

# Su-25T Cockpit Instruments

Most of the Su-25T cockpit instruments are the same as those in the Su-25:



## The Su-25T Instrument Panel

- |  |   |
|--|---|
| 1. Landing gear control lever                                    | 13. 'Sukhogruz' infrared (IR) jammer indicator lamp                 |
| 2. Autopilot control panel (ACS)                                 | 14. Weapon system control panel (WCS)                               |
| 3. Angle of Attack (AOA) indicator and Accelerometer ('G meter') | 15. Flaps, slats, airbrake and landing gear configuration indicator |
| 4. Airspeed indicator (IAS)                                      | 16. Radar altimeter   |
| 5. Attitude director indicator (ADI)                             | 17. Barometric pressure altimeter                                   |
| 6. Vertical Velocity Indicator (VVI)                             | 18. Horizontal situation indicator (HSI)                            |
| 7. Tachometer (revolutions per minute or RPM)                    | 19. Neutral (takeoff) trim in pitch, roll and yaw indicator lamp    |
| 8. Fuel quantity indicator                                       | 20. Weapon status panel   |
| 9. 'EKRA' built-in test system display                           | 21. Engine temperature  |
| 10. SPO-15 'Beryozha' radar warning receiver (RWR) panel         | 22. Hydraulic pressure meters                                       |
| 11. IT-23M cathode ray tube (CRT) television (TV) display        | 23. Warning lamps   |
| 12. Aircraft clock   |   |

The Su-25T aircraft can employ numerous types of 'air-to-surface' weapons. This arsenal includes iron bombs, cluster bombs (CBUs), guided bombs (GBUs), submunition dispensers, aerial rockets, and guided missiles. It is one of only a few aircraft in the Russian Air Force that can employ modern precision weapons such as 'Vikhr' antitank missiles with laser beam-riding guidance, Kh-25ML, Kh-29L, and Kh-29T laser- and TV-homing missiles, KAB-500KR TV-guided bombs, and Kh-25MPU and Kh-58 anti-radiation missiles.

# Cold Engine Start Procedure

## Keys Used:

|                    |                                    |
|--------------------|------------------------------------|
| <b>C-RShift</b>    | Flight Clock Start/Stop/Reset      |
| <b>=-RShift</b>    | Altimeter Pressure Increase Su-25T |
| <b>--RShift</b>    | Altimeter Pressure Decrease Su-25T |
| <b>Home-RShift</b> | All Engines Start                  |
| <b>End-RShift</b>  | All Engines Stop                   |
| <b>Home-RAIt</b>   | Engine Left Start                  |
| <b>End-RAIt</b>    | Engine Left Stop                   |
| <b>Home-RCtrl</b>  | Engine Right Start                 |
| <b>End-RCtrl</b>   | Engine Right Stop                  |

1. **[RShift-L]** Turn on the auxiliary power unit (APU)  
**[=-RShift]**, **[--RShift]** Increase or Decrease your Barometric Altimeter Pressure to match your Airfield's Altitude if necessary.
2. Set the throttles to the idle position.
3. **[RShift-Home]** Start both engines  
- or - sequentially start the right engine **[RCtrl-Home]** and then left engine **[RAIt-Home]**.
4. **Check engine compressor fans** turning on the tachometer indicator and engine **RPM stabilizes at 33%.**
5. **Check the turbine gas temperature** on the exhaust gas indicator. The exhaust gas temperature should be around **440 degrees.**

If you start the engine with the throttles not set to idle, the engine will be flooded with fuel and the engine will be held-up in an intermediate position. An uncontrollable engine temperature rise may also result and start an engine fire.

In such a situation, immediately stop the engine(s) - **[RShift-End]**. After a full engine shut-down, wait one to five minutes for the engine to cool off, and then to repeat the startup procedure.

## Quick Engine Start:

To speed up the engine start procedure it is also possible to perform an engine relight. To do this, wait for the second stage of the engine spin-up to reach at least 16% RPM; then move the throttles to their maximum thrust position.

## In Air Automatic engine start

If the engines cease to function (flame out) while in the air, you can perform an automatic restart. To do so, the airspeed must exceed 150 km/h; set the throttle to the idle position; then increase to the maximum thrust; and then back to idle. If all conditions are met, the engine will begin the restart process. A windmill start is only possible when engine speed is at or above 12%.

# Take-off Procedure

## Keys Used:

|                 |                        |
|-----------------|------------------------|
| <b>F</b>        | Flaps Up/Down          |
| <b>F-LShift</b> | Flaps Landing Position |
| <b>F-LCtrl</b>  | Flaps Up               |
| <b>C-LCtrl</b>  | Canopy Open/Close      |
| <b>P</b>        | Dragging Chute         |

|                 |                      |
|-----------------|----------------------|
| <b>G</b>        | Landing Gear Up/Down |
| <b>G-LCtrl</b>  | Landing Gear Up      |
| <b>G-LShift</b> | Landing Gear Down    |
| <b>W</b>        | Wheel Brake On       |

1. **[F]** Lower Flaps to Takeoff.
2. **[W]** Power up the engines for take-off. **Release the wheel brakes** as the **RPM climb** through **70-75%** and **increase thrust to full military power** as the aircraft begins to roll for take-off. (The wheel brakes will hold the aircraft at no greater than 80% of engine RPM.)
3. As the speed climbs to **160-180 km/h** for normal take-off weight (200-220 km/h for maximum take off weight), **pull the stick back about 2/3 of the way** to raise the nose for take-off. A good take-off pitch angle can be approximated by **placing the ends of the two pitot tubes along the horizon.**
4. The aircraft will take-off almost immediately as you raise the nose to a proper take-off angle. If the aircraft is not carrying external stores, it will have a tendency to increase pitch dynamically, which can be countered by carefully pushing the stick forward.
5. **[G]** Retract the Gear at **10 m** above the ground.
6. **[F]** Raise the Flaps as the airspeed climbs to **320-340 km/h** at an altitude of no less than **150 m.**

# Autopilot (ACS) Panel

The ACS-8 automatic control system (ACS or 'autopilot') panel is located in the left instrument panel. It indicates the ACS operational mode and includes six illuminated push buttons.



The attitude and/or altitude hold modes attempt to retain the aircraft and/or altitude as it was the moment the mode was engaged.

In all modes except for 'Emergency leveling', 'Route-following' and 'Landing,' the ACS is limited to  $\pm 60$  degrees in bank and  $\pm 35$  degrees in pitch. When any of these limits is reached, the ACS disengages and the aircraft reverts to manual control. ACS modes cannot be engaged beyond these limits.

The ACS is further limited to 15 degrees angle of attack (AOA) and 0-3 G, as measured by the aircraft instruments. It is not recommended to engage the autopilot at AOAs exceeding 12 degrees. If AOA exceeds 12 degrees while the autopilot is active, the pilot should immediately advance the engine throttles to increase airspeed and thrust.

## Autopilot Modes:

| AP Mode  | HotKey                         | Description   |
|----------|--------------------------------|---|
|          | <b>1</b>                       | <b>Navigation Modes</b>   |
|          | <b>~<br/>LCtrl</b>             | <b>Next Waypoint, Airfield, or Target</b>   |
|          | <b>~Alt</b>                    | <b>Autopilot override mode (Temporary)</b><br>The 'momentary override' mode is engaged by pressing and <u>holding</u> [ <b>LAlt-~</b> ] in any autopilot mode (corresponding to the 'SAU' trigger on the control stick of the real Su-25T). This mode allows temporary manual control of the aircraft, usually to adjust the desired attitude and/or altitude.<br><br>NOTE: This override mode has two peculiarities in the 'Combat steering' ACS mode (see the description of the 'Combat steering' mode further below).   |
| <b>1</b> | <b>1-LAlt</b>                  | <b>Attitude Hold mode (AY)</b><br>This mode stabilizes the current angles of pitch and bank.  |
| <b>2</b> | <b>2-LAlt</b>                  | <b>Barometric altitude and bank angle hold mode (AY-KB)</b><br>This mode stabilizes the current pressure altitude above sea level (ASL) and angle of bank. It is convenient for making continuous level turns.  |
| <b>3</b> | <b>3-LAlt</b>                  | <b>Emergency leveling mode (AY-ПГ) / Transition To Level Flight Control mode</b><br>This mode brings the aircraft to straight and level flight from any initial attitude. While the initial bank angle exceeds $\pm 80$ degrees, ACS control is applied first in roll, then in pitch. When bank angle is within $\pm 7$ degrees and pitch angle within $\pm 5$ degrees, the 'barometric altitude hold' ACS mode is activated and bank is further reduced to zero.<br><br>'Emergency leveling' ACS mode can be deactivated by pressing either [ <b>LAlt-9</b> ] or [ <b>A</b> ]. So in the navigation operational mode, switching from the 'emergency leveling' to 'route-following' ACS modes requires two presses of the [ <b>A</b> ] key. |
| <b>4</b> | <b>H<br/>- or -<br/>4-LAlt</b> | <b>Barometric Altitude Hold mode (AY-KB)</b><br>This mode stabilizes the current pressure altitude ASL.   |
| <b>5</b> | <b>5-LAlt</b>                  | <b>Radar altitude hold mode (AY-PB)</b><br>This mode stabilizes the current radar altitude AGL. In this ACS mode the 'Terrain Avoidance' sub mode is also active.<br><br>The 'Terrain Avoidance' sub-mode is engaged whenever: <ul style="list-style-type: none"> <li>• The current altitude AGL as measured by the Radio Altimeter is half or less than its initial value in the 'Barometric Altitude Hold' ACS mode.</li> <li>- or -</li> <li>• The rate of descent measured by the Radio Altimeter exceeds <math>-50</math> m/s.</li> </ul>  |

6

**A Route-following mode (AY-MAPШП)**

- or -

**6-LAlt**

This mode is selected by pressing the **[A]** or **[LAlt-6]** key with the aircraft avionics in the 'ENROUTE' or 'RETURN' navigation operational mode. The autopilot follows the assigned flight path.

**Landing mode (AY-ПOCAД)**

This mode is selected by pressing the **[A]** or **[LAlt-6]** key with the aircraft avionics in the 'LANDING' navigation operational mode, which is switched to automatically from the 'ENROUTE' and 'RETURN' navigation operational modes when approaching a runway. The 'Landing' ACS mode keeps the aircraft on the landing aerodrome's Glide Slope beacon. The ACS switches off automatically after descending to 50 meters altitude above ground level (AGL). If the aircraft departs the Glide Slope beacon for any reason, the ACS mode switches automatically from 'Landing' to 'Attitude to horizon' mode. The 'Landing' ACS mode is normally disengaged by the pilot for a manual landing from an altitude of 100-200 m AGL. Autopilot descent to the 50 m AGL minimum is recommended only in conditions of poor visibility, when the runway is obscured by fog.

**Combat steering mode (AY-MAPШП-KB)**

This mode is selected by pressing the **[A]** or **[LAlt-6]** key when a target or terrain point is locked by the onboard 'Shkval' targeting system. The autopilot uses bank to steer the aircraft onto the locked target bearing. The pitch axis is used to maintain altitude. Engaging the 'Momentary override' mode **AY-MAPШП** by pressing and holding **[LAlt-~]** allows the pilot to control the aircraft only in the pitch axis - the ACS retains control of bank angle. After releasing the 'override' mode, the autopilot returns the aircraft to the initial altitude.

NOTES: In the 'combat steering' ACS mode, loss of target or terrain point lock for any reason causes the ACS to automatically switch to the 'emergency leveling' mode.

In the absence of an assigned waypoint, Glide Slope beam or locked target (e.g. in non-navigation avionics operational modes), pressing **[A]** to engage the autopilot will default to the 'emergency leveling' mode, illuminating the corresponding pushbutton on the ACS-8 panel.

**9-LAlt Autopilot Disengage**

Pressing **[LAlt-9]** will disable any engaged ACS modes. (corresponding to the 'OTKL. SAU' trigger on the control stick of the real Su-25T)

When landing crosswind exceeds 10 m/s, it is recommended to disengage the ACS autopilot at a radar altitude of not less than 100 m AGL to revert to manual control.

**Barometric Pressure Altimeter Gauge:**

**--RShift** Barometric Pressure Altimeter - Increase (Set it to Altitude of Runway before Takeoff)

**--RShift** Barometric Pressure Altimeter - Decrease (Set it to Altitude of Runway before Takeoff)

**Repeated Keypress Required:**

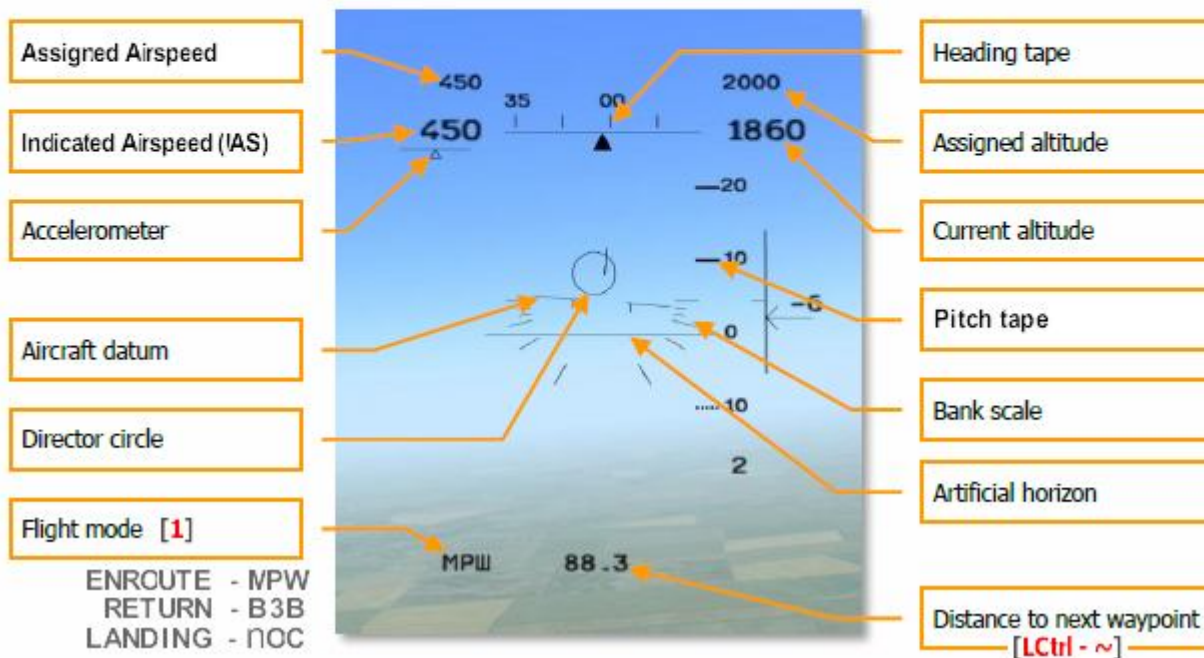
In the 'Enroute' and 'Landing' navigation operational modes of the aircraft avionics, the 'Attitude Hold' AY **[LAlt-1]** and 'Altitude Hold' ('Barometric' AY-KB **[LAlt-4]** or 'Radar' AY-PB **[LAlt-5]**) ACS modes are available. When one of these modes is engaged, the 'Route-Following' or 'Landing' ACS modes cannot be selected until the prior mode is switched off by a repeat press of **[LAlt-1]**, **[LAlt-4]** or **[LAlt-5]**.



# Operational Modes of the Su-25T HUD and TV Indicators

## Basic HUD Symbolology

The Su-25T has several operational modes. Some basic symbols displayed on the Head Up Display (HUD) are common across most modes.



### Aircraft Datum :

The Aircraft Datum in the center of the HUD rotates to indicate aircraft bank and roll.

### Director Circle:

When the aircraft is on the assigned flight path, the Director Circle is aligned with the Aircraft Datum in the center of the HUD. When the aircraft flies away from the assigned flight path, the Director Circle indicates the direction to return to it.

### Pitch Tape:

A Pitch Tape is located to the right of the Aircraft Datum. Aircraft pitch can be read from this tape with reference to the Aircraft Datum in the HUD.

### Vertical Velocity Indicator (VVI):

To the right of the Pitch Tape is a Vertical Velocity Indicator (VVI) |←. Aircraft rate of ascent or descent between  $\pm 30$  m/s is indicated by an arrow and a numeric value. The arrow stops at the VVI limit and the numeric value flashes with the vertical speed exceeds 30m/s.

### Heading Tape:

A Heading Tape appears at the top of the HUD. Tick marks are labeled in tens of degrees (e.g. the number '35' indicates a heading of 350 degrees).

### Indicated Airspeed (IAS):

To the left of the Heading Tape is the Indicated Airspeed (IAS). The Assigned Airspeed for the next waypoint (depending on the operational sub-mode) is shown directly above the IAS.

### Accelerometer:

An Accelerometer is displayed under the IAS in the form of a bar scale and triangular marker. A marker to the right of center indicates acceleration; to the left of center - deceleration.

### Current Altitude:

To the right of the Heading Tape is the Current Flight Altitude in meters. At altitudes less than 1500 m above ground level (AGL), radar altitude is indicated with 1 m accuracy. Above 1500 m AGL, pressure altitude above sea level (ASL) is indicated with 10 m accuracy. The Assigned Altitude for the next waypoint (depending on the operational sub-mode) is shown directly above the Current Flight Altitude.

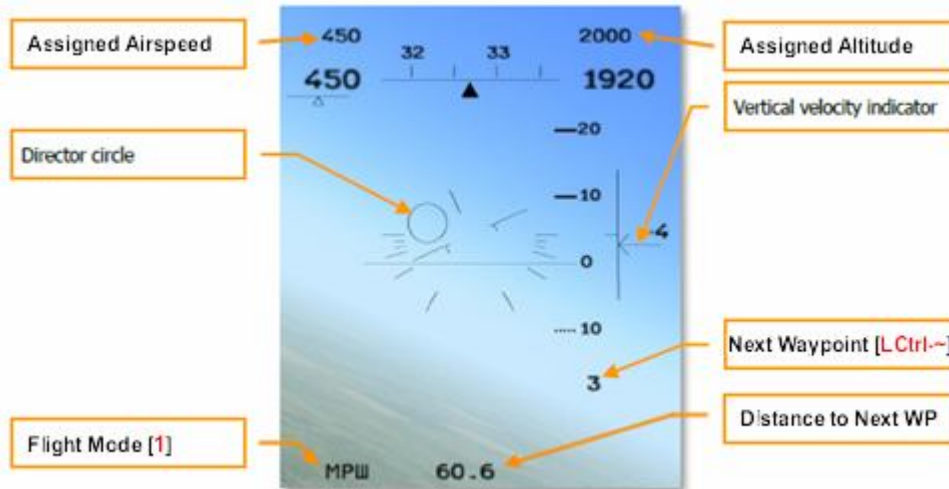
# Navigation Mode

There are **3 Navigation Sub-Modes**:

1. **ENR** - MPW - ENROUTE
2. **RTN** - B3B - RETURN TO BASE
3. **LDNG** - ПOC - LANDING

These sub-modes are **selected automatically at appropriate points along the assigned flight path**, and can also be cycled manually by pressing the **[1]** key.

## ENR - MPW - ENROUTE Sub-Mode

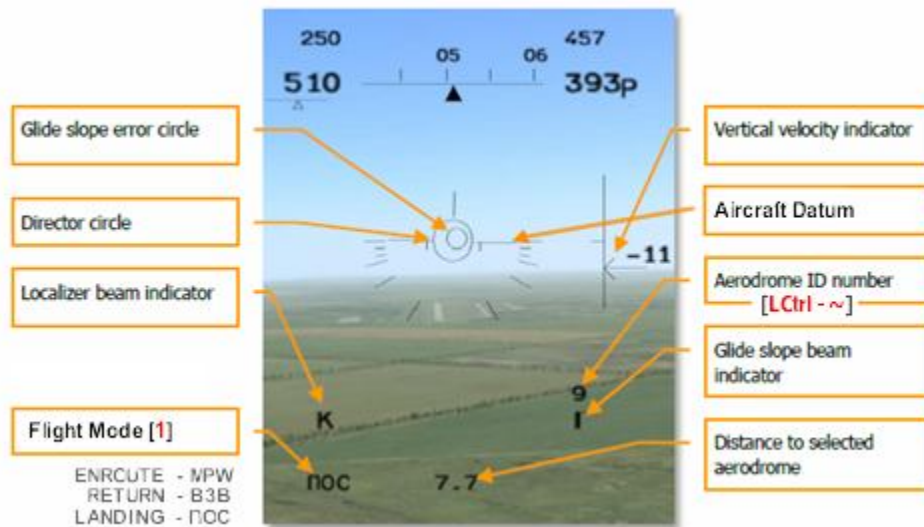


- The **Enroute** sub-mode features a **Director Circle** displayed in the HUD which indicates the direction to the **next waypoint**.
- The Assigned Altitude and Airspeed enroute to the next assigned waypoint are displayed above the current altitude and airspeed in the HUD.
- The next waypoint number is indicated in the lower right, below the pitch scale. The distance to the next waypoint is displayed at the bottom of the HUD. After arriving to the assigned waypoint is reached, the Director Circle automatically shows the direction to the one following, and the waypoint number in the lower right will advance.

## RTN - B3B - RETURN Sub-Mode

In the **Return** sub-mode, the Director Circle guides the pilot to **intercept the runway approach glide-slope**.

## LNDG - nOC - Landing Sub-Mode



The landing aerodrome can be cycled by pressing the **[LCtrl-~]** key. The aerodrome ID number is indicated in the lower right, below the vertical velocity scale indicator. The aerodrome control tower provides voice instructions when the aircraft approaches the runway.

- In the **Landing** sub-mode, a **Glide Slope error circle** appears in the HUD.
- The aircraft is on the correct approach when the **Director Circle and Glide Slope circles are both centered in the Aircraft Datum**.
- The Director Circle guides the pilot to intercept the desired Glide Slope.
- '**K**' and '**I**' indicate the presence of Localizer and Glide Slope beacons, respectively.

## Landing Procedure

|                 |                        |
|-----------------|------------------------|
| <b>F</b>        | Flaps Up/Down          |
| <b>F-LShift</b> | Flaps Landing Position |
| <b>F-LCtrl</b>  | Flaps Up               |
| <b>C-LCtrl</b>  | Canopy Open/Close      |
| <b>P</b>        | Dragging Chute         |

|                 |                      |
|-----------------|----------------------|
| <b>G</b>        | Landing Gear Up/Down |
| <b>G-LCtrl</b>  | Landing Gear Up      |
| <b>G-LShift</b> | Landing Gear Down    |
| <b>W</b>        | Wheel Brake On       |
|                 |                      |

1. **[G]** On approach, the Gear should be extended once the airspeed falls **below 400 km/h**.
2. **[F]** Extend the Flap. The aircraft will have a tendency to 'balloon'.  
(Note: If the aircraft becomes unbalanced in either its longitudinal or lateral axis when configured for landing, the gear or flaps may not have fully extended or extended asymmetrically. In this case, retract the flaps to perform the landing in normal Flight Configuration. Adjust all approach and landing speeds to increase by 40-60 km/h.)
3. Reduce speed to **290-310 km/h** by setting the aircraft into Take-off/Landing Configuration at the **start of your Glide Slope descent**.
4. Reduce speed to **260-280 km/h** by the time you reach the **Inner Marker Beacon**.
5. Begin to **flare as you approach the runway**, at approximately **5-8 m. altitude, 250-270 km/h** and **100 m** before the runway.
6. After final line up at approximately **1 m** above the ground, **reduce thrust to Idle** and as the aircraft slows down, **increase pitch** by holding the stick back so that the **pitot tubes line up with the horizon**.
7. Touchdown should occur at **220-240 km/h**.
8. **[F]** Retract the Flaps.
9. Lower the nose wheel by carefully pushing the stick forward
10. **[P]** Release the Brake Chute
11. **[W]** Engage the Wheel Brakes.
12. Maintain heading down the runway centerline with smooth pedal inputs.

(Note: If the aircraft veers when braking, release the brakes, correct heading and only then reapply the brakes. If the aircraft risks running off the runway at a speed of greater than 50 km/h, retract the gear, open the canopy, and perform an emergency shut down.)

# Weapons Delivery

## Air-to-Air Weapons

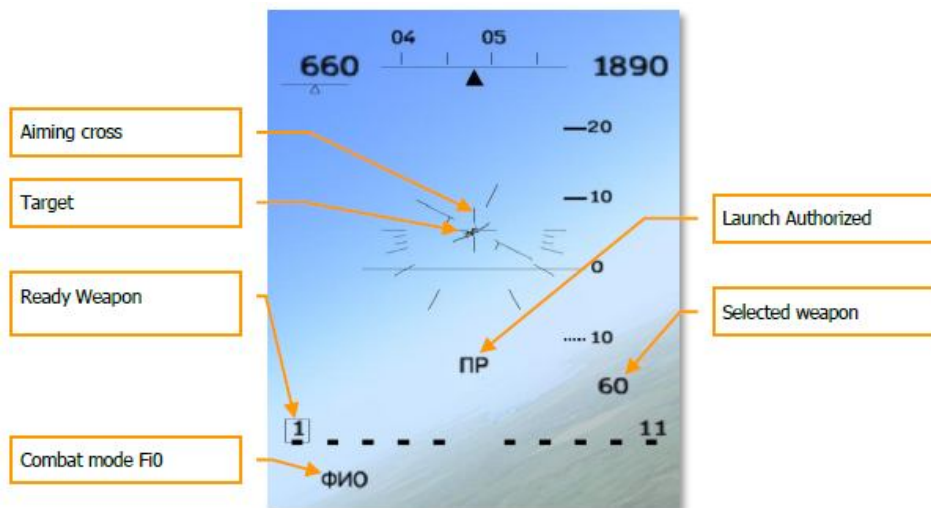
### LNGT - Short Range Missiles

In a Pursuit Intercept against a target flying at a speed of 700 km/h:

- **R-60** can be fired from **1500-2000** meters range.
- **R-73** can be fired from **3000-4000** meters range.

Since the missile seeker cannot measure the range to the target, the **pilot must estimate the range visually before firing**, to ensure the shot is within parameters.

The Su-25T can carry the R-73 and R-60 short range air-to-air missiles in the longitudinal aiming mode. When this mode is activated, the missile's seeker has a scan zone of 2 degrees that is directed forward along the aircraft's longitudinal axis. The target must enter this seeker field of view, which is represented by the center of the aircraft symbol on the HUD, to automatically lock the target.



Weapon availability and state of readiness are indicated along the bottom of the HUD. R-60 missiles at weapon stations # 1 and 11, with the flashing rectangle around station 1 indicating that it is locked and ready for launch.

1. **[6]** Select air-to-air mode.
2. **Maneuver your aircraft** to place the center of the HUD aircraft symbol over the target.
3. When the **missile seeker achieves a lock** and the 'LA' message is displayed on the HUD, this is only an indication that the target has been locked; it does not mean that the target is within range of the missile.  
Launching a missile too early may lead to a miss because the missile has insufficient energy to intercept the target. It is recommended that you not launch until the target's shape is visible or 2 km.
4. **[Space]** Launch the missile. (The missile is 'fire and forget' and requires no additional support from the launch aircraft.)

### GUN - Internal Gun and GNPD - Gun Pods - Application Against Air Targets

The internal gun and gun pods can be used against air targets, but it has limited accuracy in application.

1. **[6]** Select air-to-air mode.
2. **[C]** Select internal gun or gun pods.
3. Now in gun mode, the funnel will appear on the HUD - graphically it represents the shell's flight trajectory vs. target wingspan.
4. **[RAIt--], [RAIt++]** Set the target wingspan (also known as 'target base') in meters.
5. The target's set wingspan is indicated in the upper portion of the HUD.
6. Maneuver your aircraft to place the target inside the funnel such that the **target's wingtips touch the funnel edges**.
7. **[Space]** Press the Weapon Release button to fire.

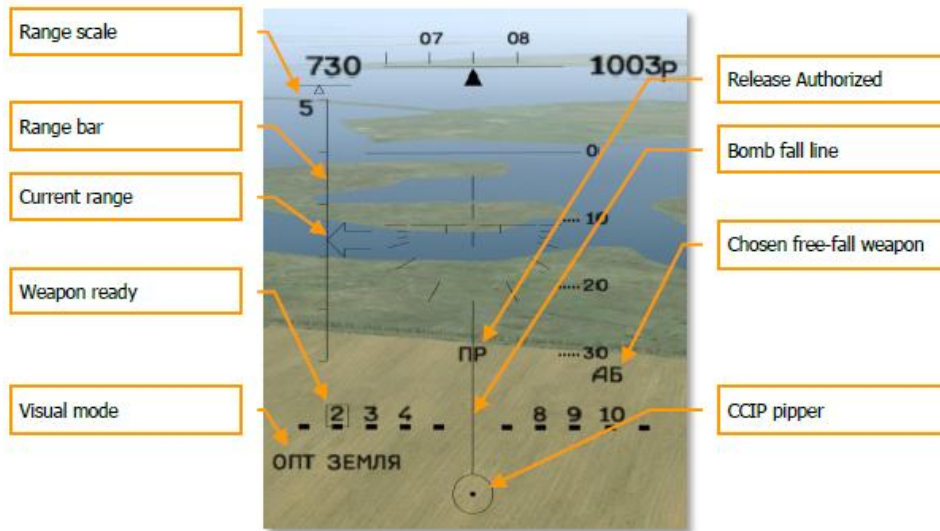
Effective fire is generally below 800 meters. For better accuracy, try to maneuver in the same plane as your target. The gun funnel is most accurate when used from behind the target.



## Air-to-Ground

### CCIP - Unguided, Low-Drag Bombs

CCIP - Continuously Computed **Impact** Point



This category bomb includes the unguided bombs:

- FAB-100
- FAB-250
- FAB-500
- FAB-1500
- BetAB-500ShP Concrete Piercing Bomb
- ODAB-500
- RBK cluster bombs
- KMGU dispensers
- ZAB-500 incendiary bombs

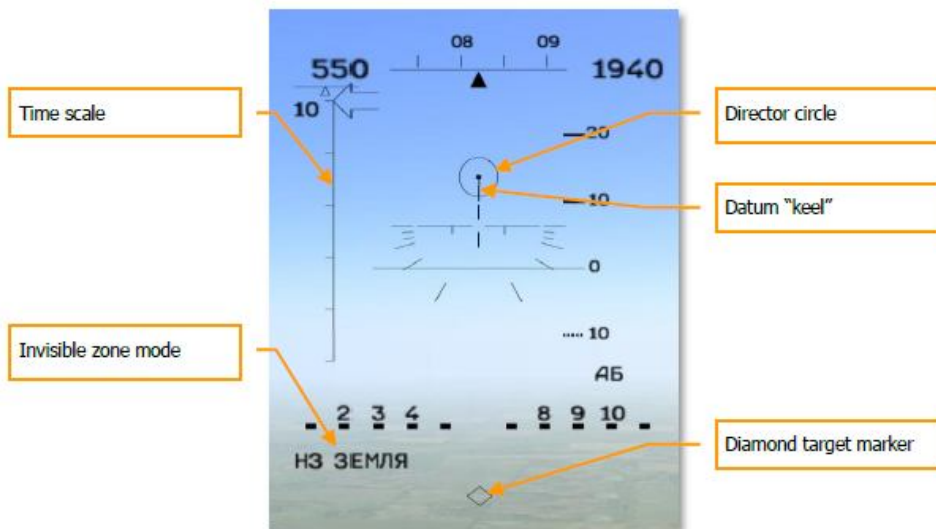
#### Low-Drag Bombs:

Have low drag indexes and flat trajectories. This often allows you to release a bomb at a target while it is **still visible in the HUD** using CCIP.

1. **[7]** Switch to air-to-ground mode.
2. **[D]** Select the weapon to be released using the weapon control panel.
3. **[LCtrl-Space]** Select the Ripple Quantity.
4. **[V]** Set the Release Interval.
5. The Aiming Mark starts moving up from the lower portion of the HUD, **Fly the Aircraft to place the Aiming Mark on the Target.**  
When the Aiming Mark is showing the true impact point underneath it and the bomb can be dropped, the orange lamp will light.
6. **[Space]** Press the Weapon Release button to fire.
7. If a bomb ripple setting has been made, keep the Weapon Release button **held down until the pulse ends.**
  - Bombs can be released once the 'LA' message appears on the HUD.
  - Before Bomb Release, enter a **Wings-Level Dive** to a point **just beyond your target.**

### CCRP - Unguided, High-Drag Bombs

CCRP - Continuously Computed **Release** Point



#### High-Drag Bombs:

They have high drag values and have a curved trajectory that significantly complicates **that targeting of visible targets.** This bomb category includes bombs with aerodynamically high drag, such as:

- various RBK types
- KMGU-2 containers
- BetAB concrete-piercing bombs

#### Bombing Automation Process:

The **Range Bar** at the left side of the HUD **becomes a Time Scale**, indicating the number of **seconds remaining before automatic bomb release.** The arrow indicating the time remaining before release doesn't begin moving until 10 seconds before release.

1. **[7]** Switch to air-to-ground mode.
2. Place the CCRP pipper on the intended target.
3. **[Space]** Press **AND HOLD** the Weapon Release button to designate the target.  
A Diamond symbol will appear on the HUD that represents the designation point and in the upper portion of the HUD, a steering ring will be displayed.
4. **Fly the aircraft** such that the **aircraft symbol 'tail' is placed in the center of this ring.**
5. The **Range Scale** on the left side of the HUD turns into a **Time-to-Release Scale** that is graduated in seconds.  
The arrow indicating time-to-release will appear on the scale only 10 seconds before the bombs release.  
For accurate bombing it is best to minimize changes in bank and yaw.
6. When the timer reaches zero, the **bomb(s) will automatically be released** and you can release the trigger.

## TV Targeting Aided Bombing - Unguided Bombs

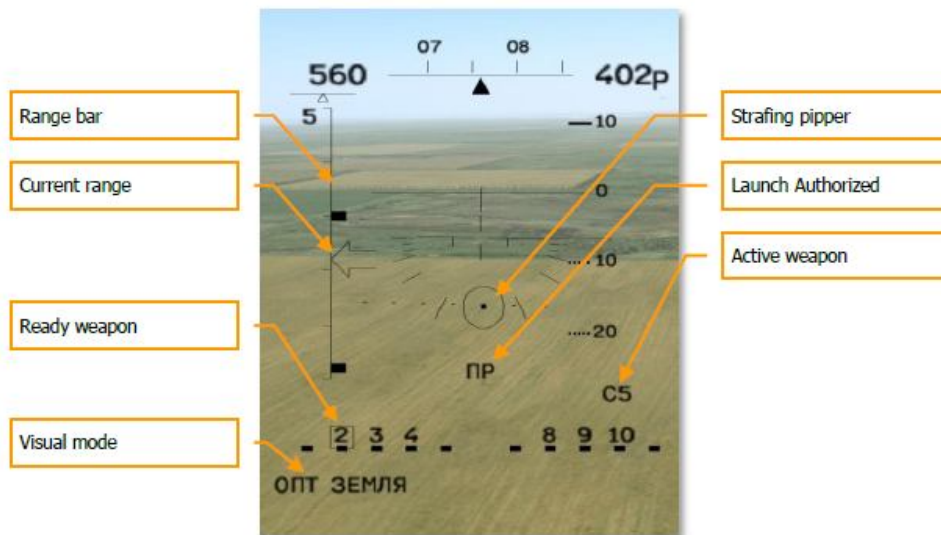
Unguided bombs can be used in conjunction with the 'Shkval' TV targeting system or the 'Mercury' low-light level TV targeting system.

1. **[7]** Switch to air-to-ground mode.
2. **[D]** Select the weapon to be released using the weapon control panel.
3. **[O]** Turn on the 'Shkval' TV targeting system for **Day Time** operations.  
-or- **[RCtrl-O]** Turn on the 'Mercury' system for **Night Time** operations.
4. **[;], [,], [.), [/]** Search for your target by moving the Target Designator using your Cursor Keys.
5. **[Enter]** Upon target acquisition, Lock (ground-stabilize) the sensor.
6. **[+], [-]** Increase (or Decrease) the TV's magnification level for positive target identification.
7. Place the acquisition frame on the target.
8. **[RShift-O]** Turn on the Laser Range-finder.
9. **[Space]** Release the Weapon.
10. On the HUD will appear a **diamond symbol** that represents the designation point.
11. In the upper portion of the HUD, a **Steering Ring** will be displayed.
12. **Fly the aircraft** such that the **aircraft symbol 'tail' is placed in the center of this ring**.
13. The **Range Scale** on the right side of the HUD turns into a **Time-to-Release Scale** that is graduated in seconds.  
The arrow indicating time-to-release will appear on the scale only 10 seconds before the bombs release. For accurate bombing it is best to minimize changes in bank and yaw.
14. When the timer reaches zero, the **bomb(s) will automatically be released** and you can release the trigger.
15. **[RShift-O]** Turn Off the Laser Range-Finder.  
Remember that the **Laser Range-Finder has a limited, continuous duration time, which is about one minute**. After that, the device needs time to cool down or risk damage. During this cool-down time indicated by 'Л', a green lamp will flash at 2 Hz; when the device has sufficiently cooled, the lamp will extinguish. The cooling time is nearly equal to the work time, and it depends on environment temperature conditions.

## Unguided Rockets and Internal Gun

Unguided rockets include all the rockets and missiles that are not equipped with guidance system. These include the S-5 in the UB-32 rocket launcher, the S-8 in the B-8 rocket launcher, the S-13 in the UB-13 rocket launcher, and the S-24 and S-25. The internal gun is the GSh-301 30-mm gun with 150 rounds.

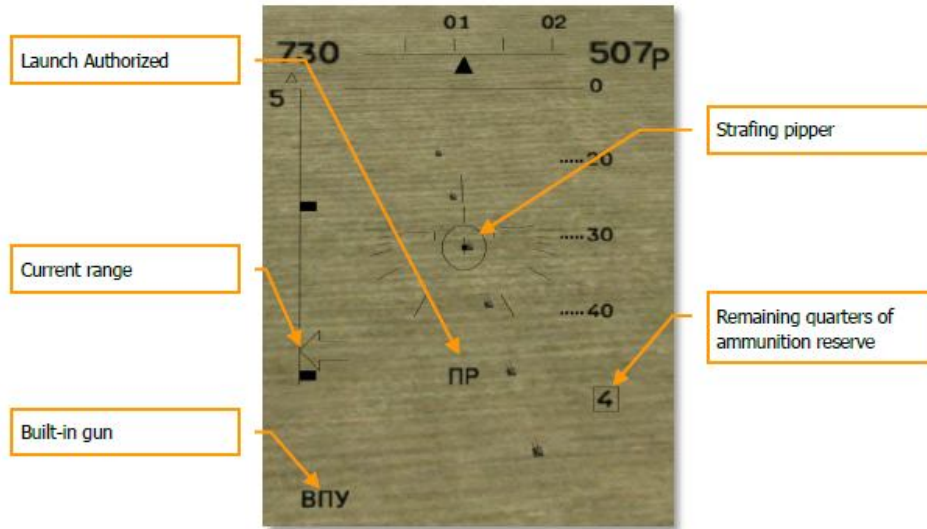
| Rocket  | Range, km | Weight, kg | Warhead type               |
|---------|-----------|------------|----------------------------|
| S-80FP  | 2.2       | 15,2       | Blast-fragmentation        |
| S-8TsM  | 2.2       | 15         | Smoke (target designation) |
| S-13-OF | 2.5       | 68/67      | Blast-fragmentation        |
| S-24B   | 2         | 235        | Blast-fragmentation        |
| S-25-OF | 4         | 480        | Blast-fragmentation        |



1. **[7]** Select the air-to-surface mode.
2. **[D]** Select your Rocket.  
- or - **[C]** Select the guns.
3. **Maneuver the aircraft** into a shallow dive towards the target.
4. When the **Aiming Pipper is over the target** and launch conditions are satisfied, the **LA** message will appear on the HUD.
5. **[Space]** Fire the rocket(s) or guns.

## GUN - Cannon Strafing Mode

Strafing with the built-in gun (internal cannon) is conducted by practically the same procedure as Rockets...



1. **[7]** Activate the Ground mode.
2. **[C]** Activate the Cannon.  
**Strafing Pipper** below the Aircraft Datum symbol indicates the rocket impact point.  
**Ammunition Quantity** in quarters is displayed beneath the pitch scale. A full magazine is indicated with '4', the last 1/4th of remaining ammunition with '1'.
3. **Pilot maneuvers the aircraft** into a shallow dive, **placing the pipper onto the target**.  
The maximum **firing range** is reached when the arrow in the range bar reaches the upper tick mark and Launch Authorized 'LA' is displayed in the HUD.
4. **[Space]** When the **Aiming Mark** on the HUD **overlays the target**, FIRE your weapon!

## GNPD - External Gun Pods

The Su-25 can carry SPPU-22-1 gun pods that can operate in:

- Zero Depression Angle mode
- Fixed Depression Angle mode
- Programmed (point tracking) mode

Because the Zero Depression Angle mode does not differ the internal gun, we shall only review two modes:

- **Fixed Depression**
- **Programmed**

### FIXED DEPRESSION MODE (USED WHEN FIRING IN HORIZONTAL FLIGHT ALONG A LINE OF TARGETS)

1. **[7]** Select the Ground mode.
2. **[C]** Select internal gun mode.
3. **[RCtrl-Space]** Select gun pods
4. Confirm weapon selection on the HUD and WCS panel; two gun pods will be selected.  
**[V],[Shift-V]** (Inc, Dec) Set the ripple **interval**/gun pods mode to **FIX** mode.  
**[LCtrl-Space]** Set the ripple **quantity** switch to **PO2**.

If the aircraft has **four gun pods** loaded onboard:

5. **[RCtrl-Space]** Select the other Gun Pods by pressing once more.  
**[V],[Shift-V]** (Inc, Dec) Set the ripple **interval**/gun pods mode to **FIX** mode.  
**[LCtrl-Space]** Set the ripple **quantity** switch to **PO2**.
6. **[RAIt--], [RAIt++]** (Inc, Dec) Adjust the barrel depression angle by moving the aiming mark along the vertical axis on HUD.
7. **Align your flight path with the target** and maintain the **level flight**.
8. **[Space]** When the **Aiming Mark** on the HUD **overlays the target**, FIRE your weapon!

While firing, you **use rudder input to cover a larger area** with fire. Note though that any deviations in bank angle can lead to significant shell deviation.

### PROGRAMMED MODE (USED FOR THE PINPOINT ATTACKS AGAINST LIGHTLY ARMORED TARGETS.)

1. **[7]** Select the air-to-surface mode.
  2. **[C]** Select internal gun mode.
  3. **[RCtrl-Space]** Select gun pods.
  4. Confirm weapon selection on the HUD and WCS panel; two gun pods will be selected.  
**[V],[Shift-V]** (Inc, Dec) Set the ripple **interval**/gun pods mode to **FIX** mode.  
**[LCtrl-Space]** Set the ripple **quantity** switch to **PO2**.
- If the aircraft has **four gun pods** loaded onboard:
5. **[RCtrl-Space]** Select the other Gun Pods by pressing once more.  
**[V],[Shift-V]** (Inc, Dec) Set the ripple **interval**/gun pods mode to **FIX** mode.  
**[LCtrl-Space]** Set the ripple **quantity** switch to **PO2**.
  6. **[RAIt--], [RAIt++]** (Inc, Dec) Adjust the barrel depression angle by moving the aiming mark along the vertical axis on HUD..
  7. **[RShift-O]** Turn on the Laser Range-Finder
  8. **[V]** Set the interval/gun pods mode switch to **PROGR (ПРОГР)** mode.
  9. In a wings-level dive, **place the Aiming Marker on the target**.
  10. **[Space]** Fire your weapon when 'LA' message appears.
  11. Avoid roll, pitch, and yaw changes while firing for better accuracy.
  12. **[RShift-O]** Turn off the laser range-finder.

## Precision Bombing

| Missile          | Launch Range | Targets   |
|------------------|--------------|---|
| Kh-25ML          | 10-12 km     | <b>Fortifications</b> , strong points, bridges, command and control centers, artillery and missile emplacements.        |
| Kh-29T<br>Kh-29L | 10-13 km     | <b>Fortifications</b> , strong points, bridges, command and control centers, artillery and missile emplacements, boats. |
| Kh-25MPU         | 40 km        | <b>SAM Radars</b> : Hawk, Roland, Crotale   |
| Kh-31P           | 100 km       | <b>SAM Radars</b> : Patriot, Nike Hercules, Improved HAWK   |
| KAB-500KR        | 15 to 17 km  | <b>Fortifications</b> , strong points, bridges, command and control centers, artillery and missile emplacements.        |
| Kh-31A           | 70 km        | <b>Ships</b> up to 8 000 t.   |
| Kh-35            | 130 km       | <b>Ships</b> up to 5 000 t.   |
| 9A4172 (Vikhr)   | 4 km         | <b>Anti-Tank</b> and Air Targets  |

### Shkval & Mercury Targeting System HUD

The Shkval and Mercury targeting systems are displayed on the IT-23M TV display in the upper right corner of the Su-25T control panel

- **Onboard** I-251 'Shkval' (**daytime-only TV**)
- **Podded** LLTV 'Mercury' (**for night operations**)

### TV-Guided Bombs and Missiles

- **KAB-500KR** - TV-guided **bombs**
- **Kh-29T** - TV-homing **missiles**  
(Kh-29T also destroys Ships)

TV guided and homing bombs and missiles are considered 'fire-and-forget', since they home autonomously. **They DO NOT Require support** from the launching aircraft after release.

#### Best Targets:

- Command Centers
- Control Centers
- Reinforced Concrete Shelters
- Other well-protected targets
- (Kh-29T also destroys Ships)

1. **[7]** Select air-to-ground mode.
2. **[D]** Select the desired bomb.
3. Confirm the selected bomb type on the HUD.
4. **[O]** Turn on the Shkval TV targeting system for **Daytime** operations.
  - - or - **[RCtrl-O]** Turn on the 'Mercury' system for **Nighttime** operations.
1. **[;], [,], [.]**, **[/]** Move your Target Cursor to select your target.
2. **[Enter]** Upon target acquisition, ground-stabilize the sensor.
3. **[+]** and **[-]** (Inc, Dec) Sensor's Zoom level.
4. **[RCtrl-+]**, **[RCtrl--]** **Set the Target Box size** to match the size of your target.
5. The 'Shkval' targeting system will automatically snap lock on to the nearest object within the acquisition frame that has dimensions comparable with the set target size.
 

By default, target specified size is 10 m. It is recommended to use the following target base values:

  - 5 m - Personnel and minor structures
  - 10 m - Cars and armored vehicles
  - 20 m - Tactical aircraft and helicopters
  - 30–60 m - Transport and strategic aircraft
  - 20–60 m - Buildings
  - 60 m - Ships

**[;], [,], [.]**, **[/]** If the incorrect object is locked, manually move the acquisition frame to the correct target.

  - When a target is locked, an '**AC**' message will appear on the TV monitor – auto-tracking.
  - Range to target is indicated by the Range Scale displayed on the HUD.
  - When the maximum launch range is reached and the '**LA**' message appears.
6. **[Space]** Release the weapon by pressing the Weapon Release button.
7. After release/launch, you can immediately begin another task.
 

Note that it is impossible to deliver TV-guided weapons in poor visibility conditions and at night; they only work in the visible light spectrum and are influenced by all the limitations associated with daytime TV-devices. To lock a target, the target must be illuminated by a natural or artificial light source.



# Laser Designation Missiles

- **Kh-29L** - Laser-homing missile
- **Kh-25ML** - Laser-homing missile

The Su-25T can use the Kh-29L and Kh-25ML laser designation homing missiles. The Kh-29L and Kh-25ML were designed to destroy buried command centers, control centers, reinforced concrete shelters and structures, antiaircraft artillery positions, artillery, and other protected targets.

1. **[7]** Select air-to-ground mode.
2. **[D]** Select the desired bomb.
3. **[O]** Turn on the Shkval TV targeting system for **Daytime** operations.  
- or - **[RCtrl-O]** Turn on the 'Mercury' system for **Nighttime** operations.
4. **[;], [,], [.), [/]** Move your Target Cursor to select your target.
5. **[Enter]** Upon target acquisition, ground-stabilize the sensor.
6. **[+]** and **[-]** (Inc, Dec) Sensor's Zoom level.
7. **[RCtrl-+]**, **[RCtrl--]** **Set the Target Box size** to match the size of your target.
8. The 'Shkval' targeting system will automatically **snap lock on to the nearest object** within the acquisition frame that has dimensions comparable with the set target size.

By default, target specified size is 10 m. It is recommended to use the following target base values:

- 5 m - Personnel and minor structures
- 10 m - Cars and armored vehicles
- 20 m - Tactical aircraft and helicopters
- 30–60 m - Transport and strategic aircraft
- 20–60 m - Buildings
- 60 m - Ships

**[;], [,], [.), [/]** If the incorrect object is locked, manually move the acquisition frame to the correct target.

When a target is locked, an '**AC**' message will appear on the TV monitor – auto-tracking.

9. **[RShift-O]** Turn on Laser Range-Finder. Range to target is indicated by the Range Scale displayed on the HUD.  
When the maximum launch range is reached and the '**LA**' message appears.
10. **[Space]** Release the weapon.
  - Take note if the target was destroyed by the missile. If not and range to target still permits, launch another missile.
  - Remember that you must **lock the target the entire time the missile is in flight**. If the lock is broken prior to the missile reaching its target, the missile will most likely miss.
  - When locked to target, restrict your maneuvering as this could bring the target outside the gimbal limits of the 'Shkval' targeting system.
11. **[RShift-O]** Turn **OFF** the Laser Range-Finder.  
Remember that the range-finder/target designator has a **limited, continuous duration time, which is about one minute**. After that, the device needs time to cool down or risk damage. During this cool-down time indicated by '**Л**', a green lamp will flash at 2 Hz; when the device has sufficiently cooled, the lamp will extinguish. The cooling time is nearly equal to the work time, and it depends on environment temperature conditions.

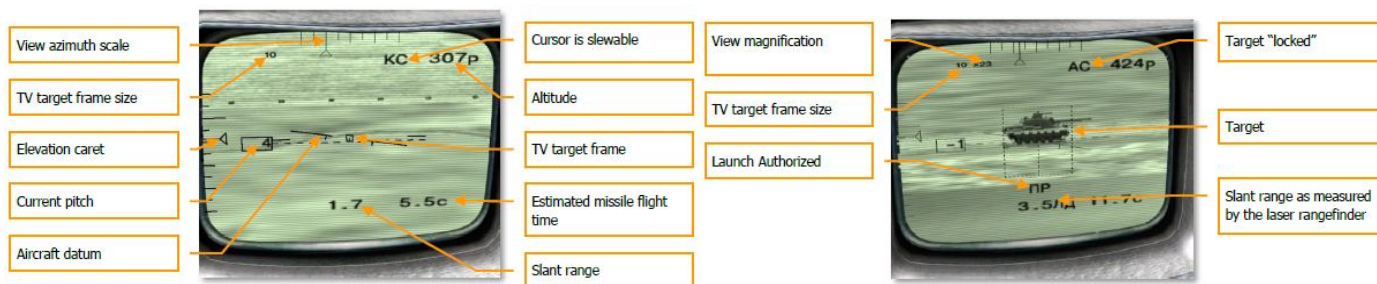
The 'Vikhr' has limited capabilities against low-speed air targets such as helicopters and low-speed aircraft. Engagement of air targets is the same as described above. However, the launch range against air targets, especially in a pursuit courses, significantly drops. Use the 'Vikhr' against air targets less than 3 – 5 km away, depending on the target speed and aspect angle.

## Laser Beam-Riding Missiles

- 9A4172 'Vikhr' - Laser beam-riding missile

The Su-25T can use the **Vikhr** laser beam-riding missile. The 'Vikhr' is a specialized antitank missile (ATGM) designed to destroy mobile armored units.

1. **[7]** Select air-to-ground mode.
2. **[D]** Select the desired missile.
3. **[O]** Turn on the Shkval TV targeting system for **Daytime** operations.  
- or - **[RCtrl-O]** Turn on the 'Mercury' system for **Nighttime** operations.
4. **[:, [, ], [, /]** Move your Target Cursor to select your target.
5. **[Enter]** Upon target acquisition, ground-stabilize the sensor.
6. **[+] and [-]** (Inc, Dec) Sensor's Zoom level.
7. **[RCtrl-+], [RCtrl--]** **Set the Target Box size** to match the size of your target.
8. The 'Shkval' targeting system will automatically **snap lock on to the nearest object** within the acquisition frame that has dimensions comparable with the set target size.  
**[:, [, ], [, /]** If the incorrect object is locked, manually move the acquisition frame to the correct target.  
When a target is locked, an '**AC**' message will appear on the TV monitor – auto-tracking.
9. **[RShift-O]** Turn on Laser Range-Finder.  
Range to target is indicated by the Range Scale displayed on the HUD.



10. Upon reaching maximum launch range, **maneuver the aircraft to position the target marker within the missile launch zone reticle**. Once aiming is complete, the **target line-of-sight symbol will be within the missile launch zone reticle**.
11. The '**LA**' message appears in the HUD.
12. **[Space]** Press the Weapon Release button.
13. **You must lock the target the entire time the missile is in flight.**  
While the missile is in flight, maintain the aircraft's current heading such that it does not exceed the Shkval's angular gimbal limits. Try to avoid high angular velocity that can cause missile to lose the laser-guidance beam.
14. **[RShift-O]** Turn **OFF** the Laser Range-Finder.

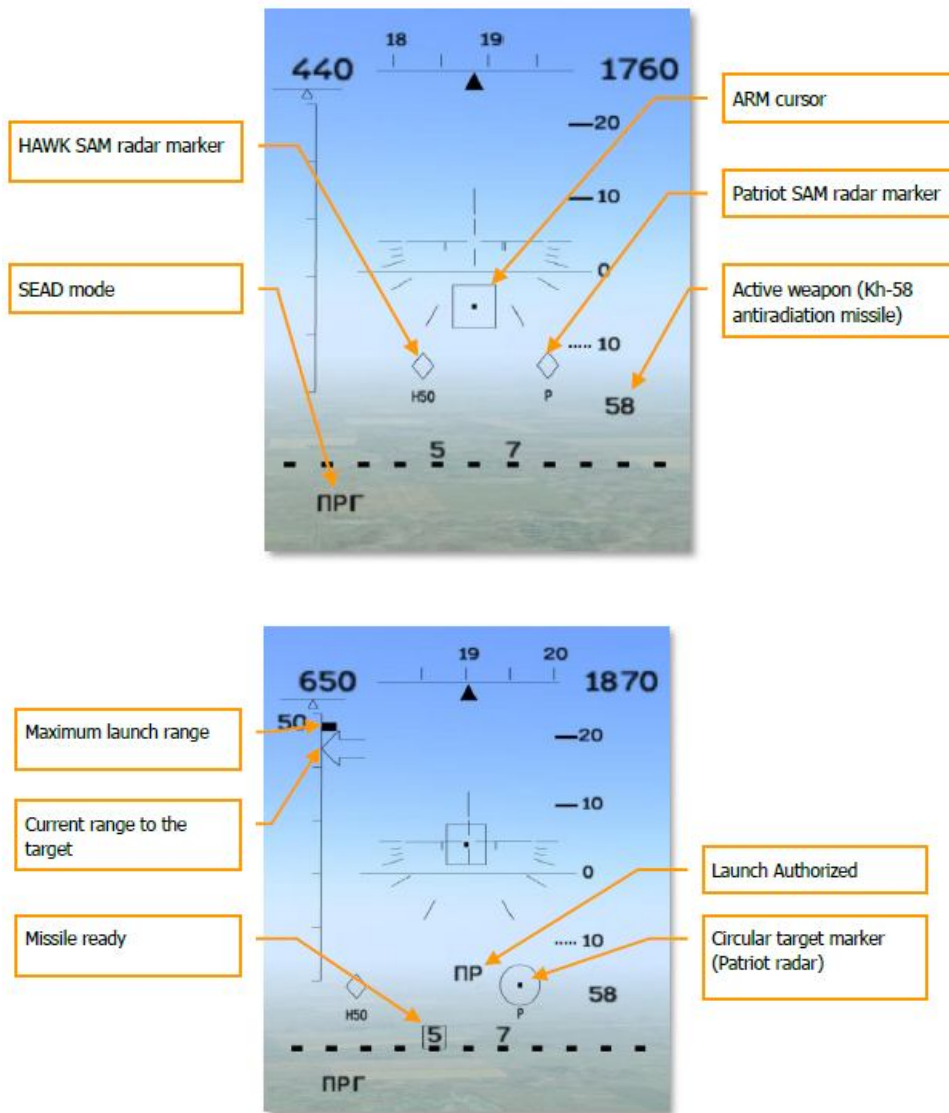
## Antiradar Missiles Delivery

Anti-Radiation missiles:

- Kh-25MPU
- Kh-58

Anti-radiation missiles (ARM) are a 'fire-and-forget' class of weapon and do not require launch aircraft support after they have been fired. After the missile has been launched, you can move on to your next task.

To target these weapons, the 'Fantasmagoria' L-081 emitter targeting system pod is suspended from the belly of the aircraft. This pod detects the radar emissions of an air defense radar and cues the missile to the designated target.



1. **[7]** Select air-to-ground mode.
2. **[D]** Select the desired missile.
3. After detecting a threat on the RWS, **maneuver your aircraft** such that you are **flying towards the threat emitter**
4. **[I]** Activate the emitter targeting system (ETS) pod.  
The ETS will detect the radar emitter and the threat marker and index will be displayed on the HUD.  
Threats type and their associated indexes are listed in the table below.
5. **[;], [,], [.), [/]** Move your Target Cursor to select your target.
6. **[Enter]** Lock the target.
7. Note the distance to target scale on the HUD. When the maximum launch range has been achieved and the 'LA' message appears on the HUD, you can launch the missile.
8. **[Space]** When the **maximum launch range** has been achieved and the 'LA' message appears on the HUD **release your weapon**.

To survive over the modern battlefield, you must be familiar with different SAM systems, the degree of danger they each pose, and strike the most dangerous first. For example: the SA-10C (C-300) or Patriot SAM systems are the most dangerous in comparisons with other SAM systems and they should be destroyed at long range with the Kh-58 ARM.

| SAM           | Radar               | HUD |
|---------------|---------------------|-----|
| Patriot       | AN/MPQ-53           | P   |
| Improved Hawk | AN/MPQ-50           | H50 |
| Improved Hawk | AN/MPQ-46           | H46 |
| Roland        | Roland search radar | G   |
| Roland        | Roland              | R   |
| S-300PS       | 64N6E               | 300 |
| S-300PS       | F5M (40V6M)         | 300 |
| S-300PS       | F1M (40V6MD)        | 300 |
| Buk           | 9S18M1              | БУК |
| Kub           | 1S91                | КУБ |
| Osa           | 9A33                | OCA |
| Tor           | 9A331               | ТОР |
| Tunguska      | 2S6                 | 2С6 |

| Ship                        | Radar       | HUD |
|-----------------------------|-------------|-----|
| USS 'Carl Vinson'           | Sea Sparrow | SS  |
| CG 'Ticonderoga'            | SM2         | SM2 |
| FFG 'Oliver H. Perry'       | SM2         | SM2 |
| 'Admiral Kuznetsov' cruiser | Kinzhal     | КНЖ |
| 'Neustrashimy' frigate      | Kinzhal     | КНЖ |
| 'Moskva' missile complex    | Fort        | ФРТ |
| 'Albatros' boat             | Osa-M       | OCA |
| 'Rezky' cruiser             | Osa-M       | OCA |

### Fixed Reticle Sight

The 'reticle' is a backup mode, usually used for strafing when the main targeting system is damaged or accurate range data is unavailable. The reticle has calibrated scales along two axes. It is used for aiming together with previously tested and known ballistic characteristics of the selected weapon and the current flight parameters. The center of the reticle is aligned with the aircraft longitudinal axis.

The fixed or 'static' reticle can be called up from any combat mode by pressing the **[8]** key. The current mode will be preserved, but the HUD will be replaced by the static reticle. The pilot can toggle the reticle on and off with the **[8]** key.

Aiming corrections in the reticle mode are made by the pilot maneuvering the aircraft to place the expected weapon impact point over the intended target. The cross hairs are positioned above the target by the required angle. Barrage rocket or cannon fire is employed at ranges of 200-400 meters.



# Weapon System Control Panel

The weapon system control panel can be seen near the bottom of the left instrument panel.



## [Space-LCtrl] Salvo Size switch:

Selects the **Quantity** of ordnance to be released with each pull of the trigger. When using onboard or podded guns, the salvo size switch positions assume a different meaning:

| Setting: | Cannon Salvo Settings: | Bomb Salvo Settings:   |
|----------|------------------------|------------------------|
| • ПО 1   | Internal Cannon Only   | Single (1 at a time) * |
| • ПО 2   | Single Pair of Gunpods | Pairs (2 at a time)    |
| • ПО 4   | ALL Gunpods            | 4 at a time            |
| • BCE    |                        | ALL                    |

## Single Salvo Mode Exceptions:

- \* Note that even the ПО 1 setting will still release ordnance hung from the outermost weapon stations in symmetric pairs, to avoid excessively unbalancing the aircraft. Only the four innermost wing stations provide individual Weapon Release with this setting.
- \* MERs always release all attached weapons together. It is not possible to command individual bomb release from the Su-25T's MERs.

## [V] Release Mode switch:

Controls the **manner** in which Air-to-Ground Weapons are employed:

| for Gunpods:  | for Free-Fall ordnance:   |
|---|---|
| <ul style="list-style-type: none"> <li>• 0 Gunpods bore sighted (aligned with aircraft longitudinal axis) for firing in a dive.</li> <li>• ФИКС (FIX) – Gunpods barrel depression set to a fixed value for strafing runs in level flight. The barrel depression angle is controlled with [=-RCtrl] and [--RCtrl].</li> <li>• ПРОГР (PROGR) – Gunpod barrel depression angle under automatic control for strafing a <b>target designated with the onboard Laser</b> rangefinder from level flight.<br/><br/>The ПРОГР mode is used to concentrate Gunpod fire on a point target from horizontal flight. For this it is necessary to depress the barrels to the desired angle with [RCtrl=-] and [RCtrl--], switch on the Laser Range-Finder - [RShift-O], maneuver the aircraft to put the pipper over the target and pull and hold the trigger. The gun barrels will automatically start firing at the right time, then deflect automatically in vertical plane to stay on target.</li> </ul> | <ul style="list-style-type: none"> <li>• ЗАЛП (SALVO) – all weapons in the salvo are released simultaneously.</li> <li>• 0.1 Individual weapons in the salvo are released with the selected interval (in seconds) between them.</li> <li>• 0.2</li> <li>• 0.3</li> <li>• 0.4</li> <li>• СЕРИЯ КМГУ-МБД (SSC-MJM SERIES) – a special release mode for the KMGU submunition dispenser and multiple ejection rack (MER). KMGU submunitions are dispensed at 2-second intervals, MER munitions are released 0.3 seconds apart, according to the total quantity specified by the salvo size switch.</li> </ul> |

# Weapon Status Panel

Weapon status panel indicates the Type, Quantity and Readiness of the currently selected weapon and remaining gun ammunition.



- **Yellow Lamps** in the upper row indicate weapon availability and presence on hardpoint stations
- **Green Lamps** in the lower row indicate currently selected weapons that are ready for launch or release.

## Weapon Type:

- Б - bombs
- УР - missiles
- НРС - rockets
- ВПУ - onboard 30 mm cannon

## Cannon Rounds:

- К - full
- 1/2 - one-half
- 1/4 - one-quarter



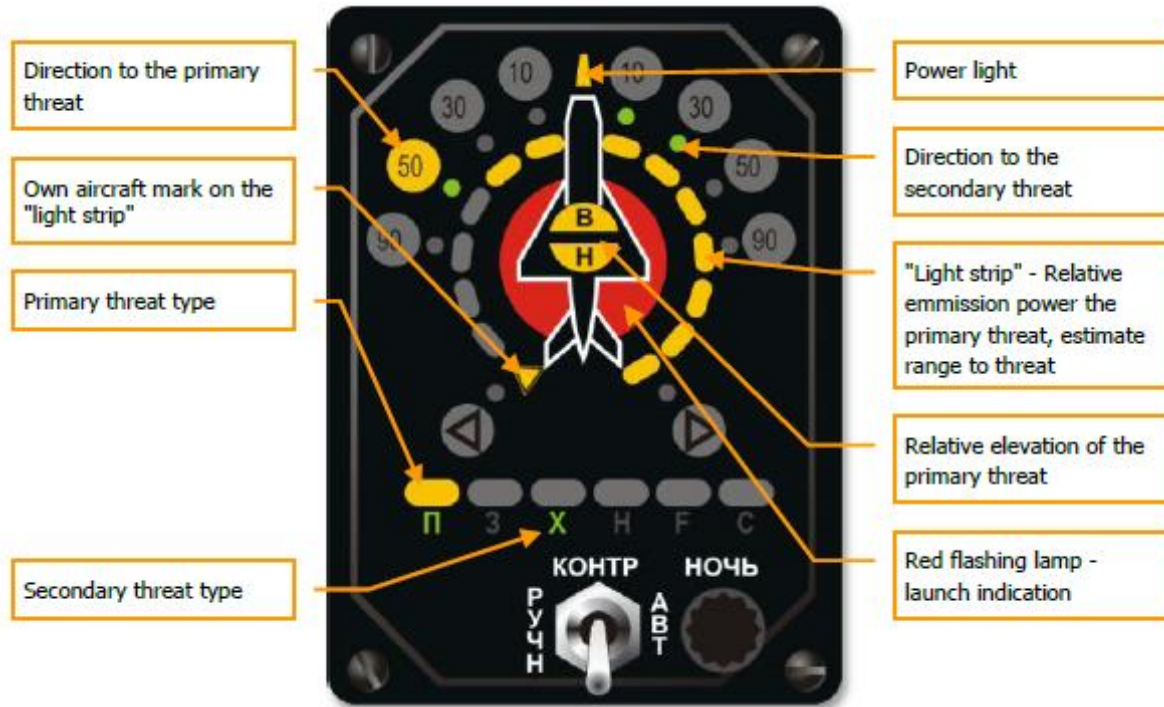
# (RWS) Radar Warning System

The system provides detection of radar signals at the following angles: Azimuth - +/- 180, and Elevation Range - +/- 30.

**[RShift-R] RWS mode filter** - In a complex threat environment, it is often difficult to define the threat type and direction. In this case it is recommended to use the RWS mode filter that removes all emitters operating in acquisition mode.

**[RAIt-], [RAIt-] RWS Audio Volume** - The RWS can produce multiple audio alerts and you can adjust their volume.

## RWS Sample scenario:



### Primary Threat:

- The **Primary Threat** at 50 degrees left (10 o'clock) is indicated in the form of a **large yellow lamp**.
- The lamp above 'П' symbol, which means 'Airborne', is lit. This type of threat includes all fighters.
- The **circular scale** of signal power ('light strip') consists of yellow segments that show the relative emission power of the primary threat's radar.
- The **large red circle** under the aircraft symbol indicates that your aircraft has been locked by the primary threat radar.
- The lit, **yellow hemispheres** marked as 'B' and 'H' in the center of the aircraft silhouette, indicates the threat's relative altitude to yours. In this situation, the primary threat is at the same altitude as your own, within 15 degrees in elevation.

### Consequently, the display can be interpreted in the following way:

Your primary threat is a **fighter** approaching from **10 o'clock**; it is near **co-altitude** with you; and judging by the **signal strength** and **lock light**, it is **ready to launch** a missile.

### Secondary Threat:

- The **Secondary Threat** is positioned at **10-30** degrees azimuth (1-2 o'clock right), and this is indicated by the **two green lamps**.
- The **green 'X'** symbol in the threat types line indicates that your being targeted by a **medium-range radar**.
- There is no additional data on secondary threats.

### Threats types:

- **П** - Airborne
- **3** - Long-Range
- **X** - Medium-Range
- **H** - Short-Range
- **F** - Early Warning
- **C** - AWACS

- 'Relative elevation' lights, 'power of emission' gauge lights and 'Lock/Launch' lights are only in regards to the primary threat.
- If the time between radar spikes of threat radar is 8 or more seconds, the azimuth lights will not blink.
- In the case of an acquisition-type spike, the low frequency audio tone will sound.
- If a radar is in lock mode, the 'Lock/Launch' indicator will light up, along with a steady, high frequency audio tone.
- If a radar-guided missile launch is detected, the 'Lock/Launch' light will flash, along with a high pitched audio tone.
- An ARH missile can be detected by the system after a missile establishes a lock using its own radar seeker. In this case, the missile will become the primary threat. The cue to recognize an ARH missile is the rapid increase in signal strength ('power of emission' lamps).
- The ability to correctly interpret the information indicated on RWS panel is vital in combat.