Soviet-Russian Tank Turret Armor: The Cold War Shell-Game

by James M. Warford

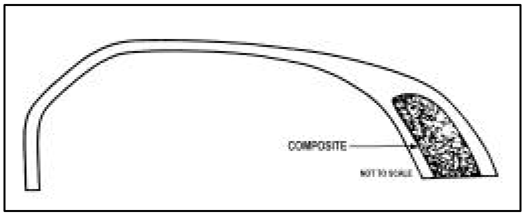
Captured Iraqi T-72s gave Western analysts a closer look at the turret armor of Soviet tanks. This tank was captured by the 24th ID and shipped to the Patton Museum for display. It is seen here being unloaded from a flatcar on arrival at Fort Knox.

Until very recently, detailed information concerning modern Soviet/Russian main battle tank (MBT) armor was virtually non-existent. Over the years, the Soviets, and now the Russians, have been very successful in maintaining almost total secrecy in this critical area. This "status-quo" was maintained until two major historical events provided an unprecedented view of Soviet/Russian tank design, Operation Desert Storm and the collapse of the Soviet Union. These two events not only led to the discovery of critical information concerning Cold War armor designs, they also provided a glimpse into the armor protecting present-day Russian MBTs.

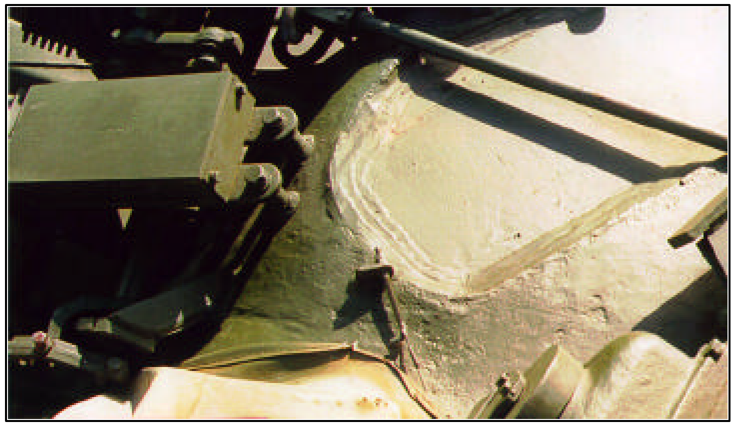
While battle damage assessment conducted during and after Operation Desert Storm provided a wealth of information concerning the armor protecting many of the tanks employed by the Iraqi Army, including the 5-layer laminated glacis armor carried by the T-72M1 MBT, details of the armor protecting the turrets of many Soviet/Russian MBTs remained a mystery. Since no photos have appeared showing any internal detail of these turret armor designs, most of the analysis over the years has been based on speculation. This all changed with the historic collapse of the Soviet Union. Suddenly, Russian sources were available at an unprecedented level to help clear away some of the mystery. Russian books like *Obozreniye Otechestvennoi Bronetankovoi Tehniki, 1905-1995,* by A. Karpenko, and *Main Battle Tanks,* 1993, by V. I. Murankhovski, have helped to both confirm and deny some earlier speculation. According to Murankhovski, the T-72's turret frontal armor (referring to variants developed after the T-72 Base Model and T-72M/T-72G MBTs, which have all-steel turrets), is a three-layer composite, an outer layer of steel, a center layer of sand or *kvartz* (quartz), and an inner layer of steel. Murankhovski also describes the T-64A MBT's turret frontal armor as a similar although more advanced three-layer composite known as "Combination-K." It consists of inner and outer layers of steel, with a center layer of combined *steklotekstolit* (a glass fiber material) and a package of ceramic plates. According to Karpenko, the ceramic material used in the T-64A's composite armor is called "corundum," which is a very hard native alumina. The Russian spelling of "*kvartz*" is important here since it may in fact be the source of the "K" in Combination-K armor. While not identified specifically, the name Combination-K implies some relationship between the T-64A and *kvartz* composite. When in production, these tank turret shells are cast with a frontal internal cavity on each side of the main gun; each cavity is then filled with the desired composite material. If viewed in profile, the filled cavities represent the center layer of the three-layer composite.

Interestingly enough, the use of quartz in tank armor is not unprecedented; in fact, it was tested as part of a U.S. Army program involving the M4A3 Sherman tank during World War II. In an effort to provide protection against the German Army's Panzerfaust anti-tank weapon, an M4A3 was fitted with an armor "kit" incorporating a mixture of quartz gravel, asphalt and wood flour known as "HCR2." This add-on armor was successfully live-fire tested in September 1945 against both the German Panzerfaust and 76mm High-Velocity Armor Piercing (HVAP) ammunition. Additionally, other Russian sources describe the center layer of this three-layer composite as consisting of *peschanye sterzhni,* or "sand rods" or "sandbar." Based on the possible configuration of the T-64A's armor cavities shown here, designed to tightly confine the composite material, "sandbar" may be the more accurate description. It's important to remember here that the sand in question is probably not typical loose-grain sand. It could actually be a form of silica similar to the "fused-silica" developed as part of a 1952 U.S. program to provide post-war tanks with built-in protection against shaped-charge projectiles, without sacrificing protection against kinetic-energy projectiles or increasing the tank's total weight. Fused-silica composite was selected for this program because it does not "flow plastically" after an impact like steel does. Instead, it rebounds after the shock wave and radially bombards attacking shaped-charge or high explosive anti-tank (HEAT) jet particles and prevents the jet from forming properly — thus degrading or preventing penetration of the tank's base armor. According to *Military Parade*, the official magazine of the Russian

INSIDE SOVIET ARMOR



A cut-away, profile view of a possible T-64A tank turret detailing the three-layer composite. (Drawing from USAREUR Intelligence Study: Warsaw Pact Tanks in the Forward Area, regraded Unclassified on December 15, 1998.)



Close-up of the T-90S turret roof detailing the right-side composite armor cavity. Note the depression in the turret roof above the cavity.

At left, a close-up of the T-80U MBT turret roof detailing the right-side composite armor cavity. Note the cover plate welded flush with the turret roof, thus eliminating the depression.

military industrial complex, Russian three-layer composite armor works in very much the same way. The composite actually absorbs energy as the HEAT jet pushes its way through the materials confined within the armor cavity. Since the energy is then also confined to the cavity, the only direction it can move is back into the path of the attacking HEAT jet. The resulting "active destructive effect" of this movement within the cavity defeats the attacking HEAT jet. The idea that this kind of protection could be incorporated into a cast-armored tank turret has been the subject of debate during and since the Cold War. Some Western analysts incorrectly felt that composite armor required the tell-tale use of flat "box-like" welded plates.

The reality is that the use of cast tank turrets does not in any way negate the employment of composite armor, a reality that not only the Soviets fully exploited, but one that the U.S. Army tested as well with the U.S. T-95 MBT program (1954-1961). The T-95 prototypes were very similar to the Soviet T-64; in fact, the first and second prototypes of the T-64, the *Obiekt* 430 and *Obiekt* 432, appeared during virtually the same time period — 1960 and 1963 respectively.

Combining the T-95 program and the newly developed fused-silica composite armor resulted in the construction of 36 siliceous-cored T-95 turrets. These turrets were subjected to successful live-fire testing from June 1, 1958 to August 1, 1960. At the completion of these tests, it was determined that fused-silica composite armor provided superior protection against HEAT projectiles, and at least equivalent protection against solid shot armor-piercing projectiles as that of an equal weight of conventional steel armor.

While the shape of Soviet tank turrets went through some not-so-subtle changes over the years, these internal cavities remained invisible. The well-kept secret of their existence was unexpectedly made-public with an improved frontal armor design that was incorporated into several of the more recent Soviet Cold War tanks; including the T-72B1, T-72B, T-72S, T-80U, and T-90S MBTs. On these tanks, the cavities actually come through the turret roof, where they can easily be seen when viewed from above. On the T-72B-based variants (T-72B1, T-72S, and T-90S), the cavities have been covered by armor plates inset below the top of the turret, leaving two large depressions in the turret roof.

On the T-80U series (T-80UD, T-80UM, and T-80UK), the cavities are still visible but they are covered by plates that are fitted flush with the turret roof, effectively deleting the two depressions. This change in turret armor design may have been based on the desire to allow the contents of each cavity to be easily upgraded during the life of the tank.

There is no doubt that the information made available since Operation Desert Storm and the collapse of the Soviet Union is critical to the study of Soviet/Russian MBT armor design. The new information included here, however, still relates to Soviet tanks dating back to the 1973 to mid-1980s time-frame. So, in effect, this represents new information on some relatively old armor designs. Normally, the challenge now would be to try to relate this information to the armor protecting Soviet/Russian MBTs developed since those discussed here. Contrary to what was normally expected, however, the strong desire to increase armored vehicle exports has convinced the Russians to openly provide information concerning some of their most modern MBTs. According to *Military Parade*, the T-80U-M1 *Bars* ("Snow Leopard" MBT — first seen by the public in September 1997) carries a turret incorporating "combined filler."

Perhaps the most important conclusions that can be drawn from these armor descriptions are: first, while certainly improving the composite materials used over the years, the Russians continue to employ the same basic armor designs that

Pockets in the turret casting of the U.S. T-95, an experimental tank, were filled with fused silica, a form of quartz sand, as an element in the tank's armor protection. It was believed that the silica would protect against HEAT warhead penetration and be no worse than steel armor in defeating kinetic energy attacks. Note also that the track system had no return rollers.

protected their tanks during the Cold War; and second, until the newly-designed "Next Russian Tanks" or NRTs (production models of the T-80U-M2 Black Eagle MBT from Omsk, and the "Uralvagonzavod MBT" from Nizhni Tagil) that have been looming just over the horizon start to roll off the production lines, these same armor designs will protect Russian MBTs well into the future.

James M. Warford was commissioned in Armor in 1979 as a Distinguished Military Graduate from the University of Santa Clara, Santa Clara, California. A frequent contributor to *ARMOR,* Mr. Warford has held Armor and Cavalry assignments ranging from tank platoon leader to brigade S3, and has served as a tactics instructor both at Fort Knox, Kentucky for AOAC, and at Fort Leavenworth, Kansas for CGSOC. Mr. Warford retired from the Army on September 1, 1996 and was awarded the Silver Medallion of the Order of Saint George. He is currently employed as an employee development analyst in the Kansas City area.