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# THE FERROUS CASTING INDUSTRY AND ITS ROLE IN SOVIET MACHINE BUILDING

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# FOREWORD

Because of the essential role played by the ferrous casting industry in the machine building industry, this report examines the historical development, present characteristics, and future prospects of the Soviet ferrous casting industry. The major emphasis of this report is on the contribution made by the ferrous casting industry to the machine building industry. In order to facilitate the evaluation of developments in the Soviet casting industry, numerous comparisons with that in the US also have been included.

The term machine building as used in this report is an approximate equivalent of the Soviet statistical classification "the machine building and metalworking industry" (mashinostroyeniye i metallo-obrabotka) and includes practically all the manufacturing branches of Soviet industry that consume ferrous castings in production of their end products.

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# THE FERROUS CASTING INDUSTRY AND ITS ROLE IN SOVIET MACHINE BUILDING*

## Summary

In 1958 the USSR became the leading producer of ferrous castings in the world, in part reflecting the growth of producer goods in the USSR compared with that in the US but also reflecting a technological lag within the USSR. Specifically, US industry consumes proportionately more forgings and rolled steel parts, which are products of higher strength than castings, than does the USSR. The US also uses proportionately more weldments, which in some applications are cheaper than castings and serve the same purpose.

Production of ferrous castings in the US reached a peak in 1951. Output has been declining during the past 10 years, reflecting not only the decrease of conventional armaments but also the substitution of more advanced methods of fabricating machine parts. On the other hand, the Soviet Seven Year Plan (1959-65) calls for an increased output of castings to 20.7 million tons,** or almost two-thirds more than the level of production in 1958.

The concentration of Soviet industries on castings reflects the historical fact that small ferrous foundries have been easy to incorporate into machine building plants. The capital requirements for these so-called "captive" foundries are small, and the technology is universally available. Such small facilities tend to be of high cost, however, because they are very labor-intensive.

Recognizing the defective structure of the existing foundry industry at the outset of the Seven Year Plan period, the USSR decided to reorient the industry from many small plants to larger, regional, specialized facilities supplying the needs of a number of local enterprises and to increase the mechanization of the industry, thereby raising both labor productivity and output sharply. By 1965 the plan is to reduce the number of foundries by 25 to 30 percent and to eliminate at least one-half of those foundries with annual capacities of less than 5,000 tons. Eventually the industry is to

* The estimates and conclusions in this report represent the best judgment of this Office as of 1 February 1961.

** Tonnages are given in metric tons throughout this report.

consist primarily of foundries with annual capacities of 10,000 tons or more. Although the USSR has a greater ability to standardize production assignments in terms of types, sizes, and quantities to assure, wherever possible, larger production lots and more specialized production, a substantial quantity of the castings produced necessarily consists of a wide variety of types and sizes, produced in small quantities -- a type of production that does not lend itself to large-scale, specialized foundries. The Soviet leadership, therefore, admits that it is impractical to eliminate all small foundries.

The Seven Year Plan implies an increased priority for the Soviet foundry industry. Through 1960, however, little actual progress was made in implementing the many aspects of the program. Only one new large foundry is presently known to be under construction. Much of the planned increase in output, therefore, will have to come from the increased productivity of existing foundries, particularly until the later years of the plan period. Completion of all the announced new construction, however, would give the Soviet foundry industry a total capacity considerably in excess of the announced goal for production of castings. It is estimated that only about 60 percent of the planned construction of new capacity need be completed and in operation by 1965 for the industry to fulfill the goals for increased output of castings. It is therefore expected that the goals for output in 1965 will be substantially achieved. The goal for labor productivity, however, which indicates an average annual increase of 9 percent per worker, may be underfulfilled.

The Seven Year Plan provides for output of foundry machinery to be 2.3 to 2.6 times the value of that produced in 1958. The annual rates of growth of 12.6 to 14.6 percent implied by this plan are well above the 7.3-percent annual rate of growth planned for production of castings. Subsequent information, although unconfirmed, suggests that the planned value of output of foundry machinery for 1965 has been raised to 3.5 to 4 times that of 1958. The fulfillment of a revised goal of this magnitude, coupled with the trend of increasing imports, would enable the Soviet foundry industry to achieve a level of mechanization that would substantially increase its capital-labor ratio. As in the case of new foundry construction, however, implementation of the program to increase production of foundry machinery appears to be behind schedule. Soviet foundries will remain dependent on nonspecialized machine building plants for a substantial share of their requirements for machinery.

Unless the volume of machinery called for in the revised plan is approached, the foundry industry will have considerable difficulty in meeting both its planned over-all level of mechanization and the over-all goals for increasing output per worker. Moreover, little or

no reduction in the labor force of the industry can be expected. Although there is little doubt that the USSR can achieve its 1965 goal for output of ferrous castings, there is much less assurance that the industry will be transformed by 1965 from its present relatively backward state into the highly productive and progressive industry that the Soviet planners have long urged.

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# I. Role of Foundry Production in Machine Building

## A. Introduction

Casting* is a basic and versatile process of metalworking. Although essential to any industralized economy, this process is relied on to a greater degree by the USSR than by the US as a method to produce semifinished shaped parts for the machine building industry. In both the USSR and the US, casting usually is considered the most economical method of producing intricate, semifinished parts of a desired shape and size.** Individual castings may vary in weight from a few ounces to several hundred tons. In addition to supplying semifinished parts to the machine building industry, the casting industry also is necessary for production of such military items as ships, aircraft, tanks, ammunition, and other weapons.

* The term casting refers to a manufacturing process that produces parts by pouring molten metal into specially prepared refractory molds. Although the foundry process produces such items as cast iron pipe and ingot molds as finished products, the majority of ferrous castings are unfinished machinery components that must be sent to machine shops, where by the use of metalcutting machine tools they are processed into finished parts with the required dimensions and surfaces. In some instances, only a minimum of machining may be required to produce a finished part, whereas in other instances multiple machining operations may remove a substantial portion of the original weight of the casting. Almost without exception, any ferrous casting component of an item of machinery must be machined. For the estimated consumption of ferrous castings by the machine building industry of the USSR and the US, see B, p. 6, below.

** The other two major metalworking processes that are used to produce semifinished shaped parts in the machine building industry are forging and stamping. Although machining also is a metalworking process that can produce, by the use of a combination of various types of metalcutting machine tools, the semifinished metal shapes made by the other metalworking processes, it is rarely economical to do so. It should be noted, however, that machining, casting, and forging are not mutually exclusive processes, for most castings and forgings also must be machined. Welding, another major metalworking process, fabricates a machine part by fusing together components that are castings, forgings, stampings, or rolled steel shapes. Rolling of metal almost always is considered a production process of the metallurgical industry rather than a metalworking process of machine building.

In classifying castings according to type of metal, ferrous castings may be conveniently divided into the two general groupings of cast iron and cast steel. Both iron and steel castings can be produced of varying chemical composition and metallurgical structure to obtain special physical and mechanical properties. Iron castings, for example, include such specific forms as gray, ductile, and malleable iron.

In many instances the use of the casting process is dictated by the size, complexity, weight, shape, or metal of a machine part.* The various forms of iron (gray, ductile, and malleable) are used only in production of castings. Steel machinery parts, on the other hand, often can be designed so that a casting, forging, stamping, or welding process can be employed. The relative advantages in castings of the various types of iron compared with steel are mainly the low cost and the ease of production and machining. There are no standard, precise criteria, either economic or engineering, to determine whether a part should be produced as a casting, forging, stamping, or weldment or whether it should be produced from iron or steel. The choice depends on a combination of any number of variable factors such as the availability and cost of labor and materials, the number of machined parts to be produced, the capacity and relative level of the technological development of the various processes, and the specific mechanical and metallurgical specifications required. According to recent Soviet estimates, castings account for an average of 50 percent of the total weight, 15 to 20 percent of the total value, and 20 to 30 percent of the total labor consumed in producing a finished machine. 1/**

B. Consumption Pattern

Although ferrous castings also are consumed by the construction industry as structural components, by the petroleum industry as fittings*** and pipes, and by the metallurgical industry as ingot molds, the machine building industry is the principal consumer of ferrous castings. According to Soviet estimates, between 75 and

* For a detailed discussion of the various casting techniques, see III, A, p. 24, below.

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*** Specifically, fittings that are not machined or threaded. Although fittings that are machined or threaded also are used in the petroleum and other industries, they are, within the terms of this report and within the statistical reporting practice in the USSR and the US, included in the figures on consumption for the machine building industry.

85 percent* of the total annual output of ferrous castings becomes inputs into the machine building industry. 3/ During 1951-58 it is estimated that comparable industries in the US consumed 70 percent of the total annual output of ferrous castings, which consisted of 65 percent of the annual production of gray iron castings, 99 percent of the annual production of malleable iron castings, and 93 percent of the annual production of steel castings.**

No conclusive information is available on the distribution by end use of either iron or steel castings or of total ferrous castings within the Soviet machine building industry. The end-use pattern of gray iron and steel castings in the US, however, does serve to show that the categories of machinery that are being emphasized in the Soviet production plans -- such as railroad equipment, rolling mills, construction equipment, machine tools, and agricultural machinery -- are very large consumers of castings. For example, of the total output of steel castings in the US during 1950-58, railroad equipment consumed an average of about 36 percent annually, construction machinery about 13 percent, and rolling mills about 10 percent. 5/ Of the total output of gray iron castings in the US during this same period, agricultural machinery consumed an average of about 7 percent annually, machine tools about 8 percent, and the automotive industry about 26 percent. 6/

The consumption of castings in the Soviet automotive industry probably accounts for a much smaller share of the total output of gray iron castings than does that of the US. The Soviet machine tool and agricultural machinery and tractor industries, however, probably

* All such figures in this section are based on output in tons. One Soviet estimate stated that at the present time almost one-half of the total annual output of rolled metal and more than three-fourths of the total annual output of ferrous and nonferrous castings are consumed in production and repair of machinery and equipment. Another Soviet estimate states that in 1958 the machine building industry consumed 65,000 tons of rolled metal and 40,000 tons of ferrous castings for every 1 billion rubles worth of output. For 1965, consumption of these products for each 1 billion rubles worth of output is planned to be 47,500 tons of rolled metal and 30,200 tons of ferrous castings. The planned gross volumes of output for the machine building and metalworking industries for 1958 and 1965 were given as 255 billion and 480 billion rubles, respectively. (Unless otherwise indicated, ruble values in this report are given in pre-1961 current rubles and may be converted to US dollars at a rate of exchange of 4 rubles to US $1. This rate does not necessarily reflect the value of rubles in terms of dollars.) It is not clear whether or not Soviet estimates include military as well as civilian machinery and equipment. 2/

** Including US consumption for military end use. 4/

account for a larger share of gray iron castings than do the comparable industries in the US. Apart from production of automobiles, the great disparity in output of consumer durables in the USSR and the US does not radically alter the consumption patterns of ferrous castings in the respective countries. It is estimated that, during recent years, consumer durables in the US accounted for only 5 percent of the average annual output of ferrous castings. 7/ In production of consumer durables, nonferrous castings, particularly aluminum castings, and stampings from rolled steel sheet and strip are the important metal inputs.*

An indication of the importance of ferrous castings in Soviet production is found in Soviet sources that cite examples of the weight of ferrous castings as a percent of the total weight of particular items of machinery. As shown in Table 1, Soviet estimates indicate that ferrous castings constitute 85 to 90 percent of the total weight of Soviet machine tools and 75 to 80 percent of the total weight of Soviet rolling mills.

Table 1

Ferrous Castings as an Average Percent of the Total Weight of Selected Soviet Machinery Items a/

| Machinery Items | Castings as a Percent of Total Weight |
|---|---|
| Machine tools (including metalcutting, metalforming, and foundry machines) | 85 to 90 |
| Rolling mills | 75 to 80 |
| General machinery (including pumps, compressors, and the like) | 60 to 80 |
| Excavators | 70 |
| Roadbuilding equipment | 50 to 70 |
| Hydroturbines for hydroelectric stations | 65 |
| Locomotives | 50 to 60 |
| Tractors | 50 to 55 |
| Agricultural machinery | 25 to 50 |

a. 9/

* Output of rolled steel sheet and strip, which is used largely in production of automobiles and consumer durables, in 1959 accounted for 15 percent of the total output of steel in the USSR compared with 49 percent in the US. 8/

## II. Foundry Production and Production Facilities

### A. Production

In 1958 the USSR became the world's largest producer of ferrous castings with an output of approximately 12.6 million tons compared with about 11 million tons in the US. Soviet output in 1958, the last year for which reported data are available, was still only about 77 percent of the peak US output, which occurred in 1951. As shown in the accompanying chart,* production of iron castings was about the same in each country in 1958, but Soviet production of 2.5 million tons of steel castings was 1.5 times larger than US production. The USSR has been the leading producer of steel castings since 1950.

Soviet foundry production recovered rapidly from the disruptions of World War II. Production of 6.0 million tons of ferrous castings in 1950 exceeded production in 1937, the last prewar year for which data are available, by 1.2 million tons. During the Fifth Five Year Plan (1951-55), annual Soviet production of ferrous castings increased by 3.3 million tons, iron castings by 2.4 million tons, and steel castings by 0.9 million tons. The average annual increase for ferrous castings during the Fifth Five Year Plan was 9.2 percent.

In spite of the substantial increases in output of castings during the Fifth Five Year Plan, Soviet planners claimed in 1955 that a shortage of both iron and steel castings existed.** At that time, Soviet officials called for a concentrated effort to complete the construction of new foundry capacity that was underway, with emphasis on projects that could most readily be put into operation. 10/ This program, combined with more intensive use of existing capacity, raised output of ferrous castings from 9.3 million tons in 1955 to 12.6 million tons in 1958. The increase of 3.3 million tons during the 3-year period 1956-58 was equal to the increase achieved during the preceding Fifth Five Year Plan.

The Seven Year Plan (1959-65) sets a goal of 20.7 million tons of ferrous castings for 1965, 8.1 million tons more than were produced in 1958. Steel castings are to account for a little more than 21 percent of the total output of ferrous castings -- about the same share as in recent years. In order to meet the goal for

* Following p. 10. For more detailed data on Soviet production, see Table 4, p. 39, below. More detailed US production data is presented in Table 6, p. 41, below, and has been converted from short tons to metric tons to conform to the Soviet metric system of weight.

** For a more detailed discussion, see C, p. 13, below.

the Seven Year Plan, an average annual increase of about 1.2 million tons will be required compared with an average annual increase of 660,000 tons achieved during the Fifth Five Year Plan. The average annual percentage increase required to achieve this goal, however, is only 7.3 percent in contrast with the average annual increase of 9.2 percent achieved during the Fifth Five Year Plan and the average annual increase of 10.7 percent achieved during 1956-58.*

B. Role of Castings in Soviet and US Industry

When viewed against estimates that place the total Soviet industrial output in 1958 at only 40 to 45 percent of US industrial output, the large absolute output of ferrous castings in the USSR indicates that Soviet industry relies more heavily on ferrous castings than does the US, partly because of the relatively greater Soviet emphasis on production of producer goods that requires large inputs of metal and partly because of the technological lag in certain rolling processes and limited capacity in some types of forging, stamping, and rolling processes.

The relatively greater emphasis on production of producer goods in the USSR is illustrated by a comparison of production of selected items of machinery in the USSR and the US. Soviet output of producer goods frequently approaches, and sometimes exceeds, US output. The USSR, for example, produced 138,000 metalcutting machine tools in 1958 compared with 30,000 produced in the US, 41,000 freight cars compared with 44,000 in the US, and 220,000 tractors compared with 265,000 in the US. 11/

Whereas significant amounts of castings are consumed in production of machinery items in the USSR and the US, because of a proportionally larger application of forged, stamped, and rolled steel parts in the US, the US consumes a smaller amount of castings per unit of output for the same type of product than does the USSR. An illustration of the emphasis placed on different manufacturing processes in the USSR and the US is found in production of caterpillar tractors. For example, track shoes of a caterpillar tractor generally are roll-forged in the US but are produced as steel castings in the USSR. Because production of caterpillar tractors accounted for approximately 54 percent of the total production of tractors in the USSR in 1958 compared with 9 percent in the US, 12/ production of caterpillar track shoes alone accounted for 5 percent** of the annual output of steel castings in the USSR. 13/ Body parts of plows also

* For a more complete discussion of the goals for output of castings under the Seven Year Plan, see D, 2, p. 21, below.

** Believed to include production of spare track shoes.

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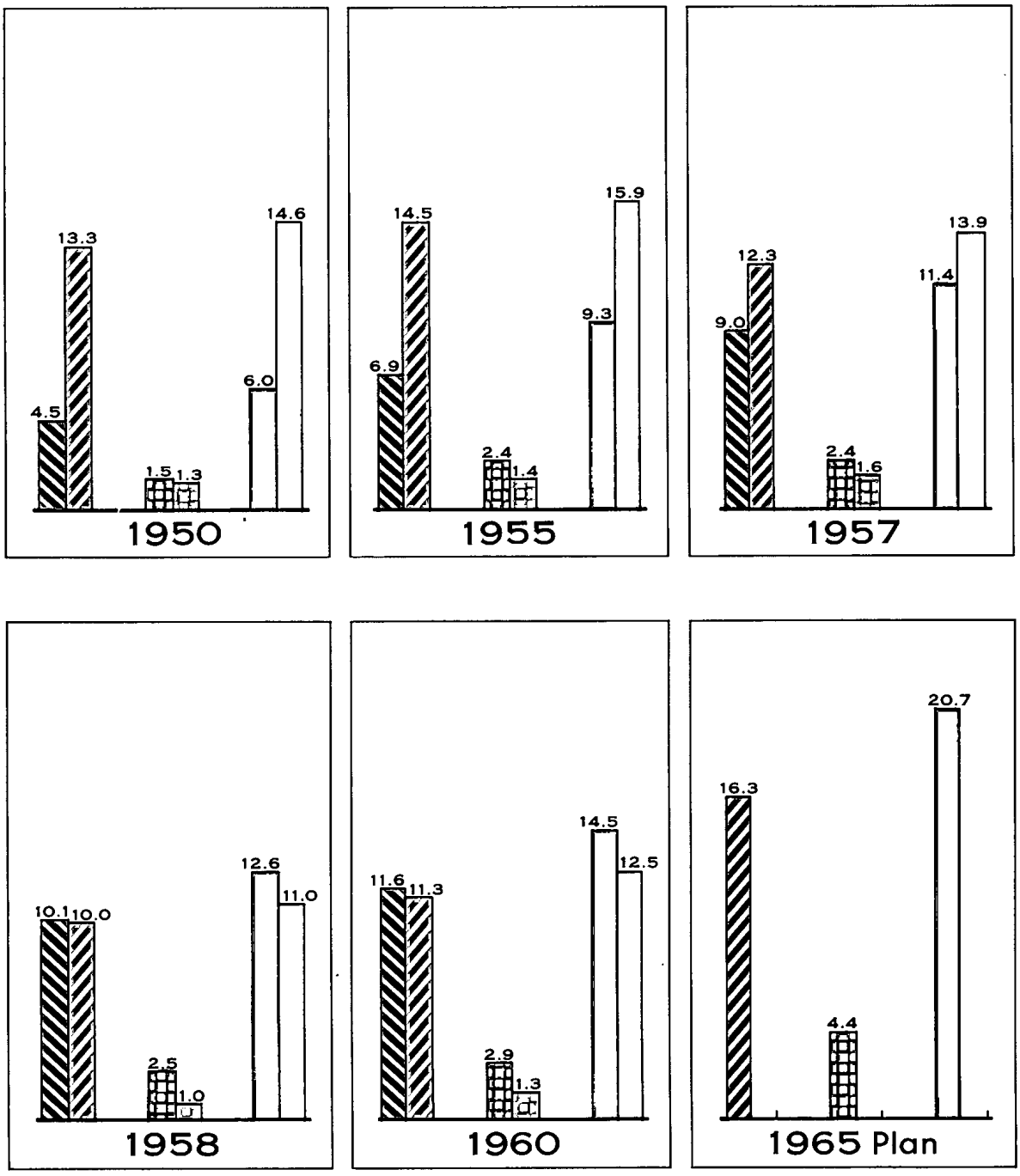
# USSR and US: Production of Ferrous Castings

## Selected Years, 1950-65

*(Million Metric Tons)*

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are cast in the USSR, but they are produced from rolled steel in the US. The total output of tractors and agricultural machinery in the US requires an average of only 5 percent of the annual output of steel castings, 14/ a smaller absolute volume of steel castings than is required for production of caterpillar track shoes in the USSR.

Steel castings in the USSR account for a much larger percentage of the total production of crude steel in the USSR than in the US. As shown in Table 2,* steel castings in the USSR in 1958 accounted for 4.6 percent of the total production of crude steel compared with 1.3 percent in the US. Although production of steel castings as a percentage of the total output of crude steel has declined slightly in the USSR since 1950, planned goals for 1965 indicate that steel castings are to continue to account for a much larger share of the total Soviet production of crude steel than has been the case in the US. These data tend to give further indirect evidence of the greater role played by castings in the USSR than in the US.

Historically the USSR has emphasized steel castings to a much greater extent than has the US. In 1955, Soviet output of steel castings reached 2.4 million tons, or 26 percent of the total output of castings, and the goal for 1965 calls for 4.4 million tons of steel castings, which is about 21 percent of the total planned output of castings. During the 4-year period 1955-58 the average annual production of steel castings in the US amounted to about 1.4 million tons, about 10 percent of the total output of castings during this period. Under the impetus of wartime production the US reached its peak production of steel castings in 1944, when an output of 2.2 million tons was reached. 15/ The Korean conflict witnessed another peak, with 1.9 million tons of steel castings being produced in 1951.

Past large-scale production of tanks and other military equipment by the USSR, which consumes large amounts of steel castings, undoubtedly also has been a very important factor in maintaining the greater relative and absolute use of steel castings in the USSR than in the US. This greater use of steel castings in the USSR relative to that in the US largely reflects both the differences in the industrial product mix of the two countries and a Soviet technological lag resulting in the limited production by some types of forging, stamping, and rolling processes. In addition, castings from captive foundries are easier to obtain than are substitutable rolled steel products, the timely delivery of which depends on an unreliable supply system and supplier. This situation tends to induce the individual machine building industries to incorporate castings rather than rolled steel parts into the design of their products.

* Table 2 follows on p. 12.

Table 2

USSR and US: Comparison of the Ratio of Steel Castings Consumed by Industry to the Total Production of Crude Steel
Selected Years, 1950-65

| | 1950 | | 1955 | | 1957 | | 1958 | | 1965 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | USSR | US | USSR | US | USSR | US | USSR | US | USSR | US |
| Crude steel a/ (million metric tons) | 27.3 | 87.8 | 45.3 | 106.2 | 51.2 | 102.3 | 54.9 | 77.3 | 91 b/ | N.A. |
| Steel castings (million metric tons) | 1.5 | 1.3 | 2.4 | 1.4 | 2.4 | 1.6 | 2.5 | 1.0 | 4.4 | N.A. |
| Steel castings as a percent of crude steel | 5.5 | 1.5 | 5.3 | 1.3 | 4.7 | 1.6 | 4.6 | 1.3 | 4.8 | N.A. |

a. 16/
b. Upper limit of the Seven Year Plan of 86 million to 91 million tons.

C. Present Trends

At the end of 1957, there was a total of approximately 3,000 foundries in the USSR.* 17/ Small and medium-size shops constitute the major part of the foundry capacity in both the USSR and the US, and foundries with annual capacities of 20,000 tons or more represent only 6 percent of the total number of foundries in the USSR and 5 percent of that in the US. Nevertheless, these larger foundries produce 50 and 60 percent of the total output of castings in the respective countries.**

Historically, as the USSR continued to stress the rapid development of the machine building industries, expediency rather than the earlier Soviet plans for a systematic development of centralized foundries became the major pattern for the development of foundry capacity. Ignoring the existing long-term plans for centralized foundries, each ministry built captive foundries*** at individual machine building plants or other industrial enterprises that required castings. At the end of the Fifth Five Year Plan (1951-55), steel castings were reported as being produced at enterprises of 28 ministries and gray iron castings as being produced by almost every industrial ministry as well as many nonindustrial ministries. 19/

Subcontracting of castings in the USSR appears to have been kept to a minimum. Before World War II, 85 percent of all gray iron castings needed by the machine building plants, for example, were produced at the individual plant's own foundry.† 20/ Although subcontracting did become more pronounced in the latter years of the

* In 1957 the total number of foundries as well as their division between iron and steel foundries was approximately the same as that of the US ferrous casting industry. In the USSR, there were 2,500 iron foundries and 500 steel foundries, whereas in the US there were 2,365 iron foundries (including 2,257 gray iron foundries and 108 malleable iron foundries) and 435 steel foundries. 18/

** For the distribution of production of ferrous castings in the USSR in 1957, by size of foundry, see D, 1, p. 17, below. For an illustration of further similarities between the structure of the capacities of the ferrous foundries in the USSR and the US, see Table 3, Appendix A, p. 38, below.

*** A captive foundry is one that produces castings for use in the final product of its parent plant and in the final product of plants that are affiliated or subsidiary to the parent plant. It is not uncommon, however, for a captive foundry also to do subcontracting work.

† All figures in this section pertaining to subcontracting are based on metric tons of castings.

Fifth Five Year Plan, it is not believed to have exceeded 25 percent of the total output of castings.* 21/ The desire for self-sufficiency on the part of the individual Soviet machine building plants was influenced in considerable part by the stress placed on achieving the goals for quantitative output. Individual plants did not want to fall short of their goals because of shortages of castings caused by the failure of subcontractors to supply on time the assortment and quantities of castings required. As a result, foundry capacity in the USSR, to a far greater degree than that in the US, consists of captive iron and steel foundries.**

In addition, the subcontracting that did exist failed to develop according to the envisioned regional principle, which had called for an interplant system based on local buying and selling of castings. Instead, each ministry developed a supply system that essentially included only plants under its jurisdiction, a practice that frequently resulted in shipping castings extremely long distances. The extent to which plants subordinate to a single ministry were interdependent is illustrated by the following data on deliveries of iron castings in 1957 as a percentage of the ministry's total shipments of iron castings: Ministries of the Electrotechnical Industry and of Construction and Road Machine Building, 96 percent; of Railroads, 90 percent; of Tractor and Agricultural Machine Building, 88 percent; of Shipbuilding, 84 percent; and of Machine Tool Building and Tool Industry, 74 percent. In the Ministry of Heavy Machine Building, which reportedly is the major supplier of large castings for the other ministries, the share was 60 to 65 percent. 24/

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* There are no comparable figures available for the total amount of subcontracting of casting that exists in the US. During 1950-57, US production of ferrous castings that were classified as "for sale" accounted for 58 percent of the average annual output of ferrous castings, consisting of 56 percent of the annual iron castings and 76 percent of the annual steel castings. Those US castings that are classified as "for sale" do not include the volume of castings shipped by a captive foundry to other plants that are affiliated with or subsidiary to the parent company of the foundry. Although such castings are included in Soviet subcontracting figures, comparisons are rather incomplete. 22/

** Foundry capacity in the US consists of captive and independent, commercial foundries. During 1950-57 it is estimated that production by captive foundries in the US accounted for an annual average of 44 percent of the iron castings and 24 percent of the steel castings, whereas output by commercial foundries in the US accounted for an estimated annual average of 56 percent of the iron castings and 76 percent of the steel castings for the same period. 23/

Recent Soviet critics of the foundry industry stress that the industry, because of ministerial attempts to maintain self-sufficiency, developed along lines contrary to the Soviet concept of rational economic development. It is probable, however, that under the administrative organization of industry which existed in the USSR in the 1930's and because of the strong emphasis placed on fulfilling goals for physical output, the Soviet foundry industry developed along lines that were generally responsive to the immediate needs of Soviet industry. The development of a more centralized foundry industry, apart from the ministerial lines of control, also would have created other, and probably equally difficult, problems relating to the establishment of priorities and to scheduling and transportation. Although more centralized production at an earlier date might have resulted in a higher degree of product specialization and in more efficient organization of production and might have justified a greater application of capital, the USSR at this stage of its industrial development was in a position in which it had to conserve capital relative to labor. Foundry production, which can substitute labor for capital much more freely than other metalworking processes, was one area in which the USSR could economize in the use of its relatively scarce factor of production. In addition, the self-sufficiency of Soviet machine building plants with respect to castings must have had a real appeal to Soviet military planners during the period before World War II.

After World War II, however, conditions in many Soviet machine building industries changed radically in comparison with the early plan years. In many lines of manufacturing, output reached impressive totals, design capabilities greatly increased, and much more emphasis was placed on putting into production new and greatly improved models and on generally expanding the product mix. At the same time, in comparison with earlier periods, labor was becoming scarcer as a factor of production. The Soviet foundry industry received increased scrutiny. Soviet officials announced that the growth of capacity to produce castings was not keeping pace with the expanding requirements for ferrous castings. The Soviet statements claimed specifically that, as a result, an acute deficit in the supply of steel and iron castings existed in 1955. 25/ The Soviet planners, however, failed to explain how, in view of this deficit, Soviet industry had been able to claim consistent fulfillment and exceeding of its production plans for almost all types of machinery and equipment.

Consistent fulfillment of its production goals, together with the existence of an actual deficit in output of castings, could mean (1) that even though the USSR was fulfilling its over-all plans in terms of gross output, specific production plans for some commodities were not being fulfilled or (2) that the deficit was pressing to the extent that production goals had actually been depressed below capacity for some

production. On the other hand, it is more probable that the Soviet planners were concerned with an anticipated bottleneck rather than a real one -- that is, although production of castings had shown steady and substantial increases, the rate of increase was still below what would be required to assure the volume of output of castings necessary to achieve the planned rate of expansion of machine building. In any event, during the period 1956-58, Soviet officials made a concentrated effort to complete capacity already under construction. Together with more intensive use of existing facilities, this effort raised output of ferrous castings, as previously stated, from 9.3 million tons in 1955 to 12.6 million tons in 1958. The increase of 3.3 million tons during the 3-year period 1956-58 equaled the increase achieved during the preceding Fifth Five Year Plan.

The responsibility for the inadequate supply of castings, real or anticipated, was placed squarely on the ministries and was, according to the Soviet critics, the result of the poor allocation and control of investment funds. 26/ Much of the criticism voiced against the foundry industry regarding the dispersement of funds to an excessive number of projects, as a result of the emphasis placed on self-sufficiency by the ministries, appears to have been justifiable. The widespread dispersion of foundry capacity obviously did lead to a dissipation of investment funds and caused Soviet planners to question whether or not foundry production would prosper from increasing the scale of output to permit a greater specialization of production, to establish better control over the quality of output, and to justify a more extensive use of mechanization.

Early in 1956, even before the major reorganization of Soviet industry in 1957, the USSR attempted to establish a more efficient and flexible administration of the foundry industry. The short-lived Sixth Five Year Plan (1956-60) reintroduced the theoretical concept of planning and developing foundry capacity on a regional basis, a concept that was really not stated clearly until the industrial reorganization of 1957. 27/

Under the new administrative organization of industry, practically all the ministries at both the national and the republic level were dissolved, and 104 regional sovnarkhozes (councils of national economy) were established to take over the operational responsibilities of industrial enterprises within their respective geographic boundaries. Some readily apparent advantages for the development of regional foundry capacity are inherent in this new administrative structure. In addition to being in a better position to enforce centralization and specialization of production of foundries that were formerly separated because of different ministerial subordination, a sovnarkhoz also is able to show a greater degree of

flexibility in assigning production responsibilities among foundries within its jurisdiction than was possible under the ministerial system. Although specialization and development of foundry capacity on a regional basis is a priority task for each of the sovnarkhozes under the Seven Year Plan, it also is recognized that there must be cooperation among adjoining sovnarkhozes aimed at developing foundries that can support the machine building industries of two or more sovnarkhozes. This cooperation is to be based on the construction of large capacity foundries for the same or similar types of castings that are required by the industries of the adjoining sovnarkhozes, no one of which alone has a demand that is large enough to warrant the creation of its own foundry under the new criteria. Cooperation among adjoining sovnarkhozes is designed to eliminate the necessity of building small-capacity foundries and to avoid a supply system of extremely long hauls, both of which were highly criticized as uneconomical features of the former ministerial structure. As mentioned before, under the old system those plants that had either no facilities or inadequate facilities were dependent on plants subordinate to their own ministry, although the supply plant might be located many miles away.

Measures have been taken by the central planning authorities in Moscow, however, to attain a more direct role in the development of foundry capacity than had existed before. Under the new industrial administrative system, it appears that Gosplan USSR is to stipulate the specific long-range and annual investments that are to be allocated for the construction of new foundries in each of the sovnarkhozes as well as to stipulate the number, capacity, and location of new foundries to be built. 28/ This curtailment of the authority of the sovnarkhoz, compared with that enjoyed by a former ministry, can be viewed as an attempt to preclude the development of autarky within the sovnarkhozes and the recurrence of the ministerial practices that were so highly criticized as uneconomical and inefficient. This limiting of authority also provides evidence that in many aspects of economic planning, especially those aspects related to investment, centralized control was strengthened rather than weakened by the industrial reorganization in 1957.

## D. Seven Year Plan (1959-65) and Future Trends

### 1. Changes in the Structure of Foundry Capacity

In addition to calling for an increase of 8.1 million tons in production of castings during 1959-65, the Seven Year Plan also outlines a number of organizational and structural changes for the foundry industry. Under the plan, at least one-half of the foundries with annual capacities of less than 5,000 tons will be abolished, and their

production will be transferred to nearby reconstructed foundries of larger capacity. Furthermore, the total number of iron and steel foundries is to be reduced by 25 to 30 percent compared with the 1957 total, and a new construction program emphasizing large-capacity foundries is to be begun. 29/

It is planned that the capacity of Soviet foundries eventually will consist primarily of foundries with annual capacities of 10,000 tons or more. Evidence of the Soviet intention to stress primarily the development of foundries with annual capacities of more than 10,000 tons is revealed in the planned distribution for 1965, by size of foundry, of the increased output of ferrous castings during 1958-65. 30/ As shown in the following tabulation, the planned net increase in output of ferrous castings is to amount to 9.3 million tons. Foundries with annual capacities of more than 10,000 tons are to increase production by 125 percent, foundries with annual capacities of 5,000 to 10,000 tons are to increase production by 41 percent, and foundries with annual capacities of under 5,000 tons are to have a sizable decrease in the absolute tonnage of castings produced:

Thousand Tons

| Size of Shop | Actual Output 1957 | Planned Output 1965 | 1965 Compared with 1957 |
|---|---|---|---|
| Up to 1,000 | 726 | 414 | -312 |
| 1,000 to 4,999 | 1,872 | 1,863 | -9 |
| 5,000 to 9,999 | 1,620 | 2,277 | 657 |
| 10,000 to 19,999 | 1,956 | 3,814 | 1,858 |
| 20,000 and more | 5,226 | 12,332 | 7,106 |
| Total | 11,400 | 20,700 | 9,300 |

The desire to eliminate foundries with smaller capacities is another reflection of the current Soviet policy of attempting to achieve the larger share of the planned increases in industrial output and labor productivity through more intensive mechanization, specialization, and improved industrial technology. Also highly important is the Soviet desire to seek reductions in costs of production and the belief that small foundries are high-cost producers.

Certain aspects of the Soviet plans to eliminate many of the foundries with smaller capacities appear to be economically

justifiable and in part are supported by industrial trends in the US.* During 1947-57 the number of gray iron foundries in the US decreased from 3,050 to 2,250. 31/ During 1958-59, 165 more gray iron foundries left the industry. 32/ The long-run reduction in the number of foundries in the US was the result of such factors as improved transportation, increased competition from other metalworking processes (although total foundry output increased), and increased emphasis on large-scale and mass production that has permitted more standardization and mechanization.

In spite of the reduction in the total number of foundries in the US, however, a large number of small foundries are still efficient producers of various types and sizes of castings in small production lots. A substantial quantity of the castings produced for both Soviet and US industry consists of a wide variety of types and sizes produced in small quantities -- a method of production that does not lend itself to the highly mechanized, large-scale foundry. In addition, in the US, and in a few instances in Western Europe, small-scale foundries have been able to introduce a considerable degree of mechanization in the auxiliary foundry tasks, such as sand conditioning and handling of materials, while maintaining the flexibility to handle diverse production runs.

The role played by the small-scale foundry in the US in part reflects the market orientation of the US economy. On the other hand, it is obvious that the Soviet economy has a much greater potential ability to allocate and standardize production assignments in terms of types, quantities, and sizes and to assure, wherever possible, more specialized production and thus larger production lots. With a more highly planned production schedule than is found in the US, the USSR should be able to achieve economies of scale in foundry production more readily than would be true in the US. In addition, even the Soviet planners admit that there is no intention of eliminating all small foundries and that in certain instances small-scale foundries will remain a part of Soviet industry. It appears that over the long run, however, the USSR can achieve economies through the consolidation

* A recent confidential study by a trade association indicates that, in general, gray iron foundries of smaller capacity in the US are more inefficient and higher cost producers than gray iron foundries of larger capacity. According to the study the average gray iron foundry with an annual capacity of less than 5,000 tons is operating at near zero profit. However, this study does not confirm the Soviet contention that small-scale producers are necessarily high-cost producers. In the US, there may be too many small-scale gray iron producers relative to the total demand for gray iron castings that are most appropriate for this type of producer, a condition that may or may not exist in the USSR.

of output of small-scale, inefficient foundries, although stress on the "automatic" gains to be achieved from such a program often appears overly simplified and too generalized.

At present the more highly specialized and larger capacity foundries of both the USSR and the US are attached to plants that mass-produce motor vehicles and tractors. The range of castings, both in size and in end use, produced in the average US foundry, however, usually is more limited than is true in the USSR because of the smaller range of end products produced by a US machine building plant and the greater tendency of a US plant to subcontract the manufacture of many components and parts. Moreover, many small and medium-size plants in the US do not have their own foundries but subcontract all of their requirements for castings to local independent commercial foundries, which also specialize in a limited degree. The latter practice is absent in the USSR, but the Soviet program of regionally centralized foundries does resemble this practice somewhat.

In the USSR the problem of determining optimum foundry capacities under conditions of varying degrees of specialization and mechanization has become essentially the responsibility of the Scientific Research Institute of Economics (Nauchno-Issledovatel'skiy Ekonomicheskiy Institut) of the State Planning Commission. According to the results of preliminary studies, the minimum annual capacity necessary for an iron or steel foundry to operate at near optimum conditions is in the range of 10,000 to 15,000 tons. This recommendation appears to apply to foundries producing small and medium-size castings either individually or in small series.* Iron foundries are allowed a maximum shipping distance of 620 miles, or one-half of the distance

* The Soviet concept of individual and small series production quantities is illustrated by the following figures showing the number of identical castings produced per year by size for each type of production, as given in source 33/:

| | Small Castings (Up to 30 Kilograms) | Medium Castings (30 to 500 Kilograms) | Large Castings (More than 500 Kilograms) |
|---|---|---|---|
| Individual production | 1 to 200 | 1 to 100 | 1 to 30 |
| Small series production | 200 to 1,000 | 100 to 500 | 30 to 100 |
| Large series production | 1,000 to 20,000 | 500 to 5,000 | 100 to 1,000 |
| Mass production | More than 20,000 | More than 5,000 | N.A. |

allowable for shipments of steel castings. 34/ Although these results were admitted to be only preliminary evaluations, they appear to have become the basis for the Soviet decision to stress the development of foundries with annual capacities of 10,000 tons or more.

2. Fulfillment of Goals for Production and Capacity

In order to achieve the goal of the Seven Year Plan of 20.7 million tons of castings, the Soviet foundry industry must produce 8.1 million tons more than were produced in 1958. To achieve the planned goal, the USSR is depending on increasing the over-all productivity of existing facilities and on constructing new foundry capacity. Of the planned increase of 8.1 million tons of ferrous castings, 60 percent, or 4.86 million tons, is to come from existing plants or plants already under construction, and 40 percent, or 3.24 million tons, is to come from new construction. 35/

To help achieve the planned increase in output, the USSR has announced impressive plans for expanding foundry capacity. These plans include the construction of 19 new, specialized foundry plants and 65 new, specialized shops.* 36/ A total of 9.3 billion rubles has been allocated for the construction of new foundries and forges, nearly 8 percent of the 118 billion rubles reportedly allocated for all machine building. 37/ In comparison, the high-priority Soviet electronics industry has been allocated 14 billion rubles. 38/ The volume of construction of new foundries is especially significant because, generally, the Seven Year Plan stresses increasing industrial output by the more intensive use of existing facilities rather than by the construction of new plants.

Thus the Seven Year Plan implies an increased priority for the Soviet foundry industry. Up to the present time, however, little actual progress has been made in implementing the many aspects of the foundry program. For example, although only one new large foundry is presently known to be under construction,** the reconstruction and modernization of existing foundries and the decommissioning of at least 700 iron foundries and of more than 100 steel foundries with annual capacities of less than 1,000 tons appears to be progressing more satisfactorily.*** It is clear that the program for new construction

* These figures appear to differ from the original goal, stated in the directives of the Seven Year Plan, of building 75 to 80 new, specialized foundries and forges.

** One such foundry plant apparently is the "large" steel foundry being built at Karaganda, Kazakh SSR, for the purpose of producing castings for tractor spare parts. 39/

*** In 1959, 40 such foundries were reported to have been closed in the Moscow Oblast sovnarkhoz alone. 40/

under the Seven Year Plan represents "measures which have been worked out" and not steps which are being taken at present. Much of the increase in output called for in the plan, therefore, will have to come from the increased productivity of existing facilities, especially until the latter years of the plan period. Soviet planners undoubtedly are counting heavily on all existing foundries, with the exception of the small marginal foundries slated for closing, to achieve continued increases in output through improved management, plant layout, and scheduling of production and increased specialization.

Moreover, 60 foundries already existing or under construction are destined to be reconstructed or completed as major specialized foundries. 41/ It is probable that the Soviet planners will allocate substantial quantities of machinery and equipment to these plants to insure that they achieve gains in productivity that are considerably above the gains which can be expected from the average foundry in the industry. Soviet foundries remain relatively labor-intensive both in comparison with current US foundry capacity and in comparison, for example, with Soviet machine shops. It is believed, furthermore, that organizational changes and managerial incentives, coupled with increments in the stock of machinery and equipment at least equal to those received in the recent past, will permit existing foundries to achieve their share of the planned increase in output. In addition, in comparison with the Fifth Five Year Plan (1951-55) and the 3-year period 1956-58, the Seven Year Plan (1959-65) does not place as heavy a demand on existing foundries to achieve further increases in output. For example, 4.86 million tons of the increase of 8.1 million tons are to come from existing capacity. This increase is to be achieved over the 7-year period 1959-65 and would require an average annual increase of 694,000 tons, approximately the same as was achieved under the Fifth Five Year Plan. In order to meet the goal for total output set for 1965, the foundry industry must achieve a 7.3-percent annual increase in contrast to the annual increase of 9.2 percent achieved under the Fifth Five Year Plan. Existing capacity need only attain an average increase of 4.8 percent annually, however, because, unlike the situation under the Fifth Five Year Plan, 40 percent of the planned increase in output is to come from new construction. This increase is in particularly sharp contrast to the annual increase of 10.7 percent actually achieved during the 3-year period 1956-58.

In addition to an increase of 8.1 million tons in output of castings, the Seven Year Plan calls for almost doubling output per worker. The announced goals for output and productivity imply a reduction of about 40,000 workers -- a 9-percent decrease in

the labor force of the foundry industry for the plan period.* It is doubtful if existing foundries could achieve so great an increase in output per man. It appears that the over-all goal for productivity is weighted by the anticipated effect of new, highly productive capacity scheduled for completion during the Seven Year Plan. It is virtually certain that the 84 foundries specified in the Seven Year Plan will not be completed and in production by 1965. If the over-all goals for productivity and output are to be met, however, Soviet planners must be depending on putting into operation a considerable volume of new, large-scale capacity. It is known that 7.1 million tons, or 76 percent of the planned increase in output scheduled during the period 1958-65, is to come from large foundries with capacities of more than 20,000 tons. If it is assumed that a capacity of 65,000 tons** is the average size of each of the 84 foundries called for in the Seven Year Plan, the ultimate aggregative capacity of these foundries would be 5.46 million tons. Because only 40 percent, or 3.24 million tons, of the planned increase of 8.1 million tons of ferrous castings for the Seven Year Plan is to come from new construction, only 59 percent of the new capacity represented by the 84 foundries need be completed and in operation by 1965 for the industry to fulfull its goals for output. Thus it would appear that much of the new capacity called for in the Seven Year Plan is related to long-term plans for increasing output of castings and not to the specific goals for output of the plan period. That is, completion of all announced new construction would give the Soviet foundry industry a total capacity considerably in excess of announced goals for output.

Even the completion of approximately 60 percent of announced plans for new construction will prove to be a formidable task, especially in view of the seemingly belated start. A failure to complete 60 percent of the new construction, however, will not necessarily mean a failure to achieve the planned output of castings for 1965. Within their over-all plan for increasing output from foundries, Soviet planners will retain some freedom of action in being able to allocate inputs of machinery between new capacity and existing capacity. For instance, confronted with a lagging construction program, Soviet planners could increase the allocation of machinery to capacity already in existence. If given substantial increments in machinery and equipment that had originally been allocated to new capacity, there is little doubt that existing capacity could achieve a growth considerably higher than the 4.8 percent requirement suggested by present data. Soviet planners, however, will not be able to rely too heavily on production of foundry machinery to bail them out of unexpected difficulties. The

* For a more complete discussion of the goals for productivity under the Seven Year Plan, see p. 29, below.

** See Appendix C, p. 45, below.

rate of growth implied by the 1965 goal for production of foundry machinery, 12.6 to 14.6 percent annually, although well above the planned increase in output of castings, 7.3 percent annually, is not at all imposing in view of the low level of foundry mechanization presently existing and the large-scale program for the construction of new foundry capacity. In addition, it appears that the Soviet program to accelerate production of foundry machinery is not progressing on schedule.*

Thus, in summary, it would appear that there is little doubt that the USSR can achieve its 1965 goal for output of ferrous castings. There is much less assurance that this achievement will be accomplished "according to plan" and little or no assurance that the Seven Year Plan will transform a backward Soviet foundry industry into the highly productive and progressive industry that Soviet planners have long urged.

## III. Technology and Mechanization of Foundry Processes

### A. Technology

Generally the technology of the Soviet ferrous casting industry is similar to that of the US and other countries of the industrial West, the processes employed in production of ferrous castings being fairly well standardized throughout the world. On the other hand, the USSR is behind the US in the extent to which mechanization has been introduced into the foundry processes.**

The basic and predominant method of producing ferrous castings in the USSR, and the US as well, is the sand-mold process. In 1957, 95 to 98 percent of the total output of ferrous castings in the USSR was produced by the use of this process.*** 42/ On the basis of the impressive scientific and experimental studies that have been published in the USSR on such aspects of the sand-mold process as the filling of molds, the casting properties of ferrous alloys, metal crystallography,

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* For a more complete discussion of production of foundry machinery and of goals, see IV, C, p. 33, below.

** For a description of the basic major operations common to the various methods of casting, see Appendix B.

*** Although no comparable US figure is available, it is believed that a slightly smaller percentage of the total output of annual ferrous castings in the US is produced by use of the sand-mold process. The difference between the US and the Soviet figures would be due mainly to a larger US volume of production of soil and pressure pipe, items that usually are produced by centrifugal casting in both countries.

the solidification of castings of various configurations, the shrinkage of castings, and the interaction of ferrous alloys with various molding materials, Soviet knowledge of the theory of the sand-mold process appears to be as broad and scientifically based as that of any country in the world. This knowledge, however, not unlike the situation in the US, undoubtedly is used principally in foundries of larger capacity the personnel of which more likely will include professionally trained foundry engineers and metallurgists.

All of the other known methods of producing ferrous castings such as centrifugal, permanent-mold, investment-mold, and shell-mold casting are used in the USSR. As these casting methods are rather specialized and have definite economic and technical limitations, however, they account for only a small share of the total annual volume of ferrous castings.

Centrifugal casting, for example, usually is limited to production of tubular parts such as pipes, bushings, gun barrels, and projectiles. Permanent-mold casting is a type of technology which usually is associated with nonferrous castings but which occasionally is used to produce small and medium-size iron and steel castings of very simple shape that require specific surface properties. Investment casting, not only the most precise but also the most expensive casting method, usually is used to produce only small castings, regardless of volume, of complex designs that are difficult to achieve by machining or of small castings of ferrous alloys that are difficult to machine. Cast parts produced by this method are so close to the required dimensions, shape, and surface finish that very little or no subsequent machining is required. There is a trend in both the USSR and the US to attempt further perfecting and mechanizing of the many existing hand operations of this process so as to enable it to become a more general and economic method of producing small castings.* The difficulties in achieving this goal, however, are reflected in the Soviet announcements that the annual production of investment castings for 1965 is planned to amount to only 50,000 to 80,000 tons.** 44/ Yet this output represents a respectable increase above production in 1958 of about 15,000 tons and represents a considerable number of individual castings when it is considered that this output consists of castings weighing not more than 30 pounds and with an average weight probably of

* A major Soviet effort toward this end is the development of the mechanization of investment casting of small sewing machine parts at the foundry of the Podol'sk Machine Building Plant imeni Kalinin, a plant that produced about 2.5 million sewing machines, or 89 percent of the total output of sewing machines in the USSR in 1959. 43/

** These figures and those for shell-mold casting, given in the next paragraph, are believed to include ferrous and nonferrous castings.

about 3 pounds. 45/ Nevertheless, it is apparent that for the foreseeable future investment casting will remain a relatively specialized method of producing castings and that it will continue to be responsible for a relatively insignificant share of the total annual output of ferrous castings.

Of all the processes of casting, shell-mold casting appears to be the only method that is likely to replace to any great degree the sand-mold method of producing small and medium-size ferrous castings in the foundries of the machine building industries. This method is particularly promising (1) because it can be more easily mechanized and automated than can sand-mold casting, (2) because it produces a casting that is metallurgically superior to that of a sand-mold casting, and (3) because, unlike sand-mold castings, shell-mold castings require but a minimum of machining to process them into finished parts. Although Soviet production of shell-mold castings is planned to reach 400,000 to 600,000 tons a year by the end of 1965, achievement of this goal will depend largely on the capability of the chemical industry to produce economically the required volume of the necessary resin-sand binding agent. 46/ Because of the present scarcity and high cost of this resin, application of Soviet developments in shell molding has not moved much beyond production in small-scale pilot processes.*

The most significant difference between US and Soviet foundry practices is to be found in production of large castings. Unlike the continuing US practice of producing large castings as one unit, the USSR has fully developed the weld-cast technique and widely emphasizes its belief in this method. The considerable economic advantage of this method is that it permits designing a large casting into components of a size that can be adapted to present mechanized procedures of the sand-mold process. The stand of a rolling mill, for example, when produced by the weld-cast technique, can be manufactured from component cast parts that can be produced by mechanized sand-mold operations. Soviet success in this weld-cast technique is due to the Soviet invention of electroslag welding, the capabilities of which for heavy-duty welding cannot be matched by the welding methods existing in the West.**

* In 1957, production in the US by shell molding amounted to about 200,000 tons. Most of this production is believed to be attributable to the foundries of the automobile industry that have recently begun to use shell molding for the mass production of a number of parts, including crankshafts. 47/

** This method of welding has spread throughout the Soviet Bloc, Belgium, France, and the UK and has been licensed for sale in the US through a Belgian firm that improved /footnote continued on p. 27/

B. Mechanization*

The level of mechanization of Soviet foundries in general and the level of the most highly mechanized Soviet foundries are not as high as comparable foundries in the US. Most of the mechanization of Soviet foundries was carried out during the 1930's with foreign technical advice and foreign-produced machinery, particularly US and German. This work was limited almost exclusively to the foundries of the motor vehicle, tractor, and agricultural machinery industries. The foundries of these industries continued to receive the major part of subsequent Soviet efforts to mechanize foundry operations, and, as a result, the foundries of these industries are the most highly mechanized foundries in the USSR today. On the basis of the age of the 1957 inventory of five motor vehicle plants,** however, it appears that the volume of labor-saving machinery introduced into the foundry industry since World War II has been quite modest. Only 4 percent of machinery for molding, coremaking, sand preparation, and cleaning at the foundries of these five plants consisted of post-1950 models, 18 percent of 1940-50 models, and 78 percent of pre-1940 models. 48/ In comparison, of the present total inventory in the US of machinery for molding, coremaking, sand preparation, and cleaning, only 8 percent consists of equipment produced before 1940, whereas 92 percent was produced since 1940. Of this 92 percent, 53 percent was produced after 1950.***

[redacted] the molding operation is the most highly mechanized operation in the Soviet foundry industry. In mid-1958, Soviet foundries were reported to be equipped with approximately 20,000 molding machines, or about 45 percent of the number of molding machines presently found in the foundry industry of the US. 50/ Whereas 91 percent of the US inventory of molding machines was produced after

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the metallurgical quality of the electrodes. The USSR has successfully welded thicknesses up to 20 inches. Welds of good quality of even one-half of this thickness have been difficult to attain by the methods used in the US and other Western countries. The USSR claims that this method is capable of welding thicknesses of more than 3 feet.

* For a description of the basic major operations and categories of machinery common to all the methods of casting, see Appendix B.

** These five motor vehicle plants are the Moscow Motor Vehicle Plant imeni Likhachev (ZIL), the Gor'kiy Motor Vehicle Plant (GAZ), the Ural Motor Vehicle Plant, the Yaroslavl' Motor Vehicle Plant (YaAZ), and the Minsk Motor Vehicle Plant (MAZ).

*** Early in 1960, there was a total of 44,207 molding machines, 12,110 coremaking machines, 19,251 sand-preparation machines, and 15,794 cleaning machines being used in the US foundry industry. 49/

1940 and includes a large number of semiautomatic, multistation models, the age of the Soviet inventory of molding machines is not believed to be much different from that previously cited for the inventory of foundry machinery of the five motor vehicle plants. Furthermore, about 30 percent of the Soviet inventory of molding machines is not power-operated but is essentially manually operated, pattern-withdrawing devices. 51/

Although no information is available on the total Soviet inventories of other categories of foundry equipment such as cleaning and coremaking machines, there is every indication that such equipment is used to a very limited extent. At the end of 1955, only 10 to 15 percent of the coremaking, trimming, and cleaning operations in all the foundries of the machine building industry were mechanized.* Other foundry operations such as sand preparation and knockout are just as poorly equipped, and little or no powered equipment is available for the numerous operations of transporting and handling of materials. 52/

Although the mechanization of production in foundries has been one of the lower priority tasks in the past, the Seven Year Plan indicates that the present Soviet stress on increasing the rate of industrial mechanization does not exclude the foundry industry. In fact, according to present plans, 70 percent of the molding operation in the foundries servicing the machine building industry and 90 percent of the knockout operation for all production of castings are to be mechanized by the end of 1965. 53/ Although progress in the mechanization of both of these operations undoubtedly will be made, the stated goals are believed to be overly ambitious and not realistically attainable within the Seven Year Plan period.

Because few industries are required to handle as great a quantity of heavy and bulky materials in their production process as the foundry industry, mechanization of production and auxiliary operations, such as materials handling, is an obvious means by which the USSR can attempt to increase output of its foundries. Moreover, progress in the mechanization of production in foundries would now seem particularly important in view of the necessity for the USSR to compensate for the decline in the current and prospective increments to its labor force resulting from the low birth rate during and immediately following World War II, as well as for the current policy of reducing the length of the workweek.

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* Mechanization, in this instance, is used by Soviet writers to show the percentage of the total annual output of castings that is processed by the use of machinery. They do not reveal, however, what percentage of the work or time necessary to carry out these operations is performed by the machine.

It is estimated that, at the end of 1958, approximately 435,000 Soviet workers* were employed in production of ferrous castings with an annual output of about 28 to 30 tons per worker. At the end of 1965 the average annual output per worker is planned to increase to about 50 to 55 tons for an annual rate of increase of about 9 percent in output per man-year during the 1959-65 period. 55/ Meeting these planned goals for productivity implies a labor force in 1965 of approximately 395,000 workers, a reduction of about 40,000 workers for the 7-year period. Although such measures as better management, new construction of modern foundries, improved plant layout of existing foundries, and the specialization program to concentrate production of like or similar castings undoubtedly have been included in Soviet planning as elements contributing to this planned annual rate of increase in labor productivity and to the resulting reduction of the total labor force, these data also appear to indicate a serious intention to improve the level of mechanization as well.

## IV. Production of Foundry Equipment

### A. Research and Design Facilities

The lack of emphasis given to the research and design of foundry machinery in the USSR is in sharp contrast to the stress placed on research and design in the Soviet machine tool industry. For example, the latter industry has long been supported by a large and competent research institute** with its own subordinate manufacturing plant for constructing prototypes of new machines and for testing and developing newly designed machines and methods of metalcutting under actual conditions of production.

On the other hand, the principal Soviet institute for the research and design of foundry machinery and related technology is the State Scientific Research Institute of Foundry Machine Building and Foundry Technology (Gosudarstvennyy Nauchno-Issledovatel'skiy Institut Liteynogo Mashinostroyeniya i Liteynoy Tekhnologii -- NIILITMASh), an institute that is poorly equipped and staffed and remains a relatively ineffective organization. NIILITMASh was established in 1951 and was formerly under the jurisdiction of the abolished Ministry of Machine Tool Building and Tool Industry. 56/ At present, NIILITMASh is believed

* This estimate was derived by dividing the productivity per worker given in source 54/ into production in 1958 as shown in Table 4, Appendix A, p. 39, below.

** The full name of this institute is the Experimental Scientific Research Institute for Metalcutting Machine Tools (Eksperimental'nyy Nauchno-Issledovatel'skiy Institut Metallorezhushchikh Stankov -- ENIMS).

to be subordinate to the State Committee for Automation and Machine Building of the Council of Ministers, USSR. 57/

NIILITMASh was conceived with the over-all responsibility for (1) development and design of new foundry machinery, (2) modernization of old equipment, (3) research and development of new molding materials, (4) development of new manufacturing processes for production of castings, and (5) giving technical assistance to foundries and machine building plants that manufacture foundry machinery. 58/

NIILITMASh, however, never has been given sufficient priority to permit it to carry out its assigned responsibilities successfully. One major problem has resulted from the fact that NIILITMASh has no facilities where machines and their components could be built and tested on an experimental basis. As a result, designs developed by the Central Design Bureau* of NIILITMASh have required up to 2 years time before a contracting plant -- almost always the Krasnaya Presnya Foundry Machinery Plant -- produced the first model. The testing of prototypes usually was nonexistent or of limited duration, and experimental models customarily were sent on to a foundry and put directly into the production process. NIILITMASh has had inadequate resources and insufficient authority to push through new designs of foundry machinery and to control their manufacture and development until such new designs were fully perfected. As a result, new models of foundry machinery developed by NIILITMASh were often unsuited to the real needs of the industry, were susceptible to frequent breakdowns, and were generally unacceptable for manufacture as a standard model. 59/

The ineffectiveness of the work of NIILITMASh forced other industrial institutes to design and develop foundry machinery for the foundries of their own industries. Since the decision of Soviet planners in 1955 to emphasize the mechanization of production in foundries, the significance of the work of these institutes has increased. 60/ The most important of these institutes, Niitavtoprom, Niitraktorosel'khozmash, and TsNIITMASH, are, respectively, the scientific research institutes of the motor vehicle, the tractor and the agricultural machine building, and the heavy machine building industries.**

* The full name of this bureau is the Central Design Bureau of Foundry Machinery Equipment (Tsentral'noye Konstruktorskoye Byuro Liteynykh Mashin -- TsKB LM).

** The full names of these institutes are as follows: (1) The Scientific Research Institute of Technology of the Motor Vehicle Industry (Nauchno-Issledovatel'skiy Institut Tekhnologii Avtomobil'noy Promyshlennosti -- Niitavtoprom), (2) the Scientific Research Institute of Tractor and Agricultural Machine Building Technology (Nauchno-Issledovatel'skiy Institut /footnote continued on p. 31/

TsNIITMASh, one of the outstanding industrial research institutes in the USSR, has a foundry section that is the principal center for the research and development of foundry metals and metal technology. Unlike NIILITMASh, TsNIITMASh is a well-equipped institute and has been very effective in discharging its responsibilities. Significant research in foundry metallurgy also is carried on in laboratories of larger Soviet foundries and at foundry departments of the Leningrad and Moscow Polytechnical Institutes, research that usually is closely coordinated with TsNIITMASh. 61/

Soviet facilities for the design and development of foundry machinery will be considerably expanded by the end of 1965 if the presently planned measures are successfully fulfilled. By the end of 1965 a design and experimental department is to be established at each of the nine plants that are to be reconstructed into specialized foundry machinery plants. 62/ Coordination of the research of these nine plants is to be accomplished through a foundry research institute subordinated to the State Committee for Automation and Machine Building. Although the name of this "head" institute has not been announced, it is presumed that it will be NIILITMASh. Of particular importance is the decision that each of these plants is to have its own experimental departments, a measure that should be very beneficial in improving the efficiency, quality, and reliability of foundry equipment produced in the USSR. These design and experimental departments, however, will prove to be of very little or no benefit during the Seven Year Plan period, as they are not expected to be functioning until the end of 1964. Once these organizations are established, it is expected that the various scientific research institutes of the other industries that are currently engaged in the design and development of foundry machinery will be relieved of this task. Until that time, however, these institutes are expected to increase their work and share responsibility with NIILITMASh in implementing the goals of the Seven Year Plan.

B. Production Facilities

Historically the USSR has placed very little emphasis on the centralized production of foundry machinery. Capacity for production of foundry machinery is among the most limited and poorly developed areas of Soviet machine building. Before the industrial reorganization in 1957, centralized production was under the jurisdiction of the Main Administration of Woodworking and Foundry Machines (Glavnoye Upravleniye Derevoobrabatyvayushchikh i Liteynykh Mashin - Glavdrevlitmash) of the

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Tekhnologii Traktornogo i Sel'sko-Khozyaystvennogo Mashinostroyeniya -- Niitraktorsel'khozmash), and (3) the Central Scientific Institute of Technology and Machine Building (Tsentral'nyy Nauchno-Issledovatel'skiy Institut Tekhnologii i Mashinostroyeniya -- TsNIITMASh).

Ministry of Machine Tool Building and Tool Industry. 63/ There were only three major plants producing foundry machinery:* (1) the Krasnaya Presnya Foundry Machinery Plant, the estimated annual output of which included 1,000 to 1,500 units of a variety of types and models of standard and specialized foundry machinery; (2) the Moscow Stankolit Plant, a centralized foundry with an annual output of 275 units consisting of 1 or 2 models of machines for basic cleaning, knockouts, and preparation and molding; and (3) the Pavlograd Foundry Machinery Plant, construction of which was begun in 1951 and which was reported to have started producing a small number of molding machines late in 1956. 64/

In addition, plants subordinate to seven other former All Union ministries and several republic ministries were engaged in production of foundry machinery, although only a few large plants, such as the Ural and Novo-Kramatorsk Heavy Machine Building Plants, belonging to the former ministries of Heavy Machine Building, of the Automobile Industry, and of Tractor and Agricultural Machine Building were the only other significant manufacturers producing foundry machinery for sale. 65/ Production within the other ministries consisted of attempts from time to time to fulfill the standard and specialized requirements for machinery for their own foundries. Thus, although many plants were engaged in the manufacture of foundry machinery, there were only 3 major and 16 secondary plants that produced foundry machinery for sale at the time of the industrial reorganization in 1957.

The Seven Year Plan deemphasized the construction of new machine building plants and did not provide for the construction of any new plants for production of foundry machinery. Rather than providing for the construction of new plants, a plan for increasing output of foundry machinery, announced in late 1959, calls for production increases to be achieved through specialization, expansion, and modernization of existing plant capacity. Specifically this program announced the intention of creating a specialized foundry machinery industry consisting of nine plants, only one of which, the Ryazan' Plant, was not formerly identified as having produced foundry machinery. 66/ Although there is no specific information as to the former production responsibility of this plant, it is believed to have been a producer of machine tools. These plants, their location,

* In line with the plans of the short-lived Sixth Five Year Plan (1956-60) to place major emphasis on the development of the Eastern USSR, construction of two new foundry machinery plants east of the Urals was begun early in 1956. These two plants, the Amur and Novosibirsk Foundry Machinery Plants, although still under construction, were reported to have been put into partial operation at the end of 1958.

and their planned production responsibilities, along with the other plants that have been identified as producing foundry equipment for sale, are listed in Appendix D.

C. Production

The only information available on the annual production of foundry machinery in the USSR is the value of production in noncomparable prices for the years 1941 and 1958, reported to be approximately 14.4 million and 157 million rubles respectively.* The Seven Year Plan calls for the value of output to be 2.3 to 2.6 times that of 1958, or a planned value of production of foundry machinery for 1965 of 360 million to 410 million rubles. 67/ Subsequent information, although unconfirmed, suggests that the planned value of production for 1965 has been revised upward to 550 million to 630 million rubles, 3.5 to 4 times that of 1958. 68/

There are no statistics available on the total annual unit output of foundry machinery in the USSR.** Similarly, with the exception of the estimated annual outputs of the Moscow Krasnaya Presnya Foundry Machinery Plant and Moscow Stankolit Plant, the total of which was previously given as 1,275 to 1,775 units, there is no indication of either the volume or the value of output of foundry equipment produced by plants for sale or for their own use.

Although little is known about the actual volume of production of the various types of foundry machinery, the product mix is limited and there is a shortage of all types of equipment. For example, both the product mix and the total volume of output of coremaking machines relative to needs is reported to be lagging. A very limited Soviet production of sand slingers, which are of particular importance to the mechanization of the molding operation for large castings, appears to have been established only after 1950. A fault-free model was not produced until 1954. 70/ Production of

* These figures are believed to represent "centralized" production of foundry machinery, excluding machinery produced by plants for their own use. For categories of machinery believed to be included in such statistical reporting, see Appendix B. The value of production for 1941 is believed to be in 1926/27 prices and that for 1958, as well as planned production for 1965, to be in July 1955 prices.

** During the 9-year period 1951-59 it is estimated that the average annual production in the US amounted to approximately 5,000 units of major items of foundry machinery, including 2,000 molding, 800 coremaking, 1,000 sand-preparation, and 900 cleaning machines.

50X1

50X1

machinery for such nonsand casting methods of producing castings as shell molding also is very limited. 71/ Such machinery as conveyors and lift trucks for mechanizing the handling of materials is virtually unobtainable by an average Soviet foundry.

It is clear from official statements that Soviet leaders are well aware of the shortcomings in the development and production of foundry machinery. Such statements have disclosed that the standards of Soviet foundry machinery are below those of the West and that most of the individual foundry machines being produced as late as 1955 had demonstrated only one-third to one-fourth of the productivity of comparable machines being produced in the West. 72/ The designs of most of this Soviet foundry machinery virtually duplicated the standard and less productive Western models that have been considerably modernized or redesigned in the past 10 to 15 years.*

Although a number of modern and productive prototype foundry machines have been developed in the USSR, few of these models have been perfected and put into production. Even though improved types of equipment are being designed, the continued production of outmoded equipment offsets any gains. In spite of complaints from users, the beginning of production of more efficient equipment is a slow and protracted process. For example, of 25 models of foundry equipment designed during 1954-57, only 3 models were being manufactured in 1959. Similarly, more than 20 models designed during 1957-58 were just in prototype production in mid-1959. 74/ The problem of reducing the time lag between research and actual production, however, has plagued the Soviet economy in all branches of industry and in the past has been caused in large measure by the lack of a strong built-in economic incentive for technical progress in the Soviet economy. The reform in 1959 in the system of bonuses to managerial personnel and the 1960 decree on bonuses and increased material incentives to workers for the creation and introduction of new machinery and technology are intended to create more favorable conditions for such progress in the future. The effect of these measures on the specific task of mastering and accelerating production of new foundry machinery, however, is difficult to assess.

The average annual rate of growth implied by the 1965 goal for production of foundry machinery is 12.6 to 14.6 percent, well above the 7.3 percent planned for output of castings. The rate of growth implied in the revised, but unconfirmed, goal would amount to 19.6 to

* A foundryman's handbook published in the USSR in 1955 lists a number of models of foundry machines and their foreign-produced counterpart models, the majority of which are models of US design. 73/

21.9 percent annually. Nevertheless, in view of the present low level of mechanization of foundries and extensive construction of new foundries called for in the Seven Year Plan, the originally planned increase in production of foundry machinery is not very impressive. Fulfillment of the revised goal, however, coupled with increased imports,* would enable the Soviet foundry industry to achieve a level of mechanization that would increase substantially its capital-labor ratio.

As in the case of new foundry construction, however, implementation of the program to increase production of foundry machinery appears to have been delayed too long for the realization of maximum returns within the Seven Year Plan period. Soviet foundries, therefore, probably will remain dependent on nonspecialized machine building

* Available information shows that the total value of Soviet imports of foundry equipment during 1955-59 amounted to about 46.4 million rubles and that imports increased by 220 percent during the same period. In 1958, imports amounted to approximately 8 percent of domestic production. The ruble value of imports during 1955-59, by country of origin, was as follows:

| | Thousand Current Foreign Trade Rubles | | | | |
|---|---|---|---|---|---|
| | 1955 | 1956 | 1957 | 1958 | 1959 |
| Czechoslovakia | 3,996 | 3,644 | 5,588 | 5,681 | 8,291 |
| East Germany | 602 | 912 | 2,784 | 4,975 | 3,611 |
| UK | 0 | 279 | 207 | 980 | 120 |
| US | 0 | 0 | 0 | 476 a/ | 0 |
| Italy | 0 | 0 | 0 | 0 | 2,697 |
| Total | 4,598 | 4,835 | 8,579 b/ | 12,112 b/ | 14,719 b/ |

a. The US Department of Commerce has no record of issuing a license for export of foundry equipment to the USSR in 1958. The equipment listed as US exports may have been received as a transshipment through another country.
b. The reported total for 1957 of 9.571 million rubles does not identify the residual of 992,000 rubles by country of origin. Similarly a 1958 residual of 556,000 rubles and a 1959 residual of 12,000 rubles are not identified by country of origin. Hungary was listed as having exported foundry equipment worth 16.1 million rubles during this period. These exports, however, consisted solely of gas generators, an item that can hardly be classified as foundry equipment. There is no indication of what specific items of foundry machinery were exported by the countries listed above. 75/

plants for a substantial share of their requirements for machinery, at least until the latter years of the Seven Year Plan period. A recurrent failure to develop new capacity for specialized production of foundry machinery such as existed until mid-1960 would seriously affect the Soviet ability to equip the new casting capacity that is scheduled to come into production during the latter years of the Seven Year Plan and beyond. Barring an unexpected major shortfall in production of foundry machinery, however, output probably will be sufficient to permit the foundry industry to meet its 1965 goal for production of ferrous castings. Unless the entire volume of foundry machinery called for in the revised plan is produced, however, the foundry industry will have considerable difficulty in meeting its planned over-all level of mechanization, and little or no reduction in the total labor force can be expected.

# APPENDIX A

## STATISTICAL TABLES

Table 3

Comparison of the Total Number of Foundries and of Output of Ferrous Castings in the USSR and the US by Size of Foundry a/

| Size of Shop (Annual Output in Metric Tons) | Total Number of Foundries: Units | | Total Number of Foundries: Percentage Distribution | | Total Output of Ferrous Castings: Thousand Metric Tons | | Total Output of Ferrous Castings: Percentage Distribution | |
|---|---|---|---|---|---|---|---|---|
| | USSR b/ | US | USSR | US | USSR | US | USSR | US |
| Less than 1,000 | 1,200 | 1,219 | 40 | 45 | 372 | 416 | 4 | 3 |
| 1,000 to 19,999 c/ | 1,620 | 1,360 | 54 | 50 | 4,278 | 5,586 | 46 | 37 |
| 20,000 and more | 180 | 145 | 6 | 5 | 4,650 | 8,977 | 50 | 60 |
| Total | 3,000 | 2,724 | 100 | 100 | 9,300 | 14,979 | 100 | 100 |

a. 76/. Unless otherwise indicated, data for the USSR are for 1955 and for the US for 1953.
b. The number of foundries reported to have existed at the end of 1957. No earlier information is available.
c. Because of differences in statistical reporting, there is no breakdown smaller than the range of 1,000 to 19,999 tons for which a comparison can be made.

Table 4

Reported and Estimated Production of Ferrous Castings in the USSR
Selected Years, 1950-65

Thousand Metric Tons

| | 1950 a/ | 1955 a/ | 1957 b/ | 1958 c/ | 1959 d/ | 1960 d/ | 1965 e/ |
|---|---|---|---|---|---|---|---|
| Iron | 4,500 | 6,900 | 9,000 | 10,100 | 10,800 | 11,600 | 16,300 |
| Gray | 4,350 | 6,700 | 8,600 | 9,650 f/ | 10,250 | 10,900 | 14,700 |
| Malleable | 150 | 200 | 400 | 450 | 550 | 700 | 1,600 |
| Steel | 1,500 | 2,400 | 2,400 | 2,500 | 2,700 | 2,900 | 4,400 |
| Total ferrous castings | 6,000 | 9,300 | 11,400 | 12,600 | 13,500 | 14,500 | 20,700 |

a. For the years 1950 and 1955, see source 77/.
b. 78/
c. For the total output of ferrous castings, see source 79/. Components of the total are estimates.
d. Estimated by using derived average annual increases for 1959-65.
e. According to the control figures of the published Seven Year Plan, the 1965 output of castings is to consist of the specialized production of 14.7 million tons of cast iron and 4 million tons of steel castings. Subsequently it was revealed that this specialized production of 18.7 million tons will represent approximately 90 percent of the total output of castings in 1965. 80/ Although this information was used to estimate 1965 production figures shown above, conflicting data were published in other Soviet secondary sources: [redacted] production of iron castings planned in 1965 as 17 million tons and that for steel castings as 4 million tons 81/; [redacted] by the end of 1965, specialized production of iron castings would amount to 82 percent and steel castings to 81 percent of the total output of each of these types of castings. 82/ 50X1 50X1
f. Including about 100,000 tons of nodular (ductile) iron castings. 83/

Table 5

Average Annual Increase in Production
of Ferrous Castings
in the USSR a/
1951-58 and 1959-65

Percent

| Period | Ferrous Castings | | |
|---|---|---|---|
| | Iron | Steel | Total |
| 1951-58 | 10.6 | 6.6 | 9.7 |
| 1959-65 | 7.1 | 8.4 | 7.3 |

a. Derived from data in Table 4, p. 39, above.

Table 6

Production of Ferrous Castings in the US
Selected Years, 1950-60

Thousand Metric Tons

| | 1950 a/ | 1951 b/ | 1955 a/ | 1956 a/ | 1957 a/ | 1958 c/ | 1959 a/ | 1960 d/ |
|---|---|---|---|---|---|---|---|---|
| Iron | 13,306 | 14,582 | 14,463 | 13,438 | 12,272 | 10,008 | 12,003 | 11,261 |
| Gray | 12,451 | 13,600 | 13,461 | 12,574 | 11,489 | 9,408 e/ | 11,172 | 10,516 |
| Malleable | 855 | 980 | 1,002 | 864 | 783 | 600 | 831 | 745 |
| Steel | 1,344 | 1,860 | 1,389 | 1,753 | 1,602 | 1,017 | 1,282 | 1,263 |
| Total ferrous castings | 14,650 | 16,442 | 15,852 | 15,191 | 13,874 | 11,025 | 13,285 | 12,524 |

a. 84/
b. 85/
c. 86/
d. 87/
e. Including 106,700 tons of nodular (ductile) iron castings.

APPENDIX B

## BASIC TECHNOLOGY OF FERROUS CASTING

Several different technologies, which can be described in terms of the molding methods used, can be employed in producing a ferrous casting. For example, sand-mold casting is a method of producing castings in a sand mold; permanent-mold casting produces castings in a metal mold that, unlike the sand mold, can be used for more than one casting; shell-mold casting is a method of producing castings in a shell-like mold of a sand-resin material; centrifugal casting is a type of permanent molding that is used almost exclusively for producing tubular or cylindrical shapes and involves rotation of a permanent mold filled with molten metal; and investment casting (also commonly referred to as lost-wax casting) produces castings that make use of a wax pattern enveloped by a refractory material. Of these processes, the sand-mold casting method is the overwhelmingly predominant method of producing ferrous castings in both the USSR and the US.

A basic set of major operations is common to production of castings by any of the above methods. The general terms identifying these major operations also identify the major categories of foundry machinery and are virtually a description of the activity they perform. These categories may be briefly described, with specific reference to the following generally prevailing procedures of the sand-mold process. Pattern-making equipment consists of general-purpose woodworking and metalworking machines and hand tools for fabricating a wooden or metal replica of the part to be cast. Sand-preparation machinery prepares the sand mixtures used in coremaking and molding. Molding machinery (1) forcibly packs a special sand mixture into containers known as flasks around half of the pattern of the part to be cast and (2) then removes the pattern, leaving in the sand an impression of half of the desired part to be cast.* Coremaking machinery shapes a special mixture of sand into cores, which are needed to form the internal cavities of the part to be cast. Melting furnaces prepare the molten ferrous metal before it is poured into a completely assembled mold that consists of cores and the two corresponding sand mold halves. After the molten metal has cooled into a casting, knockout machinery strikes or knocks the casting out of its sand encasement. Finally the scale on the surfaces of the casting is removed by various types of cleaning machinery. Machinery also is needed for such foundry auxiliary operations as materials handling and sand reclamation. The Soviet

* The entire operation is repeated to make the corresponding half mold of the part to be cast.

technical definition of foundry machinery includes all the categories of machinery mentioned above. There is evidence, however, that the present Soviet classification of foundry machinery which is used for statistical reporting is comparable with that of the US in that it excludes furnaces, pattern-making equipment, and machinery used to perform the auxiliary operations of materials handling such as conveyors, lift trucks, and cranes. 88/ One major difference, however, is believed to exist between the Soviet statistical category and its US counterpart, Foundry Machinery and Equipment (Excluding Patterns and Molds) -- Standard Industrial Classification, No. 35592. The Soviet classification of foundry machinery is believed to include die-casting machinery, whereas the US system lists it under the classification Metalworking Machinery. Die casting is a method of producing nonferrous castings exclusively.

APPENDIX C

## ESTIMATED CAPACITY OF NEW FOUNDRY CONSTRUCTION IN THE USSR 1959-65

The USSR has not reported on the progress of the construction program of new foundries, nor has it given any clues as to the specific location and capacity of the 84 foundries (19 plants and 65 shops) that are to be constructed during the period of the Seven Year Plan (1959-65). On the assumption that a relationship exists between the construction program of new foundries of the short-lived Sixth Five Year Plan (1956-60) and that of the Seven Year Plan, the new capacity that is needed by 1965 for the industry to fulfill the planned goal for output of ferrous castings may be estimated by the following method.

During the period 1956-60, 23 foundry plants were to be built with a total annual production capacity of 1.5 million tons of ferrous castings, an average capacity of 65,000 tons per year per foundry. On the assumption that this figure is representative of the size of the 84 foundries that are to be constructed during the Seven Year Plan period, the ultimate capacity of these 84 new foundries is 5.46 million tons (84 times 65,000). However, only 40 percent, or 3.24 million tons, of the planned increase of 8.1 million tons of ferrous castings during the period 1959-65 is to come from new construction. Thus only 59 percent (3.24 million tons divided by 5.46 million tons) of the new capacity that is called for in the Seven Year Plan need be completed and in operation by 1965 for the industry to fulfill the planned increase in output of ferrous castings of 8.1 million tons.

The planned regional location and distribution of 22 of the 23 foundries that were to be built under the Sixth Five Year Plan are as follows 89/:

| Economic Region* | Number of Plants |
|---|---|
| I (North and Northwest) | 1 |
| VI (Volga) | 2 |
| VII (Central) | 9 |
| VIII (Urals) | 4 |
| IX and XI (East and West Siberia) | 6 |
| Total | 22 |

50X1

APPENDIX D

## PRINCIPAL AND SECONDARY FOUNDRY MACHINERY PRODUCING PLANTS IN THE USSR AND THEIR PRIMARY PRODUCTS

| Plants a/ | Location | Region b/ | Primary Foundry Machinery Produced |
|---|---|---|---|
| Principal plants | | | |
| Amur Foundry Machinery Plant** | Komsomol'sk on the Amur | XII | Plans for this plant had been under consideration since the latter part of World War II, but construction is not believed to have begun until early 1956. The plant started limited production of foundry machinery early in 1958. Reported production has been limited to only a few molding machines of one model and a test model of a centrifugal sand-preparation machine. No information is available on the annual production capabilities of this plant. After 1964 the plant will specialize in production of molding and coremaking machines for medium castings as well as sand-preparation and cleaning machines. |
| Krasnaya Presnya Foundry Machinery Plant** | Moscow | VII | This plant is the major Soviet source for all types and models of Soviet standard and specialized foundry machinery such as molding, coremaking, knockout, cleaning, and sand-preparation machines. Annual production is estimated at 1,000 to 1,500 units of foundry equipment. After 1964 this plant will produce specialized coremaking and molding machinery for all types of casting processes as well as automatic lines. |
| Moscow Stankolit Plant | Moscow | VII | One of the four specialized foundries and one of the larger capacity foundries in the USSR. This plant specializes in production of small, medium, and large castings for the machine tool plants. Since the end of World War II the plant has designed and produced all the foundry machinery required in its attempt to mechanize its foundry operations. Since 1953 the plant has become a source of this machinery for the needs of other Soviet foundries and has supplied other foundries with about 1,650 units of foundry machinery during the period 1953-58. This foundry machinery includes Stankolit designs of various models and types of cleaning, knockout, sandslinger, sand-preparation, and molding machines. |
| Novo-Kramatorsk Heavy Machine Building Plant | Kramatorsk | III | Production of this plant is similar to that of the Ural Machine Building Plant described below. |

a. The double asterisk identifies the nine plants that have been mentioned in the announced program of creating a specialized foundry machinery industry by the end of 1964.

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| Plants | Location | Region | Primary Foundry Machinery Produced |
|---|---|---|---|
| Principal plants (Continued) | | | |
| Novosibirsk Plant of Large Foundry Machinery and Automatic Lines (Siblitmash)** | Novosibirsk | IX | Construction of this plant is believed to have begun early in 1956 and partial operation late in 1958. After 1964 this plant will specialize in production of general-purpose and specialized molding and coremaking machinery for large castings as well as centrifugal-molding, permanent-molding, and die-casting machines. It also will produce automatic foundry lines. |
| Pavlograd Foundry Machinery Plant imeni Livpat** | Pavlograd | III | This plant has been under construction for the past 7 years. Production of foundry equipment was started in mid-1957. Reported production so far has been limited to a very small quantity of only a few models of die-casting and molding machines. No information is available on the annual production capabilities of this plant. After 1964 the plant will specialize in production of molding and coremaking machines for medium castings as well as die-casting machines. |
| Ural Heavy Machine Building Plant imeni Ordzhonikidze | Sverdlovsk | VIII | The product mix of this plant is limited to foundry machinery used in foundries for production of large castings such as molding machines of 10-ton, 17-ton, and 40-ton capacity; knockout machines of load capacity up to 60 tons; hydro-sand-cleaning units of various capacities; and sand regeneration units. Annual production is not known. |
| Secondary plants | | | |
| Bobruysk Machine Building Plant | Bobruysk | IIb | This plant is reported as having produced very small quantities of sand-preparation machinery since 1949. |
| Buzuluk Machine Building Plant | Buzuluk | VIII | This plant is to start serial production in 1958 of hydro-sand-cleaning units of various capacities for large castings. |
| Dnepropetrovsk Plant imeni Artyem | Dnepropetrovsk | III | This plant is reported as having produced very small quantities of sand-preparation machinery since 1949. |
| Kishinev Machine Building Plant | Kishinev | III | This plant is reported as having produced very small quantities of sand-preparation machinery since 1949. |
| Khar'kov Turbine Plant imeni Kirov | Khar'kov | III | This plant is reported as having started series production of metal shot-blast cleaning machinery of various capacities in 1957. |
| Leningrad Metallist Machine Building Plant | Leningrad | Ia | This plant is reported to have begun series production of shell-molding machine model ASK-2M in 1958. |
| Leningrad Plant imeni Lepse | Leningrad | Ia | This plant produces a limited quantity of die-casting machines designed by NIILITMASh. |

| Plants | Location | Region | Primary Foundry Machinery Produced |
|---|---|---|---|
| Secondary plants (Continued) | | | |
| Lyubertsy Agricultural Machine Building Plant imeni Ukhtomsk | Lyubertsy | VII | This plant is reported as having started series production of coremaking machines in 1957. |
| Rostov Agricultural Machine Building Plant | Rostov on the Don | IV | This plant is reported as organizing production of shot-tumbling cleaning units in 1957. |
| Ryazan' Plant of Large Foundry Machinery** | Ryazan' | VII | This plant is believed formerly to have produced machine tools and is to be converted into a specialized foundry machinery plant by the end of 1964. The plant will specialize in production of coremaking and sand-molding machines, including sandslingers. It also will produce centrifugal-molding, cleaning, and die-casting machines. |
| Tiraspol' Mechanical Plant imeni Kirov** | Tiraspol' | III | This plant is believed formerly to have produced small quantities of sand-preparation machinery. By the end of 1964 the plant will specialize in production of permanent-molding, die-casting, and sand-preparation machinery. |
| Usman' Mechanical Plant** | Usman' | VII | This plant was reported formerly as producing a coremaking machine, model 283. By the end of 1964 this plant is to specialize in production of general-purpose molding and coremaking machines for small castings, machinery for nonsand molding, and foundry tools and instruments. |
| Volkovysk Foundry and Machinery Plant** | Volkovysk | IIb | This plant is reported as having started production of machinery for the preparation of foundry sand in 1956. After 1964 the plant will specialize in production of sand-preparation and knockout machinery. |
| Voronezh Plant imeni Lenin | Voronezh | VII | This plant is reported as having produced very small quantities of sand-preparation machinery since 1949. |
| Vyksa Vyksiyenskiy Plant | Vyksa | VII | This plant is reported as having produced very small quantities of sand-preparation machinery since 1949. |

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