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A STUDY OF SOVIET USE OF FIELD ARTILLERY
WEAPONS IN A DIRECT FIRE ROLE

A thesis presented to the Faculty of the U. S. Army
Command and General Staff College in partial
fulfillment of the requirements for the
degree

MASTER OF MILITARY ART AND SCIENCE

by

LARRY W. COKER, JR., MAJ, USA
B.A., Trinity University, 1974

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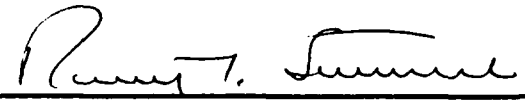
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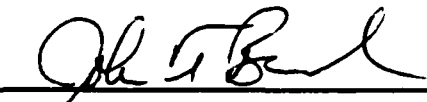
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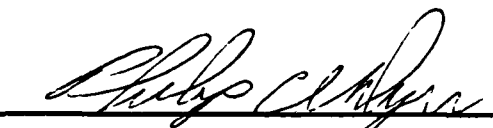
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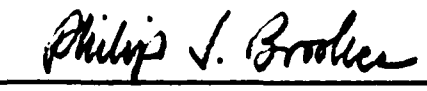
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ABSTRACT

A STUDY OF SOVIET USE OF FIELD ARTILLERY WEAPONS IN A DIRECT FIRE ROLE, by Major Larry W. Coker, Jr., USA, 102 pages.

→ This study is a detailed look at the information available in current Soviet military publications on how the Soviets use their field artillery weapons in a direct fire role. It includes a discussion of the historical background for use of direct fire as it was developed during the Great Patriotic War. The primary emphasis is on how the Soviets currently employ direct fire during offensive and defensive operations, and the training techniques used to develop direct fire skills at individual and collective levels.

The conclusions drawn from this study are that the Soviets will aggressively use their field artillery in a direct fire role in both offensive and defensive situations, but most routinely in the meeting engagement; the major advantages for the use of direct fire are timeliness, accuracy, and ammunition savings; routine training is conducted by Soviet artillery units to develop their direct fire skills; and the Soviets' significant numerical advantage in artillery assets allows them the flexibility to employ it for direct fire.

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CHAPTER 1

INTRODUCTION

In my 'upbringing' as a field artillery officer, I have been taught that field artillery weapons are extremely vulnerable when used in a direct fire role. This is especially true when a crew employs a field artillery piece against a tank. The field artillery piece is at a distinct disadvantage because its accuracy using direct fire is very limited beyond 1,000 meters, while a modern tank is capable of engaging targets with a high probability of a hit at several times that range. The difference in effective ranges between the field artillery weapon and the tank certainly gives the tank a significant advantage in an engagement between them.

Current United States Army doctrine considers the use of direct fire by field artillery weapons as strictly defensive in nature. It is a method to provide a last resort defense of the battery position prior to making a hasty displacement to an alternate position. Direct fire is also used to provide protection during road marches. For the most part, it is expected to be used out of necessity rather than by choice.

In stark contrast, the Soviets are much more aggressive in employing field artillery weapons for direct fire. They traditionally have used such fire in offensive as well as defensive situations. The aggressive use of field artillery in direct fire has a historical basis in the Soviet method for employment of artillery against the Germans during World War II. These

methods remain basically unchanged today despite the increased lethality of newer weapons on the battlefield.

Problem Statement

The purpose of this study is to determine why the Soviets readily use indirect field artillery weapons for direct fire purposes. In studying this question and determining the reasons, there are several other supporting questions that have to be answered.

1. What is the historical basis for Soviet use of field artillery in the direct fire role?
2. What are the tactics and procedures used by the Soviets in employing field artillery in the direct fire role, and how do they provide for survivability?
3. How does the direct fire role for Soviet field artillery relate to the overall mission in providing direct support to the maneuver force?
4. What impact do the characteristics of Soviet weapons systems and ammunition have on the employment and effectiveness of their field artillery in direct fire?
5. What can we learn from the methods and procedures used by the Soviets in training for use of direct fire by the field artillery?

Limitations and Delimitations

The effectiveness of this study is limited by the availability of translations of primary source material in Soviet documents. I have been

dependent on these translations due to my inability to read Russian. I do not think this has been a significant problem since there is a tremendous amount of translated material available for study.

This study is concerned with the Soviet field artillery systems most often found organic or attached at the Soviet regimental level. These are the D30 122mm towed howitzer, the 2S1 122mm self propelled howitzer and the 2S3 152mm self propelled howitzer. These weapons are primarily designed and used as indirect fire weapons. Although the Soviets are one of few modern armed forces still using specialized anti-tank artillery, these weapons will not be addressed specifically in this study.

The time period covered by this study goes back to the Soviet participation in World War II (the Great Patriotic War) only for the purpose of exploring the historical context of the problem. The primary focus is to establish the current methods and reasons for employment of field artillery in the direct fire role.

Significance of the Study

This study will serve to bring together facts about direct fire from a multitude of sources. For that reason it may be a reasonable 'primer' for military personnel on how the Soviets may employ field artillery for direct fire. By studying the Soviet use of field artillery for direct fire, it may also be possible to assess significant vulnerabilities that can potentially be exploited on the future battlefield. With the vast superiority the Soviets enjoy in the number of field artillery tubes available to them, any means to assist in the reduction of that advantage will be helpful.

Survey of Literature

There is considerably more information available on the Soviet use of field artillery for direct fire than I had initially expected to be able to find. It can be divided between the historical information, primarily tied to how the Soviets used their artillery for direct fire in World War II, and information on current intentions for employment.

Several sources have provided information for both the historical basis of Soviet use of field artillery in direct fire, and the current doctrine. The first is The Soviet Army, 1939-1980: A Guide to Sources in English¹ which is a good bibliographical source for both types of information. The second is a translation of The Artillery Battalion in Combat² by Marshal of Artillery G. Ye. Peredel'skiy and published in March, 1984. This is an excellent source for information on how direct fire is used now, as well as for specific historical examples from the Great Patriotic War. This use of historical examples is a significant indication that the employment methods for artillery in direct fire have changed very little. The third is "Soviet Combined Arms: Theory and Practice" by J. Erickson. This is an unpublished defense study done at the University of Edinburgh that traces the development of Soviet combined arms from the Great Patriotic War to present. Both The Offensive³ by A.A. Sidorenko and Antitank Warfare⁴ by G. Biryukov and G. Melnikov are books written in the 1970s by Soviet military officers who are 'candidates of Military Science.' Both also provide historical examples for direct fire use by artillery and the indication that direct fire employment remained a valid technique into the 1970s.

Strictly historical sources include a Department of the Army translation of F.A. Samsonov's Combat Experience of Artillery in the Patriotic War.⁵ This is an excellent source for information on how and why the Soviets utilized direct fire artillery in the Great Patriotic War. Another good source is the series of articles that appeared throughout the Field Artillery Journal⁶ during the years 1942-1944. These were written by Soviet artillery officers telling the American artillery community what was working well against the Germans. There are also several articles from 1946 and 1947, also from the Field Artillery Journal⁷, where British and American officers analyze the Soviet artillery experiences of World War II. Translations are available of the Soviet Military Historical Journal⁸ for issues since 1978 and they have provided several articles that discussed the Soviet employment of artillery in the Great Patriotic War.

There are many other sources that provide some historical perspective on Soviet use of field artillery for direct fire including B.H. Liddell Hart's The Red Army⁹ and Raymond Garthoff's Soviet Military Doctrine¹⁰. The latter also gives good information on the development of self propelled artillery related to a direct fire role for it. The role of self-propelled artillery is also discussed in an article, "The Postwar Development of Tank Forces" by P.A. Rotmistrov in Selected Soviet Military Writings¹¹ compiled by the U.S. Air Force. Another article in this same book is by I.N. Vorob'yev entitled "Fire, Assault, Maneuver" and provides a good historical example of offensive use of direct fire artillery. Other sources that provide analysis of Soviet artillery development are The Russian War Machine 1917-1945¹² edited by S.L. Mayer and "An Analysis of Soviet Artillery Development"¹³ by Kurt Hoffman in International Defense

Review.

There are numerous sources which provide information for my study on current Soviet use of field artillery for direct fire. The best sources are the numerous articles found in the Soviet Military Herald¹⁴. Translations are available for this monthly publication and each edition generally has several articles on artillery. Frequently the articles make some reference to the direct fire use of field artillery weapons. The majority of current information is to be found in periodicals. "The Wind of Change in Soviet Artillery," International Defense Review,¹⁵ by C.N. Donnelly provides some good background information as does "Destruction by Fire: Soviet Artillery in the 1980s and Beyond," Field Artillery Journal¹⁶ by Christopher Bellamy. The article by Bellamy is excellent for providing information on the contribution of direct fire in accomplishing the 'fire destruction' mission of Soviet artillery. The Field Artillery Journal¹⁷ and Armor¹⁸ magazine provide numerous articles on current Soviet artillery equipment and tactics.

The Soviet Armed Forces Review Annual¹⁹ edited by David R. Jones provides some background material on artillery developments. Volume 8 (1983-4) discusses the apparent Soviet move to eight guns per battery in the artillery battalions organic to maneuver regiments which will have implications on the quantity of artillery assets potentially available for direct fire. Two recent books by Richard Simpkin²⁰, Antitank and Red Armour, also provide information on the antitank role of Soviet artillery.

There are several references available to provide limited technical information on Soviet artillery equipment and its capabilities. These include Weapons of the Modern Soviet Ground Forces²¹ edited by Ray Bonds

and Jane's Armour and Artillery²². The translation of the Field Artillery Officer's Handbook²³ by Valentin Lebedev provides information on artillery ammunition and direct fire procedures.

Methods and Procedures

The primary method for conducting this study is by making an extensive search of available literature concerning the subject. Although several books are available to answer questions on the historical aspect of Soviet use of direct fire artillery, access to the vast majority of the information on how Soviets currently view the direct fire role is through periodicals.

The Soviet Army Studies Office (SASO) provided numerous 'leads' onto resources available. Through SASO I have been able to get several unpublished resources and also some access to the research data base at the Soviet Studies Research Center at Sandhurst, England.

Another resource used was a discussion with MAJ Brian McQuiston, a fellow student in CGSC whose previous assignment was at Defense Intelligence Agency where he followed Soviet artillery developments. He read the study in its final draft and provided several helpful observations and comments.

The data collected from these sources was organized into chapters generally along the lines of the supporting research questions addressed earlier in this chapter. Chapter 2 is an assessment of the historical background that gave rise to the Soviets' use of field artillery in a routine direct fire mode. The third chapter discusses the current (since 1975)

tactics and procedures used by the Soviets in the employment of their field artillery. Chapter 4 discusses current Soviet training for direct fire and comments on current Soviet artillery and ammunition for direct fire. Finally, chapter 5 contains the conclusions that can be drawn from this study and the recommendations for future study.

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- 2 G. Ye. Peredel'skiy, The Artillery Battalion in Combat (1985).
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- 8 V. Kiselev, "The Development of the Antitank Defense in the Postwar Years," Military Historical Journal (June 1978): 46-53; A. Tsynkalov, "The Great Patriotic War and the Postwar Period," Military Historical Journal (Jul 1979): 18-23; G. Peredel'skiy, "Combat Employment of Artillery in Army Defensive Operations," (November 1979): 16-21.
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- 12 S.L. Mayer, editor, The Russian War Machine 1917-1945 (1977).
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- 14 The articles from the Soviet Military Herald are too numerous to list here. They can be referenced in the bibliography.
- 15 C.N. Donnelly, "The Wind of Change In Soviet Artillery," International Defense Review 6 (1982): 737-44.
- 16 Christopher Bellamy, "Destruction by Fire: Soviet Artillery in the 1980s and Beyond," Field Artillery Journal 53 (September-October 1985): 40-5.
- 17 George R. Patrick, "Soviet SP Doctrine," Field Artillery Journal (July-August 1978): 27-29; William P. Baxter, "Soviet 122-mm Self-Propelled Howitzer," Field Artillery Journal (January-February 1980): 35-7; Keith W. Dayton, "Field Artillery Survivability: The Soviet Perspective," Field Artillery Journal (September-October 1981): 46-50.
- 18 Larry W. Williams, "Soviet Self-Propelled Artillery," Armor (September-October 1978): 18-20; John Erickson, "Soviet Combined Arms Operations," Armor (May-June 1980): 16-21.
- 19 David R. Jones, Soviet Armed Forces Review Annual. Volume 8, 1983-1984 (1985).
- 20 Richard E. Simpkin, Antitank (1982) and Red Armour (1984).
- 21 Ray Bonds, editor, Weapons of the Modern Soviet Ground Forces (1981).
- 22 _____, Jane's Armour and Artillery 1985-1986 (1985).
- 23 Valentin Y. Lebedev, Field Artillery Officer's Handbook (1984)

CHAPTER 2

HISTORICAL BACKGROUND

It is appropriate to look at the historical background in order to make an assessment of why the Soviets embrace the use of direct fire by their field artillery. Presented in this chapter are the developments that led to the routine use of direct fire in the Great Patriotic War and the continuation of these techniques after the war and into the early 1970s.

Direct Fire in the Great Patriotic War

According to Raymond Garthoff, the use of field artillery by the Soviets in the Great Patriotic War underwent five major changes. One of those was the tendency for wide use of artillery pieces in direct fire. The others were the introduction of the 'Artillery Offensive,' the increase in centralization of artillery command and control, the increase in concentration of artillery weapons and the increase in use of self-propelled weapons.¹ This study will examine these changes and the effect they had on use of artillery in a direct fire role during the Great Patriotic War.

The Use of Artillery in Direct Fire

The Soviets were not prepared for the attack by Nazi Germany on 22 June 1941. With the combination of the surprise of the attack and the power of the German armor formations, the Soviets fought the first months of the war at a great disadvantage. In this situation the Soviet troops had to delay and defend against the tanks by any means possible.² One of the primary means was to engage the tanks with direct artillery fire. The Supreme High Command required all artillery units to be prepared for the use of direct fire with attention to the likely tank approaches. This was not a new tactic, but a renewed emphasis on the tactics discussed in the existing Soviet field regulations.³

The renewed emphasis on direct fire techniques is confirmed in an account by Walter Kerr who was the Moscow correspondent for the New York Herald Tribune at the beginning of the war. He was taken on a tour of artillery units north of Moscow in early 1942 by Soviet Lieutenant General Viktor Tikhonov. There he was told by the general that since the outbreak of the war the Red Army had issued instructions that all artillery gun crews would train for antitank fire. Enemy tanks had broken through the lines too many times in the early weeks of the war and caught Russian artillery unprepared. While they were visiting the artillery regiment the gunners were practicing direct fire procedures at 600 yards.⁴

Marshal of Artillery P. Kuleshov wrote an article about the Soviet artillery in the Great Patriotic War on the occasion of the 600th anniversary of the Russian Artillery in 1982. In the article he said:

* The high combat qualities of Soviet artillery were revealed clearly at the very beginning of the war under the extremely unfavorable

conditions for our Army. Artillery's chief and most important mission in the initial period of the war consisted of combating enemy tanks and aircraft. . . .It was necessary to let the tanks come to within close range and fire on them pointblank, and that is just what our artillerymen did.⁵

The large losses of Soviet tanks and aircraft at the beginning of the war made the need for artillery to fill the direct fire role even greater. Thus, as a necessity in 1941, the Soviet artillery was routinely employed from direct fire positions on the main defensive line at ranges from 200-900 yards in order to defeat the advancing German armor.

Advantages of Direct Fire. Many advantages of using direct fire were discovered as a result of the need to use it defensively. These advantages have to do with command and control, ammunition savings and effectiveness.

In the early part of the war, the Soviets had an insufficient amount of communications equipment available to allow artillery units to communicate with forward observers for the adjustment of indirect fire.⁶ In order to communicate, the maneuver commanders moved the guns forward into their formations. The artillery could have the targets identified to them and then engage them with direct fire. It appears that this effective method for command and control of the close support artillery was used in appropriate situations even after the communications equipment situation improved.

Another major advantage to the Soviets in utilizing direct fire was the savings in ammunition expenditures. One or two rounds from a direct

fire gun could do the work of twenty rounds fired from indirect fire positions.⁷ These ammunition savings were particularly significant at the beginning of the Great Patriotic War when the Soviets were hard pressed to put up an effective defense. Artillery ammunition was lost in large quantities with the German advance and it was necessary to make each round count.

Finally, there was a marked advantage in the effectiveness of the artillery fire from direct fire positions. Soviet indirect fire procedures were not well developed and were significantly less effective than the American capabilities in the Second World War in both accuracy and timeliness. This was particularly applicable to engagement of targets of opportunity where the target was called in to the artillery for immediate engagement. It did not apply to the delivery of fire onto preplanned targets where timeliness was not such a critical factor.

A good historical example that demonstrates the effectiveness of the direct fire techniques of the Soviet artillery is an account of the action of a towed artillery battery in March of 1943 in the 16th Army Sector, possibly as part of the action in the Demyansk pocket. The Soviet battery position was attacked three times by German tanks and infantry. Over the course of the battle the battery was almost totally destroyed, but successfully held its position. Through direct fire the battery destroyed thirty-one tanks and killed over four hundred enemy soldiers.⁸ Six German tanks were destroyed for every Soviet artillery piece lost (one artillery piece survived the engagement). It is no wonder that the Soviets found it advantageous to use artillery, even towed artillery, in direct fire engagements against tanks. This is almost certainly an exceptional case

regarding the number of losses inflicted on the Germans by a single battery. However, it does show how effective the Soviet artillery could be against German tanks and infantry.

The effectiveness of using direct fire artillery was also applicable to offensive situations as described in this quote from Major General F.A. Samsonov:

"Practice has shown that artillery preparation is most effective when a section of the guns (of all calibers up to 203mm) are brought forward to fire over open sights at the embrasures of the enemy's forts and other strongly fortified positions. This method reduces the time necessary for destroying the defense works and enables the infantry to approach the object of attack without loss. It has also been found far more effective and economical than spreading the fire over whole areas."⁹

When providing this type of offensive support to the infantry, it was by no means unusual for the artillery to move out in front of the combat formations of the infantry.¹⁰ The direct fire artillery would usually try to flank these fortifications, then destroy them to allow the infantry to pass through and continue the attack. This flanking movement was obviously important to the survivability of the artillery weapon and crew.¹¹ Indications are that even when flanking a position was not possible, the artillery moved up and did its job, accepting whatever losses were required.

Vulnerability of Direct Fire Weapons The major disadvantage of using artillery in a direct fire role was its vulnerability to enemy fire,

particularly when considering towed artillery weapons and their crews as in the example above. The opinion has often been voiced that the Soviets "never shrank from hazarding losses in men and material which an Anglo-American commander would have hesitated to incur."¹² Soviet commanders were more interested in results and the benefits of using direct fire justified the costs. Direct fire was simpler for command and control and the dramatic increase in effectiveness justified the losses. Even a ratio of one tank kill to each artillery piece lost may have been considered a fair trade, especially at the beginning of the war. It is interesting to note here that both the first artillery soldier and the first artillery officer decorated as a Hero of the Soviet Union in the Great Patriotic War received their award for valor by engaging German tanks at close range by direct fire.¹³

The Soviets were perhaps somewhat more concerned with the vulnerabilities of artillery pieces used in direct fire than we give them credit for. An article from the Field Artillery Journal in September 1942 contained a detailed explanation by the Soviets of their development of the tactics to use artillery in a direct fire role.¹⁴ Emphasis was provided on several survivability techniques. These included the need for engineer preparation of firing positions prior to occupation of them and establishment of defilade positions to the rear of firing positions for artillery to 'sit and wait' until time for execution of the fire missions. Just prior to dusk the guns would be quickly rolled by hand from defilade to the firing positions and engagement of targets would commence. Withdrawal of the artillery upon completion of the missions was by echelon and was accomplished under the cover of darkness. Strict camouflage

discipline was also mentioned as critical to the success of operating with guns so close to the enemy lines. Another source indicated that immediately upon successful destruction of assigned targets the individual artillery pieces would march order and move to the rear.¹⁵ This amount of preparation indicates distinct efforts by the Soviets to limit the vulnerabilities of the artillery when required to use direct fire.

The efforts to camouflage the artillery weapons used in direct fire is also confirmed in an account of preparations for the Soviet counterattack from Leningrad in January, 1943. "Great accuracy and concealment was required in carrying out the measures directed to distribution of the direct laying weapons."¹⁶ The account goes on to discuss that these weapons were emplaced for direct fire at 400 to 800 meters from the German front lines.

The Soviets initially used their artillery in a direct fire role because of the need to use all available resources to stop the German invasion. Certain advantages became apparent with the use of the artillery for direct fire, particularly the increased accuracy and timeliness and the significant decrease in ammunition requirements. Although the Soviets were very aggressive in the employment of their artillery for direct fire, they were concerned with developing tactics that increased the chances for survivability.

The Artillery Offensive

The first months of fighting against the Germans, to include the first offensive operations of the Soviet forces in December, 1941, showed some serious shortcomings in artillery operations. One remedy to these

problems was a directive on 10 January 1942 from the Supreme High Command to institute the artillery offensive.¹⁷

The three principles of the artillery offensive were to concentrate artillery in the area of the main effort, to conduct 'unintermittent' fire through the depth of the defenses and to enforce close interaction between the infantry, tanks and artillery. The second of these principles, providing 'unintermittent' fires, had two requirements. The first was to have the battalion and regimental artillery closely accompany the maneuver force with fire until success was achieved. The principal method to achieve this was by "direct laying from exposed positions."¹⁸ Secondly, the heavier batteries were to concentrate their fire on massed enemy troops and artillery. This was of course accomplished with indirect fire.

The effectiveness of the 'artillery offensive' increased throughout the war. In the later stages, with the tremendous amount of artillery available, the preparation would usually close with one tremendous salvo delivered by all guns and mortars directed against every enemy capability to resist the attack. The results were that 50% to 70% of the enemy troops were put out of action even before the Soviet maneuver assault began.¹⁹ This capability for massive destruction earned the Soviet artillery the title of 'The God of War.'

One factor that demonstrates the effectiveness of the direct fire technique is that when fire plans were drawn up to execute an artillery preparation, the highest priority targets were the first to be singled out for destruction by direct fire. It was only in cases where direct fire was infeasible for a specific target that heavy concentrations of indirect fire were used instead.²⁰

There was still considerable defensive fighting to do even after the new doctrine of the artillery offensive was implemented. The artillery continued to play an important role in the destruction of enemy tanks by direct fire from the front lines of defensive resistance.²¹ The Soviets gained proficiency in combining direct and indirect artillery fire to break up German armor advances.

Indirect fire of artillery engaged an attacking tank formation at the maximum range possible. Damage to tanks by indirect fire was not extensive because a direct or near hit was required to destroy or demobilize a tank. However, it did serve to separate the supporting infantry and generate confusion in the attacking forces. As the tanks approached the main line of resistance, the antitank and close support artillery engaged the tanks at close range. This is where the majority of tank kills occurred. Those tanks that successfully broke through were then met by the direct fires of the artillery that had been providing the indirect fire support. This effectively insured that the tanks were subjected to artillery fire over the entire avenue of their attack on Soviet positions.²²

Even the artillery in indirect fire positions had a secondary antitank role in defense in the event of an enemy penetration. Batteries were required to select direct fire positions near their firing positions. The field artillery was usually massed along the second most likely armor avenue of approach, with the bulk of the antitank artillery covering the most likely route.²³

Increased Centralization and Concentration of Artillery

The control of the Soviet artillery underwent some changes during the Great Patriotic War. Artillery assets were initially distributed relatively evenly across the front and employed as individual units. The Soviets found it necessary to centralize some artillery in organizations at higher levels so that they could be rapidly moved en masse to whatever area was being threatened and concentrate the required numbers to create a successful defense. This technique was enforced by the principle of the artillery offensive that required concentration of artillery in the area of the main effort.

As the number of artillery weapons increased during 1942, regiments were formed to create the beginnings of the Reserve of the Supreme High Command (RGVK). As the size of the RGVK grew, these regiments were further organized into artillery divisions and even artillery corps. Eventually, almost 50% of all artillery assets were in the RGVK. The specific purpose of the RGVK was to centralize the artillery assets and provide the capability to mass great quantities of artillery on the main axes of troop operations.²⁴

The maneuver units still retained their own artillery units to create a dual level artillery organization; the centralized artillery described above and a decentralized artillery. The decentralized artillery provided support at the lowest maneuver levels and was called the close support artillery or the accompanying artillery. This close support artillery is defined in the Soviet Military Encyclopedic Dictionary as:

"subunits (guns) of battalions or regiments, as well as special self-propelled artillery, deployed in the Great Patriotic War in infantry

and tank dispositions, to deliver fire on enemy forces impeding their advance. For the most part delivered direct fire.⁻²⁵

The close support artillery was able to resort to direct fire because the centralized artillery assets were available to provide indirect fire support.

The centralization of artillery assets and the increasing numbers of artillery weapons produced by the Soviets allowed for massive concentration of artillery. The 1941-42 norm for the density of artillery pieces and mortars in the area of the main effort was 70-80 guns per kilometer. That had increased to 130-200 per kilometer by 1943, 150-250 per kilometer by 1944 and 250-300 per kilometer by 1945.²⁶ The extreme was during the final offensive against Berlin where the Soviets massed 670 guns per kilometer (22,000 artillery pieces) against the Germans. "An unusually large proportion of these guns, by Western standards, were employed in a direct fire role on the front line."²⁷

In the sectors of greatest importance for the Leningrad counterattack in January 1943 there were at least 40 direct fire guns per kilometer of front. In the main attack by 2nd Army, thirty seven per cent of the small caliber artillery pieces (mostly 76mm) were in direct fire positions, and about ten percent of the larger caliber artillery pieces (mostly 122mm, but some 152mm) were in direct fire positions. The supporting attack by 8th Army showed about fifteen per cent less use of direct fire artillery.²⁸ The weighting of the main attack with direct fire weapons reflects the importance attributed to the effectiveness of direct fire.

Self-Propelled Artillery

When the Soviets conducted offensive operations they discovered quickly that the towed artillery in the front lines was unable to keep up with the tanks during battle, particularly those providing direct fire support. The Soviets solved this major problem of providing continuous fire support to mechanized formations by increasing the use of self-propelled artillery. This use of self-propelled artillery is considered another one of the major changes in artillery development by the Soviets. The major role of self-propelled artillery was to use direct fire to assist armor forces in defeating German tanks.

The Soviets had some experience with self-propelled gun designs in the 1930s, however, the industrial capacity priority was to production of tanks until the later part of 1942. Light tank production then shifted to providing self-propelled artillery. The SU-76²⁹ was the first self-propelled gun produced, but it was not sufficiently armored or effective enough against newer German tanks. It was eventually employed primarily as an infantry support assault gun. The SU-122 entered production shortly after the SU-76, and, due to its larger caliber, was more effective in the antitank role. The SU-152, the largest caliber of self-propelled artillery, appeared in early 1943 and was a very effective antitank weapon. Its major shortcoming was a carrying capacity for only twenty rounds of ammunition, requiring continual replenishment during battle.³⁰

The first self-propelled gun regiments were formed in December 1942 with a mixture of SU-76s and SU-122s. By the beginning of 1944 the

rifle divisions included their own self-propelled artillery and the combined arms team of infantry, tanks and self-propelled artillery was employed.³¹

Soviet Marshal P. A. Rotmistrov, Chief Marshal of Armored Forces, wrote in 1945 on the Great Patriotic War experience:

"The rapid pace of offensive operations presented new requirements regarding maneuverability of artillery, and practice showed that if the attacking troops did not have artillery support at the right moment, it lost its significance at once. There is where self-propelled artillery comes in. By its firepower and mobility it supplements field artillery, assists tanks in battle, and aids in the development of the battle."³²

Rotmistrov especially stressed the antitank role of such weapons and emphatically stated: "field artillery [indirect fire] is almost useless against modern tanks."³³ In writings in the early 1970s, Rotmistrov provided the rationale for development of self-propelled artillery during the Great Patriotic War. He related that the decision to produce self-propelled artillery with guns of a caliber and lethality exceeding those of Nazi tanks was a direct result of the introduction of powerful new weapons fielded by the Germans beginning at the Battle of Kursk (the 60 ton Tiger tank and 70 ton Ferdinand self-propelled gun). Soviet self-propelled artillery was specifically expected to deal with these enemy armored vehicles.³⁴

The use of self-propelled artillery almost exclusively in a direct fire role raised some controversy as to who owned the new artillery weapons, the armor commanders or the field artillery commanders. Initially, the new self-propelled artillery was in fact subordinated to the tank forces. It was determined that under the conditions of maneuver warfare,

self-propelled artillery directly accompanying the tanks provided the best form of artillery support.³⁵ This close maneuver unit support further enhanced the concept of two artilleries: a centralized one capable of massing its assets to provide indirect fire support and another in direct accompaniment of the maneuver forces.

The concept of employment of tanks and self-propelled artillery together was an important one. The self-propelled artillery relieved the tanks of tasks relating to the direct engagement of enemy tanks allowing the tanks to perform maneuver while the artillery provided firepower.³⁶

This concept is confirmed by another quote from Rotmistrov:

"... in case of a counterattack by enemy tanks, self-propelled guns can draw this strike on themselves and open fire against attackers on the spot, giving friendly tanks an opportunity to maneuver and attack the enemy in the flank and rear."³⁷

Frequently self-propelled guns found themselves compelled to repel tank attacks on their own. An historical example of this shows how effective they were against German tanks. This is an account of action by a Soviet self-propelled artillery unit in the Orel-Kursk sector in July of 1943. Intelligence reported the movement of a German unit of twenty Tiger tanks and four Ferdinand self-propelled guns. A Soviet unit of twelve self-propelled howitzers was sent to defend against the attack. They took up concealed positions in depth. When the German unit arrived, the Soviet artillery opened up from defilade positions at a maximum range of 500 meters. Engagements were at 250-300 meters at the height of the battle.

The Soviet unit destroyed eight of the Tigers and all four of the Ferdinands, effectively repulsing the attack.³⁸

Experiences like these showed that self-propelled artillery of a large caliber was an extremely effective weapon against even the heaviest German armored vehicles. It is stressed though, that the guns had to be properly employed from concealed positions and at close ranges.

When the nature of the terrain allowed it, the self-propelled artillery utilizing direct fire were unrivalled in effectiveness for tank ambushes. Another example of this capability is an instance later in the war where the Soviets sent two artillery regiments to ambush an expected German armored counterattack. The terrain was analyzed and the most likely route for the Germans was covered by the artillery positioned in concealed positions in depth on the route. The German counterattack came in the expected direction with a total of sixty medium and Tiger tanks and Ferdinand heavy self-propelled guns. When the engagement was over the Soviet artillery had destroyed forty-five of the German armored vehicles and successfully turned back the German counterattack.³⁹

Self-propelled artillery played an ever increasing part in Soviet offensive operations. As later models were produced they tended to have stronger armor and increased mobility. This made them more flexible and more effective in operations against tanks.

To conclude the lessons learned from the Great Patriotic War, Soviet employment of direct fire became prominent out of the sheer need to defend against German armor with any means available. It had the additional advantages of ammunition savings and overcoming the obstacles

of a relatively poor indirect fire capability when engaging targets of opportunity. It was a significant contributor to the effectiveness of the 'artillery offensive' so important to the Soviet successes against the Germans. The major disadvantage of vulnerability was an acceptable tradeoff for the results achieved and was greatly overcome by the development of self-propelled artillery that could hold its own against German armor when properly employed. The Soviets came out of the Great Patriotic War with a tradition of direct fire artillery tactics that worked extremely well for them.

Soviet Artillery from the 1950s to 1973

Immediately after the war and into the mid 1950s, the tactical employment of artillery as a major factor in antitank defense operations remained essentially unchanged. Direct fire artillery and particularly self-propelled artillery was expected to engage enemy armor at the forward edge of the battlefield and into the depth of the enemy positions.⁴⁰

The major factor to subsequently affect artillery development in the mid 1950s was tied to the arrival of the Nuclear Age. The cannon artillery's pre-eminence as the prime means of mass destruction was replaced by the missile and atomic weapons. The strategic rocket forces became the important service in the military at the expense of the others. The cannon artillery faded into the background during this period and received little emphasis. The ultimate means for carrying out direct fire artillery tactics, the self-propelled weapon, received only minor

developmental attention and no further production. The prevailing opinion was that conventional warfare was unlikely because it was impossible to maintain front lines and achieve major thrusts in an era of nuclear weapons.⁴¹

The artillery weapons that were developed were improvements of towed artillery to further enhance its range and generally update it from the Great Patriotic War vintage equipment on hand. In 1955, a 203mm towed gun-howitzer was produced that was capable of firing a nuclear projectile. All the weapons that were produced continued to have a direct fire capability in deference to the lessons learned early in the Great Patriotic War.

By the mid 1960s, the Soviets had resolved that future war would not automatically involve the immediate massive use of nuclear weapons, and at least the initial stages of war could be fought conventionally. U.S. studies of the Soviet use of direct fire artillery determined their employment would be based on experience from the Great Patriotic War. It was understood that the Soviets would continue to use direct fire artillery in both defensive and offensive operations. The use of direct fire was based on a conviction of its tactical usefulness from the Great Patriotic War and the advantages derived from "defeating targets in less time with less ammunition using direct fire"⁴² Artillery weapon emplacement for direct fire was expected to be from 1,000 to 1,500 meters which is a reflection of the increased capability of the newer towed weapons that the Soviets had developed. Studies of that time concluded that all Soviet field artillery weapons were capable of direct fire up to and including the nuclear capable 203mm gun/howitzer.⁴³ The tactics of moving towed guns

up into camouflaged positions near the front line under cover of darkness to accomplish direct fire missions was also retained.⁴⁴

Soviet sources in the early 1970s indicate that the use of direct fire by artillery was indeed still a viable concept. Soviet Chief Marshal of Armored Forces P. A. Rotmistrov wrote during this period that the use of hollow-charge shells had insured that even low initial shell velocity weapons could successfully perform antitank missions. He stated specifically: "Thus, in modern offensive battle too, self-propelled artillery ... will carry a large share of the fight against enemy tanks."⁴⁵

Major General of Artillery G. Biryukov in his book, Antitank Warfare, published in 1972 stated:

"The usual ground artillery (excluding the antitank artillery) is still an important antitank weapon in modern combat. At the same time the role of artillery fire in combatting tanks with usual ammunition from covered positions [indirect fire] has considerably decreased. . ."⁴⁶

He goes on to say that the problem with indirect fire is the large ammunition expenditure and large number of guns required, and even with this the effects on a tank formation are minimal. It is the artillery placed in covered positions which engage tanks with direct fire that are effective. This is particularly important in the defense of a breakthrough by enemy armor when artillery moves from its indirect fire positions to positions allowing direct fire engagement. With special armor piercing and shaped charge ammunition the artillery can destroy any modern tank. The use of artillery in direct fire, supplementing a powerful artillery barrage is an effective means to repel massive enemy armored attacks.⁴⁷

Colonel A. A. Sidorenko in his book, The Offensive, published in 1970, stated:

"Very important significance is had during the period of the fire preparation by direct fire as the most effective method of destroying observed enemy weapons as well as destroying defensive works on the forward edge of the battle area and in the immediate depth. In the last war, guns of various calibers were used for direct fire. . . . Under contemporary conditions artillery guns. . . . may be widely used for the conduct of direct fire."⁴⁸

We see that even into the early 1970s, the Great Patriotic War experience with direct fire was carried over and considered an effective means of employing a significant percentage of artillery weapons.

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CHAPTER 3

CURRENT SOVIET TACTICS AND PROCEDURES

The number of articles available from Soviet sources¹ that discuss the direct fire use of artillery make it clear that the use of direct fire is still seen as a viable means of employing artillery in the offense, the defense and in special situations. The purpose of this chapter is to explain the current Soviet tactics and employment procedures for direct fire.

The organization of Soviet artillery is an important factor in how it is tactically employed. The Soviets can be considered to have two artillery forces.² The first force is decentralized and is the one we are concerned with in this study. It is a field artillery battalion organic to the Motorized Rifle Regiment and Tank Regiment. It provides the close support artillery assets to the maneuver force and is often used in a direct fire role. This force is also known as organic or accompanying artillery. The quantity and features of the organic artillery are discussed in Chapter 4.

The second artillery force is the centralized artillery that is controlled at division and higher levels. Some of this artillery is passed down to the regiments in organizing the force for combat. The artillery that ends up at regimental level may also find itself performing an occasional direct fire mission, but the usual method of employment is

indirect fire.³ The centralized artillery retained at division and higher levels would only rarely be employed for direct fire. They are, however, all capable of using direct fire in self defense.

Direct Fire in the Offense

There are two primary occasions in offensive operations where the Soviets will use their field artillery in a direct fire role. The first is by the artillery unit assigned to the advanced guard during a march in anticipation of a meeting engagement. Second, is by portions of the organic regimental artillery as part of a fire plan during the artillery preparation of the attack. Although these are certainly not the only occasions where direct fire will be used, they are the most prevalent in current Soviet military literature.

Meeting Engagement

The advanced guard of a Soviet regiment conducting a march is a battalion size maneuver force. It usually has an artillery battalion attached to it. Ahead of the advanced guard is a forward security element made up of a maneuver company with an artillery battery attached to it. The artillery moves in the forward elements of these formations. A platoon size reconnaissance patrol operates far enough in front of the forward security element (5 to 10 kilometers) to provide enough reaction time and space for the security element to move into combat formations prior to contact with an enemy force.

Upon a warning of enemy forces ahead, the most likely deployment for the artillery battery from the security element is to take positions that provide for direct fire engagement of the enemy force. The battery location is quickly selected based on the security element commander's plan for maneuver. Specific gun positions are directed upon arrival at the position. The battery is deployed by platoon with several hundred meters between them and as much as a hundred meters between guns of a platoon. The artillery battalion commander traveling with the advanced guard is informed of the situation and approves the course of action. The battalion commander will then direct the other two batteries of the battalion to deploy into indirect fire positions to provide support for the initial engagement as it develops. When the enemy comes into the killing zone of the direct fire battery it opens fire and the maneuver elements of the security element attack. The battery commander controls the fire of one platoon and the senior battery officer controls the other platoon. By the completion of this engagement the maneuver forces of the advanced guard have also arrived and they continue to develop the situation.⁴

The requirements to insure success in these situations are to train for deployment from the march, achieve proficiency in preparing the guns for firing, understand and properly react to control signals, and skillfully use the terrain in deploying the firing platoons for their protection.⁵ This last point is stressed in every discussion I have read of moving into direct fire positions from the march. One of the few historical examples from the Great Patriotic War that tells about a Soviet defeat is one that relates a situation where the terrain was used incorrectly. The battery tried to

move in to a direct fire position in sight of the enemy and lost five of their six guns to tank fire.⁶ The best use of the terrain is to cover the approach of the guns to their firing positions and to use it to select positions with maximum observation and fields of fire. It is preferable to position the guns to form a 'fire pocket' for the enemy vehicles to move into. This allows most of the guns to fire at the more vulnerable sides of enemy vehicles. Another advantageous use of terrain is to emplace on the reverse slopes of hills and open close range fire at tanks as they appear on the crest. This effectively takes away the tank's range advantage.

It seems to be a frequent requirement for both towed and self-propelled artillery units to train in repelling a tank attack during a meeting engagement. It is standard practice for the battery operating in the security element to deploy into direct fire positions at the report of enemy units by the reconnaissance patrol. The battery commander of a self-propelled artillery unit was berated in the Military Herald for reacting improperly during a training exercise as part of the security element conducting a meeting engagement.⁷ The situation was the same as mentioned above, and his tactical blunder was that he put his battery in an indirect fire position. The evaluator mentioned several reasons for why the choice should have been direct fire positions instead. The first point was that direct fire would have provided for more effective accomplishment of the mission with less ammunition expenditure. Secondly, there were two more batteries following with the advanced guard that were available to provide indirect fire support. The third point was that the side that fires first in a meeting engagement is the one that wins it, and he had lost that

opportunity. Finally, he failed to use the tactical features of his self-propelled howitzers. These were listed as "high maneuverability, controllability and survivability." The bottom line in the evaluation of this unit was that "those officers who exclude an opportunity to use today's self-propelled artillery in direct fire are acting incorrectly."⁸

Artillery Preparation of the Attack

The second occasion where direct fire is likely to be used in offensive operations is as part of the fire plan developed for the artillery preparation of the attack. It is routine to use some designated artillery weapons to fire from direct fire positions to complement the traditional heavy volume of indirect fires of the preparation. It has been suggested that this may have even more significance today than it did during the Great Patriotic War because of the current need to reduce the time of the preparation due to improved enemy counterfire capabilities.⁹

The artillery preparation of the attack is intended as a powerful surprise fire assault by all artillery units against preplanned targets of personnel and weapons on the forward edge of the battlefield and through the depths of the enemy defense to include artillery units and command and control targets. The weapons assigned direct fire missions destroy pinpoint targets such as tanks, infantry fighting vehicles, antitank guided missile launchers and emplacements on the forward edge.¹⁰ With the high level of mechanization of Soviet forces, the primary focus is on destruction of the enemy antiarmor capability to enhance the odds of the success of Soviet mechanized formations in the attack.

Extensive and detailed reconnaissance is performed of the enemy positions to determine the targeting requirements for the preparation. Reconnaissance detachments, combined arms commanders and commanders of organic and attached artillery perform this reconnaissance and pass information on targets to higher levels. The fire plan is prepared at the highest level involved in the operation and then passed down for execution. This can include direction for which specific targets will be engaged with direct fire. The most important targets on the forward edge of the battlefield are the ones that will be engaged by direct fire weapons. The regimental artillery chief coordinates the artillery preparation for the attack for the maneuver regiment commander. He analyzes the mission and the assets available to him, and then designates which weapons will be involved in the direct fire missions. This includes the tanks and antitank guided missiles of supported maneuver units as well as artillery pieces.

The regimental artillery chief provides very detailed information to the artillery units on their direct fire missions:¹¹

1. Specific fire missions with primary and alternate targets for each weapon. In many cases more than one weapon will be assigned for the destruction of a single target.
2. The sequence for execution.
3. The general locations for firing positions.
4. The time for position occupation and time to be ready to open fire.
5. The signals for commencing and ceasing fire.
6. The allowed ammunition consumption for each target.

The regimental artillery chief prepares a fire chart of the weapons used in direct fire to include tanks, antitank guided missiles, and artillery guns. This is considered to be the most important document of the fire plan.¹² It shows the position of the weapons and the designation of their targets.

The battery commander whose guns are to be employed in the direct fire role selects the specific firing position locations for each gun based on the information from the fire plan. The positions are chosen based on the ability to observe the target, at a range within the limits of direct fire and with approach routes that facilitate movement into the positions. The artillery commander must know the maneuver plan to insure the direct fire positions do not hinder forward movement of friendly attacking forces and the position is chosen no closer than 400 meters from enemy positions to keep it out of small arms range.¹³ The battery commander also designates the rendezvous location where the guns will reassemble following completion of the direct fire missions.

The weapon commanders study the approach to their designated firing position in detail. They will most likely physically occupy the position during the night preceding the preparation. They check the technical condition of the sighting devices, prepare the ammunition for firing and camouflage the weapon from observation. They are also responsible for establishing wire communications to adjacent guns because of the wide dispersal between guns.¹⁴

Firing from direct fire positions is usually conducted at the beginning of the artillery preparation. This is to insure that the targets are clearly observable prior to the enemy's forward edge of the battlefield becoming covered with dust and smoke from the shell bursts of the artillery preparation. The need to destroy the targets with a first round hit is greatly emphasized since later observation and correction of fire may be extremely difficult or impossible. The time available for completion of direct fire missions is estimated to be 5-8 minutes.¹⁵

It is tremendously important for the artillery to defeat the enemy's antitank capability during the preparation. This point is greatly emphasized in current Soviet articles on the artillery preparation. It is considered that an artillery preparation by only indirect fires would leave enough weapons undamaged on the forward edge to slow the attacking units and possibly prevent the success of the attack. The employment of direct fire weapons and the detailed planning process for direct fire is done to insure the defeat of this antitank capability and to facilitate the success of the Soviet maneuver forces in the attack.

Other Offensive Situations

Although this study has discussed the two situations most often mentioned by the Soviets on employment of their field artillery assets in a direct fire role, they are not the only situations. There are many other tactical situations where direct fire employment of the supporting artillery is feasible. This is particularly the case in pursuit operations

where the tactical situation can become very similar to the meeting engagement already discussed.

The phase of artillery support following the preparation is the support of the attack.¹⁶ This phase begins immediately upon the completion of the preparation fires and continues until the Soviet forces have overrun the front line battalions of the enemy. The transition from the preparation to support of the attack is supposed to be imperceptible. The artillery units in place from the preparation are capable of supporting this phase without movement from positions because of the range capabilities of their weapons. Accompanying artillery moves forward to follow the advance of the maneuver units and is capable of providing direct fire support. The majority of the artillery remains in indirect fire positions and continues to follow the fire plan for support of the attack. The fire plan usually calls for successive concentrations of artillery fire on enemy positions. The concentration is fired on the enemy position until the friendly maneuver forces reach it. The concentration is then shifted to the next enemy position. There are additional on call targets available if requested by maneuver commanders. The extensive indirect fires are supplemented by the artillery moving with the maneuver formations which is available for conduct of direct fire if needed. Direct fire use of artillery is probably minimal during this phase since it is rarely discussed.

Despite the extensive fire planning there are indications that fire support coordination during this period does not always meet expectations. It is a common theme in current literature that the maneuver and artillery commanders must know each others needs better in order to effectively

fight the combined arms battle. The emphasis for Soviet artillerymen is to understand maneuver, think like a maneuver commander, anticipate their needs and provide the required fire support in a timely manner.

In a recent article in the Soviet Military Herald, it was recommended that the artillery designated to accompany the maneuver forces in support of the attack be completely held back from participation in the preparation so that they could be prepared to immediately move forward. The primary function of the artillery was to hit all "surviving and suddenly appearing targets" dangerous to the tanks. This indicates at least some requirement for artillery in a direct fire role. The final statement of the article is an assessment that artillery officers "must be imbued with a tank spirit" to deploy rapidly and support tanks in a dynamic battle.¹⁷

Another source refers to the accompanying artillery specifically as a fire support asset that fills a void between the tank gun of the maneuver force and the indirect artillery available from the division and army artillery groups. The presence of this additional link in the fire support chain would be very beneficial for providing a guarantee of artillery support in an intensive electronic warfare environment where communication with indirect fire sources was limited or eliminated.¹⁸

The final phase of fire support is fire accompaniment in the depth of the enemy defenses. Artillery units that have provided indirect fire support displace forward by echelon in order to provide continued support. The situation becomes more fluid and the advancing maneuver units may find themselves attacking enemy defenses from the march, fighting meeting engagements and conducting pursuit operations. As the situation

continues to develop the likelihood of utilizing artillery in a direct fire role increases. The conduct of the leading artillery battery in a meeting engagement will be the same here as discussed earlier in the chapter. The accompanying artillery is also likely to deploy to direct fire positions in reaction to enemy counterattacks.

The Soviet use of field artillery for direct fire in the offense is most prevalent in the meeting engagement and in the artillery preparation for a deliberate attack. The accompanying artillery will also have opportunity to employ direct fire as it follows immediately behind the maneuver forces in the attack. As the attack succeeds against the enemy forces and the battlefield becomes more fluid, the incidence of direct fire use of field artillery assets will increase.

Direct Fire in the Defense

Some of the foundations for the use of direct fire emanated from the desperate need for the Soviets to stop the German tanks in the early part of the Great Patriotic War. The Soviets are extremely fond of using historical situations as examples of how contemporary requirements must also be met and a large portion of the historical examples that are used for direct fire relate to its value in defending against tanks. There is no question that an artillery unit is expected to stand and fight and win in a defensive engagement with tanks.

There are very few references to field artillery pieces being integrated into the front line defenses of Soviet maneuver units. I have

seen no examples of this type of deployment in current literature and it is likely that it occurs only rarely.

The artillery prepares defensive fire plans in the same detail as in offensive situations. Again, tanks, antitank guided missiles and antitank artillery are part of the overall fire plan, not just field artillery units. The most likely enemy course of action is targeted in the fire plan with on call targets and shifts prepared for other situations. Artillery fire is conducted by indirect fire means and starts at its maximum range to break up enemy formations approaching friendly positions. As the enemy approaches the forward edge of the defense, maneuver unit weapons assigned to specific sectors engage the enemy at their maximum effective range. Indirect artillery fire continues to move in closer as the enemy approaches to maximize destruction and confusion. Maximum firepower is brought to bear at the forward edge of the battlefield.¹⁹ The defense is organized in depth and as the enemy forces penetrate or bypass friendly positions the direct fire capability of the artillery is brought into action.

The direct fire capabilities of field artillery weapons are considered by the Soviets when they organize their defense in depth. Artillery firing positions in a defensive situation are deliberately selected on primary tank avenues of approach. This is to allow the artillery batteries the opportunity to destroy enemy tanks in the event they break into the defensive depth.²⁰

The specific firing positions of the field artillery units are also selected with the antitank role in mind. The battery is positioned for its primary indirect fire role with consideration for survivability from enemy

artillery fire. Specific positions are also selected for each weapon to be employed for direct fire in the case of an enemy armor attack. The terrain should favor safe movement to the direct fire position and it must allow for good observation out to the maximum effective direct fire range of the weapon. The position needs to provide for the concealment of the artillery piece to allow the tank to move within range without detection of the artillery weapon. At the position reference points are designated, ranges are predetermined to facilitate accurate engagement of tanks and specific zones of fire are allocated. The zones of fire interlock and overlap to allow more than one artillery piece to engage a target at the same time.²¹

Field artillery units, particularly self-propelled howitzers, may be designated as part of the maneuver unit's antitank reserve. This reserve would be called to reinforce maneuver units at threatened sectors.

When acting as part of an antitank reserve in a planned defensive movement, it is likely that the effectiveness of the direct fire will be enhanced by combat engineer work. The most common engineer obstacle is the minefield. The advantage of having advancing tanks distracted by a minefield at the same time that an artillery unit is engaging it in direct fire is significant.²² It makes the tanks more vulnerable by restricting mobility and enhances the survivability of the direct fire artillery.

Although antitank capabilities of artillery in direct fire positions is by far the major subject discussed, the Soviets train to employ direct fire against personnel targets as well. The Soviet artillery has several ammunition rounds designed specifically for antitank missions. For antipersonnel missions though, they simply use a high explosive round with

a time fuze on a short setting. The major problem in effectiveness is an accurate determination of the range to the target and setting the proper fuze time relative to the range. In an article from the Military Herald the ranges used to work out optimum fuze settings were between 300 and 500 meters for a 122mm howitzer unit.²³

The Soviets can be expected to use their artillery for direct fire missions when defending in the depth of their positions. Artillery will aggressively move out to meet tank attacks from prepared positions on primary tank avenues of approach. Although, the primary concern is an antitank capability, the Soviets have developed methods to insure an effective antipersonnel capability in defense of battery positions as well.

Special Situations

There are several special combat situations discussed by the Soviets that lend themselves to the use of their field artillery in a direct fire role. The situations I will discuss here are river crossings, combat in mountainous terrain, combat in built-up areas and the destruction of fortifications.

River Crossings

The artillery support provided for a river crossing is likely to involve use of field artillery in a direct fire role. Organic artillery weapons are frequently moved up to a position where they can engage

targets on the opposite bank at the crossing sites and support the establishment of the bridgehead.

In the case of a deliberate river crossing an artillery preparation is planned the same as in any other deliberate attack. The direct fire targets are destroyed early in the preparation. When the preparation fires are then shifted to the depths of the enemy defense with the crossing of the attacking troops, the direct fire artillery weapons stay in place and continue to provide a cover of close-in fire as the bridgehead is established. The priority targets are tanks and antitank weapons which can cause the most damage to crossing vehicles. When the artillery batteries cross the river to support continuation of the attack, they occupy positions on the primary avenue of approach for armor in order to repulse any counterattack effort by direct fire to protect the bridgehead.²⁴

An assault river crossing will be characterized in a similar nature to a meeting engagement. The artillery battery of the forward detachment will often be employed to provide direct fire support at the crossing site as the situation is developed for the advanced guard to secure the bridge or crossing site for the main body.

Combat in Mountainous Terrain

Combat actions in mountainous terrain have their special characteristics. Most action is along valleys but the tactical edge is to the force with the advantage of the commanding heights. Units routinely have exposed flanks and a considerable distance to the next adjacent unit.

Artillery units likewise have distinct characteristics for mountain warfare. Each battery will most often be performing its mission independently. The likelihood for using guns in direct fire is significantly increased. The advantage of the effectiveness of direct fire is even more obvious with the increased difficulty of conducting accurate indirect fire due to the tremendous differences in elevation between weapon and target. The reduced ammunition expenditure that results from direct fire is also significant because ammunition resupply is more difficult to accomplish in mountainous terrain.²⁵

Another problem in the conduct of indirect artillery fire in the mountains is the large dead spaces that cannot be fired into because of trajectory limitations. A recent article from the Military Herald discusses the advantages of using direct fire to long ranges in the mountains because of the difficulty of indirect fire.²⁶ Direct fire to long ranges is conducted by semidirect laying. With semidirect laying the direction of the tube (in the horizontal plane) is determined by direct aiming on the target itself. The elevation of the tube (in the vertical plane) is determined by a calculation of trajectory based on the range to the target and leveling of the indirect fire sight. Although first round accuracy is diminished at the longer ranges, it can evidently be adjusted to the target more quickly than with indirect fire methods under the same conditions. Although there is not a specific effective range limit discussed for using semidirect laying in the mountains, the insinuation is that if you can see the target, use it. The comment is made that visibility at up to 10 kilometers is not unusual in the mountains.

It is interesting to note the increased frequency of discussions on the nature of combat in the mountains since the Soviets have gotten involved in Afghanistan. Some of the discussions of training exercises in the mountains make the reader wonder if the action described is really just an exercise.

Combat in Built-up Areas

Combat in built-up areas is another special situation that has routine application for direct fire use of artillery. Although it is desirable to avoid and bypass built-up areas wherever possible, there are situations when it cannot be done. The tactical employment of organic artillery in large built-up area is characterized by decentralization. Batteries will likely operate as part of an assault group with platoons and individual artillery pieces given separate and distinct direct fire missions in various parts of the area of action. Indirect fire capabilities are at a disadvantage because of the limited fields of view and difficulties of observing and adjusting artillery rounds in a city. Because of the sturdiness of large buildings, requirements are increased for heavier caliber artillery (from 152mm and up) to perform direct fire as well.

The range for direct fire is likely to be very short because of the limited space available between buildings for the artillery to set up. Moving in so close to a target requires increased consideration of how to provide for survivability of the artillery piece. One technique is to place the target under heavy fire from small arms, machine guns and tanks, if possible, while the artillery piece moves into position and opens fire. In

many cases it does not take a great number of hits from a large caliber weapon for the defenders to realize their fate. Engineer preparation can be used in some situations and some cover can be gained from existing rubble or buildings. It is not uncommon to move into the direct fire position under cover of darkness.²⁷

The antitank mission for artillery is also common in the city with guns placed in covered and concealed direct fire positions to protect flanks and approaches to friendly positions from tank attacks or counterattacks.

Destruction of Fortifications

A situation that is similar to the destruction of buildings in a city is the requirement for destruction of fortifications. This situation is easier from the standpoint of emplacement options for the guns performing the mission. However, the strength of the fortification will be greater than a city building. The existence of articles in current Soviet military literature discussing the techniques for destruction of fortifications indicates that this is a valid requirement for use of direct fire artillery.²⁸

The use of heavy caliber weapons (152mm and 203mm) is directed for effective destruction of fortifications. Concrete piercing shells with delayed action fuzes are used as the ammunition. The 203mm artillery is considered most effective in the destruction of concrete structures with a wall thickness of one meter and more or earth and timber structures with a wall thickness of one and one-half meters. The 152mm artillery is considered capable of destruction of earth and timber construction with walls up to one meter thick. The forward wall of the structure is the

target and the impact of the round must be at an angle between 60° and 90° from the wall.

The contrast between the effectiveness of indirect and direct fire in performing destruction missions is greatly stressed. The lesson is "that one must always strive to destroy a [fortification] with direct fire." Detailed calculations were performed in determining the number of rounds required to destroy a gun emplacement with a 152mm artillery piece. The wall thickness was one meter and the calculations figured it would require 60 rounds (for two hits) by indirect fire. The same weapon firing at a range of 1500 meters would only need two rounds (for a single hit) with direct fire. Just as important, it would take twenty to thirty minutes to accomplish the mission by indirect fire compared to five to ten minutes by direct fire. With these differences it is easy to see why the direct fire method is preferred.²⁹

The tactics employed in conducting destruction missions of fortifications are similar to those of the artillery participating in an artillery preparation. The destruction of fortifications will often be conducted in conjunction with the preparation. Detailed reconnaissance will be conducted of the target and the firing position. The firing position is selected as close to the target as possible because the greater the velocity of the shell at impact, the greater damage will be inflicted on the fortification. The firing position will have engineer improvements made to it and camouflage to provide for survivability of the artillery piece during the engagement. Covering forces will often be assigned to provide protection as well.

The special situations described in this section have shown that there are many situations where the Soviets intend to use field artillery weapons in a direct fire role to accomplish specific purposes. The most prevalent factor that seems to drive the decision to use direct fire in these situations is that indirect fire cannot accomplish the mission as well.

Direct Fire in the Overall Field Artillery Mission

There were no sources that provided specific reference or guidance on how often direct fire will be used or what percentage of artillery assets will normally be used in a direct fire role. It is clear that the organic artillery at the maneuver regiment level is routinely prepared to utilize direct fire. Most of the articles found in current Soviet military publications discuss aspects of indirect fire or direct fire, but not both. Therefore, the interrelationship of the two is hard to determine. One indication that the use of direct fire in supporting the maneuver force is routine is the number of articles that address the use of direct fire. For instance, the Military Herald for 1984 had articles discussing the use of direct fire in five of the twelve publications for the year.

The likelihood is that the degree of use of direct fire by regimental level artillery is purely dependent on the given tactical situation. If conditions are considered favorable for a direct fire mission it will be used without hesitation. The artillery assets at the division artillery group level and above will rarely be used in a direct fire role. The most likely

employment of artillery for direct fire at higher levels is in the defensive role.

Advantages of Direct Fire versus Survivability Considerations

Two topics regularly addressed in any discussion of the direct fire use of artillery are the advantages of using it and the need for measures to insure the survivability of the artillery weapons. These two points are the primary tradeoffs in using direct fire. The survivability aspect is what provided the original interest to conduct this study.

The Advantages of Direct Fire

The major advantages of direct fire from the Great Patriotic War were:

1. It solved the problem of maneuver calling for artillery fire when there was a critical shortage of communications equipment.
2. It resulted in significant ammunition savings.
3. It was more responsive and accurate at a time when the indirect fire procedures were not very sophisticated.
4. It stopped German tanks.

Some of these same advantages are mentioned over and over again as the reasons for contemporary use of artillery for direct fire. The two advantages that are always mentioned are completion of the mission in the shortest amount of time and with the expenditure of a minimum amount of

ammunition. These points both rise from the superior accuracy of direct fire compared to indirect fire. They cannot be argued against and are well supported with the example used earlier in discussing the destruction of a fortified position.

The savings of time in performing fire missions has become more important as modern counterfire capabilities have improved. The Soviets' desire to shorten the period of artillery preparations would be well served by an increase in the use of direct fire artillery to destroy targets on the forward edge of the battlefield.

The other reasons for direct fire use in the Great Patriotic War can be related indirectly to contemporary conditions. The communications equipment shortage no longer exists. However, the active electronic warfare environment that can be expected on the modern battlefield can complicate and even negate communications capabilities. It would be a distinct advantage to have a direct fire support capability that is immediately available and capable of working by signals and unaffected by an intensive electronic warfare environment.

The poor quality of indirect artillery support in the early part of the Great Patriotic War was greatly improved even by the end of that war. Today the Soviets are as fully capable as any Western nation in putting 'steel on the target'. The exception to that may be in the rigidity of the fire planning system and a lack of flexibility in engaging targets of opportunity while scheduled fires are taking place. There is a considerable advantage for the maneuver commander to have direct fire artillery assets accompanying him on the advance to engage priority targets of opportunity.

The availability of the extra artillery prevents interruption of the scheduled fires or a reduction of its effects.

Survivability Considerations

The tradeoff for the many advantages of direct fire is the vulnerability of the artillery weapons to tanks, antitank guided missiles and other weapons while engaged on the front lines or from defensive positions. The battlefield has become more lethal since the Great Patriotic War with tremendous increases in the effective ranges and lethality of modern weapons. Can the artillery still be expected to survive to perform the direct fire mission?

The Soviets had extensive discussions about the survivability of field artillery in a series of articles in the Military Herald in the mid-1970s.³⁰ The discussion was generated because of the 1973 Arab-Israeli War, where the increased lethality of the battlefield became very apparent. The majority of the Soviet discussion centered on protection from the dangers of counterfire and did not seem to include a concern for artillery moving in the front lines other than a mention of the threat of antitank guided missiles as a new weapon system. The points that could be drawn from the articles that would pertain to direct fire missions for artillery were as follows:

1. For defensive purposes, the advantage was discussed of echeloning and dispersing the formation of guns in indirect fire positions for defense against tank attacks. This would facilitate the engagement of tanks by direct fire if the echeloning is done in the direction of likely approach. The

point was made that antitank artillery units already used the tactic for that very reason and that "any battery must present an insurmountable obstacle for tanks."³¹

2. The need for coordination with engineers for laying minefields on the approaches to the battery position was mentioned. The distraction and confusion of tanks in the minefield allows the artillery to engage the tanks with greater success and therefore enhances the survivability of the artillery unit.

3. Digging in positions for the howitzers can be done much quicker with modern engineer equipment and directional charges. This would also apply to artillery pieces moving up to the forward edge for direct fire missions as part of the preparation fires.

4. Reliable suppression of enemy weapon systems prevents them from being used against the attacker. This would particularly apply to an artillery piece operating from the forward edge of the battlefield.

5. Use of dummy gun emplacements and mock-ups can improve survivability. If a dummy gun is more observable by the enemy than an actual one, it may draw enemy fire allowing for accomplishment of the mission.

Concerns for the survivability of artillery continue into the present day as well. The means for enhancing survivability addressed above are still prevalent in the literature ten years later. The fourth point about planning suppressive fires is probably stressed the most now. One of the duties of the regimental artillery chief in planning preparation fires is to

make arrangements to provide cover for direct fire guns with the indirect fires of other fire support assets.³²

A good indication that survivability continues to be a concern is the following passage from a recent article on direct fire written by Lieutenant General of Artillery Ye. Komarov:

"Preserving viability during direct laid fire has special significance for artillery [units], since the probable enemy has new, effective kinds of weapons and ammunition. . . . How does one artfully select and camouflage an open fire position since as soon as he opens fire from it, it completely identifies itself? Consequently, if the gun does not hit the target with the first rounds and does not quickly leave the position, it will be destroyed by the enemy."³³

Unfortunately, the general never really gets around to telling the reader what the solution is to the problem he has raised. He later equates the direct fire mission to a duel, with success dependent on "beating the enemy to the punch" in accuracy and speed of fire. The crew must be well coordinated and the personnel should have "flawless bravery, valor, and endurance" and a willingness to fire until the destruction of the target is accomplished "without fearing counterfire from the enemy." The training of the gun crew must also insure inter-replaceability of personnel and a capability to perform the mission with any number of personnel. Although this may be standard Soviet rhetoric to promote the importance of each soldier performing his duties at any cost, it also demonstrates an awareness of the dangers of engaging in direct fire.

A seeming contradiction to the survivability question appears in the opening paragraph of an article on self-propelled howitzers by a Soviet colonel who states that "mobility and dependable armor plating renders these pieces invulnerable in battle"³⁴ This is certainly not found to be a predominant opinion. The same author, later in his article, discusses the difficulties of moving into direct fire positions on the forward edge of the battlefield due to the size of the self-propelled guns and the engine noise. He suggests quickly moving into the position in conjunction with the initial barrage fired by the indirect weapons or moving in at night with artificially created noise cover and suppression of enemy radar and infrared capability. These techniques would certainly not be required for an 'invulnerable' weapon.

Some of the most recent options discussed for improving the survivability of artillery firing from direct fire positions show that considerable thought is still being put into the problem. One author contends that engineer preparation of a position is not enough. If an artillery piece does not hit the target with the first round it should maneuver to a prepared alternate position and try again from there.³⁵ Another suggestion is to develop techniques that would allow for adjustment of rounds under conditions of limited visibility.³⁶ This seemed to be a reference to use of a smoke screen for protection of the firing piece. Similar to this option was an account of a direct fire exercise conducted at night where an antitank guided missile target was located with the assistance of illumination and then fired on and destroyed after

the illumination round had gone out. This would certainly make return fire on the direct fire artillery piece difficult.³⁷

The tradeoff between the many advantages of direct fire and the single disadvantage of vulnerability has been one faced by the Soviets since their employment of direct fire techniques in the Great Patriotic War. The effectiveness of current techniques are hard to determine in a training environment without an enemy returning fire. The Soviets are creatively trying to solve the question of survivability, but the bottom line may remain Suvorov's principle: "You yourself may perish, but help out a comrade."³⁸

Endnotes for Chapter 3

1 The sources referred to are primarily from the Soviet Military Herald as seen in the bibliography.

2 Christopher Bellamy, "Destruction by Fire: Soviet Artillery in the 1980s and Beyond," Field Artillery Journal, 53 (September-October 1985): 40.

3 It is likely that the organic artillery of the regiment is more routinely employed in direct fire missions than artillery passed down from higher levels to form the regimental artillery group (RAG). This is assumed because of the greater opportunity for organic artillery units to routinely train with the maneuver units.

4 V. Vishnevskiy, "The Battery on the March and in the Meeting Battle," Military Herald (August 1984): 108-9.

5 Vishnevskiy, "Battery on the March.": 109.

6 I. Tsvetkov, "A Battery Repels a Tank Attack," Military Herald (August 1974): 165-6.

7 V. Morgun, "Self-Propelled Artillery Battery in an Advance Party," Military Herald (January 1983): 116.

8 Morgun, "Self-Propelled Artillery Battery": 117.

9 G. Vasilishin, "Direct Firing During Artillery Preparation of the Attack," Military Herald (September 1983): 130.

10 G. Ye. Peredel'skiy, The Artillery Battalion in Combat (1984): 44.

11 Vasilishin, "Direct Firing During Preparation": 133.

12 V. Selyavin, "Direct Fire," Soviet Military Review (November 1975): 19.

13 I. Yepifanov, "Employment of Artillery," Military Herald (April 1982): 27.

14 Vasilishin, "Direct Firing During Preparation": 134.

15 Yepifanov, "Employment of Artillery": 29.

16 There are four phases of artillery support for an attack: fire support for a force's movement forward; artillery preparation of the attack (as already discussed); artillery support of the attack; and artillery accompaniment in the depth of the enemy defenses.

17 N. Strelkov, "Support of a Tank Attack," Military Herald (March 1984): 117-8.

18 Richard E. Simpkin, Red Armour (1984): 74.

19 V. Il'in and V. Sofronov, "Artillery Fire Plan in Support of a Motorized Rifle Battalion," Military Herald (April 1981): 35,38.

20 Peredel'skiy, Artillery Battalion: 129.

21 A. Sazevich and A. Noskov, "From the Experience of Direct Fire," Military Herald (March 1980): 138.

22 V. Pogonin, "Organizing the Plan of Fire and Engineer Obstacles," Military Herald (March 1983): 103,108.

23 Sazevich and Noskov, "Experience of Direct Fire": 139-40.

24 V. Avdeyev, "Support of a River Crossing," Military Herald (September 1983): 136-7.

25 Peredel'skiy, Artillery Battalion: 111.

26 I. Anashkin and V. Kolesov, "From a Direct Fire Position to Long Ranges," Military Herald (November 1982): 111.

27 A. Novichkov and L. Sebyakin, "Artillery Actions," Military Herald (October 1982): 62-3.

28 Yu. Koloskov, "Artillery in the Breakthrough of Fortified Areas," Military Herald (April 1976): 131-7; and V. Pogonin, "The Destruction of Especially Strong Structures," Military Herald (July 1978): 109-13.

29 Koloskov, "Breakthrough of Fortified Areas": 134-7.

30 V. Ivanov and V. Nestrov, "A Question on the Survivability of Artillery Podrazdeleniye," Military Herald (October 1975): 143-9; I. Yepifanov, "On the Matter of Survivability of Artillery Podrazdeleniye," Military Herald (April 1976): 138-41; I. Anashkin, "Jointly Solving a Problem," Military Herald (October 1976): 115-9.

31 Ivanov and Nestrov, "A Question on Survivability": 145.

32 Vasilishin, "Direct Firing During a Preparation": 133.

33 Ye. Komarov, "About Direct Laid Fire," Military Herald (August 1984): 98.

34 V. Barsukov, "Self-Propelled Howitzers on the Defensive," Military Herald (June 1978): 114.

35 Anashkin and Kolesov, "From a Direct Fire Position": 116.

36 Komarov, "About Direct Laid Fire": 100.

37 V. Karov, "ATGM Launcher Destruction by Direct Fire," Soviet Military Review (June 1979): 24.

38 V. Pogonin, "Coordination in Engagement by Fire," Military Herald (October 1984): 96.

CHAPTER 4

DIRECT FIRE ARTILLERY TRAINING AND EQUIPMENT

The Soviets routinely train to use their artillery in the direct fire role. The numerous articles that discuss training for direct fire missions are a good indication that they frequently expect to employ their artillery in a direct fire role. The two aspects of training that will be discussed in this chapter are training techniques and direct fire gunnery. The chapter then concludes with a discussion of Soviet equipment and ammunition as it relates to direct fire.

Training Techniques

Training is conducted in the Soviet army with an emphasis on the need to learn individual skills first, followed by integration of the individual skills into collective tasks at gun crew level, platoon level and on up. The trainers are required to provide immediate feedback to the personnel being trained by use of critiques. In these the trainer points out the errors that were made and how to correct them in subsequent training. Evaluations appear to be frequent with a high degree of competition between crews and units encouraged. The majority of articles found in the

Soviet Military Herald about training are discussions of the results of evaluated training exercises. The Soviets do not appear to be particularly sensitive about airing many of the mistakes made during training as an example to other units.

Realistic Training

The Soviets are urged to "train as things are done in actual combat."¹

There are many indications that resource constraints prevent them from accomplishing that objective. There are frequent references to the use of 'dry-firing exercises' and indications of extensive use of subcaliber devices and explosion simulators. In the description of one artillery unit exercise, the unit commander was discussing the use of subcaliber devices for the conduct of their direct fire training. He scoffed at the idea of using combat rounds for training because it would just be too expensive.² Other articles have indicated that an element of realism is added by making use of artillery explosion simulators down range to indicate the impact of shells in a dry-fire exercise.

The element of realism that the Soviets seem to excel in is the extensive and routine use of the combined arms exercise. This may be an advantage of the artillery being part of the maneuver regiment organization. It seems that the organic artillery units are frequently involved in exercising their immediate tactical requirements in support of the tanks and infantry of their unit. The artillery commander appears to be routinely challenged with the task of planning and exercising the fire support requirements for the regiment in varying tactical situations. A

description of one of these exercises involving employment of direct fire assets of a regiment is provided in detail later in this chapter.

Soviet trainers are often admonished to insure the tactical situations they devise for training are original and not stereotyped. An example was an artillery unit that had just qualified all of their gun crews for direct fire with high marks. They went out several days later to participate in a tactical exercise with a motorized rifle unit and the direct firing results were low. An investigation of this discrepancy revealed that the battery officers had adjusted the sights on the targets during the record fire rather than the individual gun chiefs. The exact ranges to the targets were also well known. The poor direct fire performance during the exercise with the gun chiefs firing at unknown target ranges and on unfamiliar terrain was a much better indication of the true capabilities of the unit in combat. The point that the unit needed to properly train the gun chiefs in direct fire procedures was well made.³

Individual and Crew Training

The individual and crew level skills necessary for learning artillery direct fire techniques are discussed in a recent article from the Military Herald.⁴ The initial discussion concerns the skills necessary at an individual level. The individual subjects emphasized in this unit were:

1. The selection of the correct projectile, charge and detonator according to the nature of the target.
2. How to adjust direct fire of the weapon.
3. Changes in settings of the sight and the aiming point for the sight.

4. How to fire at targets located dangerously close to their own troops.
5. The concepts of the range of direct fire.

It is interesting to note that the training in direct fire started out with a short lesson on the role of Soviet artillerymen in developing the theory and practice of direct fire during the Great Patriotic War. Historical examples were provided with the purpose of developing in the personnel "a desire to learn to strike targets with the first shot during the direct laying fire."⁵

Once the individual skills are mastered, the training progresses to crew level. The five lessons were taught at the range and included:

Lesson 1. Consolidation of the firing position and preparation of fire.

Characteristics of preparing the weapon. Determining the range to the target. Emphasis was also placed here on immediate security of the position.

Lesson 2. Adjustment of fire and fire for effect at stationary observed targets.

Lesson 3. Hitting moving land targets during frontal, flanking and oblique movement. (This lesson is twice as long as any of the others.)

Lesson 4. Fire at ranges exceeding the range of direct fire. Characteristics of fire at moving infantry. Conditions for accomplishing fire missions.

Lesson 5. Mastering the skills of fire by direct laying. (This is apparently additional practice or maybe a lesson where conditions are made more difficult.)⁶

The significance of these lessons is that a comprehensive training program is prepared to insure Soviet artillery crews are well versed in direct fire procedures. The emphasis is on skills required to effectively engage moving tanks, but anti-infantry training is conducted as well.

Along the lines of my previous comments on the realism of training, it should be noted that this unit used dry-fire with explosive charges simulating the explosions of the rounds 'fired.' They also conducted almost half of their training at night or under conditions of limited visibility with the target or their gun position screened by smoke. Another point was that a "heavy emphasis was placed upon developing bravery, selflessness, endurance, self-control and readiness to continue fire until the total elimination of the enemy."⁷ This kind of comment certainly shows an awareness of the danger in employing field artillery in the direct fire role.

The training methodology described in this article indicates an effort to integrate individual and collective tasks in order to achieve proficiency in a tactical skill. The significance of the article is the indication it gives that direct fire training is an important mission of the field artillery.

Another excellent example of crew level training is provided in the continuation of the article mentioned earlier about the unit that had the officers man the gun sights in order for the unit to score well on its direct fire qualification. An intensified training program was designed to correct the previously noted deficiencies.⁸ This account reflects how the training should have been conducted in the first place.

Practice sessions were conducted on unfamiliar terrain to develop skills in estimating ranges to targets and bursts by eye. This was a major

shortcoming in the unit's earlier failure. Training was conducted for the gun chiefs to achieve a high level of proficiency on working with the direct fire sights. Accuracy was the first goal, and then speed. The 'competitive' method of training was used. Classes on the performance of direct fire missions were first held at the smallbore range, then at a moving target range using a subcaliber device and finally on the terrain using burst simulation.

The final training exercise was held in as realistic a fashion as possible considering resource constraints. The battalion chief of staff was the trainer and met the artillery platoon at the motor park. They moved to a tactical area and were given the situation and a platoon mission to support maneuver operations with direct fire. He gave them battle assignments and they tactically moved to the vicinity of the firing position using the terrain to advantage and camouflage. The trainer then pointed out to them appropriate reference points, the ranges to them, the forward edge of the enemy defenses, probable locations of enemy antitank weapons, probable avenues of tank approach and the site for each of the platoon guns to occupy. Additional information included the conditions for firing, the route to use to the positions and the signal to occupy the positions. Once all questions were answered, the trainer gave the signal to occupy the gun positions.

When the position occupations were completed, the crews were all gathered at the first gun in order to review and emphasize proper direct fire procedures prior to engagement of the first target. A crew was put on the gun and the first target was revealed. All of the gun chiefs were required to determine the range and firing settings to engage the target.

They were all checked, evaluated and the correct ones given to the artillery piece and the first round was 'fired'. A simulator indicated the location of the burst and the gun chiefs had to calculate the correction required to adjust the next round. This continued until the target was destroyed.

The second target was handled in a similar manner with each crew manning its own gun. After completion of the second mission, a brief critique of each crew was held. Targets were then exposed at an increased rate and each crew 'fired' against about ten targets. Proficiency of the crews increased significantly by the last target engagement. A final review was conducted, common mistakes discussed and each gun chief was given a grade.

The moral of the story is that the battery was capable of properly employing direct fire procedures when required in the next combined arms exercise. This account of the training process reveals the importance of direct fire skills to the Soviet artillery unit. It verifies the employment procedures discussed in the previous chapter and indicates the desire of Soviet trainers to make training as realistic an exercise as possible, even when conducting the training 'by the numbers'.

Direct Fire in Combined Arms Training

The most complex level of collective training is the combined arms exercise. Not only is the individual unit required to perform varied missions to certain standards, but the unit must also coordinate its actions with many other units to meet a common objective. This next example of how the Soviets conduct their direct fire artillery training is significant when viewed with consideration of the effort put into this exercise. It is

an exercise designed to practice the control of weapons assigned to conduct direct fire during an artillery preparation.⁹ Although the account provided of this exercise is long and quite detailed, I think it is important for the insight it offers on the extensive training that goes into assuring proficiency of direct fire assets. It also provides an account of the command and control procedures used for direct fire employment of artillery during a preparation that supplements the information provided in chapter 3.

A practice exercise preceding the 'full blown' exercise is described in the article. It is held at a rifle range and is designed to work out command and control requirements. There is extensive use of simulations for the practice and it is unclear if the actual exercise is to be conducted with live ammunition.¹⁰ Although this is referred to as a practice exercise, it was evaluated by a large control group of officers and had the aura of a test. The regimental artillery chief was in charge of the participating units. The command and control functions that were practiced included:

1. Organization of communications.
2. Fire planning.
3. Procedures for issuance of orders to participating commanders.
4. Methods for target identification.
5. Reaction to signals.

The equipment involved in the exercise included the antitank assets of two motorized rifle battalions, an antitank guided missile battery from the antitank reserve and two 122mm self-propelled howitzer batteries

from the organic artillery battalion of the regiment. This provides a good indication of the direct fire role the artillery is expected to perform in conjunction with an artillery preparation.

The regimental artillery chief was briefed on the tactical situation several days before the exercise. This indicates a scenario of a deliberate attack on prepared enemy positions. He immediately started his reconnaissance and determined the following information for the supporting unit commanders:

1. Orientation points.
2. Firing positions for each howitzer and antitank guided missile unit.
3. Location for planned and unplanned targets.
4. How the targets will be simulated for the exercise.
5. Locations of battery commanders observation posts.
6. Routes of movement into the firing positions.
7. Planned shifts of fire.

The regimental artillery chief then developed the plan of fire for the means allocated to direct fire. He informed the subordinate commanders of the tactical situation two days prior to the exercise. The regimental artillery chief took the subordinate commanders to the area for the exercise the night before the attack and provided them the information listed above and showed them their positions on the terrain. He also provided them the names for the previously selected orientation points, the location for his own observation post and an excerpt of the fire plan that pertained to their weapons.

The exercise formally began an hour before sunrise when the unit commanders briefed the tasks to the gun chiefs and crews. During the darkness the weapons were moved into position and camouflaged. The technical preparation of the gun was completed and wire communications were laid to the regimental chief's observation post. With sunrise, the guns identified all targets and orientation points and laid the guns on their initial targets.

The preparation was scheduled to begin at 0740 hours. The evaluation team chief provided an intelligence update thirty minutes prior to the start of the preparation. The update indicated two targets had departed their positions and five targets had proven to be dummy positions. He added three newly detected targets. The reaction was to change target data and send the headquarters platoon commander and his assistant to the artillery and antitank guided missile battery commanders with the target updates.

The preparation began exactly on time and simulators were used to show the impact of the initial rounds fired. The first targets fired were individual targets away from the enemy strongpoints with indirect fire scheduled to hit the strongpoints immediately at the beginning of the preparation. As the indirect fires shifted to the depth of the enemy positions, the direct fire assets engaged targets in the strong points that survived the indirect fire. The flexibility of control of the direct fire weapons was then demonstrated with the following techniques:

1. Enemy strongpoints that put up stiff resistance were identified by naming the orientation point for the position and marking it by orange smoke grenades or by machine gun tracer bullets. The artillery batteries

were directed to shift their fire to the new targets and continue firing until directed to cease fire.

2. An enemy counterattack was formed. The target area was designated in a similar manner to the method above. The artillery was directed to engage the attacking infantry and the antitank guided missile battery was directed to engage the tanks. The counterattack was defeated.

3. The control of the units was by wire communications up to this time. The situation required a move to another position to support employment of the second echelon forces. The batteries were directed to activate their radio communications net and directed to move to new positions for continued support of the attack. The gun crews were tested at the new positions with a record fire and the exercise ended.

The complexity of this training exercise is an excellent indication of the importance direct fire assets play for Soviet units conducting an attack. It also demonstrates the high degree of centralization used in planning the employment of direct fire assets and controlling them after completion of the initial target taskings of the preparation.

The Soviets train at all levels to attain proficiency in the conduct of direct fire missions by their field artillery units. The importance of individual knowledge and expertise in performing direct fire tasks is frequently emphasized. Considerable imagination and innovation is required in promoting realism in the conduct of training within apparent resource constraints. The necessary collective training is conducted and evaluated to insure the capability of artillery systems to support the tactical plan with direct fire techniques.

Direct Fire Gunnery

Considerable time and effort go into determining the best methods for insuring the first round hits the target when conducting direct fire. Several reasons for this need have been mentioned previously. The most obvious one is the increased survivability of the artillery piece because the target doesn't have a chance to shoot back. Another frequently mentioned reason is the potential difficulty of seeing the target for subsequent adjustment of rounds. This is particularly the case for direct fire weapons participating in a preparation. The reduction in ammunition expenditure is also helpful by allowing for the engagement of more targets with the same amount of ammunition. Some basic techniques in gunnery and technical preparation of the piece are used by Soviet artillery to increase the accuracy of the initial round.

Soviet artillerymen do not just sight on the target and fire when conducting direct fire. They apply corrections based on the meteorological and ballistic conditions. The corrections become more important as the range to the target increases. It is necessary to apply these gunnery calculations to facilitate first round accuracy, particularly when engaging targets at the maximum ranges of direct fire. More details on the determination of these corrections can be found in Appendix A.

The accurate determination of the range to the target is the most important factor affecting the direct fire gunnery corrections used by Soviet artillerymen. An error in determination of the range can totally negate the validity of the corrections that were calculated and applied at the gun. As discussed earlier in this chapter, the Soviets spend

considerable time in training artillerymen to correctly estimate the range to the target.

The application of gunnery corrections when engaging direct fire targets at other than minimum distance demonstrate the Soviets' dedication to achieving first round accuracy. The emphasis that corrections cannot be ignored, no matter how small, supports that same purpose.

Technical Preparation of the Piece

The primary consideration for the technical preparation of the piece is collimation of the sights (boresighting). This can be explained as the alignment of the axis of the sight to insure it is parallel to the axis of the gun tube. The purpose is to insure that the tube is shooting where the sight is aimed. This is a point which is frequently emphasized and may indicate that it is a problem area. The need to check the sights upon arrival in the firing position is stressed to insure that weapon movement has not placed them out of proper adjustment. This is the most important technical aspect of the gun that can degrade the accuracy of direct fire.

It is also important to insure the weapon is placed in the firing position with a minimum amount of cant or 'sideways slope.' The accuracy of the artillery piece is seriously degraded if the cant is too great. In this case the tube moves in the vertical plane as well when adjustments in the horizontal plane are intended.

These are the two most frequently mentioned points to check to insure the gun is technically prepared for direct fire. The responsibility is

the gun chief's, but he can expect to be checked routinely by the battery officers.

The items discussed above on training and gunnery provide a picture of how the Soviets train to accomplish the direct fire artillery mission. The amount of information available and the frequency of articles on direct fire training and gunnery methods provide an indication of the importance of direct fire as a method of artillery employment.

Artillery Equipment and Ammunition for Direct Fire

The capabilities of the weapon systems and ammunition available must be considered when determining the suitability of using artillery in a direct fire role. The capabilities of the howitzers found at the regimental level and the types of ammunition available to them make the Soviet use of artillery in direct fire viable. A discussion of the characteristics of these weapons as they relate to their use in a direct fire role and the ammunition available can be found at Appendix B.

The artillery weapon systems usually found at the regimental level are the D30 122mm towed howitzer and the 2S1 122mm self-propelled howitzer. The 2S3 152mm self-propelled howitzer may also be found at the regimental level when it is passed down from the divisional artillery group assets. The available information indicates that these weapons are extremely capable of performing the direct fire mission assigned to them. Although they were designed primarily for the indirect fire role, some features complement direct fire employment as well. These include 360°

traverse capability, low profile and rapid emplacement time. Probably the most significant feature that supports the use of these weapons in direct fire is a high rate of fire that allows them to fire a second round relatively quickly if the first one does not hit the target.

The most important factor in the area of ammunition is that all of these weapons have an antitank projectile available. These antitank rounds are extremely important in increasing the effectiveness of the artillery in a direct fire role. The major advantage that this ammunition provides is the ability to effectively engage targets at significantly increased ranges. While a 2S1 howitzer can defeat an American Abrams tank at 2,050 meters with a high explosive antitank (HEAT) round, it must engage the same tank within 880 meters to destroy it with a fragmentation high explosive round.¹¹ The ability to engage targets at the extended range is very significant to the survivability of the artillery piece.

The Soviet artillery pieces found at regimental level have several characteristics that provide for their effective use in a direct fire role. The greatest enhancement to the direct fire capability of these weapons is the availability of effective antitank ammunition.

Endnotes for Chapter 4

- 1 G. Peredel'skiy, "Basic Directions in the Training of Artillery and Missilemen," Military Herald (February 1974): 103.
- 2 S. Kravchenko, "Artillerymen in the Arctic Region," Military Herald (December 1983): 52.
- 3 A. Shulakov, "Training in Firing by Direct Laying," Military Herald (August 1977): 72-3.
- 4 V. Voronetskiy and V. Dianov, "Teaching Firing by Direct Laying," Military Herald (November 1984): 105-7.
- 5 Voronetskiy and Dianov, "Teaching Firing": 106.
- 6 Voronetskiy and Dianov, "Teaching Firing": 105.
- 7 Voronetskiy and Dianov, "Teaching Firing": 106.
- 8 Shulakov, "Training in Firing": 73-6.
- 9 V. Tumanov, "Exercise in Controlling the Fire from Means Allocated for Direct Laying Fire," Military Herald (October 1978): 126-38.
- 10 The first thought that comes to mind here is that the final product will be a 'staged version' of an exercise. Although my impression is that such an exercise may be the case, the actual exercise is to be conducted on different terrain which can yield different results with troops added. Rehearsals prior to actual tactical missions are part of doctrine for many armies including the U.S. The discriminator in this case may be whether the 'full blown' exercise is also rehearsed first.
- 11 Voronetskiy and Dianov, "Teaching Firing": 107.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

Several different areas have been explored in an attempt to answer the question of why the Soviets readily use their indirect field artillery weapons in a direct fire role. These include the historical basis for direct fire, the features of current employment to include training methods and the equipment capabilities that the Soviets currently possess.

There is no doubt that the Soviets are willing and able to commit artillery assets in the direct fire role in any future conflict. They developed a strong tradition of the use of direct fire during the Great Patriotic War. They had no other choice in the beginning of the war because of the need to stop German tanks at any cost. The Soviets continued to use artillery in direct fire as they discovered the advantages of timeliness, accuracy and the resultant ammunition savings. The concept of self-propelled weapons reduced the vulnerabilities of the artillery and promoted its use in the close support of the combined arms operations of tanks and infantry.

The direct fire use of artillery today can be traced back to the Great Patriotic War experience and is often supported by examples from that era. The need for the use of direct fire has changed though. The numerical advantage of tank and mechanized forces rest with the Soviets. The use of

direct fire is more directed towards enemy antitank assets in order to preserve that advantage. The interest in timeliness is more related to a desire to avoid increased enemy counterfire capabilities. The self-propelled weapon emphasizes the desire to provide a responsive support weapon to the combined arms operation and less an attempt at invulnerability. Finally, the vast quantity of artillery available to the Soviets allows them to employ portions for direct fire without a degradation of their indirect fire support capabilities.

In current tactics, the Soviets employ artillery for direct fire most often during the meeting engagement to gain the initiative and provide maneuver forces the opportunity to develop the situation to their advantage. Portions of regimental artillery may be employed for direct fire missions during artillery preparations to destroy significant targets at the forward edge of the battlefield. Direct fire will also be used in special situations, most notably in mountain operations and in the destruction of fortifications and buildings. All artillery can be expected to employ direct fire in the defense. Maneuver units should understand that as they penetrate and move into the depth of Soviet defenses, artillery will move into positions to engage them with direct fire.

The Soviets provide for the survivability of their artillery employed for direct fire. The most recent emphasis has been on use of covering fires from other indirect fire means and use of limited visibility situations for protection. Current artillery weapon systems are very capable of accurate engagement using direct fire and enjoy the distinct advantage of antitank projectiles to enhance their effectiveness. Information available on how the Soviet artillery trains demonstrates that direct fire is not merely a

crew drill, but rather is integrated into the collective level of combined arms training for the regiment. All artillery units are expected to have developed a level of expertise in direct fire allowing for its employment in any situation.

In the final analysis, the advantage in artillery assets enjoyed by the Soviets offers them the flexibility to employ artillery units in direct fire roles as they see situations that require it. Although use of direct fire is not a major role for Soviet artillery, it is a distinct capability which must be expected to be used aggressively in both offensive and defensive situations.

Recommendations.

As a result of this study, there are at least two possible areas of study that could be pursued using this as a start point. The first is to perform a detailed assessment of the vulnerabilities presented by the Soviet use of artillery for direct fire on the modern battlefield and determine what assets we have to fully exploit those vulnerabilities. The second is to look at the direct fire capabilities and tactics of the United States Army and make a determination if we are perhaps too limited in our view of the use of artillery in a direct fire role.

APPENDIX A

APPENDIX A

DIRECT FIRE GUNNERY CALCULATIONS

This appendix provides information on procedures Soviet artillerymen use to determine gun sight corrections used in direct fire. The corrections are determined and applied based on meteorological and ballistic conditions.

The meteorological corrections are based on the temperature and wind conditions. The air and the powder/projectile temperature are considered to be the same. The consideration of temperature in determining corrections is particularly important at low temperature ranges where the range deviation of a round exceeds 100 meters when fired at a range of 1,000 meters at a temperature of -15°C .¹ That is a full 10% correction to the range of the round and is very significant.

Wind conditions are also an important correction factor in the conduct of direct fire. There are opposing opinions on the need to consider range wind. One opinion is that due to the short distance the round travels in direct fire, the affect of a range wind is insignificant. Another source states that a range wind of 5 meters per second should be considered because it will affect the distance the round travels by 5 meters on the ground when engaging a target at 1,400 meters. That is only a 0.35%

correction of the range of the round and would probably be insignificant for most targets. It does point out the degree to which the Soviets are willing to go to insure the first round hits the target.

Cross wind calculations are universally considered to be an important factor in the accuracy of direct fire. Using the same wind speed of 5 meters per second as a crosswind and a range to the target of 1,400 meters, the round would be laterally off target by 1.5 meters. This deviation could be the difference between a hit and a miss, especially when firing at a small target or the front end profile of a tank.

Ballistic corrections are also applied to insure the most accurate initial round possible. The most commonly discussed ballistic factor is the variation in muzzle velocity for each individual artillery piece. The muzzle velocity is different for each individual weapon and can have a sizeable effect on the range of the rounds it fires. The articles I've read concerning gunnery techniques have all recommended compilation of a direct fire table for each weapon that is based on the muzzle velocity variation of that piece.² The table also includes the variations in range based on temperatures. The result is a single table to enter for a specific artillery piece to get range corrections necessary for accurate direct fire. An example of one of these tables is shown on the next page.³

RANGE (meters)	AIR and POWDER TEMPERATURE (°C)							
	-35	-25	-15	-5	+5	+15	+25	+35
600	60	50	40	30	20	10	0	-10
1000	100	90	70	50	40	20	0	-20
1500	160	130	110	80	50	30	0	-20
2000	220	180	140	110	70	40	0	-40
2500	280	270	180	140	90	40	0	-50

Table for Range Corrections
(D30, 122mm howitzer, full charge, HE round)

One point that cannot be lost is that the accuracy of all these corrections is dependent on the accuracy of determining the range to the target. Without the correct range, the error in measuring the range totally negates the value of the corrections applied at the gun. The preferred method for the Soviets is to make use of a rangefinder for accurate information. In the absence of such equipment, extensive training must be conducted on estimating the range to targets.⁴

Endnotes for Appendix A

1. Voronetskiy and Dianov, "Teaching Firing": 106.
2. Yu. Aristarkhov, "In Order to Destroy a Target With the First Round," Military Herald (October 1976): 129-35; and Voronetskiy and Dianov, "Teaching Firing": 105-7.
3. Aristarkhov, "In Order to Destroy a Target": 131.
4. There are four rangefinders in the equipment of an artillery battalion. Each battery has one and it is part of the equipment for the commander's observation vehicle. It is not known if gun crews get much chance to use them.

APPENDIX B

APPENDIX B

ARTILLERY EQUIPMENT AND AMMUNITION FOR DIRECT FIRE

The primary role of these field artillery weapons is engagement of targets by indirect fire. Although these weapons are designed and built with this function in mind, the focus during this examination of hardware is to determine what aspects of these weapons lend themselves (or do not lend themselves) to the performance of the direct fire mission.

Each Soviet maneuver regiment has an organic artillery battalion that is equipped with 18 122mm howitzers. The BTR equipped motorized rifle regiment has D30 towed howitzers while the BMP equipped motorized rifle regiment has 2S1 self-propelled howitzers. Most tank regiments are equipped with the 2S1 self-propelled howitzers, although there may still be some with the D30. With either weapon, these are the artillery assets that are most likely to be employed in a direct fire role in support of the regiment. This discussion also includes the 2S3 152mm self-propelled howitzer, which is found in the artillery regiment at division level. This weapon will not usually be employed in a direct fire role. However, if a destruction mission is called for that requires a heavier caliber weapon, this is the most likely weapon to be used. It can also be passed down to the maneuver regiment as part of a regimental artillery group, and since all

Soviet artillery is designed for a direct fire capability to combat tanks in a defensive role, it may be seen performing that mission.

Each battalion has three firing batteries with 6 howitzers. The battery is divided into two firing platoons of 3 howitzers each for command and control. The howitzers are most likely to be employed as platoons or individual gun sections when deployed for direct fire.¹

D30 122mm Towed Howitzer. The D30 has been the 'workhorse' of the Soviet's close support artillery for a long time. It was first introduced in 1963. It has many features that promote its use in a direct fire role. First, it is emplaced on a three trail firing platform that allows for a full 360° traverse capability. It has an emplacement time of 90 seconds which is rapid for a towed weapon. The D30 has a semi-automatic vertical sliding wedge breechblock that allows for a rate of fire of 7 to 8 rounds per minute. That provides for a high rate of fire against targets on the forward edge of the battlefield or against attacking tanks or infantry. It also has a low profile of about 1.5 meter when laid for direct fire. A major plus for this weapon in performing its direct fire mission is a very effective antitank ammunition round.

The major disadvantage when considering direct fire is the total lack of protection for the crew. Since the three trails are staked down during the emplacement of the weapon, the displacement process of pulling up the stakes can also make it quite vulnerable when preparing to leave the position.²

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A STUDY OF SOVIET USE OF FIELD ARTILLERY WEAPONS IN A
DIRECT FIRE ROLE(U) ARMY COMMAND AND GENERAL STAFF COLL
FORT LEAVENWORTH KS L W COKER 06 JUN 86

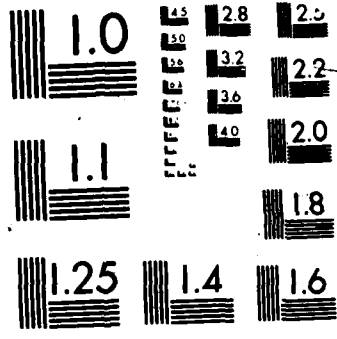
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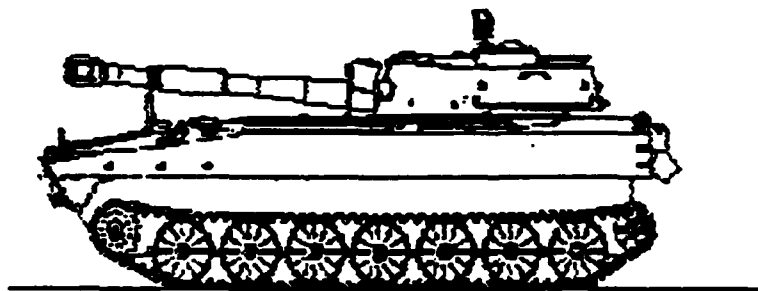
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2S1 122mm Self-Propelled Howitzer (Gvozdika). This weapon has replaced the D30 in BMP equipped motorized rifle regiments and most tank regiments. Its armament is the same tube as the D30 and it therefore has the advantage of firing the same antitank round. It has a 360° traverse capability and a very low profile for a self-propelled artillery piece (2.4 meters). The 2S1's mobility allows it to occupy and depart direct fire positions very quickly and armor plating provides crew protection. It has the same type breechblock as the D30 and a power rammer and extractor allowing a rate of fire of 5-8 rounds per minute. It has an on board carrying capacity of 40 rounds of ammunition.

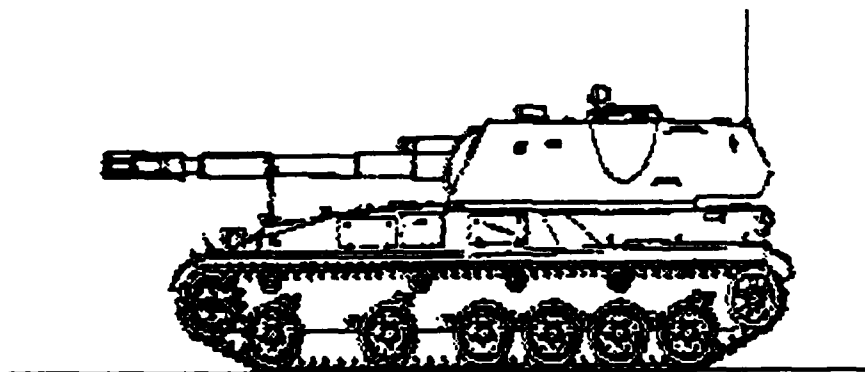
The disadvantage the 2S1 has in operating on the front lines in a direct fire role is the lightness of its armor. It is only 15mm thick at the hull and 20mm thick on the turret.³ The front hull is sharply angled though, making a straight on shot considerably more difficult.



2S1 122mm SP Howitzer

2S3 152mm Self-Propelled Howitzer (Akatsiya). This weapon is similar in appearance to the U.S. M109 self-propelled howitzer. Several of the features to be considered for direct fire are the same as the 2S1. Its self-propelled mobility, 360° traverse and crew protection features are the same. The 2S3 has a slower rate of fire of 4 rounds per minute. It also fires an antitank round, but not as an effective one as the 2S1. The on board ammunition carrying capacity is 46 rounds. Although this is a bigger weapon than the other self-propelled howitzer, it is evident that it is not as well suited to the performance of the direct fire role.

Even though this weapon appears heavier, it has the same thickness of armor as the 2S1 resulting in a weapon that is too lightly armored for operations on the front line.



2S3 152mm SP Howitzer

Ammunition. There are three types of ammunition that can be used for direct fire purposes. The first is a high explosive fragmentation (Frag-HE) round. This is the least effective against armored targets and the most

effective against personnel targets. All three weapons discussed above fire this as standard ammunition.

The success of Soviet artillery in performing an antitank mission employing direct fire techniques lies with the antitank ammunition they have available. There are two types. The most effective is the high explosive antitank round (HEAT). For the 122mm howitzers it is a non-rotating, fin stabilized projectile that is capable of a 460mm armor penetration at any range. The 152mm version of the same round will penetrate 400mm of armor. The other antitank round is the armor piercing tracer round (AP-T) and is available to the two self-propelled weapon systems. It penetrates 185mm of armor in the 122mm version and 120mm of armor in the 152mm version.

These antitank rounds are extremely important in increasing the effectiveness of the artillery in a direct fire role. The major advantage that this ammunition provides is the ability to effectively engage targets at significantly increased ranges. While a 2S1 howitzer can defeat an American Abrams tank at 2,050 meters with a HEAT round, it must engage the same tank within 880 meters to destroy it with a Frag-HE round.⁴ The ability to engage targets at the extended range is very significant to the survivability of the artillery piece.

Endnotes for Appendix B

1 The Soviets have evidently experimented with and may possibly increase the number of artillery pieces in a battalion to 24. A photograph was published in Red Star two years ago of an eight gun battery of a motorized rifle division in the Leningrad Military District. Speculation was that this could be a test of the concept of a quantitative increase in tubes without a required increase in command and control. This would provide a significant increase in the number of artillery tubes available for direct fire missions.

2 Christopher Bellamy, "Soviet Artillery and Rocket Design," Jane's Defence Review, 4 (1983): 781.

3 This can be compared to the armor plating of a T62 tank with 102mm of armor at the hull and 242mm at the turret.

4 V. Voronetskiy and V. Dianov, "Teaching Fire by Direct Laying," Military Herald (1984): 107.

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