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Military Implications of Increased Soviet Tungsten Imports

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An Intelligence Assessment

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Military Implications of Increased Soviet Tungsten Imports [redacted] 25X1

An Intelligence Assessment

The authors of this paper are [redacted] 25X1
Defense Industries Division, and [redacted] 25X1
Soviet Economy Division, Office of Soviet
Analysis. It has been coordinated with the National
Intelligence Council. Comments and queries are
welcome and may be directed to the Chief, Defense
Industries Division, [redacted] 25X1

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Military Implications of Increased Soviet Tungsten Imports [redacted] 25X1

Key Judgments

Information available as of 9 November 1982 was used in this report.

During 1979-81, the USSR bought unusually large amounts of tungsten on the international market. In 1981 it purchased some 22,000 tons of concentrated tungsten ore—equal to about 11,000 metric tons of contained metal (pure tungsten). This was more than triple the annual imports during the early and middle 1970s. In 1980 and 1981, Soviet tungsten imports amounted to about 30 percent of the total reported world production for those years. The fact that the Soviets expended about $600 million in scarce hard currency on these imports during 1979-81 reflects tungsten's high priority. [redacted] 25X1

We are confident that these sharply higher purchases are made in support of military production programs—the annual tungsten supply now substantially exceeds estimated civilian requirements. Although a variety of military applications is possible, most of the tungsten acquired probably is earmarked for production of new munitions. [redacted] 25X1

The increased imports have coincided with large purchases of Western tungsten-related manufacturing technology suitable for military use. The Kuybyshev Drill Bit Plant (built by Dresser Industries) furnished the equipment, processes, and expertise for making high-purity tungsten powders. The Soviets have also legally acquired Western powder-metallurgy pressing equipment like that used in the West to make tungsten-alloy penetrators for armor-piercing projectiles. [redacted] 25X1

[redacted] 25X1

According to current technical assessments, a tungsten-alloy core for a steel projectile could increase armor-penetrating capability by about 20 percent over the steel-alloy projectiles now in the Soviet inventory. A solid [redacted] 25X1

tungsten-alloy projectile could provide up to a 40-percent increase in penetration. Deployment of these new projectiles, therefore, would significantly improve the capability of Soviet tank guns to defeat Western tanks, equipped with either conventional or special armor. We estimate (on the basis of our understanding of planning factors used by the Soviet military) that the tungsten imported during 1979-81 alone could support production of enough cored projectiles to equip the entire Soviet tank force by 1990. [redacted] 25X1

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Military Implications of Increased Soviet Tungsten Imports [redacted]

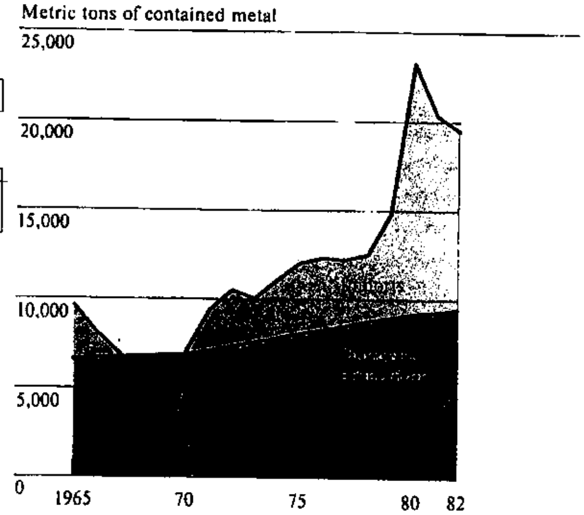
Supply of Tungsten

Accelerated Imports. The USSR has recently been buying unusually large amounts of tungsten in the international market. Imports first began to accelerate in 1979, when purchases nearly doubled—to 5,800 tons of contained metal (pure tungsten) from 3,200 tons, the average level prevailing during most of the 1970s.[redacted] Soviet imports peaked at some 14,000 tons in 1980 before falling to about 11,000 tons in 1981 (figure 1).[redacted] Soviet imports in 1980 and 1981 represented about 30 percent of the total reported world tungsten production during the same time period.

[redacted]

The large outlays of hard currency committed to these purchases clearly reflects their high priority. The Soviet Union's tungsten import bill for 1979-81 amounted to about $600 million.[redacted]

Figure 1
Tungsten Supplies in the USSR



[redacted]

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The USSR has been an importer of tungsten for many years. During 1960-67, its imports ranged from 2,000 to 8,000 tons per annum. China was the only source of supply for the Soviets during that time, and trade was conducted on a barter basis. Imports from China were halted during 1967-69 because of deteriorating political relations between Moscow and Beijing and China's desire to bolster its hard currency earnings by marketing more tungsten in the West.[redacted]

The Soviets resumed tungsten imports from both China and Western Europe in 1970. Beijing has limited its direct tungsten sales to the USSR to 700 to 1,000 tons per annum during most of the 1970s, preferring instead to market most of its output in the West for hard currency.[redacted]

The Soviets also have been buying tungsten—most of it of Chinese origin—through various metals dealers in Western Europe. [redacted] their purchases there ranged between 6,000 and 8,000 tons in 1980 and 1981.[6] The Soviets also bought 500 to 1,000 tons of tungsten directly from Bolivia and Peru in 1981 and were reportedly seeking additional supplies in South America in early 1982.[7] Recently, [redacted] he Soviets obtained several hundred tons of tungsten from sales of

[redacted]

US Government stockpiles by the General Services Administration. [redacted] The data from these open sources give no indication of an increase in Soviet imports. For example, the *Quarterly Bulletin of the UN Committee on Tungsten* reports that total imports by all Communist countries amounted to about 1,800 tons in 1979—the last year for which complete data are available [redacted] in 1979 the Soviet purchases alone were about 5,800 tons [redacted]

The market for tungsten, as well as other primary commodities, is weak. A tungsten surplus dampens the market reaction to increased Soviet purchases and reduces the visibility of these purchases. [redacted]

Table 1
Soviet, Chinese, and US Production of Tungsten [a]

Metric tons of contained tungsten

	USSR	China	United States
1960	5,400	13,990	3,160
1970	6,900	5,470	4,220
1975	8,100	6,710	2,490
1976	8,300	5,660	2,660
1977	8,500	6,470	2,730
1978	8,800	8,660	3,130
1979	9,000	10,130	3,015
1980	9,200	Unknown	2,722
1981 [b]	9,400	Unknown	3,538

[redacted]

[b] Preliminary.

[redacted]

Growing Domestic Production. The substantial growth in Soviet imports is clearly not compensation for a decline in domestic tungsten production. Annual production rose by about one-third during 1970-81 and, according to our calculations, is still growing. We estimate that output amounted to 9,400 metric tons in 1981—roughly one-fifth of total world production in that year and nearly three times the output of the United States (table 1). [redacted]

The Soviets' largest tungsten-ore-concentrating plant is at Tyryn-Auz (Northern Caucasus); others are at Dzhida (Buryat ASSR), Iul'tin (Magadan Oblast), Vostok II (Primorskiy Kray), and numerous scattered locations in Central Asia and Kazakhstan. [redacted] output was roughly 4,000 to 5,000 tons per year. [redacted] tungsten production in the Magadan Oblast fluctuated between 2,000 tons and 2,700 tons per annum during most of the 1970s. Fragmentary information suggests that tungsten production in all other regions of the USSR may have risen from about 1,000 tons in 1970 to between 2,000 and 2,500 tons in 1981. [redacted]

We anticipate that Soviet tungsten production will continue to rise during the 1980s, although possibly at a slower pace. Increased output will come from the Vostok II plant, which was commissioned in 1977 and may not yet be operating at full capacity. The Soviets have reported that they are building a second plant to exploit another deposit which has been discovered about 70 miles west of Vostok II. Increased output from these sources will offset a substantial loss of production in the Magadan Oblast by the mid-1980s, and total production probably will increase to as much as 10,000 tons per year by 1985. [redacted]

Resource Base. There is no impending decline in the Soviet domestic tungsten resource base which could explain increased imports. Soviet geological studies claim that the USSR's reserves of tungsten are among the largest in the world [13]—a claim supported by Western experts. According to the US Bureau of Mines and other Western specialists, Soviet reserves are between 150,000 and 260,000 tons, sufficient to support current production for 15 to 30 years.[14] At the upper end of the range, estimated Soviet reserves amount to about 10 percent of the world's total.[15] [redacted]

Construction of new concentrating capacity also indicates that the proven tungsten resource base is growing. Tungsten deposits were brought into operation at Ingichka in the Uzbek SSR in 1973 and at Vostok II in 1977, according to Soviet press and geological reports.[16] Other Soviet press reports [redacted] indicate that concentrating plants were built nearby to exploit these deposits. According to their published standards, the Soviets do not build a new tungsten plant unless it has a reserve base sufficient to support production for at least 20 years.[17] The size of these deposits is unknown, but the Soviets claim they are "large." According to their system of mineral classification, "large" tungsten deposits contain at least several hundred thousand tons of ore.[18] Depending on the richness of the ore body, these new deposits should ultimately yield several thousand tons of metal. [redacted]

Finally, the Soviets are continuing a large tungsten prospecting effort. The bulk of the work will be centered in Tadzhikstan, Kazakhstan, and the Soviet Far East. Because of the long leadtimes involved in bringing new deposits into operation (10 to 15 years), the present efforts can be expected to provide new tungsten supplies during the 1990s and beyond. [redacted]

Additions to Stockpiles. The Soviet Union's annual supply of tungsten—domestic production plus imports—averaged around 10,000 tons during 1971-78, according to our estimates. As figure 2 shows, annual supply rose to about 21,000 tons in 1980 and 1981 because of sharply higher imports. Assuming little or no increase in consumption (see discussion of demand, below), we calculate that Moscow will have added roughly 30,000 tons of contained metal to its tungsten stockpiles over the period 1979 through 1981.[19] Even if imports fell to the 1970s level (about 3,200 tons) during 1983-85, the steady gains in domestic production would enable the Soviets to add 9,000 tons more to their stockpiles during 1983-85. [redacted]

Figure 2
Soviet Tungsten Supply and Demand Outlook, 1978-85

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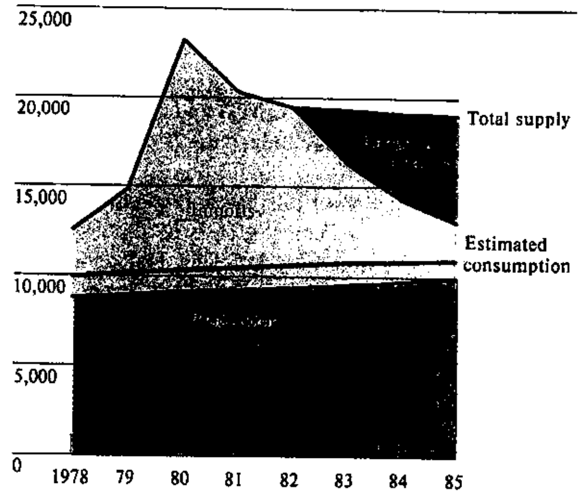

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Demand for Tungsten

Civilian Demand. Just as there is no impending decline in domestic production, neither are there any sharp changes in civilian demand that would explain the sharp growth in tungsten imports. We estimate that actual annual consumption grew slowly during 1970-78, reaching only about 10,000 tons by the end of the period. Available evidence indicates that most of this was consumed in the civilian sector, with little going to military uses. We are confident that civilian consumption has grown little since 1978, and that no major new civilian uses of tungsten are being planned (see discussion on conservation, below). [redacted]

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During the 1970s, tooling and mining uses accounted for most of Soviet tungsten consumption, reaching as much as 8,000 tons per year. [redacted]

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[redacted] the USSR used 1,500 to 2,000 tons each year for the mining industry. The largest share went for coal cutters, percussion and rock-drill bits, and blades and teeth for excavation equipment. An additional 5,000 to 6,000 tons per year went for a wide range of industrial processes and products such as cutting tools, die facings, high-temperature valves, and components for the chemical and nuclear industries. [redacted]

The poor quality of drill bits has long been one of the major impediments to Soviet efforts to make oil and gas drilling faster and more efficient. During the 1980s, greater reliance will be placed on tungsten-based drill bits to carry out ambitious drilling programs. The Soviets plan to drill about 300 million meters for oil and gas exploration during the decade, and we estimate that meeting this target will require about 3.5 million tungsten-carbide drill bits. Production at that level would require 400 to 450 tons of tungsten per year (appendix A). [redacted]

Thus, increased civilian use of tungsten in the USSR is likely to consume at most only a small share of the rapidly growing supply. This increase could be more than offset by continuing efforts to limit the industrial use of tungsten. [redacted]

As early as 1967 the Soviets decided to limit the use of tungsten for all but the most essential industrial applications—reportedly because of uncertainties regarding the supply of tungsten from China. [redacted] by 1973 the Soviets had made remarkable strides in limiting the use of tungsten for tools and steel alloys. [redacted] as recently as 1979 the Soviets were continuing the efforts to cut their use of tungsten as an alloy, using instead molybdenum (a large portion of which is imported) and other combinations of chrome, nickel, and cobalt.[20] The Soviets also are known in trading circles to use a large amount of synthetic diamonds for industrial cutting tools—for which tungsten is widely used in the West. [redacted]

According to statements made by the Minister of Nonferrous Metals, P. Lomako, in May 1982, limiting the industrial use of tungsten remains a priority objective during the current plan period. The Soviets intend to accelerate the development of tungsten-free alloys using other metal alloys and ceramics. According to their calculations, they will save as much as 650 tons of tungsten per annum during the current plan—roughly 7 percent of estimated production in 1981.[21] [redacted]

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Military Demand. In the West, tungsten has been used extensively in weapons during the past decade. The most common application is penetrator material for kinetic-energy armor-piercing projectiles. The newest types of kinetic-energy penetrators are essentially long rods fitted with fins for stability in flight. Most are either tungsten alloy cores jacketed in steel or almost entirely solid tungsten alloy. The heavy alloys used are often as much as 90 percent tungsten. Gun systems ranging from 35-mm antiaircraft cannon to 105-mm and 120-mm tank cannon fire kinetic-energy projectiles that use tungsten heavy alloy as a penetrator material. Other Western military uses of tungsten include fibers for composite materials and superalloys for aerospace applications. [redacted]

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In contrast, Soviet military use of tungsten probably declined during the 1970s. Kinetic-energy projectiles fielded during the 1950s for Soviet tank, antiaircraft, and antitank guns had bullet-shaped tungsten-carbide cores as penetrators, but the production of those older gun systems declined or ceased during the 1970s. In the early 1960s the Soviets fielded their first long-rod penetrator in the 115-mm kinetic-energy projectile for their T-62 tank. The penetrator material was alloy steel in a long-rod design which offered higher performance than that of the older Soviet projectiles with tungsten-carbide cores. The 125-mm kinetic-energy projectiles the Soviets later fielded with their T-64 and T-72 tanks also used long-rod penetrators made of alloy steel. [redacted]

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Nevertheless, the Soviets did make some military use of tungsten for composite materials, superalloys for aerospace, and components for nuclear submarines. (Appendix B compares Soviet and Western civilian and military uses of tungsten.) [redacted]

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Past Deficiencies in Soviet Tungsten Technology

Tungsten-alloy penetrator materials like those fielded in the West during the 1970s would have provided Soviet projectiles substantially greater performance. But their powder-metallurgy technology at the plant level—particularly quality control and nondestructive test equipment—was inadequate, and this precluded the production of long-rod penetrators made of tungsten alloy. As recently as the middle 1970s, Western companies that tested the quality of tungsten powders produced in the USSR judged them to be unusable by Western standards. [redacted]

[redacted]

The Future

New Military Uses. The increased Soviet imports of tungsten coincide with major purchases of tungsten-related Western manufacturing technology that has potential military applications. For example, in the late 1970s the Soviets legally purchased technology that enabled them to develop and produce tungsten-alloy penetrators for their antitank projectiles. [redacted]

[redacted]

In addition to this basic processing technology, the Soviets have already obtained, or have contracted to buy, additional manufacturing equipment and expertise of the kind used in the West to make tungsten-based penetrators. [redacted]

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[redacted] in 1979 a leading Soviet military scientific-technical journal, *Tekhnika I Vooruzheniye (Equipment and Weapons),* described a US 105-mm armor-piercing projectile, the M735, which consists of a tungsten-alloy core sheathed in a steel body [redacted] The penetrator (core) material is 90 percent tungsten, alloyed with nickel and iron. The article reveals that, at a minimum, the Soviets are familiar with the design features of the M735 and suggests that they may have adopted some of the same design approaches. [redacted] 25X1 25X1 25X1

The Soviets systematically evaluate Western military hardware and designs to incorporate desirable features into their own designs. [redacted] 25X1 25X1 25X1

[redacted]

It is reasonable to assume that the Soviets will pursue development of an even more capable projectile made of solid tungsten alloy. In this projectile design the entire body, except for the windshield (nose) and fins,

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Table 2
Tungsten Required for Projectile Production During 1985-90, Estimated by Deployment Scenario [a]

Deployment Scenario	Number of Gun Systems in Active Inventory in 1985 (estimated)	Total Projectile Requirements	Kilograms of Tungsten Required per Projectile		Contained Tungsten Manufacturing Requirements *(in metric tons)*	
			Tungsten-alloy Cored	Solid Tungsten Alloy	Cored	Solid
125-mm guns in T-64, T-72, and newer model tanks	22,000	2,700,000	5.0	10.0	13,500	27,000
115-mm guns in T-62 tanks	15,000	1,840,000	4.4	8.8	8,100	16,200
100-mm guns in T-54 and T-55 tanks	13,000	1,600,000	3.0	5.5	4,800	8,800
100-mm T-12 series antitank guns	4,000	500,000	3.8	7.6	1,900	3,800
Total	**54,000**	**6,640,000**			**28,300**	**55,800**

[a] For a discussion of the method of calculating these estimates, see appendix D.

[redacted] 25X1

functions as the tungsten-alloy penetrator. France, Israel, West Germany, Austria, and the United States have begun production of solid tungsten-alloy penetrators in the past few years. The tooling and processes they use to make such penetrators are essentially the same as those used to manufacture the cores. Manufacturing technology acquired from the West gives the Soviets the needed equipment and expertise. [redacted]

Estimated Production Requirements. We estimate that mass production of projectiles with tungsten-alloy cores is likely to be under way about 1985. The amount of tungsten needed would depend on the extent of planned deployment. For example, we estimate that in 1985 active Soviet units will have some 22,000 T-64 and T-72 series and newer model tanks. Production of the 2.7 million 125-mm projectiles needed to equip all these tanks would take five or more years and consume more than 13,000 tons of tungsten during 1985-90. [redacted]

More ambitious deployment options are possible. For example, if the Soviets chose to equip their older T-62s (we estimate that 15,000 T-62s still will be deployed in active units in 1985) with tungsten-cored projectiles, an additional 8,000 tons of tungsten would be consumed during 1985-90. In addition, we estimate that 13,000 early model T-54 and T-55 tanks will still be assigned to active units in 1985. It is unlikely that the Soviets would produce tungsten-alloy cores for the projectiles now fired by the T-54 and T-55, but if they did, it could increase the total needed by nearly another 5,000 tons. [redacted] 25X1 25X1

The roughly 30,000 tons of tungsten the Soviets have apparently added to stockpiles during 1979-81 would be enough to support production of up to 6 million projectiles with tungsten-alloy cores—enough to equip the entire Soviet tank force by 1990. Eventual production of solid tungsten-alloy projectiles probably would almost double tungsten requirements for the same number of projectiles. Because cored projectiles probably will remain effective well into the 1990s, however, the Soviets may not convert entirely to solid projectiles for some time. Table 2 shows how the total manufacturing requirements for tungsten might vary by deployment scenario. [redacted] 25X1 25X1

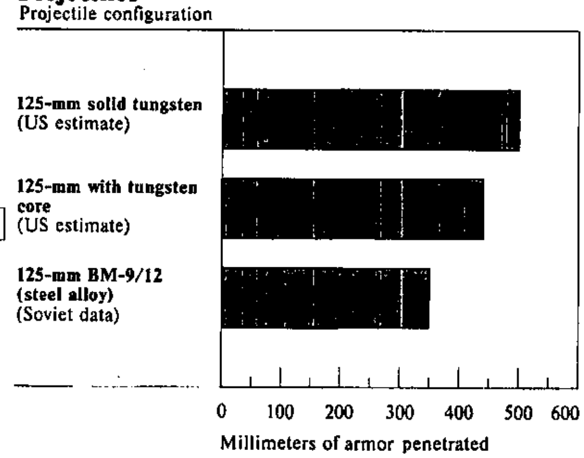
Battlefield Implications. Tungsten alloy is substantially more effective as an armor-penetrating material than the steel alloy the Soviets now use in their long-rod kinetic-energy penetrators. Deployment of tungsten-alloy long-rod penetrators would significantly improve the capability of Soviet tank guns to defeat Western tanks equipped with either conventional or special armor. According to current technical assessments, a tungsten-alloy core for a steel projectile could increase penetration as much as 20 percent, and a solid tungsten-alloy projectile could increase penetration as much as 40 percent [24] (figure 4). [redacted] 25X1

Western tank armor developments probably are driving Soviet efforts to improve their kinetic-energy penetrators. Special armor arrays, which offer Western tanks much greater protection, are likely to continue to improve. Against a given armor, on the other hand, tungsten-alloy penetrators offer the same penetration at ranges greater than are possible with steel-alloy projectiles. Combined with fire control improvements currently being made, this tungsten-alloy capability extends the effective engagement ranges of most Soviet tank guns now in service. [redacted] 25X1

[redacted] 25X4

Potential Additional Uses. Estimated production requirements for the kinetic-energy penetrators described above do not entirely explain the large quantities of tungsten the Soviets are now acquiring. With their rapidly growing inventories of tungsten and the Western powder metallurgy manufacturing technology now in place, the Soviets can pursue further uses of tungsten in their military systems. The tungsten imports began to rise sharply several years before the date when, according to our analysis, the Soviets will begin production of their new tungsten-alloy cores. This early stockpiling, plus unconfirmed emigre reporting, suggests that other military applications of tungsten may be already in train. Other production programs could consume several more thousand tons of tungsten. [redacted]

Figure 4
Potential Effect of Tungsten Alloy on the Performance of Soviet Armor-Piercing Projectiles



Penetration estimated at 0 degrees obliquity and 2,100 meters range against rolled homogeneous armor; actual penetration against special armor varies.

[redacted]

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A number of Western munitions programs that make use of tungsten alloy are available to the Soviets as models of proven design approaches:

- Sweden has developed, for its Bofors L70 automatic antiaircraft gun, a 40-mm fragmentation projectile that increases lethality severalfold by using tungsten-alloy balls rather than steel balls as its preformed fragments. The US Army recently adopted this projectile for its new Sergeant York mobile air defense gun. Combined with the improved proximity fuzes that the Soviets are now developing, tungsten-alloy fragments would make both their artillery munitions and their surface-to-air missile warheads much more lethal.

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- Sweden also has developed a new artillery munition, the Harald X-600, which uses miniature tungsten-alloy kinetic-energy projectiles (or flechettes) to penetrate the tops of armored vehicles.

- West Germany is introducing tungsten-alloy kinetic-energy projectiles for use with its Gepard air defense assault gun. The projectile is intended for use against attack helicopters.

- The United States is replacing steel fragments with tungsten alloy in the conventional warhead for the Lance surface-to-surface missile. 25X1

The Soviets may not be planning a munitions program like any of these. They simply may be unwilling to proceed with their major new tank munitions production program for tungsten-alloy penetrators before amassing large stockpiles of tungsten. Without adequate stockpiles, military production programs that require large amounts of imported material would be vulnerable to interruptions in imports like those for tungsten that occurred in the late 1960s. Another possibility is that mass production of tungsten-alloy penetrators originally was slated to begin earlier, but was delayed by technical problems encountered in development. Future trends in Soviet tungsten imports may provide some insight as to which of these explanations is more likely. 25X1

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Appendix B

Comparison of Major Civilian and Military Uses of Tungsten

	Western	Soviet
Civilian		
	High-speed steel cutting tools	High-speed steel cutting tools
	Tungsten-carbide cutting tools	Tungsten-carbide cutting tools
	Dies and die facings	Dies and die facings
	Light bulbs and electronic tube filaments	Light bulbs and electronic tube filaments
	Components for nuclear reactors	Components for nuclear reactors
	Electrical contacts and permanent magnets	Electrical contacts
	Refractory liners and electrodes	Refractory liners and electrodes
	Tungsten in gas welding	Tungsten in gas welding [a]
	Rock drill bits for gas and oil drilling	Rock drill bits for gas and oil drilling [a]
	Blades, teeth, and cutters for mining equipment	Blades, teeth, and cutters for mining equipment
Military		
	Superalloys for aerospace uses	Superalloys [a] for aerospace uses
	Chemical catalysts and pigments	
	Fibers for composite materials	Fibers for composite materials
	Tungsten-carbide bullet cores	Tungsten-carbide bullet cores
	Rocket motor components	Rocket motor components
	Tungsten-alloy penetrators for:	Tungsten-alloy penetrators for:
	Armor-piercing kinetic-energy projectiles for tank guns	Armor-piercing kinetic-energy projectiles for tank guns [a]
	Antiaircraft fragmentation warheads	
	Armor-piercing top attack munitions [a]	
	Antihelicopter kinetic-energy projectiles [a]	

[a] These are emerging technologies.

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