the ground, to turn the nose wheel when taxiing. To toggle nosewheel steering on and off press **L.Alt + Q**.

## Instrument panel

The instrument panel contains instruments and indicators. The main flight instruments are grouped together and include:



1. Flap Indicator.
2. Airspeed/Mach Indicator.
3. Attitude Indicator.
4. Pitch Trim Indicator.
5. Clock.
6. Engine Tachometers.
7. Exhaust Gas Temperature Indicators.
8. Nozzle Position Indicators.
9. Landing Gear Lever.

10. Angle-Of-Attack Indicator.
11. Altimeter.
12. Vertical Velocity Indicator.
13. Horizontal Situation Indicator.
14. Accelerometer.
15. Fuel Flow Indicator.
16. Fuel Quantity Indicator.

1.	<b>Flap Indicator</b> on the instrument panel provides visual indications of flap position when the Flap Thumb Switch on the Right Engine Throttle is used.	
2.	<b>Airspeed/Mach Indicator</b> . The Airspeed/Mach Indicator displays airspeed in knots from 80 to 850 and in Mach number from 0.5 to 2.2. The indicator includes: <ul style="list-style-type: none"> <li>• Maximum allowable indicated airspeed pointer (red);</li> <li>• Maximum allowable landing gear extension airspeed index (yellow).</li> </ul>	
3.	<b>Attitude Indicator</b> shows roll and pitch parameters relative to the horizon, providing an indication of the aircraft's orientation. When maneuvering at high angles of attack, the vertical gyro may tilt. In this case, the OFF flag will appear, and the instrument readings will be incorrect.	
4.	<b>Pitch Trim Indicator</b> . The instrument displays trim position. For players' convenience, there is a mark corresponding to 10 increments of nose-up trim on aircraft controls position indicator <b>R.Ctrl+Enter</b> .	
5.	<b>Clock</b> shows the current time.	
6.	<b>Engine Tachometers</b> indicate the current engine RPM as a percentage. Smaller scale is graduated in increments of 1%, larger scale is graduated in increments of 2%.  Red indices show the minimum idle RPM and maximum permissible RPM at Military (MIL) or Afterburner (AB) Power. The continuous RPM range is indicated in green.	

<p>7. <b>Exhaust Gas Temperature Indicators</b> display the temperature of exhaust gases in °C x 100.</p> <p>Red indices show the minimum idle temperature and maximum temperature at MIL and AB Power. Yellow index indicates the temperature range allowable under limited conditions.</p>	
<p>8. <b>Nozzle Position Indicators</b> display the current engine nozzle position as a percentage. When the pointer is at 100%, the nozzle is fully open, at 0% the nozzle diameter is minimum.</p>	
<p>9. <b>Landing gear panel.</b> Press <b>G</b> to extend or retract landing gear. Three green lights are illuminated when all landing gear struts are locked in the extended position.</p>	
<p>10. <b>Angle-Of-Attack Indicator</b> displays the angle of attack in units from 0 to 30. Units are the corrected value of angle of attack that differs from the actual degrees of angle of attack.</p>	
<p>11. <b>Altimeter</b> indicates altitude up to 80,000 feet. The last two digits (units and tens of feet) always show 00. The dial is graduated in 20 and 100-foot increments.</p> <p><i>NOTE. Altitude readout error accumulation may occur during transonic flight condition. In this case, the altimeter reverts to a standby mode (pressure altitude), i.e. the altitude is displayed with an error.</i></p>	

<p>12. <b>Vertical Velocity Indicator</b> indicates the rate of climb or descent in feet per minute.</p> <p><i>NOTE. Due to design features, the instrument operates with a slight delay. Therefore, the climb, descent or level flight conditions should be set according to the Attitude Indicator and monitored using the Vertical Velocity Indicator.</i></p>	
<p>13. <b>Horizontal Situation Indicator</b> provides the pilot with a top-down view of the aircraft's position relative to a set course, cardinal directions, and radio beacons to aid in navigation and landing. Numerical values of the distance to the current waypoint and the set course are displayed at the top.</p>	
<p>14. <b>Accelerometer</b> measures and displays the current values of positive and negative G-loads. The red indices show the maximum allowable positive and negative G-load.</p>	
<p>15. <b>Fuel Flow Indicator</b> displays the current values of the fuel flow for each engine. Fuel flow is measured in pounds per hour.</p>	
<p>16. <b>Fuel Quantity Indicator</b> is used to monitor the remaining fuel in the left and right engine fuel systems. Unit of measurement: lbs.</p>	

# CONTROLS

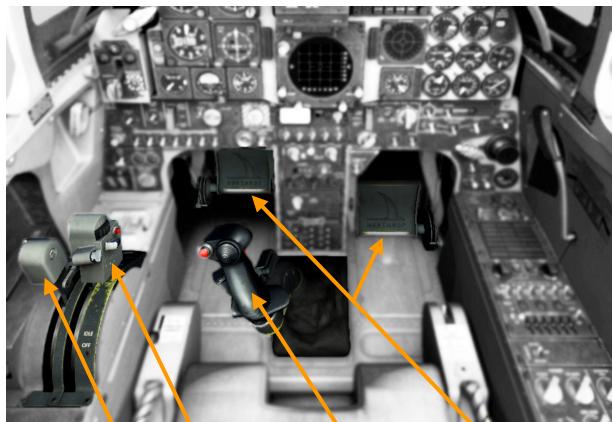
## Joystick controls

Primary aircraft flight controls include the Control Stick, Throttle, and Rudder Pedals. The control stick is used to roll the aircraft left and right to perform turns, and pitch the nose up and down to climb or descend. The throttle is used to control the engine power and airspeed. The pedals are used in flight for yaw control (turning the nose of the aircraft to the left or right) and slip compensation using the rudder. They are also used on the ground to turn the nose wheel when taxiing.

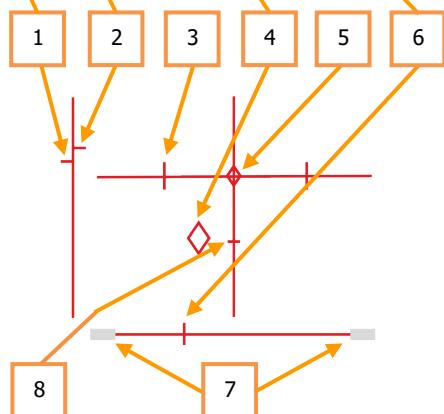


For best gaming experience, it is advisable to have a joystick equipped with a separate throttle handle and rudder pedals.

During flight, the controls position indicator can be enabled by pressing **R.Ctrl+Enter**.



1. Left Throttle and Position Indicator.
2. Right Throttle and Position Indicator.
3. Aileron Spring Stop.
4. Control Stick and Position Indicator
5. Trim Tab Position.
6. Rudder Pedals and Rudder Control Position Indicator.
7. Right and Left Wheel Brake Position Indicator.
8. Maximum Pitch Trim Indicator.



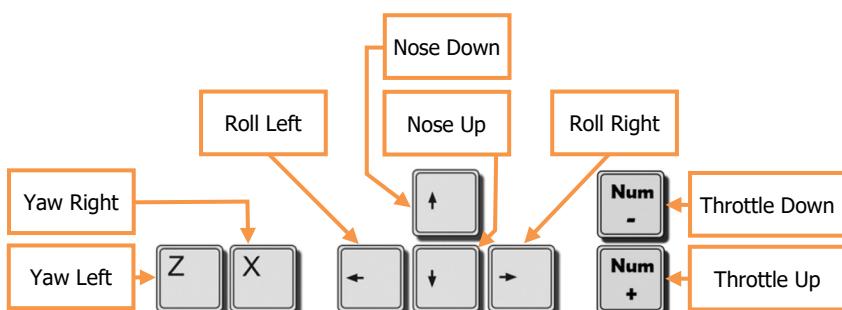
## Keyboard controls

If you are flying with only a keyboard, the primary flight control keys will be:

**Arrow keys** – to control pitch and roll,

**Numpad+** and **Numpad-** – to control throttle,

**Z** and **X** – to control rudder pedals.

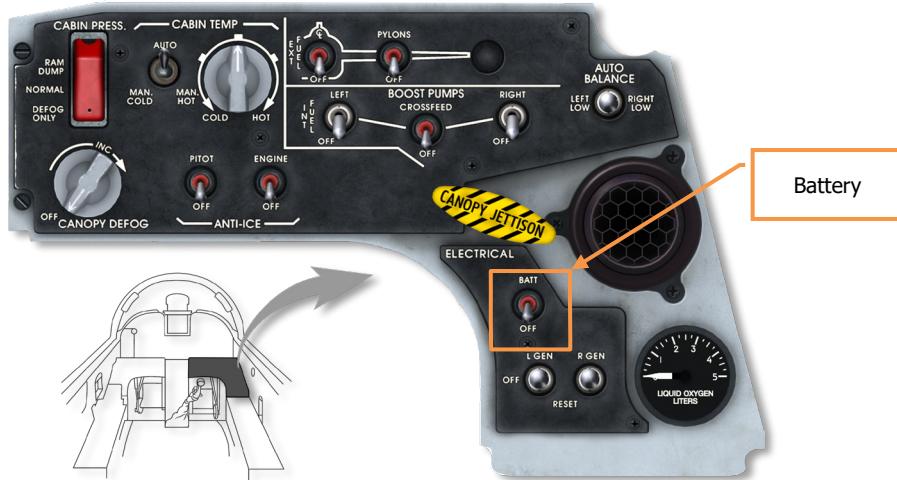


# PROCEDURES

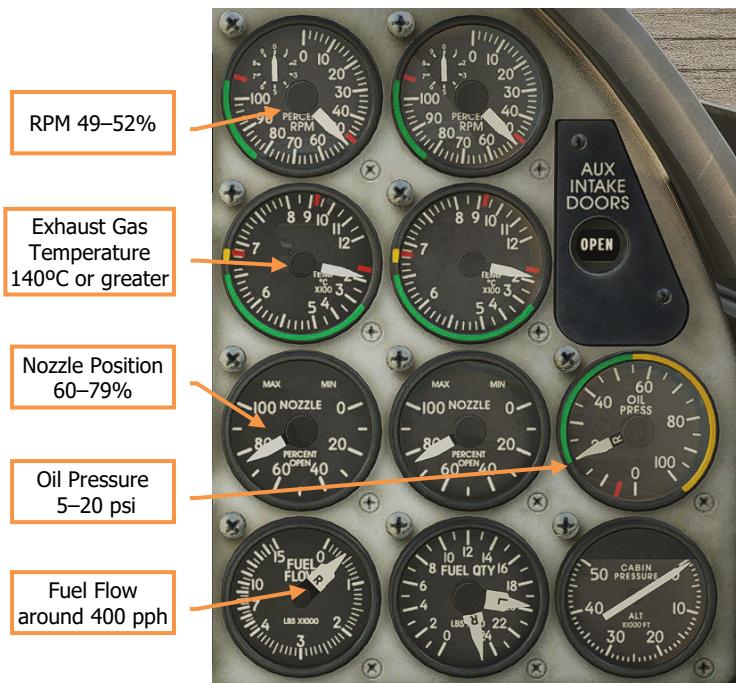
## Engine start

To start the engines when on the ground, perform the following steps:

1. Power on the battery with the switch on the Right Vertical Console by pressing **R.Shift+L**



2. Press **R.Shift+Home** to start the engines. Left engine starts first. Verify that the engines are in Idle mode, the RPM should be 49 to 52%.



## Taxi

Press **L.Ctrl+C** to close the canopy before taxi.

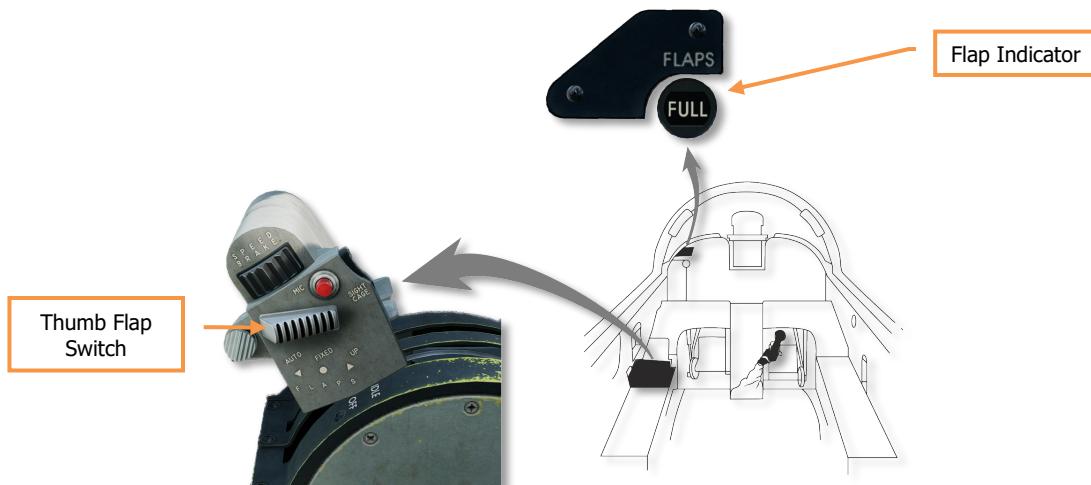
To start taxiing perform the following steps:

1. Slowly advance engine throttle to 65-70% with **Numpad+** and **Numpad-**
2. Engage nosewheel steering by pressing **L.Alt+Q**. Use pedals (**Z** or **X**) to turn.
3. Maintain taxiing speed by adjusting throttle and applying main wheel brakes **W** to prevent a roll-over. Keep engine RPM at approximately 57%.

## Before takeoff

Enter the runway. Roll forward slightly to align the aircraft with the centerline. Apply brakes **W** to stop.

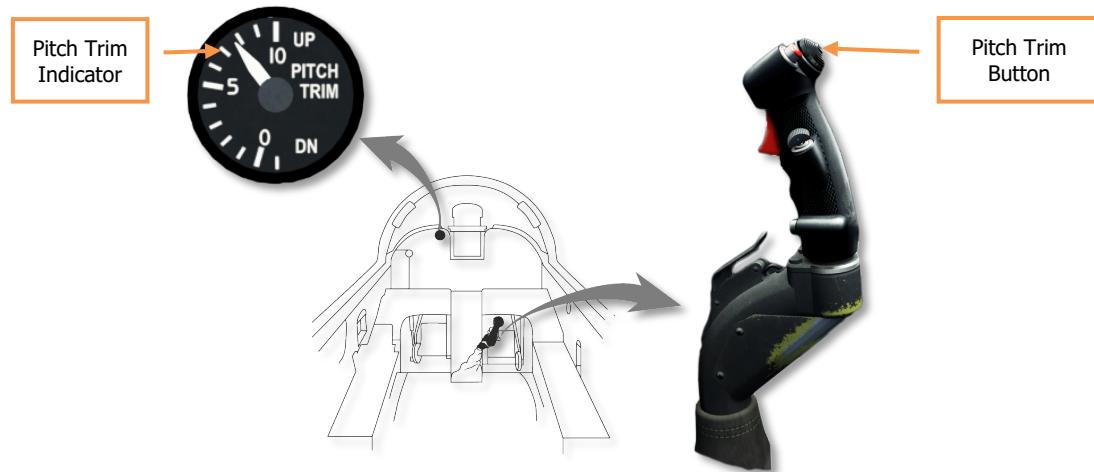
1. Press **F** twice to fully extend flaps, set Thumb Flap switch on the Throttle to **AUTO**. Flap Indicator - Verify **FULL**.



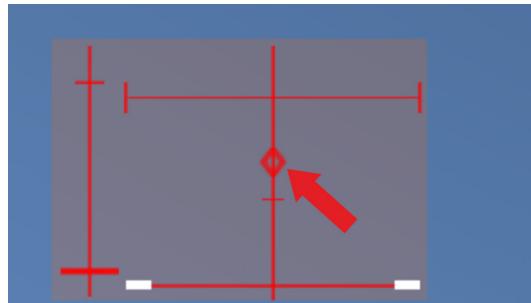
**Table 1. Thumb Flap Switch and Flap Indicator**

No	Element	Function		
1.	Thumb Flap Switch on Right Engine Throttle.	<b>UP</b> — flaps fully retracted ( $0^\circ/0^\circ$ ). Used during cruising flight with all stores configurations. <b>FXD</b> (fixed) — flaps fixed in intermediate position. Reduces wing stalling during active maneuvering at low speeds. <b>AUTO</b> (automatic) — automatic flaps control based on the angle of attack (AOA) and/or signals from the central air data computer (CADC).		
2.	Flap Indicator.		Flaps fully retracted.	
			Flaps in intermediate position.	
			Flaps fully extended.	
				Flap position is controlled automatically.

2. Press **R.Ctrl**+**.** to set Pitch Trim to takeoff position according to Pitch Trim Indicator depending on aircraft configuration and weight.



*Note. The trim indicator is located in a hard to see place. Press **R.Ctrl**+**Enter** to display controls position indicator and determine trim position on the pitch control axis relative to the mark that indicates maximum nose-up trim (10 increments).*



**Warning.** If the trim is not set to the takeoff position, a considerable dive moment will be generated after liftoff, which may cause the aircraft to crash, especially with a high takeoff weight.

Table 2. Pitch Trim takeoff position

Approximate takeoff configuration	Indicated pitch trim position
Without gun ammo, without stores	6
External fuel tanks, ammo, missiles	7
External fuel tanks, ammo, missiles, bombs, rockets	8
Ammo, missiles, bombs, rockets, containers	9

## Takeoff

Perform the following steps for takeoff:

1. Apply main wheel brakes **[W]**.
2. Advance throttles to MIL **Numpad+** ( $101 \pm 2\%$ ). After that, advance throttles to MAX **Numpad+**. The afterburner switches on within approximately 5 sec.
3. Release the brakes, start takeoff run.
4. Maintain direction along the runway centerline by using the pedals **[Z]** and **[X]**.
5. Approximately 10 KIAS before liftoff speed, gently pull back on the stick to lift the nose wheel and transition to a takeoff attitude. After liftoff, gently push the stick forward to avoid high angles of attack and stall.

Table 3 shows correlation between liftoff speed and takeoff weight.

**Table 3. Liftoff speeds based on takeoff configuration**

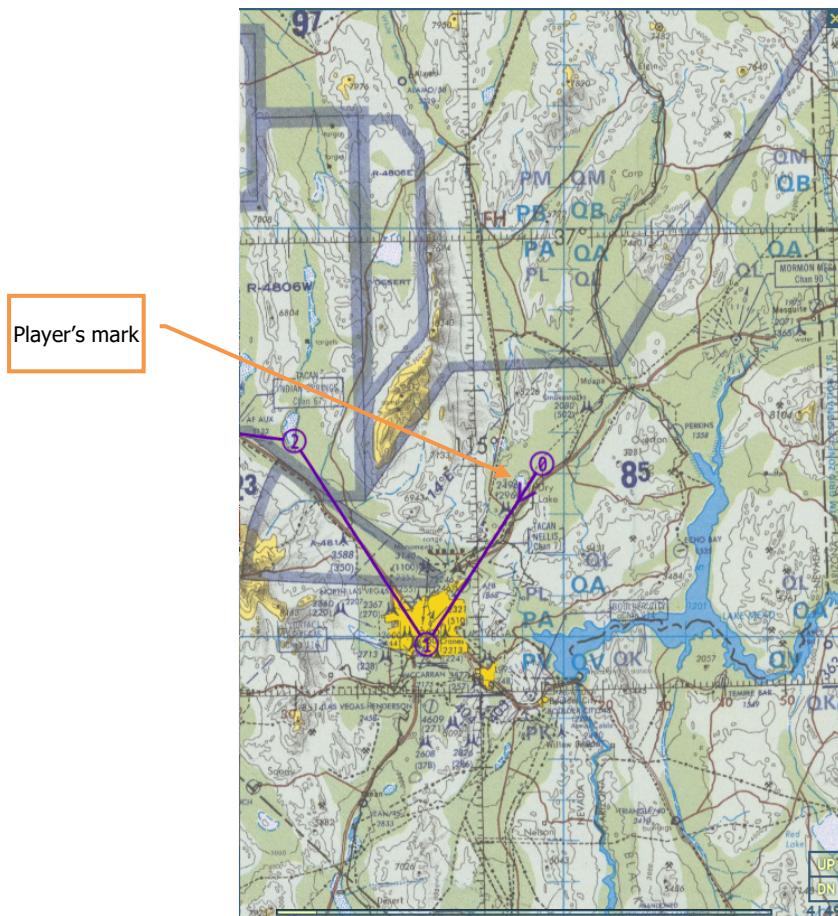
Takeoff weight, lb	Stores, ammo	Liftoff speed, KIAS
15000	none	143–145
15500–16000	Gun ammo, missiles	153–155
17000–18000	Central fuel tank, gun ammo, missiles	164–168
19000	3xFuel tanks 150, gun ammo, missiles	166–168
19000–21000	Bombs, rockets, central fuel tank, gun ammo, missiles	168–175
19000–21000	Bombs, rockets, gun ammo, missiles	168–178
22000	3xFuel tanks 275, gun ammo, missiles	178–180
23000 and more	Bombs, rockets, gun ammo, missiles	185–190



6. After liftoff, establish the climb rate so that the indicated airspeed increases and the aircraft gains altitude.
7. Press **G** to retract landing gear. Verify that the three green indicating lights are off.
8. Reduce Pitch Trim to 2-3 by pressing **R.Ctrl+;**
9. Set flaps position as required **F**.

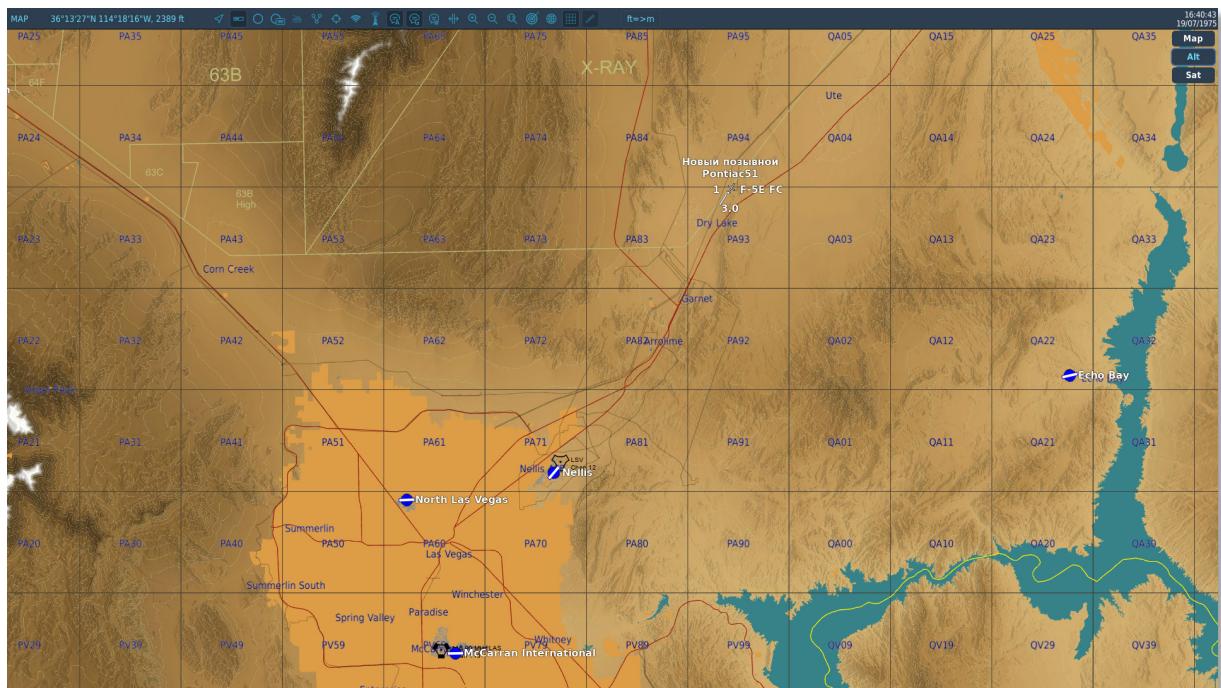
## Navigation

You can use the kneeboard (**R.Shift+K**) for in-flight navigation. Flip pages with **I** and **J** buttons to see the required area of the map. Press **R.Ctrl+K** to mark your current position.



You can also access the full-screen theater map view by pressing **F10**. It has a toolbar which can be used for orientation.





## Emergency procedures

### Single-engine flight

When flying on a single engine, direction at all speeds is maintained with a slight rudder input.

The minimum safe speed with landing gear and flaps retracted and external stores jettisoned is 190 KIAS.

Minimum single-engine climb rate (landing gear and flaps retracted, no external stores) is 300 feet per minute.

### Compressor stall

Compressor stall disrupts the gas-dynamic stability of the engine, which may result in engine shutdown.

Compressor stall may be caused by:

- high angles of attack at low airspeed and high altitude;
- high slip angles at low airspeed and high altitude;
- hot gases from gun firing entering the air intake at high altitude and negative G-load;
- maneuvering with landing gear extended at altitudes above 3,000 feet.

In case of compressor stall (RPM "hang-up", increase of exhaust gas temperature):

1. Decrease RPM until recovery. Set throttle to IDLE, **R.Alt+NumPad-** - left engine or **R.Shift+NumPad-** - right engine (**NumPad-** - both engines).
2. Initiate a gentle descent.
3. Slowly increase RPM to the desired value. **R.Alt+NumPad+** - left engine or **R.Shift+NumPad+** - right engine (**NumPad+** - both engines).
4. If the engine does not recover, shut down the engine;
5. Attempt a restart.

## Airstart

If both engines are shut down in flight, start the left engine first. To attempt an a restart perform the following steps:

1. Set the corresponding engine throttle to IDLE, **R.Alt+NumPad-** - left engine or **R.Shift+NumPad-** - right engine (**NumPad-** - both engines).
2. Descend below 25,000 feet.
3. Set the airspeed to 240-250 KIAS.
4. Press **R.Alt+Home** to start the left engine or **R.Ctrl+Home** to start the right engine (**R.Shift+Home** - to start both).
5. Verify IDLE, RPM should be between 49-52%.
6. Slowly advance the throttle to the required RPM **NumPad+** and continue the flight.

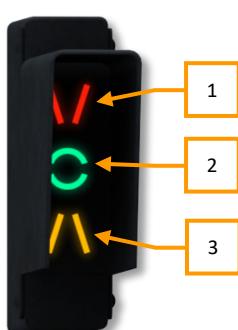
## Landing

By pressing **Numpad-** decrease RPM until airspeed reaches **300 KIAS** and assume an altitude of 1500 feet approximately 3 miles from the beginning of the runway.

1. Decrease RPM until airspeed reaches **260 KIAS**. Extend landing gear by pressing **G**.
2. Maintaining an altitude of 1500 feet, decrease RPM until airspeed reaches **165 KIAS**. If necessary, use speed brakes by pressing **B**.
3. Verify flaps - **FULL**.  
If necessary, set flaps to **FULL** by successively pressing **F**.



4. Descend with a vertical velocity of 1,000 feet/minute. Decrease RPM until the airspeed reaches **145 KIAS**. The angle-of-attack indicator should be at the 3 o'clock mark and the green index (circle) on the angle-of-attack indexer should be illuminated.



1. Airspeed lower than required landing speed.
2. Airspeed matches the required landing speed.
3. Airspeed higher than required landing speed.

5. When approaching the beginning of the runway, gently pull back on the stick **↓** to reduce the descent rate to 400 ft/min. Smoothly retard the throttle to idle **Numpad-** and, at runway approach, transition to a landing attitude adequate for soft landing on two main wheels at **135 KIAS**.

6. Smoothly lower the nose wheel, deploy the drag chute **P**. Apply brakes **W** to slow the aircraft.
7. Exit the runway. Retract flaps **F** and speed brakes **B**, (if were extended).

## Single-engine approach and landing

1. If unable to maintain the landing speed, jettison stores by successively pressing **L.Ctrl+W**. Use the afterburner mode of the running engine.
2. Extend landing gear **G** and flaps **F** on final approach.
3. Approach, descent and landing should be performed at speeds 10 KIAS higher than the calculated landing speed for the aircraft's landing weight.
4. On final approach, maintain angle-of-attack of 14 units according to the angle-of-attack (AoA) indicator.
5. Deploy the drag chute **P** during landing roll if necessary.

## Engine shutdown

To shut down the engine perform the following steps:

1. Set throttles to OFF by pressing **R.Shift+End**.
2. Turn off the battery by pressing **R.Shift+L**.

# OPERATIONAL MODES OF TARGETING AND NAVIGATION SYSTEM

Targeting and navigation system of the F-5E FC has four modes:

- "NAVIGATION" mode is selected by pressing **[1]** (default mode). In this mode, the sight and weapon control system are disabled.
- "MSL" mode is selected by pressing **[2]**. It is designed for AIM-9 employment. The mode is used for long-range air-to-air missile combat at distances up to 40 miles.
- "DOGFIGHT MISSILE" mode is selected by pressing **[4]**. It is designed for AIM-9 and guns employment. The mode is used for short-range air-to-air combat at distances up to 10 miles.
- "AIR-TO-GROUND" mode is selected by pressing **[7]**. It is designed for air-to-ground attacks.

# WEAPON EMPLOYMENT

F-5E armament:

- Two M39-A3 20mm guns with 280 rounds of ammunition each. The guns are located in the nose of the fuselage, in front of the cockpit. Special deflectors are used to prevent engine stall from powder gases entering the air intake when firing the guns. Each gun is capable of firing 1500-1700 rounds per minute.
- Launchers for guided missiles AIM-9 Sidewinder on the wingtips.
- 5 hardpoints (under-fuselage pylon and four under-wing pylons), which can be used to carry a variety of air-to-ground ordnance: bombs, cluster bomb munitions, unguided rockets, with a total capacity of more than 6400 pounds (about 3000 kg).

All external stores and pylons can be jettisoned to maximize maneuverability characteristics.



## AN/ASG-31 Lead Computing Optical Sight System

The AN/ASG-31 is designed to aid in air-to-air aiming of AIM-9 missiles and cannons, and in air-to-ground employment of bombs, unguided rockets and guns. The system calculates and displays aiming markers for missiles and guns employment in MSL, DM, DG and A/A1 or A/A2 modes.

The AN/ASG-31 consists of:

- Gyro Lead Computer (GLC);
- Optical Display Unit (ODU).

When only the AN/ASG-31 is used for air-to-air attacks, following markers and indicators will not be available: range bar, range index, in-range, minimum range and excess-g. In this case, the distance to the target can be estimated by comparing the visible target size with the reticle circle diameter.

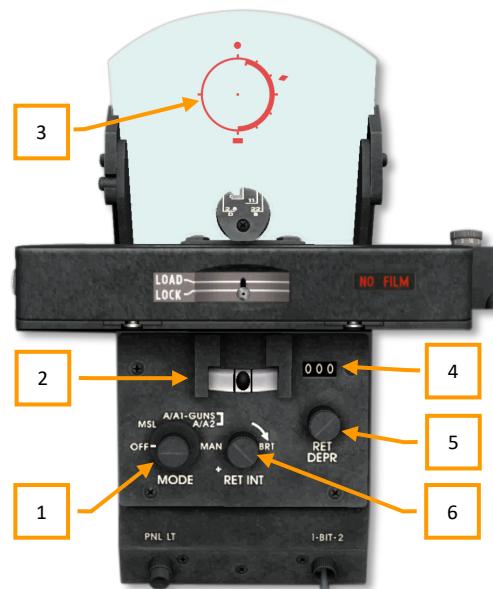
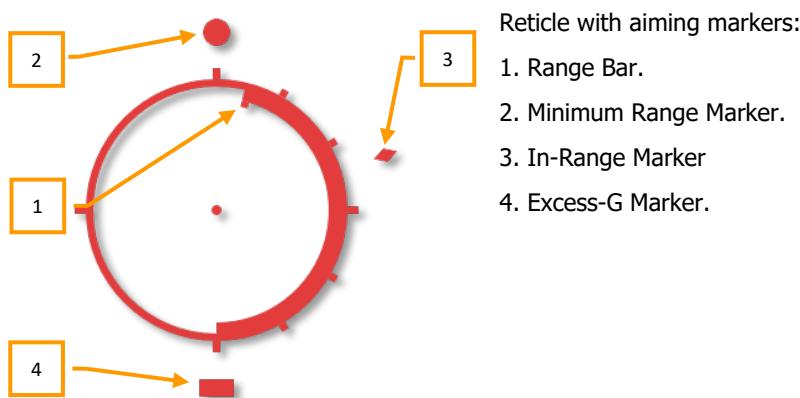


Table 4. Optical sight controls and indicators

No	Element	Function
1.	Mode Selector	<b>OFF</b> — Turns off the AN/ASG-31. <b>MSL</b> — Selects missile mode. Reticle pipper is caged to ARL (armament reference line). <b>A/A1 GUNS</b> — Selects guns mode for a maneuvering target. <b>A/A2 GUNS</b> — Selects guns mode for a target maneuvering at a constant angular velocity. <b>MAN</b> — Selects AN/ASG-31 manual control mode.
2.	Slip Indicator	Indicates aircraft slip or skid.
3.	Reticle	Displays aiming markers. Size is 50 mils. The reticle can be used to estimate the distance to the target by comparing the size of the reticle ring to the visible target size.

Nº	Element	Function
4.	Reticle Depression Readout Window	Indicates reticle depression in MAN mode.
5.	Reticle Depression Knob	Adjusts reticle depression in MAN mode. Reticle depression is measured in mils.
6.	RET INT Knob	To adjust the intensity of reticle press <b>R.Alt+R.Shift+H</b> (decrease) or <b>R.Shift+R.Ctrl+H</b> (increase).



The reticle consists of a pipper and a circle.

After radar locks-on to the target, aiming markers appear on the circle.

The range bar extends from the 6-o'clock position on the inner right side of the circle toward the 12-o'clock position, depending on the target range.

Each range index indicates 1000 feet in gun modes and 10,000 feet in missile mode. The range indexes are located on the outer right side of the circle.

When the range bar is at 6-o'clock position, range to the target is 60,000 feet in missile mode and 6000 feet in gun modes.

Decrease in target range causes the bar to move towards 12-o'clock position, and when the target range is within the permissible launch envelope, an in-range marker appears.

The in-range marker disappears when the target is beyond the minimum range of the weapon.

When the target range is equal to minimum launch range or less, a minimum-range marker appears.

## AN/APQ-159 Fire Control Radar

The AN/APQ-159 radar is designed for air target search, lock-on, and tracking for head-on and stern attacks in open airspace.

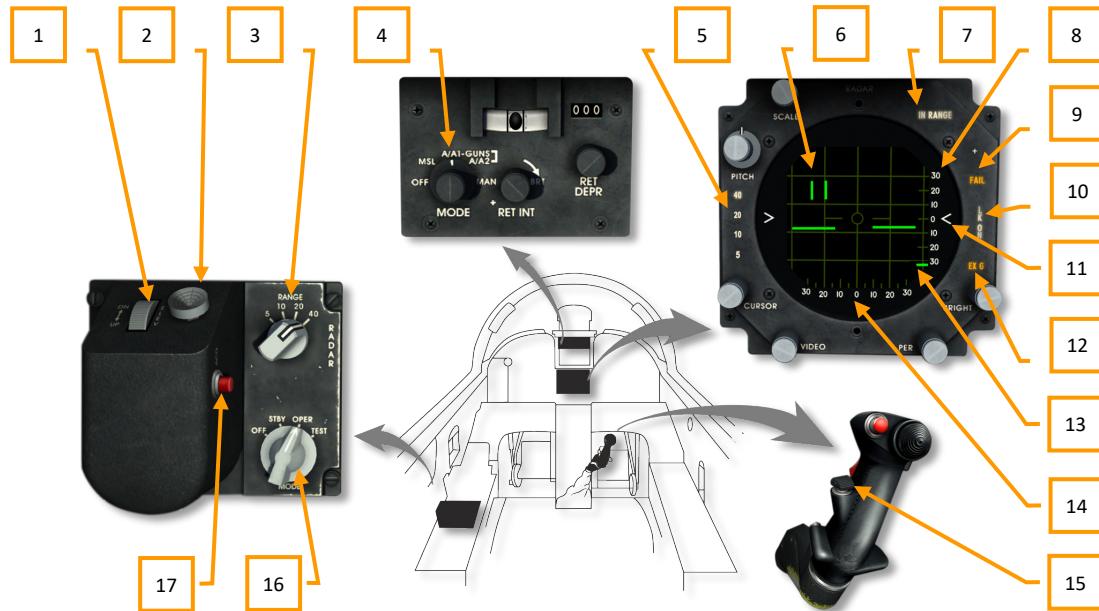


Table 5. Radar controls and indicators in cockpit

Nº	Element	Function
1.	Elevation (ELEV) Antenna Tilt Control	Adjusts antenna tilt angle 45 degrees up and 40 degrees down relative to aircraft ARL (armament reference line).
2.	Target Designator Control (TDC) button	Positions Acquisition Symbol. The maximum possible displacement of the acquisition symbol equals 10 miles.
3.	Range Selector	Selects radar range. Range is indicated in nautical miles.
4.	AN/ASG-31 Sight Mode Selector	<b>OFF</b> — Turns off the AN/ASG-31. <b>MSL</b> — Selects missile mode. <b>A/A1 and A/A2 GUNS</b> — Selects guns mode. <b>MAN</b> — Selects AN/ASG-31 manual control mode.
5.	Range Scale Lights	Indicates radar operating range in nautical miles.
6.	Acquisition Symbol	Provides target bracketing and acquisition. Displayed on radarscope in search and acquisition phases. Not displayed in 40-mile range.
7.	IN RANGE Light	Indicates permissible range.

Nº	Element	Function
8.	Elevation Scale	Allows to determine antenna elevation tilt angle.
9.	FAIL Light	Illumination indicates radar failure.
10.	LK ON Light	Illuminates when radar is locked on or range-tracking target.
11.	ARL Mark	Indicates armament reference line.
12.	Excess G Light	Indicates excess-g condition for successful missile guidance.
13.	Elevation Cursor	Indicates antenna elevation tilt angle.
14.	Azimuth Grid	Allows to determine the azimuth of target.
15.	Dogfight/Resume Search Switch	Initiates search phase and breaks lock if radar was locked on.
16.	Radar Mode Selector	Selects radar operation mode.
17.	Acquisition (ACQ) Button	<b>Press</b> (Momentary) – locks on to target or breaks lock-on.

## Fire Control System

The Fire Control System assists aiming process and provides the pilot with indications and commands required for weapon employment.

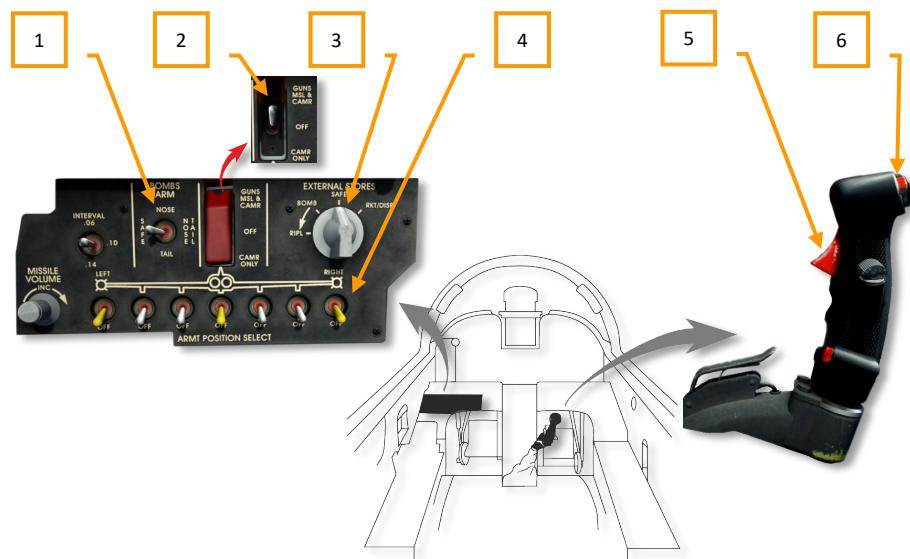
The Fire Control System consists of:

- AN/APQ-159(V)-3 Fire Control Radar (FCR).
- AN/ASG-31 Lead Computing Optical Sight System (LCOSS).

The AN/APQ-159(V)-3 and AN/ASG-31 may operate jointly or separately during air-to-air attacks.

During air-to-ground attacks, only AN/ASG-31 is used.

Guns and IR seeking missiles are used for air-to-air attacks.



**Table 6. Fire control system**

Nº	Element	Function
1.	Bombs Arm Switch	Selects arming circuits to respective bomb rack solenoids.
2.	Guns/Missile, and Camera Switch	Turns on sight camera and arms guns and wingtip missiles.

Nº	Element	Function
3.	External Stores Selector	Selects weapons on pylons. <b>SAFE</b> – Disconnects electrical power to all firing/release circuits. <b>BOMB</b> – Connects electrical power to stores release circuitry of selected pylon stations. <b>RIPL</b> – Connects electrical power to stores release interval circuitry of selected pylon stations. <b>RKT/DISP</b> – Connects electrical power to selected pylon rocket launcher or flare dispenser.
4.	Armament Position Selector Switches	Selects respective pylons and wingtip launchers. <b>OFF</b> – Disconnects electrical power. <b>UP</b> – Connects electrical power.
5.	Trigger	Fires guns.
6.	Weapon Release Button	Activates firing or release circuits for launching missiles and rockets or releasing bombs.

# JOINT OPERATION OF RADAR AND SIGHT SYSTEM DURING AIR-TO-AIR COMBAT

## MSL Mode

The MSL mode is designed for search, acquisition, lock-on and tracking when employing the AIM-9 missiles. The mode is used in long-range missile combat at distances up to 40 miles.

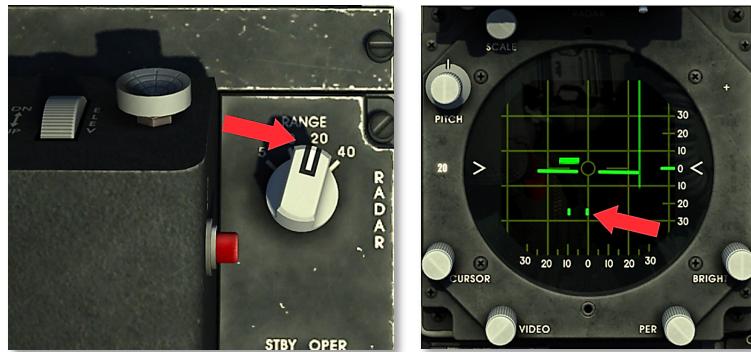
1. Press **[1]** to turn on the radar.
2. Press **[2]** to select MSL mode. GUNS/MISSILE & CAMERA switch (1) and switches of wingtip launchers with AIM-9 (2) on the armament control panel will be activated.



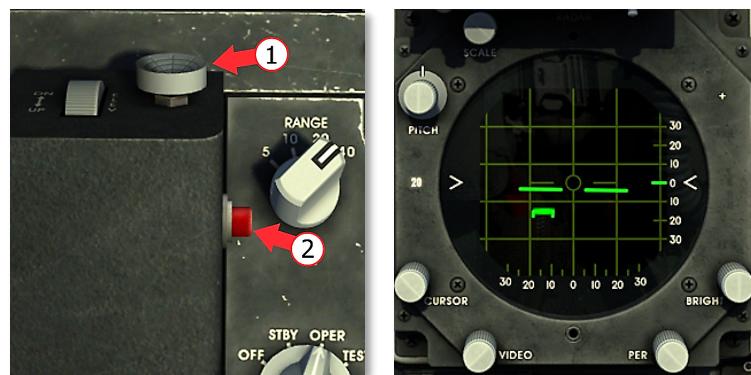
3. Use ELEV lever to watch upper and lower hemisphere (press **R.Shift+;** to adjust radar dish up and **R.Shift+.** to adjust radar dish down). Target symbol will appear on radarscope after target acquisition. Continue approach to target up to 20-mile range.



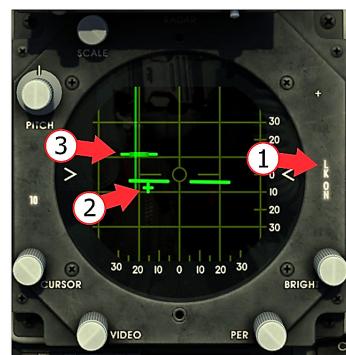
Set RANGE selector to 20 (**-**). Target acquisition symbol appears, continue approach to target up to 10-mile range.



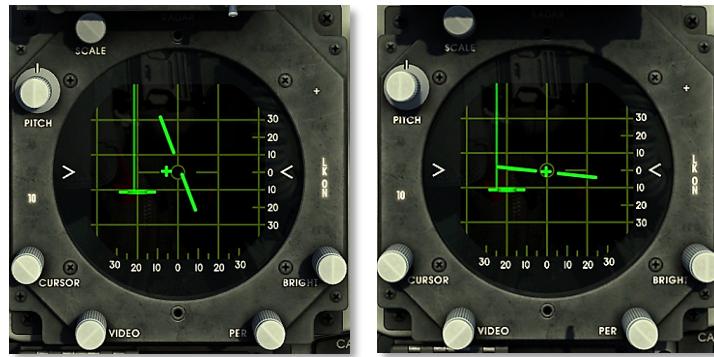
4. When 10-mile range is reached, align acquisition symbol with target using TDC button (1) (↑ – up, ↓ – down, ← – left, → – right) and press **Enter** to lock on to the target. The radar display scale will be automatically adjusted to 10 miles.



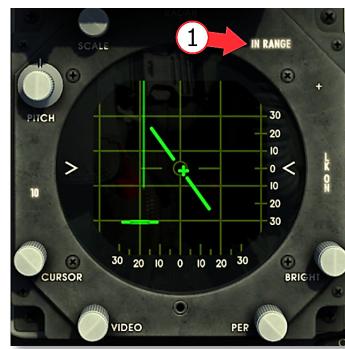
5. After the target is locked on, the LK ON light is illuminated (1) and the aim symbol is displayed (2). Radar beam is shifted to the left to facilitate the use of targeting information. Range gate on target (3) is displayed.



6. Maneuver the aircraft to align the radarscope center circle with the aim symbol and continue approach while keeping aim symbol inside center circle.



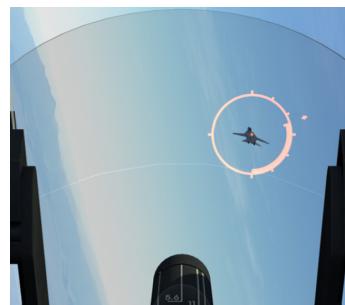
- When aircraft reaches the launch range, IN RANGE light will illuminate (1), and in-range marker will appear on the sight. Continue target approach until seeker lock-on audio tone is heard.



- Press and hold **R.Alt+Space** to launch the missile.

In MSL mode, the radar stores target parameters for 1.75 s after target lock-on is lost. The radar will continue to track the target if it appears within 1.75 s, otherwise, radar will initiate search phase. If it is necessary to break lock-on, press **Backspace**. Radar antenna will return to the position held during previous search phase. Acquisition symbol will appear in last target position before lock-on was lost. Perform target acquisition and lock-on once again.

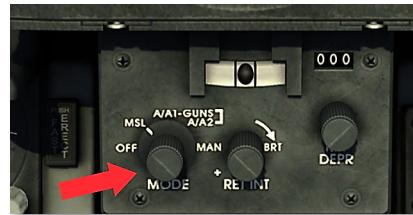
- It is also possible to use guns in MSL mode. In order to do this, arm the guns by setting the switch to A/A1 GUNS position (press **C**). Place the sight reticle pipper on the target and open fire by pressing **Space**.



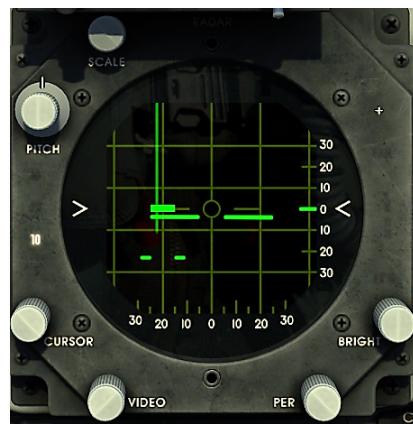
## DOGFIGHT MISSILE Mode

The DOGFIGHT MISSILE mode is designed for search, acquisition, lock-on and tracking during target engagement. The mode is used in close missile combat at distances up to 10 miles.

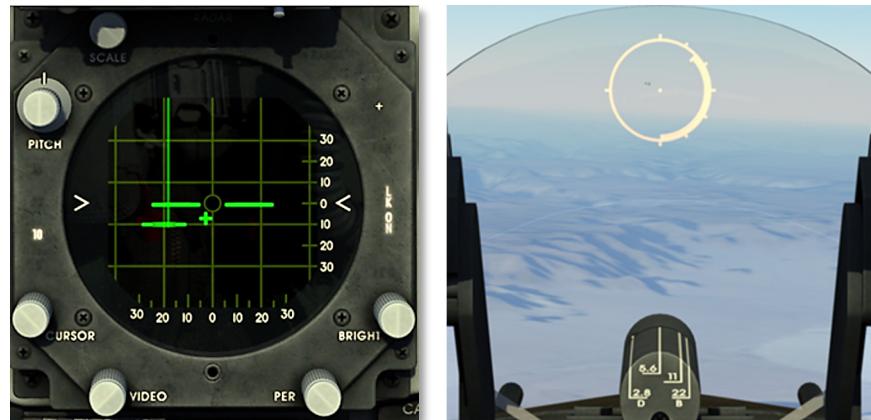
1. Press **I** to turn on the radar.
2. Press **4** to select DOGFIGHT MISSILE mode. GUNS/MISSILE & CAMERA switch (1) and switches of wingtip launchers with AIM-9 (2) on the armament control panel will be activated.



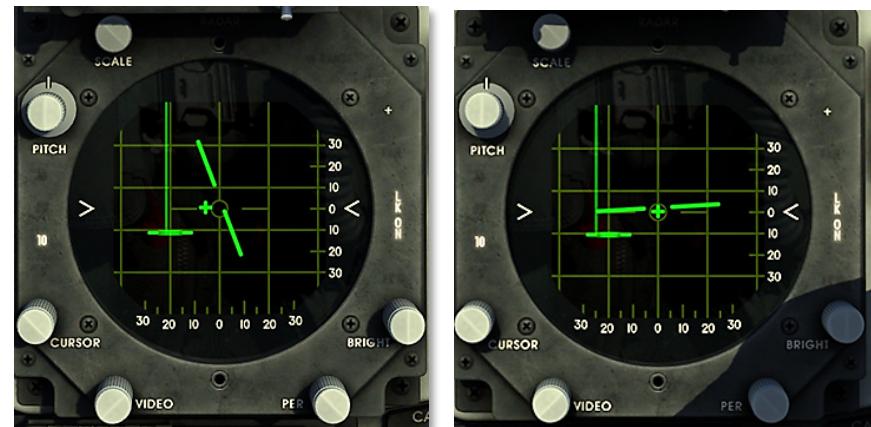
Once the mode is activated, the radar will attempt to acquire and lock on to the target. The radarscope scale will be automatically adjusted to 10 miles.



3. If target is between 500 and 30 000 ft range, radar locks on to target automatically. After target is locked on:
  - LK ON light illuminates;
  - Aim symbol appears on the radar display;
  - Targeting information is shown on reticle.



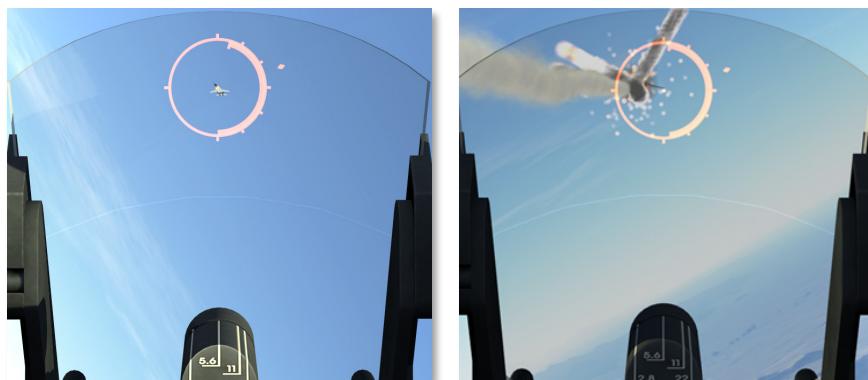
Maneuver the aircraft to align radarscope center circle with aim symbol and continue approach to the target.



- After visual contact with target, maneuver the aircraft to align reticle pipper with target. When aircraft reaches the launch range, IN RANGE light will illuminate (1), and in-range marker will appear on the sight.



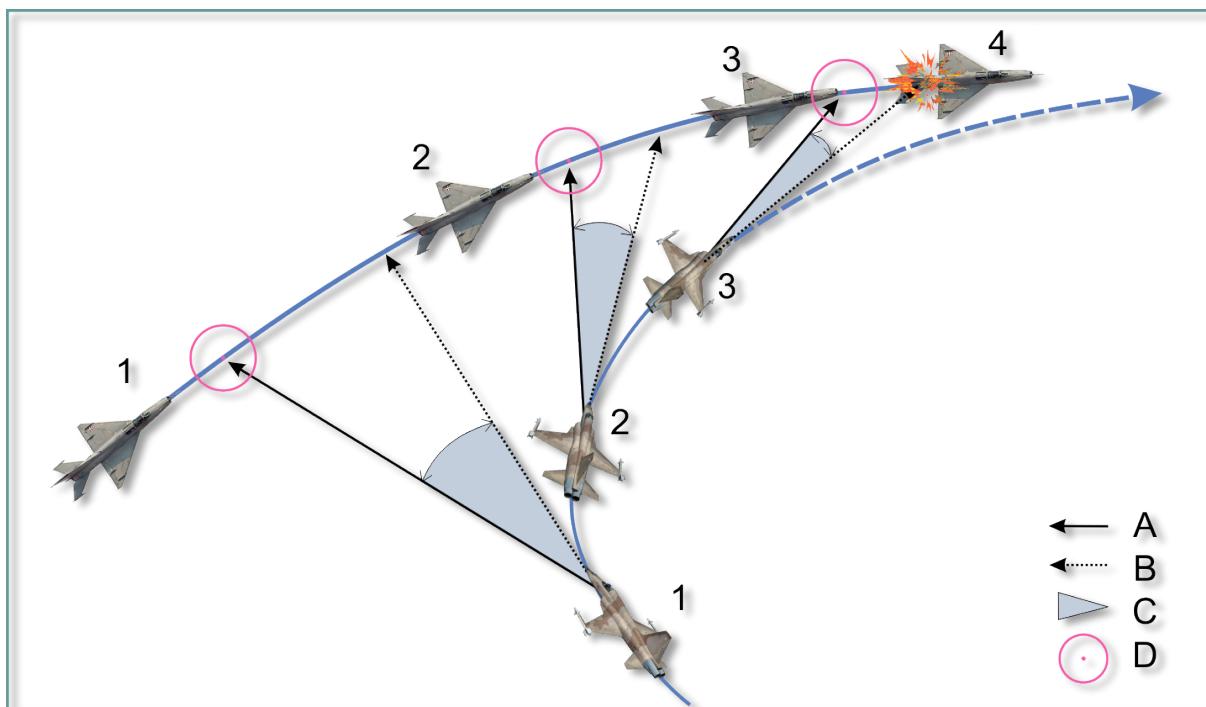
- Continue target approach until seeker lock-on audio tone is heard. After the seeker has locked on to the target, move to the attack position, then press and hold **RAlt+Space**.



*WARNING: The excess-G marker should not be displayed when the missile is launched.*

## Gun Employment in A/A1 GUNS Mode

The mode is designed for close air combat against an actively maneuvering target. The sight provides a momentary firing solution; therefore, the pilot's task is to cross the target from any direction with the sight reticle and open fire within a maximum of 1 second before the pipper of the sight reticle reaches the target.



**Attack in A/A1 GUNS mode**

- A. Line of sight.
- B. Gunline.
- C. Lead angle.
- D. Sight reticle.

- 1. Attacker and target positions at attack initiation.
- 2. Attacker and target positions at aiming.
- 3. Attacker and target positions at firing.
- 4. Target impact.

1. Press **I** to turn on the radar.
2. Press **4** to select DOGFIGHT MISSILE mode. Once the mode is activated, the radar will attempt to acquire the target. The radarscope scale will be automatically adjusted to 5 miles.
3. Press **C** to arm the guns. The sight system will operate in A/A1 mode.

After the target mark appears on the radarscope, maneuver the aircraft to achieve a target position corresponding to  $0^{\circ}$  in azimuth and elevation. Continue approach to the target up to 5,600 ft range.

If target is between 500 and 5600 ft range, radar locks on to target automatically.

After target is locked on:

- LK ON light illuminates;
- Targeting information is shown on reticle.



4. Maneuver the aircraft to move the pipper closer to the target. When aircraft reaches the launch range of 2700 feet, in-range marker will appear on the sight.



5. Press **Space** to open fire within 1 second before the pipper reaches the target.

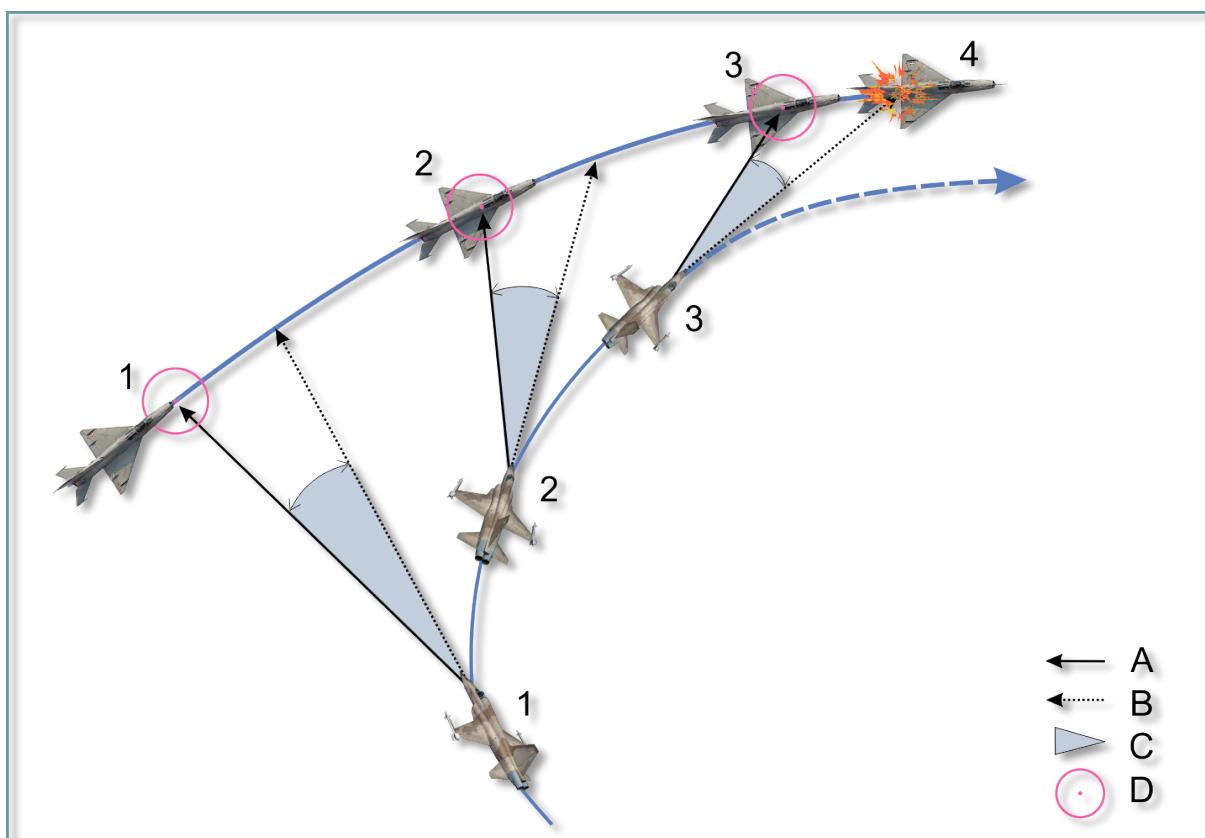
## Gun Employment in A/A2 GUNS Mode

The A/A2 GUNS mode is designed for close air combat against a target maneuvering at a constant angular velocity.

The effective range of fire is 1000-2700 feet.

The targeting information on the radarscope and sight reticle is similar to that of Dogfight Missile and A/A1 modes.

The pilot should keep the pipper of the sight reticle on the target during tracking and firing. The target must be tracked for at least 0.5 seconds before firing.



**Выполнение атаки в режиме A/A2 GUNS**

- A. Line of sight.
- B. Gunline.
- C. Lead angle.
- D. Sight reticle.

- 1. Attacker and target positions at attack initiation.
- 2. Attacker and target positions at aiming.
- 3. Attacker and target positions at firing.
- 4. Target impact.

1. Press **I** to turn on the radar.
2. Press **4** to select DOGFIGHT MISSILE mode. Once the mode is activated, the radar will attempt to acquire the target. The radarscope scale will be automatically adjusted to 5 miles.
3. Press **C** to arm the guns. The sight system will operate in A/A1 mode. Press **R.Alt+I** to select A/A2 mode.

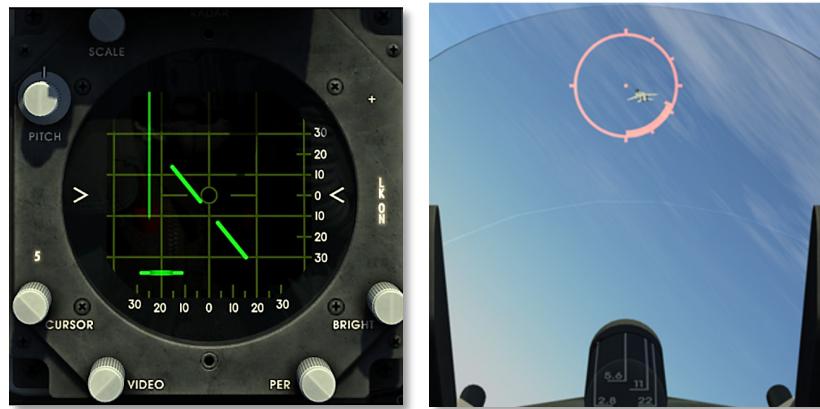


After the target mark appears on the radarscope, maneuver the aircraft to achieve a target position corresponding to 0° in azimuth and elevation. Continue approach to the target.

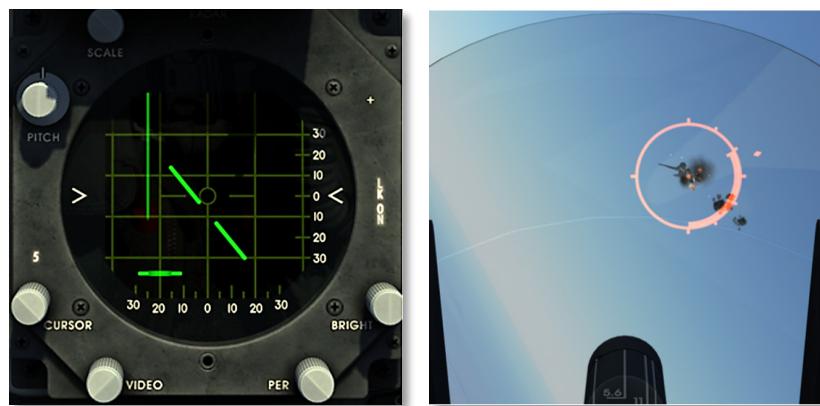
If target is between 500 and 5600 ft range, radar locks on to target automatically.

After target is locked on:

- LK ON light illuminates;
- Range bar appears on the sight reticle.



4. Maneuver the aircraft to align the reticle pipper with target. When aircraft reaches the launch range of 2700 feet, in-range marker will appear on the sight.
5. Press **Space** to open fire.



# AIR-TO-AIR COMBAT WITHOUT RADAR AID

## AIM-9 Employment

After acquiring target visually, perform the following steps:

1. Press **4** to select Dogfight Missile mode. GUNS/MISSILE & CAMERA switch (1) and switches of wingtip launchers with AIM-9 (2) on the armament control panel will be activated.



2. Maneuver the aircraft to attain attack position at target range of 5000-7000 ft and align reticle pipper with the target.



3. Keep reticle pipper on target and continue target approach until seeker locks on to target.

The seeker's lock-on range may exceed the effective launch range of missile. The distance to the target should be estimated visually by comparing the visible target size to the size of the sight reticle.



4. After attaining attack position, press and hold **R.Alt+Space** until missile launch.



# M-39A3 Guns Employment

## A/A1 GUNS Mode

After acquiring target visually, perform the following steps:

1. Press **4** to select Dogfight Missile mode.
2. Press **C** to arm the guns. The sight system will operate in A/A1 mode.



3. Maneuver the aircraft to attain the attack position at 1500 ft target range, 90 kt approach speed. The pilot's task is to cross the target from any direction with the sight reticle and open fire within a maximum of 1 second before the pipper of the sight reticle reaches the target.



4. At 1500 feet range press **Space** to fire. Distance to the target should be determined by comparing the visible target size with the size of sight reticle.



## A/A2 GUNS Mode

After acquiring target visually, perform the following steps:

1. Press **4** to select Dogfight Missile mode.
2. Press **C** to arm the guns. The sight system will operate in A/A1 mode. Press **R.Alt+I** to select A/A2 mode.



3. Maneuver the aircraft to attain the attack position at 1500 ft target range, 90 kt approach speed. Perform target approach and maneuver the aircraft to position the reticle pipper over target. Keep the reticle pipper over target.



4. At 1500 feet range press **Space** to fire. Distance to the target should be determined by comparing the visible target size with the size of sight reticle.



# AIR-TO-GROUND EMPLOYMENT

## Bombs Employment

Before approaching a target, perform the following steps:

1. Press **7** to select AIR-TO-GROUND mode. Sight Mode Selector on AN/ASG-31 control panel should be set to **MAN**. On the armament control panel, EXTERNAL STORES switch should be set to **BOMB** (1) and the pylons with bombs should be activated (2).



2. Press **D** to select bombs. The reticle depression will be automatically set to 80 MILS (2).



3. Approach target at speed and altitude specified in **Table 7** (see next page). To execute a dive bombing, approach the target in level flight at dive initiation altitude and speed. When the target visually passes the canopy, set the throttles to IDLE and approach the target by initiating a dive and performing a 180° turn.



Table 7. Dive bombing

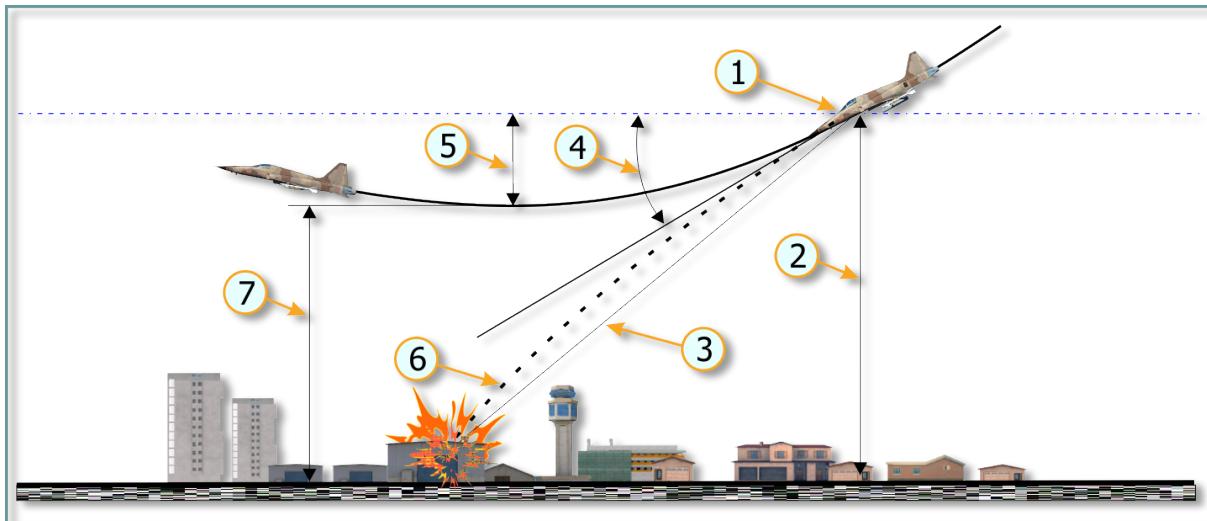
Parameter	Dive angles, degrees.	
	20	30
Dive initiation altitude, feet	5000	6000
Dive initiation speed, knots	350	350
Release altitude, feet	1500	2000
Release speed, knots	380	440

4. The dive initiation must be executed in such a way that the center point is positioned below the target at a distance of 2 radius of the sight reticle.



5. As the aircraft descends, the pipper of the sight reticle is moving towards the center of the target, and the altitude and speed are approaching the calculated release conditions. When the release altitude is reached, press **R.Alt+Space** and pull up.





Dive bombing scheme

- |                       |                                      |
|-----------------------|--------------------------------------|
| 1. Bomb release point | 5. Altitude lost                     |
| 2. Release altitude   | 6. Bomb trajectory                   |
| 3. Sight line         | 7. Minimum altitude during dive exit |
| 4. Dive angle         |                                      |

## Rockets Employment

Before approaching a target, perform the following steps:

1. Press **7** to select AIR-TO-GROUND mode. On the armament control panel, the pylons with rockets should be activated (2).



2. Check the selected armament. The EXTERNAL STORES switch (1) must be set to **RKT/DISP**. If the switch is set to **BOMB**, press **D** to select rockets. The reticle depression should be set to 14 MILS (2), which corresponds to the HYDRA-70 rockets selection.



3. Approach target at speed and altitude specified in **Table 8**.

To execute a dive bombing, approach the target in level flight at dive initiation altitude and speed. When the target visually passes the canopy, set the throttles to IDLE and approach the target by initiating a dive and performing a 180° turn.



**Table 8. Air-to-Ground attack using HYDRA rockets**

<b>Parameter</b>	<b>Dive angles, degrees</b>	
	<b>20</b>	<b>30</b>
Dive initiation altitude, feet	5000	6000
Dive initiation speed, knots	350	350
Rocket launch altitude, feet	1500	2000
Rocket launch speed, knots	380	440



- Align sight pipper with target and keep it over target. When the launch altitude is reached, press **R.Alt+Space** to launch rockets and pull up.

## Guns Employment

Before approaching a target, perform the following steps:

- Press **7** to select AIR-TO-GROUND mode.



- Press **C** to arm the guns.  
The reticle depression will be set to 12 MILS (2).



3. Approach target at speed and altitude specified in **Table 9**.

To execute a dive bombing, approach the target in level flight at dive initiation altitude and speed. When the target visually passes the canopy, set the throttles to IDLE and approach the target by initiating a dive and performing a 180° turn.

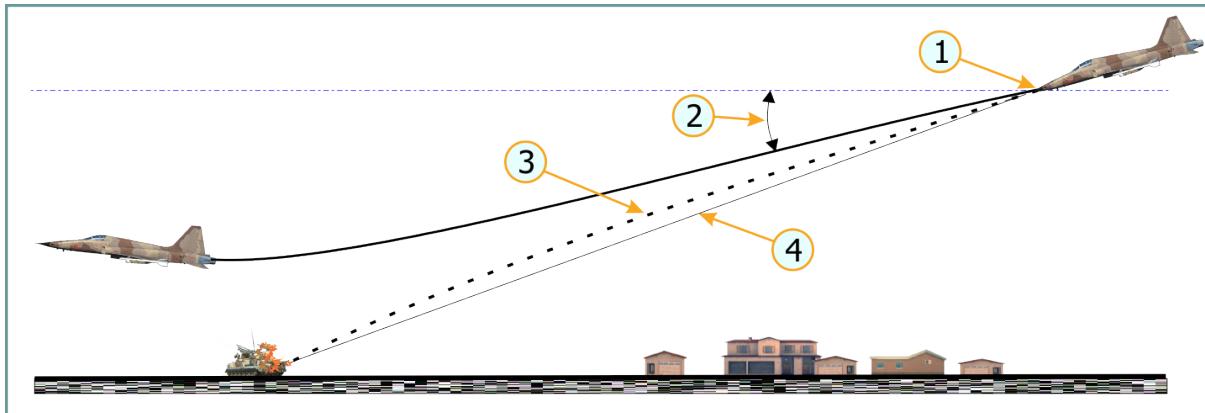


4. Align sight pipper with target and keep it over target. When the specified altitude is reached, press **R.Alt+Space** to fire guns and pull up.



**Table 9. Air-to-Ground gun attack**

Parameter	Dive angles, degrees.
	20
Dive initiation altitude, feet	5000
Dive initiation speed, knots	350–370
Firing altitude, feet	2000
Speed at the moment of firing, knots	400



Air-to-Ground gun attack scheme

- 8. Open fire.
- 9. Dive angle.
- 10. Bullet trajectory.
- 11. Sight line.

