"Source #632/2
September 11, 1944

Report of the NKV Special Laboratory #101-1 on the topic of STUDY OF CHARACTERISTICS OF STRIKING A T-34 FUEL TANK WITH AP-HE OR CUMULATIVE (HEAT) SHELLS OF THE GERMAN FASCIST ARMY

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History of the topic

In the spring and summer battles of 1943, tank commanders began to note instances of T-34s destroyed by fire or detonation of fuel tanks. For example, during the summer of 1943, at Kursk, fires happened more often than on the T-70 by 4-9%. By the order of the Head of the BTU GBTU of the Red Army, Engineer-Colonel Afonin, a special commission was formed on September 11th, 1943. Our team was tasked with exploring the possibility of detonating the T-34's fuel tank using several armour-piercing measures, and the evaluation of the impact on the crew and internal equipment.

Objective

Examination of 72 tanks at SPAM bases, destroyed during the battle at Kursk, the commission found that most of them (68%) were destroyed by un-sealing of the fuel tanks and subsequent ignition of the diesel fuel. All these tanks were struck in the side or overtrack hull by an AP, HEAT, or HE shell. Approximately a third of the examined tanks lack one or two fuel tanks, and have damage to the welding seams due to the internal explosion. Only a small portion of the tanks have traces of internal explosion and fire (8%), while 24% of the vehicles were destroyed by explosions only, with no traces of fires. The ammunition remained undamaged in the racks. Acting on our orders, we examined specifically the cause of destruction by an exploding fuel tank.
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Engineer-Colonel Gurov and Dr. Krutov, after examination of the tanks, suggested that the damage is caused by detonation of the front fuel tanks, after being hit with some kind of special German shell. Engineer-Major Firsov theorized that this could have happened after detonation of a high temperature shell inside the fuel tank, like one based on thermite. Comrade Sarafanov's team was ordered personally by the chief of the GBTU to investigate the possibility of detonation of the T-34's fuel tanks as a result of being hit with various types of shells used by the fascist armies.

Equipment used in the experiments

To evaluate the theories of comrades Gurov, Firsov, and Krutov, NII-48 and Uralmash built three T-34 full scale models from 35 mm thick armoured steel with a 135 liter (see blueprint #2) fuel tank. Also, as a result of letter #312-a sent on April 21st, 1944, the BTU supplied us with a T-34

hull, with equipment inside, but without armament.

Experiments

The first test of the models happened on December 12th, 1943, from a 75 mm model 1940 tank gun, from 30 meters. During these tests, the fuel tank was fully filled with diesel fuel, according to comrade Afonin's letter from December 5th.

8 model 38 shells were fired, as well as 5 model 39/40 shells, and 5 HEAT shells. The results are as follows: the fuel tank was destroyed completely 3 times. The fuel ignited 4 times. No explosions were observed. When struck with a model 39/40 shell, the fragments were rapidly stopped. A full T-34 fuel tank cannot be a source of an explosion, and also offers protection from armor fragments and cores of model 39/40 shells.

Comrade Krutov suggested that gasoline would also be unable to explode when the tank is full. Comrade Fedin ordered a gas tank be installed. 3 model 38 shells and one HEAT shell were fired. No explosions. The gasoline ignited 2 times.

The second stage started on February 9th, 1944. The same gun was used, along with an 88 mm recoilless model 1943 gun, shooting 88 mm HEAT shells. The tests were done on tanks that were partially filled. Before this, the full tanks were driven around on a truck for 1-2 hours on a dirt road, and then fuel was partially drained from it.
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Fourth series of shots. The tank was filled 10-25%. The tank explodes when hit by a HEAT shell at under 25% capacity. The explosion was equivalent to 30-50 grams of TNT. The fuel tank cover was knocked off. In the case of a gasoline tank, the explosion is 1.5 times weaker. The gas tank cover opens as a result of the explosion. Welding seams remain intact.
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The effect of a detonation of a 75 mm AP shell with the red ring, equipped with 80 g of TNT and a 20 g detonator, is quite different. The explosive force grows several times over. The overtrack sponson hull seams burst, and the roof of the model is deformed. The model becomes useless.

Conclusions

The best conditions for a detonation is a tank that is 10-15% full, and a detonation of the "rot" shell with 80 grams of TNT and 20 grams of phlegmatized explosive. The fumes detonate, resulting in a force equivalent to a 105-122 mm AP shell.
An even better effect is achieved by the detonation of the domestic 76.2 mm BR-350A shell, with 150 g of TNT, which is equivalent to a 152 mm shell with 400 g of TNT. With a reduced caliber, the likelihood of an explosion decreases drastically. 45 mm and 37 mm guns are nearly incapable of causing a detonation. An increase in caliber does not result in an increase of explosive effect. The optimal caliber is 75-85 mm and 50-100 grams of TNT, or a smaller amount of more powerful explosive substances (30-80 grams of A-1X-2 or 25-50 grams of phlegmatized cyclonite). The tank must be at least 100 liters in size. Tanks 30-50 liters in size do not result in significant increase of the shell's explosive force.

Countermeasures
Do not place fuel tanks inside the fighting compartment.
Use fuel from rear tanks first, as they are less likely to be hit.
Build fuel tanks that collect less vapours. As fuel is spent, replace it with an inflammable fluid or a gas that does not ignite. Before battle, flush fuel tanks with CO2, CO, or constantly ventilate front fuel tanks.
Half the size of fuel tanks in the fighting compartment.
Place the fuel tanks behind airtight armoured plates.
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