

THE USE OF CALL FOR FIRE PROCEDURES WHILE CARRYING OUT FIRE MISSIONS – CALCULATION OF ADJUSTMENTS DURING REGISTRATION BY FIRING AND CONTROL OF THE FIRE FOR EFFECT-Part II

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Abstract:

The article presents the possibilities of using CALL FOR FIRE procedures when fire missions are carried out by artillery subunits in accordance with the national procedures. The paper analyses the possibilities of calculating adjustments during registration by firing and control of the fire for effect. The article describes in detail the use of a plotting board for registration by firing while carrying out a fire mission in accordance with the CFF procedure.

Keywords:

CFF, calculation of adjustments during registration by firing, procedures for the determination of settings

INTRODUCTION

When a fire mission is carried out a Forward Observer (FO) provides relevant reports in accordance with the call for fire (CFF) procedure, whereas the officers staying at the Fire Direction Centre (FDC) should use this information in line with the procedures in place in our Armed Forces. It applies in particular to the following elements of the determination of settings and completion of a fire mission:

- determination of target coordinates;
- calculation of range and direction adjustments during registration by firing;



- calculation of range and direction adjustments while carrying out a fire for effect mission.

The determination of coordinates was described in the first part of the article, entitled The use of call for fire procedures when executing fire missions determination of target coordinates-part I. *Zeszyty Naukowe Wyższa Szkoła Oficerska Wojsk Lądowych im. gen. Tadeusza Kościuszki Journal of Science of the gen. Tadeusz Kosciuszko Military Academy of Land Forces*, 48 (3), p. 37-51.

In accordance with the CFF procedure registration by firing can be performed in two cases:

- observer supports registration by firing carried out by an artillery subunit which uses the automatic fire control system;
- observer supports registration by firing carried out by an artillery subunit which does not use the automatic fire control system.

The paper describes actions taken by the FDC when a fire mission is being completed by an artillery subunit by registration fire, without using the automatic fire control system. Fast and accurate calculations of range and direction adjustments during registration by firing determine the effective completion of a fire mission. The basis of registration by firing is the accurate and continuous observation of bursts, carried out by permanent reconnaissance elements of artillery subunits (sections of forward observers and command squads)¹.

1. PROCEDURE FOR CALCULATING ADJUSTMENTS DURING REGISTRATION BY FIRING AND CONTROL OF THE FIRE FOR EFFECT

The most often employed method of registration by firing during combat operations is adjusting/ranging with the use of a range finder. The principle of registration by firing with the use of a range finder is that at the stage of establishing the accurate target location (target reconnaissance) from the observation post of the section of forward observers (command squad) the following are determined with the use of a compass-goniometer and a range finder: the topographic azimuth of the target (T_c) and the distance between the observation post and the target (d_c). During registration by firing the following are measured: the topographic azimuth of the burst (T_w) and the distance between the observation post and the burst (d_w). On the basis of the results of the measurements conducted by a range finder operator with regard to the target and the burst it is possible to calculate range (Δd) and direction (α) deflections. The measurement of a direction deflection (α) can also be performed directly, by means of binoculars with an angle measuring reticle, an observation instrument used by the leader of a section of forward observers (command squads). The thus determined de-

¹ Sections of forward observers are used by artillery squadrons, while command squads, by support companies in mechanised battalions.



viations of the burst from the target provide the basis for calculating range (ΔD) and direction (ΔK) adjustments.

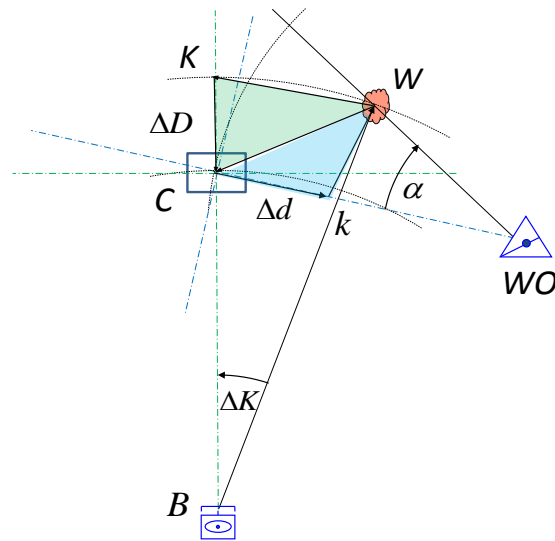


Fig. 1. The principle of observation and calculation of adjustments during registration by firing in accordance with the national procedures

Source: Own work

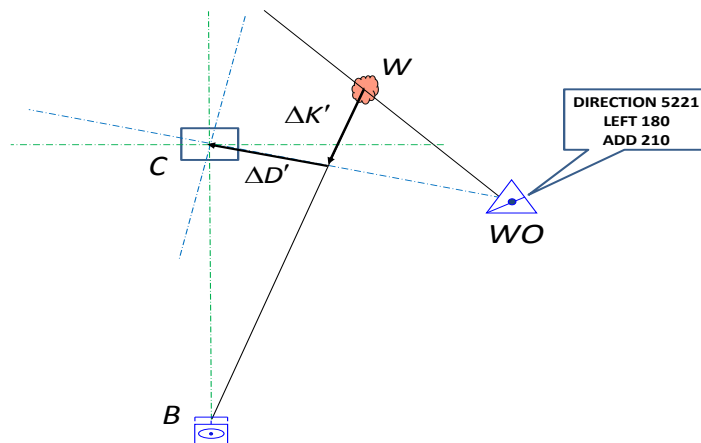


Fig. 2. The principle of observation during registration by firing in accordance with the CFF procedures

Source: Own work

During registration by firing in accordance with the CFF procedure the forward observer determines the location of the burst in relation to the target with respect to range and direction in meters. In order to determine the direction deflection of the burst, expressed in meters, the so-called OT factor table is used. In the report the FO includes



the corrections to be made regarding the location of the burst in relation to the observation post. In line with the procedures for the determination of settings, the reported corrections have to be converted into the range and direction adjustments for the firing position. The principle of observation during registration by firing in accordance with the CFF procedures is presented in Figure 2.

The range and direction ($\Delta K'$, $\Delta D'$) adjustments in relation to the observation post, presented in Figure 2, should be converted into the range and direction (ΔK , ΔD) adjustments for the firing position.

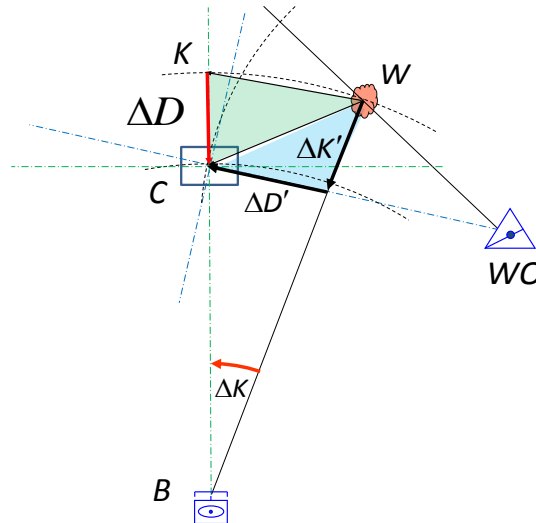


Fig. 3. The principle of calculating range and direction corrections during registration by firing in accordance with the CFF procedures

Source: Own work

Irrespective of the method used, the reported range and direction ($\Delta K'$, $\Delta D'$) adjustments have to be converted into α and Δd deflections. The range adjustment has to be converted into the deflection, making use of the formula:

$$\Delta d = -\Delta D' \quad (1.1)$$

where:

- $\Delta D'$ – range adjustment for the observation post, with the “+” sign when the burst is located before the target (ADD) and the “-” sign when the burst is located behind the target (DROP).

To make use of the reported direction adjustment $\Delta K'$ in our procedures, it is necessary to convert it into mils. For this purpose the distance of observation has to be known. The direction adjustment $\Delta K'$ has to be converted into the deflection α , making use of the formula:

$$\alpha = -\frac{\Delta K'}{0,001 \cdot d} \cdot 0,95 \quad (1.2)$$



where:

- d -distance of observation;
- $\Delta K'$ direction adjustment for the observation post, with the “-” sign when the burst is spotted to the left of the target (LEFT) and the “+” sign when the burst is spotted to the right of the target (RIGHT).

The thus computed deviations of the burst from the target regarding range and direction ($\alpha, \Delta d$) are used for the calculation of the range and direction adjustments for the firing position, in accordance with the procedures included in the Instruction for Firing and Fire Control. The calculation of adjustments during registration by firing can be done by employing one the following:

- fire control system Topaz;
- artillery calculator SKART (UKART);
- fire control instrument;
- instrument for registration by firing;
- a simplified method, when an observation angle is smaller than 5-00.
- plotting board for registration by firing.

From among the above-mentioned methods only the use of a plotting board for registration by firing has not been described in the specialist literature. Therefore, in its further part the paper focuses on this method.

To make use of a plotting board for registration by firing to determine the range and direction adjustments the following must be available:

- observer-target azimuth;
- firing azimuth;
- location of the burst in relation to the target.

The firing azimuth is calculated according to the formula:

$$T_s = T_{KZ} + kp_T^C(Kz) \quad (1.3)$$

where:

- T_{KZ} – gun-target azimuth;
- $kp_T^C(Kz)$ – topographic angle of shift between the firing direction and the target;

During registration by firing the forward observer submits reports with range and direction adjustments for the observation post ($\Delta K', \Delta D'$).

In order to plot the location of the burst on the plotting board the submitted adjustments have to be converted into range and direction deflections for the observation post.



The range deflection is calculated from the formula:

$$\Delta d[m] = -\Delta D' \quad (1.4)$$

The direction deflection is calculated from the formula:

$$U_k[m] = -\Delta K' \quad (1.5)$$

where:

- Δd – range deflection, expressed in meters, for the observation post;
- U_k – direction deflection, expressed in meters, for the observation post;
- $\Delta D'$ – range adjustment for the observation post, with the “+” sign when the burst is spotted before the target (ADD) and the “–” sign when the burst is spotted behind the target (DROP);
- $\Delta K'$ – direction adjustment for the observation post, with the “–” sign when the burst is spotted to the left of the target (LEFT) and the “+” sign when the burst is spotted to the right of the target (RIGHT).

When adjustments are determined using this method the centre of the plotting board for registration by firing is treated as the centre of the target.

The stages of calculating range and direction adjustments with the use of a plotting board for registration by firing:

- a) After setting the top of the plotting board according to the observer-target azimuth, on the basis of the computed range and direction deflections, expressed in meters, plot the location of the burst on the plotting board;
- b) Set the top of the plotting board in line with the firing azimuth and read from the bottom part of the plotting board the deviations of the burst from the target regarding range $\Delta d'$ and direction U_k' , expressed in metres, in relation to the firing position;
- c) On the basis of the range deflection for the firing position determine the range adjustment (formula 1.6) and compute arithmetically the sight adjustment (formulas 1.7 or 1.8).

The range adjustment is calculated according to the formula:

$$\Delta D = -\Delta d' \quad (1.6)$$

The sight adjustment is calculated using the formula:

$$\Delta C = \frac{\Delta D}{\Delta X_{tys.}} \quad (1.7)$$

where:

- $\Delta d'$ – range deflection for the firing position read from the plotting board;



- ΔD – range adjustment;
- $\Delta X_{\text{tys.}}$ – change in the range of fire when the sight is changed by 1 mil.

When registration by firing is carried out using M-120 mortars, the sight adjustment is calculated using the formula:

$$\Delta C = \frac{\Delta D \cdot \Delta c}{50} \quad (1.8)$$

where:

- ΔD – range adjustment;
- Δc – change in the sight setting corresponding to a change in range by 50 m.

When registration by firing is carried out using M-98 mortars, the sight adjustment is calculated using formula 1.7.

On the basis of the direction deflection U_k' the direction adjustment should be calculated [formula 1.9].

$$\Delta K = \frac{-U_k'}{0,001 \cdot D_T^c} \cdot 0,95 \quad (1.9)$$

where:

- U_k' – direction deflection, expressed in meters, in relation to the firing position;
- D_T^c – topographic distance to the target.

When exercising control over the fire for effect the range and direction adjustments are computed in the same way as during registration by firing.

CONCLUSION

The presented analysis of the selected issues related to the calculation of range and direction adjustments during registration by firing, carried out in accordance with the CFF procedure, indicates the significance of this problem and the necessity of describing it. The solutions outlined in the paper lead to the statement that in specific situations a plotting board for registration by firing can be effectively used to calculate adjustments during registration by firing. It applies in particular to registration by firing carried out in accordance with the CFF procedure. It is also important that the use of a plotting board is in no way dependent on the angle of observation.

The proposals and conclusions contained in the paper are not categorical. The conducted analysis leads to the conclusion that diversified conditions in which combat operations are performed will require artillery commanders to use the presented principles in a flexible and innovative manner. It should be realized that there are no ready-made procedures for all situations that may occur during combat operations. The presented solution variants may provide the basis for further considerations in this area.



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