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Dynamic protection of tanks (CCC R, RF)

© A. Tarasenko

History of creation

With the growth of the power of anti-tank weapons (PTS), it became clear that it was almost impossible to provide protection for armored vehicles by passive methods. Therefore, for this purpose it is necessary to use external energy sources. Such sources can be explosives (explosives), electrical energy, energy generated in the course of reactions of chemically active substances. There are many different types of devices that implement the principle of dynamic action on the PTS, differing in design options, energy sources used and methods of implementation.

For the first time in the world, the use of dynamic protection was proposed in the USSR. The possibility of the destructive effect of the products of the explosion of the explosive charge on the cumulative jet, leading to a decrease in the penetration of the cumulative jet into the barrier, was discovered back in the years of the Great Patriotic War, when there were cases of non-damage of tanks by cumulative PTS in the event of a hit on ammunition or explosives transported on their armor. A number of studies and trials have been carried out in this area.

However, a significant reduction in the depth of penetration of the cumulative jet into the barrier requires a significant amount of explosives, which entails significant problems due to the impact on the protected object. For this reason, the first samples of protective devices that implement this principle did not have the support of the military leaders. Research in this direction continued when, at the end of the 50s, more effective methods of influencing the PTS with the help of thrown metal plates were justified; in this embodiment, the explosive charge played not the main, but an auxiliary role of an energy source for the plates, which directly affected the cumulative jet.

The first samples of the universal (built-in) remote sensing were also developed during the mid-60s, however, this is a story that has yet to be told.

In parallel, development was carried out in Germany by Professor M. Held, where by the end of the 60s the first samples also appeared that successfully passed field tests.

For more information about the history of the creation of DZ in the USSR in the 1960s, see the article - [DYNAMIC PROTECTION. THE ISRAEL SHIELD WAS FORGED IN... THE USSR?](#)

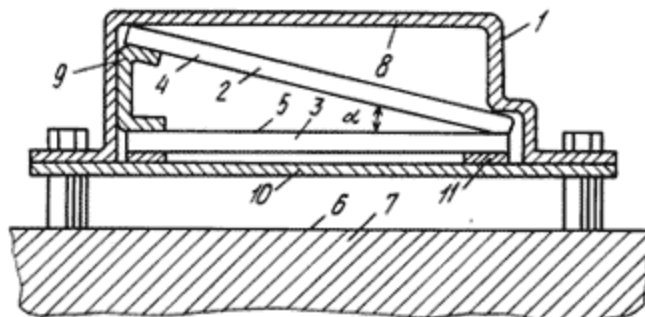
Mounted DZ complex

"Contact" (EDZ 4S20)

The complex of the first generation "Contact-1" was implemented in a hinged version. The ZUDT installation was carried out according to a two-row planar scheme, in such a way as to achieve large angles at which the interaction of the plates with the cumulative jet would be most effective. This is explained by the fact that the effectiveness of the impact on the cumulative jet of the ZUDT with the use of projectile platinum depends on the angle of impact of the cumulative jet with them. At meeting angles (the angle is measured from the normal to the surface of the container) 50-70 deg. the greatest efficiency of the impact of the movement of the metal plates of the container on the cumulative jet is achieved. At meeting angles of about 30-45 degrees. the impact of the jet container still significantly reduces the armor-piercing ability of the cumulative jet, although it is reduced by 60 percent or more from the optimal one. At meeting angles close to the normal to the surface of the container, the device loses most of its effectiveness and, as a rule, cannot protect the main armor barrier from a cumulative jet.

When a DZ element is pierced by a cumulative jet, the explosive in it detonates, and the metal plates of the EDS body begin to scatter in opposite directions. At the same time, they cross the trajectory of the jet, constantly acting on it. Part of the jet is spent on breaking through these plates, and the lateral momentum from the collision destabilizes the jet.

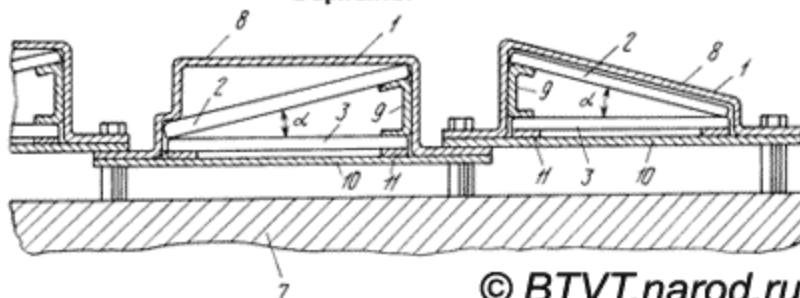
As a result of the impact of remote sensing, the armor-piercing characteristics of cumulative weapons can be reduced by 50-80%. It has practically no effect on the reduction in the armor-piercing characteristics of armor-piercing sub-caliber projectiles of the DZ type "Contact".



Контейнер НДЗ типа "Контакт-1"

- 1 – корпус, 2, 3 – контейнеры с взрывчатым веществом
 4, 5 – поверхности контейнеров, образующие острый угол
 6, 7 – защищаемая поверхность.
 9 – распорный элемент. 8, 10 стенка корпуса, 11 – упругие элементы.

Варианты



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Containers of DZ complexes of hinged type "Contact-1"

KnDZ "Contact-1" provides:

The complex provides a weight gain of 10...20 times (compared to rolled steel armor) when protected against cumulative anti-tank weapons. Installation and maintenance are carried out only by the crew, the installation time on the prepared tank by the crew is (on average) 2 hours.

Provided failure of the EDS when fired from small arms, exposed to napalm and flammable liquids. Maintainability, incl. using electric and gas welding.

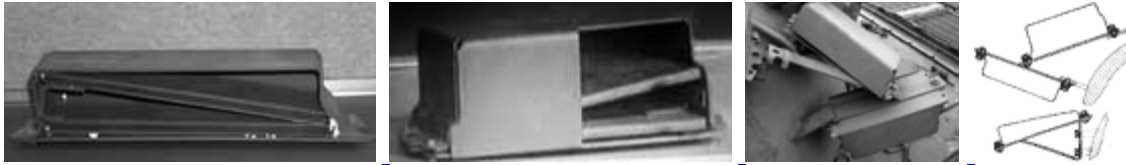
Warranty period of operation - 10 years.

The weight of the container KnDZ equipped with two elements 4S20 - five, 3 kg (without fasteners). The mass of the complex differs from the number of containers installed on the tank (for example, 165 for the T-72S, 227 for the T-72B and 265 for the T-64BV). On average about 1200- 1500 kg.

The Kontakt-1 complex is installed on the MBT T-64BV, T-64AV, T-72B, T-72AV, T-80BV medium tanks T-55AMV, T-

62MV and a number of others.

When installing the KnDZ "Kontakt-1", the designation "B" was added to the index of the basic modification of the upgraded tank. For tanks, the installation of DZ on which it was originally intended (T-72B, the first series of T-80UD and T-80U, etc.), additional designations were not applied.



When installing, 3 types of containers were used, all of them were equipped with two EDZ 2S20 and differed only in shape.

Installation of EDZ 4S20 (and others, for example, 4S24) is also possible in special flexible protective screens installed on the side projections of the tank in the event of a threat to use close-range combat vehicles (RPGs). The screen consists of a fabric cover with pockets into which the EDS are inserted. With the help of belts, the protective module is attached to the mounts on the protected projection of the tank.

The module provides protection against cumulative means of steel when firing normal to the board. The use of modules is advisable in the case of tank operations in urban areas. The installation of screens is included in the standard protection kit for the BMPT "Frame-99", and can also be installed on any other tanks.



Installation of flexible protective screens on BMPT "Frame-99". Tank T-55AM with flexible protective screens.

Further in the photo is a demonstration of the characteristics of flexible protective screens on the T-72B tank, in the photo before and after the shelling.

Complex of universal built-in remote sensing

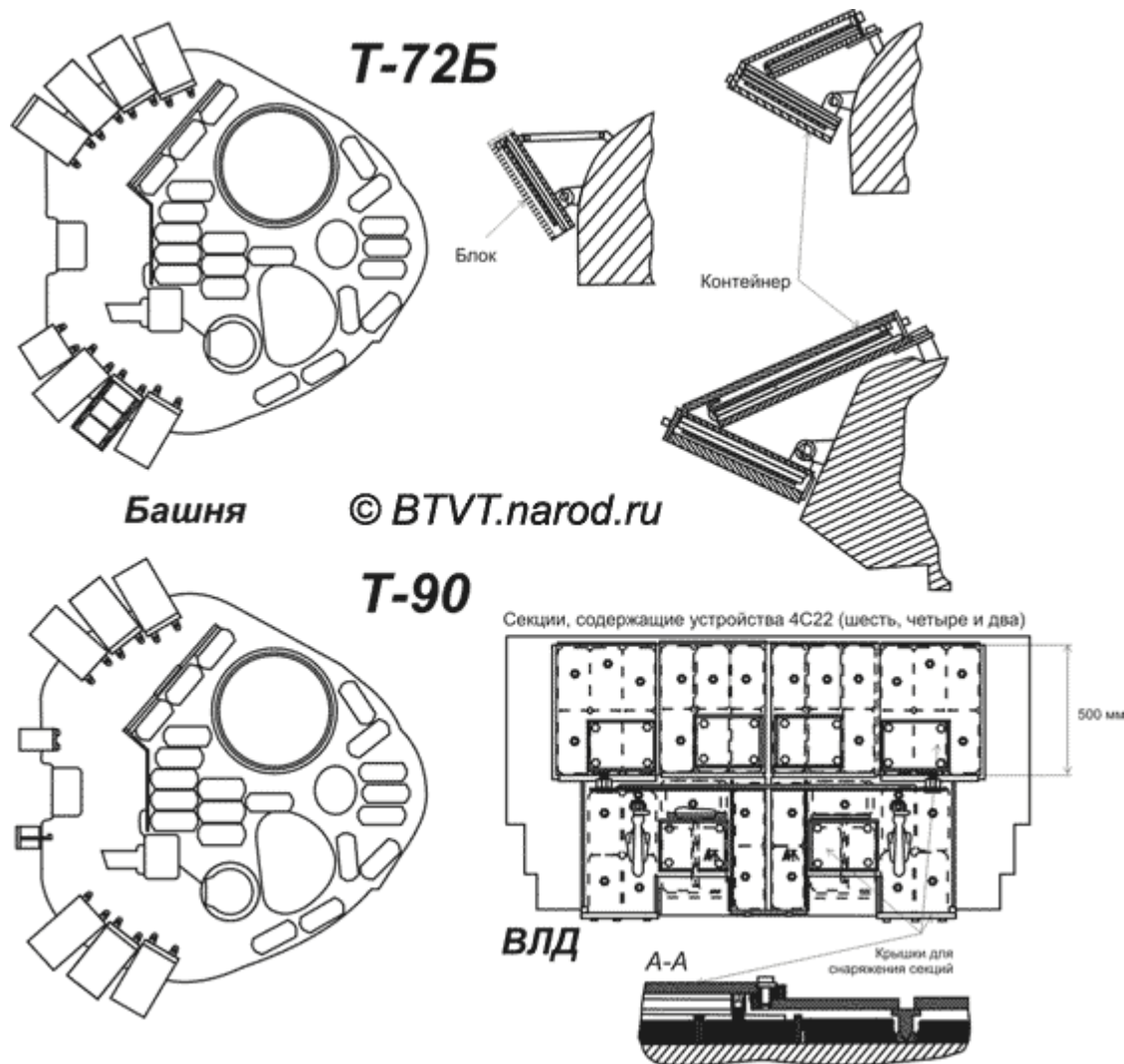
"CONTACT-V" (EDZ 4S22)

This complex provides protection against both cumulative weapons (CS) and armor-piercing sub-caliber projectiles (BPS). The cover of the DZ block made of thick high-strength steel, when hit by the BPS, generates a stream of high-speed fragments, which detonate the EDS. The impact of the moving thick cover and EDZ plates is sufficient to reduce the armor-piercing characteristics of both cumulative weapons and BPS.

The serial complex of the universal remote control "Kontakt-V" was adopted in the mid-80s. This complex was equipped with T-72B tanks of later series, the T-80U and T-80UD tanks, later the T-90.

Considering a specific installation option for the Kontakt-5 complex - the T-72B / 90 tank, it can be seen that 7 blocks and one dynamic protection container (8 blocks on the T-72B) are installed on the turret of the T-90 tank, which cover approximately 50% of the frontal projection towers at a heading angle of fire of 0 °, up to six EDZs of the 4S22 type are placed in blocks, installed in two rows.

On the upper frontal part (VLD) of the hull of the T-90 tank, sections are installed in which EDZ are placed (four and six 4S22 devices installed in two rows).



The total mass of the DZ complex is 1.5 tons (of which the weight of the DZ is less than 500 kg.)

Total number of DZ sections - 26 pcs.

The total number of EDZ 4S22 - 360 pcs.

The number of sections on the main parts of the tank:

- on the tower - 8 pcs;
- on VLD - 12 pcs;
- on board screens - 6 pcs.

The area of the frontal projection of the tank, covered by the DZ complex:

- at a heading angle of $0^\circ > 55\%$;
- at heading angles $\pm 20^\circ$ (hull) $> 45\%$;
- at course angles $\pm 35^\circ$ (turret) $> 45\%$.

Increased tank protection:

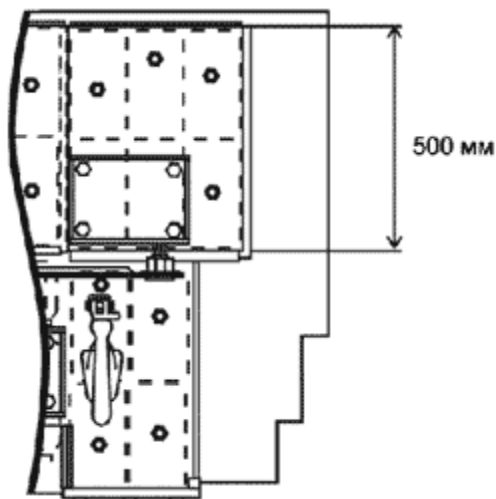
- from KSP by 1.9 ... 2.0 times;
- from BPS by 1.2 times.

EDZ does not detonate when hit by bullets 7.62 mm and 12.7 mm shrapnel and 30 mm shells. VDZ has a higher resistance to high-explosive impact, compared to KnDZ.

The detonation of the remote sensing elements under the influence of fire mixtures of the "Napalm" type is excluded.

Mass of EDZ 4S22 - 1.37 kg, overall dimensions 251.9x131.9x13 mm.

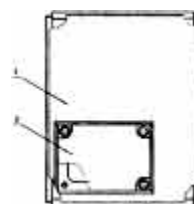
Thus, the total mass of the EDZ in this version of the complex is 493 kg. The rest of the mass is the design of sections and blocks for placing elements.



Regarding the length of the DZ elements, it is worth noting that, indeed, domestic EDS have a length 251.9 mm. But they are stacked several pieces in one container.

Two 4C22 form the same 500 mm, which are mentioned more than once in M. Rastopshin's critical articles.

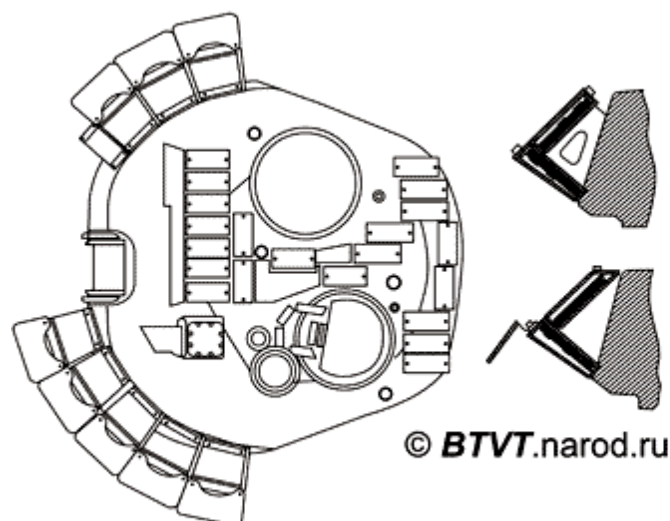
On the left - an option for placing an EDZ in sections on the VLD of the tank hull. UDZ 4S22 are installed in sections forming a working surface with a length of 500 mm.



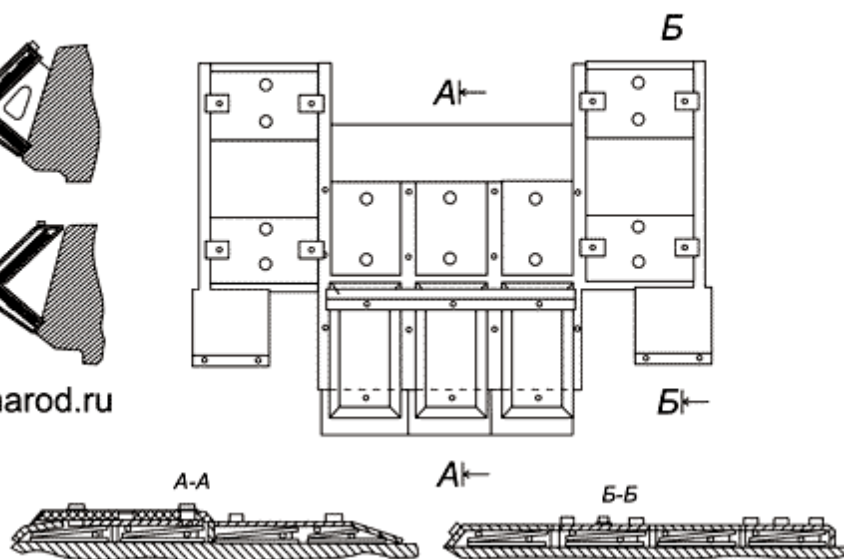
In the figure: 1 - section of the DZ equipped with a removable cover (2) for installing the EDS.

Built-in dynamic protection with EDZ 4S22 is installed on the following serial tanks - T-80U, T-80UD, T-72B (starting from 1988), T-90.

Установка ДЗ на башне Т-80У



ВЛД Т-80У с ВДЗ "Контакт-V"



Installation of the universal VDZ "Contact-V" on the tower and VLD of the T-80U hull.



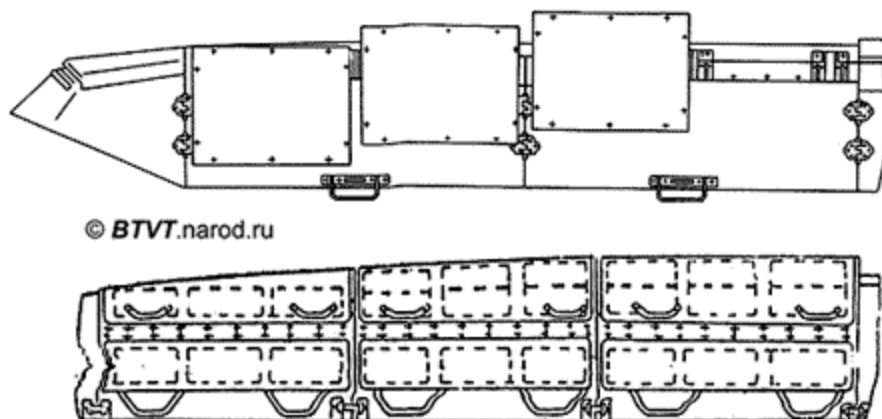
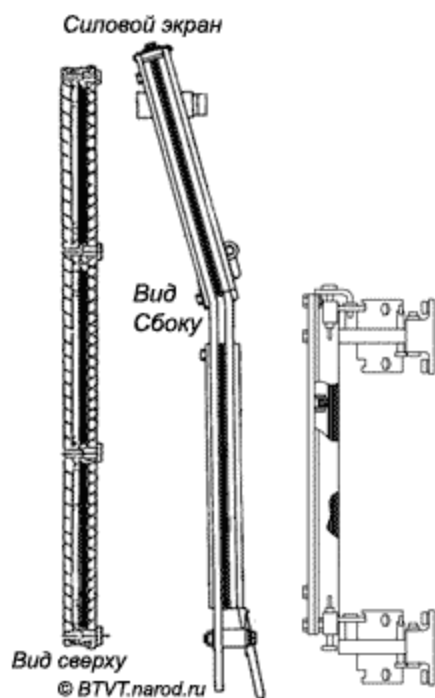
In the photo - cassettes for EDZ tower blocks, sections of the VDZ on the VLD of the hull.

The frontal armor of the T-80U and T-72B tanks has been invincible for a long time by modern BPS and ATGMs, only the latest BPS and ATGMs that have appeared in recent years can cope with it.

In the event that modern models of dynamic protection are installed on these tanks, they will be able to provide superiority over the most modern anti-tank weapons.



In the photo - T-80UD after shelling the side of the hull and turret 125 mm HEAT shells.



Power screens of the hull, on top of the T-72B / T-90 type, on the bottom T-80U.

On fig. on the left - body screens, on top of the T-80U type (left) T-72B / 90 (right). The power screens of the T-72B/T-90 hull are made of solid steel plates, such screens have a significant drawback - a much smaller section of the side projection overlapped by them. The power screens of the T-80U/UD (T-84, T-64BM) hull are split, the area covered by them is much larger than that of the T-90 screens, however, the protection against BPS provided by them is somewhat less than that of the T-72B/T screens -90.

Features of placement of VDZ "Contact- V " on MBT T-72B/T-90 and T-80U/T-80UD

As can be seen from the drawings and photos, the installation of the VDZ on the T-80U / UD and T-72B / 90 tanks is different.



T-80UD, T-80U, T-90.

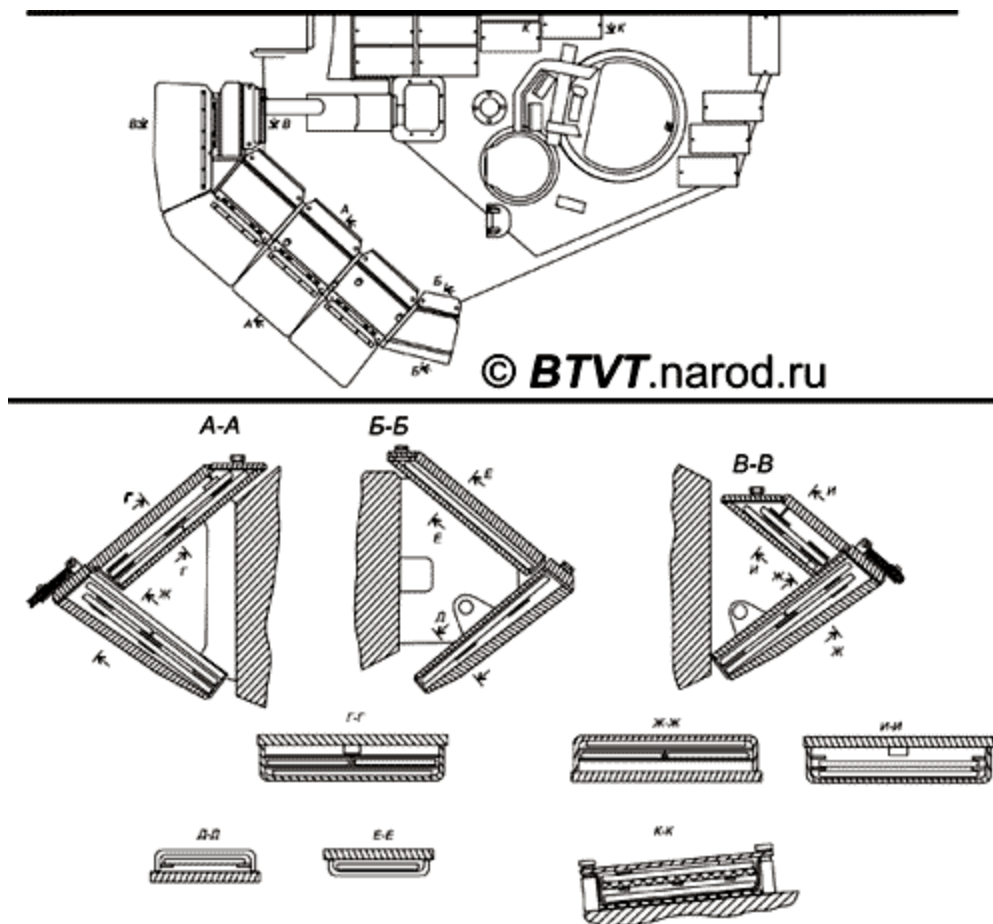
On the T-80U / UD, EDZ are installed in blocks on load-bearing elements welded to the frontal projection of the tower.

Each block cavity contains up to 4 EDS. Further on the drawings it can be seen that there are a number of containers, which, depending on their placement, differ in the shape and equipment of the EDZ.

The installation of the remote sensing ensures a uniform overlap of the frontal projection and the absence of weakened zones between the trapezoidal blocks of the remote sensing.

On the T-72B / T-90, blocks with EDZ are installed using fasteners on bolted assemblies. The block contains two cavities with cassettes for EDZ placement. Each cavity of the block contains up to 6 EDZ (6 in the upper and 4 in the lower). The tilt angle of the containers is similar to the tilt angle of the VLD of the tank and is 68 degrees, thus ensuring the ratio of the mass and speed of the material that acts on the PTS is the most optimal for a significant reduction in their penetrating effect. The installation of airborne protection on the frontal rollers of the T-72B / T-90 tower provides a slightly higher level of resistance to PTS in a number of sections (upper containers of blocks), with a smaller overlapped projection of the tower by the complex as a whole.

As can be seen from the photos and drawings, the main tanks T-80U / UD and T-72B, the mass production of which took place at the same time, were not completely unified according to the elements of the VDZ complex. This can be attributed to a shortcoming, which once again confirmed the problem of the lack of unification of domestic MBTs. At the moment, Russia is taking measures to unify the DZ complexes of tanks in service with the T-72B (T-90) and T-80B. Protection of upgraded MBTs is carried out according to a single modular scheme - "Relic".

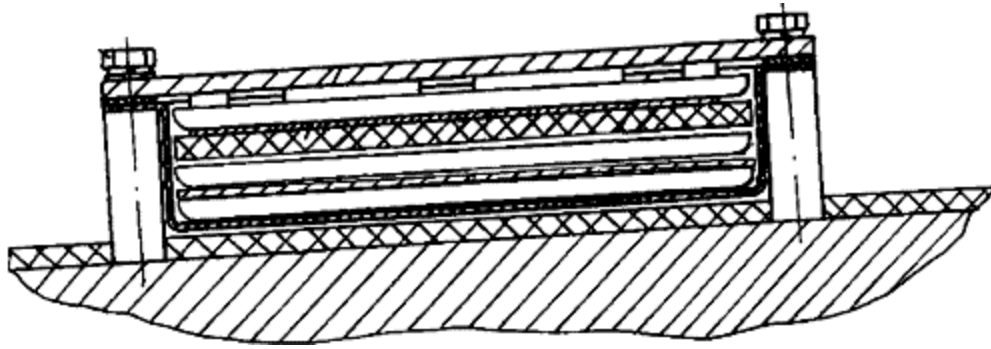


The figure shows the installation diagram of the DZ on the tank 478BE (T-80UD with a welded turret).

320 of these tanks were delivered to Pakistan.

With the advent of a large amount of ammunition attacking the tank from above and on the span, more and more requirements are being put forward to protect the roof of the tower. The protection of the roof of the towers of both domestic and foreign tanks at this stage is due to their classical layout and does not provide protection against ammunition attacking from above. Nevertheless, here domestic tanks compare favorably with foreign ones, since the roof protection is reinforced with dynamic protection, as well as layers of lining and lining made of polymer material designed to protect against radiation, as well as acting as additional protection, which minimizes the angle of expansion secondary fragments.

Dynamic protection installed on the roof of the tower of domestic tanks (for example, T-80UD, T-90, BM Bulat, etc.) provides protection against modern cumulative and kinetic weapons. Reactive armor blocked the main part of the roof area of the tower, except for hatches and sights.



The figure shows a diagram of the installation of a remote sensing system on the roof of a tank turret (option).

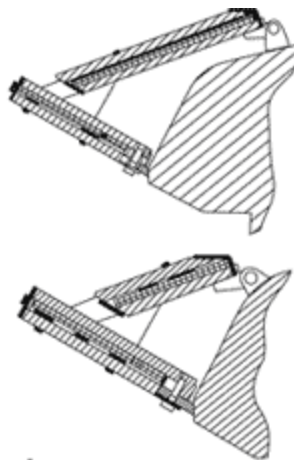
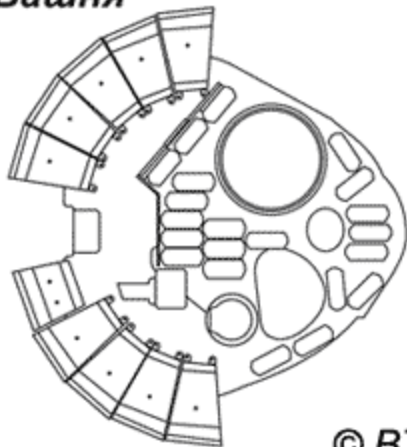
The sequential action of the EDZ and the elastic element placed between them, which additionally affects the cumulative jet or kinetic ammunition (the elastic element increases the operating time of the device, due to the dynamic compression of its material), and then the impact of the second EDZ leads to a significant reduction in the armor penetration of the attacking ammunition. In addition to the elastic elements between the EDS, additional plates of high hardness steel can be placed in the container .

Complex of universal remote sensing of modular type

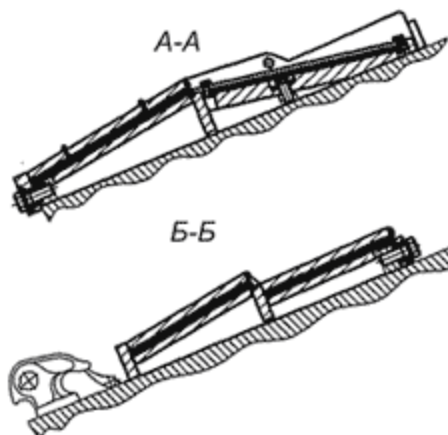
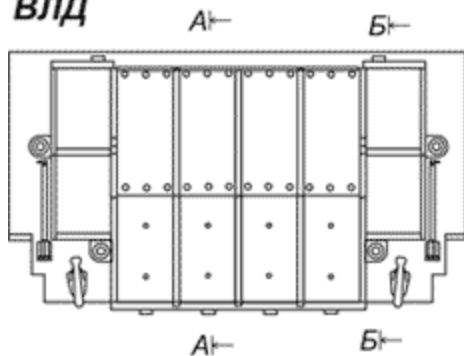
"Relic" (EDZ 4S23)

The increase in performance was achieved through the transition from a built-in to a modular complex, which provides a number of advantages, such as ease of maintenance, including the ability to replace damaged modules in the field, the ability to modernize the existing tank fleet by the enterprises of the Ministry of Defense during their planned repair.

The complex consists of a DZ module of the upper frontal part of the hull, quick-detachable DZ containers installed on the roof and side projections of the tower, as well as on the sides of the hull.

Башня

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ВЛД

Installation of the universal DZ "Relikt" on the tower and VLD of the hull of the tanks T-72B "Slingshot".

Improved devices 4S23 managed to eliminate some of the shortcomings of 4S22, such as lack of sensitivity when initiating low-velocity kinetic projectiles and some types of cumulative ammunition. Increasing efficiency in protection against kinetic and cumulative ammunition is achieved through the use of additional throwing plates, the inclusion of non-metallic elements that act on the attacking ammunition, as well as a longer interaction time. As a result of these measures, the developers managed to achieve a reduction in the armor penetration of BOPS, depending on the type of ammunition, within 20-60%. Due to the increased time of exposure to the cumulative jet,



4С23 подробнее в патенте ЕАПО [006672](#)

Общая масса комплекса ДЗ - 2,3 т. (при комплектации совместно с РЭ – до 3 т.)
 Общее количество секций ДЗ - 27 шт.
 Общее количество ЭДЗ 4С22 - 394 шт.

Количество секций на основных деталях танка:

на башне - 9 шт;

на ВЛД -12 шт;

на бортовых экранах - 6 шт.

Площадь лобовой проекции танка, перекрытая комплексом ДЗ:

при курсовом угле $0^\circ > 60\%$;

при курсовых углах $\pm 20^\circ$ (корпус) $> 45\%$;

при курсовых углах $\pm 35^\circ$ (башня) $> 55\%$.

Повышение защиты танка:

от КСП в 2 раза;

от БПС в 1,5 раза.



Модернизированные ОБТ Т-72Б и Т-80Б и БМПТ «Рамка-99» с ВДЗ «Реликт».

Комплексы защиты Т-72Б, Т-80Б и БМПТ унифицированы.

| Основные характеристики ряда распространенных серийных типов динамической защиты БМ | | | | |
|---|-------------------------------------|--|--|--|
| Название | «Контакт-1» | ВДЗ «Контакт-5» | «Реликт» | «НОЖ» |
| Страна/фирма изготовитель | СССР/НИИ Стали | Россия/НИИ Стали | Россия/НИИ Стали | Украина/ БЦКТ |
| Тип защиты | противокумулятивная | универсальная | универсальная | универсальная |
| Противодействие танковым БЧ | Не обеспечено | Не обеспечено | Обеспечено | Обеспечено |
| Принцип действия | Воздействие метаемыми пластинами | Воздействие метаемыми пластинами/ крышкой | Воздействие метаемыми пластинами/ крышкой | Направленное последовательное воздействие кумулятивной струи и продуктов взрыва |
| Снижение характеристик кумулятивных средств поражения | 50-80% (до 500 мм) | 50-80% | До 90% | До 90% |
| Снижение характеристик БОПС | Не обеспечена | Не менее 20% | До 50% | До 90% |
| Принцип размещения | Отдельные контейнеры | Секционный | Модульный | Модульный |
| Установлена на: | Т-72Б, Т-90 | Т-72Б, Т-90 | Т-72БМ | Т-64, Т-80УД, Т-84, Т-72 и пр. |

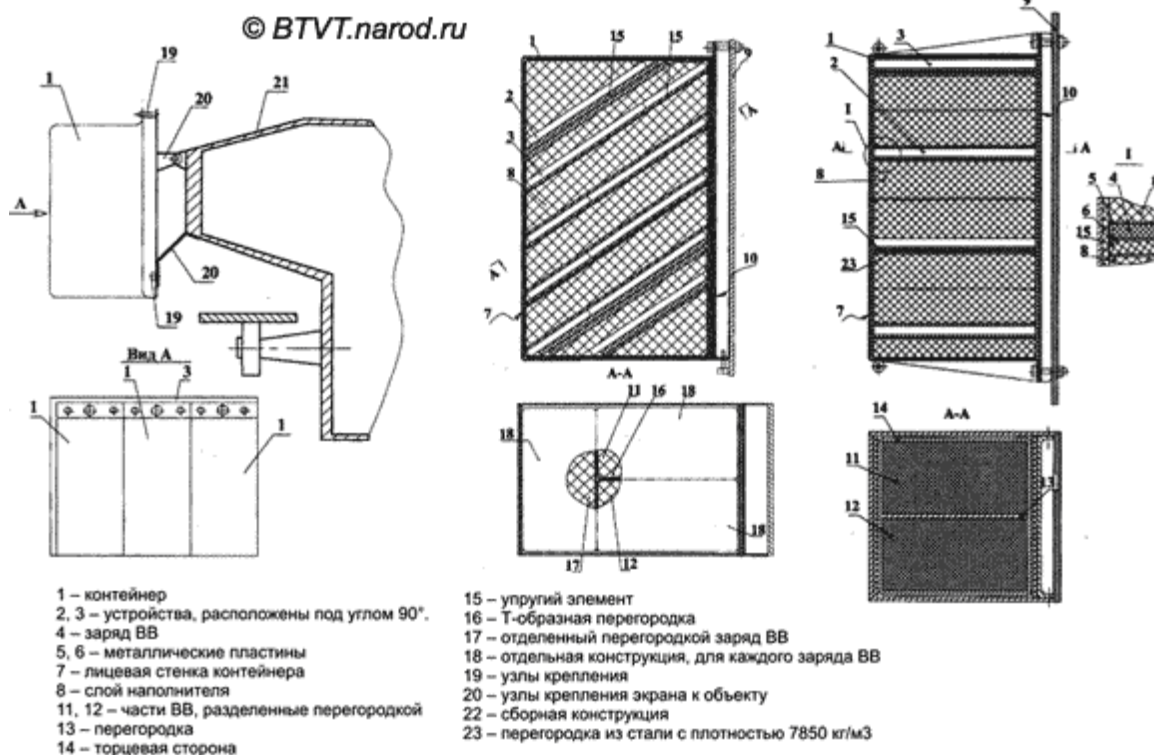
По заявлениям разработчиков комплекса, он обеспечит танкам типа Т-72Б и Т-80Б эффективную защиту от наиболее распространенных на данный момент подкалиберных снарядов типа М829А2, ДМ-53 и других с аналогичными характеристиками, а также ПТУР с танковой БЧ типа ТОВ-2А и их аналогов. Новая ДЗ также лишена некоторых недостатков своих предшественников.

Комплекс ДЗ для ЛБМ

(ЭДЗ 4С24)

Как известно, бронирование ЛБМ (БТР, БМП) намного слабее, чем у танков, в случае срабатывания ЭДЗ и ПТС на их броне при таком совместном взрыве защищаемый объект может получить серьезные повреждения. Как показывают имеющиеся результаты испытаний, в указанных условиях могут возникать проломы и значительные остаточные деформации броневых деталей, трещины сварных швов корпусов и башен защищаемого объекта. Кроме того, при этом во внутреннем объеме защищаемого объекта возникает сложная суперпозиция из нескольких ударных волн с амплитудой и временем действия, достаточным для причинения ущерба членам экипажа (разрыв барабанных перепонок и т.д.).

Для исключения вышеуказанных проблем ЭДЗ размещены слоями наполнителя из вспененного полимерного материала, который обеспечивает плавное торможение разбрасываемых взрывом металлических пластин, что, с одной стороны, позволяет им наносить повреждения проникающей кумулятивной струе, траекторию движения которой они пересекают; с другой стороны, торможение пластин в указанном наполнителе снижает скорость их удара по соседним взрывным реактивным элементам до безопасной величины.



Новый блок ДЗ с ЭДЗ 4С24 для БМП
(в сравнении со старым блоком ДЗ с ЭДЗ 4С20).

Не детонирует и не горит при попадании зажигательных пуль. Блоки обеспечивают защиту лобовых и бортовых проекций от ПТС с пробиваемостью до 600 мм (РПГ-7ВМ/ВЛ/ВС/В и пр.). В местах установки блоков ДЗ (в случае БМП-3) повышена противопульная стойкость (обеспечена стойкость борта от бронебойных пуль Б-32 калибра 14,5 мм с дальности 50 м и выше, стойкость от 23 мм снарядов обеспечена на дистанции 550 м и выше). Масса ЭДЗ 4С22 – 1,37 кг, габаритные размеры 250х130,9х10 мм. Общая масса комплекса ДЗ – 4,15 т.

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