Directorate of
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Transfer of Austrian Gun-Barrel Forging Technology to the USSR [redacted] (b)(3)

An Intelligence Memorandum

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March 1982

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Transfer of Austrian Gun-Barrel Forging Technology to the USSR (b)(3)

An Intelligence Memorandum

Information available as of 15 February 1982 has been used in the preparation of this report.

This memorandum was prepared by (b)(3)
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Office of Soviet Analysis, with (b)(3)
a contribution from (b)(3)
Comments and queries are (b)(3)
welcome and may be addressed to (b)(3)
SOVA (b)(3)

This memorandum was coordinated with the Office of Scientific and Weapons Research (b)(3)
(b)(3)

~~Secret~~

SOV 82-10046X
March 1982

Transfer of Austrian Gun-Barrel Forging Technology to the USSR (b)(3)

Summary

The Soviets are using state-of-the-art rotary-forge technology and equipment imported from Austria to produce gun barrels for a wide variety of weapons. The USSR has bought at least 26 automated rotary forges for making gun barrels since the late 1960s from GFM,[1] an Austrian firm that specializes in the manufacture of automated metalworking equipment. The Soviets use the same model of GFM equipment to produce gun barrels for the T-72 tank as the United States does for the M-1.

The legal acquisition of this Western technology and equipment through a non-COCOM source has enabled the Soviets to sharply upgrade their weapon production capabilities.[2] The process associated with the new equipment reduces manufacturing time, improves the quality of the product, and requires less metal, energy, and manpower. The new equipment alone has the potential to manufacture considerably more gun barrels than we estimate are required for ongoing weapon production programs. If older, indigenous production equipment also remains in use, the Soviets now have the ability to rapidly expand their production of gun barrels for all classes of weapons.

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[1] Gesellschaft fuer Fertigungstechnik und Maschinenbau A.G. (b)(3)

[2] Rotary forges designed for gun-barrel production are on the Munitions Control List and cannot be exported by COCOM member countries to Communist nations (b)(3)

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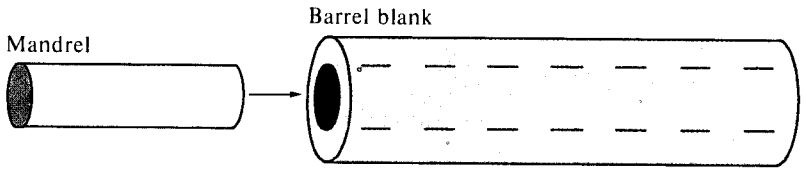
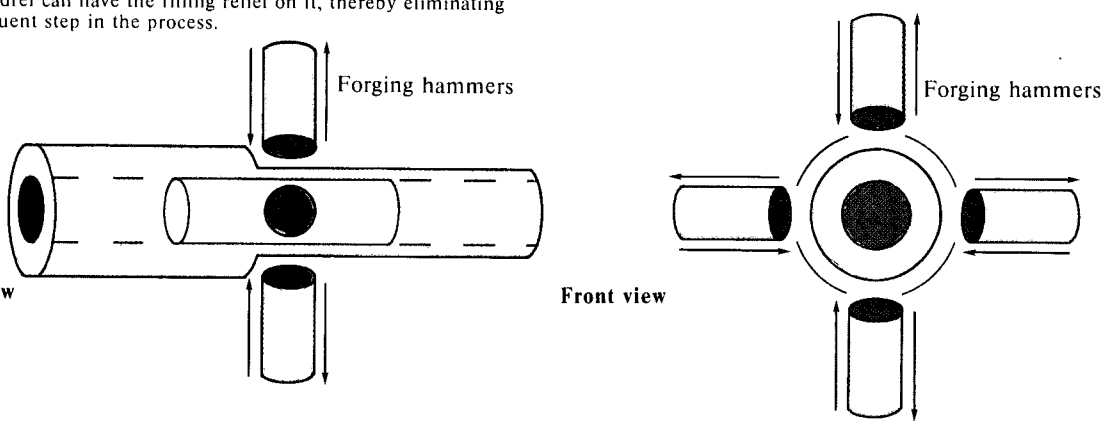
Figure 1

Rotary-Forging a Gun Barrel

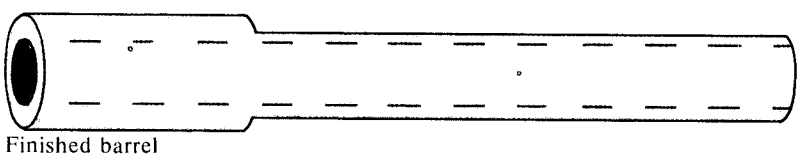
The GFM forging method is a metal-forming process in which an oversize blank is hammered into shape over a mandrel. Most blanks for small and medium gun barrels (those for assault rifles and antiaircraft guns, for example) are forged in a cold state. Barrel blanks for artillery and other large gun barrels are preheated in an induction furnace and then hot-forged.



A mandrel of the desired internal barrel diameter is inserted into the barrel blank and then both are guided into the forging box. The mandrel can have the rifling relief on it, thereby eliminating a subsequent step in the process.



Four hammers, each having the force of hundreds or even thousands of tons (depending on the size of the barrel) are positioned in a circle around the barrel. Forging takes place as the hammers pound the rotating workpiece up to 1,000 times a minute.



After two to 10 minutes of pounding, depending on whether the blank is cold- or hot-forged, the desired barrel size and shape are obtained. Finished barrels are from one-third to three times longer than the blanks and closely approximate the design length.

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Transfer of Austrian Gun-Barrel Forging Technology to the USSR (b)(3)

Background

Since the late 1960s the USSR has bought at least 26 automated rotary forges for making gun barrels from GFM, an Austrian firm that specializes in the manufacture of automated rotary forges and milling machines. GFM has gained worldwide renown as a manufacturer of highly efficient, hot- and cold-working rotary forges, which are used to produce gun barrels as well as solid ingots and hollow tubes (b)(3)

The forges developed and manufactured by GFM have fundamentally changed the method of forging gun barrels. In the past, gun-barrel blanks, prepared either by casting or preforging, were shaped in a heated state between dies driven by a steam hammer. The process was time consuming because the barrel blank had to be annealed repeatedly and scale formed during forging had to be removed. After forging, the barrel was straightened, rifled, and machined in preparation for final assembly in the weapon. (b)(3)

GFM perfected a system for simultaneously shaping and rifling the hollow gun-barrel blanks using a multiple-hammer rotary forging process (figure 1). This process, which can be used for barrels of weapons ranging in size from small arms to heavy artillery, eliminates several steps in the traditional manufacturing process, improves the precision and quality of the forgings, reduces subsequent machining time, and requires less metal, energy, and manpower. For example, a tank or artillery barrel can be forged in 10 minutes or less, whereas the conventional process would require four and one-half hours. The fatigue and mechanical properties of the gun barrels produced by the rotary forge process, moreover, are comparable to those of barrels produced by conventional forging methods. The large GFM rotary forges can also be used to recycle wornout gun tubes into smaller diameter barrels, thereby permitting substantial material and fabrication savings. (b)(3)

Soviet Acquisition of GFM Forges, 1967-74

In the 1960s the USSR and several other Communist countries bought GFM forging machines capable of cold-forging small-caliber gun barrels as well as hot-forging medium- to large-bore artillery and cannon barrels.[3] Only one of six acquired by the USSR is known to have been used for the military sector, the remainder being used to shape tubes, pipe couplings,

[3] In this paper, *small-bore* refers to calibers 8 mm or less (for example, assault rifles); *medium-bore* refers to calibers between 9 and 100 mm (for example, antiaircraft guns); and *large-bore* refers to calibers above 100 mm (for example, tank guns). (b)(3)

Soviet Purchases of GFM Barrel-Forging Equipment

Order Date	Delivery Date [a]	Model	Number	Comments
Unknown	1967	SVK 412	1	Barrels up to 8 mm.
1969	1971	SVK 412	1	Barrels up to 8 mm.
1969	1971	SHK 10	9	Barrels up to 8 mm. Installed at Tula.
1971	1973	SXP 25	1	Barrels 21 to 75 mm.
1971	1974	SXP 55	1	Barrels up to 203 mm. Installed at Perm'.
Unknown	1975	SVK 412	1	Barrels up to 8 mm.
Unknown	1975	SXP 55	1	Elektrostal' Metallurgical Plant. Military application possible.
Unknown	1977	SXP 55	1	Elektrostal' Metallurgical Plant. (Forge still in crates as of November 1981.) Military application possible.
Unknown	1977/78	SHK 17	8	Barrels 20 to 40 mm.
Unknown	1978	SXP 16	1	Barrels 20 to 40 mm. (Experimental.)
1980	1983	SXP 85	1	Barrels over 200 mm (est.). Conflicting reports on exact configuration of this machine.

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and bar stock for civilian industry. After evaluating this equipment, the Soviets undertook a major acquisition program. Known Soviet acquisitions of GFM rotary forges for military applications are listed in the table. (b)(3)
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In 1969 the Soviets placed their first major military order with GFM, for three hot-forging machines (SVK 412) and 10 recently developed SHK 10 cold-forging machines for production of small-caliber gun barrels.[4] When the first cold-forging machine was finished, the Soviets had it tested at GFM's headquarters in Steyr, Austria, in December 1970. After studying the results of that test, they requested a design change in the machine that would permit the forging of a 5.45-mm barrel with a tapered chamber. This change was intended for (b)(1)
the new Soviet light machinegun, the RPK-74. The RPK-74, which is

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based on the AK-74 assault rifle, was put into full production by mid-decade and issued as the standard Soviet infantry weapon.[5] After the design changes were made, the new forges were shipped—along with enough spare parts for 15 years of operation—to the Tula Armament and R&D Plant, where they were installed by GFM fitters in a new shop. After obtaining the initial order of small-bore rotary-forge equipment, the USSR purchased a larger rotary forge (the SXP 25) for producing medium-bore barrels for antiaircraft systems and cannons. This forge was delivered in 1973. (b)(3)

At the beginning of the 1970s, GFM was developing the huge SXP 55, the only rotary forge then capable of producing massive solid ingots as well as gun barrels greater than 200 mm in diameter (figure 2). Bohler Steel Works of Kapfenberg, Austria, a civilian manufacturer of structural steel products, had ordered the first SXP 55. When GFM had built this machine, it invited potential customers to conduct tests on it prior to delivery to Bohler. In December 1970, the Soviets prepared for the tests by holding technical discussions with GFM engineers in the USSR (b)(1)

The experiments were conducted in Austria in October 1971. Tests of the machine's capacity to forge both solid billets and hollow blanks were watched by 200 observers from 40 companies around the world. After the tests, the Soviets placed an order for what was to be the second SXP 55 produced.[6] (b)(3)

GFM shipped the Soviet SXP 55 in 1974. At roughly the same time, the Soviets initiated work on a new forge building at the Perm' Armament Works. (b)(1)

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[5] The introduction of the AK-74 and the RPK-74 and their characteristics are described in "The Kalashnikov Assault Rifle: Three Decades of Improvement," *USSR Monthly Review*, December 1981, pp. 25-27 (b)(3)

[6] The United States purchased the third GFM SXP 55 rotary forge. That machine is currently installed at the Watervliet Arsenal, where it is used to produce the 105-mm barrels for the M-60 and M-1 tanks, as well as other heavy artillery and large-diameter gun barrels. (b)(3)

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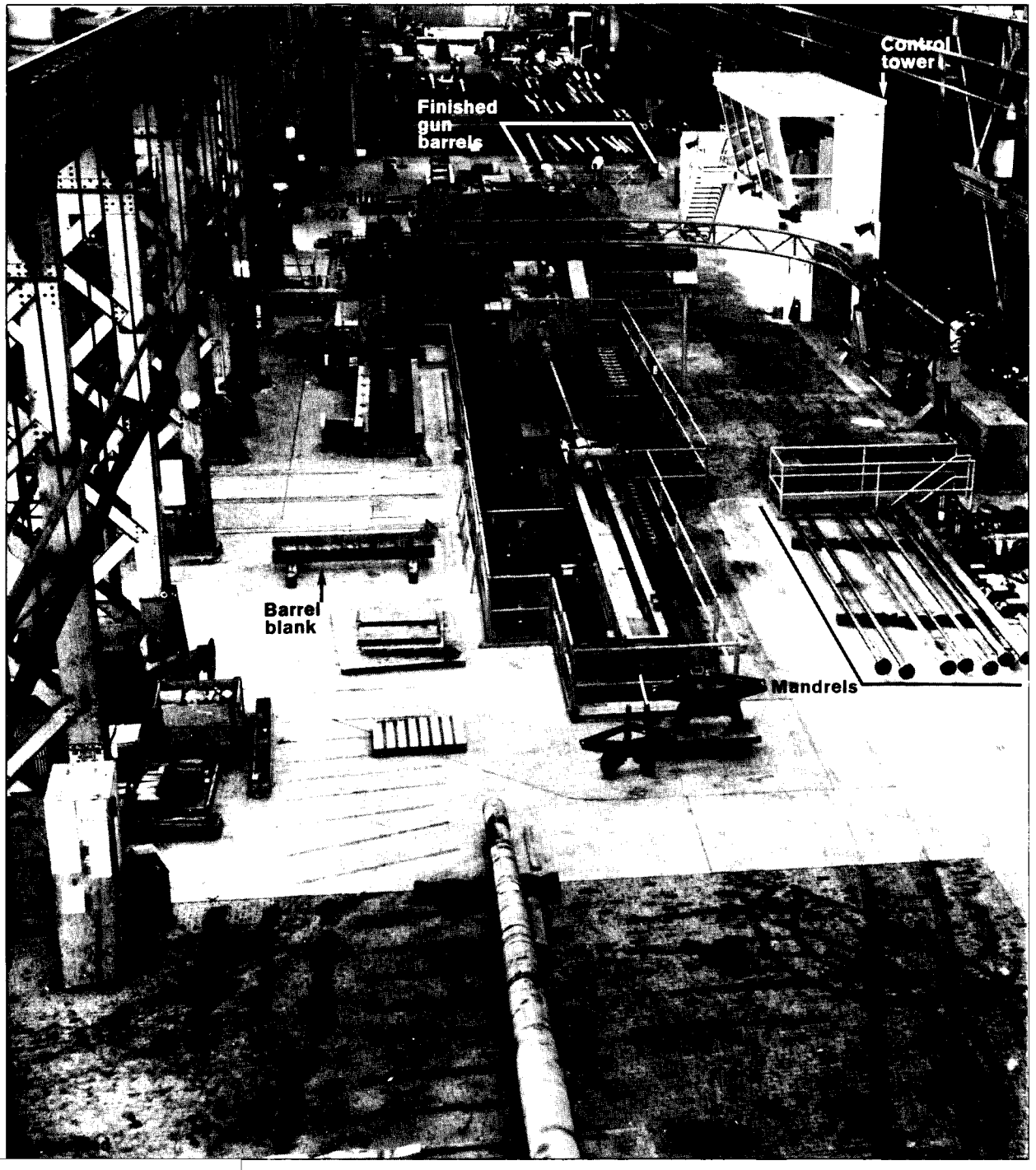
Figure 2

SXP-55 Rotary Forge at Watervliet Arsenal, New York



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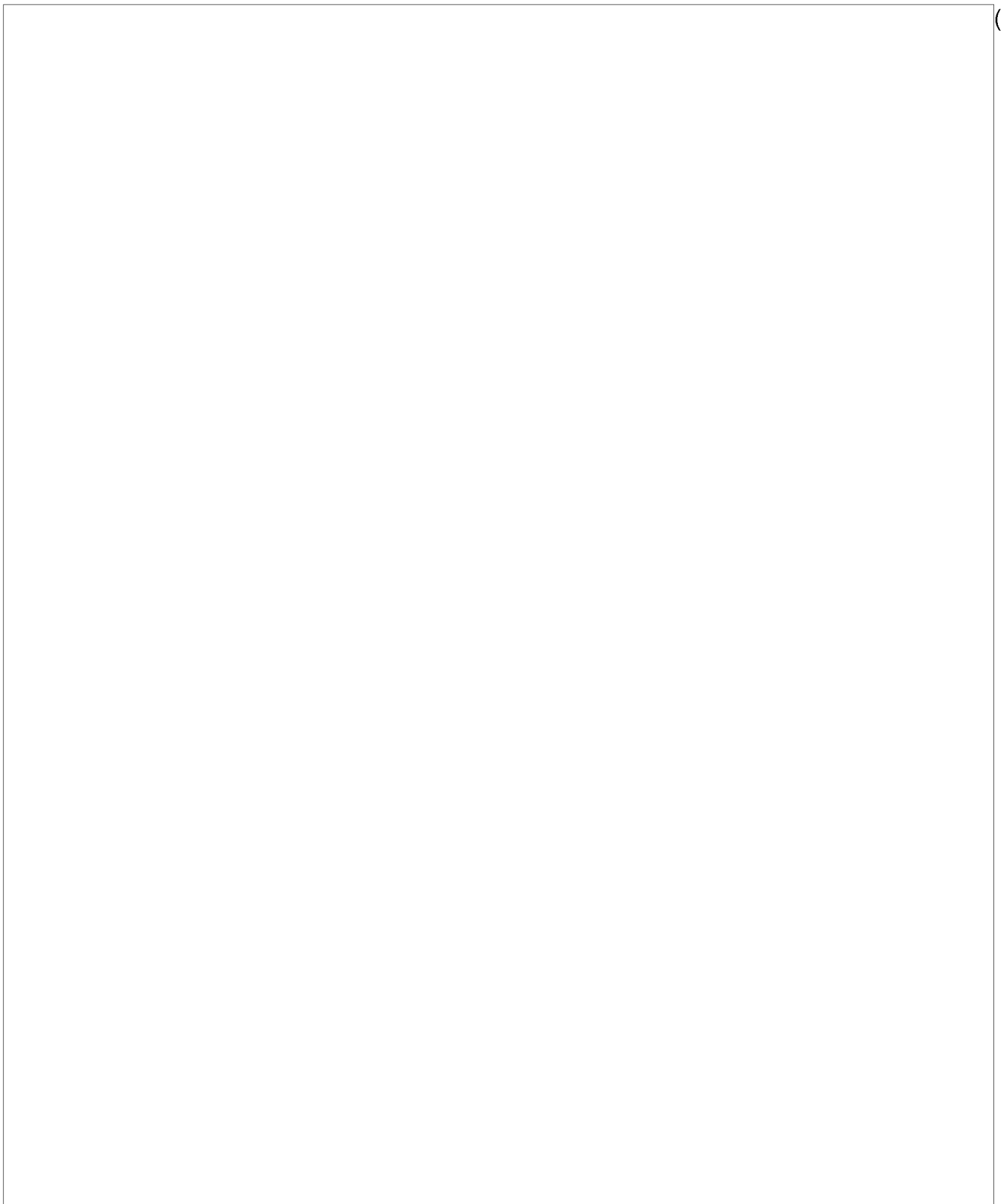

Soviet Attempts To Acquire Greater Access to GFM Technology

In 1972 the Soviets reportedly tried to negotiate a GFM license to produce their own small-caliber rotary forges, but GFM refused. The USSR then tried to induce GFM to build a plant in the USSR or Eastern Europe. According to another report, the Soviets in 1974 even offered to build the facility for GFM, promising that GFM could continue to export its forges to West European and US customers. GFM declined this offer too. At the time of the last offer the Soviets claimed that they were planning to produce all of their gun barrels using the GFM process. (b)(3)

Further Soviet Purchases of GFM Rotary Forges, 1975-80

The failure to gain some measure of control over GFM production notwithstanding, Moscow continued to import substantial quantities of GFM equipment. Between 1975 and 1980 the USSR became one of GFM's largest customers, buying more than $70 million worth of hollow-tube forging machines as well as $50 million worth of equipment clearly destined for the civil sector. The USSR expanded its small-bore gun-barrel production capacity by purchasing an additional SVK 412 rotary forge in 1975. Between 1977 and 1978 the Soviets obtained eight SHK 17 rotary forges for cold-forging 20- to 40-mm barrels, thereby doubling their medium-bore gun-barrel forging capability.[8] The Soviets also purchased two more SXP 55 forges. One, purchased in 1975, is installed at the Elektrostal' Metallurgical Plant at Zaporozh'ye, where it produces speciality steel products.[9] The second was reported to be still in shipping crates as late as November 1981. (b)(3)

Most recently, the Soviets have ordered an SXP 85, the largest rotary forge ever developed by GFM, and delivery to the USSR is expected in 1983. The SXP 85 is capable of producing barrels for the 203-mm gun and 240-mm mortar, which the Soviets now have in the field.[10] (b)(1)
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the Soviets wanted the SXP 85 for large-bore (greater than 200-mm) gun production and would use it in conjunction with the SXP 55 to first hot-forge and then cold-forge the same barrel blank. Although the Perm' forging building is currently large enough to house both the SXP 55 and the SXP 85, new construction under way will expand its size by nearly one-third. (b)(1)
This provides partial confirmation of the report (b)(1)
that the Soviets are comtemplating a further upgrading of their large-bore barrel-forging facility at Perm'. (b)(3)

[8] The Soviets also purchased an SXP 16 rotary forge in 1978, but it appears to be used for experimental purposes only. (b)(3)

[9] A recent news story on Soviet television showed the SXP 55 at Zaporozh'ye forging solid ingots. (b)(3)

[10] There are conflicting reports on the use to which the Soviets will put the SXP 85. (b)(1)
recently claimed that it has been designed to manufacture thin-walled tubes. (b)(1)
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Soviet Gun-Barrel Needs and Production Capacities

If the Soviets operated all of the rotary forges that they purchased from GFM for gun-barrel production at full capacity, they could forge the following number of barrels annually:

Small bore	730,000
Medium bore	200,000
Large bore	14,000

These estimates are based on the Soviets' own specification in purchasing Western machinery—Soviet equipment is used 4,000 hours per year (roughly two eight-hour shifts per day, five days a week)—and on the generally accepted rule of thumb that forges of this type can operate at 85 percent of capacity. The estimates take into account only the time required in the actual barrel-forging operation and exclude other portions of the process such as postforge heat treatment, barrel straightening, chrome-plating, and finish machining. We know of no limitations or capacity constraints in these stages of the production process that would necessarily limit the Soviets' barrelmaking capability. (b)(3)

The barrel-producing capacity of these machines is substantially larger than what we estimate the Soviets need for current production programs. For example, we estimate that in 1980 the USSR required the following numbers of new barrels for the weapons produced for all services:[11]

Small bore	335,000 [12]
Medium bore	24,000
Large bore	3,500

These estimates exclude stockpiled barrels and exports. Moreover, for certain types of weapons the number of replacement barrels produced may be substantially higher than the production of the basic weapon (for example, antiaircraft guns and Gatling-type cannons). (b)(3)

The large difference between current barrel production levels and capacity may be explained by one or more of the following:

- The Soviets design weapons production facilities to meet wartime production requirements and consequently have tended to acquire excess peacetime capacity (when measured by Western standards).

[11] Most small-bore barrels are for assault rifles and machineguns, used predominantly by the Soviet Ground Forces. The Navy and Air Forces, however, require nearly one-half of the medium-bore barrels. Tank barrels alone account for 65 percent of all large-bore barrels, the remainder being for artillery, mortars, and naval guns. (b)(3)

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- New medium-bore automatic guns and cannons are being deployed and others are expected in the 1983-85 time frame.[13] The large unexplained capacity for producing medium-bore barrels may have been acquired to manufacture these new gun systems and may signal a greater emphasis on medium-bore guns and cannons in the near future.

- The calculated capacities are based on two shifts. Although the Soviets specified a two-shift operation when they ordered the military forges, it is possible that the equipment will be operated for only one shift. A one-shift operation, however, would be atypical for a Soviet plant, especially in heavy industry. (b)(3)

Even taking these factors into account, GFM forges have provided the USSR with considerably more capacity than is needed to meet apparent requirements. In addition, the now obsolescent indigenously produced forges that existed prior to the acquisition of the GFM machines give the Soviets even more capacity, thereby enabling them to increase the output of gun barrels substantially and rapidly. (b)(3)

[13] For example, a new 30-mm cannon is being deployed on the latest version of the BMP infantry fighting vehicle, and a new multibarrel gun (30 mm or greater) is expected on the follow-on ZSU self-propelled air defense gun. (b)(3)

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