"Ilich's Eyebrows":

Soviet BDD Tank Armor and Its Impact on the Battlefield

by James M. Warford

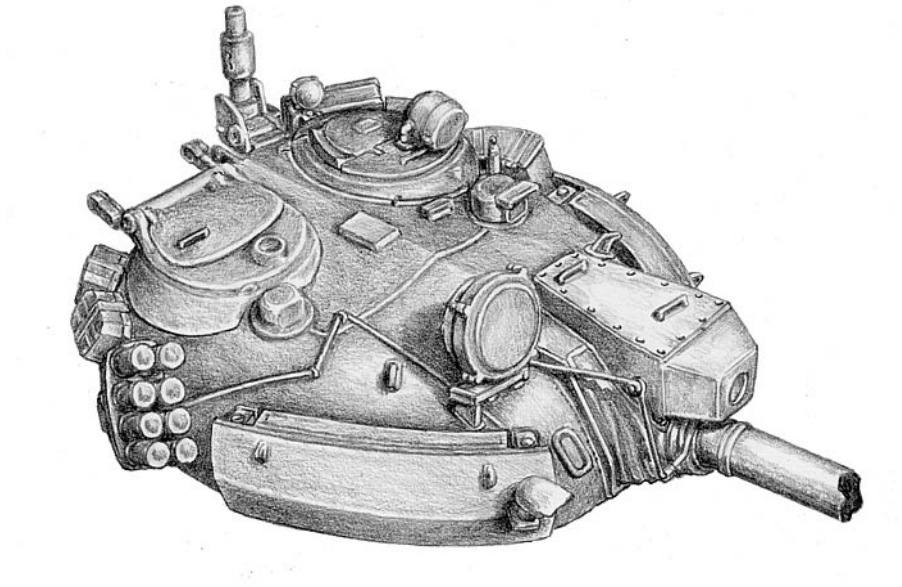
The practice of adding additional or add-on armor protection to older tanks to increase their effectiveness and lengthen their service life has been around almost as long as tanks themselves. Add-on materials ranged from a mixture of quartz gravel, asphalt, and wood flour to more sophisticated non-explosive and explosive reactive armor designs.

A classic example of successful add-on armor is the Soviet-developed BDD armor. Nicknamed "Brow" armor because of its resemblance to Vladimir Ilich Lenin's thick eyebrows, BDD armor has had a significant impact throughout its service life, most recently in the fighting in Afghanistan.

In 1983, the Soviets initiated an upgrade program for the T-55 main battle tank (MBT) intended to lengthen its service life. This rather extensive upgrade program included the addition of the new Volna fire control system with a laser rangefinder mounted externally in an armored box above the tank's 100mm main gun, and a new, stabilized primary sight for the tank gunner. The upgrade program also allowed the optional incorporation of the new 9K116 "Bastion" gun-launched anti-tank guided missile (which in NATO was known as the AT-10 Stabber). The T-55s that were equipped with this missile capability could be identified by the new and larger 1K13 turret roof-mounted gunner's primary sight.

In addition to these significant firepower improvements, the upgraded T-55s were also fitted with the new V-55U up-rated diesel engine that provided a power increase to 620 hp. These upgraded T-55s were known by a variety of designations depending on where they were produced: T-55M and T-55AM (Soviet/Russian produced); T-55AM2P (Polish produced); and T-55AM2B (Czechoslovakian produced).

While these and other less significant upgrades and modifications greatly improved the capabilities of the T-55, the most significant part of the upgrade program was the addition of the BDD or "Brow" add-on armor. The application of the BDD armor involved the addition of three external steel boxes; one large box on the glacis, and two smaller curved boxes on the turret (one on either side of the tank's main gun). The glacis box was made of steel plates 30mm thick and covered most of the original glacis. The box was filled with solid polyurethane. Encased within the beer-colored polyurethane were six angled and evenly spaced 5mm thick steel plates. These internal steel plates were held in-place within the polyurethane by what appear to be structural brackets.



The T-55 upgrade includes additional armor, a laser rangefinder above the main gun, a new fire control system, and an improved gunner's primary sight.

- Jody Harmon drawing

When viewed in profile, the BDD armor provides an impressive multi-layered array of alternating layers of steel and polyurethane. The BDD glacis box was a total of 150mm thick. The curved turret boxes, on the other hand, each had an outer layer of 60mm thick steel plates and include a larger number of the internal 5mm plates encased within the polyurethane. Additionally, these 5mm plates are apparently vertical (not angled like those used in the glacis box) and are configured in such a way to ensure an attacking projectile would be forced to penetrate several of the alternating layers before reaching the turret base armor. The complete application of BDD armor adds about 2 metric tons to the weight of the tank.

BDD armor is classified as non-energetic reactive armor (NERA) since the reaction it produces (the defeat mechanism) is not caused by an explosive material, but by the impact of an attacking projectile on the polyurethane in each box. This reaction can have a huge impact on an attacking projectile or the molten "jet" from a shaped-charge warhead. When the projectile strikes and penetrates the outer layer of the BDD steel box, it sends an intense shock wave into the polyurethane, which compresses within the steel box. Since the compressed polyurethane (and the energy transferred to it from the projectile impact) has nowhere to go due to its confinement in the steel box, it is forced to move back into the path of the projectile. The effect is like compressing a powerful spring and suddenly releasing it towards the projectile. While the cause and effect of this reaction within the BDD box is well under-

At left, Russian T-62s with the added turret armor are seen on a road in Chechnya. The close-up above shows the added armor on one side of a Czech T-55AM2B turret. Also seen on the turret roof is the larger gunner's primary sight "doghouse" that can control the AT-10 "Stabber" guided missiles.

stood, the role played by the 5mm steel plates and the structural brackets holding them in place is not as clear-cut. While some sources report that the 5mm plates are in-fact "bulging plates" (designed to be set in motion by the reaction of the polyurethane to actually "attack" the projectile), a more likely explanation is that the 5mm plates and the structural brackets are intended to further confine the polyurethane in each BDD box. By increasing the surface area beyond that provided by the box itself, the additional confinement of the polyurethane (between and around the 5mm steel plates) equates to a larger reaction working against the attacking projectile.

In recent years, *NII Stali* (Russia's primary tank armor research and development organization), has become much more forthcoming with information regarding its armor developments. In a product pamphlet called "Suggestions on Modernization of MBTs and IFVs" distributed at a recent arms exhibition, *NII Stali* provided a few important details concerning BDD armor. In a section called Armor Protection Upgrading – Variant 1, BDD armor (described as "metal-polymer block"), is credited with adding 120mm of protection against APDS and 200-250mm of protection against HEAT or shaped-charge ammunition. In effect, the 60-degree frontal arc of a T-55 fitted with BDD armor was suddenly immune to tank-fired 105mm APDS and HEAT, as well as Rocket Propelled Grenade (RPG) ammunition. This new information confirms that this additional capability was a huge step forward at the time, and easily extended the service life of these upgraded T-55s for several years. In addition to the upgraded T-55s, BDD armor was also added to upgraded T-62 MBTs starting in 1983. These upgraded T-62s were designated T-62M and T-62M1. A number of these T-62Ms were recently used in combat in Chechnya. Finally, a few years ago, a surprising single photo was published of a T-72 MBT fitted with BDD armor. Virtually nothing is known about this particular T-72 or where the photo was taken. It could have been part of a test project or it may have been (based on the terrain in the photo) one of the small number of T-72s that were reportedly deployed to Afghanistan during the Soviet-Afghan War. Interestingly enough, no confirmed photos of those Soviet T-72s have ever been published.

Close-up of 5mm steel plates embedded in polyurethane blocks, a form of non-explosive reactive armor, added to the glacis.

The value and impact offered by BDD add-on armor have once again made themselves known; this time, by the deployment of upgraded T-55AMs in Afghanistan. As part of a $45 million weapons transfer package from Russia, the Afghan United Front (also known as the Northern Alliance) was supplied with 40 T-55AM2 MBTs. These tanks offer a variety of advantages to the forces of the United Front. In addition to being simple, reliable, and well understood (ideally suited for Afghan tank crews), the "new" T-55AM2s include capabilities beyond those of tanks previously used in Afghanistan. In a manner reminiscent of the Cold War years, the BDD armor protecting these T-55AM2s provides complete frontal protection against key opposing anti-tank weapons. In Afghanistan, the weapon at the top of this list is certainly the ubiquitous RPG. Whether deployed in Afghanistan in 2001 or serving with the Soviet and Warsaw Pact forces during the Cold War years, BDD add-on armor has been an unqualified success. Perhaps the most important thing to keep in-mind when evaluating the success of BDD armor is to remember that it was not developed in a vacuum. The relationship between it and other more recently developed Soviet/Russian add-on and composite tank armors is still to be determined.

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 a variety of Armor and Cavalry assignments, ranging from tank platoon leader to brigade S3, and has served as a tactics instructor both at Fort Knox, Ky. for AOAC and at Fort Leavenworth, Kan. for CGSC. He is currently a training developer in the Kansas City area.