

How the Malaysian "Boeing" was shot down



Because since the first day after the moment of the crash of the Malaysian "Boeing" I adhere to the version where the airplane was shot down by the Ukrainian SU-25 attack jet, I simply cannot refrain from publishing a new investigation, which summarizes the arguments on this topic.

A rod from the "air-to-air" missile R-60M was found among the wreckage of MH17



A model was assembled in Holland using of the fragments of the "Boeing" that was shot down in Donetsk. Using the photos of the fragments from the crash site, it is possible to approximately reconstruct the airframe. Among the photos there were at least two that refute the version of the attack against the plane using the "BUK" complex.

On one of the photos we can see the object, which looks like a rod from the AAM missile R-60M. On the other photo — a round hole in the air intake of the right engine. There are at least nine holes in the skin that are characteristic of the effect of an "air-to-air" missile.

Circular, square, rod-shaped — what hit the Boeing

Already by the next week, on the 3rd, 5th, and 6th March of 2015, almost five thousand people — relatives and friends of those who died in the "Boeing" catastrophe in Donbass — will be able to see the model of the Malaysian Airlines Boeing-777 that is made out of wreckage on the air base Gilze-Rijen in Holland. The last major fragments, a whole truck of them, are still located in Petropavlovka – the Dutch journalists managed to reach them only by February 22 of 2015.

UPD

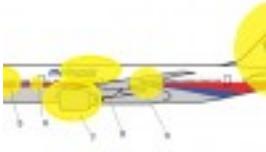
Photo from the hangar, 03.03.15



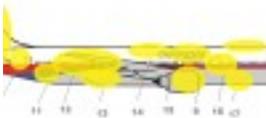
[Source](#), [Source](#)

RECONSTRUCTION

[The left side of the "Boeing".](#)



[The right side of the "Boeing".](#)



The left side of the pilot cabin immediately attracted the most attention, the aircraft had the most damage there. The largest hole in the center of the fragment has ragged edges, bent outside, which is characteristic for an internal explosion or decompression due to a sharp change in pressure.



Further on the photo we see more than 20 large round holes, which penetrated among other things the glass framing and the left side of the cabin. The material of the skin in this area has the highest density — it is made of reinforced aluminum (titanium plates are used according to other data), which is laid out in two layers in order to prevent cabin damage in the case of a possible collision with a bird. According to some data, the thickness of the first layer is 1.8 mm and the thickness of the second layer is 0.8 mm.

We also know that the thickness of the most part of the skin of the fuselage of the "Boeing"-777 is only about 2 mm (0.09 inch)

As we zoom in the photos, we can see a huge number of small marks-"pockmarks" and black patches of soot on the external side of the cabin, and also the edges of the external skin that are bent inside. This suggests that the warhead exploded in close vicinity from the plane's skin. By some estimates, [the distance between the pilot cabin and the epicenter of the explosion could be between 50 cm to 4-5m](#). At the same time the radius of the impact zone of the "BUK" is 17 m, the missile explodes above and ahead of the target, making a climb, and creates a large cloud made of six thousand of shards. ([source](#)).

[Citation from mh17webtalks](#): Detonation products — it was precisely them which left the numerous number of traces on the cockpit fragments — lose the ability to inflict mechanical damage (lose the kinetic energy) at the distance from the site of explosion equal to 15...20 radii of the explosive block. Correspondingly, given the explosive block radius of 10...15 cm we get 1.5...3.0 m The blast wave comes first after the start of the explosion, then go the hot gases, and then, due to being more bulky, shrapnel fragments. But gas slows down very quickly, so its traces can be found only next to the site of explosion.

The "BUK" doesn't match the photo with respect to the distance from the explosion. Well, perhaps it matches size of the holes?

To find out the diameter of the holes in the skin of the cabin we need to know the diameter of the head of the standard aviation rivet. It [is equal to 0,488 inch](#) or 11 mm.



By correlating the parameters we get the size of the holes of about 20-30mm. The diameter of the round holes in the skin of the cabin in the size of 2-3 diameters of the hat of the aviation rivet.



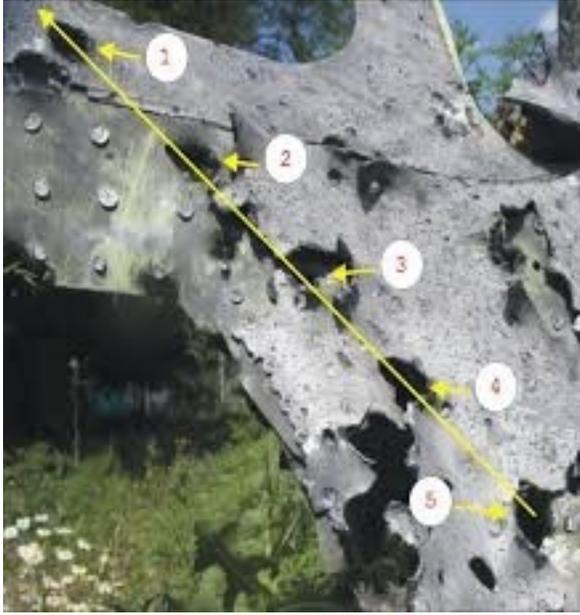
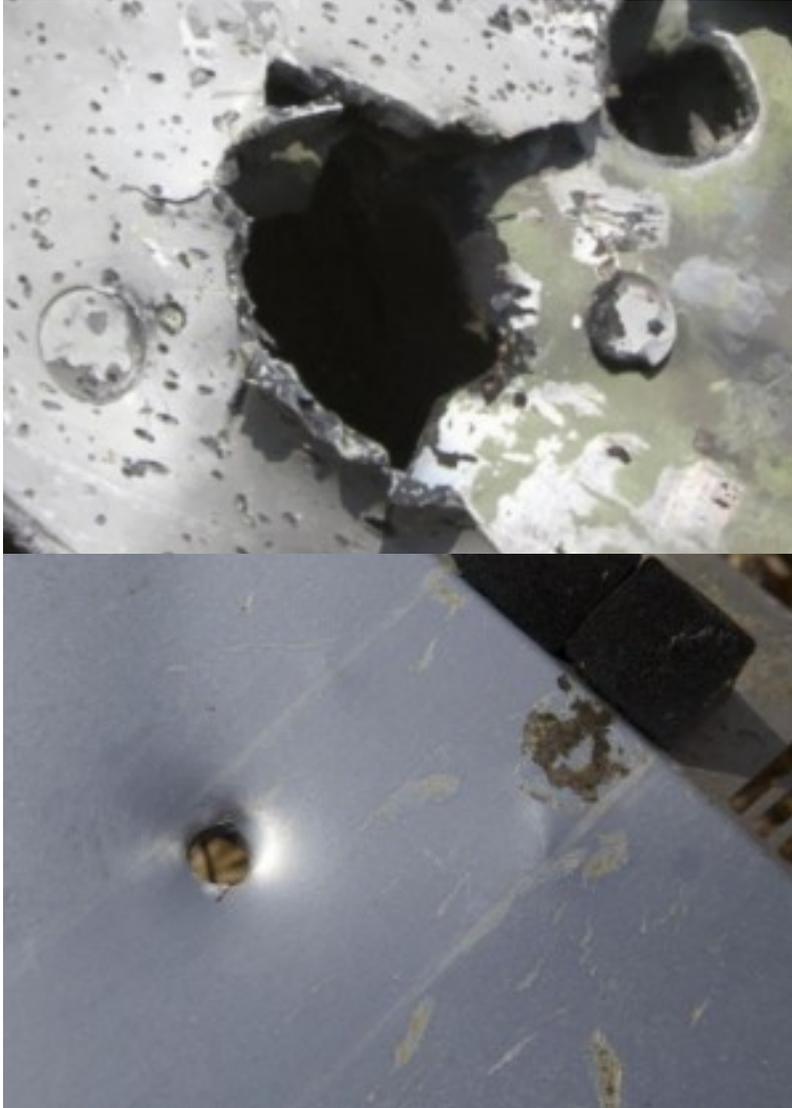


Figure 10: Cockpit floor with floor parts showing puncture holes (red circles) coming from above the floor. (Source: N844)





The yellow-red outlines of some holes are faintly visible on the first photo — perhaps, this is a trace from the copper casing of the shell that produced these holes.

(As a bullet penetrates an obstacle, it pushes some of the obstacle's material forward and widens it, leaving the particles present on the bullet on the hole that is being formed. The band of rubbing, which is several millimeters wide, leaves the particles of the soot produced during the shot, the gun grease, metallic particles from the barrel and from the bullet itself).

However, there is no copper on the shrapnel sub-projectiles from the "BUK", but there is copper on the shells of aircraft cannons.





The ribbon of armor-piercing and high-explosive shells in an aircraft cannon, the shrapnel elements have cylindrical shape.

This is shown clearly here: [How the aircraft cannon GSh-30 shoots](#)

Besides several tens of round and oval holes, in the front part of the "Boeing" there are **at least five more holes, which have rectangular and square shape**. However, none of them penetrated the skin on the outside, so it is hard to determine their size. But we can speak of the sizes above 1 cm.





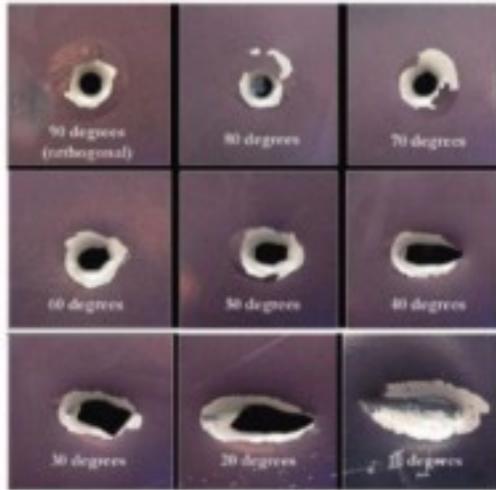


Figure 9: Part of the inside cockpit roof, indicating penetration with objects from outside. (Source: D

In the description of the R27 missile characteristics, for example (it can be also mounted on Su-25), it is said about the presence of prepared cubes above the rods in the warhead of the missile. The former service members of the Russia and Ukraine air force write on their forum that R-60 is equipped with ready-made shrapnel elements in addition to the wolfram rods (a similar description of the shrapnel and rod-based warhead is present on other websites). (A magnified image of the warhead of the R-60 training missile.) Besides this, not a single known hole on the airplane skin, which includes the skin of the pilot cabin matches the last shown element.

The skin on the side of the pilot cabin attracts attention. The charge of a fragmentation warhead may enter various surfaces of the "Boeing" at various angles. The shape of the hole may be different depending on this — for example it may be round (if a spherical sub-projectile hits at the right angle) or it may be elongated (at acute angle). Here is how this looks like when a regular bullet hits metal.

Dieses Bild zeigt Einschüsse aus verschiedenen Einschusswinkeln, vergleicht man damit das Einschussloch in der Tat, ergibt sich ein Einschusswinkel von ca. 25°.



Perhaps, this is what explains the presence of holes of various sizes on one of the skin pieces to the side of the pilot cabin (Point 4 on the scheme of the [left side of the Boeing](#)).

By comparing the holes with the rivet heads we can see that the width of these holes varies between 3 cm and 10 cm. The angle of penetration of these shards may be equal to 25-30 degrees.

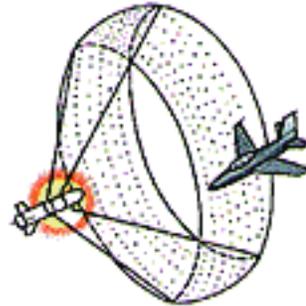




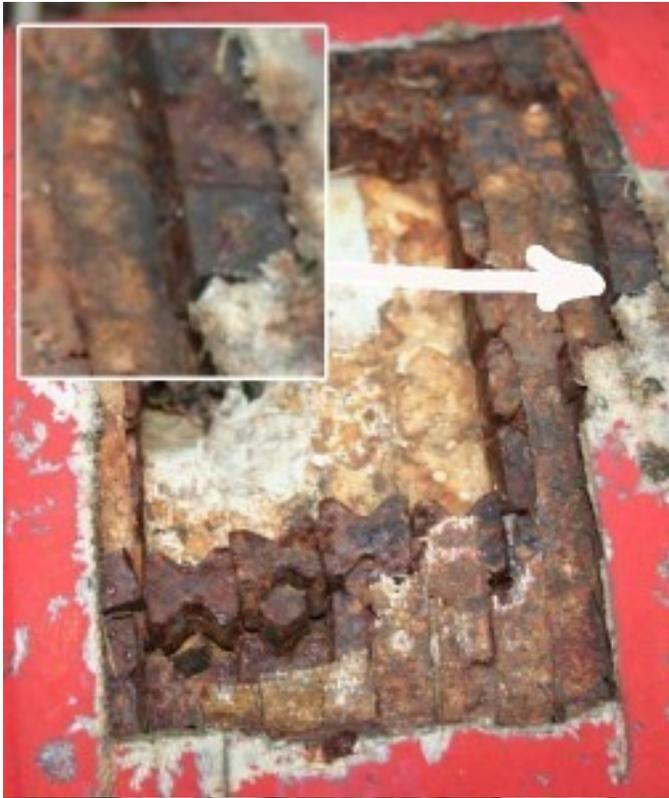
HOW "BUK" FIRES

The 9M38M1 missile, which is used in the "BUK-M1" complexes, consists of the fragmentation warhead 9H314, which weighs 70 kg. In its base there

are 32 kg of sub-projectiles (4500 sub-projectiles, each weighing 8 g in the shape of an I-section [something between the shape of H and X] and of 1500 cubes, each weighing 4 g). [The source](#)



On the internet there is a photo of one of the warheads of the missile complex. **The I-section shrapnel –13 mm. The diameter of cubes is below 10 mm.** [Source](#) and [another source](#)



If this type of the "ground-to-air" missile was used to attack the "Boeing", then the majority of the shrapnel holes would leave characteristic rectangular-shaped traces (the I-shaped fragments have better penetration force capabilities than the cubes).

One of the "Livejournal" users conducted an experiment — the "BUK" would have to leave the following type of traces in the skin of the "Boeing" if

at least several sub-projectiles out of 4.5 thousands flew into it at an angle close to the right angle.

Gunfan
Участник

2014-12-17 18:11:39

Наконец удалось проверить, какой след оставляет в дюралевой обшивке пресловутый "двухтарник", как его окрестили в интернете, точнее, X-образные готовые поражающие элементы, которые видны на разрезе корпуса БЧ Бук. За неимением настоящего, пришлось изготовить подобный. На отверстие в центре можно не обращать внимание: "я его слепила из того, что было".
Материал - сталь, скорость около 1500 м/с.



А вот результат попадания.

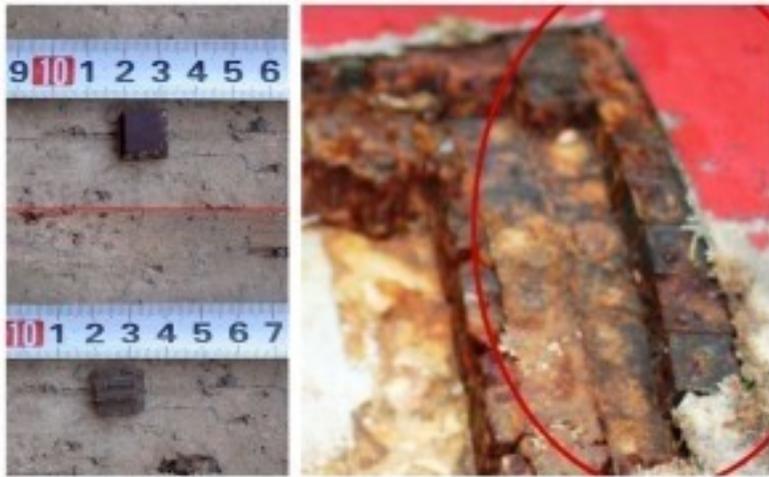


К сожалению "крестик" подошел к преграде имея некоторый угол, поэтому отпечатался не плашмя. Тем не менее в такой пробине его можно легко узнать. Так, что, если бы вблизи Боннга взорвалась БЧ, оснащенная ПЗ такой X-образной формы, на оставшихся деталях обшивки до сих пор можно было бы увидеть подобный след. Таким образом, версия о применении ракеты Бук той модификации, которая имела характерные поражающие элементы, выглядит вполне правдоподобно.

[A detailed description of the experiment HERE.](#)

On the skin of the discovered fragments of the "Boeing" there is not a single hole of this size.

Furthermore, as the author of the experiment states, the sub-projectiles flying at the speed of 1200 m/s would have to leave a more clear trace in the thin material of the fuselage rather than say in the plating of the cabin, where the aluminum layer is reinforced. With the correction for the HE charge and the penetration angle, the "BUK" fragments may leave traces with the diameter of 18-20mm in the skin. One may read about the real sizes left by the fragmentation charges [here](#), [here](#), and [here](#).



Two square fragments that were found in the cabin were [exposed](#) — one of them ended up being made of ceramics, the other one didn't match due to the beveled edge.

How an airplane that was shot down using a "BUK" looks like

On the internet there are photos of the remains of three airplanes that were shot down over the last 15 years presumably using "BUK" SAM complexes. In all three cases the crew remained alive for some time after the missile strike. In all cases the skin of the airplanes looks roughly the same: many small round or cross-shaped holes. [More detail here.](#)



The wreckage of An-26 plane, which was shot down in Ukraine on July 14, 2014, at the height of 6500 m.

It is well-known that on June 29 of 2014 the militia fighters captured the military unit 1402 in Donetsk, where there was one defective "BUK" vehicle. However, at that time the DPR representatives said that [they are not going to repair it](#). It is also known that the "Osa" complexes that are present in Ukraine are also able to hit the targets like An-26 or Su-25 at the height of 6000 m.

Rod-shaped holes. One of the rods was found

We can see at least three cutting holes among the wreckage: on the left wing, in the area of the second left door, on the elements of the tail (see the scheme [Left side of "Boeing"](#)). For example, the hole in the skin next to the second left door has the length of about 10 cm.



The left wing



The cabin floor near to the second left door.

Next to this hole and the frames that are "cut" along it we can see an elongated element, which is externally similar to a fragment of the rod-shaped sub-projectile from the "air-to-air" aviation missile R-60M. [The original photo](#)



The skin of the lower part of the fuselage, next to the second door on the left [Source](#)



Left – this is approximately how the rod-based warhead that is used on the Ukrainian attack jets looks like ([Source](#)). Right – the warhead of the R-60 missile



The cross-section of the rocket without the striking elements [Source](#)



Фото 16. Ракеты Р-60М на внешней подвеске самолета

P-60M	
Длина, м	2,1
Диаметр, м	0,1
Размах крыла, м	0,39
Масса, кг	45
Масса БЧ, кг	3,5
Скорость	2,5М
Диапазон высот поражения цели	0,03
Максимальная дальность пуска, ППС/ЗПС	10/8
Минимальная дальность пуска, ЗПС, км	0,3 -

REFERENCE Su-25M1 attack jet, R-60M missile

The material of the warhead rods is the alloy of zirconium and molybdenum / wolfram. The warhead has relatively low power and is maximally effective by penetrating inside the frame of the target airplane. The detonators are the non-contact radio detonator "Kolibri" (developed in 1971) and also the contact backup detonator. The radius of the radio detonator is 5 m. The damage radius is 2.5 m. [Source](#)

Here is a description of the R-60M warhead (the 62M model). The rods used in it are a bit different from the classical thin elongated sagittal rods. In the export variant a set of "pseudo-rods" is used. These sub-projectiles are made of wolfram, which is heavier than steel. "The overlapping sub-projectiles made of wolfram, which is twice heavier than alloy steel. The cut the power wing set, airframes, and engines," — says the description of the R-60M warhead.

Some sources state the mass of the rods: 3 g. The mass of the warhead is 3 kg. The rods are laid out in the case with a triangular framing — the rods probably have triangular section. "The space between the case and the rod-shaped sub-projectiles is filled with TNT, which has pyramidal holes next to each semi-prepared sub-projectile in the casing. The sub-projectiles weigh 3 g and reach the speed of 7.5km/s" ([Source](#))

"The rod-shaped warhead of R-60M (62M) with wolfram rods laid out perpendicularly would result not in linear but rather in huge delta and diamond-shaped holes.

Only R-62 and, starting from the 80s, R-62M were exported. 70% of both missiles had a shrapnel (or "pseudo-rod based") rather than rod-based warhead.

[Source](#) and [HERE](#) - <http://vkjournal.ru/doc/3501214>

We can see large inbound ragged delta-holes, for example, on the right side in the skin of the second compartment. The soot trace can be seen on one of them. Besides, two similar holes can be seen on the floor of the front baggage compartment, not far from the pilot cabin.

Six delta- and diamond-shaped holes and three cutting holes on the left wing and on the lower part of the skin next to the second left door:







[Source](#)



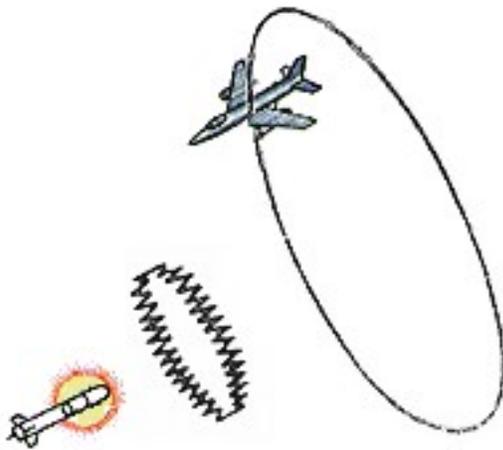
[Source](#)

The shapes of the holes match the damage that would be expected from the warhead of the R-60M, which is mounted on Su-25M1 attack jets.

The missile could target the "Boeing" engine but explode in 5 m to its side, which may include the area next to the left wing and the floor near the L2 exit, where the two holes characteristic to the rods were found. The Ukrainian PO "Arsenal" worked on modernizing the missile. The missiles were equipped with almost full-perspective infrared guidance system OGS-75T "Komar-M". *(It supports magnification of the view up to 2/4 or even 1/4 (the possibility to launch into the front hemisphere of the target given the bearing at a certain angle), it is provided by the cooling of the photo-receiver of the target-seeking head. Serial production was done by NPK "Progress" (city of Kiev, [source](#)). The targeting range — sector of 34 degrees. The maximum speed of target displacement – 35 deg/s).*

It is also possible that after activating the lifting charge at the closest distance to the "Boeing" the warhead opened and the carrier R-60 hit the skin

of the "Boeing" in the area of the landing gear chassis, close to the engines.



"Shrapnel-rod warheads are typically used on the "air-to-air" missiles due to their compact size. At the moment of the closest approach to the target, the lifting charge is exploded and a beam of rods heads towards the target at almost space velocity. If there is a hit, such a rod may be able to fully penetrate the airplane just due to the kinetics in almost every plane, destroying the internal infrastructure of the airplane and ruining the onboard equipment. The kinetics of the rod is such that it may be able to cut even a titanium longerone in two. Such warhead has another advantage: the missile doesn't need to be perfectly precise — it is blown up before contacting the

target and the rods spread towards the airplane in a cone. Even if only 2-3% of these rods hit the target, the plane is doomed." [Source](#)

HOW THE MH17 "BOEING" WAS SHOT DOWN

Just seven seconds passed after the moment of the last response by the MH17 crew until the loss of the connection with the airplane. The crew didn't have enough time to tell the dispatchers about any threatening situation (if we believe the authenticity of the "missing" records from the air traffic control office in Dnepropetrovsk). So, the events in the pilot cabin unfolded rapidly.

After the impact the "Boeing" was turned around, it sharply lost airspeed — from 900 km/h down to 400 km/h and later it planned from the height of 10 thousand meters down to the height of about 2 thousand meters. The residents of Grabovo and Torez heard two very loud bangs in the sky. After going below the clouds, the "Boeing" started to disintegrate — a large piece of the fuselage landed in a forest plantation the closest to the original place where the plane was hit. This was a part of business-class and of the second compartment of the economy-class. They were found in Petropavlovka. Next to it, in Rassypnoye they found the separated pilot cabin and the bodies of 40 more people. The tail and the central part of the fuselage, along with the landing gear and the wings flew the farthest — in the field of the Grabovo village.

Between July 2014 and February 2015 the majority of the Boeing pieces were found. The right wing and the right side of the business-class, and also the nose of the "Boeing" are missing. Up until now three passengers of the plane are not identified. Overall, there were 298 people onboard. Metallic fragments were found in the body of the pilot, according to the Malaysian press. Overall, 25 metallic objects that triggered investigators' suspicion were found.

The left side of the cabin, the skin of floor of the cabin received the most damage from the shrapnel elements. Numerous holes are visible in the area of the crew commander chair, several holes — in the chair of the second pilot. At least four holes are visible in the body of the crew commander. All of these holes have round shape.



The back of the seat of the second pilot, numerous holes can be seen on the side and in the back.



Considering the remains of the soot and a large number of small black dots — the traces of impact by the detonation products, the missile charge was engaged in exactly this area — outside the pilot cabin at close range.

Considering the height of this flight – 10 thousand meters, the cabin could be reached either by a SAM complex (S-300, "BUK") or by an "air-to-air" missile.

And because there are no traces of the impact of rod-shaped sub-projectiles in the pilot cabin, but there are many holes with jagged edges — it was a fragmentation charge that exploded there. Such shells with round contact

elements are used in the GSh-30 aircraft cannons, they are also characteristic for the S-200 and S-300 SAMs.

Because there are no cross-shaped traces — the dominating sub-projectiles of the BUK missile, and because the actual explosion occurred at the distance of no more than 5 m, we may reject the version of the use of BUK. The S-200 complexes are "not used" in the Ukraine since 2001, nobody recorded a launch of S-300 missiles in this area.

ATTACK ON THE BOEING FROM THE RIGHT, "IN PURSUIT"

Thus, the version of one or two Su-25M1 attack jets arose. These are modernized attack jets, which are present in Ukraine (by the moment of the tragedy, the Ukrainian air force had five such jets — one of the six Ukrainian Su-25M1 was shot down one day before the "Boeing" catastrophe).

Besides the object found among the wreckage, which is similar to the rod-shaped sub-projectile of the R-60M missile, this version is confirmed by the fragment of the air intake of the right engine of the "Boeing".



The fragment faces us upside-down — on the left side we can see a piece of the internal skin that was torn out and the right side is the other side with faint RR letters — if this piece is turned, then this will be a part of the air intake of the RIGHT ENGINE.

This small hole was discovered on the right engine of the "Boeing" — as stated by the authoritative sources of the [Wall Street Journal](#). The edges of

the hole are torn to the outside, so in this case the piece of shrapnel penetrated the air intake by flowing from the tail side.

There is another piece of the engine — the rim of the turbine with the traces of the inbound holes, however it is impossible to determine which of the engines it belongs to. It is known that [this fragment was found](#) in the outskirts of Petropavlovka, where the right air intake was located. However, the left door was found here as well, which is located in front of the left engine.



If this is indeed a fragment of the right engine, then the fire was performed using an aircraft cannon from the right and the back and later from the right side through the broadside and the right engine towards the pilot cabin. Most likely fire was opened at close range (about 500-700m).

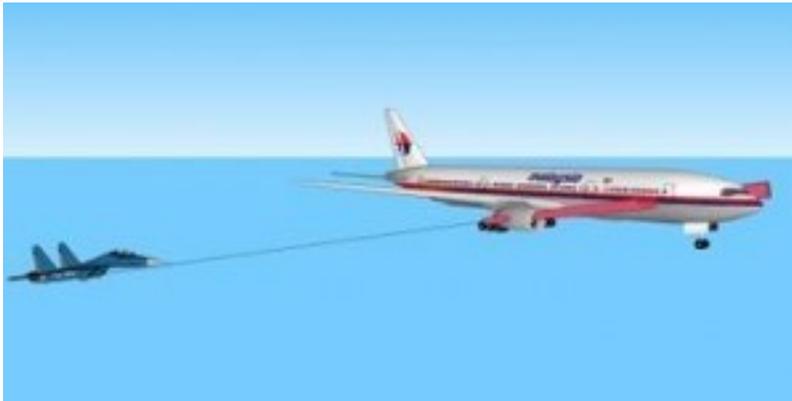
The right side of the "Boeing" skin between the cabin and the second door on the right wasn't found (at least, there are no photos of it in the open access) Wall Street Journal published the photos of the baggage shelves from the right side of the business-class. At the Gilze-Rijen air base the journalists were not allowed to come close to precisely these fragments of business-class by covering them with squares because the objects are of interest to the investigation.



[Source](#) [Source](#)

Su-25 (Rook).

The aircraft is equipped with double-barreled immobile GSh-30 cannon on the left of the airframe in the lower nose part of the fuselage (the caliber is 30 mm, the ammunition load is 250 shells), which is mostly supposed to destroy weakly armored targets like APCs. Additionally, up to 4 GSh-23L cannons may be mounted, each of which has a mobile barrel that can veer down by 30 degrees (the ammunition load is 260 shells), and also two "air-to-air" missiles R-60 or R-27. In some variants it is possible to mount the R-77 missiles.

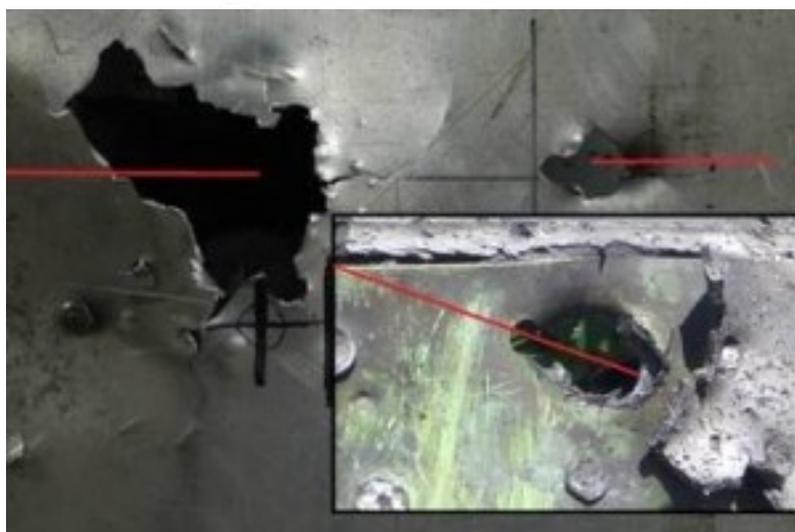
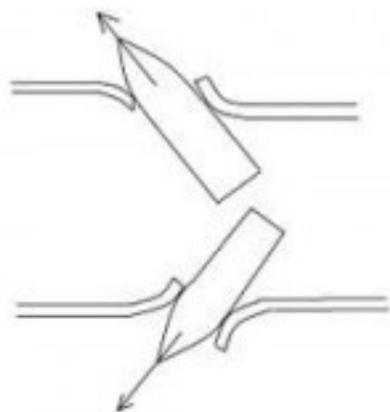


Here is how the first attack using the aircraft cannon from the right and the back "in pursuit" — the bullets penetrate the engine skin, the right side of the business-class and hit the pilots in the back. [This version is considered in more detail here.](#)

Either the aircraft cannon GSh-30 with armor-piercing or fragmentation ammunition (see above) with the caliber of 30 mm or the four cannons GSh-23 with the ammunition of 23 mm caliber could be used for shooting. Several holes on the discovered piece of skin of the pilot cabin and also the back of seat of the second pilot were most likely damaged by the shrapnel no bigger than 20-30mm, which flew from the side of the tail. This is suggested by several sources at once ([link](#) and [another link](#)).

The pilots didn't see the attack jet in front of them — they were mortally wounded from the back. Already after this the Su-25 attacked the cabin from the front, when the "Boeing" was turned around. This is how the numerous entry and several exit holes on the cockpit plating were formed.

Entry and exit holes in the pilot cabin





The back seat of the pilot. It is possible to compare how the holes that form due to penetrating the fabric and the metal one may compare [here](#) and [here](#)



The body of the crew commander with holes in the chest.

CONCLUSION: A combined strike from a Su-25 M1 attack jet was performed against the Malaysian Boeing. The first attack from the Su-25M1 was performed on the course of the "Boeing" flight in pursuit — most likely the attack jet was located on the right side of the tail of the Malaysian airplane and fired while moving towards the right engine — in this direction the jet made several shots using its 23 mm or 30 mm aircraft cannon.

The pilots died after the first attack, a large-scale decompression occurred in the cabin, the electronics went out of order, the plane turned right and the "Boeing" was probably attacked by the attack jet again, but this time on the left side, in the cabin area from the side of the crew commander using the aircraft cannon and a R-60M rocket in the

area of the left engine and the left door, on which the traces of penetration by rod-shaped sub-projectiles remained.

P.S. The author of the photo — the Dutch correspondent of RTL Yeroyen Akkerman – to whom I referred with respect to this fragment, ignored this topic. Unfortunately, we can only judge based on the photo.

<http://evanesce-girl.livejournal.com/79977.html> (in Russian) — link

Original article: <http://colonelcassad.livejournal.com/2077046.html> (in Russian)