

COMBAT CAPABILITY OF MODERN SUPERSONIC AIRCRAFT FOR CZECH AIR FORCE

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Abstract: *The contribution describes the modern supersonic fighter aircraft designed for fighter missions in service of the Army Czech Republic. There are also noted armament options for air combat and new trends of development in accordance with the tactics used by the fighters. In conclusion there is mentioned properties of airborne radar and calculated maneuverability of airplane in an assault.*

Keywords: *Aircraft, armament, radar, Czech Air Force.*

1. INTRODUCTION

Fighter aircraft are generally the smallest and lightest current combat airplanes with high performance, in one version fighters are able to perform both fighter tasks and destroying the ground (sea) targets, and doing the reconnaissance. In air combat they can both take part in dogfight and destroy targets beyond visual contact. We can also use them as an overflow or patrolling fighters. With special container they can perform tasks of tactical reconnaissance.

2. ANALYSIS OF SUPERSONIC AIRCRAFT AND ITS EQUIPMENT

The aircraft in Czech Air Force service is a canard-configuration aircraft, featuring a cropped delta wing with a sweep of 45 degrees (Fig. 1).

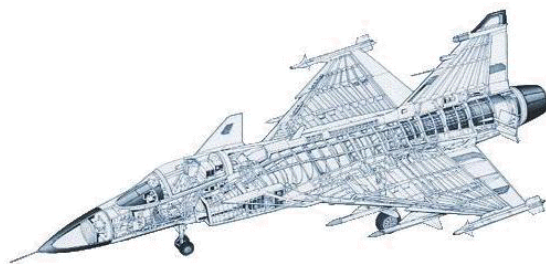


Fig. 1 Drawing of the aircraft [6]

All-moving canard forewings are with a sweep of 45 degrees and dihedral. The wings are midbody-mounted to provide clearance for underwing stores, and each has a leading-edge flap plus two trailing-edge drooping "elevons" to improve short-field performance, as well as maneuverability.



Fig. 2 Radar PS/05A [5]

There are two tiny strakes on the nose to generate vortices that improve flight control at high angles of attack. The PS-05/A works in the 8-10 GHz band and has 1 kW energy output (7 kW maximum output).

The radar is capable of detecting, locating, identifying and automatically tracking multiple targets in the upper and lower spheres, on the ground and sea or in the air, in all weather conditions, as the Fig. 2 shows. It consists of four parts and all parts can be replaced in 30 minutes. The

latest version of PS-05/A radar which is currently in use and has been available since 2005 is MK-3.

It is capable of detecting fighter aircraft from 120 km distance and can see road traffic and count ships at anchor in a harbour at 70 km. Radar modes:

a) Air-to-Air modes: Long Range Search (LRS) is used to detect and identify targets at high ranges, Track While Scan (TWS) allows to track targets and search for other targets, Multiple Priority Target Tracking (MPTT), Priority Target Tracking (PTT) allows accurate targeting and tracking Air-to-Air missiles, Single Target Track (STT) Air Combat Mode (ACM) is used for automatic target detection in dogfight.



Fig. 3 Supersonic fighter aircraft used in Czech Air Force. Foto author

b) Air-to-Surface modes: Long Range Search (LRS) is used for ground or sea target search at long distances, Raid Assessment (RA) ensures bombing, Stationary and Moving Target Indication (SMTI) is used for ground stationary or moving targets, Ground and Sea Priority Target Tracking (GSPTT), Ground Mapping (GM) ensures mapping of terrain under the aircraft for navigation purposes (e.g. terrain copying at night or adverse weather condition), High Resolution Mapping (HRM) ensures terrain mapping by synthetic aperture in order to gain high resolution pictures, RANGING high accuracy ground target ranging and all information is processed by 32-bit computer SDS-80 Ericsson with 7 000 000 operations per second.

Data from radar and other external systems gets to the pilot through the three panels **Head Down Display (HDD)** in the cockpit of the aircraft (Fig 4).



Fig. 4. Head Down Display [4]

This is all due to data communication in real time which can be used for example to supply information to other pilots who get the necessary information to engage in combat action and do not have to turn on active systems on their airplanes, which would made possible their detection.

Another important way to increase the combat use and especially to increase the combat value of the aircraft is helmet system called **HMS ODED** (Fig.5). This system is highly efficient and able to work when shooting at target, which is not in a straight line even when using bullets SRAAM with high maneuverability, which means that it is ready to missile IRIS-T and other belonging to new generation.

3 POSSIBLE ARMAMENTS OF SUPERSONIC AIRCRAFT

Already during local conflicts it has been found that although guided missiles are great in dogfight, if you run out them, you can protect yourselves only by cannon. Another factor that speaks for the gun is that it cannot be fooled by any jamming device or instruments of electronic warfare. The aircraft is equipped with the **Mauser BK27** cannon, which is designed on the revolver

principle. It is, due to the performance, a compact, lightweight revolver manufactured by German company Mauser-Werke.

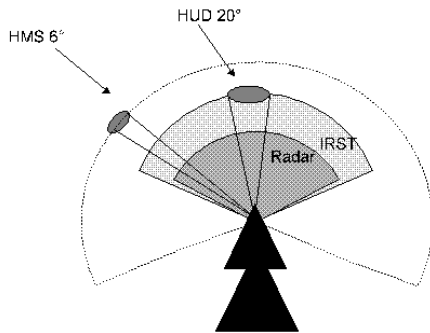


Fig. 5. System HMS ODED [5]

Basic armament is thus rapid-fire cannon BK-27 (Fig. 6) with 27 mm caliber by Mauser company with an optional rate of shooting 1000 or 1700 rounds per minute, placed in the fuselage below the right input air channel into the engine. It may also be equipped with different formations of air-to-air and air-to-surface missiles and bombs. They are hung on 6 wing and 1 fuselage weapon stations.



Fig. 6 BK-27 air cannon for aircraft [3]

For dogfight with aircraft and helicopters it can be armed with air-to-air guided missile with short range AIM-9 with infrared guidance system, medium-range missiles SKY FLASH MICA or AIM-120A with up to 100 km range. It is expected with the introduction of the IRIS-T, Meteor and ASRAAM.

To fight against ground targets and for close air support of ground troops it is possible to hang air-to-surface guided AGM-65 missiles with a range of about 3 km for the combat vessels then antiship guided missiles RBS-15F or other types of guided missiles. It may also be armed with multi-purpose container weapon with anti-

tank, anti-personnel, anti-concrete guided submunition, ballistic bombs and missiles.

Analysis of actual conflicts and simulations of clashes of piloted aircraft carried out since the early nineties clearly demonstrate that more than 30% of aerial combat, no matter on the distance of opponents at the beginning of the engagement, ended at close range. It implies that the critical combat fighter weapon remains a cannon and short-range guided missile - **Short Range Air-to-Air Missile (SRAAM)**.

If the combat takes place at a greater distance than the potential range of cannon, mentioned guided missiles are used instead. These missiles can be divided according to the guidance system and according to range. Basically, we have only three main categories:

- Missiles with active radar homing,
- Missiles with semi-active radar homing,
- Missiles with infrared homing.

For evaluation areas of possible attack is necessary to start from mathematical relations. For example for relative coordinate system holds:

$$\frac{dD}{dq} = \frac{v_s - v_c \cos q'}{\frac{g}{v_s} \sqrt{n_s^2 - 1} \pm \frac{g}{v_c} \sqrt{n_c^2 - 1}} \quad (1)$$

Calculation of the distance is obtained from following expression:

$$D = \frac{V_s V_c}{g \sqrt{n^2 - 1}} \sin q' \quad (2)$$

Distance for positive overload of fighter aircraft is gained by derivative equation of circle of constant overload.

$$D = \frac{v_s v_c}{g \sqrt{n_{\max}^2 - 1}} \sin q' \quad (3)$$

Fig. 7 shows area of possible assault for different opening air assault angles on air target with airspeed 800 kph and interceptor airspeed 950 kph. This figure was made by computer simulation.

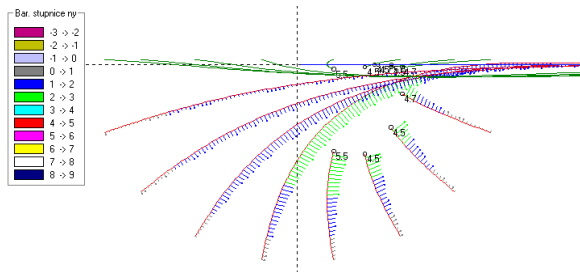


Fig. 7 Area of possible assault on the air target

Next figure (8) presents flight modeling of aircraft attack on ground target with air-to-ground missiles AGM-65 Maverick. Both models are presented in [4] written by scientists from University of Defence.



Fig. 8 Calculation of aircraft manoeuvrability using mathematical simulation

4. CONCLUSION

The aircraft is the first representative of the new generation of multipurpose combat aircraft, that entered operational assignment. It uses the most modern technologies and therefore it is able to conduct a wide range of combat tasks, both air-to-air and air-to-ground, while it can use the most modern weapon systems.

This aircraft is constructed to be able to face present and future threats and to meet strict requirements of flight safety, reliability, effective training and low-cost operation. The aircraft is in the service of

Swedish Royal Air Force and Czech Air Force. It has been ordered by air forces of South Africa and Hungary. The British elite test pilot' school (Empire Test Pilots' School – ETPS) operates aircraft as a jet trainer for advanced training of test pilots from all over the world.

In modeling area of possible assault is clear that in assault from backward hemisphere is this area smallest. From aside it increases and from forward hemisphere is largest. This is caused by energetical abilities of guided missile and range of aircraft's radar.

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