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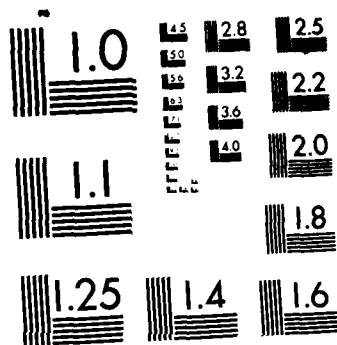
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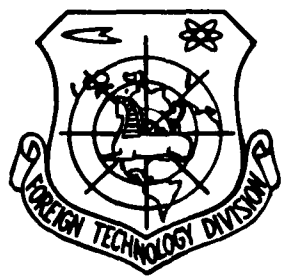
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SU-7 AND SU-17

Li Xin

Su-7 Fighter bomber

/17

In the early fifties, Sukhoi Design Bureau designed two kinds of aircraft in order to contend for the next generation model consideration to replace the MIG-19s then in service in the Soviet Air Force. One was the delta-wing all-weather interceptor Su-9. The other was the swept-wing daytime interceptor Su-7. It was a surprise that both were approved to be put into production. Although Su-7 was designed as an interceptor for air combat, yet with its large wing surface area and abundant fuel tank capacity, complemented by its good performance in low altitude bombing runs, it was then used as a fighter bomber. It was not expected that this "change of application" model later turned out to be an aircraft with powerful development potential. A number of variants of Su-7 were produced (the most distinguished change was from fixed-wing aircraft into variable geometry swept-wing aircraft). The aircraft was still in production and development even into the eighties. Extensive export was noticed. Its effect and influence greatly exceeded those of its twin brother, the Su-9.

The major production version, the Su-7B or the "Fitter A", is a single seat single engine fighter bomber. Major design characteristics are: air intake in the nose; equipped with AL 7Φ 1 turbojet engine rated at 7000 kg and 10,000 kg with afterburning; swept-back 60° on leading edges; no sweepback was observed on the leading edge near the wing-root; two HP 30 guns are installed; four underslung pylons are capable of carrying bombs and rockets.

When Su-7B is carrying out ground support missions, it has definite air combat capability after dropping the externally stored weapons. As a light fighter bomber, the fatal weaknesses

of Su-7B are its short combat range (low altitude combat range is only 300 km); poor takeoff/landing performance; high requirement on airfields. After Su-7B was officially in service in the Soviet Air Force, not only the two seat Su-7Y trainer was developed, but in order to upgrade the performance were Su-7BM, Su-7BKL and Su-7BMB developed. All of these had different levels of enhancement in their performance when compared with Su-7B, yet their ranges as well as takeoff/landing performance were still not satisfactory.

Su-17 variable geometry swept-wing fighter bomber

Sukhoi Design Bureau then made drastic changes in Su-7B by adopting wings with variable sweep angle. The advantage of variable geometry design was to ensure the aircraft's performance either under high speed or low speed. The sweepback angle of the wing could be adjusted according to the requirement of different flight status. The variable geometry Su-7B was named "Fitter B". It kept the same engine. When compared with Fitter A, performance in all aspects was improved though not significantly. On the B version of this aircraft, Sukhoi acquired experiences to convert a fixed wing aircraft into a variable geometry one. R&D expenses were saved. The risk was also greatly reduced in development effort. The prototype of this Su-7B variable geometry design was demonstrated at the Soviet Aviation Day Display in 1967. It attracted a lot of attention.

Later, on the basis of the B version aircraft, the aerodynamic configuration was modified. A new engine $\text{A}7-21\text{B}$ with higher power was installed. Electronic systems with a better performance were also installed. The number of external pylons was increased. Because this new version was much different from the original Su-7, the Soviets gave this aircraft a new serial number, Su-17. In the western world, it is called the "Fitter C".

When compared with Su-7, the speed of Su-17 was increased from M1.6 to M2.17. External store capacity was doubled. Required

runway length was less than half. Its range was increased by 25 to 30%. Maneuverability as well as quality of control were both satisfactory in low altitude flight.

Design characteristics of Su-17 are: cantilever mid-wing monoplane with inner panels sweep angle fixed and variable geometry outer panels. Pivot axis located at one-half position of half wing span. Sweep angle has a variation range of 34° , with a minimum sweep angle of 28° and maximum sweep angle of 62° . The sweep angle is manually controlled. Full span leading edge slats on movable panels. The entire trailing edge of each movable panel is made up of a slotted flap, operable when the wings are spread. Large main fence on each side, at the junction of fixed and movable panels. A shorter fence above the center section on each side, inboard of the main fence.

The fuselage is a conventional all metal semi-monocoque structure with a circular section. Ram-air intake in the nose with variable shock-cone centerbody. A large dorsal spine fairing was observed along the top of the fuselage from the canopy to the fin, with control circuits, avionics and fuel tanks. Four door-type airbrakes on the sides of the rear fuselage on the same cross-section.

The landing gear system is the retractable tricycle type. The nosewheel retracts forward, requiring the blistered door to enclose it. The main units retract inward into the center section.

The power plant includes one A7-21-3 turbojet engine rated at 8100 kg without afterburning and 11,200 kg with afterburning. The fuel system is automatically controlled. The fuel capacity in the internal tanks is 3700 kg. The provision is for carrying up to four 800 liter drop tanks on the outboard wing pylons and under the fuselage.

Two guns are installed as armament. Four pairs of weapon pylons (increased from the two pairs in Su-7 to four pairs: two under the main wing fence and two under the fuselage). When the outboard pylons are used to carry drop tanks, other pylons can be used for ordinary bombs, rockets, air-to-surface missiles with a total 3000 kg.

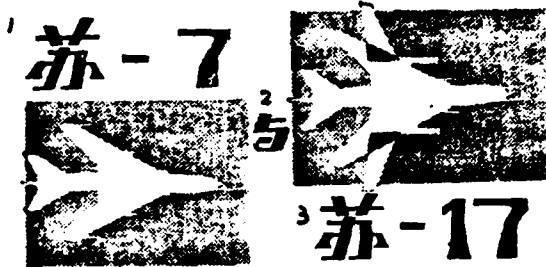
Since the Su-17 officially served in the Soviet Air Force in 1971, it has gradually become the important aircraft for the frontline air force. Export began in 1973. Serial numbers for /18 the exported versions are Su-20 and Su-22. The difference is that equipment with lower performance rates were installed instead.

Single seat versions of "Fitter D,H" and two-seat versions of "Fitter E,G" were then developed after Su-17 was in service. It is expected that these aircraft will be in service until the nineties. From the first service of Su-7 in the mid-fifties, Su-7/Su-17 series have been in use for nearly 30 years. It should be recognized that the aircraft did have powerful potential. The incremental development work of the Sukhoi Design Bureau should be deemed successful.

Principal technical dimensions for the Su-17 are:

Wing span: (swept angle 28°) 14.0 meters, (swept angle 62°) 10.60 meters. Overall length (excluding probes) 15.40 meters. Height 4.75 meters. Wing area (sweep angle 28°) 40.1 square meters, (sweep angle 62°) 37.2 square meters. Takeoff weight (without external store) 14,000 kg. Maximum takeoff weight 17,700 kg. maximum level speed (high altitude) M2.17. Service ceiling 18,000 meters. Combat radius (with 2000 kg stores, hi-lo-hi flight) 630 km. Takeoff run (with takeoff weight 17,000 kg) 620 meters. Takeoff distance (takeoff weight, to 15m altitude) 835 meters. Landing run (from 15m altitude) 600 meters.

Illustrations by Yang Maohua



- 1-- Su-7
- 2-- and
- 3-- Su-17

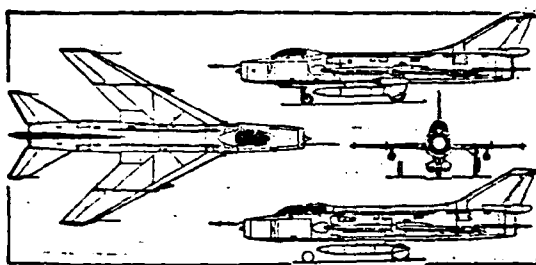


Figure 1 Three-sided view of Su-7

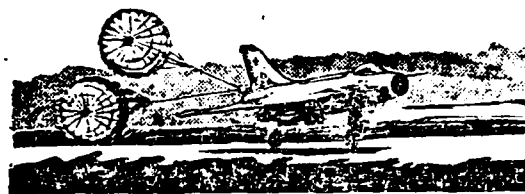


Figure 2 Su-17 ready to land

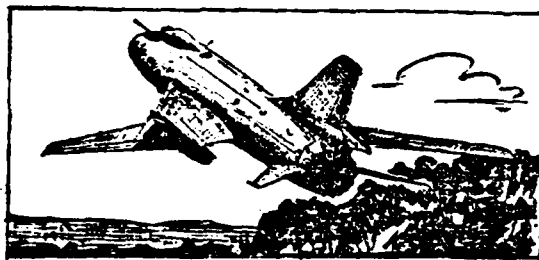


Figure 3 Su-17 takes off

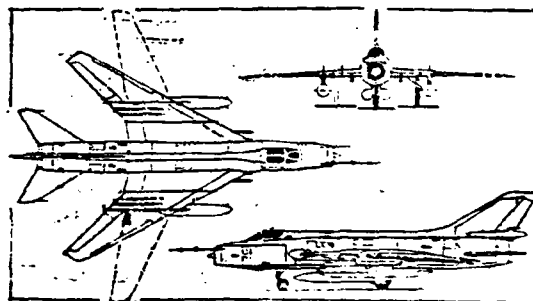


Figure 4 Three-sided view of Su-17

INFRARED DECOY

Wang Zhenwu

The major threat to all kinds of military aircraft in contemporary warfare is the missile; the infrared guided ones play a very important role. Currently, the United States alone has publicly declared more than 100 serial types of infrared guided missiles. Above all, 60% of the air-to-air missiles are infrared guided. In the early fifties, the "Sidewinder" air-to-air missile was extensively deployed in the United States Air Force. The missile, just like its name suggested, acts like a vicious snake devouring aircraft. It accounted for several hundred kills during the Middle East confrontation. Dozens of aircraft were downed again in the Falkland Islands combat. Credit must be given to this weapon system. In order to catch up with the advancement of its intended targets, renovations and improvements were constantly pursued. It now has more than 10 versions to form a "Sidewinder" family. However, the only thing that has not been changed too drastically was the guidance routine. Most of the "Sidewinder" missiles are still using infrared homing to engage the targets. Infrared homing uses the detection head to locate and chase the source of infrared radiation. The detection head is actually an infrared sensor installed in the nose of the missile. It is composed of an infrared sensing module and control module. It is able to automatically guide the missile to chase the target according to the position of the target. An aircraft is a very large target of heat radiation. Both the metallic heat of the engine nozzle and the exhaust airstream are very strong sources of heat radiation. This is especially true for aircraft with afterburners. When afterburning is activated, the heat radiation is increased by several dozen times. Thus the infrared guided missile engages the target until destruction. Well, then, does it mean that once the aircraft is being chased by such a missile there is nothing else to do but "wait to die"? No. Contemporary combat aircraft have all been equipped with relevant infrared countermeasures to deal with the threat from an infrared

missile. Among all of these countermeasures, the one that was first developed and most widely applied is the so-called "scape-goat" infrared decoy.

The infrared decoy is a type of deceiving fake target during opto-electronic confrontation. It is used to evade passive target detection missiles. The passive target detection type of missiles have a common fatal weakness. That is while seeking, chasing targets, the missiles depend entirely on the guidance head that is infrared sensitive. Usually these guidance heads do not have the capabilities to distinguish among real and fake targets. They will "engage" any targets as long as the radioactive characteristics are similar, and the radiated energy is strong enough. Therefore, they are easily deceived. The following types of decoys have been installed, or are going to be installed, in foreign countries.

Smoke and flame decoy

The early United States smoke and flame decoy was converted from a photographic flash bomb. The chemicals consisted of magnesium powder and potassium nitrate. This type of decoy gave similar heat radiation as the tail heat of an aircraft while burning and a close spectrum of the tail flame. However, the radiated energy was weak and the combustion time was too short. The deceiving effect was not satisfactory. Significant portions of this type of decoy that are manufactured now in the United States are developed and improved on this basis. One company is now producing an infrared decoy bomb with 50 millimeter diameter. The chemicals consist of magnesium-polytetrafluoro-ethylene and nitrated cotton. The combustion time is three seconds. Radiated power is 15 kilowatts. The infrared radiation wave length locates in the near infrared band. /19

The schematic representation of using a smoke and flame decoy to evade infrared missiles is shown in Figure 1.

A smoke and flame decoy is easy to use. When the aircraft is threatened by infrared homing missiles, it will then fire the decoy. The decoy in turn attracts the missile. Thus the aircraft eludes the danger. A smoke and flame decoy is inexpensive and simple. It is a typical decoy used in the opto-electronic confrontation.

Composite decoy

The composite decoy has recently been developed. The conventional smoke and flame decoy had been successful to deceive infrared missiles thus greatly reducing the probability of kill. In the recent years, therefore, the air-to-air and surface-to-air missile systems have extensively adopted composite guidance with infrared and radar (or television). The composite decoy, therefore, came into existence. A composite decoy can simultaneously deceive the infrared and radar guidance systems. The configuration can generally be categorized into two types. In the first type, both infrared decoy material and jamming metallic platinum strips are installed into the same shell. When the decoy explodes, the metallic platinum strips form a jamming layer while the chemicals ignite to form an infrared decoy. Thus missiles guided by an infrared radar composite system can be taken and suppressed. Another type uses metallic platinum strips with smoke-flame agents possessing corresponding infrared radiation attached to one side. The other side of the strip is painted black. The strips thus treated are then fitted into the shell. The decoy is shot into the air, exploded and combusted to generate an infrared-radiation zone and jamming zone. It also has the dual effects of deceiving and suppressing/jamming.

Fuel type of decoy

This type of decoy is generally formed with specific fuels carried by the aircraft. When the aircraft is threatened, it then spreads the fuel towards the direction that the threats come from.

When the fuels are ignited, a combustion zone will be generated. A strong source of infrared radiation similar to the aircraft tail heat source with equivalent radiation characteristics of the tail flame results. Infrared missiles are attracted by this fake source. This is represented in Figure 2.

Principal advantages of this type of decoy lie in that the composition of the fuel can be adjusted conveniently according to actual requirements. Thus, optimal effects of elusion can be achieved.

Definitely, the infrared decoys are not limited by the above categories. With the development of modern infrared weaponry, there will be more advanced decoys to emerge. However, no matter what type of new decoy it will be, it must be matched with its carrier in the radiated spectrum. Its radiated energy must be strong. It must be able to maintain a longer period of existence when in use. Thus, better deceiving effects can be achieved. It will then be a perfect "scapegoat" for the aircraft.



1-- Infrared Decoy

2-- Wang Zhenwu

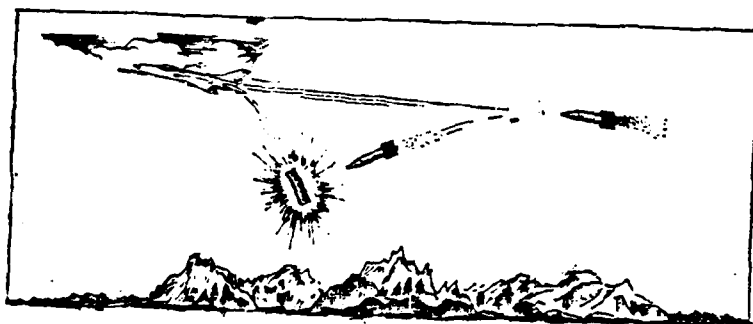


Figure 1 Schematic representation of using Smoke-and-flame type of decoy to elude infrared-guided missiles

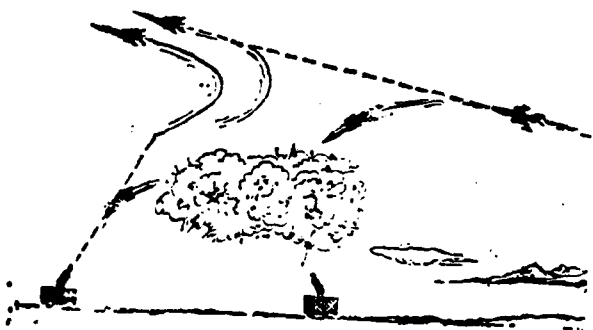


Figure 2 Schematic representation of using fuel type decoy to elude infrared-guided missiles

Comrade Editor:

Your journal has published in September 1979 a paper entitled "Soviet Fighters". It pointed out that "the variable geometry swept fighter bomber Su-20 is derived from the fighter bomber Su-7". However, in your December 1983 issue, you published another paper, "Nomenclature of Soviet aircraft", which pointed out that "the new variable geometry fighter bomber Su-19 was put into batch production. It was renamed Su-24. The export versions were named Su-20 and Su-22 fighter bomber". If Su-20 was derived from Su-7, how could it be the export version of Su-19? Furthermore, in your October 1983 issue, in a paper entitled "Aerospace News", you have illustrated in the caption of a similar Su-22 three-sided view that "Su-22 is the export version of Su-17 fighter bomber". If Su-22 was the export version of Su-19, how could it be the export version of Su-17? Can you explain the relations between Su-7 and Su-20; Su-20 and Su-22; Su-19 and Su-20; Su-17 and Su-19; Su-19 and Su-22.

Your sincere reader,
Wu Xin, 3rd High School
Chungching

Fellow Student Wu:

I must first correct an error. In our published paper, "Nomenclature of Soviet Aircraft", it was incorrect to state that Su-20 and Su-22 were the serial numbers for the export versions of Su-19. They should have been the serial numbers of Su-17's export versions. A summary introduction for Su-7, Su-17, Su-19, Su-20, Su-22 and Su-24 is presented in the following. Relations between these aircraft can be identified from the summary.

Su-7. Su-7 was based on the requirements of the Soviet Air

Force for a next generation aircraft to replace MiG-19s and designed by Sukhoi Design Bureau in 1950. It was a fixed wing swept daytime fighter. Single seat and single engine, air intake from the nose. The first flight was conducted in 1955. Production commenced from 1958. It started its service in 1959. It was designated as Su-7B. NATO referred to this aircraft as "Fitter A". Although this aircraft was designed to perform as a dog fighter interceptor, however, due to its large wing area, relatively more capacity to carry weaponry than other contemporary interceptors, plus its good performance in low altitude bombing runs, Su-7 was extensively used as a fighter bomber. Besides the Soviet's own use, it has been exported to Algeria, Czechoslovakia, Egypt, East Germany, India, Poland and Syria. The 30-mm guns were installed near the wing root. It has definite dogfight and self defense capabilities after it releases the external stores. Major weaknesses include short combat range--its low altitude range is only 300 km radius--and poor takeoff/landing performance. It was not suitable to use in frontline airports. Except Su-7B, there were other versions such as Su-7BM with afterburner; Su-7BMK with improved takeoff/landing performances and Su-7BKL.

S-17, -20, -22: Su-17 was derived from Su-7. It was developed from a fixed wing swept design to a variable geometry swept version. The prototype Su-71G was first demonstrated at the Soviet Aviation Day in July 1967. Since this was the first development effort of the Soviets on variable geometry aircraft, only the outboard of the wing at half span (about 4 meters) was pivoted to reduce the development risk. All other parts, including the engine, remained the same. When compared with Su-7, except that the takeoff/landing performances were improved, total performances have not been enhanced significantly. Based on the prototype Su-71G, a more powerful power plant AL-21F-3 was installed, better electronic systems were incorporated, external pylons were increased; loading capacity was also increased, thus the official production type with serial number Su-17 resulted. NATO gave this aircraft a code name "Fitter C". When compared with Su-7,

Su-17 had better takeoff/landing performance (required length of runway was less than half of Su-7). Its external store capacity was doubled. Range was increased by approximately 30%. The Su-17's in the Soviet Air Force have several other variations. One of those is called "Fitter D" by NATO. It has the characteristics of extended fuselage by 38 centimeters. A radome was added under the nose.

Su-17 has two export versions: Su-20 and Su-22.

Su-20 is the direct export version of Su-17, but replaced with lower standard equipment. Some western publications presumed that the AL-7F-1 engine rated at 10,000 kg originally used on Su-7 was installed on Su-20. This aircraft has been exported to Algeria, Egypt, Iraq, Poland and Vietnam.

Su-22 was the export version based on Su-20 yet with further simplification of equipment. The first sale to Peru was made in 1977 with two shipments or a total of 48 aircraft. This was the first time that a South American country employed Soviet fighters. It was reported in foreign journals that there was no Doppler navigation system on these aircraft. Furthermore, a Sirena 2 radar warning and homing system with poorer performance was used instead of the Sirena 3 which provides 360° coverage. The identification friend or foe (IFF) system was incompatible with SA-3 surface-to-air missiles.

Su-24. Su-24 (Su-19 before 1981) is a two-seat, two-engine variable geometry fighter bomber developed in the mid-sixties by the Sukhoi Design Bureau. The configuration is similar to the U. S. F-111. Air intakes are located on both sides of the fuselage. Two seats are aligned side by side with engines installed side by side at the rear section of the fuselage. The size of the aircraft is between that of the U. S. F-111 and the western European "Tornado". Each wing comprises a fixed glove-box and pivoted outer panel. The pivot is closer to the fuselage

than in Su-17. The leading edge sweepback on the outer panels are at minimum 23° and maximum 70°. It can be adjusted at three positions: 23°, 45° and 70°. As far as the power plant is concerned, two possibilities are reported. One assumes that similar power plants used on the Su-17, AL-21F-3 turbojet with afterburner, were installed. This engine is rated at 8000 kg without afterburning and 11,200 kg with afterburning. The other assumption was based on the proportion of the fuselage and the air-intake duct, that two R-29B turbofan engines by Tumansky Design Bureau were installed.

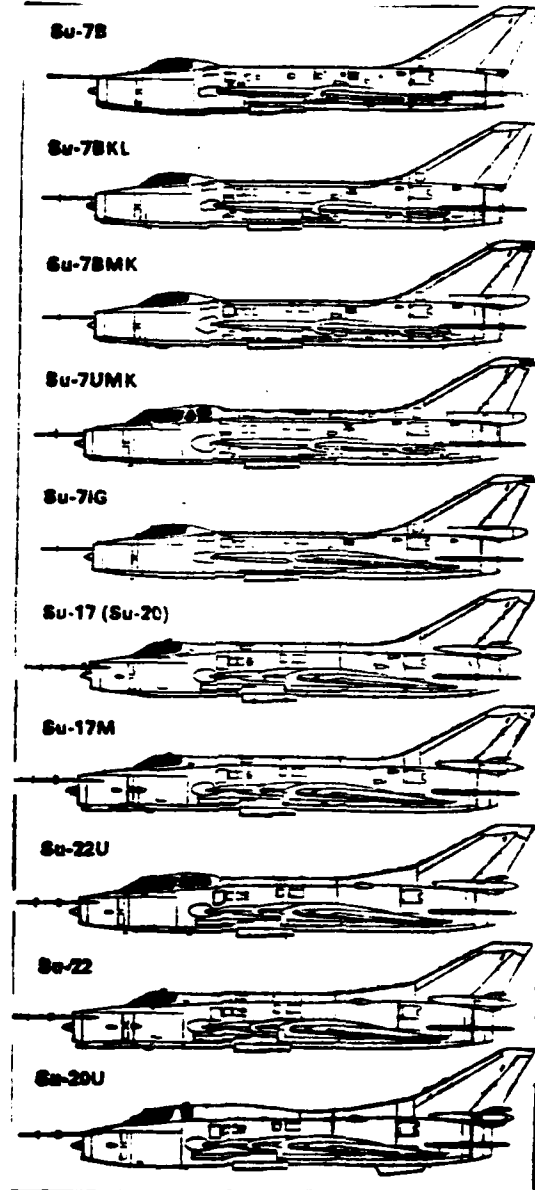
It is generally recognized that Su-24 is the first Soviet fighter bomber that is designed specifically for the ground attack mission after the Second World War. Both range and store capacity are significantly enhanced. It is equipped with avionics to perform all weather and low altitude penetration missions. It is believed to be the most advanced Soviet aircraft thus presenting the most threat to western European countries.

Fellow student Wu, I have concisely summarized three types (with five versions) of Soviet aircraft herein. Their relationships were explained. As far as detailed technical data and performance are concerned, Hangkong Zhishi has already published a few papers regarding this information. I will not repeat them here (refer to the figures on page 21, lower right).

(answered by Zhong, Chi)



Friend of the Readers



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