

POLISH THERMAL VISION SYSTEMS FOR THE T-72 MAIN BATTLE TANK

Polish PCO S.A. company has prepared an upgrade concept with regards to the T-72M1 main battle tank's targeting/observation systems. The platform in question is being operated by the Polish military, among other users. New thermal vision component in the fire control system is the main element of the package. Furthermore, remaining active night vision systems would be replaced with more modern, passive counterparts.

The offer created by PCO S.A. is related to conceptual study, the goal of which is to find the best way to modernize the Polish land component's T-72 main battle tanks. Polish engineers and designers proposed that observation and targeting system should undergo relevant modernization.

The changes would include the following:

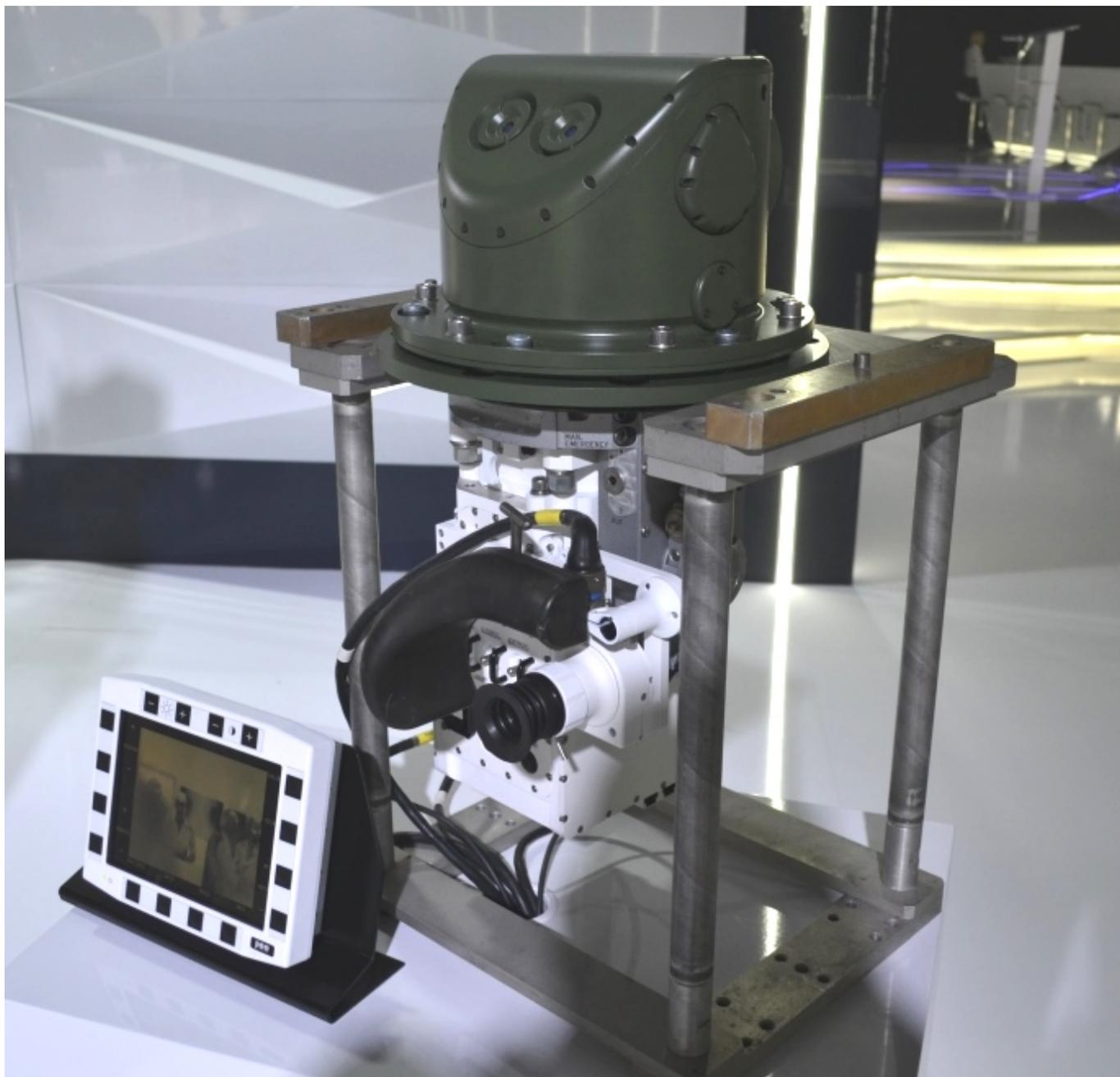
- Replacement of the former TPN-1-23-1 night sight with a new PCT-72 system, based around the PCO S.A.'s KLV-1 thermal vision camera;
- Change of the active TKN-3B commander's observation system into a passive solution, by installing the TKN-3Z variant of the instrument in question;
- Introduction of a passive PNK-55/72 system for the driver, replacing its active predecessor.

Upgrade as such, based around the domestically available industrial potential, would enhance the T-72's combat capabilities, especially at night and in conditions, in case of which the visibility remains limited. However, not only would this make it possible to carry out observation and fire control operations, as the upgrade would also make all of the targeting and observation devices passive, thus rendering the older active night vision systems obsolete.

In case of the formerly used T-72 optonics, active night vision systems were the primary solution utilized. In complete darkness systems as such were ineffective, while in conditions that are defined as favourable, they only allowed the crew to observe the situation at distances of up to 600 - 800 metres. In a situation as such it would have been required to illuminate the observed area with an external infrared source. The light emitted by the infrared systems is invisible to the naked eye, but the enemy could potentially observe it and locate the tanks with the use of the night vision systems remaining at his disposal. Making use of NVG systems in optoelectronics of MBTs may expose their position.

Thermal vision observation systems are gradually becoming a standard solution for both modern, as well as upgraded main battle tanks or infantry fighting vehicles. Introduction of the thermal imaging technology expands the capability to fight at night and makes it easier to operate the tank during the night, allowing for faster detection and neutralization of targets. Instruments offered by PCO can be fitted onto the T-72 without any in-depth upgrade of the tanks or their fire control systems. This greatly limits the potential cost of the upgrades.

The solution proposed for the Polish land forces has already seen practical application, since PCO S.A. carried out a full upgrade of the optronic system in case of the Ukrainian T-72 vehicles. Furthermore, the effectiveness of the upgrade made to the targeting and observation system has been proven by field tests in Ukraine. The results complied with the Ordering Party's requirements and the system has been certified for use in the Ukrainian military.



PCT-72 thermal vision sight with K LW-1 camera element visible in the back. Image Credit: M. Dura

PCT-72 Thermal Vision Sight

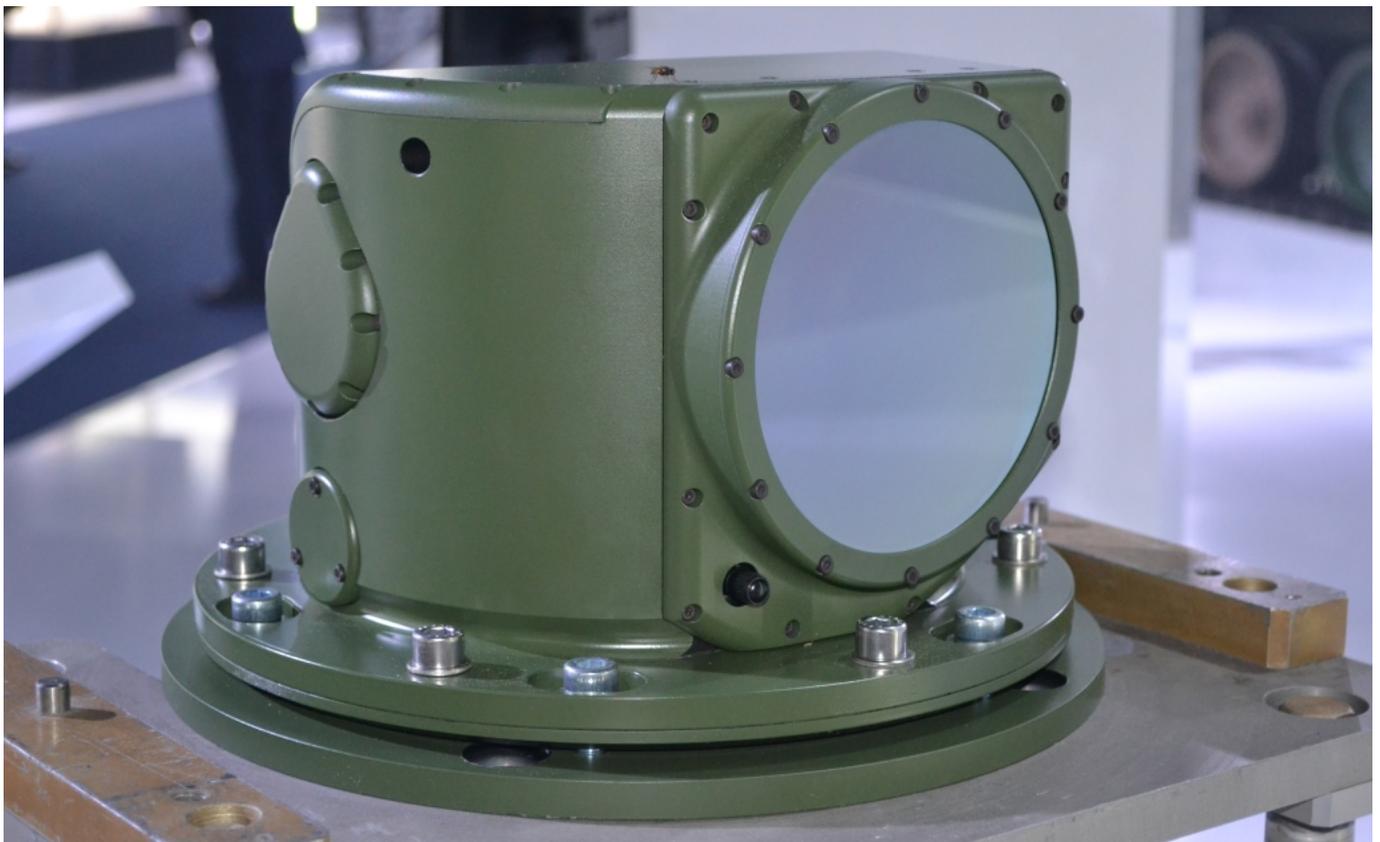
Replacement of the TPN-1-23-11 system with a PCT-72 Periscope-borne Thermal Vision Sight is one of the most important components of the upgrade package proposed by PCO S.A. for the T-72 platform. The system in question consists of the following elements:

- K LW-1 thermal vision camera;
- Periscope element with a pan adapter;
- MD-1 gunner display, with a support and a headguard;

- MFM-2 commander's MFD;
- Electrical harnesses;
- Mounting rings.

The kit may also feature an armoured casing for the periscope head prism, compliant with NATO STANAG protection level 2. Integration of the system on the tank does not require any design changes, while the imagery is accessible both for the gunner, as well as for the commander.

The K LW-1 camera adapted for the PCT-72 system has been originally designed to be used in the Drawa-1T and Drawa-1M fire control systems of the modernized PT-91 tanks. Some steps have also been made to use the K LW-1 camera (K LW-1R variant) with the Rosomak APC fitted with the Hitfist-30 turret. K LW-1 cameras will also be used in case of the modernized Leopard 2PL main battle tanks. K LW-1 "Asteria" cameras can thus be viewed as a standard piece of kit used on a variety of Polish armoured and mechanized platforms.



K LW-1 thermal vision camera head in the PCT-72 sight - front view. Image Credit: M. Dura

K LW-1 is in fact a night observation system, the main element of which is a thermal-vision camera operated in the LWIR bandwidth (wavelength between 8 and 12 μm). The camera is fitted with a cooled III-gen MCT detector, with a resolution of 640 \times 512 pixels (pixel size: 15 \times 15 μm). NETD coefficient does not exceed the value of 30 mK.

The camera is placed in a special-purpose housing ensuring the lens elements stability when field of view and temperature changes occur. The housing also complies with mechanical and climate-related requirement usually defined for military-grade equipment. In case of K LW-1 the above translates into operational temperature range between -30 $^{\circ}\text{C}$ and +52 $^{\circ}\text{C}$.

Detection and identification ranges remain dependent on the field of view and are characterized in a following manner:

- For the wide field of view (WFOV - $10.0^\circ \times 8.0^\circ \pm 10\%$) and a standard NATO target (2.3x2.3 m), the range is greater than 4700 metres in case of detection, it exceeds 1500 metres in case of recognition, and the targets can be identified at a distance of more than 750 metres;
- For the narrow field of view (NFOV: $3.0^\circ \times 2.5^\circ \pm 10\%$), and a standard NATO target (2.3x2.3 m), the range is greater than 5000 metres in case of detection, and it exceeds 2500 metres in case of identification.



KLW-1 infrared LWIR system. Image Credit: M. Dura

KLW-1 camera features manual and autofocus systems. It also utilizes germanium-based aspherical lens elements. Thanks to the above, the lens allows the camera to record non-distorted thermal vision imagery, also allowing the user to increase the image contrast and clarity, in order to inspect the relevant details. The special functions include an ability to change image polarization and orientation, 2x digital zoom, as well as manual and automatic contrast and brightness adjustment. The whole system weighs 10.5 kilograms and its size is contained in the following dimensions: 377.2x150x165 mm.

Modernized TKN-3Z Commander's Observation Instrument

Within the framework of the upgrade package for the T-72 main battle tank's optronics, PCO S.A. also proposed that it would modernize the binocular daytime/night commander's observation system - the TKN-3B solution. The system makes it possible for the tank commander to observe the terrain at night and during the day, including the movement of the vehicles nearby.

Modernization is to introduce passive Gen-II image intensifier in the optical night observation path, replacing the active solution. In this way, a night passive observation system has been created, that is easy to set up. There is no need to redesign the mounting socket in the tank, as dimensions remain unchanged. Some further enhancements have also been made, as a LED-based indicator has been embedded within the system, signalling that the night observation system is active or damaged.

The tests have proven that the modernized observation system makes it possible to detect 2.5×2.5 m vehicle silhouette at distance of up to 900 metres, with 3.5 mlx of light available and with 50% background contrast (dark moonless night), and at distance of up to 1800 metres with 30.50 mlx of light available and with background contrast level of 50% (moonlight available). One should note that magnification of 4.75x is available for daylight observation, whereas 4.2x magnification is provided in night mode.

The modernized TKN-3Z commander observation system features a diopter adjustment and an automatic intensification adjustment and automatic safety system protecting the intensifier from bright light that could be emitted by flares, fire or a strong light source. The power supply voltage is additionally stabilized as well.



Modernized TKN-3Z Commander's Observation Instrument. Image Credit: PCO S.A.

PNK-55/72 “Radomka” Night Vision Driver’s Periscope

Replacement of the driver’s night vision system with a passive solution is the third change proposed by PCO S.A., for the T-72 Main Battle Tank platform. For that purpose, PNK-55/72 “Radomka” Night Vision Driver’s Periscope is introduced.

Similarly as in case of the TKN-3Z system, the dimensions are identical as in case of the formerly used solution, thus it is a plug and play upgrade.

The PNK driver’s night-vision periscope offers stereoscopic night vision and it is a system designed with a variety of armoured vehicles in mind, including, above all, T-55 and T-72 main battle tanks and their derivatives, as well as BMP-1 and BMP-2 IFVs and their derivatives. The system makes it possible for the driver to observe the route at night and when the visibility is limited.

The periscope features two separate optical channels with two XDR/XR5 image intensifier, without any magnification system applied. The ocular spreading is 64 mm, and field of view is defined as 30 degrees.



PNK-55/72 “Radomka” Night Vision Driver’s Periscope Image Credit: PCO S.A.

Replacement of to gunner’s thermal vision sight and passive driver’s and tank commander’s night vision sights may be an important element of any upgrade package dedicated for the T-72 main battle tanks. Introduction of the above described modifications does not require any changes to be made to the tank design, and it greatly enhances the tank’s combat capacity. KLV-1 and PNK-72 systems are also used on other Polish armoured platforms, including the PT-91 Twardy main battle tank.

Modernization of the optronics is one of the elements that shall be taken into account, when speaking

of T-72 Main Battle Tank upgrade programmes. Alongside these elements, the platform may benefit from new anti-tank rounds, extra ERA, radio communication systems or SSP-1 Obra-3 laser warning receiver. Detailed scope of T-72 Main Battle Tank modernization is yet to be defined, however the upgrades shall make it possible to maintain the vehicles in combat-capable shape, until a new generation tank is introduced, that is expected to be developed within the framework of industrial cooperation.

The article has been prepared on the basis of the press materials provided by the PCO S.A. company

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