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ECONOMIC INTELLIGENCE REPORT

PRODUCTION OF LOCOMOTIVES AND ROLLING STOCK IN THE USSR AND THE EUROPEAN SATELLITES

CIA/RR 27

31 December 1953

CENTRAL INTELLIGENCE AGENCY

OFFICE OF RESEARCH AND REPORTS

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FOREWORD

This report deals mainly with the USSR, which accounts for the greater part of the production of locomotives and rolling stock in the Soviet Bloc. It deals more briefly with the European Satellites, which account for a smaller but nevertheless significant part of this production. Supplemental reports will deal more completely with the European Satellites. Communist China also contributes to this production and will be considered at a later time.

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NOTE ON CLASSIFICATION

The over-all classification of this report is SECRET. Some illustrations, however, are of lower classification and are so designated.

PRODUCTION OF LOCOMOTIVES AND ROLLING STOCK IN THE USSR AND THE EUROPEAN SATELLITES*

Summary

The production of locomotives and rolling stock in the USSR since World War II, supplemented by imports from the European Satellites, has been sufficient to allow the USSR to meet the current transportation needs of the Soviet economy and to modernize to some extent the Soviet inventory of locomotives and rolling stock. The production of locomotives and rolling stock in the European Satellites apparently has been barely adequate, after meeting requirements for reparations exports to the USSR, to meet their current needs. Their inventories have remained at minimum levels, with no "cushion" to meet emergency demands.

In the USSR, domestic production supplies a large part of current requirements for locomotives and rolling stock. Soviet production of locomotives in 1952 is estimated at approximately 2,250 steam, 280 electric, and 230 diesel units; the production of freight cars at approximately 64,000 4-axle units and 9,000 2-axle units; and the production of passenger cars at approximately 2,800 units.** All these numbers greatly exceed comparable numbers for any prewar years. Soviet input requirements cannot be accurately estimated at present. On the basis of US analogy, raw steel -- the most significant material input -- would have amounted to roughly 2 million metric tons in 1952.

In the European Satellites, planned production in 1952 was to amount to a total of 1,200 locomotives (steam units, except for 65 electric units), 53,000 freight cars, and about 2,000 passenger cars. It is estimated that these planned goals were substantially fulfilled. Satellite production evidently constitutes a significant contribution to the Soviet Bloc economy. Although a large proportion of Satellite production is destined for export to the USSR, as

* This report contains information available as of 1 July 1953.
** For estimates of the Soviet production of locomotives and rolling stock, 1928-60, see V, below.

reparations or under commercial trade agreements, it has not been possible to determine accurately the amount of these exports for any of the postwar years.

During World War II the Soviet inventory of locomotives and rolling stock declined in quality and numbers as a result of hard use, losses, and lowered production. Following the war the prewar rate of expansion was quickly regained and has been maintained. Estimates show an inventory in the USSR at the end of 1952 of 33,500 steam locomotives, 1,380 electric locomotives, 1,088 diesel locomotives, 450,000 2-axle freight cars and 415,000 4-axle freight cars (a total freight car inventory of 1,280,000 equivalent 2-axle units), and 41,933 passenger cars.* These inventory figures include a considerable number of old and somewhat inferior units, in spite of increasing rates of retirement, which allow for gradual standardization and modernization.

Inventories of locomotives and rolling stock in the European Satellites are much less homogeneous (taken country by country or collectively) than the Soviet inventory. Satellite inventories still include a much greater diversity of types and a greater proportion of obsolete or obsolescent units. As a whole, the Satellite inventories, although improved in quantity and quality since World War II, are less adequate than the Soviet inventory to meet current traffic requirements. The total inventory of the European Satellites at the end of 1952 is estimated at some 20,000 locomotives, 475,000 freight cars, and 33,000 passenger cars, including unserviceable units. In the absence of reliable information it is assumed that about 20 percent of the total inventory is unfit for service at any given time.

In the USSR, 20 plants are known to be engaged in the production of locomotives and/or rolling stock, and there are 36 others that also may be so engaged. In addition, several plants have been identified definitely either as overhaul or repair shops or as parts plants. Steam locomotive production has been established at plants in Bezhitsa, Gor'kiy, Kolomna, Krasnoyarsk, Ulan-Ude, and Voroshilovgrad. Production of electric locomotives occurs at Novocherkassk, and production of diesel locomotives occurs at Khar'kov. Freight cars are produced at Altayskoye, Bezhitsa, Dneprodzerzhinsk, Engel's, Kalinin,

* For estimates of the Soviet inventory of locomotives and rolling stock, 1928-60, see IX, below.

Kaliningrad, Kiev-Darnitsa, Nizhniy Tagil, and Zhdanov. Production of passenger cars has been identified at Leningrad, Mytishchi, and Riga. These plants are under the authority of the Main Administrations of Locomotive Building and Railroad Car Building, which in turn are subordinate to the Ministry of Transport and Heavy Machine Building.*

The organization of production in the Soviet locomotive and rolling stock industry is different from that in the US, inasmuch as the Soviet industry is state-owned and production control is at a national level. As a consequence, production at a given plant is usually serial production of a single model for a reasonably long period, thus affording more opportunity for mass production economies. In the US, production is usually of a "batch" nature, as each producer manufactures units in smaller numbers in response to orders received from the individual railroads. Both systems have merit, the Soviet one lending itself to assembly-line production with a larger ratio of semiskilled labor to skilled labor and the US system resulting in the production of units specifically designed to meet the needs of each railroad rather than the production of all-purpose equipment which may not be best suited for any particular service.

Of the 7 European Satellites, only 5 contain facilities of significant size for the production of locomotives and rolling stock -- East Germany, Poland, Hungary, Czechoslovakia, and Rumania. The production of locomotives and rolling stock in the various European Satellites is organized in very much the same fashion as in the USSR, although on a smaller scale and on a less standardized basis.

In design and technology the production of locomotives and rolling stock, both in the USSR and in the European Satellites, rests on a solid basis established before World War II. In general, the USSR produces a sufficiently wide range of specialized models, which are similar in design to average US units of the same classifications. Since the war the USSR has been expanding the production of electric and diesel locomotives, initiated on a small scale before World War II. An extensive shift to diesel locomotives has not become evident, although such a trend may develop if it is found that the additional technological difficulties of production and maintenance as well as the problem of fuel supply can be met satisfactorily. Freight cars are modern specialized units of the 4-axle type, and passenger cars are mostly of all-metal construction.

* See II, below.

The European Satellites produce a wide variety of equipment, including several specialized items such as hospital cars which East Germany and Czechoslovakia have been reported to be building; special heavy-duty flatcars built in large numbers in East Germany; armored cars built in Czechoslovakia and Poland; and diesel train sets built in Hungary in sizable quantities not only for the USSR but also for East Germany, Bulgaria, and Argentina.

Railroad operations in the Soviet Bloc are significantly affected by the difference between the Soviet track gage, which is 5 feet, or 1,524 mm (broad gage), and the European track gage, which is 4 feet 8-1/2 inches, or 1,435 mm (standard gage). This difference does not affect the operation of locomotives, which normally do not operate in any but their home country, nor does it seriously affect passenger train operation, since the transfer of passengers from one car to another is easily made. It therefore affects production of locomotives and passenger cars only by differentiating models produced in the European Satellites for Soviet and Satellite use. It has, however, led to attempts to overcome the need for transloading freight, which entails the expenditure of considerable time and effort. The USSR has instituted three methods to ease or overcome the problem of transloading. The first and most practical of these methods is to change the wheel set or the bogie by raising the car and rolling out the first set and substituting one of the wider or narrower gage. This method involves some changes in brake rigging in some cases, but such changes are not usually difficult. This method also requires a sizable stock at the transfer point of wheel sets and bogies of both gages. The second method, also practiced to some extent, is that of removing the wheel and axle from the car and hydraulically moving the wheel on the axle to the desired gage. This method works well if the gage is to be changed only once or, at the most, a few times. Since the wheels are normally pressed on an axle with 40 tons or more pressure, continual shifting of the wheel over the same area would cause eventual loosening because of deformation of the metal. The third method which can be used is that of a wheel and axle set on which the wheel gage may be adjusted by means of a device such as a pin which can be pulled from a slot in the axle and reinserted in another slot when the gage change has been effected. This third method is subject to rather severe technological difficulties, and actual use of the method is not believed to be common. Production of cars with adjustable gages has not been reported in any Soviet plant.

Neither the production facilities nor the inventory of locomotives and rolling stock of the Soviet Bloc is significantly vulnerable to any cold-war action by the West, although shortages of raw materials, particularly steel, are more frequently reported in the Satellites than in the USSR and a cut-off of Western exports of steel to them would have a limited effect on their cold-war capabilities to produce locomotives. In the case of a hot war, the producing plants in the USSR would become vulnerable to direct or indirect attack of various types. The possibility of direct attack on or sabotage of electric power supplies, foundries, and labor supply would provide the most important physical vulnerabilities, and any attack which interfered with the flow of raw material into the plant would indirectly affect output. The operating inventory of locomotives and rolling stock also would be vulnerable under hot-war conditions. Destruction of a significant portion of the inventory would make it impossible for the railroads to meet the traffic demands placed on them for the movement of freight and military items, including troops, and would reduce the industrial and military capabilities of the whole economy, including the railroad equipment industry itself. The Satellites would have much the same hot-war vulnerabilities as the USSR with respect to production facilities, but their inventory would be somewhat more vulnerable because of the lack of "cushion."

So far as can be determined, Soviet intentions are to continue the present program of building up the inventories with newer and more modern equipment, at the same time increasing the total capacity of the railroads in terms of ability to move larger amounts of freight. Soviet statements in the Fifth Five Year Plan (1951-55) call for an increase by 1955 in railroad freight transportation of some 35 to 40 percent, and estimates of production and inventory indicate that this goal is not unrealistic. The trend of postwar production indicates an increase of about 40 percent in the freight car inventory during the period, an increase which corresponds favorably with the Plan target of an increase in railroad freight transportation of some 35 to 40 percent. The steam locomotive inventory probably is due to increase by somewhat less, and electric and diesel locomotives inventory by much more, than this percentage. The passenger car inventory also is due to increase, although at a lower rate than that of freight cars.

During the Fifth Five Year Plan period, more powerful steam locomotives probably will be introduced, as will more modern diesel and electric locomotives. Freight cars will continue to be predominantly

of the modern 4-axle types, and passenger cars should continue to improve in numbers and in accommodations for passengers. No present indication of a trend toward extensive dieselization is evident. Such a program might be expected at a later date, since Soviet imitation of US practice has been common in the past. The additional problems of production, cold-weather operation, and fuel supply, however, are deterrents to any early trend in this direction.

Soviet facilities for the production of locomotives and rolling stock were partially converted to armaments production in World War II, and present Soviet Bloc facilities presumably would be converted again to such a purpose in the event of a hot war. Indications of conversion to armaments production have not been noted to date. Any such indications would represent a significant shift in Soviet economic policy.

The primary determinant of the intentions of the European Satellites is Soviet policy. Should Soviet planners so decide, the Satellites could convert their present capacity to armaments production, or, conversely, they could undertake to increase their production of railroad equipment for the USSR, thus releasing internal Soviet plants for conversion. Present indications point to a maintenance of the status quo at least for the time being, with a large percentage of Satellite production being diverted to the USSR.

PART I: USSR

I. Introduction.

A. General Description of the Industry.

The locomotive and rolling stock industry of the USSR is somewhat different from that of the US. Since this industry, like nearly all Soviet industries, is state-owned, the production plans for the various plants are determined not by orders placed by the various railroad systems but rather by order of the State Planning Commission. The basic result of this system is that individual plants engage in series production of one type of unit over a considerable period of time. In the US, on the other hand, a company -- usually a producer of only locomotives or rolling stock -- receives its orders from various railroads and constructs 1 or more units for each of these railroads to specifications agreed on by the 2 parties. This practice results in what may be called "batch" production, although production usually takes place on an assembly-line basis if the number of units is significant.

Both systems have merit. The Soviet system of continuous production of one type of unit within a plant better lends itself to assembly-line mass production by semiskilled or unskilled labor, whereas the US system lends itself to production of units specifically designed to meet the traffic and road conditions of the particular railroad which has ordered them.

1. Classification of Products.

The products of the Soviet locomotive and rolling stock industry are classified within this report as follows:

a. Locomotives.

(1) Steam.

A steam locomotive is a power unit which derives its energy from the combustion of coal, oil, or other fuel in a fire-tube boiler. The steam produced in this boiler is piped to cylinders, and the energy developed is converted to reciprocating motion and thence to rotary motion at the driving wheels by means of mechanical linkages.

(2) Electric.

An electric locomotive is a power unit which derives its energy from overhead or side transmission lines carrying electrical current of the required voltage and density. This energy is converted to rotary motion at the driving wheels by means of electric motors mechanically geared to the driving axles.

(3) Diesel.

A diesel locomotive is a power unit which derives its energy from the combustion of fuel oil in an internal combustion engine of the compression-ignition type (diesel engine). In most mainline units the rotating energy thus produced is converted to electrical energy by means of an electric generator, and this electrical energy is then converted to rotary motion at the driving wheels in the same manner as in the electric locomotive. In some smaller switch and shunt locomotives the diesel motor is connected mechanically with the driving wheels, effecting a direct drive rather than a diesel-electric drive.

(4) Other Types.

Other types of locomotives, primarily of experimental design, have been produced in the USSR. They include steam-diesel locomotives and gas-turbine locomotives.*

b. Rolling Stock.

(1) Freight Cars.

Freight cars are nonpowered units which are designed for the carrying of goods of various types. The principal types of freight cars produced in the USSR are the following: boxcars, flatcars, gondola and hopper cars, tank cars, refrigerator cars, and other special-purpose cars.

* For a description of these types of locomotives, see III, A, 1, below.

(2) Passenger Cars.

Passenger cars are units, usually nonpowered, which are designed for the carrying of persons and for other passenger train operations. They include coach, sleeper, mail, diner, and baggage cars. Some passenger cars such as subway cars and motor rail cars contain a power unit and are thus self-propelled, but they still are classified as rolling stock.

(3) Other Cars.

Other cars include such units as crane cars, track-laying cars, and other maintenance cars.

2. Relationship of the Industry to the General Planning and Economy of the USSR.

The locomotive and rolling stock industry of the USSR is an integral part of the economy. As industrial capacity increases, so must the number of locomotives and rolling stock units increase to supply the expanded industrial facilities of the country with the goods required. Basically the railroad transportation service is responsible for carrying the expanded traffic, but it, in turn, is dependent on the availability of locomotives and rolling stock to meet the demands placed on it.

B. Importance of the Industry.

1. Key Position in the Economy.

The modern economy of the USSR requires an ability to concentrate its resources for production and to disperse the products to the consumer for end use or for purposes of further production. In 1947 the railroad transportation service of the USSR accounted for approximately 85 percent of the total transportation services. The railroad transportation service depends on the locomotive and rolling stock industry to supply the units required to render its services. In an expanding economy, new locomotives and rolling stock are required not only to replace retired units but also to meet the increasing demands placed on the railroad transportation service.

Indicative of the importance of locomotive and rolling stock production in the USSR is the emphasis placed on it in all

the past Five Year Plans, together with indications that such emphasis is continuing at present. Cessation of production of locomotives and rolling stock would not have an immediate effect on the economy of the USSR, because the present inventory could be overutilized for perhaps 2 or 3 years and the required services still could be rendered by the railroad transportation service. After such a period of time, however, such a large percentage of the inventory would be out of service for major repairs or mandatory retirement that without new units as replacements the rail transportation service of the country would suffer greatly and eventually collapse.

2. Ease of Conversion to War Production.

The locomotive and rolling stock industry of any country is ideally suited to war production. During World War II, both the US and the USSR converted many of their locomotive and rolling stock establishments to armaments production. The American Locomotive Company and the Baldwin Locomotive Works* in the US produced tanks during the war and are engaged in some production of this nature during the present cold-war situation.

In the USSR those plants which were neither destroyed nor evacuated during World War II were converted to armaments production. A prime example is the railroad car plant at Nizhniy Tagil in the Urals. This plant reportedly turned out over 50,000 tanks during the war and at present is building both railroad cars and tanks on parallel assembly lines. 1/**

The raw materials, tools, equipment, and labor required for the manufacture of heavy armaments are strikingly similar to those used in railroad equipment plants. With the proper preparation beforehand, conversion from production of railroad equipment to production of military armaments can be made easily. It may be assumed that the Russians are well aware of this fact and have made the necessary preparations to carry out such a conversion should it appear appropriate.

* The Baldwin Locomotive Works was merged with the Lima-Hamilton Corporation on 30 November 1950, the new combine becoming the Baldwin-Lima-Hamilton Corporation.

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3. As an Indicator of Capabilities for Heavy Industrial Production.

Because the production of locomotives and rolling stock normally keeps pace with the general peacetime industrial development, the rate of production of these units provides a rough index of a country's general level of industrial production. In addition, since the large-scale production of locomotives and rolling stock requires a large amount of heavy industrial equipment and considerable engineering and management skill, the ability of the USSR to produce these items to varied specifications in extremely large numbers is a good indication of Soviet general ability to produce heavy capital goods.

C. History of the Industry.

1. Pre-World War II.

a. General.

The manufacture of railroad equipment, particularly locomotives, reached a comparatively high level in Tsarist Russia, and the USSR inherited a relatively well-developed industry, particularly as contrasted with the machine tool and metallurgical industries, which are primarily Soviet developments. 2/ The industry then included the following plants: the Alexandrovsk and Nevskiy plants at Leningrad and plants at Kolomna, Votkinsk, and Voroshilovgrad (then Lugansk), all of which built locomotives; a plant at Bezhitsa (Ordzhonikidzegrad), which built locomotives and railroad cars; and plants at Kalinin (then Tver') and Kryukov, which built railroad cars.

During the Russian Revolution and civil war and thereafter until 1926 the locomotive and rolling stock industry of the USSR was almost dormant as far as expansion of production was concerned. But with the initiation of the First Five Year Plan, begun in 1928, the locomotive industry of the USSR underwent tremendous expansion. During the 1930's the USSR became virtually independent of foreign imports. The few US- and UK-built locomotives supplied to the USSR in 1931-33 probably were acquired largely for their value in indicating the latest developments in foreign locomotive design. The principal locomotive plants developed under the prewar Five Year Plans were those at

Kolomna, some 60 miles east of Moscow, and at Voroshilovgrad, in the Eastern Ukraine. The second of these concentrated chiefly on the production of FD-class engines.* Other locomotive plants were situated at Khar'kov, Bryansk, Gor'kiy, Orsk, Ulan-Ude, and Novocherkassk, and electric locomotives were built at the Moscow Order of Lenin and Order of Labor Red Banner Dynamo Works imeni Kirov. 3/

The principal rolling stock plants developed before World War II, in addition to those built in pre-Soviet years, were those at Dneprodzerzhinsk and Nizhniy Tagil. 4/ During the First and Second Five Year Plans (1928-37), rolling stock plants also were set up in Kryukov and Dnepropetrovsk, and, during the Third Five Year Plan (1938-42), car foundries were established in Ust'-Katav and Sverdlovsk. 5/

In 1938, when there was a serious deficiency of rolling stock, a number of other plants undertook to supplement the production of railroad cars: namely, Balashov machinery factory, Kazan shipyard, and Chkalov repair plant. Other supplementary production was planned but was interrupted by World War II. 6/

b. Steam Locomotives.

Before the Revolution, Russia was using largely freight locomotives of classes O, E, Shch, and F and passenger locomotives of classes N, K, and S.* In 1913, Russian locomotive production totaled 418 units. The O class, with an 0-8-0 wheel arrangement** and weighing only some 52 tons, predominated; 11,000 out of Russia's total stock of 20,500 locomotives in 1917 were of that type. Considerable numbers of these old locomotives are still used for switching and shunting. 7/

After the Revolution the steam locomotive inventory of the USSR was in extremely poor condition. In 1921 the Soviet inventory of steam locomotives amounted to 18,500 to 19,000 units,

* For specifications of these and other types of Soviet locomotives and rolling stock, see Appendix A. Class designations of types of Soviet locomotives throughout this report are transliterated from the Russian.

** The wheel arrangement of a steam locomotive is commonly expressed by means of three figures denoting the number of wheels on the leading truck, the driving gear, and the trailing truck, respectively. Thus an 0-8-0 wheel arrangement indicates a locomotive with no leading truck, 8 driving wheels, and no trailing truck.

but some 60 to 66 percent were not serviceable. Furthermore, only 3 to 4 percent of them were heavy-duty locomotives, and 25 percent were from 20 to 60 years old. In spite of the fact that, during the period from 1922 to 1927, repair of nonserviceable locomotives was stressed, the inventory declined by 1928 to 17,000 units, most of which were old. New freight locomotives produced during this period were largely of the E class, and the bulk of the locomotives produced for passenger service were of the newly designed Su class.

In 1921-22, after the Revolution and civil war, there appeared an altered version of the E-class locomotive (classified as Eg and Es) produced by German and Swedish manufacturers. During the first decade of the Soviet regime, in fact, all the steam locomotives built or imported by the USSR were based on prerevolutionary types: thus, for example, the Su-class passenger locomotive, of which between 500 and 1,000 were built after 1925, was a development of the Tsarist S class. 8/

In 1927, the last year before the inauguration of the Five Year Plans, production of steam locomotives amounted to only 458 units. 9/

During the First Five Year Plan (1928-32), 3,412* new steam locomotives were built, 10/ principally E-class freight and Su-class passenger units. 11/ This production resulted in an increase of 43 percent in the total tractive effort of the locomotive inventory. 12/ In 1932, output reached 827 steam locomotives per year.** 13/

During the Second Five Year Plan (1933-37), 5,957*** new steam locomotives were built, 14/ including the new FD- and SO-class freight and JS-class passenger locomotives, 15/ as well as the older E- and Su-class units. The highest level of prewar production was reached in 1935, when a total of 1,556**** steam locomotives was produced. 16/

In reviewing the steam locomotive inventory of the USSR, mention must be made of the huge AA (Andrei Andreyev) class, which, with its 4-14-4 wheel arrangement, is the largest type of steam locomotive ever built in Europe. The original prototype of

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* This figure is lower than the evaluated average of 3,442 as given in Figure 15, following p. 54, below.

** For estimates of the Soviet production of locomotives and rolling stock, 1928-60, see V, below.

*** This figure is higher than the evaluated average of 5,918 as given in Figure 15, following p. 54, below.

**** This figure is higher than the evaluated average of 1,518 as given in Figure 15, following p. 54, below.

this class was produced by the Voroshilovgrad Locomotive Works in 1934, the main object being the comparison of the efficiency and power of such a locomotive with that of the Beyer-Garrett or Mallet types of locomotives. The distribution of adhesion weight of the AA-class locomotive over as many as 7 driving axles enables the axle load to be kept down to about 20 tons only.* It would appear that only a very small number of these locomotives were built and that they were intended for use on the Donbas coal traffic lines. Also worthy of mention is the Beyer-Garrett articulated locomotive, with a 4-8-2 + 2-8-4 wheel arrangement, which was supplied to the Soviet railroads by Beyer, Peacock, and Company of Manchester, England, in 1932. At the time of its construction this Beyer-Garrett locomotive, weighing 255 tons, was the heaviest and most powerful steam locomotive ever built in Europe. It had a maximum axle load of 19 tons and was given the classification of Ya. It is reported, however, that the maintenance requirements of this locomotive did not accord with Soviet operating conditions and that it consequently was dismantled in 1937. 17/

During the Third Five Year Plan (interrupted in 1941 by World War II), production of steam locomotives in terms of physical units declined steadily, probably because of the building of prototypes and the placing in serial production of new units. This decline was largely offset by the fact that the average tractive effort of the steam locomotives built in these years steadily increased, with the larger portion of the production being of SO-, FD-, and JS-class power.

Shortly before World War II the Soviet railroads also had brought into use on the Moscow-Leningrad "Red Arrow" express service a new type of passenger steam locomotive with a 4-6-4 wheel arrangement, produced by the Kolomna Locomotive Works, claimed to be capable of a maximum speed of 112 miles per hour. A similar passenger locomotive also was produced by the Voroshilovgrad Steam Locomotive Plant imeni October Revolution, with an even higher claimed maximum speed. In addition, various experimental steam locomotives (such as high-pressure and steam-electric) were being tested in the USSR before the war. Then, in February 1941, only a few months before the extension of the war to the USSR, the Kolomna Locomotive Works produced the initial steam locomotive of another

* Tonnages throughout this report are given in metric tons.

class, the LK (Lazar Kaganovich), with a 2-8-2 wheel arrangement and an axle of 23 tons. The usefulness of this locomotive is restricted by its comparatively high axle loading. 18/

The changes which occurred during the first three Five Year Plans in the production of steam locomotives are shown in Table 1.

Table 1 19/

Estimated Steam Locomotive Production in the USSR by Classes
Selected Years, 1928, 1934, 1937, and 1940

Percent

Class	1928	1934	1937	1940
Freight				
FD	0	1.2	9.5	14.5
SO	0	0	3.5	8.9
E (All Types)	25.5	41.9	40.2	47.3
Others	74.5	56.9	46.8	29.3
Total	100.0	100.0	100.0	100.0
Passenger				
JS	0	0.1	2.7	12.0
Su	16.8	29.9	42.4	48.5
Others	83.2	70.0	54.9	39.5
Total	100.0	100.0	100.0	100.0

The average drawing power (tractive effort) of freight steam locomotives in the inventory increased from 21,200 pounds in 1913 to 31,600 pounds in 1940, and of passenger steam locomotives from 17,200 pounds in 1913 to 21,500 pounds in 1940. 20/

Between 1938 and the outbreak of the war in 1941 the improvements in the Soviet steam locomotive inventory resulted in an inventory of steam locomotives over half of which were less than 12 years old, the youngest inventory in the world. 21/

c. Electric Locomotives.

The first Soviet electric locomotive was assembled in 1932. Within 4 years, production had risen to 44 units annually. In the years following 1936, however, production declined steadily, probably because enough units were available for the trackage electrified. This type of locomotive is particularly useful for regions with difficult grades, such as the Caucasus and the Urals. It also is more efficient than the steam locomotive in the colder regions and for hauling heavy loads. In addition, low-grade fuels or water power may be used to supply the necessary electricity. These advantages are somewhat offset by the higher initial cost of the production of these units over the cost of steam locomotives and in addition by the cost of electrification of the trackage where these units are to operate. 22/

Prewar models of electric locomotives produced in the USSR were the SS, VL-19, VL-22, and PB classes. The first two models of the SS class were built in the US and the remainder in the USSR. The SS class is a freight locomotive designed for use in the heavily graded 39-mile section of the Suram Pass in the Caucasus. The VL classes predominated in prewar years, 100 of the stock of 140 electric locomotives in 1937 being of that class. The VL classes are passenger-freight models, and the PB class is a passenger locomotive. In addition to these three principal classes, electric locomotives of Italian construction with the classification of SK were introduced before the war in connection with the Kizel-Sverdlovsk electrification. 23/

d. Diesel Locomotives.

The first diesel locomotives in the USSR were produced singly, probably as experimental prototypes. The earliest model, the Shch-EL-1, was built in 1924 in Leningrad. Following the production of this unit the Russians developed plans for the O-EL-6 and O-EL-7, and for the E-EL-2, -3, -5, -8, and -9. Of these, the O-EL-6 and O-EL-7 as well as the E-EL-5 and E-EL-8 were actually produced in Germany for the USSR in 1931 and 1932. The E-EL-2 was built in 1924 and redesigned in 1928 by the Russians. They also constructed 1 E-EL-5 unit in 1931 and 1 unit designated the VM-20 in 1934. It is not known just when the E-EL-9 was built, but it was followed in 1932 or 1933 by the E-EL-12, which became the first series-produced diesel locomotive

in the USSR. Both of these units were built at Kolomna. This E-EL-12 class was the standard diesel locomotive in the USSR before World War II. 24/

Soviet acquisitions of diesel locomotives (domestic production plus German-built models) before World War II amounted to some 27 units. During the Second Five Year Plan, some 248 diesel locomotives were to have been produced, 110 of them in 1937. 25/ Technological problems probably were the reason why only the 27 units were actually placed in service during this period.

e. Freight Cars.

The level of freight car production in Tsarist Russia was comparatively lower than that of locomotive production, and the task of the USSR under the Five Year Plans was consequently more difficult. The vast majority of freight cars were small 2-axle units with link couplers and hand brakes. By 1927-28, actual physical production was 7,871 freight cars, of which 5,130 were 2-axle units* and the remaining 2,741, 4-axle units. Freight car production increased slightly from 1927-28 to 1934, with both 2-axle and 4-axle units being produced, in a ratio of about two 2-axle units to one 4-axle unit. In 1935, however, the production of freight cars was deemed too low, and L.M. Kaganovich was appointed Commissar of Railroads, evidently in the expectation that he would achieve almost immediate results. Production in fact jumped to 85,675 2-axle units in 1935. This increase was accomplished by the following two means: (1) passenger car production, which had been increasing during the preceding years, was cut

* Almost all Soviet statistics on freight car production and inventory are given in 2-axle units. The 2-axle unit is the early type of freight car produced by the Russians, with a tare weight of 7 tons and a capacity of 16.5 tons. This type of car is standard on most European railroads today. In the USSR, however, production of larger freight cars with 4 axles has been increasingly predominant, until at present almost all production is of the 4-axle type. For the purposes of counting, however, a 4-axle unit is considered to be equivalent to two 2-axle units. In this report, all estimates will be in terms of equivalent 2-axle units, unless otherwise stated.

back sharply; and (2) production of 2-axle flatcars, which are easier to produce than any 4-axle car and any other type of 2-axle car, increased sharply. Two-axle flatcars, which had accounted for only 21 percent of the total freight car output in 1927-28, constituted 73 percent of the total in 1935. 26/ In the years after 1935, production declined, primarily because of the trend toward larger and more complex units, which are harder to build. In 1939, production reached a low of 37,600 equivalent units. In 1940 it began an upswing, which continued in 1941 until the outbreak of World War II. 27/

The rise in the number of 4-axle freight cars in the total inventory has been consistent. Relative to the total inventory, they amounted to only 1.5 percent in 1913 and increased to 5.5 percent by 1928, to 8.5 percent by 1932, and to 19 percent by the end of 1937. By 1940 the number of 4-axle freight cars had risen to approximately 25 percent of the total inventory. 28/ In line with the increase in the percentage of 4-axle cars, the number of freight cars equipped with automatic couplers and air brakes has also increased greatly. In 1913, only 15 percent of the cars were equipped with brakes, and then with hand brakes only. By 1 January 1940, 68.4 percent of the units had air brakes. 29/ The increase in number of freight cars equipped with automatic couplers has been more recent. In 1935, only 3.4 percent of the freight cars had automatic couplers, the remainder being of the link-screw type, whereas by 1 January 1940, 31.2 percent were so equipped. 30/

f. Passenger Cars.

Under the Five Year Plans before World War II, Soviet passenger car production advanced considerably. Between 1927-28 and 1934, it almost quadrupled. Thereafter, until the outbreak of the war, production declined unevenly. Under the First Five Year Plan (1928-32), 4,054* passenger cars were produced, and under the Second Five Year Plan (1933-37), 5,291** were produced. Under the Third Five Year Plan (1938-42), before the outbreak of war, some 3,300 units were produced. 31/ In 1941 the passenger car inventory was 80 percent higher than in 1920. 32/

The passenger cars produced before the war were mainly 4-axle units of the wooden type, equipped with compressed air brakes. Two main classes of passenger cars were produced by the Russians, "hard" and "soft" classes, providing a minimum of accommodations for the passengers. One concession made to the

* This figure is higher than the evaluated average of 4,038 as given in Figure 17, following p. 58, below.
** This figure is lower than the evaluated average of 5,561 as given in Figure 17, following p. 58, below.

Soviet climate was the installation of individual heating units in each car rather than reliance on steam heat supplied from the locomotives. Just before the outbreak of the war, all-metal passenger cars were put into production, but only small numbers were produced at that time. 33/

2. World War II.

During World War II, plants which were previously engaged in the production of locomotives and rolling stock and had not been destroyed or evacuated because of the German invasion were converted to armaments production. Production of locomotives and rolling stock virtually ceased, and the USSR became dependent on Lend-Lease shipments and captured "war prizes" for additions to its inventory.* The Voroshilovgrad, Bezhitsa, and Khar'kov locomotive plants were destroyed by enemy action or Soviet demolition. Much of the equipment, however, was evacuated to the East. The Kolomna locomotive plant was evacuated during the war but was not destroyed. 34/

The locomotive plant at Krasnoyarsk was equipped during the war with equipment evacuated from the plants in the Ukraine, but it did not start production of locomotives until after the end of the war. The Kalinin and Dneprodzerzhinsk railroad car building plants were destroyed during the war, restored after the war, and went back into production in 1946. 35/ At Nizhniy Tagil, the site of a huge railroad car building combine, tank production was introduced on a mass production basis. Reportedly, over 50,000 tanks were produced at this plant, an excellent demonstration of the effectiveness with which the industry may be converted to armaments production.

3. Postwar.

With the end of hostilities the locomotive and rolling stock industry of the USSR began a tremendous program of reorganization, restoration, and new construction. The Moscow Dynamo Plant imeni Kirov, which produced electric and diesel locomotives before World War II, turned to the production of parts and subassemblies for the production of these units at other plants. The locomotive plant at Khar'kov was devoted to the production of main-line diesel

* For estimates of Lend-Lease and war-prize acquisitions by the USSR, see VII, C, below.

locomotives. Novocherkassk began the production of main-line electric locomotives. Voroshilovgrad, Bezhitsa, and Kolomna were reconstructed and began production of steam locomotives. Nizhniy Tagil was reconverted to the production of freight cars. Kalinin and Dneprodzherzhinsk were rebuilt and once more began production of freight cars. Numerous other plants also were involved in this postwar program.*

The goals of the Fourth Five Year Plan (1946-50) were high of necessity. The locomotives and rolling stock of the USSR suffered greatly during the war, both from enemy action and from overutilization and lack of maintenance. Getting the railroads back into shape was essential if the planned industrial expansion of the economy was to be attained. The Fourth Five Year Plan included the following production goals for the 5-year period: 6,160 steam locomotives, 555 electric locomotives, 865 diesel-electric locomotives, 472,500 freight cars, and 6,000 passenger cars. 36/ Principal types of steam locomotives to be built included the new L (Pobeda) class, as well as the prewar FD, SO, JS, and Su classes. New types were also to be developed. Diesel locomotives were to be of the TE-1, TE-2, and TE-5 classes, and electric locomotives were to be of the VL-22m class. Postwar passenger cars were to be largely all-metal types. Freight cars scheduled to be produced were to be almost exclusively 4-axle units, with substantial production of specialized types.**

Reports on development of the industry after the end of the Fourth Five Year Plan are scattered and poor. Plans for the future have not been announced, and speculation as to the progress of the industry to date and in the future is dependent to a large extent on projections of earlier estimates.***

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* For a more complete list of plants engaged in postwar production of locomotives and rolling stock see IV, below.

** Actual accomplishments under the Plan are discussed in detail in V and X, below, and specifications of the types of units will be found in Appendix A.

*** These speculations are discussed in detail in X, below. See also Appendix C, which provides comparative statistics on the US and the USSR for interpreting Soviet capabilities.

II. Administrative Organization of the Industry. 37/

Before 1939 the locomotive and rolling stock industry of the USSR was lumped together, for administrative purposes, with the other machine building industries.

The ukase of the Supreme Soviet of the USSR of 5 February 1939 ordered the partition of the People's Commissariat of Machine Building, which had emerged from the People's Commissariat of Heavy Industry in August 1937, into three independent commissariats: the People's Commissariat of Heavy Machine Building, the People's Commissariat of Medium Machine Building, and the People's Commissariat of General Machine Building.

The People's Commissariat of Heavy Machine Building controlled a Main Administration of Transport Machine Building (comprising the Krasnyy Profintern Railroad Locomotive Plant at Bezhitsa and the Voroshilovgrad Steam Locomotive Plant imeni October Revolution), and the People's Commissariat of Medium Machine Building controlled another Main Administration of Transport Machine Building (comprising all railroad car building plants).

On 15 October 1945 the People's Commissariat of Transport Machine Building was created from the People's Commissariat of the Tank Industry, which in 1942 had emerged from the People's Commissariat of Medium Machine Building. In March 1946 the People's Commissariat of Transport Machine Building was changed to the Ministry of Transport Machine Building. As late as March 1953, Yuriy Yevgen'yevich Maksarev was Minister of Transport Machine Building, and the following have been identified as Deputy Ministers: Sergey A. Stepanov, A.I. Mosin, Ya.A. Nazarov, P.M. Zernov, N.V. Zherekov, I.A. Lebedev, M.N. Popov, and D.E. Kochetkov. The following main administrations of the Ministry of Transport Machine Building also have been identified:

Main Administration of Locomotive Building (with Shcherbakov as chief).

Main Administration of Railroad Car Building (with Shevyakov as chief).

Main Administration of Supply.

Main Administration of River Shipbuilding.

Main Administration of Workers' Supply.

Main Administration of Diesel Production.

The death of Stalin and the rise to power of Malenkov in March 1953 resulted in several changes in the higher echelons of administrative authority. The effect on the Ministry of Transport Machine Building was to combine it with the Ministries of the Shipbuilding Industry, Heavy Machine Building, and Construction and Road Machine Building to form the new Ministry of Transport and Heavy Machine Building. The former Minister of the Shipbuilding Industry, Vyacheslav A. Malyshev, became Minister of the new ministry. In June 1953, Malyshev became Minister of Medium Machine Building and was succeeded in his former post by Ivan I. Nosenko.

III. Current Design and Technology.

A. Equipment.

The USSR produces railroad equipment more or less standard throughout the world, although it is adapted to a degree to Soviet conditions and is in general somewhat behind the most advanced Western standards.

1. Locomotives.

a. In Use.

(1) Steam.

A large variety of types of steam locomotives is in use in the USSR. Since steam locomotives in the USSR are used as long as 45 years before they are scrapped, there are still a great many old units in service. 38/ Freight steam locomotives now in use on the Soviet lines include the SO, FD, L, E, and Shch classes as well as numerous US Lend-Lease units of the Ye class (Decapods).* The principal types of passenger steam locomotives in service, in the order of their importance, are units of the

* A locomotive with a 2-10-0 wheel arrangement. For specifications of all types of Soviet locomotives and rolling stock, see Appendix A.

JS, Su, and N classes. Switch steam locomotives are mainly of the O class, which has been produced for many years with slight changes each year over the preceding model.

(2) Electric.

Electric locomotives in use in the USSR are the combination freight-passenger VL classes (VL-19, VL-22, and VL-22m) and the SS class, which is a mountain-service freight engine.

(3) Diesel.

Diesel locomotives in use in the USSR include various models of the E-EL class, the VM-20, the US-built DA (produced by the American Locomotive Company), the US-built DB (produced by the Baldwin Locomotive Works), and the postwar TE-1, TE-2, and TE-5 classes.

b. In Production.

(1) Steam.

Steam locomotives in production in the USSR are units of the L, SO, FD, JS, and Su classes. The L class is the predominant unit in production.

(2) Electric.

The latest information indicates that the VL-22m class is the principal model of electric locomotive now in production at the Novocherkassk Electric Locomotive Plant imeni Budennyy, although a later model of either the same or a new class may now be in production.

(3) Diesel.

The Khar'kov Transportation Machine Building Plant (KhZTM) is continuing its production of the TE-2 and TE-5 classes of diesel locomotives. No other units are known to be in production currently.

c. Planned.

(1) Steam.

Several Soviet experimental types of steam locomotives have been reported in postwar years. Most of them have been prototypes which are undergoing extensive tests before being accepted for mass production. One of the most important is a freight locomotive with a 2-10-4 wheel arrangement, which reportedly passed tests in 1951. 39/ It has an axle load of 22.5 tons, which predicates its use on main lines with heavy rails, but it is reported as having a higher speed than the SO class, thus increasing the carrying capacity of single-track lines. Another important type is a passenger locomotive with a 4-8-4 wheel arrangement and an 18.5-ton axle load. It has a tractive effort of 120 to 125 percent of the now standard Su class and reportedly will be used extensively on both main and secondary lines when put into operation. 40/

(2) Electric.

No reports of development of new types of electric locomotives in the USSR have been received, but progress in this field is undoubtedly continuing, since the mileage of electrified lines is increasing and presumably creating demands for new types of equipment.

(3) Diesel.

Development of diesel locomotives in the USSR beyond the TE-2 and TE-5 classes has not been reported. In view of the probable extensive dieselization of Soviet railroads (following US practice), it is likely that development of new types of units is under way.*

(4) Other Types.

Two other types of locomotives should be mentioned here. The first of these is the so-called steam-diesel locomotive. This unit is designed to take advantage of the superior starting effort of a steam locomotive and the higher fuel efficiency of a diesel locomotive. Briefly, 2 opposed piston cylinders are mounted on the

* See X, below.

locomotive, 1 on each side. They are situated between the driving axles of the locomotive, so that the wheel arrangement becomes a 2-4-4-2. When starting the locomotive, steam is admitted and exhausted from one side of the pistons. On reaching a certain minimum speed, the steam supply is cut off, fuel is injected into the other side of the pistons, and the engine operates as a compression-ignition engine. One locomotive of this type is known to have been built in the USSR, and it is believed that a second was built.* This is the first such unit built anywhere in the world, and it is of interest in indicating the capabilities of the USSR in technological development.

The second type of locomotive to be considered is the gas-turbine locomotive. The Russians claim to have built a 220-hp unit in 1933 and, on the basis of the success of this unit, to have built a 4,500-hp unit (date unknown). 41/ The Soviet claim cannot be validated, but it indicates that the Russians are seriously interested in this type of unit and may be well along in research on it. Development of gas-turbine locomotives was originally begun by the Brown-Boveri Company of Switzerland, and the first unit was put into operation in that country in about 1941. Since then interest in this type has been high. The British have purchased several Swiss units and have built some themselves. In the US, several units are undergoing road tests, and others are under construction for the purpose of testing.

d. Trends.

There are no indications of any unusual trends in the development of locomotives in the USSR. Steam locomotives are increasing in weight and power as roadbeds permit and are being equipped with modern features commonly found on US units, such as superheaters, automatic stokers, drifting valves, roller-bearing journal boxes, air-operated sanders, and similar modern appurtenances. Electric locomotive production is fairly well developed in the USSR and can be expected to continue to improve in types and numbers. Diesel locomotive production, which was started late, is gradually increasing, and the types of units being built conform fairly closely to US standards. All locomotive production is following earlier US trends and can be expected to continue to do so for many years to come. The

* For full specifications of this locomotive, see Appendix A, 2.

locomotive production programs in the USSR are comparable to a high degree with US programs of 15 to 20 years ago. The gap is closing, however, and in time the Soviet units probably will be on a par with their US contemporaries.

2. Rolling Stock.

a. In Use.

(1) Freight Cars.

The types of freight cars in use in the USSR are similar to US types in that the USSR is using flatcars, boxcars, gondola cars, refrigerator cars, tank cars, and other standard types. In a second respect, however, there is a vast difference. About one-third of the carrying capacity, or numerically about one-half of the present inventory of Soviet freight cars, consists of 2-axle low-capacity units, which means more cars and hence longer trains per given train load. In addition, a great many cars are not equipped with air brakes or automatic couplers. The lack of air brakes requires that, in mixed trains,* cars not equipped with air brakes be equipped with pipes enabling those cars equipped with air brakes to be piped to the locomotive. The lack of air brakes also decreases braking power on hills and in emergencies. The lack of automatic couplers results in a considerable time loss in making up trains and in cutting out cars at classification yards. Since rolling stock is in short supply, a great many cars in use are overage and in bad repair.

(2) Passenger Cars.

Little information is available on the types of passenger cars in use in the USSR. They seem to be an aggregate of various types of wooden and all-metal cars, largely 4-axle types, predominantly of older and inferior construction.

* Mixed trains are trains made up of a mixture of cars equipped with air brakes and cars not equipped with air brakes.

b. In Production.

(1) Freight Cars.

During the Fourth Five Year Plan (1946-50) the production of freight cars was largely of 4-axle units of modern construction, equipped with automatic brakes, automatic couplers, and other up-to-date features. The Plan called for the production of the various types of cars in the following percentages: boxcars, 38 percent; flatcars, 30 percent; tank cars, 10 percent; gondola and hopper cars, 20 percent; and refrigerator cars, 2 percent. 42/ Presumably this proportion was produced and is still the yardstick for production. A small number of 2-axle cars are being produced in an effort to maintain the inventory of this type of car at a level of about 450,000 units.

(2) Passenger Cars.

Information available indicates that current production of passenger cars in the USSR is largely of the all-metal type, with little or no emphasis on the production of wooden passenger cars.

c. Planned.

(1) Freight Cars.

The USSR will continue to stress the production of specialized freight cars in an attempt to rid the inventory of its heavy overload of flatcars and boxcars. Four-axle cars with modern features will continue to dominate the production schedules, although some production of 2-axle cars will continue for a number of years, since this type of car is well suited to use on lines with light rails and to short hauls of small loads.

(2) Passenger Cars.

For propaganda purposes, the production of the relatively more expensive and more complicated all-metal passenger car in the USSR probably will continue. Equipment for the transportation of more passengers is likely to continue to take a lower priority than the production of de luxe cars, which can be cited as examples of the "glorious" accomplishments of the Soviet economy.

d. Trends.

(1) Freight Cars.

The trend of the past half-century will continue until such time as the Soviet inventory of freight cars is sufficient to meet the demands placed on it. No indications of stress on the production of cars peculiarly adaptable to military use have been received, the trend being instead an attempt to bring the freight car inventory up to a par with the more modern motive-power inventory.

(2) Passenger Cars.

The present trend in passenger car production in the USSR probably will continue until the freight car inventory no longer requires the top priority. Those cars that are built will be of modern design, but no attempt is evident to provide the Soviet people with an adequate number of passenger cars to meet its needs.

3. Other Units.

a. In Use.

Electric trains used in suburban service in electrified regions of the USSR were first produced in 1928 and have continued to increase in number since that time. They consist of motor rail cars which are equipped with traction motors and overhead current collectors and of trailer cars which are, in effect, ordinary passenger cars similar in appearance to the motor rail cars.

Several diesel train sets imported from Hungary also are in use and consist of motor rail cars and trailer cars.*

b. In Production.

Electric train sets are presently being produced in the USSR, and diesel train sets are being imported from Hungary.

* For references to these train sets, see Part II, Section II, C, below.

c. Plans and Trends.

No significant information is available on future Soviet plans for the production of the special units mentioned above, and no trends, other than the continued production and importation of these trains, are obvious or significant.

B. Gage Standards and Problems of Gage Conversion.

The gage of Soviet locomotives and rolling stock is 5 feet, or 1,524 mm (broad gage), although that of almost all of the other European countries is 4 feet 8-1/2 inches or 1,435 mm (standard gage). The through movement of trains in or out of the USSR, therefore, is restricted, and considerable time is lost in transloading goods or passengers or in regaging the wheel sets to permit transfer to a different gage. This problem has become more and more important as the USSR has developed its trade with the European Satellites and other European countries. Various schemes have been devised and tried by the Russians to solve this problem, but it is still of major concern.

1. Adjustable Gages.

a. Locomotives.

Since electrified lines do not cross the border of the USSR and since diesel locomotives are not widely used in either the USSR or other European countries, there is no need for gage conversion on these types. Steam locomotives are therefore the only types to be considered for gage conversion at present. Since in normal operation locomotives are assigned to certain districts, however, the necessity of gage conversion in peacetime does not exist, except for permanent transfer of a unit from one country to another.

Steam locomotives produced by the European Satellites for the USSR are usually equipped with wheel sets of standard European gage without main and side rods and are towed to a transfer point with the wheel sets of the Soviet broad gage and the main and side rods on a flatcar behind the locomotive. On reaching the transfer point, the necessary conversion is made, and the locomotive can then proceed under its own power.

Steam locomotives captured by the Russians were converted to broad gage by blocking out the cylinders from the cylinder pads with steel inserts in order to move the center line of the piston out to the wider gage of the wheels. This operation can be performed relatively easily on a locomotive whose frame is of the rail type on which the cylinders are bolted. On a locomotive with a cast frame on which the cylinders are an integral part of the locomotive bed, such a change is not possible, and it is not believed that gage conversions on any such locomotives have been made.

In peacetime, when both the standard- and broad-gage lines have a sufficient supply of motive power, it is likely that no gage conversion of locomotives other than for importation purposes takes place. In case of war, when one gage would conceivably have enough of its units destroyed by enemy action to warrant using locomotives of the other gage, such conversions could be effected with a minimum of effort on locomotives of rail-type bed construction. (Most steam locomotives in service in Europe today are of the rail-type bed construction.)

b. Freight Cars.

Several devices for adjusting the gage of freight cars have been tried by the USSR.* There are three basic methods of changing the gage of a car, as follows:

(1) The first method of gage conversion involves the removal of one wheel set or bogie and the substitution of another. In the case of 4-axle cars, this substitution is relatively simple, since the entire bogie is changed and the brake rigging and journal boxes are integral with the bogie frame. In the case of 2-axle cars (or any car where the brake rigging is hung from the car frame), the substitution becomes somewhat more difficult, since clearances for the wider or narrower wheel and axle set must be allowed for. In most cases, this means cutting the journal-box supports away in some areas and arranging the brake rigging for adjustment to either gage. After these adjustments have been made the first time, future changes are made with ease.

* Since passenger traffic is not heavy in and out of the USSR, the gage difference does not create a problem in passenger transfer.

To change the wheel set or the bogie, the cars are run one at a time onto a special track which has 1 rail on 1 side and 2 parallel rails on the other side, set to the 2 gages. One end of the car is jacked up, and the wheel set or the bogie is changed by running it out from under the car. The wheel set or the bogie of the new gage is then run under the car, and the jacks are lowered. This operation is then repeated at the other end of the car. It is a relatively quick and easy method of gage conversion, except that a sizable stock of wheel sets and bogies of both gages must be maintained.

(2) The second method of gage conversion reported is that of jacking up the car at one end as before, running out the present wheel set (in this case only the wheels and axles are removed from bogies), and placing the wheel set on a hydraulic press which forces the wheel in or out along the axle as required to adjust the gage to the width desired. This method works well if the gage is to be changed only once (or, at the most, a few times). The wheels are normally pressed on the axles with a pressure of about 40 tons. Moving the wheel back and forth over the same area under this pressure will cause deformation of the metal and eventual loosening of the wheel. This method was used on most of the freight cars captured by the Soviet army during World War II and sufficed as long as these cars remained on Soviet-gage trackage. Many cars have been returned to the European Satellites (particularly East Germany), but information is not available as to whether it was possible to regage the wheel sets hydraulically or whether new wheel sets were necessary.

(3) The third method of gage conversion involves the installation on the wheel and axle of some special device which will permit the widening or narrowing of the gage by means of pulling a pin out of the axle and reinserting it in the axle in a different hole when the gage conversion is made. These devices have been reported at various times and vary somewhat in detail. The technological difficulties of such a scheme are such that it does not appear likely that the idea has gone much beyond the experimental stage. Substituting a small pin for the holding force of a wheel pressed on an axle with a pressure of some 40 tons is neither safe nor likely, and this method of gage conversion must be regarded with caution until further information is available on the technical details.

2. Transloading of Goods.

The only alternative to changing the gage of freight cars so that goods may be transported from standard to broad gage, or vice versa, is to transfer the lading from one freight car to another. This is still the practice in many cases. It involves considerable labor, which, however, in the European Satellites does not seem to be a problem, because the labor required can in most cases be of an unskilled, forced, or convict nature.

C. Influence of and Similarity to Foreign Designs.

The development of Soviet locomotives and rolling stock has been influenced considerably by foreign designs, since the Russians are prone to take advantage of improvements developed and proved by other countries.

Development of steam locomotives in the USSR was for many years dependent on copying imported locomotives, particularly those of US and UK make. Steam locomotives produced by the American Locomotive Company and the Baldwin Locomotive Works were shipped to the USSR both before and during World War II. Some of the items that are now standard equipment on Soviet steam locomotives which are a result of foreign influences are the automatic coupler, welded boilers, air-brake equipment (a close copy of Westinghouse equipment and interchangeable with it in many instances), automatic stokers, superheaters, and roller-bearing journal boxes.

Electric locomotive production in the USSR seems to have been predicated to some extent on the units imported from Italy and the US. The first units used in the USSR were imported, and the specifications of later units indicate considerable copying.

In diesel locomotive production the same situation seems to exist. The first diesel locomotives in operation in the USSR were German-built. Later units, built by the Russians, are so closely copied that they even bear the same class designation, although the model number is changed. Postwar models built by the locomotive works at Khar'kov bear striking similarity to US road-transfer and road-freight locomotives.

In more recent years the Russians seem to have taken the initiative to some extent and have been trying to develop units which are basically of their own design: for example, the steam-diesel locomotive discussed earlier. Just how successful these units have been or will be remains to be seen.

In freight car production the Russians consistently have been trying to emulate the US. Four-axle freight cars are the rule now, and they are equipped, much as are their US counterparts, with air brakes, automatic couplers, and other modern devices. It will be a long time, however, before the present inventory of 2-axle low-capacity freight cars is out of service.

In passenger car production the Russians seem to be taking a different point of view. The all-metal passenger car program seems to be intended to impress on the Soviet people the abilities of the Russians to provide de luxe accommodations. As the inventory of such cars is, however, inadequate, such an impression may be short-lived.

IV. Production by Plants.

Locomotive and rolling stock plants are numerous in the USSR. About 120 plants have been reported as producing complete locomotives and/or rolling stock. Plants which may only repair or maintain equipment, however, are often reported as producing plants. All the plants reported since World War II as producing plants have been studied, therefore, to determine whether or not they were in fact producing plants during the postwar period and, if they were, to determine what their production rate was. Twenty plants were positively identified as producing plants, and 36 others were tentatively so identified.* The rest of the plants were identified either as overhaul or repair shops (41 such installations were identified) or as installations with various special functions such as the production of parts, the production of narrow-gage equipment, and the production of maintenance equipment.**

The 20 plants positively identified as producing plants have been studied carefully for information bearing on the type of

* For maps showing the locations of locomotive and rolling stock plants in the USSR, see Figures 1 and 2, following p. 34. The Konus Railroad Equipment Plant [redacted] at Saratov (see p. 48, below), which 50X1-HUM is producing locomotive tenders, is not included in this computation and is not shown on the maps.

** For a list classifying all these plants, see Appendix B.

equipment produced and the rate of production. Estimates have been made, where possible, by recording and plotting in chronological order all reported actual and planned rates of production, which are given on different bases ranging from daily to yearly bases. These plotted rates have been examined, obviously inaccurate ones have been eliminated, and yearly production rates have been estimated. Since all the plants for which production information has been found were in the process of reconstruction, reactivation, or new construction at one time or another during the postwar period, rates of production given for these plants may be considered as representing the maximum capacity of the plants for the years in question.

Production estimates for the 20 plants positively identified as producing plants account for a very large part of estimated Soviet production of locomotives and rolling stock. Eight plants account for all but a small part of the total estimated production of locomotives in the USSR. Nine plants account for the greater part of the total estimated production of freight cars. The information available on passenger car production is insufficient to indicate whether or not a significant number of passenger cars may be produced by plants other than the three plants positively identified as producing passenger cars.

A. Locomotives.

Production information is available for all the postwar years on 7 of the 8 Soviet plants positively identified as producing locomotives. The estimates made for these plants on the basis of this information indicate that they account for all but a small fraction of the estimated total Soviet production of locomotives. The close relation, indicated in Table 2,* between the total for these plants and the total estimated production of locomotives in the USSR,** reflects the fact that locomotive production is a heavy industrial operation that can be undertaken by only a limited number of plants, about which there is considerable information.

Information about the plants listed in Table 2 is summarized below, together with production estimates.

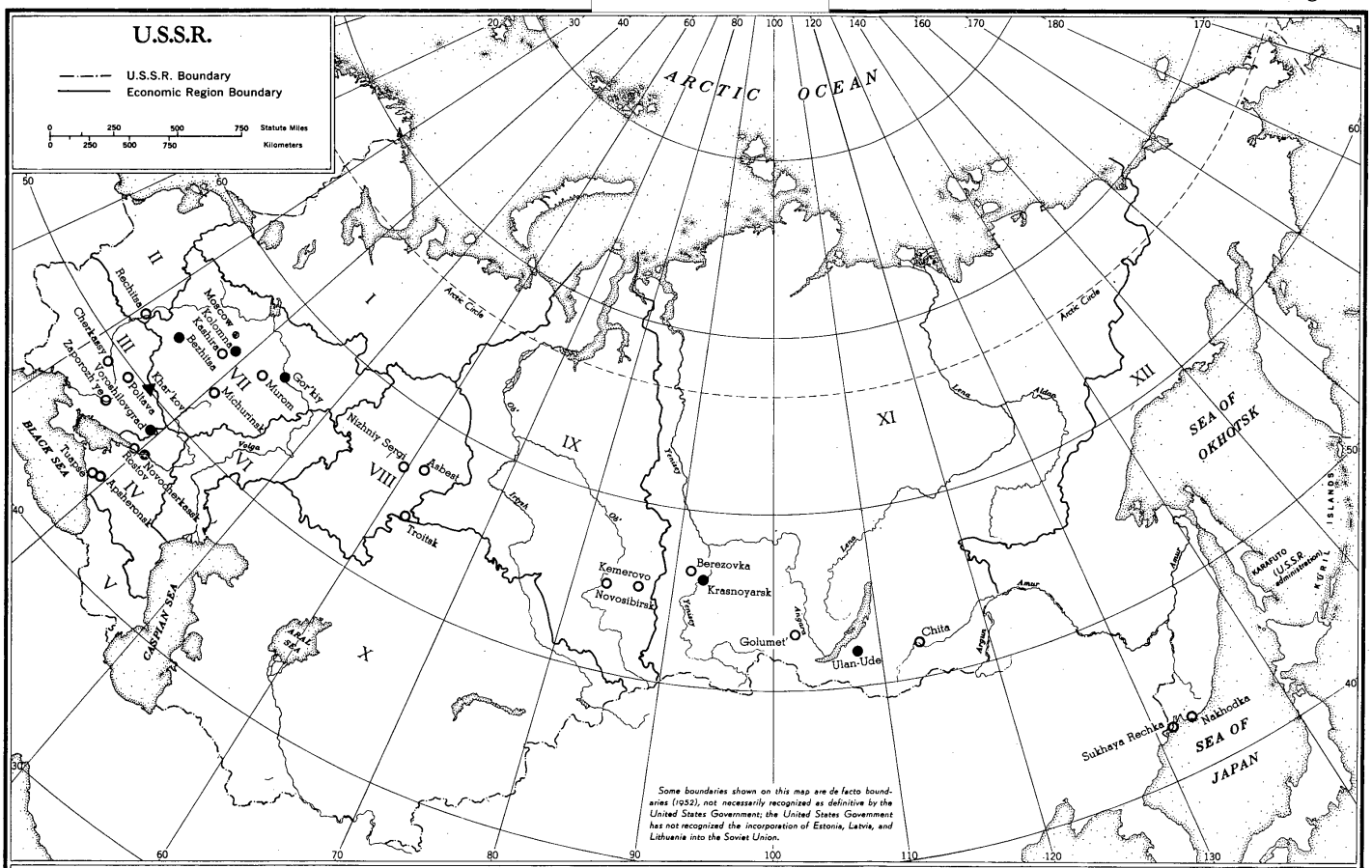
* Table 2 follows on p. 35.

** Estimated total production of locomotives is presented and explained in V, below.

SECRET

Figure 1

50X1



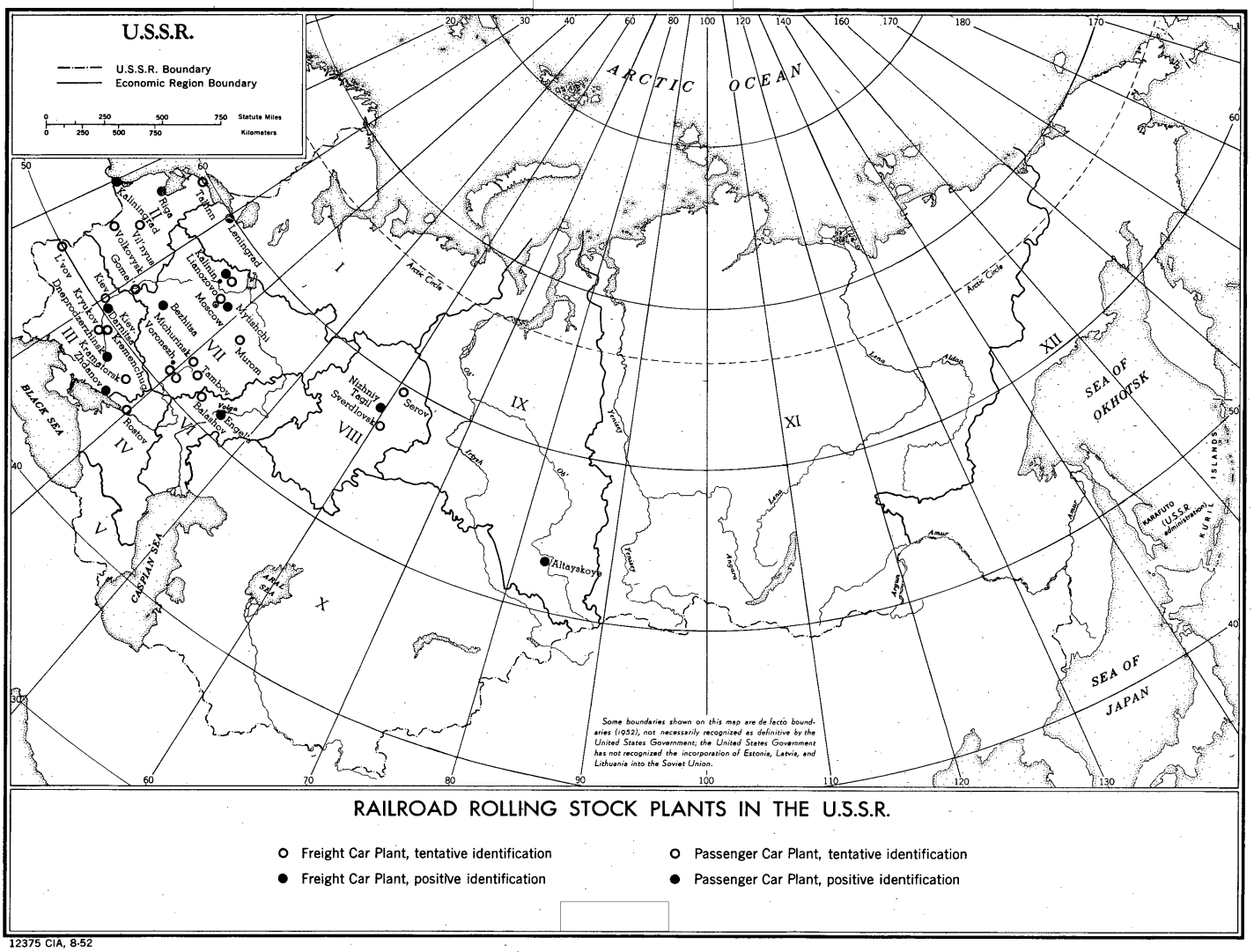
50X1

12376 CIA, 8-52

SECRET

Figure 2

50X1



50X1

12375 CIA, 8-52

Table 2

Estimated Locomotive Production in the USSR
by Plants Positively Identified as Producing Locomotives
Compared with Total Estimated Production a/
1946-52

Units

Type and Plant	1946	1947	1948	1949	1950	1951	1952
Steam							
Bezhitsa	0	12	88	180	300	360	360
Gor'kiy	N.A.	25	200	250	250	250	250
Kolomna	50	180	270	360	390	400	400
Krasnoyarsk	144	144	120	110	120	130	140
Ulan-Ude	80	165	220	260	295	320	340
Voroshilovgrad	20	220	360	480	600	650	675
Total Plant-by-Plant	294	746	1,258	1,640	1,955	2,110	2,165
(Total Estimated Production)	(330)	(900)	(1,360)	(1,700)	(2,040)	(2,170)	(2,250)
Electric							
Novocherkassk	N.A.	25	55	100	165	220	265
(Total Estimated Production)	(2)	(25)	(60)	(110)	(170)	(225)	(280)

a. Figures on total estimated production, which are rounded, are taken from Figure 15, following p. 54, below.

Table 2

Estimated Locomotive Production in the USSR
by Plants Positively Identified as Producing Locomotives
Compared with Total Estimated Production
1946-52
(Continued)

Units

Type and Plant	1946	1947	1948	1949	1950	1951	1952
Diesel							
Khar'kov	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
(Total Estimated Production)	(1)	(40)	(75)	(140)	(185)	(205)	(230)
All Types							
Total Plant-by-Plant	294	771	1,313	1,740	2,120	2,330	2,430
(Total Estimated Production)	(333)	(965)	(1,495)	(1,950)	(2,395)	(2,600)	(2,760)

1. Bezhitsa *

Since World War II the Krasnyy Profintern Railroad Locomotive Building Plant at Bezhitsa, a suburb of Bryansk, has been engaged in the construction of the L (Pobeda)-class steam locomotive for freight service (see Fig. 3**). Production began in 1947 with 12 units. In 1948, production increased to 88 units. In 1949, 1950, and 1951 there were further increases, to 180, 300, and 360 units, respectively. Estimates for 1952 indicate that the plant may have reached its planned capacity of 360 units, since the 1951 production of 360 units is the estimate of planned capacity arrived at by CIA Industrial Register studies.

2. Gor'kiy.

Postwar production figures for the Krasnoye Sormovo Plant imeni Zhdanov at Gor'kiy are scattered and varied. The type of unit is not clearly specified, but reports indicate that the production is largely of JS-class passenger steam locomotives (see Fig. 4**). The best estimate of postwar production of units that is possible from the information available is as follows:

1947:	25
1948:	200
1949:	250
1950:	250
1951:	250
1952:	250

There is an indication in the reports that the plant may have started production of some type of freight car in 1948. No positive information, however, is available.

3. Kolomna.

The Kuybyshev Railroad Locomotive Plant at Kolomna is the second largest locomotive plant in the USSR. Many estimates are available [redacted] and the best compilation of these various estimates shows that the type of unit produced has been predominantly the L-class freight locomotive. In 1946, production began again with the output of 50 units. From 1947 to 1951,

50X1

* Plants discussed throughout this section are numbered consecutively to correspond to the numbering of plants in Appendix B.
** Following p. 38.

production increased rapidly, with 180 units in 1947, 270 in 1948, 360 in 1949, 390 in 1950, and 400 in 1951. In 1952 the estimate of production is the same as in 1951. In 1947-48, 1 experimental Mallet-type locomotive with a wheel alignment of 2-6-6-2 and 3,000 hp was built by this plant. Further production of this new model, known as the P-34-001, has not been reported, although, if it proved successful in trials, it is probable that some additional units have been or will be produced.

4. Krasnoyarsk.

The Sibirskiy Heavy Machine Plant (also known as the Stalin Locomotive and Crane Plant) at Krasnoyarsk (see Fig. 5*) was enlarged and set up for the production of locomotives with equipment evacuated from the war areas of the USSR during World War II. Production in quantity was begun in 1946, and, with a sizable force of Japanese prisoners of war, production amounted to 144 units. This production rate was maintained in 1947, but in 1948, with the release of large numbers of prisoners of war, production dropped to 120 units. In 1949 there was a further drop to 110 units. In the succeeding 3 years, production is estimated to have increased by 10 units a year, until, in 1952, approximately 140 units were produced. The type of locomotive produced is the SO-class freight steam locomotive (see Figs. 6 and 7*).

5. Ulan-Ude.

The railroad locomotive plant at Ulan-Ude (see Fig. 8*) was enlarged from a repair plant during World War II and is at present the largest production plant for railroad locomotives in Asiatic USSR. As in the case of the Krasnoyarsk plant, production is of the SO-class freight steam locomotive. The eventual capacity of the plant has been repeatedly reported as one unit per day. [redacted] this goal has not yet been met, although this rate was to be almost reached in 1952. Estimates of production of units from 1946 on are as follows: 50X1

* Following p. 38.

FIGURE 3. FIRST L (POBEDA)–CLASS FREIGHT STEAM LOCOMOTIVE PRODUCED AFTER WORLD WAR II AT THE KRASNYY PROFINTERN RAILROAD LOCOMOTIVE BUILDING PLANT AT BEZHITSA, A SUBURB OF BRYANSK. The inscription on the front of the locomotive, *pervenets Bryanskikh parovozostroiteley*, means "First-born of Bryansk steam locomotive builders."

S-E-C-R-E-T

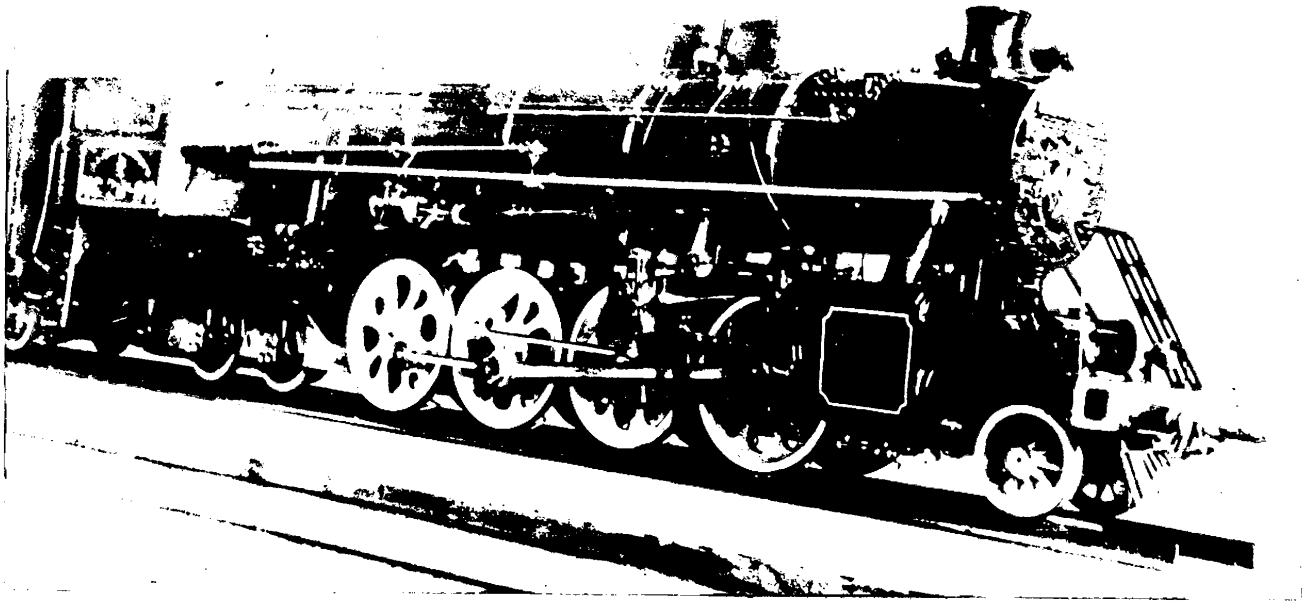


FIGURE 4. WORKING MODEL OF THE JS–CLASS PASSENGER STEAM LOCOMOTIVE, THE MOST MODERN SOVIET PASSENGER STEAM LOCOMOTIVE CURRENTLY IN SERIAL PRODUCTION. The inscription on the front of the locomotive is *I Stalin*. The Krasnoye Sormovo Plant imeni Zhdanov at Gor'kiy is known to be producing the JS–class passenger steam locomotive at the present time.

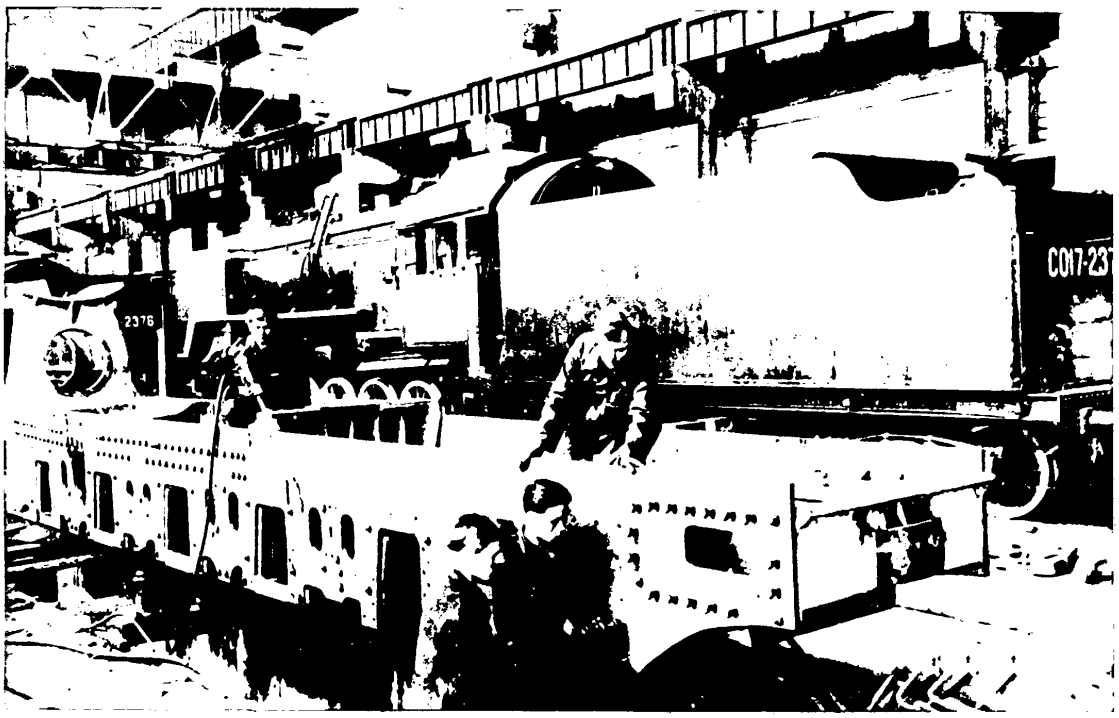


FIGURE 6. LOCOMOTIVE ASSEMBLY LINE AT THE SIBIRSKIY HEAVY MACHINE PLANT AT KRASNOYARSK. Note the pneumatic wrenches in use on the bolted, rolled steel frame. The boiler saddle and frame brackets appear to be of cast steel. The tender in the background is largely of welded construction.

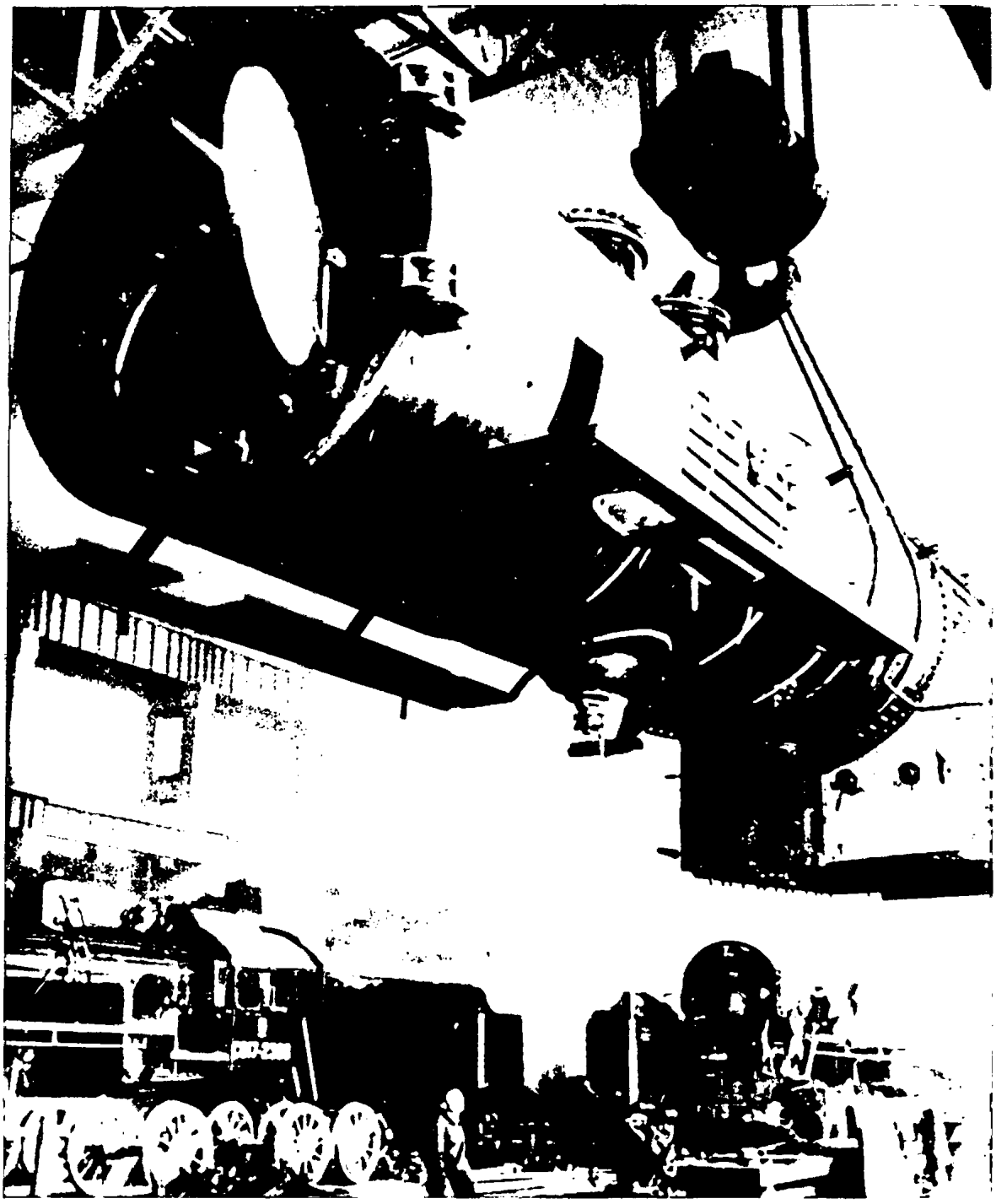


FIGURE 7. INTERIOR OF THE LOCOMOTIVE ASSEMBLY SHOP AT THE SIBIRSKIY HEAVY MACHINE PLANT AT KRASNOYARSK, 1948. Note that the boiler and the firebox are riveted together. The remainder of the boiler and the smokebox are apparently of welded construction.

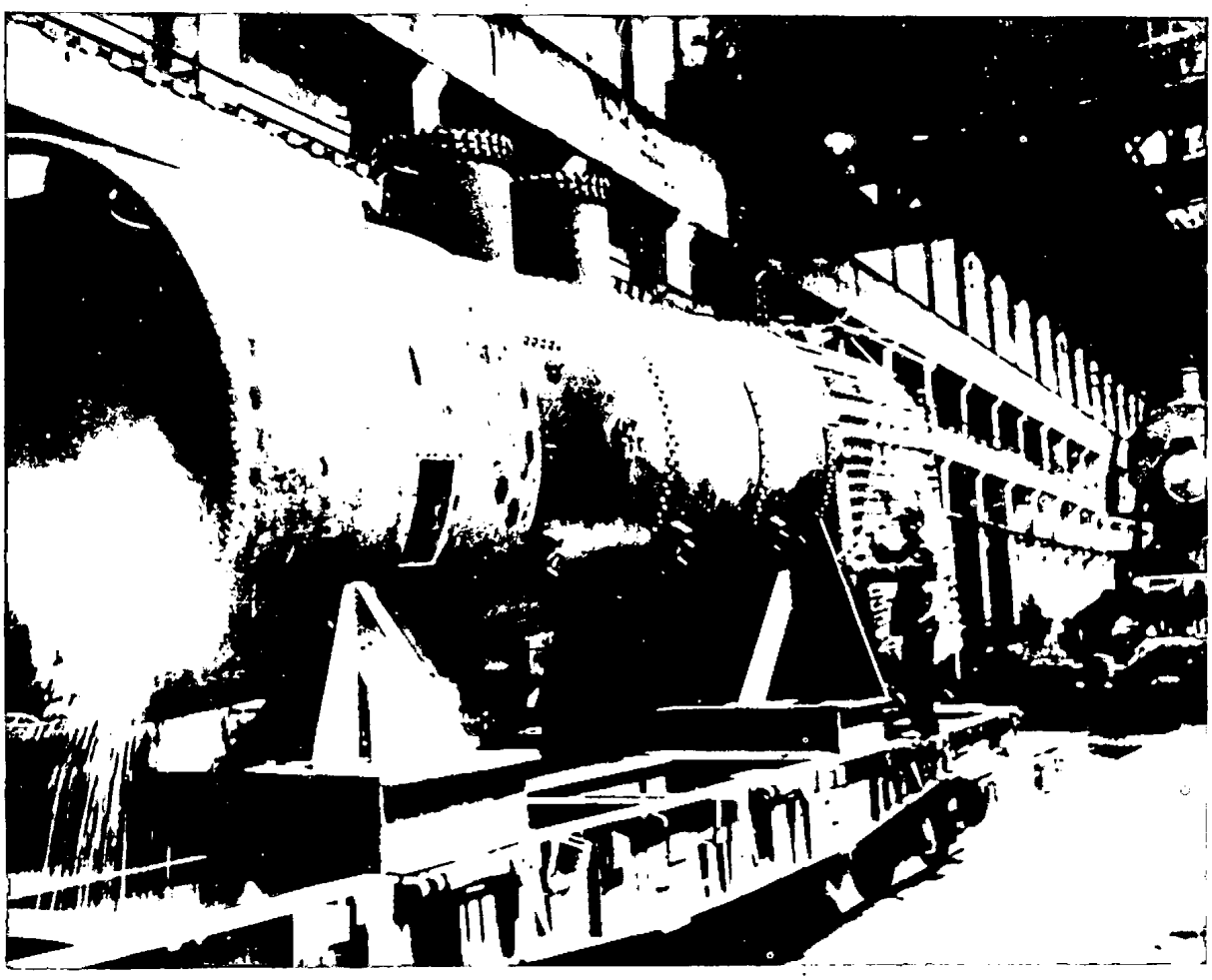


FIGURE 8. INTERIOR OF THE LOCOMOTIVE ASSEMBLY SHOP AT THE RAILROAD LOCOMOTIVE PLANT AT ULAN-UDE, 1948. Note the riveted construction of the boiler.

1946:	80
1947:	165
1948:	220
1949:	260
1950:	295
1951:	320
1952:	340

6. Voroshilovgrad.

The Voroshilovgrad Steam Locomotive Plant imeni October Revolution (see Fig. 9*) is the largest producer of steam locomotives in the USSR. Since World War II, it has produced freight steam locomotives of the SO class and is reported as having produced some locomotives of the JS class. In addition, this plant was responsible for the production of the first steam-diesel locomotive, known as the "Teploparavos." (See Appendix A.) Estimated production of units at this plant from 1945 to 1952 is as follows:

1945:	12
1946:	20
1947:	220
1948:	360
1949:	480
1950:	600
1951:	650
1952:	675

7. Novocherkassk.

The Novocherkassk Electric Locomotive Plant imeni Budennyy is the only plant in the USSR that has been definitely identified as producing electric main-line locomotives in postwar years. The pilot models of the locomotive that Novocherkassk has produced have been developed and built at the Moscow Dynamo Plant imeni Kirov (see Fig. 10*), but the serial production of these units has been carried out at Novocherkassk. From 1947 to some time in 1950 the plant was engaged in the production of the VL-22m-class electric locomotive (see Fig. 11*). Some time in 1950, production may have been

* Following p. 40.

started on a later model, [redacted] 50X1
[redacted] It has been possible, however, to 50X1
estimate production of electric locomotive units since the plant began producing in 1947. Estimated production of units at this plant from 1947 to 1952 is as follows:

1947:	25
1948:	55
1949:	100
1950:	165
1951:	220
1952:	265

There is no evidence that the plant reached its maximum capacity in 1952. Production will probably continue to increase in the future.

8. Khar'kov.

After the termination of World War II the Khar'kov Transportation Machine Building Plant (KhZTM) was to be rebuilt and assigned the task of producing diesel locomotives. The Kolomna plant had been the only producer of diesel locomotives in the USSR before the war. Very little statistical information on the production of diesel locomotives in the USSR is available. [redacted] 50X1
[redacted] the 50X1
first postwar diesel locomotive was completed at Khar'kov in September 1946 and was of the TE-1 class (1,000 hp) and that the first TE-2 class (2,000-hp) diesel-electric locomotive (see Fig. 12*) was completed in November 1948. No other production figures are available.

B. Freight Cars.

The estimated production during the postwar period of the nine plants positively identified as producing freight cars constitutes a large part of the estimated total Soviet production of freight cars. As indicated in Table 3,** however, a significant fraction of production remains, from which it follows that at least some of the plants tentatively identified as producing freight cars probably do produce them in considerable numbers.

* Following p. 40.
** Table 3 follows on p. 41.

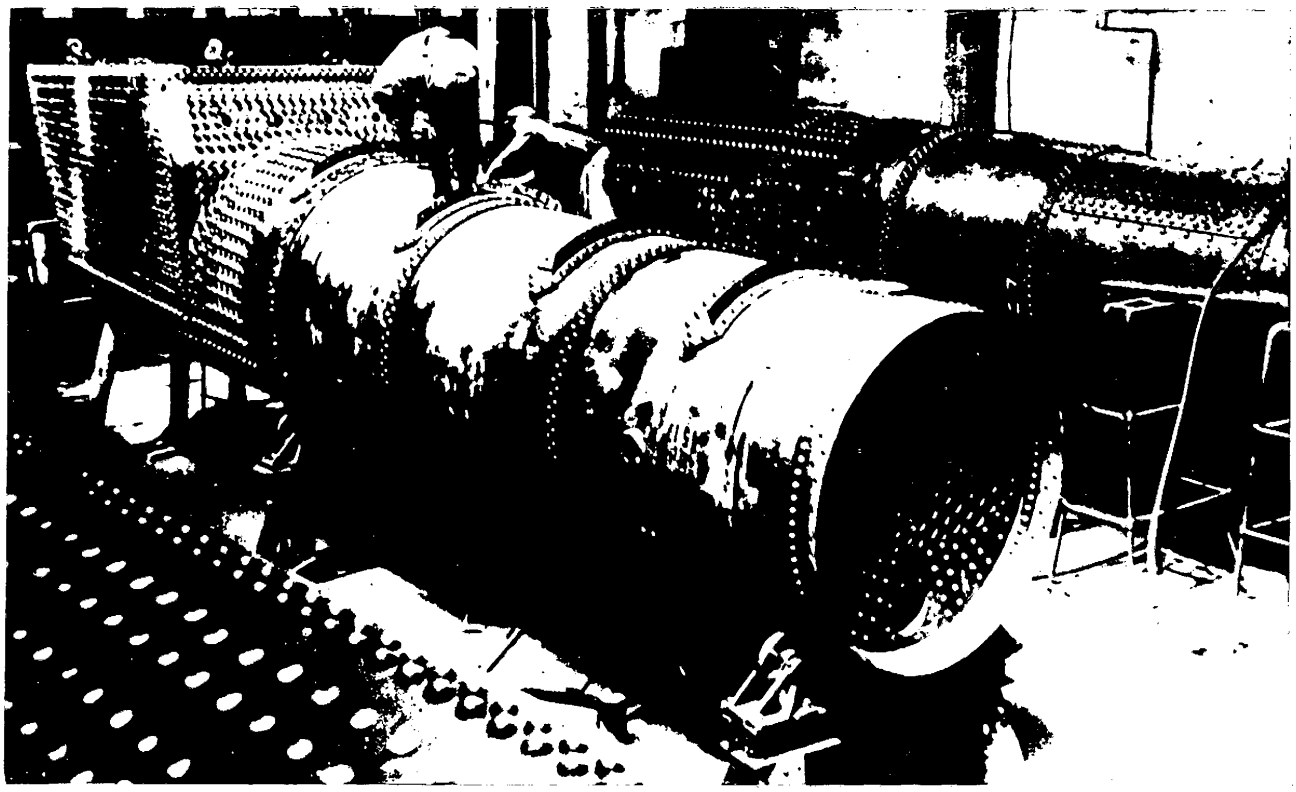


FIGURE 9. PREWAR CONSTRUCTION OF BOILERS AT THE VOROSHILOVGRAD STEAM LOCOMOTIVE PLANT IMENI OCTOBER REVOLUTION, 1934. Note the all-riveted construction and the use of jigs for positioning the boiler in order to facilitate work.

FIGURE 10. SOVIET VL–19–CLASS ELECTRIC LOCOMOTIVE, PRODUCED ABOUT 1933. Before World War II, this class of locomotive was produced at the Moscow Dynamo Plant imeni Kirov.

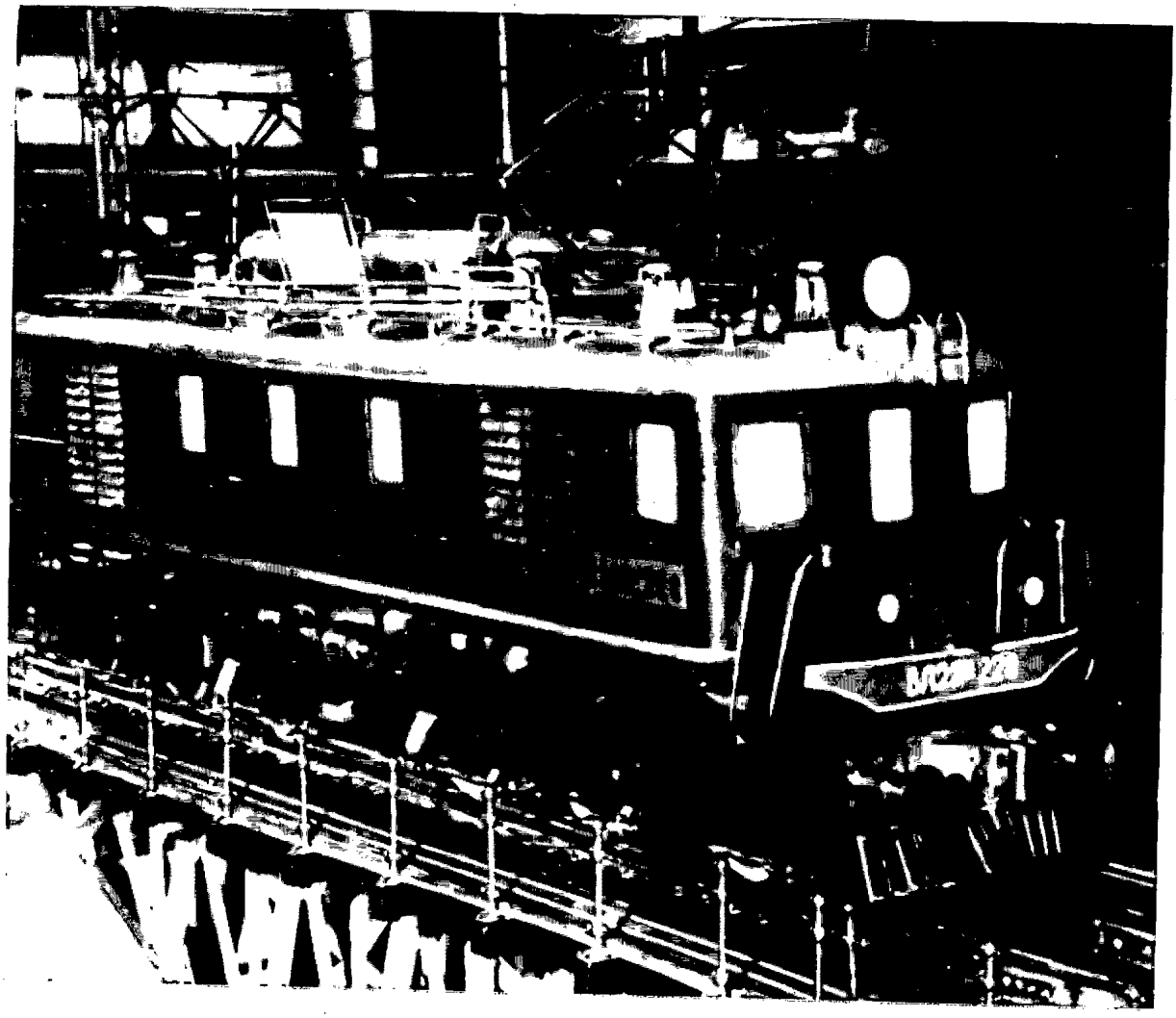


FIGURE 11. SOVIET VL–22M–CLASS ELECTRIC LOCOMOTIVE, 1952. The photograph is of a model of the locomotive as produced by the Novocherkassk Electric Locomotive Plant imeni Budennyy. Basically this model seems to be a slightly more modern version of the VL–19–class electric locomotive as produced before World War II at the Moscow Dynamo Plant imeni Kirov.

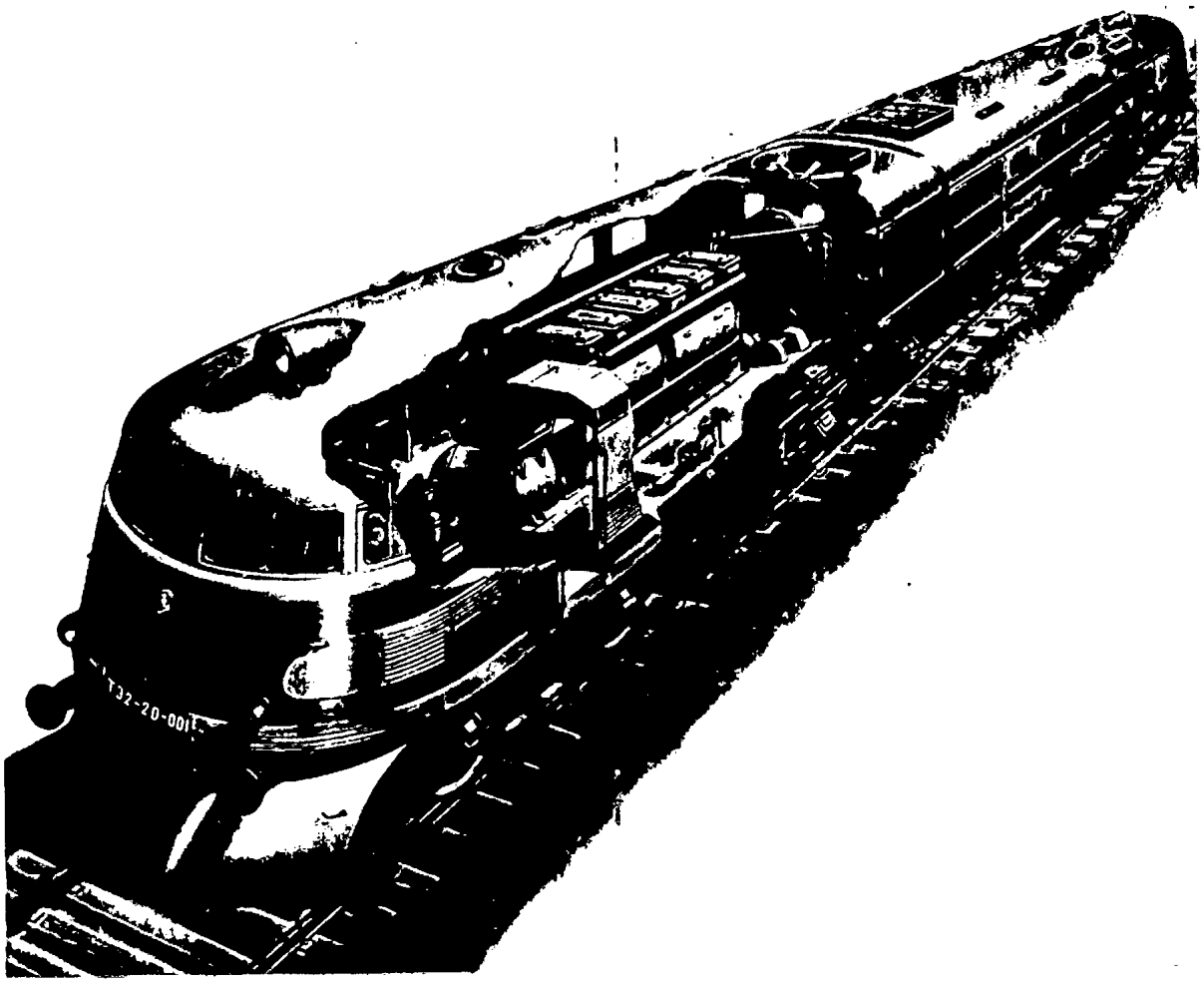


FIGURE 12. CUTAWAY VIEW OF THE TE-2-CLASS DIESEL-ELECTRIC LOCOMOTIVE CURRENTLY IN PRODUCTION AT THE KHAR'KOV TRANSPORTATION MACHINE BUILDING PLANT. The locomotive consists of 2 units, each of 1,000 horsepower.

Table 3

Estimated Freight Car Production in the USSR
by Plants Positively Identified as Producing Freight Cars
Compared with Total Estimated Production a/*
1946-52

Units

Type and Plant	1946	1947	1948	1949	1950	1951	1952
2-Axle							
Altayskoye	150	450	800	1,300	1,000	1,700	1,700
Engel's	600	600	1,200				
Zhdanov	3,000	2,500	2,000				
Total Plant-by-Plant	3,750	3,550	4,000	1,300	1,000	1,700	1,700
(Total Estimated Production)	(5,200)	(6,200)	(7,000)	(8,000)	(9,000)	(9,000)	(9,000)
4-Axle							
Dneprodzerzhinsk	1,300	2,200	3,100	3,700	3,900	4,100	4,300
Engel's		600	1,200	3,000	3,300	3,450	3,600
Kalinin	420	520	620	720	720	720	720
Kaliningrad	300	750	1,100	1,300	1,400	1,500	1,600

* Footnotes for Table 3 follow on p. 42.

Table 3

Estimated Freight Car Production in the USSR
by Plants Positively Identified as Producing Freight Cars
Compared with Total Estimated Production a/
1946-52
(Continued)

Units

Type and Plant	1946	1947	1948	1949	1950	1951	1952
(4-Axle Continued)							
Kiev-Darnitsa	200	700	1,400	2,300	3,100	3,700	4,000
Nizhniy Tagil	9,900	15,000	18,000	19,800	21,000	21,500	22,000
Zhdanov		2,500	4,000	6,500	6,500	6,500	6,500
Bezhitsa b/				70 to 100			
Total Plant-by-Plant	12,120	22,270	29,420	37,320	39,920	41,470	42,720
(Total Estimated Production)	(11,400)	(24,000)	(35,000)	(47,500)	(57,000)	(61,000)	(64,000)
All Types							
Total Plant-by-Plant	15,870	25,820	33,420	38,620	40,920	43,170	44,420
(Total Estimated Production)	(16,600)	(30,200)	(42,000)	(55,500)	(66,000)	(70,000)	(73,000)

a. Figures on total estimated production, which are rounded, are taken from Figure 16, p. 56, below.
b. See B, 10, p. 43, below.

9. Altayskoye.*

The Pravda Railroad Car Plant at Altayskoye is a small freight car plant engaged in the production of 2-axle flatcars. It is the only plant which has been reported as producing 2-axle units as late as 1952, although it is believed that production of such units is being carried out at other unidentified small plants. Estimates of the production of units for this plant from 1946 are as follows:

1946:	150
1947:	450
1948:	800
1949:	1,300
1950:	1,600
1951:	1,700
1952:	1,700

Estimates for the later years are not considered firm but are the best available.

10. Bezhitsa.

In 1949, [redacted] between 70 and 100 refrigerator cars were built at the Krasnyy Profintern Railroad Locomotive Building Plant at Bezhitsa. No later information concerning the production of freight cars of any type by this plant is available, but it is probable that freight car production continues on at least a small scale. 50X1

11. Dneprodzerzhinsk.

Since 1945 the Railroad Car Construction Plant imeni Gazety Pravda at Dneprodzerzhinsk has been engaged in the production of 4-axle gondola cars with capacities of from 40 to 60 tons. In 1951, some cars of 100-ton capacity were produced, but [redacted] this was a special order rather than a switch to serial production for this new type of car. The standard car in the later years has been the car of 60-ton capacity. Production in 4-axle units has been estimated as follows: 50X1 50X1

* Plants discussed throughout this section are numbered consecutively to correspond to the numbering of plants in Appendix B.

1945:	400
1946:	1,300
1947:	2,200
1948:	3,100
1949:	3,700
1950:	3,900
1951:	4,100
1952:	4,300

12. Engel's.

The Railroad Car Building Plant imeni Uritskiy at Engel's (also known as Saratov Engel's) started production again in 1945, at which time it produced 2-axle flatcars of 18- to 20-ton capacity and repaired war-damaged cars. During 1947, production was switched to a combination manufacture of 2-axle flatcars of 20-ton capacity and 4-axle flatcars with low wooden sides of 60-ton capacity for ore and the like. Less emphasis was placed on repair. The 1947 product mix seems to have been continued in 1948. Since 1949, production has been entirely of 4-axle cars, with little or no repair work. In 1951, however, the type of car produced was switched to pneumatic dump cars, and [redacted] such production would continue through 1952. Production for these years has been estimated as follows: 50X1

1945: 300 2-axle flatcars of 18- to 20-ton capacity.
1946: 600 2-axle flatcars of 18- to 20-ton capacity.
1947: 600 2-axle flatcars of 20-ton capacity.
600 4-axle flatcars of 60-ton capacity with low wooden sides for ore and the like.
1948: 1,200 2-axle flatcars of 20-ton capacity.
1,200 4-axle flatcars of 60-ton capacity with low wooden sides for ore and the like.
1949: 3,000 4-axle flatcars of 60-ton capacity with low wooden sides for ore and the like.
1950: 3,300 4-axle flatcars of 60-ton capacity with low wooden sides for ore and the like.
1951: 3,450 4-axle pneumatic dump cars of 60-ton capacity.
1952: 3,600 4-axle pneumatic dump cars of 60-ton capacity.

13. Kalinin.

The main efforts of the Railroad Car Building Plant imeni Kalinin are devoted to the construction of freight cars of approximately 50-ton capacity. These are flatcars with wooden sides for ore and the like. Some boxcars may also be produced, and a secondary function of the plant seems to be the production of passenger cars. The plant is a small one, [redacted] 50X1
[redacted] The best estimates of production show 50X1
a production rate of 420 4-axle cars in 1946, increasing by 100 cars per year until 1949, when production is estimated at 720 units. This production rate has been estimated to continue through 1952.

14. Kaliningrad.

The Kaliningrad Railroad Car Plant is engaged in the production of 4-axle all-metal pneumatic gondola dump cars. The cars are of advanced design, being of all-welded construction with 14 unloading hatches. Operation of the dump mechanism may be controlled from the locomotive cab. Production began in 1946 with some 300 units. In 1947, production jumped to 750 units, and in 1948 to 1,100 units. In 1949, 1,300 units were turned out, and production increased after that by about 100 units per year. In 1952 it is estimated that 1,600 freight cars were produced.

15. Kiev-Darnitsa.

The railroad car plant at Kiev-Darnitsa is engaged in the capital repair of freight cars as well as the production of new units. Separating the two functions [redacted] 50X1
[redacted] is difficult because a 50X1
car which has undergone capital repair is often reported as a new car. [redacted] new production, all of 4-axle 50X1
units, has been screened out and estimated as follows:

1946:	200
1947:	700
1948:	1,400
1949:	2,300
1950:	3,100
1951:	3,700
1952:	4,000

The planned production of this plant is, according to statements by the Soviet press, to be 12,000 2-axle freight cars and 2,500 passenger cars per year. No reports of passenger cars being produced at this plant were found, and estimates of freight car production in 1952 amount to only two-thirds of the stated Plan.

16. Nizhniy Tagil.

The Ural Railroad Car Plant imeni L.M. Kaganovich at Nizhniy Tagil is the largest freight car plant in the USSR. During World War II it was converted entirely to the production of tanks for the Soviet Army. One of the 3 production lines is reported still to be engaged in the production of tanks, although the other 2 have been reconverted to freight car production. In 1946 it is estimated that 9,900 4-axle flatcars with wooden sides were turned out. In 1947 this figure was raised to 15,000 flatcars. In 1948 the production rate increased to 18,000 units, but 20 percent of the production was boxcars. In 1949 the ratio of products remained the same, and 19,800 cars were produced. In 1950, 1951, and 1952, production was gradually raised to 21,000, 21,500, and 22,000 cars, respectively. Of these, 20 percent were boxcars, but the remaining 80 percent were reported to be all-metal gondola cars rather than flatcars, as previously reported.

17. Zhdanov.

The Mariupol' Steel Plant imeni Il'ich at Zhdanov is the largest, and perhaps the only, producer of tank cars in the USSR. In 1945 and 1946 the type of car produced was a 2-axle unit with a capacity of 25 cubic meters (see Fig. 13*). In 1947 and 1948, production seems to have been split between 2-axle cars and 4-axle cars with a capacity of 50 cubic meters. From 1949 on, it is estimated that only the larger 4-axle car with a capacity of 50 cubic meters has been produced. Production of units at this plant and their capacities have been estimated as follows:

1945:	750	2-axle, 25-cubic-meter
1946:	3,000	2-axle, 25-cubic-meter
1947:	2,500	2-axle, 25-cubic-meter
	2,500	4-axle, 50-cubic-meter

* Following p. 46.

FIGURE 13. TANK CAR ASSEMBLY LINE AT THE MARIUPOL' STEEL PLANT IMENI IL'ICH AT ZHDANOV, 1946. The photograph shows assembly-line production of 25-cubic-meter tank cars. Note the all-welded construction of the tanks.

1948: 2,000 2-axle, 25-cubic-meter
4,000 4-axle, 50-cubic-meter
1949: 6,500 4-axle, 50-cubic-meter
1950: 6,500 4-axle, 50-cubic-meter
1951: 6,500 4-axle, 50-cubic-meter
1952: 6,500 4-axle, 50-cubic-meter

C. Passenger Cars.

18. Leningrad.*

The Railroad Car Building Plant imeni Yegorov at Leningrad is engaged in the production of passenger and mail cars. Information on rates of production is very sketchy, and no estimate of production could be made. It is the plant which produces the much-publicized all-metal passenger cars for service on express trains in the USSR (see Fig. 14**).

19. Mytishchi.

The Mytishchi Railroad Car Building Plant builds passenger cars for the Moscow "Metro" (subway). Postwar production of V- and G-class passenger cars has been reported, and there are indications that production of a new type of car, the M-5 class, was started in 1951. No estimates of production rates were possible [redacted] 50X1
The Fourth Five Year Plan (1946-50) calls for the production of 500 cars for the subways, but no cars were produced until the middle of 1948. It is doubtful that the Plan figures were realized.

20. Riga.

The Riga Railroad Car Building Plant "Vayrogs" produces electric train sets for use on suburban electric lines. An electric train set consists of three cars, the middle car of which is the power car. It contains a 200- to 300-hp electric motor which draws its current from overhead electric wires by means of a pantograph. Production of train sets at the plant has been estimated as follows:

* Plants discussed throughout this section are numbered consecutively to correspond to the numbering of plants in Appendix B.
** Following p. 48.

1946:	3
1947:	36
1948:	60
1949:	80
1950:	93
1951:	103
1952:	110

Since 1950, some tramcars (streetcars) have been produced. Since 1951, some of the train sets produced have been of the new "low-platform" type, which permits the loading and unloading of passengers from track level rather than from a raised platform.

D. Locomotive Tenders.

21. Saratov.*

The Konus Railroad Equipment Plant [redacted] produced tanks during World War II and continued to produce them until the summer of 1947, when the production of 4-axle tenders for steam locomotives was begun. Reconversion to tank production probably could be made on short notice. Tender production from 1947 on has been estimated as follows: 50X1-HUM

1947:	120
1948:	300
1949:	360
1950:	390
1951:	410
1952:	410

* Plants discussed throughout this section are numbered consecutively to correspond to the numbering of plants in Appendix B.

FIGURE 14. ALL-METAL PASSENGER CAR, PRODUCED BY THE RAILROAD CAR BUILDING PLANT IMENI YEGOROV AT LENINGRAD, 1947. The inscription on the side of the car at the top, *goluboy ekspress*, means "Blue Express." On the lower part of the car the inscription *zhestkiy M. Kur. 4001* means "hard (seats), Moscow-Kursk (Railroad) 4001."

V. Production Estimates, 1928-60.

Production estimates of Soviet locomotives and rolling stock [redacted] are given in Tables 4, 5, 6, 7, and 8* and are presented in graphic form in Figures 15, 16, and 17.** In the commentary following each of these tables a detailed discussion of the method used in the development of the appropriate graph is given. The following general comments apply, however, to all three graphs. 50X1

The production figures shown for the period 1928-June 1941 are probably accurate within a very small margin of error, as they are largely Soviet figures which are considered reliable. In some cases, differing estimates were averaged, and in others the more highly evaluated estimate was chosen.

The production figures developed for 1945-50 are based on [redacted] 50X1
[redacted] estimates made from figures obtained from plant studies, 50X1
[redacted] They are subject 50X1
to a greater margin of error than the prewar estimates.

The projected production figures for 1951-60 are based largely on estimates of productive capacities. The capacities and their rate of expansion are based on the general rate of increase of the production of the unit concerned during 1928-40. These estimates do not purport to forecast the industrial plans of the USSR. Instead they show the estimated possible production rates with respect to particular commodities, taking into account previous average rates of capacity increase.

A. Locomotives.

1. Steam.

Estimates of steam locomotive production in the USSR [redacted] are given in Table 4*** (see also Fig. 15****). 50X1

* Pp. 50, 52, 53, 55, and 57, respectively, below.
** Following pp. 54, 56, and 58, respectively, below.
*** Table 4 follows on p. 50.
**** Following p. 54.

Table 4

Estimated Steam Locomotive Production in the USSR [redacted] 50X1

1927-52

Units

Year	I 43/	II 44/	III 45/	IV 46/	V 47/	VI 48/	VII 49/	VIII 50/	IX 51/	X 52/
1927-28							479		479	479
1928-29							575			575
1929-30							625			625
1931							810			810
1932			827				827		827	827
1933			930				930		930	930
1934			1,211				1,165		1,165	1,165
1935			1,529			1,500	1,518		1,518	1,518
1936							999		1,194	999
1937							1,171		1,214	1,171
1938							1,144			1,200
1939							1,000			1,030
1940		915					917			920
1941							739			650
1942										
1943										
1944										
1945	13	13					10	12		9
1946	390	390				300	300	334		280
1947	1,080	1,020				830	865	746		770
1948	1,650	1,500			1,200		1,200	1,258		1,180
1949	1,880	1,800			1,380		1,600	1,630		1,600
1950	2,200	2,000		2,164			2,200	1,955		2,200
1951								2,110		
1952								2,165		

[redacted] 50X1

The estimates in Table 4 were plotted (see Fig. 15*), and the best estimate of steam locomotive production was made from these plotted

* Following p. 54.

points. Consideration was given to the evaluation attached to each of the reported estimates, and the best estimate arrived at in this report will not therefore necessarily be an arithmetic average of the several estimates for each year. The projections for the years beyond 1952 were made by estimating the average increase in the production rate from 1928 to 1940 and using this as a guide to probable increases in production rate during future years. The curve was rounded off to meet the predicted rate evenly. Precluding a change in production because of a shift to armaments production, the production rate as projected is given a range of error of plus or minus 20 percent, and the estimates before 1952 are given a range of error of plus or minus 10 percent.

2. Electric.

Estimates of electric locomotive production in the USSR [redacted] are given in Table 5* (see also Fig. 15**). 50X1

Estimates in Table 5 for the years before 1938 agree to a reasonable extent. They are plotted (see Fig. 15**) with preference being given to the higher estimate, since no evidence has been found to substantiate the sudden drop in production indicated in Table 5, Column VI. In the years following World War II, estimates of production vary greatly. [redacted] 50X1
[redacted] the electric locomotive 50X1
plant in Novocherkassk, it seems to be the only plant producing main-line electric locomotives at present. These figures are regarded as the most reliable presently available. Projections beyond 1952 are made on the basis of possible expansion of capacity through increased efficiency and additional plant facilities. Requirements of the railroads through increased electrification of the system have not been considered by themselves, but, considering the advantages of electrification in mountainous and cold regions, it is felt that a continued expansion of the electrified network of the Soviet railroads will occur. For this reason, the production as projected is on a continually increasing basis at a rate equivalent to the expansion of the production of electric locomotives in the immediate postwar years. This expansion conforms to a degree with the estimates of required production of electric locomotives as shown in

* Table 5 follows on p. 52.
** Following p. 54.

Table 5

Estimated Electric Locomotive Production in the USSR

[redacted]

1932-54

50X1

Units

Year	I 53/	II 54/	III 55/	IV 56/	V 57/	VI 58/	VII 59/
1932				1		1	
1933				17		17	
1934				19		19	
1935				34		34	
1936				44		44	
1937				39		39	
1938				30		15	
1939				25		10	
1940	10			20		5	
1941				10		3	
1942							
1943							
1944							
1945							
1946				2		2	
1947	20	20		30	25	3	
1948	50	50	88	50	55		
1949	110	110	190	80	100		
1950	140	140		125	165		256
1951					220		306
1952							356
1953							406
1954							456

Table 5, Column VII. Combining this conformity with the relative paucity of information on Soviet plans, a range of error of plus or minus 25 percent has been assigned to the estimate for the years 1952-60, and plus or minus 10 percent for the preceding years, for which reports are much more complete.

3. Diesel.

Estimates of diesel locomotive production in the USSR [redacted] are given in Table 6 (see also Fig. 15*). 50X1

Table 6

Estimated Diesel Locomotive Production in the USSR
from Various Sources
1931-50

Units

Year	I 60/	II 61/	III 62/	IV 63/
1931			2	
1932		1	1	1
1933		1	1	1
1934		8	8	8
1935		4	4	4
1936		1	1	13
1937		1		
1938		1		
1939				
1940	5			
1941				
1942				
1943				
1944				
1945				
1946	1			
1947	60	45		
1948	150	85		
1949	180	125		
1950	200	175		

As can be seen from Table 6, diesel locomotive production before World War II was extremely small. Postwar estimates are practically nonexistent, and those available differ widely. [redacted] 50X1
[redacted] the 50X1
Khar'kov plant, which is now the sole producer of main-line diesel locomotives for the USSR.

* Following p. 54.

US shipments of diesel locomotives to the USSR as a part of Lend Lease together with imported German technical skills have increased the production ability of the Russians considerably. Diesel engines of 1,000 hp have been and are being built for tanks, and these same engines or similar engines are adaptable for locomotive use. Because of the higher efficiency of the diesel locomotive over the steam locomotive, it is believed that the USSR will push the production of this type of unit to the limit. The projection of the estimate to 1960 is made with this belief (see Fig. 15*). Dieselization of the Soviet railroads in the future may well follow the same pattern as in the US, in which case the production of diesel locomotives will be increased at a rate even greater than indicated.

Prewar estimates are believed to be accurate within plus or minus 10 percent, and postwar estimates are given a range of error of plus or minus 25 percent because of the scarcity of information available.

B. Rolling Stock.

1. Freight Cars.

Estimates of freight car production in the USSR [redacted] are given in Table 7** (see also Fig. 16***). 50X1

The various estimates given in Table 7 were plotted (see Fig. 16***), and the best estimate of freight car production in terms of 2-axle units was made from these plotted points. Prewar estimates agree fairly well, and little difficulty is encountered in making an estimate for these years. In the postwar years, however, estimates vary widely, and it is difficult to arrive at a best estimate. Primary consideration was given to those estimates which were more highly evaluated. In addition, the estimates for the years 1945-48 [redacted] were a valuable guide in estimating production during the immediate postwar years. [redacted] 50X1 50X1 50X1 50X1

* Following p. 54.
** Table 7 follows on p. 55.
*** Following p. 56.

Figure 15

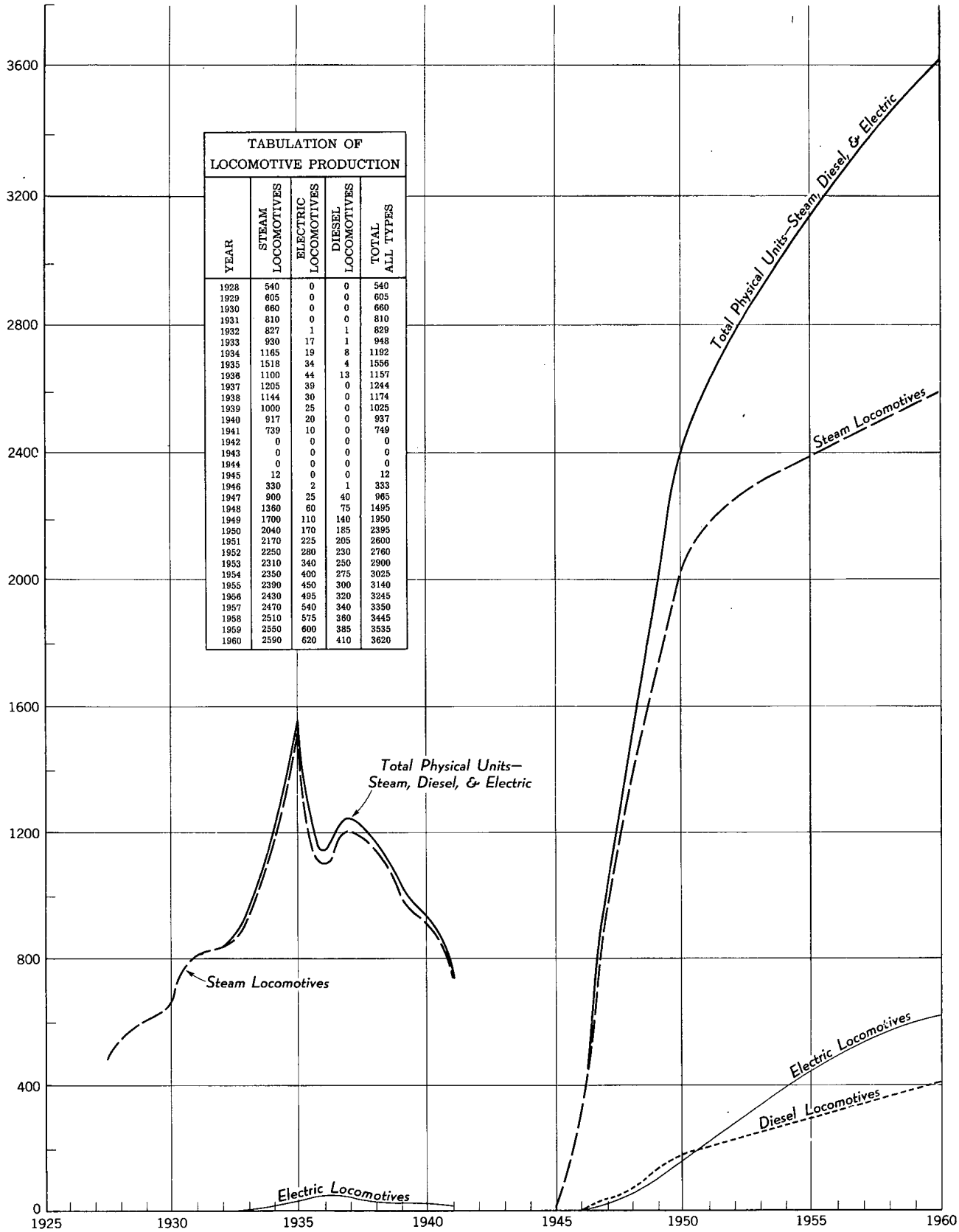
USSR

LOCOMOTIVE PRODUCTION

1928-1960

TABULATION OF LOCOMOTIVE PRODUCTION

YEAR	STEAM LOCOMOTIVES	ELECTRIC LOCOMOTIVES	DIESEL LOCOMOTIVES	TOTAL ALL TYPES
1928	540	0	0	540
1929	605	0	0	605
1930	660	0	0	660
1931	810	0	0	810
1932	827	1	1	829
1933	930	17	1	948
1934	1165	19	8	1192
1935	1518	34	4	1556
1936	1100	44	13	1157
1937	1205	39	0	1244
1938	1144	30	0	1174
1939	1000	25	0	1025
1940	917	20	0	937
1941	739	10	0	749
1942	0	0	0	0
1943	0	0	0	0
1944	0	0	0	0
1945	12	0	0	12
1946	330	2	1	333
1947	900	25	40	965
1948	1360	60	75	1495
1949	1700	110	140	1950
1950	2040	170	185	2395
1951	2170	225	205	2600
1952	2250	280	230	2760
1953	2310	340	250	2900
1954	2350	400	275	3025
1955	2390	450	300	3140
1956	2430	495	320	3245
1957	2470	540	340	3350
1958	2510	575	360	3445
1959	2550	600	385	3535
1960	2590	620	410	3620



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50X1

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Table 7

Estimated Freight Car Production in the USSR

[redacted] 50X1

1928-50

Units

Year	I 64/	II	III 65/	IV 66/	V 67/	VI 68/	VII 69/
1928			10,612	10,800	10,612		
1929			15,190		15,190		
1930			19,427		19,427		
1931			21,175		21,175		
1932			20,152	23,100	20,152		
1933			18,126	21,600	18,126		
1934			28,957	33,500	28,957		
1935		85,000 70/	85,675	90,800	85,675		
1936			67,200	67,100	67,100		
1937		59,000 71/	59,000	66,100	59,000		
1938			43,400		49,100		
1939			40,000		33,900		
1940	55,000	47,000 72/	50,000	52,000	47,000		
1941			55,000		60,000		
1942							
1943							
1944							
1945	1,000		800		1,050	1,850	
1946	30,000		23,200	31,500	26,190	30,500	
1947	47,000	60,000 73/	45,000		63,500	47,340	60,000
1948	68,000	80,000 74/	65,000		105,500	61,840	80,000
1949	100,000	117,600 75/	92,000		127,000	76,040	110,000
1950	117,000	126,900 76/	125,000		146,000		135,000

[redacted] 50X1

Projections for the years beyond 1950 are largely based on two lines of reasoning. First, since the Soviet freight car inventory is overutilized by Western standards, the production of freight cars will continue to increase in an attempt to bring the inventory up to a higher standard. Second, the annual increase in production after 1950 is assumed to equal the average numerical

increase during the prewar years, when the industry was engaged in what might be called normal, but intensive, development.

Estimates up to 1952 are given a range of error of plus or minus 10 percent. Without considering the possible shift to armaments production* in some of the freight car plants, production rates from 1952 on are given a range of error of plus or minus 20 percent.

With the exception of a few specialized units such as depressed-center cars and the like, production of freight cars in the USSR has consisted of 2-axle and 4-axle units. To show the trends in the type of units produced, estimates have been made of the production of each of these two types of units as well as of the total number of physical units. The method used in making these estimates was the same as the method used in estimating production of equivalent 2-axle units, with the exception of the production estimate of total physical units, which is merely the summation of the 2 estimates of 2-axle and 4-axle units. Where required, the various estimates were modified so that they agreed when totaled.

2. Passenger Cars.

Estimates of passenger car production in the USSR [redacted] 50X1
[redacted] are given in Table 8** (see also Fig. 17***). 50X1

The various estimates given in Table 8 were plotted (see Fig. 17***), and the best estimate of passenger car production was made from these plotted points. As can be seen, there is not much conflict among the three estimates in most years. Information on passenger car production is not voluminous, but the estimates for the years 1928-50 are considered to be accurate within 10 percent. [redacted] 50X1
50X1

[redacted]

Projections for the years beyond 1950 are based on two lines of reasoning. First, the Russians do not consider passenger car production a high-priority item. Such units as are presently produced seem to be produced in an attempt to picture

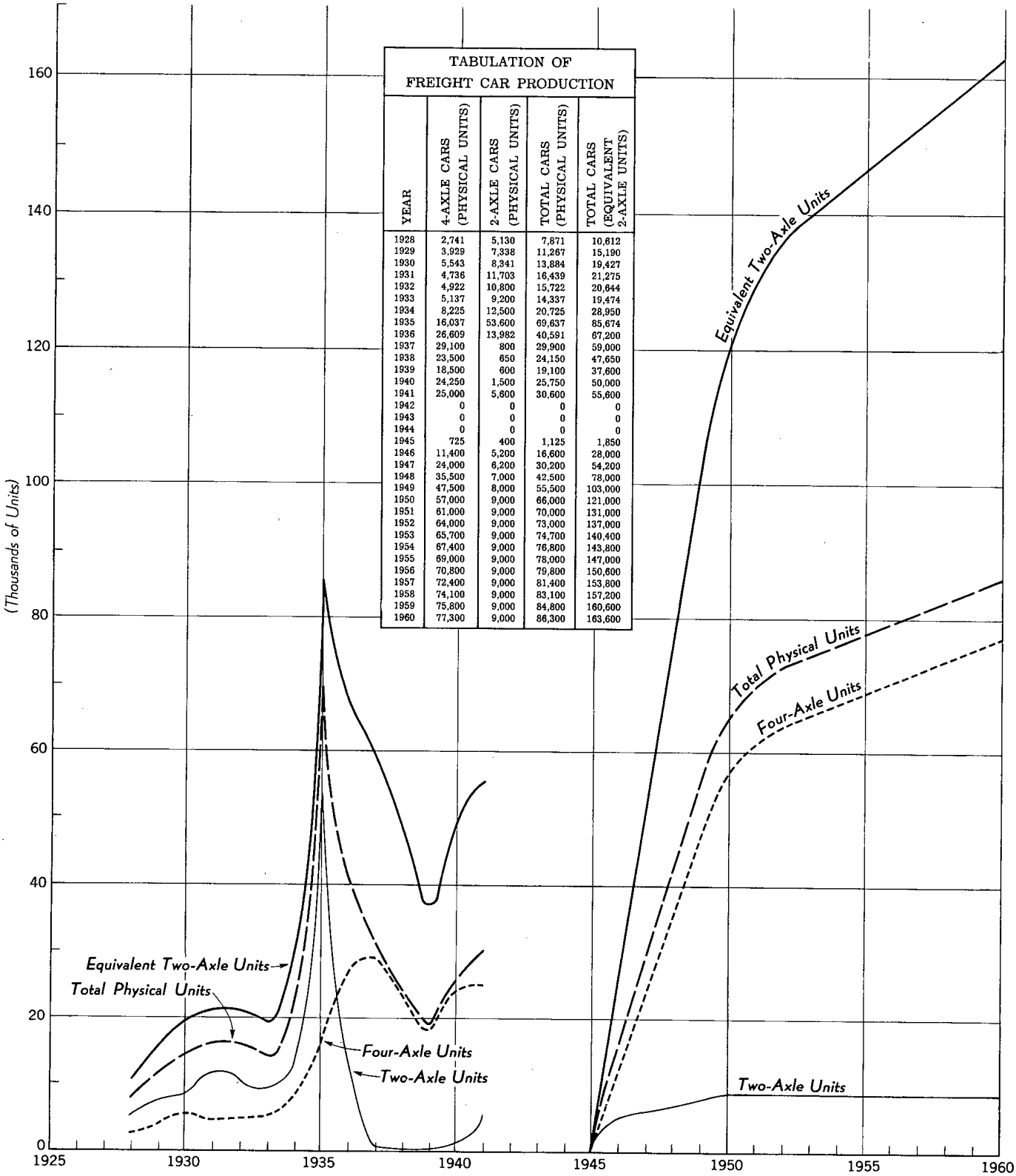
* The results of a shift to armaments production are discussed in X, below.
** Table 8 follows on p. 57.
*** Following p. 58.

Figure 16

USSR
FREIGHT CAR PRODUCTION
1928-1960

TABULATION OF FREIGHT CAR PRODUCTION

YEAR	4-AXLE CARS (PHYSICAL UNITS)	2-AXLE CARS (PHYSICAL UNITS)	TOTAL CARS (PHYSICAL UNITS)	TOTAL CARS (EQUIVALENT 2-AXLE UNITS)
1928	2,741	5,130	7,871	10,612
1929	3,929	7,338	11,267	15,190
1930	5,543	8,341	13,884	19,427
1931	4,736	11,703	16,439	21,275
1932	4,922	10,800	15,722	20,644
1933	5,137	9,200	14,337	19,474
1934	8,225	12,500	20,725	28,950
1935	16,037	53,600	69,637	85,674
1936	26,609	13,982	40,591	67,200
1937	29,100	800	29,900	59,000
1938	23,500	650	24,150	47,650
1939	18,500	600	19,100	37,600
1940	24,250	1,500	25,750	50,000
1941	25,000	5,600	30,600	55,600
1942	0	0	0	0
1943	0	0	0	0
1944	0	0	0	0
1945	725	400	1,125	1,850
1946	11,400	5,200	16,600	28,000
1947	24,000	6,200	30,200	54,200
1948	35,500	7,000	42,500	78,000
1949	47,500	8,000	55,500	103,000
1950	57,000	9,000	66,000	121,000
1951	61,000	9,000	70,000	131,000
1952	64,000	9,000	73,000	137,000
1953	65,700	9,000	74,700	140,400
1954	67,400	9,000	76,800	143,800
1955	69,000	9,000	78,000	147,000
1956	70,800	9,000	79,800	150,600
1957	72,400	9,000	81,400	153,800
1958	74,100	9,000	83,100	157,200
1959	75,800	9,000	84,800	160,600
1960	77,300	9,000	86,300	163,600



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50X1

Table 8

Estimated Passenger Car Production in the USSR

[redacted] 50X1

1928-50

Units

Year	I 77/	II 78/	III 79/
1928	387	387	
1929	414	321	
1930	817	828	
1931	1,295	1,299	
1932	1,141	1,157	
1933	1,274	1,338	
1934	1,495	1,616	
1935	887 a/	1,080	
1936	723 a/		
1937	912 a/		
1938	1,000		
1939	1,200		
1940	800		1,000
1941	300		
1942			
1943			
1944			
1945			
1946	100		100
1947	500		200
1948	1,100		1,200
1949	1,700		1,800
1950	2,600		2,500

a. The drop in production in these years was due to the stress on and the shift to freight car production.

the USSR as having modern, well-equipped passenger car facilities. No attempts seem to be made to supply the railroads with sufficient numbers of passenger cars to meet traffic demands. Second, it is further reasoned that production in the years after 1950 has

continued and will continue to follow the average pattern of the prewar years: that is, production will be increased, but at a rate roughly equivalent to the average increases in production in the years 1928-40. Without considering a shift to armaments production,* the projected production rates are given a range of error of plus or minus 20 percent.

VI. Input Requirements.

The determination of inputs of materials, power, labor, services, and capital required for the production of locomotives and rolling stock in the USSR is a problem that can be approached by several methods. The ideal method would be to obtain complete bills of material for all types of units produced, complete lists of all machine tools required for the production of a specified number of these units, and figures on the number of men and on the power required for this production. A lengthy study of Russian-language documents and texts available in the Library of Congress may show that such information is available in sufficient detail to permit such estimates. This method, although undoubtedly the most accurate, would be the longest process.

[redacted] 50X1

[redacted] analogy with US practice, for which there are figures rather readily obtainable from the US Census of Manufactures and the US Bureau of Labor Statistics. Because of the pressure of time, this method of approach has been applied fully in this report. 50X1

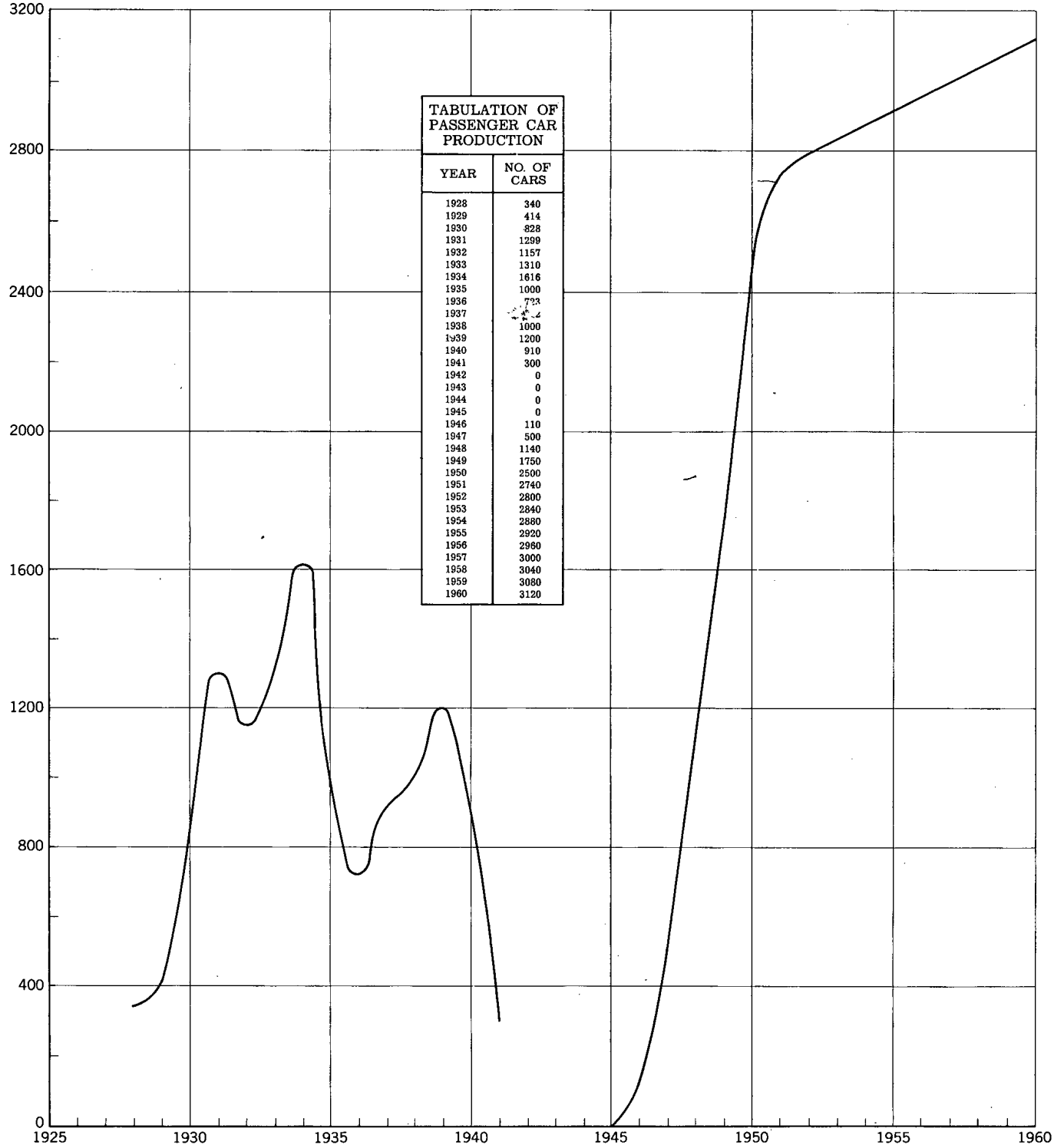
Estimates of inputs to the locomotive and rolling stock industry in the USSR were made on the basis of figures obtained from the US Census of Manufactures, 1947, and from tabulations of purchases made by the locomotive and parts industry and the railroad and streetcar industry in 1947. 80/ The tabulations list the dollar values of inputs of materials, fuel, electricity, and contract work to these two industries. By reference to the 1947 Census and these tabulations, it was possible to determine an index of amount of input required per unit of output.

* The results of a shift to armaments production are discussed in X, below.

Figure 17

50X1-HUM

PASSENGER CAR PRODUCTION
1928-1960



TABULATION OF PASSENGER CAR PRODUCTION

YEAR	NO. OF CARS
1928	340
1929	414
1930	828
1931	1299
1932	1157
1933	1310
1934	1616
1935	1000
1936	723
1937	[illegible]
1938	1000
1939	1200
1940	910
1941	300
1942	0
1943	0
1944	0
1945	0
1946	110
1947	500
1948	1140
1949	1750
1950	2500
1951	2740
1952	2800
1953	2840
1954	2880
1955	2920
1956	2960
1957	3000
1958	3040
1959	3080
1960	3120

50X1

GR1269 CIA, 11-52

For purposes of estimating inputs, the Soviet units of steam, diesel, and electric locomotives currently produced have been considered as being comparable to units produced in the US in 1947. A comparison of the gross weight of individual locomotives currently produced in the USSR and the average gross weight of units produced in the US in 1947 substantiates this assumption.

In the case of freight cars, the average US freight car is a 4-axle unit, and the inputs derived for these 4-axle units have been halved and listed as inputs per equivalent 2-axle unit.

In the case of passenger cars, lack of time in which to make a similar estimate by reference to the 1947 Census made it necessary to estimate inputs to passenger cars on the basis of freight car inputs, using a suitable correction factor. The tare weights of passenger and 4-axle freight cars are in the ratio of approximately 2.5 to 1. Since the largest part of such cars is iron and steel in various forms, this ratio has been applied to all input items for freight cars to derive inputs to passenger cars. It is realized that this approximation is not accurate, but since the number of passenger cars involved as compared with the number of freight cars is small, it is felt that the error introduced by using this approximation will not alter materially the inherent error involved in making input estimates by the analogy method.

It should be noted here that the so-called analogous method of making input estimates is subject to many errors and requires many assumptions. It is merely a first approximation, which must be followed by estimates made by other methods or combinations of methods. It is, however, a start toward the solution of problems of input estimation. Further discussion of methodology and an evaluation of the analogous type of estimation will be found in Appendix C. The figures which follow in Table 9* are estimates of inputs per unit required for the production of representative or "average" types of steam, diesel, and electric locomotives and freight and passenger cars currently produced. Table 10** gives an estimate of the total input requirements for the production of the total number of locomotive and rolling stock units to be built in the years 1950, 1952, 1955, and 1960, as estimated in V, above.

* Table 9 follows on p. 60.
** Table 10 follows on p. 61.

Table 9

Estimated Input Requirements per Unit
of Production of Locomotives and Rolling Stock
in the USSR a/

Item of Input	Units	Steam Locomotives	Electric Locomotives	Diesel Locomotives	Freight Cars (2-Axle)	Passenger Cars
Labor	man-years	13.65	19.50	14.50	0.25	1.25
Agricultural Products	mt	0.00164	0.00243	0.00174	0	0
Raw Steel	mt	164.39	218.10	192.51	9.527	47.635
Aluminum	mt	0.59	0.87	0.62	0.009	0.045
Copper	mt	2.12	3.19	2.27	0.009	0.045
Zinc	mt	0	0	0	0.012	0.060
Bituminous Coal	mt	48.23	71.36	50.94	1.272	6.360
Electric Power	kwh	51,300	75,000	54,400	860	4,300
Fuel Oil	mt	7.63	10.9	8.07	0.205	1.025
Rubber	mt	0.21	0.315	0.225	0.0018	0.0090
Paper and Paperboard	mt	0.0214	0.0314	0.0227	0	0
Plastics	mt	0.0334	0.0495	0.0353	0	0
Compressed and Liquefied Gases	thousand cu ft	4.28	6.3	4.53	0	0
Flat Glass	sq ft	738	1,100	780	0	N.A.
Mineral Wool	mt	1.82	2.73	2.06	0.031	0.155
Asbestos	mt	0.30	0.44	0.32	0.001	0.005
Lumber	thousand bd ft	4.17	6.17	4.42	0.440	2.200
Plywood	sq ft	0	0	0	1,530	7,650
Unallocated	percent of value	14.65	14.65	14.65	16.10	16.10
Trucks	2-ton units	0.0246	0.0365	0.0261	N.A.	N.A.
Shunt Locomotives	number	0.024	0.036	0.026	N.A.	N.A.
Rolling Stock	2-axle units	0.057	0.085	0.061	N.A.	N.A.
Motors and Generators	kw	110	1,800	1,410	0	0
Antifriction Bearings	number	537	793	565	6.3	31.5
Capital Equipment (Not Elsewhere Counted)	mt of raw steel	4.02	5.03	4.26	0.049	0.245

a. Estimated for representative or "average" types currently produced.

Table 10

Estimated Total Input Requirements
for the Locomotive and Rolling Stock Industry
in the USSR
1950, 1952, 1955, and 1960

Item of Input and Year	Units	Steam Locomotives	Electric Locomotives	Diesel Locomotives	Freight Cars	Passenger Cars	Total
Labor a/*	thousand man-years						
1950		27.8	3.3	2.7	30.3	3.1	67.2
1952		30.7	5.5	3.3	34.3	3.5	77.3
1955		32.6	8.8	4.4	36.8	3.7	86.3
1960		35.4	12.1	5.9	40.8	3.9	98.1
Agricultural Products	mt						
1950		3.3	0.4	0.3	0.0	0.0	4.0
1952		3.7	0.7	0.4	0.0	0.0	4.8
1955		3.9	1.1	0.5	0.0	0.0	5.5
1960		4.2	1.5	0.7	0.0	0.0	6.4
Raw Steel	thousand mt						
1950		335.0	37.0	36.0	1,153.0	119.0	1,680.0
1952		370.0	61.0	44.0	1,305.0	133.0	1,913.0
1955		385.0	98.0	58.0	1,400.0	139.0	2,080.0
1960		426.0	135.0	79.0	1,559.0	149.0	2,348.0
Aluminum	mt						
1950		1,200.0	150.0	110.0	1,090.0	110.0	2,660.0
1952		1,330.0	240.0	140.0	1,230.0	130.0	3,070.0
1955		1,380.0	260.0	190.0	1,320.0	130.0	3,280.0
1960		1,530.0	360.0	250.0	1,470.0	140.0	3,750.0

* Footnotes for Table 10 follow on p. 67.

Table 10

Estimated Total Input Requirements
for the Locomotive and Rolling Stock Industry
in the USSR
1950, 1952, 1955, and 1960
(Continued)

Item of Input and Year	Units	Steam Locomotives	Electric Locomotives	Diesel Locomotives	Freight Cars	Passenger Cars	Total
Copper	mt						
1950		4,320.0	540.0	420.0	1,090.0	110.0	6,480.0
1952		4,770.0	890.0	520.0	1,230.0	130.0	7,540.0
1955		4,960.0	1,440.0	680.0	1,320.0	130.0	8,530.0
1960		5,490.0	1,980.0	930.0	1,470.0	140.0	10,010.0
Zinc	mt						
1950		0.0	0.0	0.0	1,450.0	150.0	1,600.0
1952		0.0	0.0	0.0	1,640.0	170.0	1,810.0
1955		0.0	0.0	0.0	1,760.0	180.0	1,940.0
1960		0.0	0.0	0.0	1,960.0	190.0	2,150.0
Bituminous Coal b/	thousand mt						
1950		98.4	12.1	9.4	153.9	15.9	289.7
1952		108.5	16.4	11.7	174.3	17.8	328.7
1955		112.9	32.1	15.3	187.0	18.6	365.9
1960		124.9	44.2	20.9	208.1	19.8	417.9
Electric Power b/	million kwh						
1950		104.7	12.8	10.1	104.1	10.8	242.5
1952		115.4	21.0	12.5	117.8	12.0	278.7
1955		120.0	33.8	16.3	126.4	12.6	309.1
1960		132.9	46.5	22.3	140.7	13.4	355.8

Table 10

Estimated Total Input Requirements
for the Locomotive and Rolling Stock Industry
in the USSR
1950, 1952, 1955, and 1960
(Continued)

Item of Input and Year	Units	Steam Locomotives	Electric Locomotives	Diesel Locomotives	Freight Cars	Passenger Cars	Total
Fuel Oil b/	thousand mt						
1950		15.6	1.9	1.5	24.8	2.6	46.4
1952		17.2	3.1	1.9	28.1	2.9	53.2
1955		17.9	4.9	2.4	30.1	3.0	58.3
1960		19.8	6.8	3.3	33.5	3.2	66.6
Rubber	mt						
1950		430.0	50.0	40.0	220.0	20.0	760.0
1952		470.0	90.0	50.0	250.0	30.0	890.0
1955		490.0	140.0	70.0	260.0	30.0	990.0
1960		540.0	200.0	90.0	290.0	30.0	1,150.0
Paper and Paperboard	mt						
1950		44.0	5.0	4.0	0.0	0.0	53.0
1952		48.0	9.0	5.0	0.0	0.0	62.0
1955		50.0	14.0	7.0	0.0	0.0	71.0
1960		55.0	19.0	9.0	0.0	0.0	83.0
Plastics	mt						
1950		68.0	8.0	7.0	0.0	0.0	83.0
1952		75.0	14.0	8.0	0.0	0.0	97.0
1955		78.0	22.0	11.0	0.0	0.0	111.0
1960		87.0	31.0	14.0	0.0	0.0	132.0

Table 10

Estimated Total Input Requirements
for the Locomotive and Rolling Stock Industry
in the USSR
1950, 1952, 1955, and 1960
(Continued)

Item of Input and Year	Units	Steam Locomotives	Electric Locomotives	Diesel Locomotives	Freight Cars	Passenger Cars	Total
Compressed and Liquefied Gases	thousand cu ft						
1950		8,730.0	1,070.0	840.0	0.0	0.0	10,640.0
1952		9,630.0	1,760.0	1,040.0	0.0	0.0	12,430.0
1955		10,020.0	2,840.0	1,360.0	0.0	0.0	14,220.0
1960		11,090.0	3,910.0	1,860.0	0.0	0.0	16,860.0
Flat Glass	thousand sq ft						
1950		1,500.0	190.0	140.0	0.0	N.A.	1,830.0 c/
1952		1,660.0	310.0	180.0	0.0	N.A.	2,150.0 c/
1955		1,730.0	500.0	230.0	0.0	N.A.	2,460.0 c/
1960		1,910.0	680.0	320.0	0.0	N.A.	2,910.0 c/
Mineral Wool	mt						
1950		3,710.0	460.0	380.0	3,750.0	390.0	8,690.0
1952		4,100.0	760.0	470.0	4,250.0	430.0	10,010.0
1955		4,260.0	1,230.0	620.0	4,560.0	450.0	11,120.0
1960		4,710.0	1,690.0	840.0	5,070.0	480.0	12,790.0
Asbestos	mt						
1950		610.0	70.0	60.0	120.0	10.0	870.0
1952		680.0	120.0	70.0	140.0	10.0	1,020.0
1955		700.0	200.0	100.0	150.0	20.0	1,170.0
1960		780.0	270.0	130.0	160.0	20.0	1,360.0

Table 10

Estimated Total Input Requirements
for the Locomotive and Rolling Stock Industry
in the USSR
1950, 1952, 1955, and 1960
(Continued)

Item of Input and Year	Units	Steam Locomotives	Electric Locomotives	Diesel Locomotives	Freight Cars	Passenger Cars	Total
Lumber	million bd ft						
1950		8.5	1.1	0.8	53.2	5.5	69.1
1952		9.4	1.7	1.0	60.3	6.2	78.6
1955		9.8	2.8	1.3	64.7	6.4	85.0
1960		10.8	3.8	1.8	72.0	6.9	95.3
Plywood	million sq ft						
1950		0.0	0.0	0.0	185.1	19.1	204.2
1952		0.0	0.0	0.0	209.6	21.4	231.0
1955		0.0	0.0	0.0	224.9	22.3	247.2
1960		0.0	0.0	0.0	250.3	23.9	274.2
Trucks	2-ton units						
1950		50.0	6.0	5.0	N.A.	N.A.	61.0 d/
1952		55.0	10.0	6.0	N.A.	N.A.	71.0 d/
1955		58.0	16.0	8.0	N.A.	N.A.	82.0 d/
1960		64.0	23.0	11.0	N.A.	N.A.	98.0 d/
Shunt Locomotives	number						
1950		49.0	6.0	5.0	N.A.	N.A.	60.0 d/
1952		54.0	10.0	6.0	N.A.	N.A.	70.0 d/
1955		56.0	16.0	8.0	N.A.	N.A.	80.0 d/
1960		62.0	22.0	11.0	N.A.	N.A.	95.0 d/

Table 10

Estimated Total Input Requirements
for the Locomotive and Rolling Stock Industry
in the USSR
1950, 1952, 1955, and 1960
(Continued)

Item of Input and Year	Units	Steam Locomotives	Electric Locomotives	Diesel Locomotives	Freight Cars	Passenger Cars	Total
Rolling Stock	2-axle units						
1950		116.0	14.0	11.0	N.A.	N.A.	141.0 d/
1952		128.0	24.0	14.0	N.A.	N.A.	166.0 d/
1955		133.0	38.0	18.0	N.A.	N.A.	189.0 d/
1960		148.0	53.0	25.0	N.A.	N.A.	226.0 d/
Motors and Generators	thousand kw						
1950		220.0	310.0	260.0	0.0	0.0	790.0
1952		250.0	500.0	320.0	0.0	0.0	1,070.0
1955		260.0	810.0	420.0	0.0	0.0	1,490.0
1960		280.0	1,120.0	580.0	0.0	0.0	1,980.0
Antifriction Bearings e/	thousand standard pieces						
1950		1,095.0	135.0	105.0	762.0	79.0	2,176.0
1952		1,208.0	222.0	130.0	863.0	88.0	2,511.0
1955		1,257.0	357.0	170.0	926.0	92.0	2,802.0
1960		1,391.0	492.0	232.0	1,031.0	98.0	3,244.0
Capital Equipment (Not Elsewhere Counted)	mt of raw steel						
1950		8,200.0	860.0	790.0	5,930.0	610.0	16,390.0
1952		9,050.0	1,410.0	980.0	6,710.0	690.0	18,840.0
1955		9,410.0	2,260.0	1,280.0	7,200.0	720.0	20,870.0
1960		10,410.0	3,120.0	1,750.0	8,020.0	760.0	24,060.0
Unallocated f/ (Percent Each Year of Total Value)		14.65	14.65	14.65	16.10	16.10	

Table 10

Estimated Total Input Requirements
for the Locomotive and Rolling Stock Industry
in the USSR
1950, 1952, 1955, and 1960
(Continued)

a. At present, Soviet labor is considered to be approximately two-thirds as efficient as US labor. (See note a, Appendix D, Table 39.) It is probable that the labor efficiency of the Russians will increase in the coming years. For this reason, the estimates of the labor force required in the years 1955 and 1960 may be too high, since no allowance has been made for this increased efficiency. It is conceivable that production may increase at the rates estimated while the size of the labor force remains constant or nearly constant. The figures in Table 10, therefore, represent the labor force required for the years 1950, 1952, 1955, and 1960 at the present estimated efficiency level of the labor force.
b. The estimates for bituminous coal, electric power, and fuel oil presented here are representative of US power practice. It should be remembered that the Russians may not, on the average, follow this practice and that their fuel requirements may therefore differ from US requirements. These figures, then, are presented as a sample of what the fuel requirements may be. More detailed studies of the fuel requirements of the USSR for individual plants will have to be made before more reliable estimates can be made.
c. The total as shown does not include any estimate of flat glass for passenger car production.
d. The totals as shown do not include any of these items for either passenger car or freight car production.
e. The antifriction bearings as shown here represent average-size bearings. Since the bearings used in railroad equipment are usually considerably larger than this average size, the figures shown here do not represent actual numbers of bearings. A typical US 2-10-4 freight locomotive requires the following antifriction bearings:

	Type	Bore (Inches)	Number Required
Driver-Journal Boxes	Roller	12	20
Guiding Truck	Roller	7	4
Side and Main Rods	Roller	7 to 9	14
Eccentric Rods	Roller	$3\frac{1}{2}$	2
Stoker	Roller or Ball	2 to $2\frac{1}{2}$	8
Valve Gear	Needle	$1\frac{1}{4}$ to 4	24
Valve Pilot	Ball	3/8 to $1\frac{1}{2}$	12
Throttle	Ball	3/4	1
Reverse Gear	Ball	1-3/8	1
Generator	Ball	1-3/8	2
Feed Water Pump	Roller or Ball	2	2
Tender-Journal Boxes	Roller	$6\frac{1}{2}$ to 7	24
Train Control	Roller or Ball	$1\frac{1}{2}$	4
Total			118

Table 10

Estimated Total Input Requirements
for the Locomotive and Rolling Stock Industry
in the USSR
1950, 1952, 1955, and 1960
(Continued)

It should also be noted that Soviet freight cars are not reported as generally being equipped with antifriction-bearing journal boxes and that the figures for freight cars shown in Table 10 will not apply unless evidence is found to indicate that such bearings are in fact being used on Soviet cars.

f. This item represents the percentage of the total inputs to the industry which cannot be allocated to any of the previously listed industries. It must not, however, be construed as anything other than a raw material, fuel, power, labor, or contract input.

VII. Imports.

A. From the European Satellites.

A complete statistical breakdown of postwar imports of locomotives and rolling stock from the European Satellites by the USSR is not possible. Also, there is insufficient information on any of the Satellites to permit an accurate estimate of exports to the USSR. Such information as could be compiled is presented in Table 11.*

It is well known that the Russians are exploiting the European Satellites to the extent that the inventories of these countries are suffering from shortages of both locomotives and rolling stock.** The point at which this shortage begins to affect the delivery of other items of reparations which the USSR has demanded from these countries and to impair the Soviet program of Satellite industrialization is difficult to estimate. Thus it is also difficult to determine when the Russians will decide that retention of a larger portion of production within the Satellite countries will produce more benefits to the USSR than additions to its own operating inventory of locomotives and rolling stock.

The information as presented in Table 11 represents a compilation of available estimates. It is not intended as a firm estimate of Soviet Bloc contributions to the USSR but as an index of probable trends in Soviet demands on the European Satellites. A range of error of plus or minus 50 percent should be applied to these estimates.

B. From Non-Soviet Bloc Countries.

Importation of locomotives and rolling stock from non-Soviet Bloc countries by the USSR is not extensive. The largest known commitment was that of Sweden for the delivery of 300 YE-class (Decapod)*** steam locomotives to the USSR between 1947 and the end of 1952. 81/ Delivery of these units has not as yet been reported.

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* Table 11 follows on p. 70.

** For a more detailed breakdown of the various types of units being imported from the European Satellites by the USSR, see Part II, below.

*** A locomotive with an 2-10-0 wheel arrangement. For specifications of all types of Soviet locomotives and rolling stock, see Appendix A.

Table 11

Estimated Soviet Imports of Locomotives and Freight Cars from the European Satellites
1946-52

Units

Item by Country of Origin	1946	1947	1948	1949	1950	1951	1952
Steam Locomotives							
East Germany	0	0	0	0	0	0	32 [82]
Poland	N.A.	N.A.	20 [83]	50 to 83 [84]	50 to 120 [85]	150 [86]	150 [87]
Czechoslovakia	N.A.	20 [88]	20 [89]	45 [90]	45 [91]	N.A.	N.A.
Rumania	60 [92]	65 [93]	65 [94]	60 [95]	60 [96]	70 [97]	70 [98]
Hungary	20 to 42 [99]	130 [100]	120 [101]	120 [102]	120 [103]	130 [104]	140 [105]
Total	80 to N.A.	215 to N.A.	225	275 to 308	275 to 345	350 to N.A.	392 to N.A.
Freight Cars							
East Germany	1,700 [106]	1,800 to 2,700 [107]	1,800 to 2,700 [108]	1,800 to 2,700 [109]	4,700 to 5,200 [110]	5,000 to 5,700 [111]	6,700 to 7,800 [112]
Poland	2,500 [113]	2,750 [114]	3,000 [115]	3,000 [116]	3,000 [117]	N.A.	N.A.
Czechoslovakia	N.A.	500 [118]	5,400 [119]	7,700 [120]	7,700 [121]	N.A.	N.A.
Rumania	N.A.	1,500 [122]	5,400 [123]	7,200 [124]	N.A.	N.A.	N.A.
Hungary	354 [125]	1,336 [126]	2,275 to 3,000 [127]	3,000 to 5,440 [128]	3,000 [129]	N.A.	N.A.
Total	4,554 to N.A.	7,886 to 8,786	17,875 to 19,500	22,700 to 26,040	18,400 to N.A.	N.A.	N.A.

Finland, under terms of its reparations agreement with the USSR, is to ship to the USSR a total of 500 narrow-gage locomotives and 5,500 4-axle narrow-gage freight cars. 130/ These units probably are for mining or lumbering purposes in the USSR and as such do not enter into the main-line locomotive and rolling stock inventory.

Japan shipped 15 passenger cars, 27 locomotives, and 270 freight cars to the USSR during 1949. 131/ Shipments probably have continued during the succeeding years, but the amount is small because of Japan's own shortage of railroad equipment. 132/

Postwar shipments for COCOM-participating countries are nil with respect to main-line locomotives and rolling stock. Shipments from nonparticipating countries probably will continue to be small because of pressure from the US and other Western powers against such exports. The USSR is not in such straits with respect to its railroad equipment inventory as to be alarmed over such controls, although it would undoubtedly accept any offers of locomotives and rolling stock, particularly diesel locomotives and specialized types of freight cars. It is not felt that present or future shipments of this type of goods will be of much consequence in Soviet attempts to procure strategic material from the West. Parts for the maintenance of foreign-built units probably are of much more importance to the Russians, and it can be expected that attempts to procure some of the more important of these parts are being made and will continue to be made. Such parts would specifically include equipment for the 82 US Lend-Lease diesel locomotives and perhaps for US-built steam locomotives, which were also Lend-Lease equipment. (For types of Lend-Lease locomotives and rolling stock shipped to the USSR, see Figs. 18, 19, 20, 21, and 22.*)

Although no evidence has been received as yet, it is more than likely that an attempt to procure roller bearings for journal boxes for Soviet cars will be made if the USSR intends to carry out its proposal in the Fifth Five Year Plan to equip all rolling stock with roller bearings during the period 1951-55.**

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* Following p. 72.

** For discussion of this stated intention, see X, C, 1, below.

C. Acquisitions as a Result of World War II.

1. Lend Lease.

Table 12 gives the number of locomotives and items of rolling stock shipped to the USSR by the US from 22 June 1941 to 20 September 1945 as Lend-Lease aid and supplemental shipments during 1946 and 1947 under the so-called "pipeline" agreements.* 133/

Table 12

US Shipments of Locomotives and Rolling Stock to the USSR
1941-47

Item	Units: Lend Lease (1941-45)	Units: Pipeline (1946-47)
Steam Locomotives	1,911 a/	290
Diesel Locomotives b/	70 c/	16
Electric Locomotives d/	8	
Flatcars	10,000 e/	20
Dump Cars f/	1,000	
Tank Cars g/	120	
Heavy Machinery Cars h/	35	

a. Including 11 steam locomotives lost en route to the USSR and the following: eight 50-ton 0-4-0; fifteen 70-ton 0-6-0; 200 80-ton 2-8-0; and 1,685 105-ton 2-10-0.
b. Units built by the American Locomotive Company and the Baldwin Locomotive Works (Russian DA and DB classes).
c. Including 4 diesel locomotives lost en route to the USSR.
d. 20-ton units, probably for mining.
e. Including 8 flatcars lost en route to the USSR and fifty 12-ton cars for mining. The remainder consist of 50-ton 4-axle main-line cars.
f. 40-ton 4-axle cars.
g. 10,000-gallon 4-axle cars.
h. Including various 125- to 200-ton heavy-duty well-type cars with 6 or 8 axles.

* Agreements for the shipments of equipment produced for Lend Lease but not shipped before the termination of Lend Lease in September 1945.

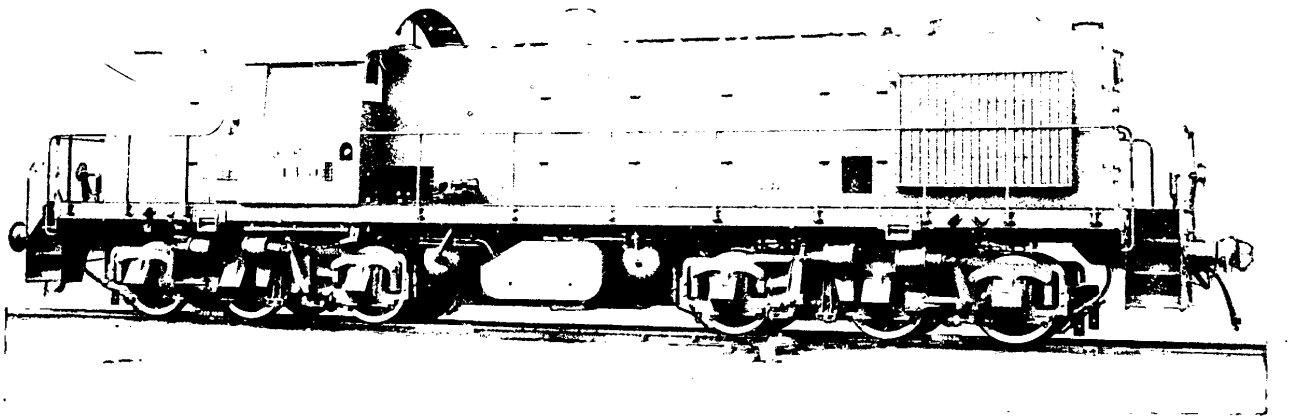


FIGURE 18. DA-CLASS DIESEL-ELECTRIC LOCOMOTIVE (1,000 BRAKE HORSEPOWER), PRODUCED BY THE AMERICAN LOCOMOTIVE COMPANY AND SHIPPED ON LEND LEASE TO THE USSR, 1945.

FIGURE 19. DB–CLASS DIESEL-ELECTRIC LOCOMOTIVE (1,000 BRAKE HORSEPOWER), PRODUCED BY THE BALDWIN LOCOMOTIVE WORKS AND SHIPPED ON LEND LEASE TO THE USSR, 1945.

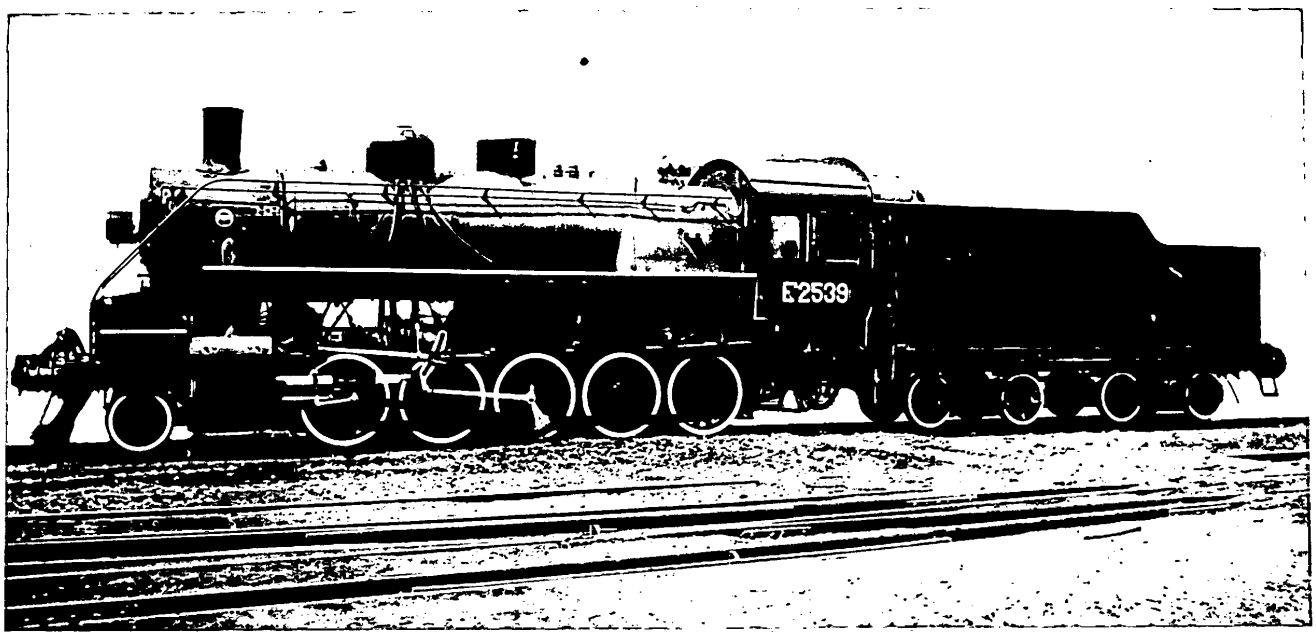


FIGURE 20. EA-CLASS STEAM LOCOMOTIVE OF THE 2–10–0 TYPE, PRODUCED BY THE BALDWIN LOCOMOTIVE WORKS AND SHIPPED ON LEND LEASE TO THE USSR.

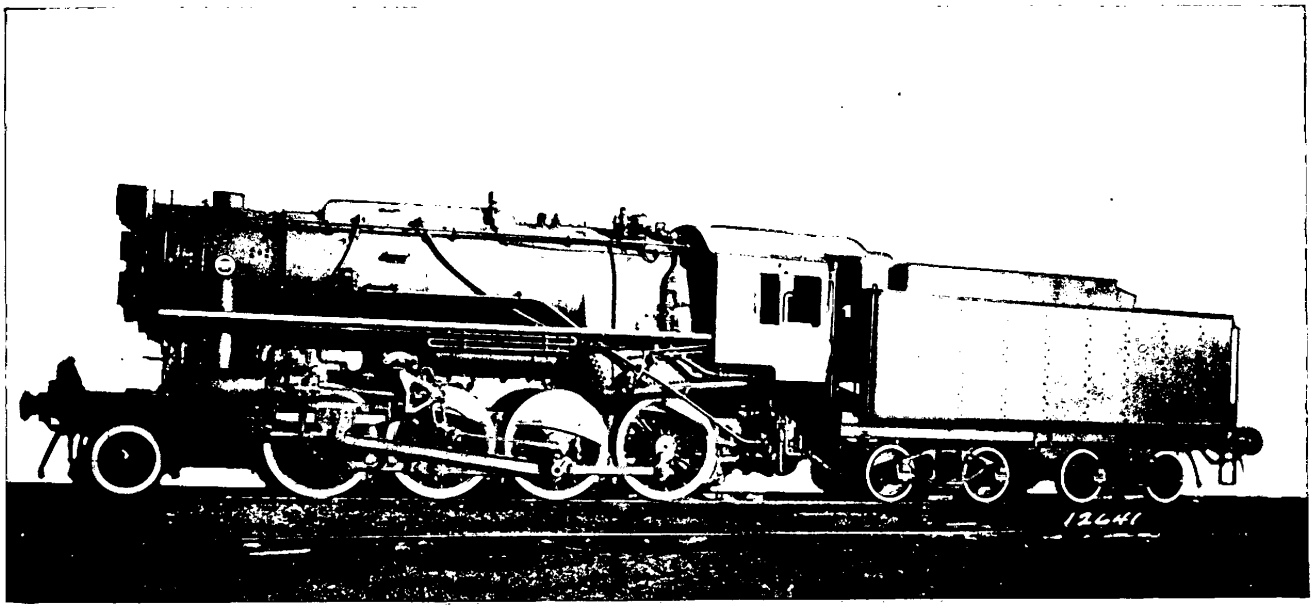


FIGURE 21. SHA-CLASS STEAM LOCOMOTIVE OF THE 2–8–0 TYPE, PRODUCED BY THE BALDWIN LOCOMOTIVE WORKS AND SHIPPED ON LEND LEASE TO THE USSR.

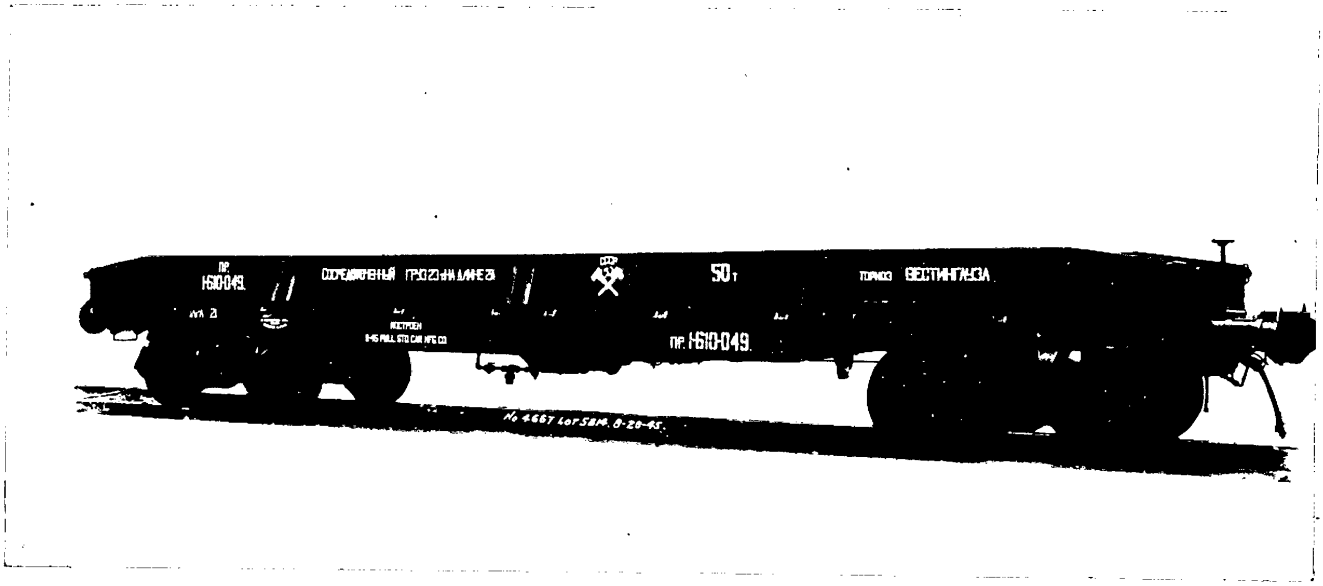


FIGURE 22. 4-AXLE FLATCAR OF 50-TON CAPACITY, PRODUCED BY THE PULLMAN-STANDARD CAR MANUFACTURING COMPANY AND SHIPPED ON LEND LEASE TO THE USSR. Eighty of these cars were delivered to the USSR. Postwar Soviet-built flatcars are undoubtedly similar to this unit. Note the inscriptions in Russian stenciled on the car before delivery. The inscription on the side of the car at the top left, *sosredotochenny gruz*, means "concentrated freight"; at the top right, *tormoz Vestingauza*, "Westinghouse brakes"; and at the bottom left, *postroyen 8–45 Pull. Std. Car Mfg. Co.*, "built August 1945 (by the) Pullman-Standard Car Manufacturing Company."

2. War Prizes.

During the course of World War II the USSR lost many locomotives and railroad cars, captured or destroyed, to the advancing German armies. When the Russians took the offensive, many of these units were recaptured along with locomotives and cars of German origin. It is claimed by the USSR that some 15,800 steam locomotives and 428,000 cars were lost to the Germans. 134/ It is estimated that some 70 to 75 percent of these were subsequently recaptured. In addition, some 2,000 German steam locomotives and 178 electric locomotives,* as well as 45,000 2-axle and 2,500 4-axle freight cars, were captured in the Soviet advances and in looting after the end of the war. 135/

Including retirements and Lend-Lease additions, it is estimated that as a result of World War II the USSR suffered a net loss of 900 steam locomotives, 35,000 2-axle freight cars, and 24,000 4-axle freight cars. At the same time, it gained some 66 US diesel-electric locomotives and the previously mentioned 178 German electric locomotives.

VIII. Adequacy of Production.

A. Postwar to Present.

It is believed that the production of locomotives and rolling stock in the USSR during the period from 1945 to the present has been adequate for the needs of the Soviet economy. The general basis for this rather broad statement is indicated below.

According to official Soviet statements, the goals of the Fourth Five Year Plan (1946-50) were substantially fulfilled. The mining, metals, machine building, power, and chemical industries as

* These locomotives were included in the estimate of the Soviet locomotive inventory during 1945-52 as given in IX, below. It is likely that, because of differences in electric equipment, they were not part of the serviceable inventory. [redacted] 50X1
[redacted] 50X1 most, if not all, of these locomotives will be returned to East Germany by the USSR during late 1952 and in 1953. For this reason, these 178 locomotives have been dropped from the inventory estimates from 1953 on. 136/

well as agriculture and other sectors of the economy all fulfilled (or slightly overfulfilled or underfulfilled) their goals. Rail transportation goals were overfulfilled in 1950 by some 13 percent. 137/ Since some 85 percent of all transportation of industrial goods in the USSR is by rail, it follows inevitably that had the supply of railroad equipment been grossly inadequate during the period, the Plan would have been underfulfilled to a large extent.

Other more specific information which supports the belief that the production has been adequate is as follows:

1. Retirement Rates.

Retirement rates are a clue to adequacy of production. Lowering the rate of retirement* means that a greater portion of the production in a given year will constitute a net addition to the operating inventory. At the same time, however, a reduction in retirement rates means an increase in the labor and material required to maintain the old equipment and, usually, a decrease in the efficiency of railroad transportation operations. When the demand for additional men and materials begins to exceed the supply, then it follows that the younger equipment in the inventory may suffer from insufficient preventative maintenance, and the results may be that the useful age of the newer equipment will be lowered. This would be the situation if the supply of new equipment were inadequate.

On the contrary, however, estimates of inventory increases of Soviet locomotives and rolling stock indicate a gradually increasing rate of retirement. This indicates that the production of these units has been adequate, since, in the event of an inadequate supply, the Russians probably would find it easier to hold the retirement rate at a lower figure and supply additional maintenance men and materials as heretofore mentioned than to attempt to increase production at a rate faster than it has been increased.**

* The rate of retirement is the ratio of locomotives and railroad cars retired to their respective inventories.
** In X, A, below it is pointed out that Soviet production has been at maximum capacity since the end of World War II.

2. Soviet Press Complaints of Shortages.

Had the supply of locomotives or freight cars been grossly inadequate during the period from the end of World War II to the present, the Soviet press, following the Communist theory of "self-criticism," would undoubtedly have included many complaints about such shortages. Such comments have been few, however, and only local in nature, thus supporting the belief that sufficient units have been generally available.

3. Over-All Fulfillment of the Fourth Five Year Plan (1946-50).

As discussed in detail in X, A, below, with the addition of the Satellite contributions of locomotives and rolling stock during 1946-50 the goals of the Fourth Five Year Plan for the production of these items were fulfilled. If it is assumed that in planning these goals, the Russians set production goals at a level equal to the requirements of the rail transportation service, then it follows that the number of units supplied by internal production and Satellite imports has been adequate for the needs of the USSR.

B. Outlook for the Future.

It is not possible to forecast positively the adequacy or inadequacy of the future production of locomotives and rolling stock in the USSR. The fact that such production has evidently been adequate in the past few years is somewhat of a yardstick for stating that it probably will continue to be so in the future.

The Fifth Five Year Plan (1951-55) calls for an increase in freight transportation by rail of 35 to 40 percent. Although this figure seems low when compared with the projected increases in industrial and agricultural production,* it does indicate that the Soviet inventory of locomotives and rolling stock is considered to be adequate and that the estimated trends in production and inventory are reasonable.

* The Plan calls for over-all increases by 1955 in industrial production of about 70 percent and in agricultural production of about 50 percent. The apparent discrepancy between these goals and the projected increase in freight transportation by rail is at least partly covered by the very rapid projected increases in other forms of transport. 138/

Production of all types of rail units in the USSR is increasing, as are imports from the Satellites. Retirement rates are also evidently rising. Inventory estimates as made in IX, below, show a 41-percent increase in both locomotive and freight car inventories (1955 over 1950), validating, to a degree, the Soviet claim of the ability to increase freight transportation by rail 35 to 40 percent by 1955.* For these reasons, it is believed that the production and inventory of this equipment in the USSR will continue to be adequate to meet the demands of the planned industrial growth of the country.

IX. Inventory Estimates.

The best available estimates of the inventory of Soviet locomotives and rolling stock are given in Tables 13, 14, 15, 16, and 17** and are presented in graphic form in Figures 23,*** 24,**** and 25.**** The tables are followed by a detailed discussion on the method of estimation and reference is made to appropriate graphs. The following general comments apply, however, to all three graphs. 50X1

Inventory estimates are, in general, difficult to make. Information on the actual retirement rates of Soviet locomotives and rolling stock is not available, and it is necessary to assume some reasonable figure. In addition, the effect of imports from the Satellite countries is difficult to assess. Since the utilization factor (degree of use) of Soviet equipment is much higher than for

* The estimates of inventory increases of both locomotives and freight cars as presented in IX, below, were made independently of each other and several months before the publication of the Fifth Five Year Plan. Accepting the Soviet goal of a 35- to 40-percent increase in freight transportation by rail in this same period (1951-55) means that the inventory increases as predicted may in fact prove to be accurate within a narrow margin of error. Since production estimates during this same period were used as a guide in making inventory estimates, the Soviet stated goal also tends to substantiate the accuracy of the production estimates as reported in V, above.

** Pp. 78, 80, 81, 82, and 83, respectively, below.

*** Following p. 78, below.

**** Following p. 84, below.

any other country of the world and since the ability of the Russians to maintain equipment under these high rates of utilization is not known, there is still more guesswork involved in estimating inventories. Uncertainty as to gains and losses during World War II constitutes another problem in making such estimates.

The estimates as presented below represent the best approximation possible, taking into account the above-mentioned factors. It is believed that they are reasonably accurate, at least with respect to yearly increases if not in actual count.

A. Locomotives.

1. Steam.

Estimates of the steam locomotive inventory in the USSR are given in Table 13* (see also Fig. 23**). 50X1

Scattered information has been found to support the estimates as given in Table 13 for the years shown through 1950, and these estimates are accepted as being reasonably correct. The postwar estimates are more subject to error than the prewar estimates because no positive statement of postwar inventory has been released by the Russians. Even if the 1945 estimate is off, the order of magnitude of inventory increase since that time is felt to be substantially accurate. Estimates beyond 1950 were made on the following assumptions: first, that the inventory increases would become smaller as the years go on, and electrification and dieselization of the Soviet railroads would increase; second, that this decrease in the rate of expansion of the inventory would become more noticeable as the units built during years of high production became of age for retirement. The second assumption does not affect the estimates greatly, because locomotives in the USSR are used for periods ranging up to and over 45 years, and the majority of the high production years are much more recent.

On these assumptions the curve of inventory was extended and mechanically plotted to begin to level off in the later years of the estimate. Since it is felt that this inventory

* Table 13 follows on p. 78.
** Following p. 78.

[redacted] 50X1-HUM

Table 13

Estimated Steam Locomotive Inventory in the USSR

[redacted] 50X1

1929-54

Units

End of Year	I 139/	II 140/	III 141/	IV 142/
1929	16,665			
1930	17,441			
1931	18,300			
1932		19,500		
1933		20,100		
1934		21,000		
1935		22,200		
1936		22,800		
1937		23,500		
1938		24,400		
1939		25,100		
1940		25,700		
1941		26,200		
1942				
1943				
1944				
1945		25,300		
1946		25,600	26,000	
1947		26,200		
1948		27,200		
1949		28,500		
1950		30,500		30,500
1951				32,000
1952				33,500
1953				34,500
1954				35,500

estimate is relatively accurate, the range of error applied to it has been set at plus or minus 10 percent for the years up to 1941 and plus or minus 15 percent for the postwar years up to 1960.

[redacted] 50X1-HUM

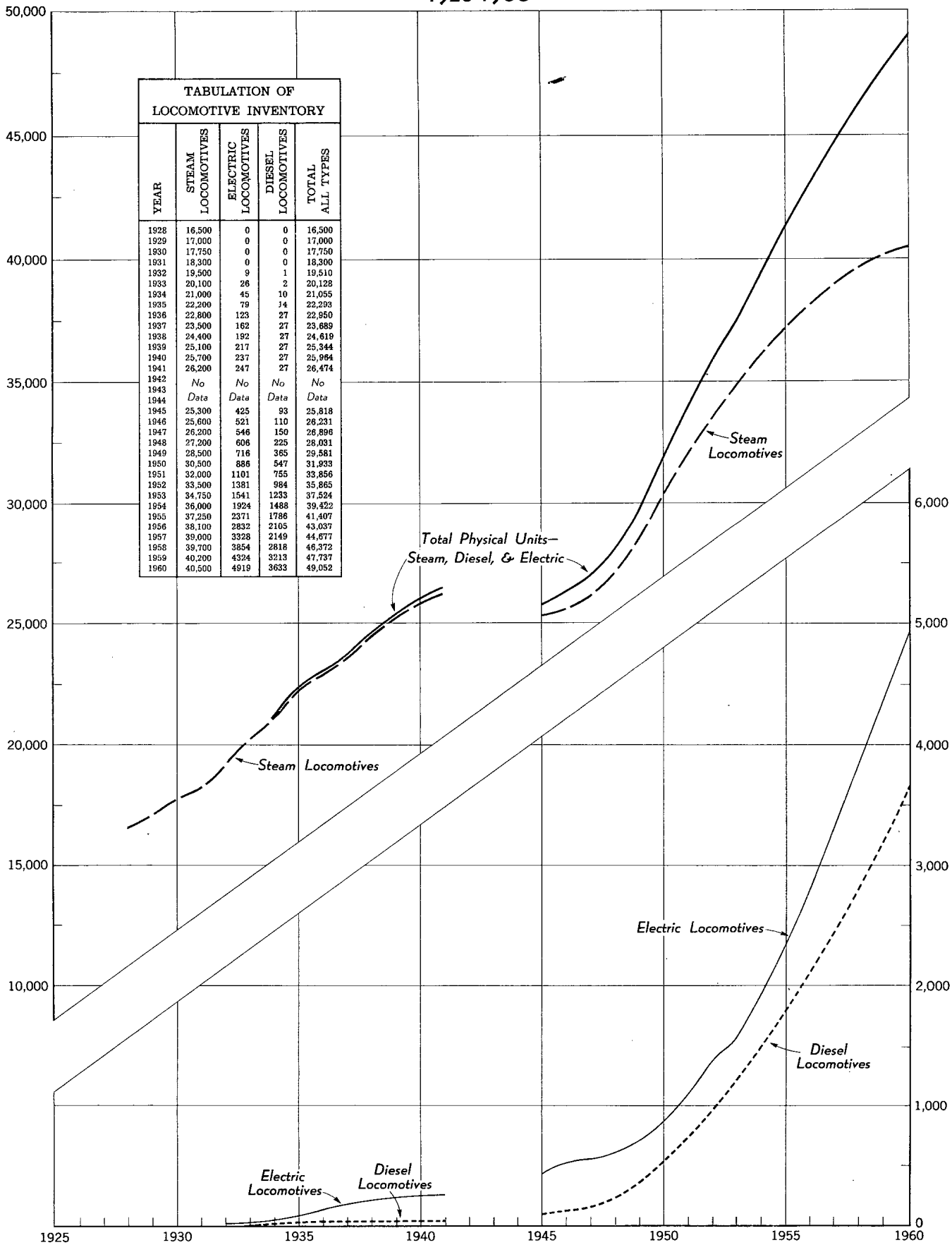
USSR

LOCOMOTIVE INVENTORY

1928-1960

TABULATION OF LOCOMOTIVE INVENTORY

YEAR	STEAM LOCOMOTIVES	ELECTRIC LOCOMOTIVES	DIESEL LOCOMOTIVES	TOTAL ALL TYPES
1928	16,500	0	0	16,500
1929	17,000	0	0	17,000
1930	17,750	0	0	17,750
1931	18,300	0	0	18,300
1932	19,500	9	1	19,510
1933	20,100	26	2	20,128
1934	21,000	45	10	21,055
1935	22,200	79	14	22,293
1936	22,800	123	27	22,950
1937	23,500	162	27	23,689
1938	24,400	192	27	24,619
1939	25,100	217	27	25,344
1940	25,700	237	27	25,964
1941	26,200	247	27	26,474
1942	No	No	No	No
1943	Data	Data	Data	Data
1944				
1945	25,300	425	93	25,818
1946	25,600	521	110	26,231
1947	26,200	546	150	26,896
1948	27,200	606	225	28,031
1949	28,500	716	365	29,581
1950	30,500	886	547	31,933
1951	32,000	1101	755	33,856
1952	33,500	1381	984	35,865
1953	34,750	1541	1233	37,524
1954	36,000	1924	1488	39,422
1955	37,250	2371	1786	41,407
1956	38,100	2832	2105	43,037
1957	39,000	3328	2149	44,677
1958	39,700	3854	2818	46,372
1959	40,200	4324	3213	47,737
1960	40,500	4919	3633	49,052



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2. Electric.

Estimates of the electric locomotive inventory in the USSR (see Fig. 23*) are based on the following assumptions: first, that the average life of an electric locomotive is 20 years (this life expectancy is in accord with US practice, and it is not believed that the Russians are able to extend the life of this type of unit much, if any, over this length of time); second, that the inventory will consist of those units purchased by the Russians from other countries plus those produced by the Russians themselves and that the inventory will increase each year in direct proportion to these numbers minus those units which become 20 years of age and are thus retired. 143/

This method of estimation is necessarily subject to the variables of retirement age, accident, and unknown acquisitions, and for this reason a range of estimation of 10 percent is applied to the prewar years and 20 percent to the postwar years.

3. Diesel.

Estimates of the diesel locomotive inventory in the USSR (see Fig. 23*) are even more difficult than those of the electric locomotive inventory. Estimates of production rates are less reliable, and estimates of length of life are subject to a greater variation. Inventory estimates of the diesel locomotive inventory were made on the same basis as in the case of electric locomotives. The range of error, however, has been set at plus or minus 30 percent for the postwar years because of the paucity of information available, and at plus or minus 10 percent for the prewar years.

B. Rolling Stock.

1. Freight Cars.

Estimates of the freight car inventory in the USSR [redacted] are given in Tables 14, 15, 16, and 17** (see also Fig. 24***). 50X1

* Following p. 78, above.
** Table 14 follows on p. 80; Table 15, on p. 81; Table 16, on p. 82; Table 17, on p. 83.
*** Following p. 84.

Table 14

Estimated Freight Car Inventory in the USSR

in Terms of Equivalent 2-Axle Units
1928-54

End of Year	I [144]/	II [145]/	III [146]/	IV [147]/	V [148]/	VI [149]/
1928						
1929			487,400			
1930			499,400			
1931			516,000			
1932					564,500	
1933					573,600	
1934					591,700	
1935					664,900	
1936					716,700	
1937		756,600			756,700	756,700
1938		789,550			784,400	
1939		818,200			791,700	
1940		856,800			814,900	814,900
1941		900,350			850,000	
1942						
1943						
1944						
1945		866,500			770,000	770,000
1946		889,400			777,400	779,500
1947		919,900		815,000	816,800	817,500
1948		947,400			895,300	870,700
1949		1,028,500			990,900	971,000
1950	1,100,000	1,144,300			1,100,000	1,085,000
1951	1,185,000					
1952	1,275,000					
1953	1,362,200					
1954	1,454,300					

[redacted] 50X1-HUM

Table 15

Estimated Freight Car Inventory in the USSR [redacted] 50X1

in Numbers of Physical Units
1928-50

End of Year	I 150/	II 151/	III 152/
1928		450,000	
1929			
1930			
1931			
1932		520,300	
1933			
1934			
1935			
1936			
1937	622,700	622,700	622,700
1938	634,600		
1939	644,425		
1940	659,775	651,950	651,900
1941	679,425	680,000	
1942			
1943			
1944			
1945	649,300	610,000	610,000
1946	665,350		609,400
1947	673,400		623,800
1948	685,100		655,200
1949	730,550		711,700
1950	794,300	775,000	772,500

[redacted] 50X1-HUM

Table 16

Estimated Freight Car Inventory in the USSR

in Numbers of 2-Axle Units
1928-50

End of Year	I 153/	II 154/	III 155/
1928			725,500
1929			
1930			
1931			
1932			476,100
1933			
1934			
1935			
1936			
1937	488,800	488,800	488,800
1938	479,650		
1939	470,650		
1940	462,750	489,000	489,000
1941	458,500		510,100
1942			
1943			
1944			
1945	432,100	450,000	450,000
1946	441,300	439,300	
1947	432,900	429,500	
1948	422,800	429,100	
1949	432,600	441,800	
1950	444,300	448,900	450,000

Table 17

Estimated Freight Car Inventory in the USSR

in Numbers of 4-Axle Units
1928-50

End of Year	I 156/	II 157/	III 158/
1928		25,000	
1929			
1930			
1931			
1932		44,200	
1933			
1934			
1935			
1936			
1937	133,900	133,900	133,900
1938	154,950		
1939	187,275		
1940	197,025	162,950	162,900
1941	220,952	170,000	
1942			
1943			
1944			
1945	217,200	160,000	160,000
1946	224,050		170,100
1947	240,500		194,300
1948	262,300		226,100
1949	297,950		269,900
1950	350,000	325,000	323,600

Each of the estimates in Tables 14, 15, 16, and 17 was plotted, and tentative curves showing estimates from 1928 to 1950 were drawn on the basis of the points plotted. Then, by giving added weight to estimates which were more highly evaluated and by adjusting the curves so that the totals represented checked, a final estimate was made and plotted. Projection of estimates to 1960 was made on the basis of estimated production, estimated imports, and estimated retirement. As shown in Figure 24,* the estimated net increase in inventory in terms of 2-axle units from 1950 to 1960 is 90,000 units per year. It is believed, barring a major change in planning or a war, that this projected estimate should have a range of not more than plus or minus 20 percent. The estimates for the years shown up to 1950 bear a range of error of plus or minus 10 percent.

2. Passenger Cars.

Estimates of the passenger car inventory in the USSR are almost nonexistent. The available estimates are plotted in Figure 25,* and the inventory for the other years estimated on the basis of production and calculated retirements. 159/

The average retirement age of passenger cars in the USSR is not known. Since the inventory is reported as being very inadequate, it has been assumed, for the purposes of calculating the inventory, that the retirement each year is approximately 1 percent of the end-of-year inventory of the preceding year. It is believed that imports from the Satellite countries in the postwar years, not included in the inventory computation, are sufficient to make the actual retirement rate nearer to 2 or 3 percent of the end-of-year inventory.

It is believed that the "best estimate" curve in Figure 25 represents a figure that shows the probable maximum inventory of passenger cars in the USSR rather than a middle-of-the-road estimate as is shown in the other inventory estimates. For these reasons, the prewar estimates are given a range of plus 5 percent and minus 15 percent, and the estimates for the postwar years projected to 1960 are given a range of plus 10 percent and minus 30 percent.

* Following p. 84.

USSR

FREIGHT CAR INVENTORY
1928-1960

TABULATION OF FREIGHT CAR INVENTORY

YEAR	4-AXLE CARS (PHYSICAL UNITS)	2-AXLE CARS (PHYSICAL UNITS)	TOTAL CARS (PHYSICAL UNITS)	TOTAL CARS (EQUIVALENT 2-AXLE UNITS)
1928	25,000	425,000	450,000	475,000
1929	27,000	438,000	465,000	492,000
1930	29,000	450,000	479,000	508,000
1931	31,000	463,000	494,000	525,000
1932	33,000	474,000	507,000	540,000
1933	41,000	479,000	520,000	561,000
1934	64,000	482,000	546,000	610,000
1935	86,000	484,000	570,000	656,000
1936	110,000	486,000	596,000	706,000
1937	134,000	486,000	620,000	754,000
1938	148,000	485,000	633,000	781,000
1939	161,000	484,000	645,000	806,000
1940	178,000	482,000	660,000	838,000
1941	200,000	480,000	680,000	880,000
1942				
1943	No	No	No	No
1944	Data	Data	Date	Data
1945	176,000	445,000	621,000	797,000
1946	188,000	433,000	621,000	809,000
1947	210,000	429,000	639,000	849,000
1948	240,000	429,000	669,000	909,000
1949	280,000	435,000	715,000	995,000
1950	325,000	445,000	770,000	1,095,000
1951	370,000	450,000	820,000	1,190,000
1952	415,000	450,000	865,000	1,280,000
1953	460,000	450,000	910,000	1,370,000
1954	505,000	450,000	955,000	1,460,000
1955	550,000	450,000	1,000,000	1,550,000
1956	595,000	450,000	1,045,000	1,640,000
1957	640,000	450,000	1,090,000	1,730,000
1958	685,000	450,000	1,135,000	1,820,000
1959	730,000	450,000	1,180,000	1,910,000
1960	775,000	450,000	1,225,000	2,000,000

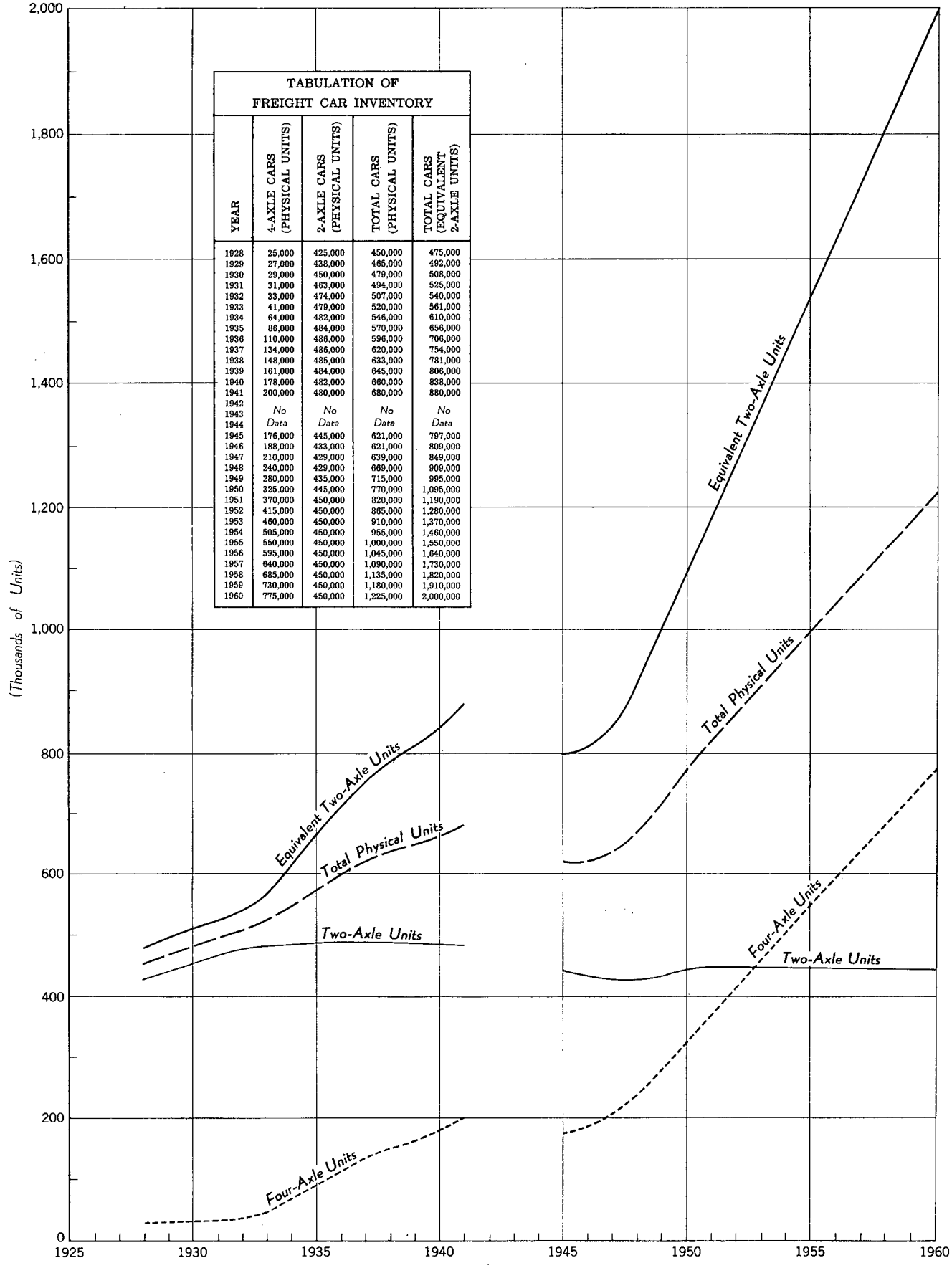

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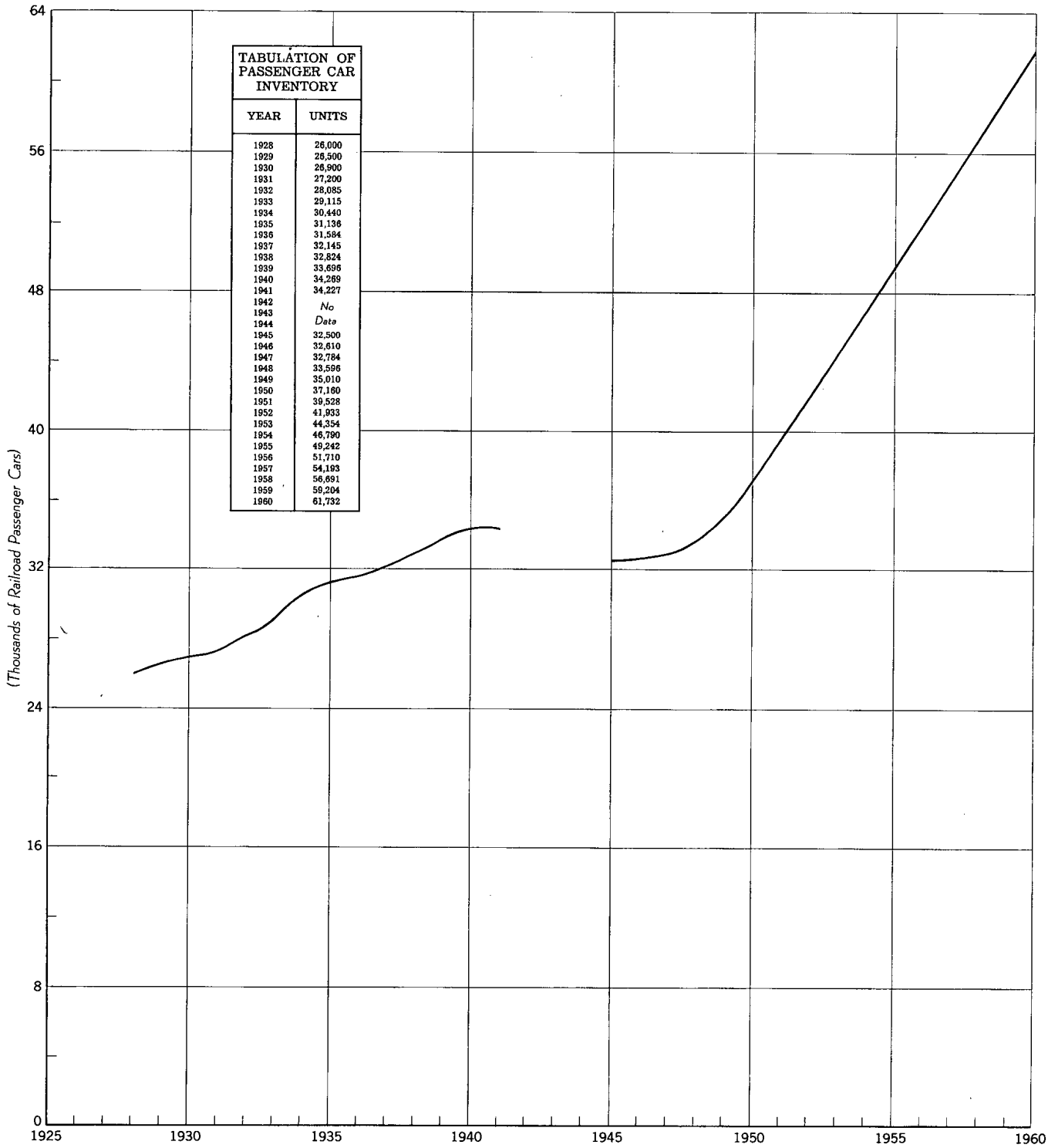
Figure 25

USSR

PASSENGER CAR INVENTORY
1928-1960



TABULATION OF PASSENGER CAR INVENTORY

YEAR	UNITS
1928	26,000
1929	26,500
1930	26,900
1931	27,200
1932	28,085
1933	29,115
1934	30,440
1935	31,136
1936	31,584
1937	32,145
1938	32,824
1939	33,696
1940	34,269
1941	34,227
1942	No
1943	Data
1944	
1945	32,500
1946	32,610
1947	32,784
1948	33,596
1949	35,010
1950	37,160
1951	39,528
1952	41,933
1953	44,354
1954	46,790
1955	49,242
1956	51,710
1957	54,193
1958	56,691
1959	59,204
1960	61,732

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Until firmer information on imports, retirement rates, and inventory for a recent year are available, it is felt that this is the best estimate that can be made of the Soviet passenger car inventory.

X. Capabilities, Vulnerabilities, and Intentions.

A. Capabilities.

This section is a discussion of Soviet capability to produce locomotives and rolling stock from the point of view of postwar production rates, future possible production, and the ability to convert to production of other types of locomotives or rolling stock or to convert to production of military end items.

1. Postwar to 1950.

It is believed that, in order to build the operating inventory of locomotives and rolling stock into a more modern and efficient one, Soviet manufacture of these items has been at capacity since the end of World War II and will continue to be so in the foreseeable future, barring any major change in the national economy.

The condition of the Soviet inventory of locomotives and rolling stock at the close of World War II was such that it was necessary for the Russians to exert a tremendous effort toward getting production facilities into full swing again in order to provide the railroads with sorely needed equipment. Thus, during 1945-50 the Soviet locomotive and rolling stock industry was engaged in a double undertaking. First, the plants not damaged by war but engaged in armaments production during hostilities were again converted, this time back to locomotive or freight car production. The plants rendered either wholly or partially inoperable by German and Soviet bombing or demolition were reconstructed and re-equipped with the purpose of getting them back into production as quickly as possible. At the same time, some new plants were also under construction.* Second, the production of locomotives and rolling stock was undertaken concurrently with the program of reconversion and rebuilding. As quickly as assembly lines could be put into operation, production of new equipment was begun. Thus, although production in 1945 was

* See I, C, 3, and IV, above.

almost nil, production by 1950 had reached a point considerably higher than in any prewar year.* It is estimated that over the period of the Fourth Five Year Plan (1946-50) the quotas for production of locomotives and rolling stock were fulfilled by the following percentages:

	Percent
Locomotives (All Types)	94
Steam	103
Electric	66
Diesel	51
Freight Cars	81
Passenger Cars	100

Although accurate figures for Satellite contributions during this period are not available, the estimates shown in VII, A, above, when added to Soviet production, show a percentage figure for locomotives (all types) of 109 percent and for freight cars of 97 percent.** Thus it can be seen that during the period of intensive effort to reconstruct and reconvert, as well as to build new plants, the USSR was able, with Satellite aid, to supply to the railroads as much equipment as was required by the planners.***

In the case of diesel locomotives, Soviet capabilities were initially hampered by the fact that mass production of this item had not taken place during the prewar years. Numerous experimental models had been built, however, and it is believed that

* Estimated production in 1950 was as follows: steam locomotives, 2,040; electric locomotives, 170; diesel locomotives, 185; freight cars, 121,000 (in equivalent 2-axle units); passenger cars, 2,500. The best prewar production was as follows: steam locomotives, 1,518 in 1935; electric locomotives, 44 in 1936; diesel locomotives, 13 in 1936; freight cars, 85,674 in 1935 (in equivalent 2-axle units); passenger cars, 1,616 in 1934.

** Many of these Satellite cars are 4-axle units and would probably push the total over 100 percent if counted as such.

*** For a discussion of the adequacy of this production, see VIII, above.

Soviet capabilities in the production of diesel locomotives increased greatly, if this experience is considered in combination with (a) the rebuilding of the Khar'kov plant for the production of diesel locomotives exclusively, (b) the aid of German technicians which was available after the war, and (c) the US Lend-Lease units which were on hand for studying and copying.

2. Probable Changes after 1950.

by the end of 1950 the Soviet program of rebuilding and reconversion was nearly complete and that gains in production after this date are ascribed to increased efficiency of labor, "normal" additions to capital equipment, and the like. It has been assumed that the Russians are capable of increasing their production of steam and electric locomotives and passenger and freight cars at a rate equivalent to the average increase in production during the prewar years 1928-40.* Since it also seems evident, as pointed out in VIII, above, that such capacity production will provide an adequate amount of stock for the railroads, there is no reason to suspect that the Russians will attempt any future program of accelerated expansion of the industry. 50X1

The probable sole exception to this last statement might be an accelerated drive to increase the production of diesel locomotives. Such an expansion is not indicated in the information published in the Draft Directive of the Fifth Five Year Plan (1951-55). Since the Russians have shown a predilection for copying US practice in many cases, however, it is possible that the present US trend toward extensive dieselization might be reflected in future Soviet plans. Two major deterrents, technological skill required for manufacture and fuel oil required for operation, would probably delay and somewhat modify such a trend. In the event that such an attempt were to be made, it would be further hampered by the lack of capital facilities for the production of such units and by the additional skilled labor required. Should the Soviet planners put sufficient priority on such a plan, it is possible that they would be capable of increasing production of diesel locomotives severalfold over the estimates made in V, A, 3, above.

* For a more detailed explanation of this estimate of the rate of expansion, see V, above.

3. Conversion.

During the postwar rebuilding and reconversion period, it is possible that the number of steam locomotives produced could have been increased at the expense of production of the diesel and electric locomotives. A similar increase in the number of diesel or electric locomotives produced at the expense of the production of steam locomotives would probably not have been feasible, however, because of the higher degree of technological skill and greater labor skill required. This is further borne out by the fact that production of diesel and electric locomotives over the period of the Fourth Five Year Plan (1946-50) was only 51 percent and 66 percent, respectively, of the planned production.

Similarly, the product mix of freight cars could have been varied from what was actually produced, and the total production would have been slightly higher if more basic units (such as flatcars and boxcars) had been produced and somewhat lower if more specialized units (such as refrigerator cars and tank cars) had been produced.

Although it is not possible to estimate what the variations in product mix could be in terms of post-1950 capabilities, the same general application of a variation of results as in the preceding paragraphs would hold true. The building of new capital facilities for production also would alter the capability picture, but no evidence has been received of any extensive construction program.

As discussed in I, above, conversion to the production of armaments is not difficult in the locomotive and rolling stock industry.* Such conversion took place with relative ease during World War II, and it is doubtless true that Soviet plans for reconversion in the event of another war have already been made. [redacted] 50X1
50X1
occasional references to 50X1
the fact that a particular plant had on hand the plans and/or tooling for conversion were noted. No firm over-all picture of these conversion plans could be obtained [redacted] but it seems 50X1
only logical that the Russians have anticipated such actions should the need arise.

* See I, B, 2, above.

In the event of such conversion, production of locomotives and rolling stock would taper off and possibly cease entirely if conditions should warrant such action. The capacity for railroad equipment production would inherently remain, as before, but actual available capacity would be determined by the military demands placed on production facilities.

B. Vulnerabilities.

For the purposes of this report, vulnerability is defined as the liability to attack of the industry under discussion causing (a) a reduction or cessation of production and (b) a reduction in the size of the inventory. Such liability will be discussed from the point of view of both cold and hot war and of the consequences of such attack.

Locomotives and rolling stock are not, in themselves, military end items. It is the consequences of damage or destruction to either the production facilities or the equipment inventory that provide a reason for a discussion of the vulnerabilities which exist. The railroads of the USSR are responsible for moving some 80 percent of the freight traffic in the USSR. 160/ Any action which reduces the effectiveness of the rail transportation service will cause a reduction in the flow of supplies to industrial installations, thus causing production difficulties, and, in time of war, may critically affect the movement of troops and military supplies, thus making military planning dependent to a varying degree on the services available from the railroads. It can be seen that, whether it be in a period of hot or cold war or by direct or indirect attack on either production facilities or equipment inventory, the effect of exploiting the vulnerabilities hereafter discussed must be considered in the light of the consequences of such action on the over-all economic activities and the military planning of the USSR, rather than the immediate effects on the industry in question.

Since locomotive and rolling stock plants are easily converted to the production of heavy armaments such as tanks, attacks on such installations must consider the degree of conversion which these facilities have undergone. This degree of conversion, in turn, will be effected by the Soviet planners on the basis of their estimate of whether hostilities will be of a long- or short-term nature. In a relatively short-term period of hostilities, the Russians would

be likely to plan that the current inventory of railroad equipment would suffice and that complete or at least nearly complete conversion to military production would be most effective in aiding the war effort. In the case of a long-term war, the inventory would be expected to suffer from enemy action to the extent that replacements would be necessary. It is thus possible that only partial conversion would take place and that production of new locomotives and rolling stock would continue throughout the war.

Since the vulnerabilities of the production facilities are similar for either railroad equipment or armaments production in the same plant, the discussion of plant vulnerabilities which follows applies to either type of production.

1. Cold-War Production.

It is believed that the production facilities of Soviet railroad equipment are not significantly vulnerable under any cold-war conditions. Neither raw materials nor fabricated parts are known to be imported by the USSR in sufficient quantity to affect production noticeably. Shortages of men, materials, or capital equipment which might cause a "soft spot" in the production picture have not been found, although with all plants presumably working at capacity there is probably little or no "cushion" which the USSR could fall back on in the event of need.

It is the lack of "cushion," together with the possibility of conversion to armaments production, that presents the most vulnerable aspect in the production of locomotives and rolling stock under cold-war conditions. Should the Soviet planners consider it necessary to convert some of these facilities to the production of armaments, the production of railroad equipment would suffer accordingly.

2. Hot-War Production.

In the event of a hot war, the railroad equipment industry of the USSR will almost certainly be converted, in whole or in part, to armaments production. Consequently, any attacks against its facilities will be, at least in part, attacks against armaments production as well as against locomotive and rolling stock production. In a prolonged war, however, it will be impossible to convert the industry completely, especially in the absence of external supplies such as Lend Lease.

a. Direct Attack.

Since substantially the same men, materials, power, and capital equipment would be used for production regardless of the degree of conversion, it is believed that some discussion of the vulnerability of specific items involved in the production of either railroad equipment or armaments should be made. Specific definitive vulnerability studies of individual plants would have to be made in order to determine the most effective type of attack for each facility. Since this is not within the scope of this report, the following comments are intended to provide information as to the effect of partial or complete destruction of a phase or phases of production and not to determine the means of causing disruption of production in a given plant.

As can be seen from the input estimates shown in VI, above, large amounts of raw materials in the form of steel, coal, coke, and other goods are required for the production of a single locomotive or railroad car.* Therefore, the production facilities are dependent to a great extent on the rail transportation service which they themselves supply, and any significant interruption in the flow of raw materials to these plants would cause a comparable decrease in production. Such interruption would have to be continuous to be completely effective. By contrast, an industry which requires but relatively small inputs would be less affected by restrictions of such raw materials: for example, the electronics industry, whose production is of highly complex, but usually small, items.

By the same token, attacks on the iron and steel and other supplying industries would have some effect on production at locomotive and rolling stock plants.

Damage to the power supply of these plants would also hamper production greatly. Determination of whether the supply of electric power for a given plant is internal to the plant area or external from a transmission grid would depend on individual plant studies. Machine tools, welding gear, cranes, and similar equipment which are dependent on electric power would be idle during

* For instance, a single locomotive and tender weighs from 100 to 150 tons on the average, almost all of which is steel in some form.

a period of power interruption, and, although it is true that a certain amount of production which does not require such power could continue and perhaps even increase with the additional labor available, a stoppage of the power supply to a plant would curtail its production to a large extent.

The foundries in locomotive and rolling stock plants are also important links in the production picture, since a great deal of the metal going into the production of these items is in the form of iron and steel castings. Destruction of a foundry would hamper production for the period of time required to repair or rebuild the furnaces.

A general direct attack on the plant area would create the problem of clearing debris and repairing damaged equipment. Since a large part of the equipment used in the manufacture of locomotives and rolling stock is heavy, it is believed that only a direct hit on a piece of equipment would destroy it and that a general attack has only nuisance value as compared with a more precise attempt to inflict damage on a specific phase of production.

Any open hostilities would of course draw away from all types of production a certain amount of labor for military service. Destruction of the remaining labor force in the plant areas also would be a means of interrupting production. A somewhat more appealing action, yet as effective, would be the contamination of the work area by some means.

The following statement, from a survey of actions such as are described above during World War II, summarizes the general vulnerability of such facilities: "The results of the attacks on Henschel and Krupp do indicate the relative ease with which locomotive building facilities can be effectively nullified. They indicate, moreover, the serious difficulty and consequent long delay in recuperation, especially where the supplying industry is also suffering." 161/

b. Sabotage.

In the field of sabotage, two considerations must be reviewed in general terms. The first of these is the encouragement of such acts as passive resistance, work slowdown, poor workmanship, and the like by the employees in the plant. In the case

of the USSR, such actions conceivably could be spontaneous because of unrest within the country.

The second consideration would be sabotage by individuals or teams acting covertly within the USSR. Sabotage would be effective when directed against the same targets as discussed in 2a, above.

3. Cold-War Inventory.

It is not believed that the operational inventory of locomotives and rolling stock in the USSR is vulnerable to cold-war actions. Imports by the USSR of either complete units or parts from other than the Satellites is not significant, and a complete embargo on these shipments probably would not affect significantly the number of units available for service. Also, because of the internal security measures taken at present in the USSR, sabotage of locomotives and rolling stock in the inventory on even a small scale is unlikely.

4. Hot-War Inventory.

The USSR is perhaps most vulnerable with respect to its locomotive and rolling stock inventory under hot-war conditions. This vulnerability is not peculiar to the USSR but applies to any country whose economy is dependent to a very large degree on railroad transportation. One factor which perhaps makes the USSR somewhat more vulnerable than many other countries is the lack of a "cushion" in the operational inventory of locomotives and rolling stock. In spite of efforts to maintain a reserve inventory for emergency use, the inventory presently on hand is being used at near maximum capacity, as is evidenced by the Soviet efforts to reduce turnover time, to raise train speeds, and to increase the ratio of actual loads to capacity loads in freight cars. Thus a reduction in the operational inventory over and above what reserves may be available would put a burden on the railroad transportation service which would be difficult to overcome by increasing the efficiency of operations.

a. Direct Attack.

Direct concentrated attacks on the operating inventory of locomotives and rolling stock by bombing of individual

trains, marshalling yards, and repair depots would reduce the ability of the Russians to move the raw materials and finished goods needed in a war economy. Initial losses could perhaps be offset by divergence of undamaged equipment from less essential services, but since some plants would be converted to armaments production, the Russians would find it impossible to replace all of the destroyed inventory.

b. Sabotage.

On the same premise, destruction of locomotives and rolling stock by sabotage would create the same type of shortage of inventory. Sabotage could take the form of direct attack on the vehicles or indirect attack on the right-of-way, which would result in damage to the vehicles as the result of wreckage. In such attacks the locomotive, the more complex piece of equipment, would be the logical target, since its replacement is accordingly more difficult.

Thus, in summarizing, it can be seen that, although the exploitation of the vulnerabilities of both the production facilities and the inventory of railroad equipment in the USSR would perhaps not be considered as a direct attack on the military capabilities of the USSR, its effect would be to reduce the kinetic energy of Soviet efforts to wage war by effectively reducing their ability to supply the production economy and the military machine of the country with their requirements.

C. Intentions.

1. Specific Indications from the Fifth Five Year Plan (1951-55).

The following statement is quoted from the Draft directive of the Fifth Five Year Plan (1951-55): " ... To meet fully the demands of railway transport in long-distance locomotives, electrically driven locomotives, and diesel locomotives and in railway freight cars, refrigerated cars, and passenger coaches; to complete in the main the introduction of automatic couplings on all rolling stock and to equip all rolling stock with roller bearings; to begin the production of new powerful locomotives, electric locomotives and diesel locomotives,

including gas-generator locomotives." 162/ With a single exception, it appears from this statement that the intention of the Russians is to continue the production of railroad equipment in much the same vein as during the 1946-50 Plan period: that is, production of diesel and electric locomotives will continue to increase as rapidly as technology and facilities will permit, more modern units of all types will be designed and placed in production, and the locomotive and rolling stock industry as a whole will continue to expand at a rate consistent with the economic development of the country. Neither the Fifth Five Year Plan nor other external sources indicate an intention to expand capital facilities significantly.

The single phrase from the above statement to which exception must be taken is "to equip all rolling stock with roller bearings." A study of this phrase by a language expert in the original Russian text as printed in Pravda led to the following conclusions: (a) it could literally mean the equipping of all rolling stock with roller bearings (both locomotives and cars according to the Soviet use of the term rolling stock), or (b) it could mean the equipping of all new equipment with roller bearings, or (c) it could mean undertaking a program to equip either all or all newly constructed locomotives and rolling stock with roller bearings. The third of the possible meanings is believed to be the most reasonable: that is, during the course of the Plan, attempts will be made to equip all newly constructed units with roller bearings. Even this interpretation is subject to some question, since the installation of roller-bearing journal boxes on freight cars has not been carried out extensively even in the US, where, if such practice were considered sound from an economic and engineering point of view, no production problem would prevent their installation. The principal advantage of roller-bearing journal boxes is in the reduced power required for starting a train. Roller bearings are most common in the US on locomotives and passenger cars, and the same can be expected in the USSR. In the case of freight cars, the additional maintenance problem imposed by roller bearings has offset the advantages to the point that only a relatively small number of freight cars in the US have been so equipped. Roller-bearing journal boxes are more subject to damage by humping operations than are solid sleeve-type bearings. For this reason and the reason that the roller bearings production industry in the USSR is not producing enough bearings for present Soviet needs, it is not believed that any serious attempt to equip even new freight cars with roller-bearing journal boxes will be made by the USSR during the 1951-55 period. 163/

2. Indications of Economic or Political Changes.

The current intentions of the Russians with respect to the production of locomotives and rolling stock do not indicate any change in the political or economic activity of the USSR. Railroads, together with the development of their operational inventory through production of new locomotives and rolling stock, are an inherent part of the Soviet economy, and normal expansion of the industry indicates nothing but the continued development of the industrialization of the country.

Any conversion of the Soviet locomotive and rolling stock production facilities to armaments production probably would indicate changes in economic or political intentions. Since there is no such conversion at present, it appears that the Russians are emphasizing the long-term growth of the economy with the possibility of ultimately either raising the standard of living or expanding the Soviet war potential. Conversion of these facilities would imply a de-emphasis on long-term armaments expansion in favor of short-term military advantage. The rate and degree of conversion might well indicate something about the Soviet evaluation of the imminence of hostilities.

PART II: EUROPEAN SATELLITES

I. Introduction.

Part II of this report is not intended as a completed basic research study on each of the European Satellites* as is Part I on the USSR. Section II, below, presents only the immediate post-war intelligence estimates on these countries, including such basic information as a brief description of the administrative organization of the industry, production and inventory estimates, information on individual plants from the point of view of production, and some additional information on particular items of intelligence value. Section III, below, is a discussion of over-all capabilities, vulnerabilities, and intentions of the European Satellites.

Technological specifications of equipment and statistical comparisons between the US and the European Satellites have been omitted here

II. Studies of Individual European Satellites.

A. East Germany.

1. Administrative Organization.

The production of locomotives and rolling stock in East Germany is controlled by two apparently independent organizations. The first of these is the Transmash Soviet Corporation (Ministerstvo Transportnogo Mashinostroyeniya Sowjetische Aktiengesellschaft -- Transmash SAG) which is Soviet-owned and Soviet-operated and controls the activities of railroad equipment plants at the following places 164/: Dessau,** railroad cars; Weimar,** narrow-gage railroad cars and refrigerator cars; Ammendorf,** express train coaches; Ilsenburg,** railroad wheel sets; and Berlin

* For a map showing the locations of locomotive and rolling stock plants in the European Satellites, see Figure 26, following p. 98.
** These plants were resold by the USSR to the German Democratic Republic (GDR) in mid-1952. Information obtained in August 1953 lists them under the administration of the Association of People-Owned

(formerly Knorr-Bremse), brake equipment. Railroad equipment constructed by these plants is considered as reparations even though the plants are Soviet-owned and Soviet-controlled.

The second organization is the Association of People-Owned Enterprises, Locomotive and Railroad Car Works (Verwaltung Volkseigener Betriebe - Lokomotiv und Waggon -- VVB-LOWA).* The plants under the direction of this administration are engaged in the production of railroad equipment for the USSR as reparations and of items for the internal use of the East German railroad network. Wildau is the seat of the LOWA administration, but no production is carried out there, with the possible exception of conversion of steam locomotives to coal-dust firing. People-Owned Enterprises (Volkseigene Betriebe -- VEB's) under the VVB-LOWA administration are located at the following places: Goerlitz, Niesky, Bautzen, Werdau, Babelsberg, Gotha, Uebigau, and Vetschau. 166/

2. Production Estimates.

The estimated production of locomotives and rolling stock in East Germany in 1950, 1951, and 1952, [redacted] is given in Table 18.** 50X1 50X1

3. Inventory Estimates.

a. Locomotives.

The estimated locomotive inventory in East Germany as of 29 February 1952 is given in Table 19.***

b. Freight Cars.

The estimated freight car inventory in East Germany as of 20 December 1951 is given in Table 20.***

Enterprises, Locomotive and Railroad Car Works (Verwaltung Volkseigener Betriebe - Lokomotiv und Waggon -- VVB-LOWA), and even though the administrative function of the VVB's was reported to have been assumed by the Ministry of Machine Construction as a result of its reorganization in January 1953, the use of the term VVB-LOWA as a commodity group designation has continued. 165/

* See p. 97, note **, above.
** Table 18 follows on p. 99.
*** Tables 19 and 20 follow on p. 101.

50X1-HUM

Figure 26 50X1

EUROPEAN SATELLITES
RAILROAD LOCOMOTIVE AND/OR ROLLING STOCK PLANTS

Scale 1:10,000,000

0 100 200 300 400 Statute Miles

0 100 200 300 400 Kilometers

50X1

12450 CIA, 10-53

Table 18

Estimated Production of Locomotives and Rolling Stock in East Germany
1950-52

Units

Item	Destination	Gage (mm)	1950	1951	1952
Freight Cars					
Refrigerator Cars	USSR	1,524	1,551 to 1,820	2,296 to 2,696	1,890 to 2,940
4-Axle Slag and Dump Cars	USSR	1,524	500	95 to 120	72 to 96
Gondola Cars	USSR	1,524	0	N.A.	400
Tank Cars	USSR	1,524	7+	600 to 720	720
Flatcars	USSR	1,524 and 1,435	350	610 to 730	2,420 to 2,444 a/*
Boxcars	USSR	1,524	2,081 to 2,281	950	0
Freight Cars (Type Not Specified)	USSR	1,524	250	500	960
Boxcars	Czechoslovakia	1,435	0	0	250
Coal Cars	Poland	1,435	0	350 to 500	0
Coal Cars	East Germany	1,435	0	0	400
Total Freight Cars b/			4,739 to 5,208	5,401 to 6,216	7,112 to 8,210
Passenger Cars					
Passenger Cars	USSR	1,524	650 to 850	995 to 1,170	535 to 895
Dining Cars	USSR	1,524	25	40 to 50	80
Double-Deck Passenger Cars	East Germany	1,435	0	36	100
Total Passenger Cars			675 to 875	1,071 to 1,256	715 to 1,075
Work Cars					
15-Ton Railroad Cranes	USSR	1,524	75 to 80	90	144
25-Ton Railroad Cranes	USSR	1,524	60 to 65	100 to 115	120 to 150
50-Ton Railroad Cranes	USSR	1,524	0	45 to 50	72 to 100
Total Work Cars			135 to 145	235 to 255	336 to 394

* Footnotes for Table 18 follow on p. 100.

Table 18

Estimated Production of Locomotives and Rolling Stock in East Germany
1950-52
(Continued)

Units

Item	Destination	Gage (mm)	1950	1951	1952
Work Trains c/	USSR	1,524	0	0	5
Hospital Cars	USSR d/	1,435	0	40	660 to 700
Coal-Dust Tenders	East Germany	1,435	15 to 17	0	0
Steam Locomotives					
Steam Locomotives	USSR	1,524	0	0	(30 Plan)
Steam Locomotives	East Germany	1,435	0	0	(32 Plan)
Total Steam Locomotives			0	0	(62 Plan)
Electric Locomotives	USSR	1,524	50	80	61
Narrow-Gage Cars					
"Long Timber" Cars	USSR	750	1,200 to 1,440	240	0
Mobile Generator Cars	USSR	750	353 to 360	400 to 720	295
Freight Passenger Cars	USSR	750	557	0	40
Passenger Cars	USSR	750	600	0	0
Utility Cars	USSR	750	600	0	0
Flatcars	USSR	750	0	650	400 to 600
Total Narrow-Gage Cars			3,310 to 3,557	1,290 to 1,610	735 to 935
Mining Locomotives	USSR	750	200	Over 100	Over 160
Mining Locomotives	Czechoslovakia	Unknown	0	100	0

a. 2,300 of these are 1,435-mm gage. For details, see 5b, below.
b. [redacted] estimate of freight car production for 1950 and 1955. The 1950 estimate is 4,760 cars. The 1955 Plan estimate is 11,900 cars. Straight-line interpolation between 1950 and 1955 shows estimates for 1951 and 1952 of 6,188 and 7,616 units, respectively. These estimates all fall within the range of estimate as shown in this table. Since these estimates as shown were made by summing up individual plant production estimates and since the estimate [redacted] is subsequent to these plant estimates, the concurrence of the two estimates lends a great deal of support to the contention that individual plant studies which result in estimates of production may well be a valid means of estimating total production within a given country.
c. Composition unknown.
d. For details, see 5a, below.

Table 19

Estimated Locomotive Inventory in East Germany
as of 29 February 1952 168/

Units

Locomotives	In Service	Under or Awaiting Repair	Damaged	Total
Reichsbahn-Owned Locomotives	2,981	1,845	621	5,447
(Including Coal-Dust Locomotives)	(35)	(41)		(76)
Column Locomotives a/	305	66	0	371
Foreign-Owned Locomotives b/	10	7	986	1,003
Narrow-Gage Locomotives	147	63	5	215

a. These are locomotives used exclusively for the transportation of goods to the USSR.
b. Probably locomotives captured during World War II, largely badly damaged and not capable of repair.

Table 20

Estimated Freight Car Inventory in East Germany
as of 20 December 1951 a/ 169/

Units

Type of Freight Car	In Service	Damaged	Reserve	Total
Boxcars	26,182	1,925	5	28,112
Flatcars	15,306	1,332	25	16,663
Open Cars	43,680	3,894	68	47,642
Tank Cars	4,043	157	73	4,273
ZMW Cars (Tank Cars for Edibles)	1,599	92	11	1,702
Refrigerator Cars	430	95	113	638
Other Cars	3,511	446	0	3,957
Cars for Special Use (Various Types)				3,963
Total	93,063	7,849	295	105,158

a. All figures, including the totals, are as given [redacted] The totals at the foot of the table do not represent exact sums of the columns. A 2-percent margin of error is allowed by East Germany in the figures for types of cars and in the totals, since the count is a paper one and not an actual one.

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c. Passenger Cars.

The estimated passenger car inventory in East Germany as of 31 January 1952 is given in Table 21. [redacted] 50X1

50X1

[redacted]

Leaving out the narrow-gage, railway service, and S-Bahn cars, 8,502 cars were in service on 1 January 1952 (of which 1,767 were baggage cars and 656 were mail cars) and 1,610 were out of service awaiting repairs.

Table 21

Estimated Passenger Car Inventory in East Germany as of 31 January 1952 170/

Units

Type of Passenger Car	Operable	Under Repair	Beyond Repair a/	Total
Express Train (D-Zug)	457	127	98	682
Limited Stop Train (E-Zug)	199	44	10	253
Local Train	5,400	894	179	6,473
ISG Sleeping			38	38
ISG Dining			39	39
Mitropa Sleeping	10	1		11
Mitropa Dining	13			13
Baggage	1,767	390	232	2,389
Berlin S-Bahn	1,018	111	179	1,308
Narrow-Gage	636	118	98	852
Mail	656	154	11	821
Railway Service	1,344	153	1	1,498

a. These cars can be used only for obtaining parts (cannibalizing).

4. Plant Information.

Estimates of production in 1950 and 1951 and planned production in 1952 at those of the above-mentioned and other plants which produce locomotives and/or rolling stock follow. 171/

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a. Dessau.

Proper Name: Waggonfabrik Dessau.

Production: 1950: 1,000 refrigerator cars.
60 to 65 25-ton railroad cranes.
75 to 80 15-ton railroad cranes.
150 to 200 express train coaches.
Unknown number (probably small) of 4-axle slag and dump cars.
Unknown number of flatcars.

1951: 1,500 to 1,800 refrigerator cars (see Fig. 27*).
100 to 115 25-ton railroad cranes.
45 to 50 50-ton railroad cranes.
90 15-ton railroad cranes.
35 to 60 slag cars.
60 dump cars.
250 express train coaches.
Unknown number of flatcars.

1952: 1,440 to 2,100 refrigerator cars.
144 15-ton railroad cranes.
120 to 150 25-ton railroad cranes.**

* Following p. 104.
** Railroad cranes are to be shipped as special flatcars to Waggonbau Bautzen for installation of crane riggings.

a. Dessau (Continued).

Production: 1952: 72 to 100 50-ton railroad cranes.*
36 to 48 foundry cars.
120 to 144 flatcars.
36 to 48 slag cars.

b. Weimar.

Proper Name: Waggonbau Weimar.
Former Name: Fritz Saukel Werke.

Production: 1950: 1,200 to 1,440 narrow-gage "long-timber" cars.
353 to 360 narrow-gage mobile generator cars.
557 narrow-gage freight-passenger cars.
451 to 720 refrigerator cars.
Unknown number of tank cars.

1951: 240 narrow-gage "long-timber" cars.
720 refrigerator cars.
400 to 720 narrow-gage mobile generator cars.
600 to 720 tank cars.

1952: 295 narrow-gage mobile generator cars.
40 narrow-gage passenger-freight cars.
450 to 840 refrigerator cars.
400 soft-coal cars (probably gondola cars).
720 tank cars.

* Railroad cranes are to be shipped as special flatcars to Waggonbau Bautzen for installation of crane riggings.

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FIGURE 27. REFRIGERATOR CAR, PRODUCED BY WAGGONFABRIK DESSAU SAG AS REPARATIONS FOR THE USSR. The photograph was taken at the Coswig Bahnhof on 3 August 1951. Note the modern construction of the car and the inscription in Russian stenciled on the car before delivery. The inscription on the side of the car at the top, *lednik,* means "Refrigerator."

50X1-HUM

c. Ammendorf.

Proper Name: Waggonfabrik Ammendorf.
Former Name: Gottfried Linder AG.

Production: 1950: 350 to 450 coaches (convertible to hospital cars).
600 narrow-gage passenger cars.
600 narrow-gage utility cars.

1951: 355 to 390 passenger coaches.
650 narrow-gage flatcars.

1952: 480 to 540 passenger coaches.
400 to 600 narrow-gage flatcars.

d. Goerlitz.

Proper Name: Waggonbau Goerlitz.
Former Name: Wumag Waggon und Maschinen Werke.

Production: 1950: 100 to 150 express train coaches.
500 4-axle dump cars.
350 flatcars.
25 dining cars.

1951: 350 to 500 coal cars (for Poland).
40 to 50 dining cars.
10 80-ton flatcars.
250 coaches.
36 double-deck passenger cars.
40 reconstructed hospital cars.

1952: 100 double-deck passenger cars.
50 to 350 coaches.
80 dining cars.
60 to 100 hospital cars.

d. Goerlitz (Continued).

Production: 1952: 700 50-ton 4-axle flatcars.*
400 coal cars.

e. Niesky.

Proper Name: Waggon- und Stahlbau Niesky.
Former Name: Christoph und Unmack.

Production: 1950: 781 boxcars.
15 to 17 coal-dust tenders.

1951: No information.

1952: 1,600 80-ton 6-axle flatcars.*
250 boxcars (for Czechoslovakia).

f. Bautzen.

Proper Name: Waggonbau Bautzen.
Former Name: Busch Waggonbau.

Production: 1950: 800 to 900 boxcars.
50 (or more) passenger cars.
Unknown number of coal cars (gondola cars).

1951: 950 boxcars.
140 to 280 passenger cars.
Unknown number of coal cars.

* The total order from the Soviet Control Commission is for 2,300 flatcars of 50- and 80-ton capacity. The order consists of 700 50-ton 4-axle cars and 1,600 80-ton 6-axle cars. Distribution of production assignment between Waggonbau Goerlitz and Waggon- und Stahlbau Niesky is positive. The flatcar program is said to take priority over all but orders for hospital cars. 172/

f. Bautzen (Continued).

Production: 1952*: 200 3-car hospital trains.
250 crane cars from Dessau for finishing.
5 work trains (composition unknown).

g. Werdau.

Proper Name: Waggonbau Werdau.
Former Name: Schumann Werke.

Production: 1950: 500 to 600 boxcars.
100 refrigerator cars.
7 tank cars.

1951: 76 to 176 refrigerator cars.
No other information.

1952: Converted to motor vehicle production.

h. Babelsberg.

Proper Name: Karl Marx Werke.
Former Name: Orenstein und Koppel.

Production: 1950: 200 narrow-gage steam and diesel mining locomotives.

1951: Several hundred narrow-gage steam and diesel mining locomotives.

1952: Unknown number of narrow-gage mining locomotives.
30 broad-gage steam locomotives planned but not built.

* Waggonbau Bautzen is to discontinue railroad equipment production at the end of 1952 and concentrate on motor vehicle production. 173/

i. Gotha.

Proper Name: Waggonbau Gotha.
Former Name: Gothaer Waggonfabrik.

Production: 1950: 250 freight cars (type unknown).

1951: 500 freight cars (type unknown).

1952: 960 freight cars (type unknown).

j. Hennigsdorf.

Proper Name: Lokomotivenbau Elektrotechnische Werke (LEW).*
Former Name: AEG Borsig Lokomotivbau.

Production: 1950: 50 80-ton Bo-Bo electric locomotives.**

1951: 80 electric locomotives of varying types and weights.
100 narrow-gage electric mining locomotives for Czechoslovakia.

1952: 221 electric locomotives of varying types and weights.***
32 steam locomotives planned but not built.
5 passenger coaches.

* LEW Hennigsdorf is under the administrative control of the Ministry of Machine Construction through the Main Administration for Electrical, Radar, and Electronics Construction.
** A Bo-Bo wheel arrangement consists of two 2-axle trucks. Each of the four axles is driven by its own traction motor.
*** Of which 61 are of over 60-ton total weight.

All production of the SAG-owned plants is for the USSR as reparations. Unless stated to be of narrow gage, the equipment produced is of Soviet broad gage. It is shipped to a border point on standard-gage wheel sets, and then the broad-gage wheel sets, which accompany the equipment, are installed. The narrow-gage equipment listed is primarily 750-mm-gage units for use in mines and in timber hauling.

The VVB-LOWA plants are primarily engaged in reparations production for the USSR, with the following exceptions: at Waggonbau Goerlitz the double-deck passenger cars are being produced for the East German State Railways; at Waggon- und Stahlbau Niesky the coal-dust tenders are for internal East German use; and at Hennigsdorf the mining locomotives noted in 1951 are for Czechoslovakia, and the 32 steam locomotives scheduled in 1952 are for internal East German use.

5. Additional Information of Intelligence Value.

a. Hospital Cars.

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In late December 1951, Waggonbau Goerlitz received orders from the USSR to construct a number of hospital trains. These trains were to consist of 5 or 6 cars each (1 power car equipped with generators and other special equipment, 1 car equipped for surgery, 1 first-aid car, and 2 or 3 cars for casualties). The original order seems to have been for 10 such trains. The cars are reported to be of standard European gage and not convertible for broad gage. This could mean that they are for the use of Soviet troops stationed in Germany as mobile aid stations where permanent hospital facilities are not available.

50X1

further production of these hospital trains at Waggonbau Goerlitz after the completion of the first 10. 174/

50X1

in 1952 Waggonbau Bautzen was ordered to produce 200 emergency hospital trains consisting of 3 cars each (1 surgery car, 1 X-ray car, and 1 car of unknown type). 175/

b. Heavy-Duty Flatcars.

Another item of importance is the 1952 Soviet order for 2,300 heavy-duty flatcars from East Germany. These cars, of 50- and 80-ton capacity, are said to be under construction at Waggonbau Goerlitz and Waggon- und Stahlbau Niesky and are reported to have a priority over all production except hospital cars. The present inventory of such cars in East Germany is not over 250 units, so that this order takes on added significance. 50X1 the East Germans are making efforts to obtain special strip steel for these cars from sources outside the Soviet Bloc and are willing to pay extremely high prices for it. 50X1 50X1

Since a loaded depth of 18 to 24 inches on the flatcars would load them to their capacity, they would be well suited for the purpose. In addition, in case of necessity the cars can be used for the transportation of tanks and other similar heavy military equipment. 176/

c. Coal-Dust Locomotives.

In East Germany, supplies of black coal are almost nonexistent, and the firing of locomotives is done largely with brown coal briquettes. This procedure causes a marked loss in operating efficiency as well as other unpleasant features, and for this reason the development of locomotives fired with coal dust was urged by the coal and other industries.

Before World War II the Reichsbahn had explored the possibility of using locomotives fired with coal dust and had constructed a total of 10 such units. The operation was not too successful, because of the expense of the coal dust, until 1937, when the Halle'sche Pfaennerschaft, an old mining corporation, established a large coal-dust-grinding mill in Senftenberg and, having to find a regular account, offered coal dust to the Reichsbahn on favorable terms and prices. The coal-dust locomotives were used in the transport of heavy brown coal briquettes to Berlin and the return of the empty trains to Senftenberg.

During World War II, coal-dust locomotives lost their importance because they depended on a specific fuel base.

When the Russians occupied Germany at the end of the war, they dismantled the coal-dust plant at Senftenberg, and the locomotives were no longer used.

The coal-dust locomotive program was reopened at the beginning of 1949, and a German civil engineer, Hans Wendler, undertook the assignment of developing such locomotives for use in East Germany. He started with a prewar model and, after considerable experimentation, succeeded in developing a unit which would operate well on relatively poor grades of coal dust. Major changes were made in the prewar models: They were considerably simplified and thus made more dependable as well as more efficient. The advantages claimed for coal-dust firing with the Wendler design are the following: there is no shortage of steam; flying sparks are completely eliminated, as well as ash dumping along the right-of-way; there is no more smoke, and fuel combustion is almost complete; steaming up normally takes about 45 minutes as compared with 4 to 6 hours for a grate-fired locomotive; coaling is cleaner and quicker; and the fireman on the locomotive is released from physical labor, leaving him free to watch with the engineer for signals and the like, thus enhancing the safety of operation of the locomotive. In addition to these advantages, it is also claimed that a fuel saving of some 30 percent over the grate-fired locomotive is achieved.

The disadvantages of coal-dust operation are also considerable, [redacted] 50X1

"Lately, there has been a shortage of suitable coal dust because it was found that, as heretofore, only coal dust with a maximum residue of 20 percent on the 4,900 sieve is actually usable. Such coal dust is in short supply in the Halle area, and Senftenberg has not resumed deliveries yet. Therefore, plans are being voiced to reconvert part of the coal-dust-fired locomotives to grate firing. Furthermore, the high sulphur content of the brown coal dust always creates difficulties. Those copper fireboxes still in existence are almost corroded through, and steel fireboxes cannot be manufactured in the German Democratic Republic as yet. Thus, several boilers have torn open already, an occurrence

which always constitutes considerable danger for everybody in the vicinity." 177/

The fact that some of the coal-dust locomotives may have been reconverted is borne out by an official tabulation of locomotives in East Germany as of 31 January 1952 which indicates that 83 coal-dust locomotives were included in the inventory, and by a second similar tabulation as of 29 February 1952 which indicates only 76 such units in the inventory, although the total inventory remained the same. These same tabulations also indicate that, on 31 January 1952, 42 of the coal-dust locomotives were in operational condition (50.5 percent) and that, on 29 February 1952, only 35 were in operational condition (46 percent). Thus it can be seen that the program for coal-dust firing may not be as successful as anticipated. 178/

The development of this coal-dust locomotive program is of interest because of the fact that successful development of such units will, to a large extent, aid the East German railroads in their present problems of fuel shortages. It is estimated that 1,250 locomotives so fired would effect an annual saving of 8 million tons of briquettes. 179/

d. Return of Equipment from the USSR.

In 1951, some 20,000 freight cars seized by the Russians in eastern Germany during World War II were returned. These cars were in such poor condition that most of them had to be scrapped. 180/ It was also reported that in 1952 20,000 additional freight cars would be returned 181/ and that 180 electric locomotives which were similarly seized during the war also will be returned. 182/ The freight cars in this second return probably also will be in such poor condition that few can be rebuilt for addition to the East German inventory. Any additions, however, will be of use to East Germany, as there is a continual shortage of freight cars on its railroads at present. The electric locomotives will need extensive repair, and it was estimated that about 50,000 East German marks would have to be provided by the East German government for the repair of each of these units. Where the materials and money for these repairs are to come from is not known, even by the East German authorities, and it is doubtful that the electric locomotives will be placed in service at an early date. 183/

B. Poland.

1. Administrative Organization.

Administratively, the plants in Poland which produce railroad equipment are subordinate to the Central Administration of the Metal Industry, which, in turn, is subordinate to the Ministry of Heavy Industry. The production of locomotives and rolling stock at these plants in Poland is presently scheduled according to the requirements of the current Six Year Plan (1950-55). Previous to the current Plan a Three Year Plan (1947-50) was in effect.

2. Production Estimates.

It is impossible to estimate the total yearly production of locomotives and rolling stock in Poland [redacted] There are, however, several reports of production on a yearly basis which make it possible to estimate total production for the years 1946-49 and the 1950-55 Plan, inclusive. These estimates are given in Table 22.

50X1
50X1

Table 22

Estimated Production of Locomotives and Rolling Stock in Poland 1946-49, 184/ 1950-55 Plan 185/

Units

Year	Steam Locomotives	Freight Cars (2-Axle Equivalent)	Passenger Cars
1946	178	5,221	5
1947	254	11,500	108
1948	265	15,000	232
1949	267	14,200	200
1950 Plan	280	16,200	300
1951 Plan	290	15,500	400
1952 Plan	300	16,400	400
1953 Plan	300	16,400	400
1954 Plan	300	16,400	400
1955 Plan	300	18,000	400
1955 a/	315	18,800	630

a. These figures were introduced at the request of the Soviet Control Commission after the 1950-55 Plan was announced.

3. Inventory Estimates.

Estimates of the inventory of locomotives and rolling stock in Poland vary to an appreciable extent over the years 1946-52 and the 1955 Plan. All estimates [redacted] have been considered, and Table 23 gives a summary [redacted] considered to be most reliable.

50X1
50X1

Table 23

Estimated Inventory of Locomotives and Rolling Stock in Poland 186/
1946-52, 1955 Plan

Units

Year	Steam Locomotives	Passenger Cars	Freight Cars
1946	5,200 to 5,700 a/	7,276	110,000 b/
1947	5,848 a/	8,161	164,996 c/
1948	5,860 a/	N.A.	170,500 c/
1949	4,800	8,000	160,000 b/
1950	4,870 d/	8,250 d/	165,500 d/
1951	4,950 d/	8,500 d/	171,000 d/
1952	5,030 d/	8,750 d/	176,500 d/
1955 Plan	5,240	9,500	193,000

a. Including an undetermined number of damaged units.
b. Freight cars actually in use.
c. Total number of freight cars in use and damaged cars.
d. Increases between 1949 and the 1955 Plan are arbitrarily divided equally.

4. Plant Information.

Some 17 plants in Poland have been reported as producing locomotives and/or rolling stock. [redacted]

50X1
50X1

* A summary of total production of the major plants indicates that plants noted with a dagger (†) are of minor importance and may actually be engaged in parts production rather than in actual assembly of locomotives and/or rolling stock.

a. Sanok.

Proper Name: Polish Railroad Car Plant.
Former Name: Zieleniewski Railroad Equipment Plant.

Production: This plant reportedly resumed production after World War II in 1946 with a monthly production of 100 coal cars. No recent information is available.

b. Chrzanow.

Proper Name: Dzierzynski Railroad Locomotive Plant.
Former Names: First Railroad Locomotive Plant.
Fablok Railroad Locomotive Plant.

Production: Production reports vary, but it seems clear that this plant has produced the TY-45-class and the OK-21- and OK-22-class steam locomotives for the USSR (see Fig. 28*). Production of the TY-45 was begun in 1946, and some 100 units were reported as produced for the USSR by November 1947. 150 locomotives of "other" types also were reported as produced in 1947. These were probably tank-type shunt locomotives of the "Ferrum" class for the USSR. The 1948 Plan purportedly called for the production of 217 main-line locomotives -- 150 for Poland and 67 for export to the USSR. The PT-47-class express locomotives for Polish use were first built in 1948 (see Fig. 29*). It is described as the largest and most powerful steam locomotive presently produced in Europe. Production in 1949 is reported as 332 units of all types. No later information is available.

* Following p. 116.

c. Wroclaw (Breslau).

Proper Name: Pafawag Railroad Car Plant.
Former Name: Linke-Hoffmann Railroad Car Plant.

Production: The following breakdown of production was reported:

1946: 1,468 coal cars in the first 7 months.

1947: 5,400 to 5,800 coal cars.
76 to 82 locomotive tenders.
17 to 18 passenger cars.

1948: 5,300 coal cars.
122 locomotive tenders.
46 passenger cars.

1949: 66 mail coaches.
Beginning on 1 October 1949, troop transport railroad cars to seat 130 men were to be produced at the rate of 1 car every 2 days.
Beginning on 1 October 1949, armored freight cars at the rate of 1 a day were to be produced.

1950: 30 special flatcars with 8 axles and a gear ring in the center of the car for an artillery piece.

1951: 150 additional special 8-axle flatcars by May.
1,000 freight cars for Hungary, delivery to start on 1 August 1951.
About 80 percent of all production was for the USSR.

50X1-HUM

FIGURE 28. MODERN POLISH FREIGHT STEAM LOCOMOTIVE, PRODUCED IN 1946, PROBABLY AT CHRZANOW.

50X1-HUM

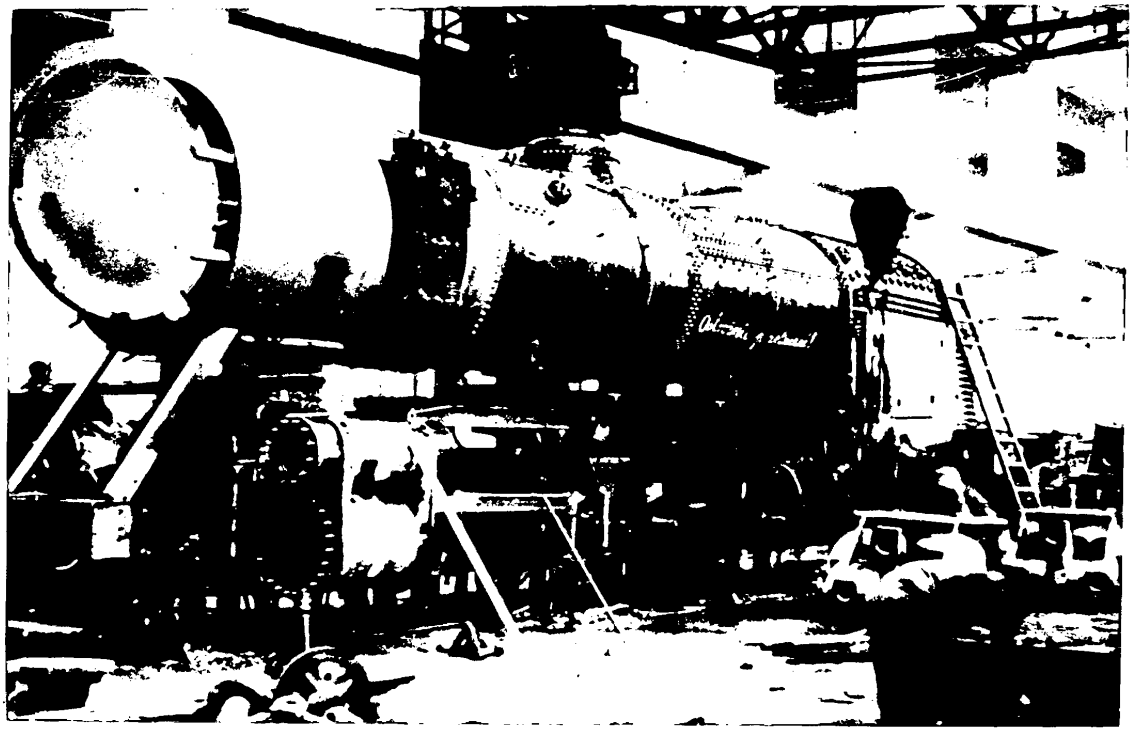

FIGURE 29. INTERIOR OF THE BOILER ASSEMBLY SHOP AT THE CHRZANOW LOCOMOTIVE WORKS, 1949. The boiler shown is probably for a PT-47-class steam locomotive. The inscription written on the side of the boiler, *Ostroznie partaczu!*, means "Careful, bungler!"

d. Poznan.

Proper Name: Cegielski Locomotive and Machine Plant.

Production: [redacted] production for the USSR did not start until November 1949. A total of 8 locomotives for the USSR was reported for 1949 and about 90 for 1950. [redacted] No figures are available after 1950 or before 1949.

50X1
50X1
50X1
50X1

e. Gdansk (Danzig).

Proper Name: Waggonfabrik Railroad Car Plant. /

Production: No information.

f. Chorzow.

Proper Name: Kosciuszko Iron Works.
Former Names: J.G. Katowice and Laura Iron and Steel Corporation.
Koenigshuette Steel Plant.

Production: No information is available.

g. Luban.

Descriptive Name: Railroad Car and Locomotive Plant. /

Production: Prewar: Electric locomotives.
Present: Locomotives and cars.
No other information is available.

h. Lublin.

Descriptive Name: Railroad Locomotive Plant. /

Production: No information is available.

i. Sosnowiec.

Proper Name: Babcock and Zieleniewski Plant.

Production: Said to have produced 100 locomotives from the end of World War II to October 1947. Bulgaria reportedly ordered 30 locomotives from this plant. No other information is available.

j. Warsaw.

Proper Name: Lilpop, Rau, and Loewenstein, Inc.

Production: In 1951 the plant was reported as producing 40-hp mining locomotives.

k. Warsaw.

Proper Name: Ostrowiec Railroad Locomotive Plant.

Production: Also produces 40-hp mining locomotives. May possibly be the same plant as the preceding one or may be engaged in joint production of these mining locomotives with this plant.

l. Wroclaw (Breslau).

Proper Name: Zaodrzanski Railroad Car and Bridge Building Plant.

Production: [redacted] production target for 1947 was 300 freight cars per month. 50X1

m. Zielona Gora (Gruenberg).

Proper Name: Zaodrzanski Railroad Car and Bridge Building Plant.

Production: As of March 1950 a total of 3,000 4-axle coal cars has been reported as shipped to the USSR since the end of World War II. In addition, some 300 tank cars were reported shipped up to December 1949. No other information is available.

n. Bedzin.

Proper Name: Zamkost Railroad Tank Car Plant. 7

Production: Reportedly produces tank cars for the Polish railroads. No other information is available.

5. Additional Information of Intelligence Value.

a. Exports to Communist China, Albania, and Bulgaria.

Polish capacity for the production of locomotives and rolling stock is such that, in addition to production for the USSR and for its own use, it is able to produce some units for export to other Satellites. On 7 October 1951, 2 locomotives and 29 railroad cars were loaded on the SS Kosciuszko, presumably for shipment to Communist China. 188/ [redacted] this shipment as going to Albania. 189/ Whether this particular shipment went to Communist China or to Albania, the likelihood is that both countries are receiving some units from Poland. In addition, on 11 July 1951 a 2-year trade agreement between Bulgaria and Poland was signed in which Poland agreed to ship both locomotives and rolling stock to Bulgaria in 1952 and 1953. 190/ Even though no complete statistics on such exports are available, it is important to note that the capacity of the Polish industrial plant is high enough to satisfy both internal and Soviet demands and still leave a surplus for export.

50X1

b. Imports from Sweden.

Poland has recently received from Sweden forty-four 3-coach electric train sets (for use on the Warsaw subway) and 8 electric locomotives. The first of the electric train sets was put into service in December 1950, and the first locomotive was put into service in May 1951. It is interesting to note that, even though Poland has sufficient capacity to produce steam locomotives in exportable quantities, it evidently does not have the proper facilities for the construction of electric locomotives within its own boundaries. 191/

C. Hungary.

1. Administrative Organization.

The production of locomotives and rolling stock in Hungary is scheduled according to the current Five Year Plan Act (1950-54). Previous to the current Plan, the Three Year Plan (1947-49) was in effect. The locomotive and rolling stock plants are controlled by the Ministry of Heavy Industry, as the higher authority, with a form of chief directorate having immediate administrative authority over the individual plants. 192/

The Three Year Plan and the Five Year Plan were, and are, flexible enough to permit changes in production quotas to meet current economic conditions. The Three Year Plan was reportedly fulfilled in 2 years and 5 months, resulting in considerable changes in the 1949 schedules, and the Five Year Plan was reported extensively revised in 1951. 193/

The Hungarian locomotive and rolling stock industry is concentrated in six plants. Only one of these, the Mavag Heavy Machinery Plant in Kobanya, makes substantial numbers of locomotives, and only the Ganz Electrical Equipment Factory in Budapest, the Wilhelm Pieck Railroad Car Plant in Gyor, and possibly the MAV Railroad Car Plant in Miskolc make substantial numbers of freight cars.*

* For details on each of these plants, see 4, below.

2. Production Estimates.

Estimates of the production of locomotives and rolling stock in Hungary by type of equipment for the years 1946-54 are given in Table 24.

Table 24

Estimated Production of Locomotives and Rolling Stock in Hungary
1946-54

Units

Item	1946	1947	1948	1949	1950	1951	1952	1953	1954
Steam Locomotives 194/	20	130	155	175	185	200	210	220	N.A.
Electric Locomotives 195/	0	0	0	0	0	2	4	8	N.A.
Freight Cars 196/	N.A.	N.A.	N.A.	4,850	N.A.	N.A.	6,500	N.A.	10,000
Passenger Cars 197/	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	507 to 610	N.A.	N.A.
Diesel Train Sets 198/	0	0	0	N.A.	5	16	N.A.	N.A.	N.A.

50X1

In the case of freight cars, estimates of yearly production are even more difficult, because, even though production at the two major plants, at Budapest and Gyor, has been fairly well established, there is probably enough production at Miskolc (on which little information is available) to preclude the possibility of making a production estimate solely on the basis of plant information. A statement by the Hungarian press giving 1949 production and 1954 planned production is available 50X1

50X1 These yearly estimates are logical from the point of view of the plant production information available and are therefore given in Table 24 as the best estimates of freight car production available.

There are no estimates of Hungarian passenger car production on a yearly basis available. Two plants are engaged in the production of passenger cars, and an estimate for their total production of passenger cars in 1952 is shown in Table 24.

The Ganz plant in Budapest is engaged in the production of diesel train sets for export.

3. Inventory Estimates.

Estimates of the inventory of locomotives and rolling stock in Hungary as compiled are given in Table 25. these figures as shown should be allowed a range of error of plus or minus 15 percent. 201/

50X1
50X1

Table 25

Estimated Inventory of Locomotives and Rolling Stock in Hungary a/
1938, 1946-52, 1954 Plan b/

Units

Item	1938	1946	1947	1948	1949	1950	1951	1952	1954 Plan
Locomotives	1,841	1,144	1,680	1,440	1,470	1,616	1,685	N.A.	N.A.
Passenger Cars	3,970	1,930	2,472	2,300	2,350	2,396	3,096	N.A.	N.A.
Freight Cars	46,915	16,375	32,855	35,000	37,880	42,000	43,152	46,760	54,600

a. Including locomotives and rolling stock owned and held by the Hungarian State Railways (Magyar Allamsutak -- MAV) and excluding foreign-owned stock in Hungary and MAV stock abroad. The estimates are as of 31 December for each year shown.
b. The large increase in inventory between 1946 and 1949 is attributed to a return by the USSR to Hungary of considerable numbers of locomotives and rolling stock seized by the Russians at the end of World War II. Changes in inventory after that period are attributed to retirements plus additions as the result of production which was not sent to the USSR. Since retirements probably are determined by the amount of new equipment available, it is not possible to estimate, on the basis of increases to Hungarian inventory, the percent of production which actually is exported to the USSR.

4. Plant Information.

50X1

a. Kobanya.

Proper Name: Mavag Heavy Machinery Plant.

Production: This plant is the only one in Hungary engaged in the production of main-line steam locomotives. For this reason it is possible to use yearly estimates of Hungarian production as well as estimates of the production rate of the plant in determining the probable actual production rate. By so doing, the production of units of steam locomotives for the years 1946-53 has been estimated as follows:

1946:	20	1950:	185
1947:	130	1951:	200
1948:	155	1952:	210 (Plan).
1949:	175	1953:	220 (Plan).

In addition to the production of steam locomotives, the plant is engaged in a joint project with the Ganz plant in Budapest on the production of a new model electric locomotive for the Budapest-Komarom-Hegyeshalom main line. These locomotives are 5-motor, single-phase to three-phase converter units with a Bo-Co wheel arrangement* (see Fig. 30**). The Ganz plant is supplying the electrical equipment for the

* A Bo-Co wheel arrangement consists of one 2-axle truck and one 3-axle truck. Each of the five axles is driven by its own traction motor.
** Following p. 124.

a. Kobanya (Continued).

Production: locomotives, and the Kobanya plant is supplying the frames and the like and is responsible for the assembly of the units. Two units were built in 1951, 4 are scheduled for 1952, and 8 are planned for 1953. 203/

b. Budapest.

Proper Name: Ganz Electrical Equipment Factory.

Production: In addition to cooperating with the Kobanya plant in the production of the electric locomotive mentioned in a, above, this plant produces diesel train sets and freight and passenger cars.

Before World War II, 1-, 2-, and 3-car diesel train sets were built for export, primarily to Argentina, Egypt, Rhodesia, Uruguay, Bulgaria, and other European countries. Immediately after the war and up to early 1951 the plant was engaged in the conversion of Soviet diesel train sets to the Ganz-Jendrasik system. It is not known how many such conversions took place in this period. The mass production of diesel train sets began again in 1948-49. Three types are now in production: 4- and 5-car units for Argentina and 6-car units for the USSR. The first and last car of each train set is motor-driven by a Ganz-Jendrasik diesel engine and generator set.

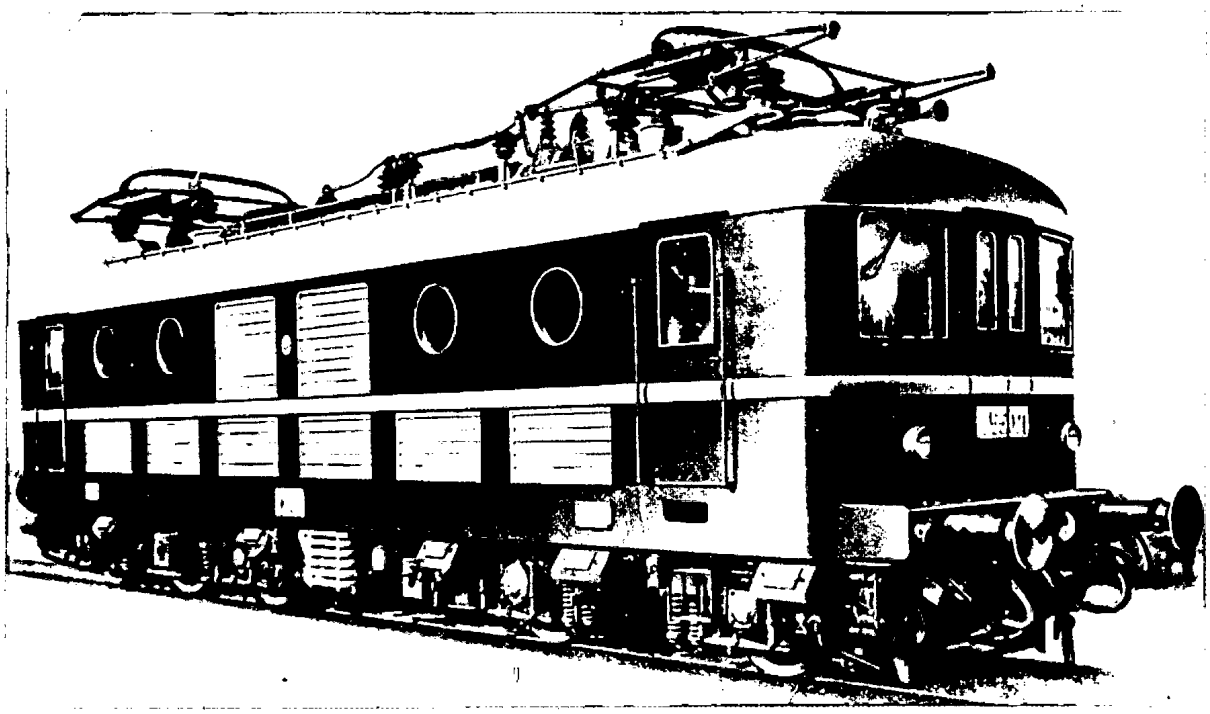

FIGURE 30. SINGLE-PHASE TO THREE-PHASE CONVERTER ELECTRIC LOCOMOTIVE OF THE KANDO SYSTEM, PRODUCED FOR THE HUNGARIAN STATE RAILWAYS, 1952.

b. Budapest (Continued).

Production: Freight cars produced by this plant are almost wholly for export to the USSR as reparations. Types produced include 40-ton 4-axle boxcars, 60-ton 4-axle gondola cars, 50-ton 4-axle tank cars, 2-axle tank cars, and 2-axle refrigerator cars.

Passenger cars are produced for the USSR and the MAV. The cars for the USSR are 4-axle type "CAK"* modern express coaches, and the MAV cars are 2-axle third-class coaches.

Electric mining locomotives for Hungary and for export at the rate of 20 to 30 units per year are also produced at this plant.

This plant is also engaged in considerable production of diesel engines of the Ganz-Jendrasik design, gears, pumps, turbines, and other capital goods, which account for about 50 percent of the value of production at the plant. 204/

An estimate of production at this plant from 1947 through 1951 is given in Table 26.** 205/

c. Gyor.

Proper Name: Wilhelm Pieck Railroad Car Plant.
Former Name: Gyor Railroad Car Plant.

* Hungarian abbreviation for a car designed for internal traffic.
** Table 26 follows on p. 126.

Table 26

Estimated Production of Locomotives and Rolling Stock
at the Ganz Electrical Equipment Factory, Budapest
1947-51

Units

Item	1947	1948	1949	1950	1951
Freight Cars					
2-Axle Tank and Refrigerator Cars (for the USSR)	750 to 800	950 to 1,000	300 to 400	300 to 400	150 to 300
4-Axle Boxcars, Tank Cars, and Gondola Cars (for the USSR)			800 to 850	900 to 950	1,000 to 1,100
Passenger Cars					
2-Axle Cars (for the MAV)	170 to 190	200 to 220	130 to 160	150 to 160	140 to 150
4-Axle Cars (for the USSR)			100 to 120	150 to 160	180 to 200
Diesel Train Sets					
4-Car Units (for Argentina)	0	0	0	0	1
5-Car Units (for Argentina)	0	0	N.A.	5	7
6-Car Units (for the USSR)	0	0	0	0	8
Conversion (for the USSR)	N.A.	N.A.	N.A.	0	0
Mining Locomotives	N.A.	N.A.	20 to 30	20 to 30	20 to 30

c. Gyor (Continued).

Production: This plant is the largest manufacturer of railroad cars in Hungary. The plant produces all types of passenger and freight cars for both internal use and export to the USSR and other countries. Production in 1951 amounted to about 1,800 cars. Before 1951 the plant produced mostly standard types of freight cars, and production has been largely of specialized types of freight and passenger cars since that date. Orders on hand at the end of 1951 were reported as follows:

Passenger Cars:

100 type "CAK" 18-ton 2-axle third-class cars for Czechoslovakia. Delivery by mid-1952 (50 of this order were delivered in 1951).

50 type "CAK" cars, specifications as above, for the MAV. Delivery by end of 1952.

100 broad-gage 20-ton 2-axle second-class cars for the USSR -- 50 in 1952 and 50 in 1953.

60 20-ton 2-axle special first-class cars for the Egyptian State Railways. Delivery to be complete by end of 1952 (some were delivered in 1951).

50 broad-gage 24-ton 2-axle luxury sleeping cars for the USSR. Delivery by end of 1953 (a few were delivered in 1951).

c. Gyor (Continued).

Production: Freight Cars:

900* broad-gage 60-ton 4-axle ore cars for the USSR.

40 30-cubic-meter 2-axle tank cars for the USSR. Delivery by end of 1952.

Unknown number of 15-ton ore-tipping cars, refrigerator cars, timber cars, and the like. Probably constructed in small lots as orders are placed.

Spare Parts:

40,000 tons of spare parts for the MAV.

Other Products:

In addition to the rolling stock portion of this plant, there is considerable production of such items as trucks and buses, lift trucks, bridge parts, rail points and crossings, and the like. Approximately 50 percent of the plant capacity is involved in other than railroad equipment production.

* This order, current since 1945, amounted in all to 5,000 cars by the end of 1952. It was a reparations item, and prompt delivery was enforced. This order accounted for 50 percent of the entire output of rolling stock at this plant.

d. Budapest.

Proper Name: Rossemann Harmatta Factory.

Production: Reported in 1949 as producing narrow-gage diesel mining locomotives.

e. Miskolc.

Proper Name: MAV Railroad Car Plant.

Production: Formerly a repair shop. Reported as producing new cars in 1951.

f. Diosgyor.

Proper Name: Mavag Steel Plant.
Former Name: Diosgyor Steel Works.

Production: Mostly parts for locomotives. Possibly some industrial-type locomotives of 275 hp.

5. Additional Information of Intelligence Value.

a. Hospital Cars.

In early September 1951 it was reported that conversion of passenger and freight cars to hospital cars was taking place at 2 shops in Hungary, the former Wagon-Lits Workshop in Budapest and the MAV General Workshops some 12 km north of Budapest. Third-class coaches with wooden seats of both 2- and 4-axle types, as well as 2-axle 15-ton boxcars, were being converted. As of the end of August 1951 the total number converted was 150 freight cars and 35 to 40 passenger cars. Of these, 8 to 10 were fitted as surgical cars, and the remainder were fitted as double-deck hospital cars. 206/

The total number of cars converted is not known, nor is it known whether the program is still in progress. The last reported date of production of these hospital cars was October 1951. 207/

b. Imports from Poland.

About September 1951 a consignment of Polish freight cars was delivered to the MAV. It consisted of 1,500 freight cars of 20-ton capacity, 500 of which were covered. One thousand additional cars, also of 20-ton capacity, have been ordered. 208/ It is interesting to note that, even with a sizable freight car production capacity, Hungary is forced to depend on Poland for such units because of the required delivery of cars to the USSR.

c. Export of Diesel Train Sets.

A trade agreement between Hungary and East Germany signed on 6 June 1952 calls for the delivery of 12 diesel train sets to the East German government by 1955. Three of these train sets are to be delivered at the end of 1953. Some details of the agreement remain to be cleared up, but the production of such train sets by Ganz for Argentina and for the USSR suggests that these train sets for the East German government will be similar to those made for these two countries. 209/ It has also been reported that Bulgaria was to import some of these diesel train sets from Ganz in 1952 and afterward. 210/

D. Czechoslovakia.

1. Administrative Organization.

Economic planning in Czechoslovakia started with the Two Year Plan (1947-48) and has been continued with the present Five Year Plan (1949-53). The planning begins with the Central Planning Board, which has as its operating agency the State Planning Office.

The State Planning Office is divided into four divisions. With respect to production of locomotives and rolling stock, the division which controls heavy industry, light industry, construction, and transportation is the one which must be considered. 211/ Of these sections, only the ones for heavy industry and light industry are directly pertinent here. The exact apportionment of firms and plants within these sections is not clear, but there are four main enterprises, or "state organizations," which fall within these sections. Since they are all large industrial combines, each of the four probably produces items which fall into both the heavy industry and light industry sections. These four enterprises are as follows:

a. Skoda Works (the main plant, the Skoda Machine Building Factory -- the V.I. Lenin Plant -- at Plzen, is the only one engaged in the production of locomotives and rolling stock).

b. CKD (one CKD plant in Prague produces locomotives).

c. Zbrojovka Brno (one plant in Brno produces rolling stock).

d. Tatra Works (the main plant at Koprivnice and the branches at Prague, Studenka, Ceska Lipa, and Kolin all produce locomotives or rolling stock).

There are several other independent installations in Czechoslovakia engaged in the production of locomotives and rolling stock, but they also are state-controlled (see 4, below).

2. Production Estimates.

There are several estimates of over-all yearly production of locomotives and rolling stock in Czechoslovakia. From a consideration of these estimates 50X1 50X1 the production of locomotives and rolling stock in Czechoslovakia has been developed in Table 27.*

3. Inventory Estimates.

Estimates of the inventory of locomotives and rolling stock in Czechoslovakia, 50X1 are given in Table 28,** showing actual inventory in 1937, 1947, and 1948 and planned inventory for 1949 and 1953. In view of Czechoslovak production capacity, it is felt that, considering possible changes in plans, the figures as given are correct within an estimated range of error of plus or minus 10 percent. 212/ 50X1

* Table 27 follows on p. 132.
** Table 28 follows on p. 133.

50X1-HUM

Table 27

Estimated Production of Locomotives and Rolling Stock in Czechoslovakia 213/
1945-53

Units

Item	1945	1946	1947	1948	1949	1950	1951	1952	1953
Locomotives	50	150	234	290	320	360	400	440	480
Passenger Cars	N.A.	N.A.	N.A.	306	N.A.	N.A.	N.A.	N.A.	N.A.
Freight Cars	N.A.	10,600	15,345	11,000	13,000	15,000	15,000 to 18,000 a/	N.A.	N.A.

a. [redacted] 29,000 freight cars for 1951. This figure is believed to have been obtained on the assumption that a new plant at Brezna went into operation in 1951. This plant was to be a subsidiary of the Tatra Works. Its construction was begun during the Two Year Plan and was to have been completed sometime in 1950. Somewhat belatedly it was realized that the capacity of those plants already in operation was about 18,000 cars per year and that an additional plant was not needed. Accordingly, the plans were changed, and this plant is at present believed to be engaged in the production of bridge sections. Production of freight cars in 1951, therefore, probably lies between the 1950 figure of 15,000 and the estimated capacity of 18,000 for the entire industry.

50X1

50X1-HUM

Table 28

Estimated Inventory of Locomotives and Rolling Stock in Czechoslovakia
1937, 1947-53

Units

Item	1937	1947	1948	1949	1950 a/	1951 a/	1952 a/	1953
Steam Locomotives	3,962	4,114	4,249	4,190	4,180	4,171	4,161	4,152
Freight Cars b/	95,112	82,961	85,763	83,073	83,931	84,789	85,647	86,505
Passenger Cars c/	10,526	7,826	8,125	8,279	8,479	8,679	8,879	9,080
Motor Rail Cars	523	579	532	546	602	659	715	772
Postal Cars	521	524	544	579	563	547	531	514

a. Straight-line interpolation between 1949 and 1953 estimates.
b. Including approximately 1.3 percent service cars.
c. Including approximately 13.0 percent baggage cars.

4. Plant Information.

a. Plzen.

Proper Name: Skoda Machine Building Factory (V.I. Lenin Plant).

Production: From the end of World War II to about the middle of 1948, approximately 250 locomotives were built by this plant. Of these, 10 to 12 were electric locomotives for Czechoslovakia, 4 were freight steam locomotives for Czechoslovakia, 6 were narrow-gage mining locomotives for Czechoslovakia, and the remainder were steam locomotives (similar to the Soviet L class) for the USSR (see Fig. 31*). Production from mid-1948 to the present seems to be of a similar nature. The probable capacity of the plant is about 120 to 180 units per year. In addition to exports to the USSR, a few units have gone to Bulgaria, Communist China, and Rumania.

In 1951, 2 armored trains were constructed for the USSR, with composition as follows: 4 flatcars with 150-mm naval guns mounted in turrets, 3 armored boxcars, 2 flatcars with antiaircraft guns, 4 ammunition boxcars, and 1 armored locomotive.

* Following p. 134.

FIGURE 31. INTERIOR OF THE LOCOMOTIVE ASSEMBLY SHOP AT THE SKODA MACHINE BUILDING FACTORY AT PLZEN, SHOWING POSTWAR SERIAL PRODUCTION OF LOCOMOTIVES SIMILAR TO THE SOVIET L CLASS.

a. Plzen (Continued).

Production: (The locomotive was reportedly built by the plant in Krakow, Poland.) Three more armored trains were reportedly scheduled for production in 1951.

b. Prague.

Proper Name: CKD Sokolovo Locomotive and Motor Vehicle Plant.
Former Names: CKD Liben Locomotive and Motor Vehicle Plant.
Praha Liben Motor Vehicle Plant.

Production: Production in 1946, 1947, and 1948 was about 120 to 150 steam locomotives. Of these, 50 to 80 percent were for the USSR. In 1949, production was at least 150 units, of which some 25 to 50 were scheduled for delivery to Turkey. The remainder were sent to the USSR, with the exception of seven, which were reported as produced for the Czechoslovak railroads.
In 1950 and 1951, no total production figures are available, but [redacted] exports to the USSR of 96 units in 1950 and 90 units in 1951 indicate that production probably was continued at a rate of 150 to 200 units per year. Production in 1952 has not been reported, except for mention of a coal-dust locomotive which was built at this plant. 50X1

c. Brno.

Proper Name: Gottwald Machine Building Factory.
Former Names: 1st Brno Machine Building Factory.
Konigsfelder Machine Building Factory.
Kralovo Pole Machine Building Factory.

c. Brno (Continued).

Production: Production estimates at this plant, available only for the years 1950 and 1951, are given in Table 29.

Table 29

Estimated Rolling Stock Production
at the Gottwald Machine Building Factory, Brno
1950-51

Units

Type of Car	1950 (Actual)	1951 (Plan)	Remarks
Electric Cars	47	15	For Czechoslovak use. Specifications unknown.
Streetcars	30		For local Brno use.
Flatcars a/*	80	244	Ordered by the Ministry of National Defense. 1950 Plan was for 324 cars. 1951 Plan was for the balance of cars not built in 1950.
Tenders, Narrow-Gage b/	300	124	For the USSR. 1950 Plan was for 424 tenders. 1951 Plan was for the balance of tenders not built in 1950.
Tenders, Broad-Gage c/	140	220	For the USSR. 1950 Plan was for 360 tenders. 1951 Plan was for balance of tenders not built in 1950.
Tank Cars d/	80		For Czechoslovak State Railroads.
Railroad Cranes	3		For Czechoslovak State Railroads.
Factory Railroad Cranes e/	1		For Vitkovice Iron Works.
Diesel Cars		38	For Czechoslovak State Railroads.
Mobile Post-Office Cars		27	For Czechoslovak State Railroads.
Fire Cars for Coking Plants f/		3	For Vitkovice Iron Works.
Large Tenders g/		65	For Czechoslovak State Railroads (4 to Communist China).
Cabooses		50	For Czechoslovak State Railroads.

* Footnotes for Table 29 follow on p. 137.

[redacted]

50X1-HUM

Table 29

Estimated Rolling Stock Production
at the Gottwald Machine Building Factory, Brno
1950-51
(Continued)

a. 4-axle 50-ton flatcars with Knorr brakes and SKF roller-bearing axles.
b. Factory railroad tenders with SKF roller-bearing axles.
c. 4-axle tenders with Knorr brakes and SKF roller-bearing axles.
d. 2-axle tank cars with 200-hectoliter capacity.
e. 4-axle flatcar with crane installed.
f. 4-axle coke-quenching cars with SKF roller-bearing axles.
g. 4-axle tender with Knorr brakes and SKF roller-bearing axles, with broad- or standard-gage axles to suit.

d. Koprivnice. .

Proper Name: Tatra Narodni Podnik (NP).
Former Name: Ringhoffer Railroad Car and Motor Vehicle Plant.

Production: [redacted] 50X1
[redacted] 50X1
[redacted] Production is mainly freight cars, most of which go to the USSR. 50X1
[redacted] 50X1
production of passenger cars for the USSR and diesel motor rail cars, probably for Czechoslovak use. Capacity of the plant seems to be about 15 to 20 freight cars per day. If this is correct, this plant is one of the larger producers of this type of equipment in the Satellite area. An examination of the area covered by this plant indicates that such capacity estimates are in line with the size of the plant.

[redacted]

50X1-HUM

e. Prague.

Proper Name: Tatra Railroad Car Plant, Smichov.
Former Name: Ringhoffer Railroad Car and Motor Vehicle Plant.

Production: [redacted] 50X1

[redacted] 50X1 Capacity seems in 1949 and 1950 to have been approximately 5 freight cars per day. Production of the plant, in addition to freight cars, is reported as passenger cars, electric trains, and streetcars. Seventy percent of the production is reported as destined for the USSR. A small part of this 70 percent probably goes to Poland and Bulgaria.

An order placed in December 1951 reputedly calls for the production of 200 boxcars for the USSR in 1952. These cars are 4-axle units with double doors on either side. They are reported as being convertible to hospital cars on an 8-hour notice.

f. Studenka.

Proper Name: Tatra Railroad Car Plant.
Former Name: Ringhoffer Railroad Car and Motor Vehicle Plant.

Production: Little information. Postwar capacity is about 6 to 12 freight cars per day. There is some possibility that Tatra in Koprivnice and Prague send chassis of freight cars to Studenka for finishing. Gondola cars and boxcars are reported as being produced at this plant.

g. Ceska Lipa.

Proper Name: Tatra Railroad Car Plant.
Former Name: Czecho Huta Railroad Car Plant.

Production: This plant has a postwar capacity of 150 to 300 freight cars per year. Its importance is small as compared with the preceding three plants.

h. Kolin.

Proper Name: Tatra Railroad Car Plant.
Former Name: Ringhoffer Railroad Car Plant.

Production: Reported capacity from end of World War II to June 1951 was one freight car per day. Some production of passenger cars for Turkey in 1948 and 1950 was indicated. [redacted] 50X1
[redacted] the 50X1
facilities of the plant were to be converted to tracked military vehicles in mid-1951.

i. Klatovy.

Descriptive Name: Railroad Locomotive and Aircraft Engine Plant.

Production: [redacted] 50X1

j. Liberec.

Descriptive Name: Railroad Car Plant.

Production: From 1945 to 1949, reportedly produced railroad cars. From 1949 to 1952, engaged in production of armaments, but no confirmation is available.

k. Trnava.

Descriptive Name: Railroad Car Plant.

l. Blatna.

Descriptive Name: CKD Railroad Car Plant.

m. Turciansky-Svaty-Martin.

Descriptive Name: Railroad Locomotive Plant.

n. Sumperk.

Descriptive Name: Railroad Car Plant.

Production: A new plant, reportedly completed about the end of 1951. Production is to be of diesel motor rail cars. No estimate of the rate of production is possible, nor is confirmation that production has in fact begun available.

5. Production Capacity.

Czechoslovakia has a capacity for the production of some 18,000 freight cars per year. 216/ Production estimates from 1946 through 1950 indicate that production has not been at capacity. One

explanation for this situation is that, although the various plants have machine tools and capital equipment of other types, raw materials and labor may not be available to bring production up to capacity. Another explanation is that, since Czechoslovakia is a large producer of armaments which would have top priority in Soviet planning, it is possible that the production of freight cars has had to take second place and that capacity production will not take place until raw materials and/or labor are available over and above what is required by the armaments industry.

The Russians have been and are obtaining from the European Satellites so much of their freight car production that the European Satellites are hard-pressed to meet their own needs. It is interesting to note that this situation apparently does not apply to Czechoslovakia.

E. Rumania.

1. Administrative Organization.

Since the end of World War II, Rumania has been reorganizing its economic administration along Soviet lines, resulting in a constantly increasing government domination of industry. Rumania had 1-year plans in 1949 and 1950 and is presently in its First Five Year Plan (1951-55). The industrial establishments engaged in producing locomotives and rolling stock are all nationalized and operate under the directives of the present Plan.

2. Production Estimates.

[redacted] 50X1

[redacted] 50X1

[redacted] 50X1

[redacted] Two apparently independent 50X1
estimates of yearly production, however, are available. 217/ They
are close to one another [redacted] 50X1
[redacted] They have been ac- 50X1
cepted as the best estimates available and are given in Table 30.

* Table 30 follows on p. 142.

[redacted] 50X1-HUM

Table 30

Estimated Production of Locomotives and Rolling Stock in Rumania
1948-52, 1955 Plan

Units

	1948	1949	1950	1951	1952	1955 Plan
Steam Locomotives	110	117	122	124	130	N.A.
Freight Cars	N.A.	N.A.	3,000	3,600	N.A.	5,200
Diesel Cars	4	N.A.	12	24	N.A.	N.A.

Passenger cars are produced at the Flamura Rosie Railroad Car Plant in Arad, but no estimates of total production are possible. It is believed, however, that passenger car production in Rumania is small.

[redacted] 50X1

3. Inventory Estimates.

The best possible estimate of the Rumanian inventory of locomotives and rolling stock covering the years 1938 and 1946 through 1952, [redacted] 218/ is given in Table 31.* 50X1 There are, however, several gaps and inconsistencies in the information as presented here.

4. Plant Information.

[redacted] 50X1

[redacted] there are four main producers of locomotives 50X1 and/or rolling stock in Rumania plus several smaller installations which may produce some items of rolling stock. The available information is summarized below. 219/

* Table 31 follows on p. 143.

[redacted] 50X1-HUM

Table 31

Estimated Inventory of Locomotives and Rolling Stock in Rumania
1938, 1946-52, 1955 Plan

	1938	1946	1947	1948	1949	1950	1951	1952	1955 Plan
Steam Locomotives									
Serviceable	1,986	1,947	2,047	1,987	N.A.	2,465	N.A.	N.A.	N.A.
Unserviceable	1,434	1,048	940	1,086	N.A.	435	N.A.	N.A.	N.A.
Total	3,420	2,995	2,987	3,073	N.A.	2,900	N.A.	N.A.	N.A.
Freight Cars									
Serviceable	55,595	59,924	31,651	35,235	36,125	41,400	N.A.	N.A.	N.A.
Unserviceable	7,492	16,901	10,214	8,265	6,375	4,600	N.A.	N.A.	N.A.
Total	63,087	76,825 a/	41,865	43,500	42,500	46,000	47,000 b/	48,000	51,000 b/
Passenger Cars									
Serviceable	2,997	N.A.	2,187	N.A.	N.A.		N.A.	N.A.	N.A.
Unserviceable	478	N.A.	746	N.A.	N.A.		N.A.	N.A.	N.A.
Total	3,475	3,071	2,933	3,652	N.A.	3,500	N.A.	N.A.	N.A.

a. Includes foreign-owned freight cars.
b. 10,000 freight cars to be added by 1955, of which 50 percent are assumed to be for retirement replacements and the remainder at a rate of 1,000 cars per year. 220/

a. Recita.

Proper Name: Sovrommetal Steel Plant.
Former Names: UDR Steel Plant.
Metaltras Metallurgical Plant.

Production: 1948: 76 steam locomotives, 56 of which went to the USSR.

1949: 98 steam locomotives, 79 of which went to the USSR.

1950-52: Production has probably increased during these years to approximately 125 locomotives in 1952. Probably 80 percent or more went to the USSR.

b. Bucharest.

Proper Name: 23d August Steel Plant.
Former Names: Malaxa Steel Plant.
Republica Steel Plant.

Production: 1948: 10 steam locomotives, type 150.000 (see Fig. 32*), for the Rumanian State Railways.
24 steam locomotives for the USSR.
559 50-ton 4-axle boxcars for the USSR.
4 diesel motor rail cars for the Rumanian State Railways.

1949: 10 locomotives, type 150.000, for the Rumanian State Railways.
9 locomotives for the USSR.
48 narrow-gage steam locomotives, destination unknown.
300 2-axle freight cars for the Rumanian State Railways.

* Following p. 144.

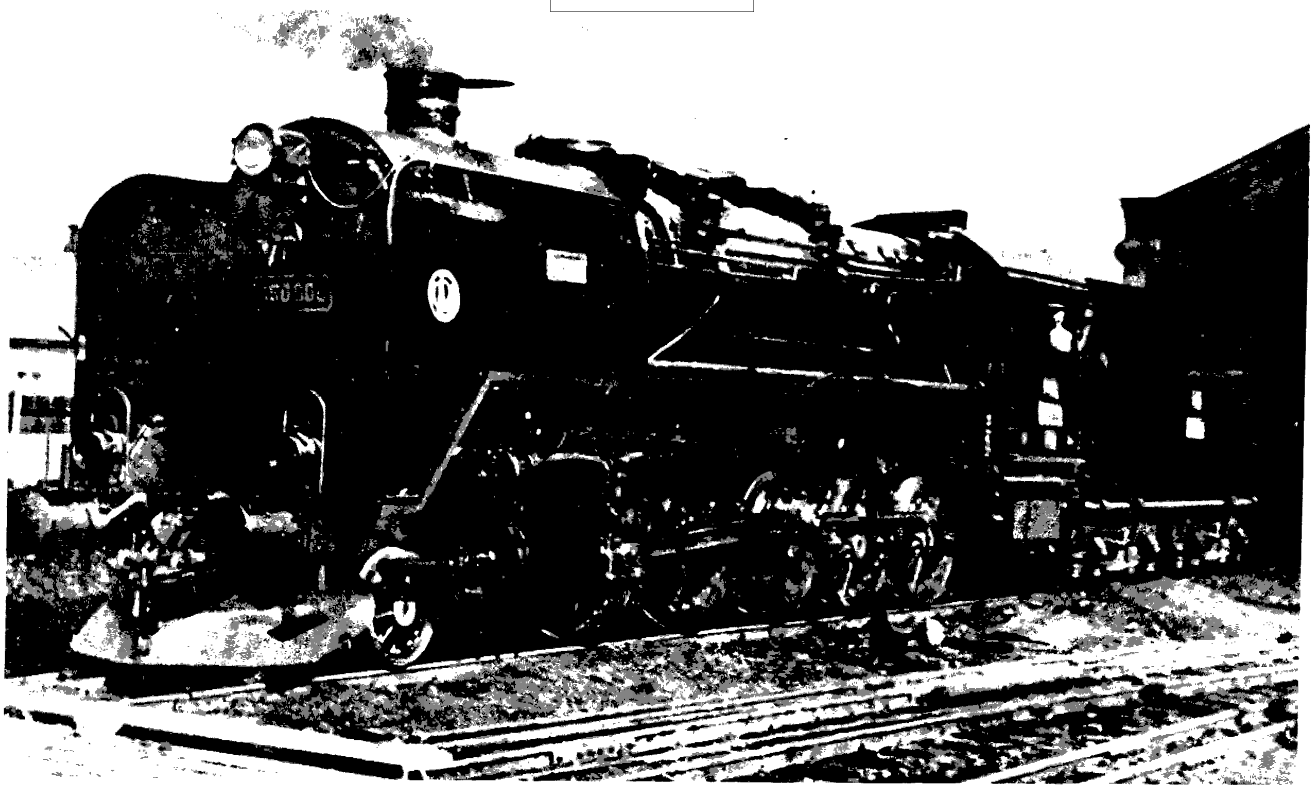

FIGURE 32. POSTWAR STEAM LOCOMOTIVE, TYPE 150.000, PRODUCED BY THE 23D AUGUST STEEL PLANT AT BUCHAREST.

b. Bucharest (Continued).

Production: 1949: 100 4-axle freight cars for the USSR.
Unknown number of diesel motor rail cars.

1950: 12 steam locomotives, type 150.000, for the Rumanian State Railways.
12 steam locomotives for the USSR.
800 50-ton 4-axle freight cars for the USSR.
12 diesel motor rail cars for the Rumanian State Railways.

1951: 3 steam locomotives, type 150.000, for the Rumanian State Railways.
1 locomotive for the USSR.*
1,200 4-axle freight cars for the USSR. This is a Plan figure. The actual production was probably about 720 cars.
24 diesel motor rail cars for the Rumanian State Railways.

1952: Continued production of freight cars for the USSR. Planned production was 100 per month, but actual production was probably nearer 60 per month, as in 1951. This 1951-52 production is part of a Soviet order for 2,000 such cars. When this order is complete (about 1954), production is to convert to 2-axle units for the Rumanian State Railways.

There is no information available on the production of diesel motor rail cars in 1952.

* Steam locomotive production ceased at this plant in early 1951.

c. Brasov.

Proper Name: Steagul Rosu Railroad Car Plant.
Former Name: Astra Vagone Railroad Car Plant.

Production: 1945-47: 731 4-axle tank cars for the USSR.
486 4-axle freight cars for the USSR.

1949-51: Continued production of tank and freight cars for the USSR. Production was predominantly tank cars. In February 1951 an order for 2,000 additional tank cars was reportedly received from the Russians.

1952: Tank cars at the rate of 3 per day for the USSR plus some 50-ton boxcars for the USSR.

d. Arad.

Proper Name: Flamura Rosie Railroad Car Plant.
Former Name: Astra Vagone Railroad Car Plant.

Production: 1945-49: 2,500 4-axle boxcars for the USSR.

1950: Capacity stated to be 70 freight cars or 26 passenger cars per month. Actual 1950 production rate estimated at 45 to 50 freight cars or 16 to 18 passenger cars per month (see Figs. 33 and 34*).

1951: No information.

1952: Reported as producing tank cars for the USSR.

* Following p. 146.

FIGURE 33. POSTWAR FIRST-CLASS PASSENGER CAR, PROBABLY PRODUCED BY THE FLAMURA ROSIE RAILROAD CAR PLANT AT ARAD.

50X1-HUM

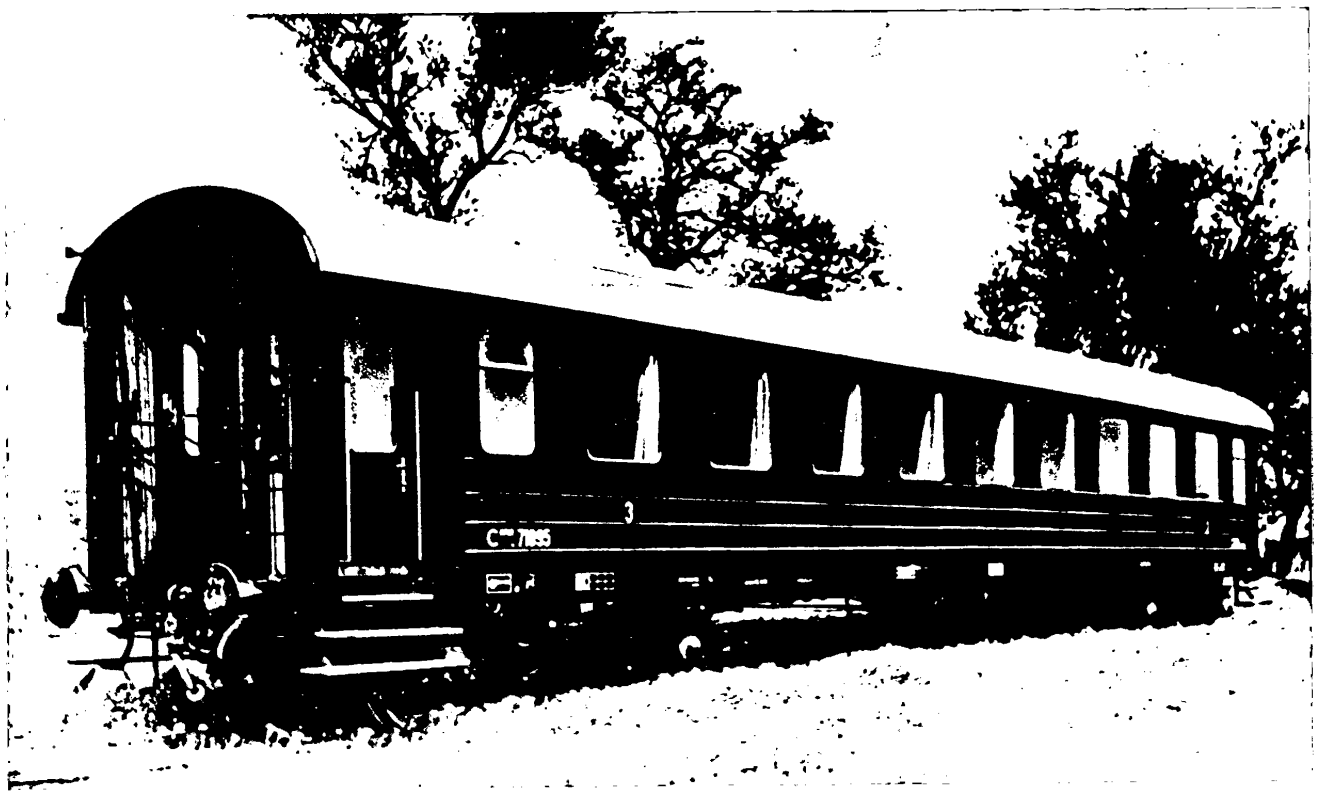

FIGURE 34. POSTWAR THIRD-CLASS PASSENGER CAR, PROBABLY PRODUCED BY THE FLAMURA ROSIE RAILROAD CAR PLANT AT ARAD.

50X1-HUM

50X1-HUM

e. Craiova.

Descriptive Name: Railroad Car Plant.

Production: There is no evidence of railroad car production at this plant. 50X1

50X1

This plant may have been confused, however, with the Electroputere Electrical Equipment Plant located in the same city, which conceivably could construct such units 50X1

50X1

f. Constanta.

Proper Name: Pallas Railroad Car Plant.
Former Name: Astra Railroad Car Plant.

50X1

g. Braila.

Proper Name: Progressul Railroad Equipment Corporation.
Former Names: Regia Metallurgical Plant.
Franco Romana Railroad Equipment Plant.

50X1

5. Additional Information of Intelligence Value.

Although a large percentage of the production of steam locomotives and rolling stock in Rumania is destined for the USSR, Rumania seems to be allowed by the Russians to retain enough to keep its operating inventory at a level commensurate with the demands

50X1-HUM

of industry as a whole. The only indication of the importation of foreign equipment is the fact that several 1949-model Swiss diesel locomotives have been observed in operation in Rumania. 221/ The number of such units is not known, but it is probably small. No indications of any present or future plans for the importation of foreign equipment have been found.

F. Bulgaria.

1. Administrative Organization.

The economic policy of Bulgaria, like that of the USSR and the other European Satellites, receives its formal expression in periodic economic plans. The current Plan covers the years 1949-53. 222/

2. Production Estimates.

The production of locomotives and rolling stock in Bulgaria is negligible. The first locomotive (steam) ever produced in Bulgaria was completed about September 1948, the second was completed in September 1949, and the third was reportedly to be completed almost 2 years later, in August 1951. No evidence of locomotive production after that date is available.

The Plan calls for the production of 1,300 freight cars in 1953, but since production is limited by the capacity of 2 small shops and, more important, by the importation of component parts, it is not believed that actual production will even approach the Plan figure.

The first sleeping car to be produced in Bulgaria was completed in May 1951. The level of passenger car production, however, is probably even lower than that of freight cars.

3. Inventory Estimates.

In 1948 the Bulgarian inventory consisted of 568 steam locomotives, 11,000 freight cars, and 475 passenger cars. By the end of 1953 the Plan calls for increases in the inventory to 655 steam locomotives, 14,250 freight cars, and 595 passenger cars. 223/

4. Plant Information.

[redacted] there are only two plants in Bulgaria engaged in the production of locomotives and rolling stock. 224/ Information on these plants is summarized below. 50X1

a. Sofia.

Proper Name: Georgi Dimitrov Locomotive and Railroad Car Plant.

Production: 1948: First steam locomotive in September.

1949: Second steam locomotive in September.

1950: No production.

1951: Third steam locomotive was to have been completed in August.

Freight car production at this plant has been reported to be at the rate of about one car per year.

b. Dryanovo.

Proper Name: Andrei Zhdanov Railroad Car Plant.

Production: [redacted] 50X1
[redacted] the first sleeping car produced in Bulgaria was manufactured at this plant and was finished in May 1951. There is probably some production of freight cars at this plant, largely from imported components, but no estimate can be made of the rate of production. 50X1

5. Imports.

As can be noted from the information presented above, Bulgaria is almost wholly dependent on imports for additions to its inventory of locomotives and rolling stock. These are procured almost entirely from the European Satellites. 225/ Total imports during the present Plan are planned to amount to about 87 locomotives, 3,250 freight cars, and 120 passenger cars. 226/ 50X1 the receipt of six locomotives from Austria in 50X1 May 1952 227/ and a trade agreement calling for imports of locomotives and rolling stock from Poland in 1952 and 1953 228/ and Ganz diesel train sets from Hungary in 1952 and later. 229/

G. Albania.

Albania produces no locomotives or rolling stock and is entirely dependent on imports from either the European Satellites or other countries for its railroad equipment. The Albanian railroad equipment inventory in 1950 consisted of 65 freight cars, 63 passenger cars, and 7 locomotives. Only four of the locomotives were in serviceable condition, and none of the equipment was in good condition. 230/

In 1949 and 1950, Poland exported 50X1 to Albania 3 locomotives, 10 passenger cars, and 43 freight cars (of which 11 were tank cars). 231/

III. Capabilities, Vulnerabilities, and Intentions.

A. Capabilities.

The capabilities of the European Satellites are to a large extent determined by the direction of the USSR. Since the Communist political organization is such that Moscow directs the activities of all of its Satellites, it is the desire of the Russians which ultimately affects the production of the Satellites.

The European Satellites are capable of producing almost any type of railroad equipment desired by either the Russians or themselves for internal use or for export to Western countries. Hospital cars, heavy-duty flatcars, refrigerator cars, and electric locomotives as produced by East Germany; diesel train sets as produced by Hungary; and the generally high quality of all of the equipment produced by the Satellites attest to this fact.

A summation of the production capacities of each of the European Satellites shows that 1952 planned production was in the neighborhood of 1,200 locomotives (including some 65 electric units), some 53,000 freight cars,* and about 2,000 passenger cars.** Shortages of materials and Soviet demands for some specialized units may well reduce this total. Provided with sufficient raw material, either by the Russians or through trade with the West, the present production capacity of the European Satellites is probably close to the aforementioned totals. A large part of the production capacity of these countries is devoted to the manufacture of units for export to the USSR. Until more specific information on each plant can be obtained and analyzed, the best estimate of the percentage of production which goes directly to the USSR either as reparations or as commercial exports is something over 50 percent. In addition, a small percentage of Satellite production is exported from the Soviet Bloc to such countries as Egypt, Argentina, and Turkey. This is probably done not because the Bloc can particularly afford such exports but because it needs hard currency for purchases from the West.

The USSR appears to be allowing the European Satellites to retain only enough of their production to maintain their operating inventories at bare minimum levels. Thus the present status of the Satellite production capabilities in the field of locomotives and rolling stock is one of supplying the USSR with its demands, exporting a few pieces for hard currency, and maintaining internal inventories at the lowest possible level of adequacy. The total inventory of the European Satellites at the end of 1952 is estimated at some 20,000 locomotives, 475,000 freight cars, and 33,000 passenger cars, including unserviceable

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* This total is a combination of 4-axle and 2-axle units. It is not yet possible to break down the product mix into specific items of production, so that the figure of 53,000 must be taken with the reservation that it may vary considerably when sufficient information becomes available to allow a detailed breakdown of types.

** Separate figures on passenger car production are not available for Czechoslovakia and Rumania. It is probable that the freight car production figures include some passenger car production, since freight car estimates as stated above include passenger car production in these two countries.

units. In the absence of reliable information it is assumed that about 20 percent of the total inventory is unfit for service at any given time.

Should the Russians so direct, conversion of any or all of the locomotive and rolling stock plants of the European Satellites to the production of armaments is entirely feasible, and such conversion would of course directly affect the capabilities of these countries to produce railroad equipment.*

B. Vulnerabilities.

The discussion of Soviet vulnerabilities found in Part I, X, 2, above, applies also to the European Satellites with the following supplemental, definitive additions and differences.

Since the inventories of the European Satellites are in generally poorer shape than the inventory of the USSR, they are consequently more vulnerable to any form of attack. By the same token, such attack would reduce the economic and military potential of the European Satellites by disrupting their transportation services. Should a general war develop in which the Russians were depending on significant contributions from the European Satellites, then a general attack on the Satellite operating inventories of locomotives and rolling stock would have a direct effect in reducing their contributions to the Soviet military efforts.

In addition, there appears to be a rather general shortage of steel and other raw materials in the European Satellites. Should this shortage be intensified by any means, production of railroad equipment would suffer. Some attempts to procure steel from the West have been noted, and the refusal of steel and similar materials to the Satellites would make them more vulnerable to at least a reduction in production capacity.

C. Intentions.

The primary determinant of the intentions of the European Satellites is the desire of the USSR. The production of hospital cars and special heavy-duty flatcars by East Germany is an example.

* For further reference to such conversion, see C, below.

Such production was not designed to carry out the autonomous policies of the East German authorities but was made necessary by the demands of the USSR. Should the USSR so desire, the production capacity of the European Satellites could be altered in either of two ways.

First, production of military end items could be undertaken at converted Satellite plants to increase the military potential of either the USSR or the Soviet Bloc as a whole. Such conversion would lower the capacity of these countries for the production of railroad equipment in proportion to the degree of conversion.

More likely is the intensification of production through increased production of locomotives and rolling stock for the USSR, thus releasing production facilities in the USSR for conversion to production of military end items. It is believed that such action as this is more probable, since, with the more stringent security in the USSR, such conversion would be less readily observed in the USSR than in the Satellites.

Thus it is possible that the intentions and actions of the European Satellites with regard to the production of locomotives and rolling stock may well be a barometer of Soviet military intentions. At the present time the Satellite program seems to be one of assisting, by Soviet request, in building up the Soviet rail transportation service and in maintaining their own inventories at the best level permitted under Soviet control. There are no present indications of an intent to change this program.

[redacted] 50X1-HUM

APPENDIX A

TECHNOLOGICAL SPECIFICATIONS OF SOVIET LOCOMOTIVES AND ROLLING STOCK

1. Soviet Locomotives and Rolling Stock.

[redacted] 50X1-HUM 50X1 50X1 50X1 50X1 50X1

2. Soviet Steam-Diesel Locomotive.

The following details of the so-called steam-diesel locomotive, known as the "Teploparavos," are included here as evidence that the Russians are capable of original design and construction in the field of locomotive technology. The practicality of the unit as designed and built by the Voroshilovgrad Locomotive Works is subject to question, particularly since no evidence of mass production of this type of unit has been found, but the fact that it was actually constructed and tested shows no little skill on the part of the USSR.

The following description of the design and operation of the unit is translated [redacted] 50X1

"One of the advantages of the piston steam-engine is its ability to develop a high torque, starting from zero velocity -- that is, when the locomotive commences to get under way and accelerate. On the other hand, this engine also possesses a serious fault, its low thermal efficiency, which amounts to about 13 to 14 percent. For its part, the internal-combustion engine has a substantial advantage in economy of operation, but because of the specific features of its construction, it cannot take on a load before reaching a certain number

* Table 32 follows on p. 159; Table 35, on p. 195; Table 36, on p. 197; Table 37, on p. 199.
** Table 33 follows on p. 173; Table 34, on p. 191.

[redacted] 50X1-HUM

of revolutions. In other words, it is unable by itself to start from rest and accelerate. Thence the logical conclusion is to unite or combine in a single engine the valuable properties of both, so that the locomotive can start from rest at any moment and develop the speed of an ordinary locomotive while operating like a Diesel-locomotive at medium and high speeds. Such a locomotive is the steam-diesel locomotive.

"The motor-steam engine of the locomotive consists of 2 cylinders, 1 on each side, located in the center of the frame. The cylinders are designed in the form of a separate block straddling the frame. The cylinder diameter is 430 millimeters, and the piston stroke 770 millimeters. Two opposing pistons operate in each cylinder, thus forming three spaces: the middle one, between the pistons, which is termed the Diesel part, and two outer spaces, between the pistons and the front and back covers, respectively, which are termed the steam part.

"When the locomotive starts to move, steam appears in all three spaces of each cylinder. When a speed of 12 to 15 kilometers per hour has been reached, the admission of steam into the diesel spaces is cut off, and liquid fuel is injected into them by a pump with an Arshaulov gas-plunger. The middle spaces then operate as a two-cycle internal-combustion engine as blast-air commences to be delivered to them by a special turbine air-blower.

"The piston bosses of the diesel portion of the cylinders are cooled by water circulating around the walls in a closed cycle, and the heat of this water is used on the tender to heat the boiler feedwater.

"The boiler is analogous to that in the Su locomotive and differs from the latter only in its higher pressure (20 atmospheres) and use of a radial firebox instead of one with a flat crown.

"The torque is transmitted to the wheel pairs by two gearshafts located respectively in front of the pairs and behind them. The existence of opposing pistons made it necessary to place the pins of the connecting rod and the coupling rod on the front gear shaft at an angle of 180 degrees, thereby assuring the proper connection between the front and back gear shafts. The right and left cranks on each gear shaft are mutually displaced by 90 degrees. The heads of the coupling and piston connecting rods on the back gear shaft are placed on the same axis and are therefore counterbalanced.

"The wheel-pairs, coupling rods, and frame assembly are the same as those on the JS-class locomotives.

"All of this taken as a whole made it possible to bring the rated power of the locomotive, with a wheel formula of 1-4-1, up to 3,000 horsepower, and its speed up to 130 kilometers per hour.

"The motor-steam locomotive received its preliminary tests in 1940 on the test track of the All-Union Rail Transport Research Institute and then had its operating tests in 1941-42 on various lines and main routes of the Soviet railways. It was subsequently put into trial operation.

"According to the data of the operating tests, its efficiency was 11.4 percent, and the length of a run without taking on water was 350 kilometers. It was also established that with a wheel diameter of 1,850 millimeters the internal-combustion engine picked up the load at a speed as low as 12 kilometers per hour, while acceleration to a speed at which that engine could be placed in service took place in only 100 to 250 meters of travel.

"In 1943, substantial improvements were made in the design of the motor-steam locomotive, allowing operation on a so-called mixed cycle. This consists essentially in the introduction of a predetermined amount of steam, by means of special equipment, into the middle space of the cylinder while it is running on the diesel cycle. In this way the mean indicated pressure could be raised to 9.3 kilograms per square centimeter, or, in other words, the power of the locomotive was considerably increased.

"The consumption of fuel per unit (10,000 ton-kilometers), according to the average monthly data, is 50 to 60 percent of that consumed by a JS-class locomotive of equivalent power. The locomotive's train speed reached 130 kilometers per hour. Working the diesel cycle, the locomotive developed its peak power of 3,000 horsepower at 78 to 80 kilometers per hour.

"But the Mayzel steam-diesel locomotive, like any other new machine, is not free of certain more or less substantial faults of design, which do not permit putting it into regular service. Our best designers are energetically working with the designer of the locomotive to eliminate these defects.

"At the present time (1949) the Voroshilovgrad plant is completing the construction of an analogous locomotive of type 1-5-1 of 3,200 horsepower intended for freight train service. All the faults of design revealed by the trial operation of the passenger motor-steam locomotive have been taken into account.

"This motor-steam locomotive was designed to work on a mixed steam-gas cycle, which afforded still more opportunity for simplifying the engine and improving its tractive-thermal characteristics. In contrast to the passenger locomotive, the freight steam-diesel locomotive has a 4-cylinder engine with two opposing pistons in each cylinder. The pistons are connected to the gear shaft and drivers by means of connecting rods and driving connecting rods. The coupling rods that join the wheels and the gear shaft act at the same time as piston-synchronizers.

"The engine operates as follows. As the pistons separate, the space between them is filled by blast air, which is compressed as the pistons again approach each other. As the pistons arrive at dead center, fuel is injected into the chamber by the fuel pump. This fuel ignites, producing pressure in the cylinder, and the pistons again begin to separate. At the moment when the pressure in the cylinder becomes equal to that in the boiler, steam is automatically admitted into the chamber by a valve gear, following the line of gas expansion, with the cut-off, set by the reverse, regulating the amount of such steam. The steam mixes with the gases, is superheated to 600 to 700 degrees centigrade and by acting on the pistons jointly with the gases brings them to the extreme dead centers, after which the exhaust occurs.

"With these peculiarities of design a motor-steam locomotive is able to develop more power than a steam locomotive with equivalent boiler, since the work of the steam is supplemented by that of the gas, while the reduction in the dimensions of the boiler, in turn, makes it possible to do without a mechanical stoker and extended combustion chamber, thus reducing the amount of metal that must be used in the locomotive per unit of power, etc. All these factors, taken as a whole, should reduce the operating costs of maintenance and care for the locomotive. This locomotive will shortly leave the plant for its trial operation."

Table 32

Technological Specifications of Soviet Steam Locomotives a/*

Class		Basic Data							
Transliteration	Russian Symbol	Type b/ (Axle Arrangement)	Year Built	Highest Speed	Weight on Drivers	Fire Grate Area	Type of Engine c/	Nature of Steam d/	Diameter of Driving Wheels
B	Б	2-3-0	1908	120	47.0	2.80	2 p	Sup	1,830
Gp	Гп	2-3-0	1901	110	50.2	2.80	2 p	Sup	1,750
Yef, Yek, Yes	Еф,Ек,Ес	1-5-0	1915	75	77.6	6.00	2 p	Sup	1,320
Yel	Ел	1-5-0	1917	75	80.3	6.00	2 p	Sup	1,320
Z	З	2-3-0	1906	100	44.8	2.34	2 p	Sup	1,700
I (or J)	И	1-4-0	1909	80	55.6	3.03	2 p	Sup	1,500
IS (or JS)	ИС	1-4-2	1932	130	82.0	7.04	2 p	Sup	1,850
K	К	2-3-0	1910	115	45.4	2.76	2 p	Sup	1,700
Ku	Ку	2-3-0	1911	120	48.0	3.14	2 p	Sup	1,900
Lp	Лп	2-3-1	1915	140	51.9	4.65	4 p	Sup	1,840
Mr	Мр	2-4-0	1927	120	69.5	6.00	2 p	Sup	1,720
Nv	Нв	1-3-0	1903	120	45.0	2.22	2 k	Sat	1,900
Nv	Нв	1-3-0	1904	115	45.5	2.22	2 k	Sat	1,700
Nu	Ну	1-3-0	1911	120	47.9	2.60	2 k	Sat	1,900
Nu	Ну	1-3-0	1911	115	45.0	2.60	2 k	Sat	1,700
Np	Нп	1-3-0	1911	115	44.0	2.22	2 p	Sup	1,700
Oo	Оо	0-4-0	1910	50	50.0	1.85	2 p	Sat	1,150
Od	Од	0-4-0	1897	50	52.5	1.85	2 k	Sat	1,200
Ov	Ов	0-4-0	1901	55	52.5	1.85	2 k	Sat	1,200
Op	Оп	0-4-0	1933	60	52.4	1.85	2 p	Sup	1,200
Och	Оч	0-4-0	1926	55	52.5	1.85	2 k	Sup	1,200
S	С	1-3-1	1911	115	47.2	3.80	2 p	Sup	1,830
Su	Су	1-3-1	1925	130	53.9	4.73	2 p	Sup	1,850
SO	СО	1-5-0	1934	75	87.0	6.00	2 p	Sup	1,320
SOk	СОк	1-5-0	1936	75	94.0	6.00	2 p	Sup	1,320
F	Ф	1-5-0	1916	80	87.6	5.10	4 k	Sup	1,450
FD	ФД	1-5-1	1931	85	103.0	7.04	2 p	Sup	1,500
Chn	Чн	0-4-0	1893	50	50.0	1.91	2 k	Sat	1,220
Sh	Ш	1-4-0	1901	65	62.3	2.80	2 k	Sat	1,300
Shch	Щ	1-4-0	1907	75	64.2	2.80	2 k	Sat	1,300
Shchp	Щп	1-4-0	1910	75	64.3	2.80	2 p	Sup	1,300
Shchch	Щч	1-4-0	1918	75	64.7	2.80	2 k	Sup	1,300
Y	Н	0-4-0	1910	65	59.5	2.55	2 k	Sat	1,200
Ych	Нч	0-4-0	1912	65	60.9	2.55	2 k	Sup	1,200
E	Э	0-5-0	1913	65	80.5	4.46	2 p	Sup	1,320
E, Eg, Esh	Э,Эг,Эш	0-5-0	1914	65	81.2	4.46	2 p	Sup	1,320
Eu	Эу	0-5-0	1926	65	83.0	4.46	2 p	Sup	1,320
Em	Эм	0-5-0	1931	65	82.0	4.46	2 p	Sup	1,320
Er	Эр	0-5-0	1934	65	83.0	5.09	2 p	Sup	1,320
Vs e/	Вс	0-4-0	1914	65	64.2	3.32	2 p	Sup	1,300
Ea, Em	Еа,Ем	1-5-0	1944	75	88.7	6.00	2 p	Sup	1,320
Sha	Ша	1-4-0	1944	65	64.0	3.80	2 p	Sup	1,448
L	Л	1-5-0	1945	80	91.0	6.00	2 p	Sup	1,500
50	50	0-5-0	1911	60	74.4	2.63	2 p	Sup	1,400
52	52	1-5-0	1942	80	75.0	3.90	2 p	Sup	1,400
56	56	1-4-0	1920	65	68.0	3.40	2 p	Sup	1,400
57	57	0-5-0	1911	60	71.5	2.62	2 p	Sup	1,400
140	140	1-4-0	1918	50	57.3	3.87	2 p	Sup	1,309
Tu-23	Ту-23	1-5-0	1923	60	85.0	4.50	2 p	Sup	1,450
Pt	Пт	1-4-1	1931	100	73.0	4.50	2 p	Sup	1,850
OK-22	ОК-22	2-3-0	1922	100	51.0	4.00	2 p	Sup	1,750

* Footnotes for Table 32 follow on p. 171.

Table 32

Technological Specifications of Soviet Steam Locomotives a/
(Continued)

Class		Boiler							
		Heating Surface Area							
Transliteration	Russian Symbol	Boiler Pressure	Firebox	Total	Superheater	Length	Width	Boiler Diameter (Average)	Length over Tube Sheets
B	Б	13.0	15.2	164	41.0	2,744	1,016	1,543	4,420
Gp	Гп	12.0	15.6	169	47.5	2,714	1,020	1,600	4,375
Yef, Yek, Yes	Еф,Ек,Ес	12.7	18.0	240	61.3	2,750	2,180	1,769	5,143
Yel	Ел	12.7	21.1	242	66.9	2,750	2,180	1,769	5,132
Z	З	12.0	12.6	147	31.0	2,284	1,030	1,470	4,550
I (or J)	И	12.0	12.8	163	40.4	2,196	1,444	1,588	4,660
IS (or JS)	ИС	15.0	31.2	295	148.4	3,200	2,200	1,960	5,970
K	К	12.0	13.6	164	40.0	2,400	1,152	1,572	4,660
Ku	Ку	13.0	15.4	181	47.4	2,689	1,184	1,588	4,660
Lp	Лп	12.0	17.6	270	85.5	2,500	1,860	1,816	5,350
Mr	Мр	14.5	18.5	260	87.7	2,994	1,988	1,833	5,150
Nv	Нв	12.0	12.6	152		2,240	990	1,425	4,200
Nv	Нв	12.0	12.6	152		2,240	990	1,425	4,200
Nu	Ну	13.0	14.2	157		2,616	968	1,425	4,500
Nu	Ну	13.0	14.2	157		2,616	968	1,425	4,500
Np	Нп	12.0	13.9	127	38.9	2,514	1,024	1,430	4,500
Oo	Оо	12.0	10.7	153		1,790	1,026	1,455	4,660
Od	Од	11.5	10.7	153		1,790	1,026	1,455	4,660
Ov	Ов	12.0	10.7	153		1,790	1,026	1,455	4,660
Op	Оп	14.0	10.7	127	41.1	1,790	1,026	1,455	4,660
Och	Оч	12.0	10.7	132	29.2	1,790	1,026	1,455	4,660
S	С	13.0	15.4	207	51.5	2,362	1,602	1,584	5,150
Su	Су	13.0	18.5	197	72.0	3,038	1,558	1,584	5,150
SO	СО	14.0	24.6	230	93.6	3,050	1,960	1,970	4,660
SOk	СОк	14.0	24.6	230	93.6	3,050	1,960	1,970	4,660
F	Ф	14.0	19.9	262	60.8	2,900	1,760	1,837	5,000
FD	ФД	15.0	31.2	295	148.4	3,200	2,200	1,960	5,970
Chn	Чн	11.0	10.7	166		1,826	1,024	1,470	4,965
Sh	Ш	14.0	15.6	206		2,714	1,020	1,600	4,375
Shch	Щ	14.0	15.2	206		2,750	1,016	1,617	4,375
Shchp	Щп	12.0	15.2	169	40.8	2,744	1,016	1,602	4,373
Shchch	Щч	14.0	15.2	177	59.0	2,750	1,016	1,617	4,375
Y	Ы	12.0	11.8	185		1,850	1,438	1,572	4,200
Ych	Ыч	12.0	11.7	147	43.0	1,850	1,438	1,572	4,200
E	Э	12.0	18.1	207	49.7	2,748	1,627	1,703	4,660
E, Eg, Esh	Э,Эг,Эш	12.0	18.1	207	49.7	2,748	1,627	1,703	4,660
Eu	Эу	12.0	18.1	198	64.6	2,748	1,627	1,703	4,660
Em	Эм	14.0	18.1	198	64.6	2,748	1,627	1,703	4,660
Er	Эр	14.0	22.8	203	66.4	2,748	1,605	1,703	4,660
Vs e/	Vc	12.5	13.2	179	43.1	3,171	1,602	1,594	4,450
Ea, Em	Еа,Ем	12.7	18.5	229	75.0	2,077	2,191	1,753	5,105
Sha	Ша	15.8	12.6	165	44.6	2,748	1,784	1,746	4,088
L	Л	14.0	22.5	222	113.5	2,137	1,830	1,906	5,150
50	50	12.0		144	50.2				
52	52	16.0		177	63.6				
56	56	14.0		167	53.1				
57	57	12.0		146	53.0				
140	140	13.0		138	45.0				
Tu-23	Ту-23	14.0		224	73.5				
Pt	Пт	12.0		237	90.2				
OK-22	ОК-22	12.0		182	61.6				

Table 32

Technological Specifications of Soviet Steam Locomotives a/
(Continued)

Class		Engine								
		Cylinder					Valve Diameter			
Transliteration	Russian Symbol	Simple Engine Number and Diameter	Compound Engine Number and Diameter: High Pressure	Compound Engine Number and Diameter: Low Pressure	Piston Stroke	Type of Valve Gear f/	High Pressure g/	Low Pressure g/	Length of Main Rod	Cylinder Pitch
B	Б	2 x 550			700	B	250		2,275	0
Gp	Гп	2 x 560			700	B	250		2,275	1/30
Yef, Yek, Yes	Еф,Ек,Ес	2 x 635			711	B	305		2,794	0
Yel	Ел	2 x 635			711	B	305		2,794	0
Z	З	2 x 575			600	B	160		3,300	0
I (or J)	И	2 x 575			650	B	250		3,280	0
IS (or JS)	ИС	2 x 670			770	B	330		3,850	0
K	К	2 x 575			650	B	250		3,280	0
Ku	Ку	2 x 575			650	B	250		3,280	0
Lp	Лп	4 x 460			650	B	250		3,050/1,800	0
Mr	Мр	2 x 540			700	B	250		3,450/2,100	0.1/10
Nv	Нв		1 x 500	1 x 730	650	B	240	Flat	2,210	0
Nv	Нв		1 x 500	1 x 730	650	B	240	Flat	2,210	0
Nu	Ну		1 x 500	1 x 750	650	B	240	Flat	2,210	0
Nu	Ну		1 x 500	1 x 750	650	B	240	Flat	2,210	0
Np	Нп	2 x 540			650	B	250		2,210	0
Oo	Оо	2 x 500			650	B	Flat	Flat	2,520	1/25
Od	Од		1 x 500	1 x 730	650	J	Flat	Flat	2,520	1/25
Ov	Ов		1 x 500	1 x 730	650	B	Flat	Flat	2,520	1/25
Op	Оп	2 x 500			650	B	250		2,520	1/25
Och	Оч		1 x 500	1 x 730	650	B	250	Flat	2,520	1/25
S	С	2 x 550			700	B	250		2,240	30
Su	Су	2 x 575			700	B	250		2,350	0
SO	СО	2 x 650			700	B	250		2,730	1/30
SOk	СОк	2 x 650			700	B	250		2,730	1/30
F	Ф	4 x 500			660	B	260		2,850/2,150	
FD	ФД	2 x 670			770	B	330		3,025	0
Chn	Чн		1 x 500	1 x 730	650	C	Flat	Flat	2,500	1/33.8
Sh	Ш		1 x 510	1 x 765	700	B	340	425	2,430	1/30
Shch	Щ		1 x 510	1 x 765	700	B	Flat	Flat	2,715	1/30
Shchp	Щп	2 x 580			700	B	250		2,715	1/79
Shchch	Щч		1 x 540	1 x 765	700	B	300	Flat	2,715	1/30
Y	Н		1 x 520	1 x 770	650	B	240		2,540	1/30
Ych	Нч		1 x 520	1 x 790	650	B	250	340	2,540	1/30
E	Э	2 x 630			700	B	250		2,730	1/30
E, Eg, Esh	Э,Эг,Эш	2 x 650			700	B	250		2,730	1/30
Eu	Эу	2 x 650			700	B	250		2,730	1/30
Em	Эм	2 x 650			700	B	250		2,730	1/30
Er	Эр	2 x 650			700	B	250		2,730	1/30
Vs e/	Вс	2 x 575			650	B	250		2,735	0
Ea, Em	Еа,Ем	2 x 635			711	B	304		2,794	0
Sha	Ша	2 x 483			660	B	254		2,936	0
L	Л	2 x 650			800	B	300		3,100	0
50	50	2 x 630			600	B				
52	52	2 x 600			660	B	300			
56	56	2 x 620			660	B				
57	57	2 x 630			660	B				
140	140	2 x 570			630	B				
Tu-23	Ту-23	2 x 650			720	B				
Pt	Пт	2 x 630			700	B				
OK-22	ОК-22	2 x 575			630	B				

Table 32

Technological Specifications of Soviet Steam Locomotives a/
(Continued)

Class		Foundation and Running Gear Dimensions									
Transliteration	Russian Symbol	Diameter of Driving Wheel Centers	Diameter of Trailing Wheels	Front Truck b/	Spring Rigging	Frame Thickness	Wheel Base	Over-All Length	Maximum Width	Maximum Height	Height to Boiler Center Line
B	Б	1,700	1,030	BO	3	32	9,090	11,526	3,100	5,143	2,800
Gp	Гп	1,600	950		4	32	9,265	11,574	2,960	5,089	2,770
Yef, Yek, Yes	Еф,Ек,Ес	1,170	762	B	3	114	8,482	12,665	3,310	4,683	2,927
Yel	Ел	1,170	838	B	3	114	8,482	12,344	3,310	5,156	3,048
Z	З	1,570	1,030		3	33	7,840	10,430	3,100	5,158	2,500
I (or J)	И	1,370	1,030	K	7	33	8,000	10,863	3,100	5,184	3,100
IS (or JS)	ИС	1,700	1,050	K	3	125	12,605	16,365	3,350	4,825	3,225
K	К	1,570	1,030		3	33	7,930	10,665	3,100	5,200	3,100
Ku	Ку	1,770	1,030		7	33	7,930	11,066	3,110	5,200	3,200
Lp	Лп	1,700	940 & 1,310	BO	3	29	11,505	14,000	3,035	5,187	3,185
Mr	Мр	1,570	1,050 & 1,320		3	28	10,680	14,190	3,216	5,302	3,450
Nv	Нв	1,766	1,030	B	3	32	7,440	9,975	3,190	4,882	2,550
Nv	Нв	1,566	1,030	B	3	32	7,440	9,975	3,190	4,882	2,550
Nu	Ну	1,766	1,030	B	3	32	7,360	10,365	3,190	4,990	2,550
Nu	Ну	1,566	1,030	B	3	32	7,360	10,365	3,190	4,990	2,550
Np	Нп	1,570	1,030	B	3	32	7,440	10,665	3,000	5,020	2,550
Oo	Оо	1,020			4	33	3,890	9,672	3,090	4,715	2,090
Od	Од	1,070			4	39	3,890	9,672	3,090	4,715	2,090
Ov	Ов	1,070			4	33	3,890	9,672	3,090	4,715	2,090
Op	Оп	1,070			4	33	3,890	9,672	3,090	4,715	2,090
Och	Оч	1,070			4	33	3,890	9,672	3,090	4,715	2,090
S	С	1,700	1,030 & 1,200	TS	3	30	8,900	12,247	3,170	5,070	3,050
Su	Су	1,700	1,050 & 1,320	K	4	30	10,300	13,424	3,136	5,210	3,300
SO	СО	1,170	900	B	4	30	8,430	13,088	3,110	5,230	3,450
SOk	СОк	1,170	900	B	4	30	8,430	13,088	3,160	5,230	3,450
F	Ф	1,300	900	F	5	30	10,115	12,947	3,150	4,280	2,900
FD	ФД	1,350	900	B	3	125	12,370	15,974	3,350	4,650	3,250
Chn	Чн	1,090			4	33	3,890	9,731	2,975	4,717	2,020
Sh	Ш	1,170	830	B	5	32	7,920	11,669	2,960	4,879	2,560
Shch	Щ	1,170	930	B	5	32	7,800	11,701	3,396	5,019	2,600
Shchp	Щп	1,170	930	B	5	32	7,800	11,750	3,260	5,018	2,600
Shchch	Щч	1,170	930	B	5	32	7,800	11,701	3,396	5,019	2,600
Y	Н	1,070			4	32	3,890	9,740	3,110	5,150	2,660
Ych	Нч	1,070			4	32	3,890	9,840	3,110	5,150	2,850
E	Э	1,170			4	32	5,780	11,456	3,100	5,212	3,100
E, Eg, Esh	Э,Эг,Эш	1,170			4	32	5,780	11,456	3,100	5,212	3,100
Eu	Эу	1,170			4	32	5,780	11,456	3,100	5,212	3,100
Em	Эм	1,170			4	32	5,780	11,456	3,100	5,212	3,100
Er	Эр	1,170			4	32	5,780	11,506	3,100	5,212	3,105
Vs c/	Vc	1,150			4	30	4,200	10,085	3,170	4,650	2,900
Ea, Em	Еа,Ем	1,170	838	B	3	127	8,531	12,624	3,124	5,160	3,048
Sha	Ша	1,295	838	B	3	114	7,087	10,719	2,840	3,924	2,820
L	Л	1,050	900	B	3	140	9,750	13,757	3,150	5,000	3,400
50	50						6,000				2,700
52	52		850								
56	56		1,000				6,000	11,500		4,250	2,700
57	57						6,000	10,700			2,600
140	140		870								
Tu-23	Ту-23		860				9,050	12,550		4,620	3,100
Pt	Пт		1,000 (1,200)				12,220			4,570	3,230
OK-22	ОК-22		1,000				8,350	11,222		4,625	3,150

Table 32

Technological Specifications of Soviet Steam Locomotives a/
(Continued)

Class		Weight Diagram			Proportions				Derivative Value		
Transliteration	Russian Symbols	Average Weight on Driving Axle	Empty Weight	Weight in Working Order	Cylinder Capacity	Combined Heating Surface to Grate Area	Superheating Surface to Evaporating Surface	Weight on Drivers to Over-All Weight	Tractive Force (kg)	Driving Wheel rpm at 10 km/hr	Average Piston Stroke in Meters per Second at 10 km/hr
B	Б	15.7	68.0	74.5		59	0.25	0.63	14,600	29.0	0.68
Gp	Гп	17.0	67.3	75.2		60	0.28	0.67	14,800	30.6	0.71
Yef, Yek, Yes	Еф,Ек,Ес	15.5	79.8	87.0		40	0.26	0.89	26,770	40.1	0.95
Yel	Ел	16.0	81.0	88.0		40	0.27	0.88	26,770	40.1	0.95
Z	З	15.0	59.8	65.3		63	0.21	0.69	13,600	31.2	0.62
I (or J)	И	14.0	62.2	69.0		64	0.29	0.80	16,700	35.4	0.76
IS (or JS)	ИС	20.2	120.6	135.0		42	0.50	0.60	27,100	28.7	0.74
K	К	15.1	66.6	74.0		60	0.24	0.61	14,700	31.2	0.68
Ku	Ку	16.0	67.3	74.3		60	0.26	0.65	14,300	27.9	0.61
Lp	Лп	17.3	85.6	96.7		58	0.32	0.54	17,400	28.8	0.62
Mr	Мр	18.1	88.3	99.5		44	0.32	0.73	22,500	30.8	0.72
Nv	Нв	15.0	54.5	59.0	2.13	73		0.76	10,600	27.9	0.61
Nv	Нв	14.5	51.8	57.8	2.13	73		0.75	11,900	31.2	0.68
Nu	Ну	16.0	55.9	61.7	2.25	60		0.78	12,100	27.9	0.61
Nu	Ну	15.0	52.5	59.0	2.25	60		0.76	13,600	31.2	0.68
Np	Нп	13.8	50.7	57.3		52	0.31	0.77	12,500	31.2	0.68
Oo	Оо	13.1	46.0	52.5	2.13	82		1.00	16,800	44.2	0.96
Od	Од	13.1	46.4	52.5	2.13	82		1.00	16,100	44.2	0.96
Ov	Ов	13.1	46.0	52.5	2.13	82		1.00	16,800	44.2	0.96
Op	Оп	13.1	47.5	52.4		69	0.32	1.00	18,740	44.2	0.96
Och	Оч	13.8	48.0	55.0	2.13	72	0.22	1.00	16,800	44.2	0.96
S	С	15.7	67.5	76.8		50	0.25	0.61	14,600	29.0	0.68
Su	Су	18.3	77.9	86.0		42	0.34	0.63	15,800	28.6	0.67
SO	СО	17.4	87.0	96.6		38	0.41	0.90	30,900	40.1	0.94
SOk	СОк	20.4	94.4	104.0		38	0.41	0.90	30,900	40.1	0.94
F	Ф	17.5	89.8	104.7		51	0.23	0.84	30,900	36.6	0.80
FD	ФД	20.1	120.6	135.0		42	0.50	0.79	33,450	35.4	0.91
Chn	Чн	12.5	45.4	50.0	2.13	90		1.00	15,200	43.5	0.94
Sh	Ш	15.6	66.1	75.3	2.25	74		0.83	19,900	40.8	0.95
Shch	Щ	16.0	69.0	77.2	2.25	78		0.83	21,400	40.8	0.95
Shchp	Щп	16.0	69.2	77.3		60	0.25	0.83	22,300	43.1	1.01
Shchch	Щч	16.2	71.2	78.2	2.00	63	0.33	0.83	21,400	40.8	0.95
Y	Н	14.9	53.3	59.5	2.19	72		1.00	18,700	44.2	0.96
Ych	Нч	15.2	54.8	60.9	2.06	58	0.29	1.00	19,700	44.2	0.96
E	Э	16.2	72.7	81.2		46	0.24	1.00	24,500	40.1	0.94
E, Eg, Esh	Э,Эг,Эш	16.2	72.7	81.2		46	0.24	1.00	26,100	40.1	0.94
Eu	Эу	16.2	72.7	81.2		44	0.33	1.00	26,100	40.1	0.94
Em	Эм	16.2	72.7	81.2		44	0.33	1.00	30,000	40.1	0.94
Er	Эр	16.7	74.7	83.3		39	0.34	1.00	30,100	40.1	0.94
Vs e/	Vc	16.0	57.6	64.2		54	0.24	1.00	20,000	40.8	0.84
Ea, Em	Еа,Ем	18.3-17.7	90.7-92.5	99.6-103.0		32.2	0.33	0.89-0.86	27,150	40.2	0.96
Sha	Ша	16.0	66.7	73.8		43.3	0.27	0.86	16,500	36.6	0.81
L	Л	18.8	94.0	105.3		37	0.51	0.89	31,100	35.4	0.94
50	50	14.8	67.8	74.4		55	0.35	1.00	22,100	38.0	0.84
52	52	15.0	81.0	85.6		45.5	0.36	0.87	26,650	38.0	0.84
56	56	16.0	74.8	82.1		49	0.32	0.82	25,300	38.0	0.84
57	57	17.0	65.3	71.5		56	0.36	1.00	22,458	38.0	0.84
140	140	14.4	61.2	68.3		36	0.32	0.84	24,000	40.5	0.85
Tu-23	Ту-23	17.0		95.0		50	0.33	0.89	28,400	37.0	0.87
Pt	Пт	18.2	95.0	105.0		52.5	0.39	0.68	17,400	29.0	0.89
OK-22	ОК-22	17.0		79.0		45.5	0.34	0.64	13,000	30.5	0.64

Table 32

Technological Specifications of Soviet Steam Locomotives a/
(Continued)

Class		Tender			Locomotive and Tender		
Transliteration	Russian Symbol	Axles	Water Supply (cu m)	Empty Weight	Wheel Base	Over-All Length	Rated Weight (Tender Two-Thirds Loaded)
B	Б	4	23	25.5	17,730	20,516	120
Gp	Гп	4	21	24.3	17,342	20,255	120
Yef, Yek, Yes	Еф,Ек,Ес	4	27	25.2	18,476	21,807	135
Yel	Ел	4	28	25.7	18,375	21,486	140
Z	З	4	23	25.8	16,652	19,479	110
I (or J)	И	3	14	17.0	14,095	17,548	105
IS (or JS)	ИС	6	51	54.0	25,565	28,910	235
K	К	3	16	20.2	13,992	17,512	110
Ku	Ку	4	23	22.7	16,110	19,498	120
Lp	Лп	4	28	27.5	19,582	22,695	150
Mr	Мр	4	28	27.5	19,564	22,885	155
Nv	Нв	3	14	17.2	13,482	16,622	90
Nv	Нв	3	14	17.2	13,482	16,622	90
Nu	Ну	3	16	18.6	13,792	17,212	95
Nu	Ну	3	16	18.6	13,792	17,212	95
Np	Нп	3	14	17.1	13,482	17,302	95
Oo	Оо	3	14	16.4	11,630	16,319	85
Od	Од	3	14	16.4	11,630	16,319	85
Ov	Ов	4	23	21.9	14,340	18,721	95
Op	Оп	4	23	21.9	14,340	18,721	95
Och	Оч	4	23	21.9	14,340	18,721	95
S	С	4	23	26.0	18,504	21,276	120
Su	Су	4	23	23.6	18,620	21,748	130
SO	СО	4	23	24.0	18,541	22,497	145
SOk	СОк	4	14	48.6	22,854	25,606	170
F	Ф	3	24	25.1	16,809	19,511	150
FD	ФД	6	44	56.0	25,817	28,967	235
Chn	Чн	3	11	17.2	11,960	16,791	80
Sh	Ш	4	21	24.3	17,282	20,350	120
Shch	Щ	4	25	23.7	17,730	20,721	120
Shchp	Щп	3	15	18.0	15,214	18,175	110
Shchch	Щч	4	25	23.7	17,730	20,721	120
Y	Ы	3	16	19.6	11,382	16,457	95
Ych	Ыч	3	16	19.6	11,482	16,557	95
E	Э	4	23	23.0	15,816	20,467	125
E, Eg, Esh	Э,Эг,Эш	4	23	23.0	15,816	20,467	125
Eu	Эу	4	23	23.0	15,816	20,467	125
Em	Эм	4	23	23.0	15,816	20,467	125
Er	Эр	4	23	23.0	16,274	20,925	130
Vs e/	vc	3	16	16.7	11,920	16,035	100
Ea, Em	Еа,Ем	4	28	28.1	19,200	21,963	160
Sha	Ша	4	24	18.9	15,742	19,047	120
L	Л	4	30	30.3	21,575	25,641	168
50	50	4	16	25.8	14,090	18,912	115
52	52	4	34	18.0		18,890	135
56	56	4	20	21.0			125
57	57	4	16	21.0			120
140	140				14,050		
Tu-23	Ту-23	4	21	22.0	17,015	20,065	140
Pt	Пт	4	32	26.5	20,235	23,835	160
OK-22	ОК-22	4	21	26.6	15,565	18,612	125

Table 32

Technological Specifications of Soviet Steam Locomotives a/
(Continued)

a. Linear dimensions are in millimeters; area is in square meters; axle load and weight are in metric tons; speed is in kilometers per hour; pressure is in atmospheres.
b. The axle arrangement of a locomotive is another way of expressing wheel arrangement. It differs from wheel arrangement in that the number of axles instead of the number of wheels is specified. Since there are 2 wheels per axle, to convert axle arrangement to wheel arrangement, multiply each figure by 2. Thus a 2-3-0 axle arrangement is the same as a 4-6-0 wheel arrangement.
c. 2 k = 2-cylinder compound; 2 p = 2-cylinder simple; 4 k = 4-cylinder compound.
d. Sup = superheated; Sat = saturated.
e. V (v) ("izhitsa," with a phonetic value of "i") has been supplanted in the Russian alphabet by И (и), transliterated "i."
f. B = Walshaert; J = Joy; C = Stephenson.
g. Flat = flat surface value.
h. BO = Borris; B = Bissel; K = Krauss; TS = Tsara; F = Flamm.

Table 33

Technological Specifications of Soviet Main-Line Diesel Locomotives

Item	Class (1) Shch-EL-1	(2) E-EL-2 (Redesigned)	(3) E-EL-5	(4) O-EL-6	(5) O-EL-7	(6) E-EL-8	(7) E-EL Serial	(8) VM	(9) TE-1	(10) TE-2	(11) TE-5.	(12) DA	(13) DB
Axle Arrangement	1-3-0+ 0-4-0+ 0-3-0	1-5-1	2-5-1	1-4-1	1-4-0	2-5-1	2-5-1	2-4-1+ 1-4-2	3+3	2(2+2)	3+3	3+3	3+3
Distance between Front and Rear Couplings (mm)	22,760	14,221	15,820	13,770	12,465	17,850	15,710	27,202	16,892	23,895 (23,140) a/*	16,892	16,852	17,687
Complete Frame (mm)	19,360	10,400	11,820	9,920	7,950	13,850	11,820	23,100	11,890	19,826 (19,450) a/	11,890	11,887	14,021
Over-All Operating Weight (mt) with Full Load of Water, Fuel, Lubricant, and Sand	180.0	124.8	133.7	100.7	98.7	149.0	138.0	245.58	123.9	166.0		121.2	122.6
Operating Weight on Drivers with Full Equipment (mt)	160.0	91.9	96.5	73.2	84.4	106.5	98.0	157.8	123.9	166.0		121.2	122.6
Rail Load (mt)													
Carriage Axle	10.0	16.3	11.7 to 11.9	13.6	14.3	14.25	12.5	14.78+ 15.83					

* Footnotes for Table 33 follow on p. 189.

Table 33

Technological Specifications of Soviet Main-Line Diesel Locomotives
(Continued)

Item	Class (1) Shch-EL-1	(2) E-EL-2 (Redesigned)	(3) E-EL-5	(4) O-EL-6	(5) O-EL-7	(6) E-EL-8	(7) E-EL Serial	(8) VM	(9) TE-1	(10) TE-2	(11) TE-5	(12) DA	(13) DB
Rail Load (mt) (Continued)													
Driving Axle	16.0	17.5 to 19.25	19.3	18.3	21.1	21.3	19.6	19.725	20.65	20.75		20.2	20.43
Supporting Axle	10.0	16.6	13.6	13.9		14.0	15.0	13.280					
Fuel Consumption (mt)	8.0	4.0	3.9	2.5	2.4	6.0	3.95	7.8	5.15	7.0 = 2x3.5	5.15	5.15	2.57
Diameter (mm)													
Driving Wheels	1,050	1,220	1,220	1,320	1,220	1,320	1,220	1,220	1,014, Nos. 1 to 121, inclusive, 1,050	1,050	1,014	1,016	1,067
Carriage Wheels	950	950	1,050	950	950	1,050	1,050	900					
Supporting Axle Wheels	950	950	1,050	950		1,050	1,050	900					
Running Speed (km/hr)													
With Engine Disengaged (Constructive Speed)	75	50	55	55	55	65	55	72	90	100	90	96	96
With Engine Engaged (under Current)	50	50	50	50		60		65					

Table 33

Technological Specifications of Soviet Main-Line Diesel Locomotives
(Continued)

	Class												
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Item	Shch-EL-1	E-EL-2 (Redesigned)	E-EL-5	O-EL-6	O-EL-7	E-EL-8	E-EL Serial	VM	TE-1	TE-2	TE-5	DA	DB
Year Built	1924	1924: redesigned, 1928	1931	1931	1930	1932	1932	1934	1947	1948	1948	1945	1946
Maximum hp		900	830			1,200	900	1,635	765		765	835	770
Main Engine													
Fuel Atomization	noncompression	compressed air	noncompression			noncompression (antechamber)	noncompression						noncompression with wind chamber
Strokes per Cycle	4	4	4	4	4	4	4	4	4	4	4	4	4
Cylinder Diameter (mm)	368	450	450	280	280	310	450	450	318	318	318	317.5	324
Length of Piston Stroke (mm)	381	420	420	380	380	370	420	420	330	330	330	330	394
Number of Cylinders	10	6	6	6	6	2 x 8	6	2 x 6	6	2 x 6	6	6	8
Maximum Regular rpm	395	350	420	700	700	640	425	400	740	740	740	740	625
Effective hp at Maximum rpm	1,000	1,000	1,100	600	600	2 x 825	1,050	2 x 1,050	1,000	1,000 x 2	1,000	1,000	1,000
Engine Starting	storage battery	compressed air		storage battery			compressed air		storage battery				

Table 33

Technological Specifications of Soviet Main-Line Diesel Locomotives
(Continued)

Item	Class (1) Shch-EL-1	(2) E-EL-2 (Redesigned)	(3) E-EL-5	(4) O-EL-6	(5) O-EL-7	(6) E-EL-8	(7) E-EL Serial	(8) VM	(9) TE-1	(10) TE-2	(11) TE-5	(12) DA	(13) DB
Turboblower													
Output, cu m/hr									5,100	5,100	5,100	5,800	
Pressure, kg/sq cm									0.22 to 0.34	0.22 to 0.34	0.22 to 0.34	0.35 to 0.36	
Operating rpm									1,600 to 10,300	1,600 to 10,300	1,600 to 10,300	2,200 to 10,500	
Maximum rpm									13,000	13,000	13,000	13,000	
Main Generator													
Nominal Power (kw)	2 x 400	800	752	378 378		2 x 510	796	796	700	700	700	700	736
Maximum Volts	360 to 720	1,100	700 at 450 rpm	630 at 750 rpm		800	750	750	900	900	900	900	1,050
Amperage, Average	1,500	800 at 1,000 v & 800 kw	1,450 at 21°C	1,160 at 335 v		975	845 at 750 v & 450 rpm		1,150 at 40°C 1,350 under 35°C			1,200 at 40°C	1,060
Amperage, Maximum	3,000	1,330 at 600 v & 800 kw b/	1,750 at 21°C	1,400 at 270 v			1,750 at 450 v & 450 rpm		1,500 at 40°C 1,800, short-term			1,550 at 40°C	1,200 c/
Rotor Coupling to Engine Shaft	rigid	rigid	flexible	flexible	flexible	rigid	flexible converted to rigid		rigid	rigid	rigid	rigid	rigid
Excitement	inde-pendent	inde-pendent 2 step	inde-pendent 1 step	independent & counter compound armature		inde-pendent	inde-pendent	inde-pendent cascade	inde-pendent	inde-pendent	inde-pendent	inde-pendent	inde-pendent

Table 33

Technological Specifications of Soviet Main-Line Diesel Locomotives
(Continued)

Item	Class (1) Shch-EL-1	(2) E-EL-2 (Redesigned)	(3) E-EL-5	(4) O-EL-6	(5) O-EL-7	(6) E-EL-8	(7) E-EL Serial	(8) VM	(9) TE-1	(10) TE-2	(11) TE-5	(12) DA	(13) DB
Exciter													
Nominal Power (kw)	2 x 10.5 = 21	12.5/1 a/	61 at 250 to 450 rpm	40 at 750 rpm	40 at 750 rpm	2 x 100	61	160	3.6	3.6	3.6	5	
Operating Voltage		50/110 to 135	135 to 140 at 210C	140	140	150	135	160 at 1,360 rpm	55	55	55	55	
Operating Amperage	250	250/9	550 at 125 v, 20 min	285, average; 350, for 20 min	285, average; 350, for 20 min	667	452		65	65	65	65	110 maximum
Excitement		independent			shunt	storage battery	compound & shunt armature	auxiliary generator	combination	combination	combination	combination	combination
Maximum rpm	400	550		750	750	650	450		1,776	1,776	1,776	1,776	2,500
Auxiliary Generator (Auxiliary Exciter)													
Nominal Power (kw)								12.5	5	5	5	5	
Maximum rpm									1,776	1,776	1,776	1,776	2,500 shunt
Excitement									self-excitement				
Voltage								160 at 1,320 rpm	76	76	76	75	130

Table 33

Technological Specifications of Soviet Main-Line Diesel Locomotives
(Continued)

	Class												
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Item	Shch-EL-1	E-EL-2 (Redesigned)	E-EL-5	O-EL-6	O-EL-7	E-EL-8	E-EL Serial	VM	TE-1	TE-2	TE-5	DA	DB
Electric Drive Motors													
Nominal Power (kw)	100	142	140	350	140	230	140	140	98	98	98	99	
Amperage, Average		160 at 835 rpm & 1,000 v.				2 x 195	169 at 750 v & 1,000 rpm e/		680 at 40°C 725 at 25°C	725	680 at 40°C	700 at 40°C 740 at 30°C	1,000
Amperage, Short-Term		235 at 440 v & 600 rpm for 100 min				2 x 242	350 at 440 v & 410 rpm e/	375 at 440 v	770 at 40°C 840 at 25°C		770 at 40°C	780 at 40°C 850 at 30°C	
Field Shunting (percent)									35	50	35	55	38/33 29/25
Transmission Ratio	4.625	6.14	5.73 = 86/15	4.75	5.73	6.8	5.73 = 86/15	4.316 = 82/19	4.6875 = 75/16	4.6875 = 75/16	4.6875 = 75/16	4.6875 = 75/16	4.857 = 68/14
Number of Drive Motors	10	5	5	1 group	4	5 double	5	2 x 4	6	2 x 4	6	6	6
Transmission Type		two-sided	two-sided		two-sided	one-sided to shaft, torsion to axle	two-sided with conical teeth		one-sided	one-sided	one-sided	one-sided	one-sided
Maximum rpm of Rotor	1,750		1,400 at 55 km/hr	1,030	1,400	1,770	1,400	1,350 at 72 km/hr	2,200	2,200	2,200	2,200	2,300

Table 33

Technological Specifications of Soviet Main-Line Diesel Locomotives
(Continued)

Item	Class (1) Shch-EL-1	(2) E-EL-2 (Redesigned)	(3) E-EL-5	(4) O-EL-6	(5) O-EL-7	(6) E-EL-8	(7) E-EL Serial	(8) VM	(9) TE-1	(10) TE-2	(11) TE-5	(12) DA	(13) DB
Electric Drive Motors (Continued)													
Scheme of Inclusion of Drive Motors at Start-Up and at Cruising Speed of Locomotive	parallel	parallel	parallel		parallel		parallel	parallel	series	series	series	series	2 parallel groups with 2-step shunting
Basic Scheme of Inclusion of Drive Motors	parallel	parallel	parallel		parallel		parallel	parallel	series parallel	series parallel	series parallel	series parallel	
Voltage		1,000				800	750		157	235	157	130 to 268	360 maximum
Storage Battery													
Characteristics	acid	acid	base	base	base	base	acid	acid	acid	acid	acid	acid	acid
Number of Elements		54	80	82	82	92	52	2 x 52	32	2 x 32	32	32	56
Ampere Hours/Discharge Time	600/1	60/3	160/3	500/3	500/3	400/3	81/3	2 x 81/3	550/10	2 x 550/10	550/10	360/6	260-type 1 280-type 2 6-hr discharge
Voltage			135	120 to 140	140	140	104	135	64	64	64	64	130
Maximum Amperage Discharge								55	1,700	1,700	1,700		

Table 33

Technological Specifications of Soviet Main-Line Diesel Locomotives
(Continued)

Item	Class (1) Shch-EL-1	(2) E-EL-2 (Redesigned)	(3) E-EL-5	(4) O-EL-6	(5) O-EL-7	(6) E-EL-8	(7) E-EL Serial	(8) VM	(9) TE-1	(10) TE-2	(11) TE-5	(12) DA	(13) DB
Air Compressor													
Number of Steps		4	2	1	1		2	2	2	2	2	2	2
Number of Cylinders		4	2	2	2		2	2 x 2	3	3	3	3	3
Capacity													
Numerator (cu m/min) Denominator (rpm)			1.08/315 or 1.3/385	1.0/450	1.0/450		1.08/315	1.08/315 or 1.3/385	2.2/250 or 5.5/740	2.2/250 or 5.5/740	2.2/250 or 5.5/740	2.2/250 or 5.5/740	
Air Pressure (kg/sq cm)			60	8	8		60	60	9.8	9.8	9.8	9.8	9.8
Condenser													
Flow from Water Pump (cu m/hr)	20	49	95	60	60	130	45	38.6	80	2 x 80	80	78	104
Flow from Lubrication Pump (cu m/hr)		5	12/36 = 48 f/	9	9	35	13	22	16	2 x 16	16	18	11
Maximum rpm of Blower	1,200	1,290	1,230	1,300	1,200	1,000	1,200	1,120	1,240	970	1,240	1,240	1,600
Maximum Air Supply (cu m/hr)	100,000	138,000	144,000	126,000	115,000	162,000	150,000	2 x 126,000	66,000		66,000		97,000

Table 33

Technological Specifications of Soviet Main-Line Diesel Locomotives
(Continued)

Item	Class (1) Shch-EL-1	(2) E-EL-2 (Redesigned)	(3) E-EL-5	(4) O-EL-6	(5) O-EL-7	(6) E-EL-8	(7) E-EL Serial	(8) VM	(9) TE-1	(10) TE-2	(11) TE-5	(12) DA	(13) DB
Condenser (Continued)													
Number of Water Coils			4	9	9	6	5	2 x 4	21	2 x 20	21	21	10
Number of Lubricant Coils			2+5 = 7 f/	3	3	2	6	2 x 4	5	2 x 6	5	5	2
Water Coil Surface (sq m)	700	672.5	320	405	405	480	410	2 x 450	429	2 x 409	429	429.5	336.8
Lubricant Coil Surface (sq m)	32	134.5	160+400 = 560 f/	135	135	160	205	2 x 450	95	2 x 114	95	102	69.5
Number of Speeds of Blower		1	2		2		1	1	1	1	1	1	1

a. Figures in parentheses refer to locomotive TE-2 of first production.
b. Current shown for time of 100 minutes.
c. Current shown for time of 40 minutes.
d. Figures in the denominator refer to the small exciter which is driven by belt transmission from shaft of the main exciter.
e. Correspond to a flow of 45 cubic meters per minute of air blown through the motor.
f. First figure refers to cooling of engine lubricant; second, to cooling of pistons.

Table 34

Technological Specifications of Soviet Diesel Locomotives with Mechanical Transmission

Item	Class (1) EMH-3	(2) MH-1 & MH-2	(3) AA-1	(4) M D/2	(5) Projects of Kolomen Works	(6) Projects of Kolomen Works
Type	2-5-1	0-2-0	0-3-0	0-2-0	2-5-1	2-5-2
Length over Buffers (mm)	16,696	8,640	9,200	7,764	19,100	19,200
Length of Basic Frame (mm)	11,935	3,200	4,400	2,150	14,300	15,650
Drawbar Pull (mt)						
Over-All	131	38	54	26	165	170
Trailing	88	38	54	26	110	100
Rail Load (mt)						
Front Carriage Axle	13 & 14				17.5 & 18.5	17.5
Front Carriage Wheels	17.6	19	18	13	22	20
Supporting Axle	16				19	17.5
Fuel Consumption (mt)	3.5	0.85		0.93		5.2
Diameter (mm)						
Driving Wheels	1,320	1,220	1,220	1,200	1,520	1,500
Carriage Wheels	1,030				1,050	900
Supporting Axle Wheels	950				900	900
Running Speed (km/hr)						
With Engine Disengaged	55	45				65
With Engine Engaged	48	36	50	39		61
Year Built	1927	1931	1933	1936	projected in 1934	projected in 1934 (incomplete)

Table 34

Technological Specifications of Soviet Diesel Locomotives with Mechanical Transmission
(Continued)

Item	Class (1) EMH-3	(2) MH-1 & MH-2	(3) AA-1	(4) M D/2	(5) Projects of Kolomen Works	(6) Projects of Kolomen Works
Main Engine						
Engine Designation	MAN	MAN	6D 22/28	SD 19/32 (Kaluga Works)	53 N 8	45 NK-8
Cylinder Diameter (mm)	450	220	220	190	410	410
Length of Piston Stroke (mm)	420	320	280	320	530	450
Number of Cylinders	6	6	6	4	8	8
Maximum rpm	450	850		460	450	500
Top Operating rpm	400	700	650	430	450	500
Effective hp at Top Operating rpm	1,050	300	300	140	2,500	2,300
Fuel Atomization	air	jet		antechamber	mechanical	air
Strokes per Cycle	4	4	2	2	2	2
Condenser						
Maximum Supply of Water Pump (cu m/hr)	48	12		10		
Maximum Lubrication Supply (cu m/hr)	20	3.5		2 x 1.3		
Number of Water Condenser Coils	6	3		grading		front, 11; rear, 1
Surface of Water Condenser Coils (sq m)	530	82				
Number of Lubrication Condenser Coils	6	3				front, 11; rear, 3

Table 34

Technological Specifications of Soviet Diesel Locomotives with Mechanical Transmission
(Continued)

Item	Class (1) EMH-3	(2) MH-1 & MH-2	(3) AA-1	(4) M D/2	(5) Projects of Kolomen Works	(6)
Condenser (Continued)						
Surface of Lubrication Condenser Coils (sq m)	200	55		7.4		
Number of Gears of Blower Reducer	2	2		driven by exhaust gases		1
Maximum Number of rpm of Fan	1,200	1,200				front, 1,200; rear, 1,400
Maximum Supply of Air (cu m/hr)	110,000			1,600		front, 190,000; rear, 50,000
Maximum hp Required by Fan	68					
Gear Box						
Number of Cross Shafts	3	5		4	5	5
Number of Speeds	3	4	4	4	4	4
Transmission Figures						
Speed I	6.923	23.		17.8		11.14
Speed II	3.966	13.35		9.544		5.72
Speed III	2.053	7.60		4.9		3.40
Speed IV		4.43		2.63		2.27

Table 34

Technological Specifications of Soviet Diesel Locomotives with Mechanical Transmission
(Continued)

Item	Class (1) EMH-3	(2) MH-1 & MH-2	(3) AA-1	(4) M D/2	(5) Projects of Kolomen Works	(6)
Locomotive Speed in km/hr at Maximum rpm						
Speed I	14.4	3.5 to 8.5	10.5	5.46		12.3
Speed II	25	6 to 14.6		10.2		23.95
Speed III	48	10.6 to 25.9		19.8		40.2
Speed IV		18.2 to 45	50	37		60.4
Generator						
Function	feeding of couplings, lighting, battery charging	battery charging, lighting				feeding of couplings, battery charging
Type of Current	direct	direct				direct
Maximum rpm	2,500					
Voltage	110/135					113
Kilowatts	6					
Traction Motor						
Function	for lubrication pump at tender	engine starting				for lubrication pump
Voltage	110					

Table 35

Technological Specifications of Soviet Electric Locomotives

Item	Class			
	VL-19	SS	VL-22	VL-22m
Service	freight-passenger	freight, mountain service	freight-passenger	freight-passenger
Wheel Arrangement	0-3-0+0-3-0	0-3-0+0-3-0	0-3-0+0-3-0	0-3-0+0-3-0
Plant	Dynamo Works imeni Kirov a/	Dynamo Works imeni Kirov a/	Dynamo Works imeni Kirov a/	Novocherkassk b/
Year in Service	1932	1932		1947
Current	DC	DC	DC	DC
Voltage on Pantograph	3,000	3,000	3,000	3,000
Hp, Hourly Rate	2,770	2,770	2,770	3,260
Designed Speed (km/hr)	83	70		
Total Weight (mt)				
With Stabilizer	126	132	132	132
Without Stabilizer	120	126		
Weight on Driving Axle (mt)				
With Stabilizer	21	22	22	22
Without Stabilizer	20	21		
Diameter of Drivers (mm)	1,220	1,220	1,220	1,220
Diameter of Auxiliary Wheels (mm)				

a. Moscow Order of Lenin and Order of Labor Red Banner Dynamo Works imeni Kirov.
b. Novocherkassk Electric Locomotive Plant imeni Budennyy.

Table 35

Technological Specifications of Soviet Electric Locomotives
(Continued)

Item	Class			
	VL-19	SS	VL-22	VL-22m
Driving Gears				
System	resilient duplex gears	resilient duplex gears	duplex gears	duplex gears
Gear Ratio	3.74	4.45	4.45	4.45
Piston Gear, Number of Teeth	23	20		
Spur Gear, Number of Teeth	86	89		
Traction Motor				
Number of Motors	6	6	6	6
Suspension	tramway	tramway	tramway	tramway
Locomotive Dimension (mm)				
Over-All Length between Buffers	16,220	16,480	16,390	16,390
Body Length	13,500	13,500		
Wheel Base	11,800	12,200	14,200	14,200
Wheel Rigid Base	4,000	4,200	4,200	4,200
Height, Locked-Down Position of Pantographs to Top of Rail	4,990	4,825		
Braking	rheostat	regenerating	regenerating	regenerating

Table 36

Technological Specifications of Soviet Freight Cars

Type	Year Built	Light Weight (mt)		Capacity a/ (mt)	Axle Load a/ (mt)	Length over Buffers (mm)		Distance between End Axles (mm)	Distance between Truck Centers (mm)	Length a/ Inside (mm)	Width Inside (mm)	Floor Space a/ (sq m)
		With Hand Brakes	Without Hand Brakes			With Hand Brakes	Without Hand Brakes					
2-Axle Boxcar, Russian Type	1887	8.6		15/18	13.3/13.1	8,236	7,634	3,810		6,400	2,743	17.56
2-Axle Flatcar, Russian Type	1900	7.8	7.3	15/18	12.9/12.65	10,394	10,394	5,500		8,612/9,104	2,740	23.6/24.94
2-Axle Refrigerator Car, Built by the Tambov Freight Car Repair Plant	1932	18.4	18.0	19.0	18.7/18.5	10,394	10,394	5,500		8,410/9,010	2,700	22.7/24.3
2-Axle Boxcar, Built by Soviet Car Plants	1927	10.5	9.9	20.0	16.05/15.65	8,540	7,850	3,900		6,600	2,750	18.15
2-Axle High-Side Flatcar of Welded and Riveted Construction	1928	9.9	9.2	20.0	14.95/14.6	10,424 b/	10,424	5,500		8,364/9,114	2,750	23.0/25.1
2-Axle 25-cu-m Tank Car for Hauling Ammonium		13.5		25.0	19.25	8,980		3,900		6,740	2,200	
2-Axle Self-Unloading Hopper Car	1931	12.2		25.0	18.6	7,140		3,900		5,912	2,916	
2-Axle 25-cu-m Tank Car Built by Soviet Car Plants	1931-37	11.7	11.0	25.0	18.35/18.0	8,960	8,780	3,900		6,740	2,200	
4-Axle Boxcar of Riveted Construction, Built by Soviet Car Plants	1928-36	24.2	23.4	50.0	18.55/18.35	15,058	14,308		9,272	13,000	2,750	35.75
4-Axle Boxcar of Welded Construction, Built by Soviet Car Plants	1936-41	22.79	21.9	50.0	18.18/18.0	15,350	14,730		9,830	13,430	2,750	36.9

a. Numerator refers to cars having hand brakes; denominator, to cars without hand brakes.
b. With automatic couplers.

Table 36

Technological Specifications of Soviet Freight Cars
(Continued)

Type	Year Built	Light Weight (mt) With Hand Brakes	Light Weight (mt) Without Hand Brakes	Capacity a/ (mt)	Axle Load a/ (mt)	Length over Buffers (mm) With Hand Brakes	Length over Buffers (mm) Without Hand Brakes	Distance between End Axles (mm)	Distance between Truck Centers (mm)	Length a/ Inside (mm)	Width Inside (mm)	Floor Space a/ (sq m)
4-Axle All-Welded Flatcar	1932	18.4	18.4	50.0	17.1	14,224	14,224		9,300	12,914	2,780	35.9
4-Axle Flatcar, No Sides	1935		24.0	60.0	21.0		14,220		9,300	13,000	3,100	40.3
4-Axle Flatcar, Welded from Rolled Steel	1936	22.2	22.0	60.0	20.55/20.5	14,194	14,194		9,294	12,102/12,874	2,770	33.52/35.66
4-Axle Depressed Center Car			44.4	38.0	20.5		16,490		11,450	6,740	2,060	12.0
4-Axle 50-cu-m Tank Car of Welded and Riveted Construction, Built by Soviet Car Plants	1937-41	22.5 to 24.7	21.8 to 24.0	50.0	18.65/18.5	12,220	12,030		7,120	9,600	2,600	
4-Axle Welded Gondola Car, Built by Soviet Plants	1933	22.7	22.7	60.0	20.67	13,920	13,920		8,650	12,004	2,960	35.53
4-Axle Low-Side Coal Hopper Car	1932-33	21.0	21.0	50.0	17.75	10,030	10,030		5,810	8,740	3,080	
4-Axle Industrial Low-Side Ore Hopper Car	1933	17.1	17.1	70.0	21.78		7,300		4,350	5,900	3,114	
4-Axle Dump Car	1931	24.0		40.0	16.0	10,210			5,170	7,910	2,700	21.36
6-Axle Depressed Center Car		34.3		50.0	14.05	17,690			13,050	6,500	2,900	18.85
8-Axle Depressed Center Car	1934	43.5		70/80	15.45	22,652			14,300	7,000	3,000	21.0
12-Axle Depressed Center Car	1934	88.0		150.0	19.85	30,435			20,270	9,156	2,440	22.3

a. Numerator refers to cars having hand brakes; denominator refers to cars without hand brakes.

Table 37

Technological Specifications of Soviet Passenger Cars

Type	Year Built	Light Weight (mt) With Hand Brakes	Light Weight (mt) Without Hand Brakes	Capacity (mt)	Axle Load (mt)	Length over Buffers (mm) With Hand Brakes	Length over Buffers (mm) Without Hand Brakes	Distance between End Axles (mm)	Distance between Truck Centers (mm)	Length Inside (mm)	Width Inside (mm)
2-Axle 14-m Suburban Traffic Passenger Car, with Hard Seats	1925	21.5 to 24.0		9.0	15.25 to 16.5	15,160		8,200		14,000 a/	3,040
4-Axle 20.2-m Suburban Traffic Passenger Car, with Hard Seats	1928	45 to 48.5		12.24	14.31 to 15.19	21,390			13,970	20,200	2,980
4-Axle 20.2-m Long-Distance Passenger Car, with Hard Seats and Noncompartmented	1931	42 to 45.5		10.76	13.19 to 13.81	21,360			13,970	20,200	2,980
4-Axle 20.2-m Passenger Car, with Hard Seats and Compartments	1928	43.5 to 47		4.0	11.88 to 12.75	21,360			13,970	20,200	2,930
4-Axle 20-m First-Class Through-Traffic Coach	1928	53.5		2.02	13.88	21,190			14,000	20,030	2,950
4-Axle 20.2-m Through-Traffic Sleeping Car, First or Second Class	1928	54.64		2.24	14.22	21,360			13,970	20,200	2,900
4-Axle 20.2-m Baggage Car	1928	32.0		20.0	13.0	21,360			13,970	20,200	2,910
4-Axle 20-m Mail Car	1928	42.0		16.0	14.5	21,160			14,500	20,200	2,930

a. Length over vestibules.

Table 37

Technological Specifications of Soviet Passenger Cars
(Continued)

Type	Year Built	Light Weight (mt) With Hand Brakes	Light Weight (mt) Without Hand Brakes	Capacity (mt)	Axle Load (mt)	Length over Buffers (mm) With Hand Brakes	Length over Buffers (mm) Without Hand Brakes	Distance between End Axles (mm)	Distance between Truck Centers (mm)	Inside Length (mm)	Inside Width (mm)
4-Axle Electric Rail Motor Car	1928	58.0		10.0	17.0	20,010				19,130	3,304
4-Axle Trailer Car for Electric Motor Car Trains	1928	37.5		10.0	11.9	20,010				19,130	3,304

[redacted] 50X1-HUM

APPENDIX B

LIST OF PLANTS REPORTED AS PRODUCING LOCOMOTIVES AND/OR ROLLING STOCK IN THE USSR 235/

As explained in the text,* about 120 plants which have been reported as producing locomotives and/or rolling stock in the USSR have been studied, with a view to determining whether they were in fact producing plants during the period 1945-52. As a result, these plants have been broken down into four main categories, as follows: (1) plants definitely identified as producing plants; (2) plants reported but not definitely identified as producing plants, [redacted] 50X1 (3) plants definitely identified as either overhaul or repair shops which do not produce new units; and (4) other plants identified as producing parts for locomotives and/or rolling stock, maintenance units for the railroad system, or narrow-gage equipment for mining or other similar operations. It is felt that categories 1 and 2, below (as mentioned above), include all plants in the USSR engaged in production of new units, as well as a number of plants (in 2, below) which are merely engaged in overhaul or repair. Since the plants listed under categories 3 and 4, below (as mentioned above), do not fall within the scope of this report, no attempt has been made to make these particular lists complete, but they are presented here as a guide in evaluating other reports of production and as a guide for other studies pertaining to repair and parts plants. 50X1

The following is a list of plants located alphabetically by the name of the city.** The list is divided into four parts as mentioned above. In addition, the plants listed in 1 and 2, below, are grouped according to type of units produced.

* See Part I, Section IV, above.

** For maps showing the locations of locomotive and rolling stock plants in the USSR, see Figures 1 and 2, following p. 34, above.

[redacted] 50X1-HUM

[redacted] 50X1-HUM

1. Plants Definitely Identified as Producing Plants.

a. Steam Locomotive.

(1) Bezhitsa (VII).*

Proper Name: Krasnyy Profintern Railroad Locomotive Building Plant.

(2) Gor'kiy (VII).

Proper Name: Krasnoye Sormovo Plant imeni Zhdanov.

(3) Kolomna (VII).

Proper Name: Kuybyshev Railroad Locomotive Plant.

(4) Krasnoyarsk (XI).

Proper Name: Sibirskiy Heavy Machine Plant (also known as the Stalin Locomotive and Crane Plant).
Former Names: Krasmashstroy Railroad Equipment Plant.
Krasnyy Profintern Railroad Equipment Plant.
Onega Metallurgical Engineering Plant.
Krasnyy Profintern Machine Building Plant.

(5) Ulan-Ude (XI).

Descriptive Name: Railroad Locomotive Plant.

(6) Voroshilovgrad (III).

Proper Name: Voroshilovgrad Steam Locomotive Plant imeni October Revolution.

* Numbers in roman numerals following the names of cities refer to the economic regions defined and numbered [redacted], USSR: Economic Regions. 50X1-HUM 50X1-HUM

b. Electric Locomotive.

(7) Novocherkassk (IV).

Proper Name: Novocherkassk Electric Locomotive Plant imeni Budennyy.
Former Name: Kuchimovskiy Electric Locomotive Plant.

c. Diesel Locomotive.

(8) Khar'kov (III).

Proper Name: Khar'kov Transportation Machine Building Plant (KhZTM).
Former Names: Komintern Railroad Locomotive Plant.
Tank Plant No. 75.
Tank Plant No. 183.

d. Freight Car.

(9) Altayskoye (IX).

Proper Name: Pravda Railroad Car Plant.

(10) Bezhitsa (VII).

Same as (1).

(11) Dneprodzerzhinsk (III).

Proper Name: Railroad Car Construction Plant imeni Gazety Pravda.

(12) Engel's (also known as Saratov Engel's) (VI).

Proper Name: Railroad Car Building Plant imeni Uritskiy.

(13) Kalinin (VII).

Proper Name: Railroad Car Building Plant imeni Kalinin.

(14) Kaliningrad (II).

Proper Name: Kaliningrad Railroad Car Plant.
Former Name: Ludwig Steinfurth Railroad Car Plant.

(15) Kiev-Darnitsa (III).

Descriptive Name: Railroad Car Plant.

(16) Nizhniy Tagil (VIII).

Proper Name: Ural Railroad Car Plant imeni L.M. Kaganovich.
Former Names: Dzerzhinskiy Railroad Car Plant.
Stalin Railroad Car Plant.
International Railroad Car Plant.
Komintern Railroad Car Plant.

(17) Zhdanov (III).

Proper Name: Mariupol' Steel Plant imeni Il'ich.
Former Name: Kuybyshev Pipe Plant.

e. Passenger Car.

(18) Leningrad (I).

Proper Name: Railroad Car Building Plant imeni Yegorov.

(19) Mytishchi (VII).

Proper Name: Mytishchi Railroad Car Building Plant.

(20) Riga (II).

Proper Name: Riga Railroad Car Building Plant "Vayrogs."

f. Locomotive Tender.

(21) Saratov (VI).

Proper Name: Konus Railroad Equipment

2. Plants Reported but Not Definitely Identified as Producing Plants.

a. Steam Locomotive.

(22) Apsheronsk (IV).

Descriptive Name: Railroad Locomotive Plant.

(23) Asbest (VIII).

Proper Name: Novo-Stroika Railroad Locomotive Plant.

(24) Berezovka (XI).

Descriptive Name: Railroad Locomotive Plant. Repair shop (same as Stalin Locomotive and Crane Plant, Krasnoyarsk).

(25) Cherkassy (III).

Descriptive Name: Railroad Locomotive Plant, Electric.

(26) Chita (XI).

Proper Name: Voroshilov Railroad Equipment Repair Shop imeni Voroshilov.

(27) Golumet' (XI).

Descriptive Name: Railroad Locomotive Plant.

(28) Kemerovo (IX).

Descriptive Name: Railroad Locomotive Repair Shop.

(29) Michurinsk (VII).

Descriptive Name: Michurinsk Locomotive Repair Plant.

(30) Murom (VII).

Proper Name: Plant imeni Communist Party of France.
Former Name: French Communist Party Steel Plant.

(31) Nakhodka (XII).

Descriptive Name: Railroad Locomotive Repair Shop.

(32) Nizhniye Sergi (VIII).

Descriptive Name: Railroad Locomotive Plant.

(33) Novosibirsk (IX).

Descriptive Name: Railroad Locomotive Plant.

(34) Poltava (III)

Proper Name: Poltava Locomotive Repair Plant imeni Zhdanov.

(35) Rechitsa (II).

Descriptive Name: Railroad Locomotive Plant.

(36) Sukhaya Rechka (XII).

Descriptive Name: Railroad Locomotive Plant.

(37) Tuapse (IV).

Descriptive Name: Railroad Locomotive Plant.

(38) Zaporozh'ye (III).

Descriptive Name: Railroad Equipment Repair Shop.

b. Electric Locomotive.

(39) Kashira (VII).

Descriptive Name: Electric Locomotive Plant.

(40) Rostov (IV).

Descriptive Name: Railroad Electric Locomotive Plant.

(41) Troitsk (VIII).

Descriptive Name: Railroad Electric Locomotive Plant.

c. Freight Car.

(42) Gomel' (II).

Proper Name: Gomel' Railroad Car Repair Plant.
Former Name: Tormoznaya Masterskaya Railroad Car Repair Plant.

(43) Kramatorsk (III).

Proper Name: Lenin Tank Car Plant.

(44) Kremenchug (III).

Descriptive Name: Railroad Car Plant.

(45) Kryukov (III).

Proper Name: Kryukov Railroad Car Plant.

(46) L'vov (III).

Descriptive Name: Railroad Equipment Repair Shop.

(47) Michurinsk (VII).

(48) Murom (VII).

Same as (30).

(49) Rostov (IV).

Same as (40).

(50) Serov (VIII).

Descriptive Name: Railroad Car Plant.

(51) Tallin (II).

Proper Name: Dvigatel' Railroad Car Plant.

(52) Tambov (VII).

Proper Name: Tambov Railroad Locomotive and Car Repair Plant.

(53) Vil'nyus (II).

Proper Name: Vil'nyus Locomotive Repair Plant.

(54) Volkovysk (II).

Descriptive Name: Railroad Freight Car Plant.

(55) Voronezh (VII).

Proper Name: Otrozhka Railroad Car Repair Plant imeni Thaehlmann.

(56) Zhdanov (III).

Proper Name: Tank Plant imeni Lenin.

d. Passenger Car.

(57) Balashov (VI).

Proper Name: Oboz Transportation Equipment Plant.

(58) Kalinin (VII).

Same as (13).

(59) Kiev (III).

Descriptive Name: Railroad Car Plant.

Possibly the same as (15).

(60) Lianozovo (VII).

Proper Name: Lianozovo Railroad Car Building Plant.

(61) Sverdlovsk (VIII).

Proper Name: Voyevodin Railroad Car Plant.

(62) Voronezh (VII).

Same as (55).

3. Plants Definitely Identified as either Overhaul or Repair Shops.

(63) Alapayevsk (VIII).

Descriptive Name: Railroad Locomotive Repair Shop.

(64) Anzhero-Sudzhensk (IX).

Descriptive Name: Railroad Car Repair Shop.

(65) Baku (V).

Proper Name: Baku Railroad Car Repair Plant imeni October Revolution.

(66) Barnaul (IX).

Proper Name: BVRZ Railroad Car Repair Plant.

(67) Bologoye (VII).

Descriptive Name: Railroad Equipment Repair Shop.

(68) Borisoglebsk (VII).

Proper Name: Borisoglebsk Railroad Car Repair Plant.

(69) Chkalov (VIII).

Descriptive Name: Railroad Equipment Repair Shop.

(70) Chkalov (VIII).

Descriptive Name: Railroad Locomotive Repair Shop.

(71) Dnepropetrovsk (III).

Proper Name: Dnepropetrovsk Locomotive Repair Shop.
Former Name: Promparavoz Railroad Locomotive Plant.

(72) Dnepropetrovsk (III).

Proper Name: Mytishchensk Railroad Car Plant (Nizhnedneprovskiy imeni Kirov).

(73) Gryazi (VII).

Proper Name: Gryazi Railroad Car Repair Shop.

(74) Kagan (X).

Descriptive Name: Railroad Locomotive Repair Shop.

(75) Kaliningrad (II).

Descriptive Name: Railroad Car and Locomotive Repair Shops.

(76) Kirov (VII).

Descriptive Name: Railroad Equipment Repair Shop.

(77) Konotop (III).

Proper Name: Konotop Railroad Steam Locomotive and Car Repair Plant.

(78) Krivoy Rog (III).

Descriptive Name: Railroad Car Plant.

(79) Leningrad (I).

Proper Name: October Revolution Railroad Car Repair Plant imeni L.M. Kaganovich.

(80) Lisichansk (III).

Proper Name: Lisichansk Railroad Car Repair Plant imeni L.M. Kaganovich.

(81) Maksatikha (VII).

Proper Name: Krasnyy Kustar' Railroad Car Plant.

(82) Minsk (II).

Proper Name: Minsk Railroad Car Repair Plant imeni Myasnikov.
Former Name: "Plamya Revolyutsii" Railroad Car Plant.

(83) Moisakula (II).

Descriptive Name: Railroad Car Plant.

(84) Mogilev (II).

Descriptive Name: Railroad Equipment and Car Repair Shop.

(85) Nikolayev (III).

Descriptive Name: Railroad Equipment Repair Shop.

(86) Novorossiysk (IV).

Proper Name: VRZ (Railroad Car Repair Plant) imeni L.M. Kaganovich.

(87) Orsk (VIII).

Descriptive Name: Railroad Locomotive Plant.

(88) Popasnaya (III).

Proper Name: Popasnaya Railroad Car Repair Plant.

(89) Poti (V).

Proper Name: Locomotive and Railroad Car Repair Shops imeni Ordzhonikidze.

(90) Stalinsk (IX).

Descriptive Name: Railroad Locomotive and Car Plant.

(91) Stryy (III).

Descriptive Name: Railroad Car Repair Plant.

(92) Svir'stroy (I).

Descriptive Name: Railroad Car Plant.

(93) Syzran' (VI).

Descriptive Name: Railroad Locomotive Repair Shop.

(94) Tallin (II).

Proper Name: Tallin Plant No. 9.
Former Names: "Krull" Machine Building Plant.
Glavgaztopprom Machine Building Plant.
Punane Krull Machine Building Plant.
Thevis Machine Building Plant.
Veduriremontitehas Railroad Plant.

(95) Tapa (II).

Descriptive Name: Railroad Freight Car Plant.

(96) Tashkent (X).

Proper Name: Krasnyy Vostochnyy Railroad Equipment Repair Shop imeni L.M. Kaganovich.
Former Name: 1 May Railroad Equipment Repair Shop.

(97) Tayshet (XI).

Descriptive Name: Railroad Equipment Repair Shop.

(98) Tula (VII).

Descriptive Name: Railroad Locomotive Parts and .Repair Plant.

(99) Ufa (VIII).

Proper Name: Kuybyshev Railroad Locomotive Plant.

(100) Valga (II).

Descriptive Name: Railroad Car Plant.

(101) Voroshilov (XII).

Proper Name: 25 October Railroad Locomotive Plant.
Former Name: Voroshilov Ussuriyskiy Railroad Locomotive Plant.

(102) Yaroslavl' (VII).

Proper Name: Yaroslavl' Locomotive Repair Plant.

(103) Zaporozh'ye (III).

Descriptive Name: Railroad Equipment Repair Shop.

4. Other Plants.

(104) Alma-Ata (X).

Descriptive Name: Railroad Equipment Repair Plant.

(105) Kaluga (VII).

Proper Name: Kaluga Machine Building Plant.
Descriptive Name: Railroad Shunt and Mining Locomotive Plant.

(106) Kambarka (VIII).

Descriptive Name: Railroad Car Plant.

(107) Kolpino (I).

Proper Name: Izhorsk Works imeni Gor'kiy.
Former Names: Kuybyshev Steel Plant.
Zhdanov Steel Plant.

(108) Kulebaki (VII).

Proper Name: Kulebaki Metallurgical Plant imeni Kirov.

Descriptive Name: Railroad Wheel and Tire Plant.

(109) Kutaisi (V).

Proper Name: Gornyak Mining Equipment Plant.

(110) Leningrad (I).

Descriptive Name: Trolley Car Plant.

(111) Makkaveyevo (XI).

Descriptive Name: Railroad Locomotive Plant.

(112) Mamadysh (VII).

Descriptive Name: Railroad Shunt Locomotive Plant.

(113) Moscow (VII).

Proper Name: Moscow Order of Lenin and Order of Labor Red Banner Dynamo Works imeni Kirov.

(114) Novocherkassk (IV).

Proper Name: Osna Electric Locomotive Plant.
Descriptive Name: Railroad Mining Locomotive Plant.

(115) Odessa (III).

Proper Name: Odessa Plant imeni Yanvarskogo Vosstaniya (January Uprising).

(116) Podol'sk (VII).

Proper Name: Podol'sk Machine Building Plant imeni Ordzhonikidze.
Descriptive Name: Railroad Mining Locomotive Plant.

(117) Prokop'yevsk (IX).

Proper Name: Prokop'yevsk Mining Machinery Plant.
Former Name: Rudo Remont.

(118) Troitsk (VIII).

Descriptive Name: Railroad Electric Locomotive Plant.

(119) Ust'-Katav (VIII).

Proper Name: Railroad Car Plant imeni Kirov.
Descriptive Name: Trolley Car Plant.

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APPENDIX C

STATISTICAL COMPARISONS OF THE LOCOMOTIVE AND ROLLING STOCK INDUSTRIES IN THE US AND THE USSR

Some statistical comparisons of the locomotive and rolling stock industries in the US and the USSR are given in Table 38.* The statistics shown for the US are all from open sources and are unclassified. Those shown for the USSR are taken either directly from the text of this report or from statistics available in previously published intelligence summaries dealing with the Soviet railroads.

It will be noted from Table 38 that the Soviet locomotive inventory at the end of 1951 is nearly equal to that of the US at the same time. Examination of the table shows further, however, that if this inventory figure is multiplied by the average tractive effort per locomotive, then the US inventory becomes almost two times greater than the Soviet inventory in terms of total power available.

It should also be noted that, in terms of 4-axle units, the USSR is somewhat more efficient than the US in making use of available loading capacity in its freight cars. It is this fact plus a higher utilization rate that enables the USSR to move approximately one-half the total volume of freight that is moved annually in the US with only about one-fourth to one-third the freight car inventory of the US.

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* Table 38 follows on p. 218.

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Table 38

Statistical Comparisons of the Locomotive and Rolling Stock Industries in the US and the USSR

Year	Locomotive Inventory (Units)		Locomotive Production (Units)		Average Locomotive Tractive Effort (Lbs)		Freight Car Inventory (Thousand Units)		Freight Car Production (Thousand Units)		Average Load per Freight Car (Metric Tons)		Freight Traffic (Billion Ton-Kilometers)	
	US	USSR	US	USSR	US	USSR a/	US	USSR	US	USSR	US	USSR b/	US	USSR
1928	63,311	16,500	N.A.	540	43,838	26,000	2,347	238	N.A.	5.3	24.3	N.A.	638	93
1930	60,189	17,750	1,023	660	45,225	26,500	2,322	254	N.A.	9.7	24.3	N.A.	565	N.A.
1935	49,514	22,293	201	1,556	48,367	28,000	1,867	328	N.A.	42.8	23.7	N.A.	416	258
1940	44,333	25,954	501	937	50,905	29,600	1,684	419	62.3	25.0	25.1	33.2	550	415
1941	44,375	26,464	1,104	749	51,217	30,000	1,733	440	80.6	27.8	26.0	34.0	700	460
1945	46,253	25,741	2,845	12	53,217	31,000	1,787	398	43.9	0.9	29.3	33.0	1,000	314
1946	45,500	26,334	1,677	333	53,800	31,400	1,768	405	42.0	14.0	28.5	35.9	872	338
1947	44,344	26,999	2,884	965	54,507	31,700	1,739	425	68.5	27.1	N.A.	35.9	960	354
1948	39,764	28,134	3,152	1,495	55,189	32,000	1,731	455	112.8	39.0	30.0	36.50	938	450
1949	38,981	29,684	1,920	1,950	56,333	32,300	1,755	498	92.6	51.5	N.A.	37.0	760	525
1950	40,494	32,036	4,669	2,395	57,075	32,700	1,721	548	44.0	60.5	N.A.	36.7	850	532
1951	34,217	33,959	4,477	2,600	N.A.	33,000	1,751	595	96.0	65.5	N.A.	N.A.	935	N.A.

a. This figure is based on an assumption of a ratio of 4 freight locomotives to 1 passenger locomotive in the inventory and a straight-line extrapolation of estimates for 1910 and 1940.
b. Two 2-axle units are counted as one 4-axle unit.

APPENDIX D

METHODOLOGY

The primary purpose of this report has been to examine and to make estimates of the production of locomotives and rolling stock in the Soviet Bloc. Included as what might be termed necessary by-products of such a study are such items as organization, inputs, inventory, requirements, imports and exports, and current design and technology.

In general, the method has been strictly empirical.

the analysis in each section has been compared and integrated with all the other sections to eliminate any incompatibility between the various sections of the report.

In the case of production and inventory estimates, details of the methodology used for the USSR are presented in the text as an integral and essential part of the estimates, since only by reference to these methods can the graphic presentation of production and inventory estimates, shown in Part I, Section V, above, be understood fully (see Figs. 15, 16, and 17* and 23,** 24,*** and 25***).

Thus a production estimate issued by the Soviet

* Following pp. 54, 56, and 58, respectively, above.
** Following p. 78, above.
*** Following p. 84, above.

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By further reference to the 1947 Census, it was possible to determine prices per unit of weight or amount of the various items of input. Then, finally, by applying the indexes obtained above against the price per unit of weight or amount, a resulting index of amount of input required per unit of production of locomotive and rolling stock was obtained. These results are shown in Tables 39 and 40.*

* Table 39 follows on p. 223; Table 40, on p. 227.

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For purposes of estimating, the Soviet units of steam, diesel, and electric locomotives currently produced have been considered as being comparable, for input purposes, to units of these types produced in the US in 1947. A comparison of the gross weight of individual units of locomotives currently produced in the USSR and the average gross weight of units produced in the US in 1947 substantiates this assumption.

In the case of freight cars, the average US freight car is a 4-axle unit, and the inputs derived for these 4-axle units have been halved and listed as inputs per equivalent 2-axle unit.

In the case of passenger cars, lack of time in which to make a similar estimate by reference to the 1947 Census has resulted in making necessary the estimate of inputs to passenger cars on the basis of freight car inputs, using a suitable correction factor. The tare weights of passenger and 4-axle freight cars are in the ratio of approximately 2.5 to 1. Since the largest part of such cars is iron and steel in various forms, this ratio has been applied to all input items for freight cars to derive inputs to passenger car units. It is realized that this is not an accurate approximation, but since the number of passenger cars involved as compared with the number of freight cars is small, it is believed that the error introduced by using this approximation will not materially alter the inherent error involved in making input estimates by the method of analogy.

It should be noted that this so-called analogous method of making input estimates is subject to many sources of error and requires the estimator to make many assumptions. It is merely a first approximation of input estimates, which must be followed by estimates which have been made by other methods and combinations of methods. It is, however, a start toward the solution of input estimation problems.

Table 39

Soviet Items of Input per Unit of Production of Locomotives as Calculated from the US Census of Manufactures, 1947

Item	Units	US Input Factors from 1947 "Census"			Correction Factor	Soviet Input per Unit of Production			Remarks
		Steam	Electric	Diesel		Steam	Electric	Diesel	
Agriculture	mt	0.00164	0.00243	0.00174	none	0.00164	0.00243	0.00174	Includes cotton and rayon textiles.
Labor	man-years	9.1	13.5	9.65	1.5x a/*	13.65	19.50	14.50	
Steel (Raw) b/	mt	164.39	218.10	192.51	none	164.39	218.10	192.51	Includes raw steel equivalents of the following items: rolled steel, cast iron, cast steel, boiler shop products, sheet metal, lighting fixtures, steel springs, bolts and the like, fabricated metal, pumps and compressors, blowers and fans, valves and fittings, wiring devices, mechanical measuring instruments, power transmission equipment, mechanical stokers, measuring and dispensing pumps, machine shops, hardware, and internal combustion engines.
Aluminum	mt	0.59	0.87	0.62	none	0.59	0.87	0.62	
Copper	mt	2.12	3.19	2.27	none	2.12	3.19	2.27	Includes rolled and drawn copper and alloy castings.
Coal c/ (Bituminous)	mt	48.23	71.36	50.94	none	48.23	71.36	50.94	Includes anthracite and bituminous coal, natural and manufactured gases, and coke. All have been converted to equivalent tons of bituminous coal.
Electric Power	kwh	51,300	76,000	54,400	none	51,300	76,000	54,400	
POL (Fuel Oil) d/	mt	7.63	10.9	8.07	none	7.63	10.9	8.07	
Rubber	mt	0.21	0.315	0.225	none	0.21	0.315	0.225	
Paper and Paperboard	mt	0.0214	0.0314	0.0227	none	0.0214	0.0314	0.0227	
Plastics	mt	0.0334	0.0495	0.0353	none	0.0334	0.0495	0.0353	
Compressed and Liquefied Gases	thousand cu ft	4.28	6.3	4.53	none	4.28	6.3	4.53	
Flat Glass	sq ft	738	1,100	780	none	738	1,100	780	
Mineral Wool	mt	1.82	2.73	2.06	none	1.82	2.73	2.06	

* Footnotes for Table 39 follow on p. 225.

Table 39

Soviet Items of Input per Unit of Production of Locomotives as Calculated from the US Census of Manufactures, 1947
(Continued)

Item	Units	US Input Factors from 1947 "Census"			Correction Factor	Soviet Input per Unit of Production			Remarks
		Steam	Electric	Diesel		Steam	Electric	Diesel	
Asbestos	mt	0.30	0.44	0.32	none	0.30	0.44	0.32	Includes asbestos paper and asbestos gaskets.
Lumber	thousand bd ft	4.17	6.17	4.42	none	4.17	6.17	4.42	Includes products from sawmills and planing mills.
Unallocated	percent	14.65	14.65	14.65	none	14.65	14.65	14.65	Represents percentage of total investment of industry which cannot be allocated to particular industries.
Trucks	2-ton	0.0246	0.0365	0.0261	none	0.0246	0.0365	0.0261	
Railroad Locomotives	number	0.024	0.036	0.026	none	0.024	0.036	0.026	Represents yard-type switch locomotives.
Rolling Stock	2-axle units	0.057	0.085	0.061	none	0.057	0.085	0.061	
Motors and Generators	kw	110	1,800	1,410	none	110	1,800	1,410	
Antifriction Bearings e/	number	537	793	565	none	537	793	565	Represents equivalent bearings of standard unit size.
Capital Equipment (Not Elsewhere Counted)	mt raw steel	4.02	5.03	4.26	none	4.02	5.03	4.26	Represents raw steel input contained in the following items: cutting tools, hand tools, hand saws and blades, abrasive products, industrial furnaces and ovens, and general industrial machinery.

a. For the purpose of this estimate, it has been assumed that the USSR uses 1-1/2 times as much labor per unit of production as does the US. This assumption is based on the fact that reports indicate that the labor force in the USSR is less skilled and generally less efficient in its work organization.
b. The various items in this list have been converted to raw steel. This conversion is based on a factor of 1.39: that is, 1 ton of rolled steel equals 1.39 tons of raw steel.
c. All items in this table have been converted to equivalent tons of bituminous coal. Btu values of the items were taken as follows: anthracite coal, 15,100 btu per lb; bituminous coal, 14,400 btu per lb; coke, 11,800 btu per lb; natural gas, 1,150 btu per cu ft; manufactured gas, 600 btu per cu ft.
d. A conversion factor of 336 lbs per barrel was used to obtain the result in mt.
e. The number of antifriction bearings indicated here is the number of equivalent bearings of a standard size of 1 lb and a standard value of $1.50. The number of bearings used per unit is much fewer (on the order of 50 to 70 antifriction bearings per unit).

Table 40

Soviet Items of Input per Unit of Production of Rolling Stock as Calculated from the US Census of Manufactures, 1947

Item	Units	US Input Factor from 1947 "Census" for 4-Axle Freight Cars	Correction Factor a/	Soviet Input per Unit of Production of 2-Axle Rolling Stock Units	Remarks
Labor	man-years	0.339	0.75 b/	0.2543	
Steel (Raw) c/	mt	19.154	0.5	9.527	Includes raw steel equivalents of the following items: rolled steel, cast steel, forgings, hardware, heating and cooling apparatus, boiler shop products, metal stampings, lighting fixtures, steel springs, bolts, nuts, pumps and compressors, blowers and fans, power transmission equipment, refrigeration machinery, machine shop products, and railroad car parts.
Aluminum	mt	0.018	0.5	0.009	
Copper	mt	0.018	0.5	0.009	Includes rolled and drawn copper and alloy castings.
Zinc	mt	0.024	0.5	0.012	
Coal d/ (Bituminous)	mt	2.544	0.5	1.272	Includes anthracite and bituminous coal, natural and manufactured gases, and coke. All have been converted to equivalent mt of bituminous coal.
Electric Power	kwh	1,720.0	0.5	860	
POL (Fuel Oil) e/	mt	0.410	0.5	0.205	
Rubber	mt	0.0036	0.5	0.0018	
Mineral Wool	mt	0.062	0.5	0.031	
Asbestos	mt	0.002	0.5	0.001	
Lumber	bd ft	880	0.5	440	Includes products from sawmills and planing mills.
Plywood	sq ft	3,060	0.5	1,530	3/8-inch-thick sheets.
Unallocated	percentage of value	16.1	none	16.1	Represents percentage of total investment of industry which cannot be allocated to particular industries.
Antifriction Bearings f/	number	12.6	0.5	6.3	Represents equivalent bearings of standard unit size.
Capital Equipment (Not Elsewhere Counted)	mt raw steel	0.098	0.5	0.049	Represents raw steel input contained in the following items: cutting tools, hand tools, and hand saws and blades.

a. A constant correction factor of 0.5 has been used to convert from a 4-axle freight car to a 2-axle rolling stock unit.
b. For the purposes of this estimate, it has been assumed that the USSR uses 1-1/2 times as much labor per unit of production as does the US. This assumption is based on the fact that reports indicate that the labor force in the USSR is less skilled and generally less efficient in its work organization.
c. The various items in this list have been converted to raw steel. The factors used were: rolled steel, 1.39; forged steel, 1.76; and castings, 1.08.
d. All items in this table have been converted to equivalent tons of bituminous coal. Btu values of the items were taken as follows: anthracite coal, 15,100 btu per lb; bituminous coal, 14,400 btu per lb; coke, 11,800 btu per lb; natural gas, 1,150 btu per cu ft; manufactured gas, 600 btu per cu ft.
e. A conversion factor of 336 lbs per barrel was used to obtain the result in mt.
f. The number of antifriction bearings indicated here is the number of equivalent bearings of a standard size of 1 lb and a standard value of $1.50.

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