

Magnetic properties of unfired and fired 100 mm projectiles and their impact on interpretation in magnetic UXO-detection

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Abstract: In the frame of a research project conducted at the Institute of Forensic Science of the Police Force of the Slovak Republic special tasks related to the magnetic properties of projectiles have been studied. As typical ammunition samples, five unfired and four fired (but unexploded) 100 mm artillery shells have been selected.

We have conducted a variety of field magnetic measurements over those projectiles with the aim of estimating the role of remanent magnetization within the interpretation procedure. The magnetic measurements have been realized by Cs-vapour magnetometer TM-4, mostly with its sensors in vertical distance of 1.70 m over the selected

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projectiles. The projectiles were having different orientations and were rotated by different angles along their longitudinal axes during individual measurements.

Obtained and interpreted results confirm that the magnetic properties of projectiles play crucial role of in the interpretation of magnetic anomalies. This fact has already been pointed out in several UXO-oriented magnetic studies (e.g. Billings et al., 2009). Generally, we have experienced great importance of remanent magnetization. In the case of one of the four fired projectiles we can even speak about its dominance. Consequently, the remanence should have large impact on the shape, wave-length and amplitude of the measured anomaly. Logical result then is that also the interpreted source parameters have been influenced, namely, the interpreted depths tend to be larger than the real ones and the same is true for the interpreted projectile dimensions. Here we should mention that the interpreted parameters have been obtained by means of fitting the measured magnetic response to the response of one specific projectile from the library (Stanley, 1996). This kind of knowledge can improve the interpretation procedures in UXO-detection.

In addition, we have performed also simple estimations of average magnetic susceptibility of the projectiles. This was realized by means of in-situ measurement by the magnetometer in a constant projectile-sensor distance while manually rotating the projectile, as was suggested by Breiner (1973). The average susceptibility value in the case of the nine studied projectiles was 8.8 [SI units], which is in relative good coincidence with results of other authors (e.g. Hunt et al., 1995 in Goodrich, 2007). Such a simple and low-cost procedure has large potential for future magnetic data interpretation developments.

Key words: UXO, detection, magnetic susceptibility, remanent magnetization

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