

THE NEW PROTRACTOR FOR MILITARY USE

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Abstracts: *The working tool on the map is a device conceived and realized by the members of the research team on the project entitled "M.U.D.C.-01 Protractor of Angles, Distances and Coordinates", an element of novelty which aims to solve a problem identified in the daily activity of the military and is ultimately an effective and modern way of working on military topographic maps as well as an easy way for implementing an expeditious procedures of topographic work in field measurement, for required land distances and angles of orientation and navigation. This military protractor can also be used, eventhough it is less user-friendly and is designed primarily to measure the azimuth, angle slopes, distances and rectangular coordinates with two grid scales and standard army military symbols, by military personnel which work on maps in terrain or in military headquarters.*

Keywords: protractor, symbols, azimuth, compass, coordinates.

1. Introduction

The design of an instrument with the tactical and technical features adapted to the new conditions of combat missions, exercises and applications (resistant to sunlight, dust, bending and scratching) and with dimensions adapted for easy wearing on the training outfit constituted the foundation for the need of this scientific initiative. Ending the use of Gauss-Krüger cartographic projection in the favor of Universal Transverse Mercator projection (NATO standard) involved changes in the form and manner of determining the coordinates of the rectangular target (targets) by using the M.G.R.S. (Military Grid Rectangular System) format. Also one of the lessons learned in the military insurance requires a unique tactical instrument that contains a set of applications in the form of graded rulers, sectors and inscriptions for fast determination of the various components and distances, angles and values. The

appearance of the document "Handbook of conventional signs of Romanian Army - 2014 Edition" which is based on STANAG 2019 APP-6 (C) NATO Joint Symbology, 6th Edition, has led to the use of new types of conventional signs, in the form of graphical symbols used to represent units, equipments and their actions on maps, plans and drawings on paper format. Also for carrying out military actions under the aegis of the UN, NATO or other military structures it has been identified the need to use a tool compatible with the staff of the partners of the Alliance.

2. Scientific and technological support needed

This tool is designed to be made on a plastic material with shade of yellow-orange and translucent, thickness of 1,5 mm, to ensure a high level of flexibility required to prevent breakage or cracking (common incident appearing at existing instruments).

Embossing is to be achieved by laser engraving on the material in order to obtain a reduced thickness of markings and thus ensure a high degree of accuracy in the execution of measurement.

In order to achieve laser marking was necessary to develop a model of electronic instrument by using CorelDraw software.

3. M.U.D.C. – 01 (Protractor of Angles, Distances and Coordinates – 01) – edition 2015 tool description.

The instrument designed and manufactured physical to 1:1 scale by the members of the research team on the project entitled "M.U.D.C.-01 Protractor of Angles, Distances and Coordinates" carried out by the Departmental Plan for Research, Development of National Defense to the year 2015 as an element of novelty which aims to provide an efficient and modern way of working on military topographic maps as well as an easy way for implementing expeditious procedures of topographic work in field measurement, for required land distances and angles of orientation and navigation.

The instrument is made in accordance with the provisions of valid instruction manuals and applicable both in the Romanian army and other NATO armies, as well as procedures for working on UTM projection in the topographic military maps. These standards and handbooks are: *FM 1-02 (FM 101-5-1) - MCRP 5-12A - Operational Terms and Graphics, 2004 edition, STANAG 3680/AAP-6 (2003), NATO Glossary of Terms and Definitions, AAP-15, NATO Glossary of Abbreviations Used in NATO Documents and Publications, STANAG 2019 APP-6 (C) JOINT SYMBOLOGY, 6th edition, STANAG 2019/APP-6A, Military Symbols For Land Based Systems and QSTAG 509, Military Symbols.*

Conventional signs (symbols) contained within the tool (Figure 1) are in accordance with the manuals and standards that apply in all NATO armies and underlying „Handbook of conventional signs of Romanian Army, 2014 Edition”.

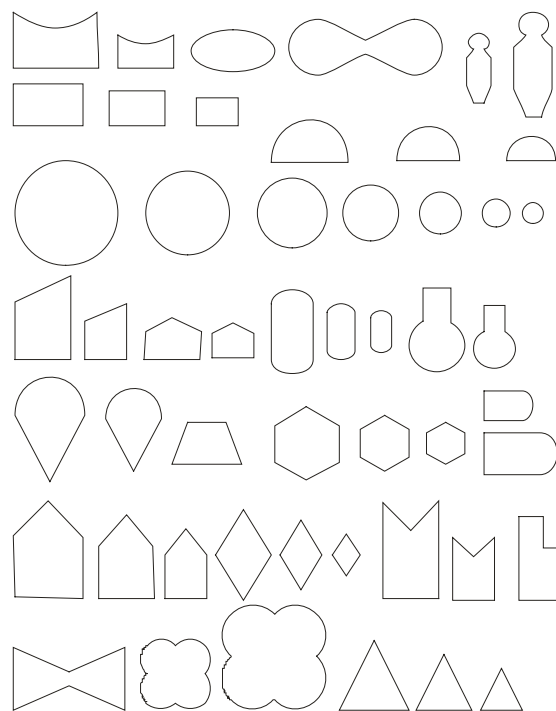


Figure 1: Conventional signs (symbols) contained within the instrument M.U.D.C. – 01

Due to limited available space were made the most representative and most commonly used conventional signs as well as a number of standard graphic symbols that combine to provide other conventional signs that were not able to be represented individually. The signs and symbols were made for more dimensions that allow the user (depending on the scale or existing space) to represent all the elements necessary. In the four sectors there are represented 47 signs and symbols to which you add other 6 sectors of fire (300/300, 300/200 and 200/200) at scales of 1:25,000 and 1:50,000 needed for the representation of ground targets for artillery.

The instrument comprises a central representation of the main directions towards the cardinal points (N, S, E, W), as well as the intermediate directions (NE,

NW, SE, SW). In the same place there is a clock sector, together with the hole in the center of the tool, the user provides a way of determining the NORTH direction applying timely work method with the help of the sun and the clock sector (Figure 2). For use of this clock sector it is necessary to enter into the hole in the center of the instrument a small stick (recommended shape and size of a toothpick), a very easy to find object. This method is provided in the following manuals: *Military topographic surveying*, Military Topographic Department, Bucharest, 1976, *Military Topography*, first volume, The Land Forces Academy Publishing House, Sibiu, 1999, *Military Topography*, second volume, Land Forces Academy Publishing House, Sibiu, 2008, as well as in foreign topographic training manuals.

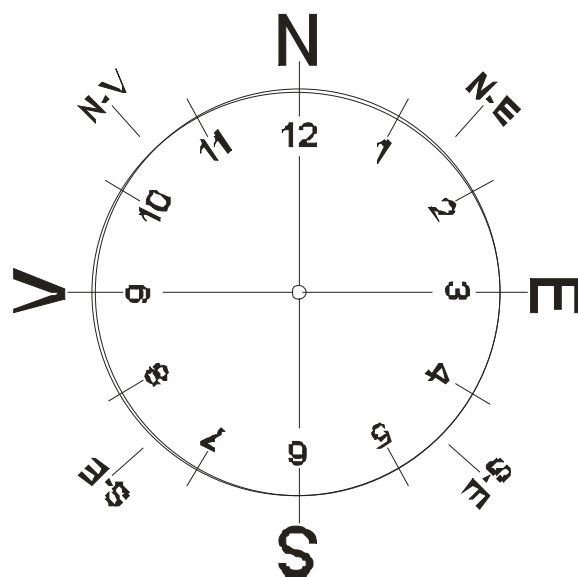


Figure 2: The main directions and intermediate representation to the cardinal and time zone of the quadrant clockwise

The tool includes two rectangular coordinates to determine the coordinates of targets and the planimetry military detailed in topographic maps UTM projection at the scales of 1:50,000 and 1:25,000 (Figure 3). These scales have been established since the commanders (Major Staffs where applicable) from the echelons of platoon, company, battalion and brigade, used for military topographic maps or working

assemblies military topographic maps at these scales.

These protractors which comply with those laid down in other instruments of NATO armies (see Graphic Training Aid 5-2-12 Coordinate Scale and Protractor). How to use these standard protractors is provided in the instruction manuals available. The existence of these protractors helps a user to determine these coordinates with an

accuracy of ± 1 mm at the map scale, precision that comply with standards

relating to this type of measurement.

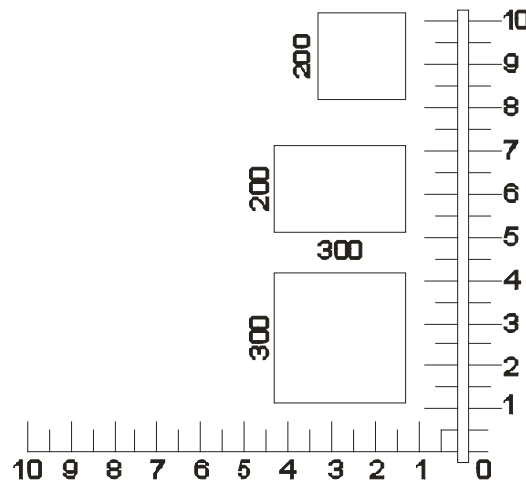


Figure 3: Protractor for the measurement of coordinates

The time required for such determinations is reduced to the maxim possible, thus not exceeding, for inexperienced military, about 15 seconds for identifying the point on the map. Because the old tools did not provide an effective way of determining these coordinates, it was required the use of common rulers graded in millimeters and users were forced to carry out the transformation from millimeters in meters and rounding them to the proper scale, which sometimes generated errors. Using this tool removes these shortcomings and

shortens the time required to perform properly.

The same purpose is provided on the left side, a scale for measuring distances between places (details of planimetry) at scales of 1:50,000 and 1:25,000 (Figure 4). Scales are graded as follows:

- for the scale 1:25,000 – graduation of every 25 meters, numbered from 500 to 500 meters from 0 to 3000 meters;
- for the scale 1:50,000 – graduation of every 50 meters, numbered from 1000 to 1000 meters from 0 to 6000 meters.



Figure 4: Scale for measuring distances between places (details of planimetry) at scales 1:50,000 and 1:25,000

At the bottom of the instrument there is a scale for measuring the distances with the help of the graded ruler (Figure 5), the procedure provided in the training manuals used in topographic practice by the military. This graduated scale replaced ruler which often is lost, breaks or simply missing and

the respective military does not have an easy way and sufficiently accurate for the determination of the distances. Scale is marked with graduation in millimeter, numbered by centimeters to centimeters the from 0 to 10 centimeters.

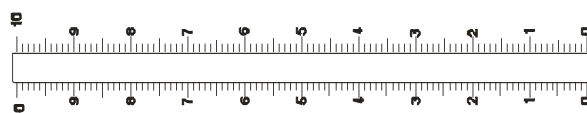


Figure 5: The scale for determining the distances with the help of the graded ruler.

The left side is engraved a semicircular sector for timely measurement of slope angle (Figure 6), process envisioned in the topographic training manuals and very necessary used in practice by the military. This scale replaces an instrument called the „*eclimetru*”, an instrument that does not exist in the standard but may be achieved by the military, the process (manufacturing and working) being provided in instruction

manuals topographic effect. This scale allows to determine expeditiously the angle of slope of the terrain in order to determine the possibilities of transfer of military equipment to fight or transport. The scale is graduated in sexagesimal degree, numbered from 10° to 10° from 0 to 90° . For using this scale is necessary to attach a piece of rope with a certain weight, very easy to find objects.

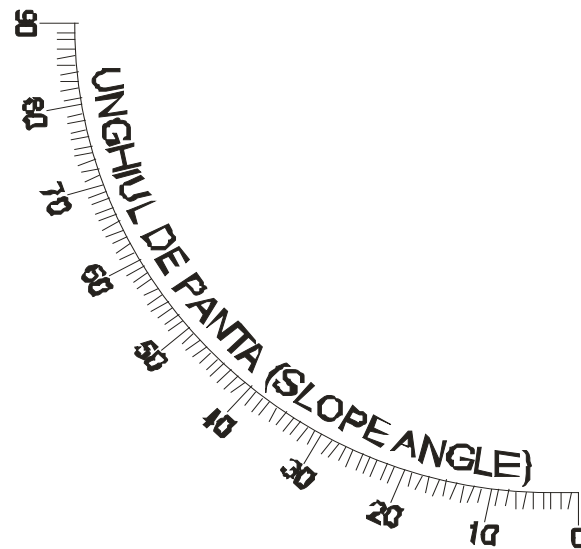


Figure 6: Semicircular sector pattern for timely determination the angle of the slope

In the upper right-hand side is engraved a semicircular sector for timely determination of the sinus and tangent angles expressed in instrumental mils (Figure 7). These values of sine and tangent are necessary for application of the formulas for calculating the right-angled triangle required determining the distances or height of the various details of planimetry and to solve any triangle (technique often used by ground artillery). The scale is graded as follows:

- for sinus scale graduation from 0.05 in 0.05, the numbered from 0.1 in 0.1 from 0 to 0.95, corresponding angles from 0 to 72°
- tangent scale-in the first part of the 0,05 0,05 graded, numbered from 1 to 0.1 from 0 to 1, then the graduation from 0.1 in

0.1, the numbered from 0,2 in 0,2 from 1 to 2.5 corresponding angles of up to 68° .

For using this scale is necessary to attach a piece of rope with a certain weight, very easy to find objects.

On the circumference of the instrument are engraved two scales necessary for measuring horizontal angles from 0 to 60-00 (in instrumental mils) and from 0 to 360° (in sexagesimal degrees). The two scales are emblazoned as follows:

- mils scale is engraved on the outside and is graded from 0-10 to 0-10 instrumental mils, numbered from 1-00 in 1-00 from 0 to 60-00, in the sense of clockwise;
- scale degrees sexagesimal is engraved on the inside and is graded from 10° to 10° ,

numbered from 100° to 100° 0 to 360°, in the sense of clockwise.

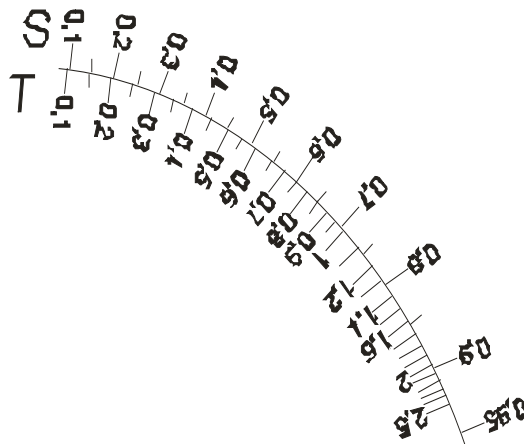


Figure 7: Semicircular sector for timely determination of the sinus and tangent angles expressed in instrumental mils

The tool includes a symbol targets (represented at two different scales) for the purpose of drawing up schemes to help with the layout of the field of targets within the shooting camp for the purpose of to make

the documents of the instructors of rifle marksmanship (Figure 8). Other symbols of targets as needed is accomplished by combining or truncated representation of this generalist symbol.

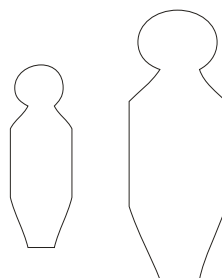


Figure 8: Target symbol

4. Cost structure categories and corresponding budget items cycle phases of acquisition and optimal variants

The costs for the development of this prototype phase are estimated at about 9,500 RON:

- software CorelDraw acquisition costs 2935,50 RON;
- hardware acquisition costs 4,500 RON;
- the equivalent of prototype materials and manufacturing costs 2064,50 RON.

5. Risk analysis program

Program risks residing in disagreement within the structures of the General Staff and of the Land Forces Staff surveyed

about the advisability of placing in equipping the forces of this instrument.

The response of these structures will influence and importance that priority will be given to this program, and in the case of a mostly negative response when this project will be stopped.

Another risk comes from the withdrawal of the funds necessary for testing the reaction of the material mode of the instrument to destructive factors (dust, moisture, heat, strong sunlight, bending, breakage, wear, etc.). The result will consist of postponing planned stages (extension) or ultimately

delaying achievement of the prototype up to the allocation of the necessary funds.

There's also a potential risk that derives from the prototype tests the nonconformities concerning who will be subjected to in the sense that its shape or material will not correspond to the nominal parameters needed. The result will be to identify and change them with other materials in accordance with the technical specifications.

A final risk will come from non-identified by the military operational structures to which the tools of „0 serie” will be sent for operational testing. The result will be a change of form and content disclaimer at manufacturing and failure in equipping the armed forces.

6. Proposals for the implementation of the research theme

To carry out the following steps it is recommended that an agreement in principle over opportunity, shape and content of this instrument from stakeholders in the implementation of and equipping forces with this tool, you agree to be acquired by the Land Forces Academy with the assistance of the military staff of the Land Forces.

The finality of the project will consist in the realization of the final form of the instrument M.U.D.C. 01 (Protractor of Angles, Distances and Coordinates) which later to be proposed for approval and introduction in manufacture of series to replace the template with the conventional signs, the master of the line staff officer and artillery protractor of the structures of the Ministry of National Defense (and other structures in the national defense system which it deems reasonably necessary).