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SECURITY INFORMATION

CENTRAL INTELLIGENCE AGENCY 33

OFFICE OF RESEARCH AND REPORTS

PROVISIONAL REPORT NO. 8
(CIA/RR PROJECT 38-51)

INPUT REQUIREMENTS OF THE AIRCRAFT INDUSTRY OF THE USSR

29 October 1951

Note

This report is a working paper. The data and conclusions contained herein do not necessarily represent the final position of ORR and should be regarded as provisional only and subject to revision. Additional data or comment which may be available to the user is solicited. This report contains information available to ORR as of 15 October 1951.

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SECURITY INFORMATION

I. Special Classification of Certain Sections.

The following sections are specially classified

"PROPRIETARY INFORMATION-CONFIDENTIAL":

1. III B, p. 16: weights listed for the F-86E in the table, "Comparison of the Materials Input Requirements of the USAF F-86E and the Soviet MIG-15"

2. III C, p. 17: table, "Airframe Bill of Selected Materials for the B-29"

3. III D, p. 18: 1st table, "Airframe and Bills of Materials Weights of Selected US Aircraft"

4. IV C, p. 28: last sentence of 3d paragraph and C1 through 6 (pp. 28-30)

5. V L, p. 48: L1 through 4 and L6 (pp. 48-49)

25X1A 6. Figure 15, following p. 49

[redacted]

II. Textual Changes.

1. List of Illustrations in Table of Contents, Figure 6, line 2: for Board read Bureau

2. II B, 2d par. beginning on p. 6, line 6: for Board read Bureau

3. Heading of Figure 6, following p. 10, line 2: for Board read Bureau

4. III B, p. 16, 3d par., line 2: for two Soviet MIG-15's in question: read the Soviet MIG-15:

5. III B, p. 16, footnote c to table, line 1: delete Crashed aircraft, sight unseen; and for based read Based

6. Figure 10, Map, following p. 16: delete the plant shown on the Kamchatka Peninsula.

7. IV A, p. 21, 4th par.: for centrifugal-blow read centrifugal-flow

8. IV D, p. 31, line 2: for Board read Bureau

9. V C, p. 35, line 3: for is no read may be some

10. Appendix A, p. 54, line 4: for Board read Bureau

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SECURITY INFORMATION

CENTRAL INTELLIGENCE AGENCY

OFFICE OF RESEARCH AND REPORTS

PROVISIONAL REPORT NO. 8
(CIA/RR PROJECT 38-51)

INPUT REQUIREMENTS OF THE AIRCRAFT INDUSTRY OF THE USSR

1. Notice regarding Special Classification of Certain Sections

2. Textual Changes

13 December 1951

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INPUT REQUIREMENTS OF THE AIRCRAFT INDUSTRY OF THE USSR

FOREWORD

This report is a provisional working paper which has been issued as a preliminary survey of the information available on a continuing project: namely, to estimate on a detailed basis the input requirements of the Soviet aircraft industry. These estimates will be derived from information on the total input requirements of the Soviet economy in relation to Soviet resources and will cover manpower, materials, technology and equipment, and economic services.

As a provisional working paper, this report does not provide the estimates toward which the continuing project is directed. The principal purpose of this paper is to provide a preliminary exposition of research to date on this problem to serve as a basis for discussion so that those persons having knowledge of the industry who might be of assistance will be aware of the problem. They may assist in its best solution by suggesting further avenues for investigation or, in the case of intelligence personnel, furnish some of the information required.

In Section II, "Methodology," an attempt is made to set forth the various formulas which can be used in estimating the output of the aircraft industry, from which in turn the input requirements can be estimated. These formulas for estimating production fall into three broad patterns: (a) the rough index, estimating the capacity of a country to produce aircraft from a ratio of aircraft produced per year per million of population; (b) the semidetailed approach, applying to information on the floor area of factories a formula giving pounds of aircraft per month per square foot of floor area or applying to employment data an estimate of pounds per month per direct worker; and (c) the detailed approach, estimating output from information available on all of the factors involved in production. Various means of cross-checking the accuracy of production estimates arrived at by these several formulas also are outlined. This paper does not, however, attempt to evaluate the various methods or to indicate which combination would probably provide the most satisfactory data for CIA objectives.

Section III, "Materials Input Requirements of the Soviet Airframe Industry," gives a comparison of the materials input requirements of two captured Soviet MIG-15 jet fighters and of similar US aircraft and of a Soviet bomber, probably similar to the B-29. If the applicability of such requirements to the Soviet aircraft industry as a whole can be determined, a basis on which to estimate the raw materials input requirements of the industry will be established. No attempt is made to estimate requirements for a variety of Soviet aircraft.

In Section IV, "Materials Input Requirements of the Soviet Aircraft Engine Industry," the discussion is confined principally to an analysis of the requirements of two types of Soviet centrifugal-flow turbojet engines, parts of which have been available for examination, and of one US reciprocating engine which is believed to be the model for the major Soviet engine of this type.

Section V, "Manpower Input Requirements of the Soviet Aircraft Industry," discusses broadly the situation of labor in the industry, the available labor supply, government controls, labor relations, welfare and morale, skill and training of workers, pay system, etc., as general background for the specific problem of estimating from man-hours input the specific rates of production of various types of aircraft. Definite estimates of this kind will be part of the continuing project to determine Soviet input requirements. The only estimates of man-hours given in this paper are limited to some statistics on US aircraft, which can be used in working out comparative estimates.

Section VI, "Provisional Field Collection Requirements," outlines some of the more urgent requirements for the collection of specific information in the field.

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CONTENTS

APPENDIXES

ILLUSTRATIONS

With few exceptions, footnote references which are found in the text that follows in Parts II through V are numbered consecutively in arabic numerals for each Part. The footnotes themselves, labeled Sources, are listed in the final section of each Part. In much of the discussion of Part II the footnotes are referred to as Sources with appropriate references (such as Source 15, Source 16, etc.). Explanatory footnotes, indicated by asterisks (or, in tables, by lower-case letters), are given on the page in the text where the reference occurs.

The over-all classification of this report is Top Secret. Appendix D and cer[tain illustrations ...]ated.

INPUT REQUIREMENTS OF THE AIRCRAFT INDUSTRY OF THE USSR

I. Introduction.

A. Problem.

To set forth in detail the input requirements essential to the production of aircraft and aircraft engines by the USSR as derived from information on over-all Soviet economic input requirements in relation to Soviet resources, including manpower, materials, machines and methods, and economic services.

B. Purpose.

To establish:

1. Possible upper limits to input requirements of the Soviet aircraft industry, assuming that lower limits are provided by air order-of-battle intelligence.

2. Soviet input capabilities and vulnerabilities applying to the aircraft industry in the USSR.

3. Gaps in present information on these input requirements that may be filled through possibly new, and certainly improved, field collection requirements.

4. An improved intelligence methodology applicable to the Soviet aircraft industry.

5. The impact of input requirements of Soviet aircraft industry on affected areas of the over-all Soviet economy.

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II. Methodology.

A. Introduction.

This study of methodology is not a finished product on the methodology applicable to the analysis of an aircraft industry. It is merely a progress report or a first approximation. It attempts to outline the problem and to set forth present knowledge and deficiencies. Although applicable to the aircraft industry of any country, the following methodology is set forth with particular reference to the aircraft industry of the USSR.

B. Coarse-through-Detailed Approaches.

1. Rough Index.

A rough index of productivity is the ratio of aircraft produced per year per million of population. Data for the US, the UK, Germany, Italy, and France (during World War I and World War II) are shown in the following tables (see plotted data, Fig. 1):

World War I

Country	Population	Maximum Production Rate	Index
US	102,962,000 1/	25,000 per year 2/	243
Germany	67,800,000 3/	13,240 per year 4/ 5/	204 a/
Italy	36,700,000 3/	6,840 per year 6/	186
France	40,000,000 3/	31,000 per year 2/	776
UK	42,000,000 b/ 3/	41,400 per year 7/	985

a/ If the trend had continued to 1919, this figure would be 530.
b/ England, Scotland, and Wales.

World War II

Country	Population	Maximum Rate	Index
US	120,000,000 3/	109,404 per year 8/	912 a/
Germany	86,690,000 3/	50,400 per year 9/	582
Italy	45,700,000 3/	Being obtained 10/	Being obtained
France	41,700,000 3/	9,600 per year	230
UK	48,000,000 11/	28,800 per year 12/	600
USSR	200,000,000	43,200 to 53,700 per year 13/	216 to 268
Japan	72,700,000 3/	31,200 per year 14/	429

a/ Planned production was 1,260 aircraft per year per million population.
b/ Planned production was 970 aircraft per year per million population.

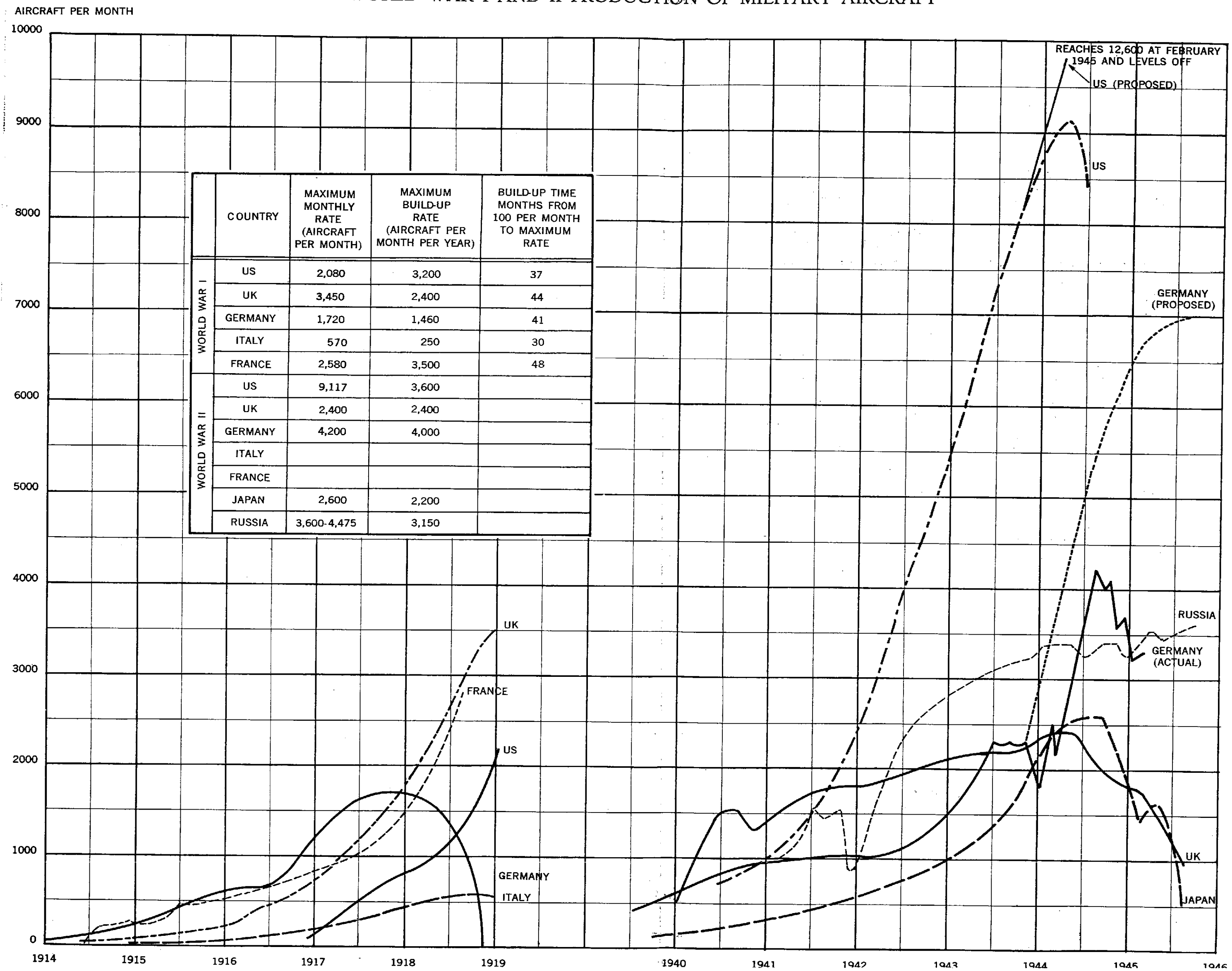
The following conclusions can be drawn from the above tables:

a. The probable upper limit of production is about 1,000 aircraft per year per million of population. This has been reached by the highly industrialized countries, the US, the UK, and Germany.

b. The rate of build-up to the upper limit cannot be much greater than 4,000 aircraft per month in 1 year. In other words, to reach 8,000 aircraft per month, starting from zero, it would take at least 2 years for the most highly organized industrial countries.

c. Examination of UK and USSR curves for World War II (Fig. 1) shows a flattening at the top of the curve. Mathematical investigation proves the suspicion that these lines are the result of an "80-percent law" (see below) at

WORLD WAR I AND II PRODUCTION OF MILITARY AIRCRAFT



	COUNTRY	MAXIMUM MONTHLY RATE (AIRCRAFT PER MONTH)	MAXIMUM BUILD-UP RATE (AIRCRAFT PER MONTH PER YEAR)	BUILD-UP TIME MONTHS FROM 100 PER MONTH TO MAXIMUM RATE
WORLD WAR I	US	2,080	3,200	37
	UK	3,450	2,400	44
	GERMANY	1,720	1,460	41
	ITALY	570	250	30
	FRANCE	2,580	3,500	48
WORLD WAR II	US	9,117	3,600	
	UK	2,400	2,400	
	GERMANY	4,200	4,000	
	ITALY			
	FRANCE			
	JAPAN	2,600	2,200	
	RUSSIA	3,600-4,475	3,150	

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FIGURE 1

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work. In other words, both countries had reached a peak of production. This peak may have been planned or it may have been the maximum capacity. The UK line may have been held down by bombing. This matter could be pursued further.

d. The rapidity of recovery from bombing, as indicated by the German World War II curve, is evident.

e. Other possible indexes should be explored. The rate of build-up shown by the curve of Figure 1 should be further investigated.

2. Semidetailed Approaches.

a. Pounds per Month per Square Foot of Floor Area (Fig. 2).

This method has been examined in Source 15, which assumes that floor space, airframe weight, and date of start of production are known.

(1) In Source 15 a "build-up" curve is arrived at statistically and assigned a "degree of confidence." It would seem desirable to pursue this further in an effort to ascertain the engineering reasons for the spread. Source 16 mentions that for 86 World War II factories in the US, the UK, Germany, and Japan a build-up time of from 12 to 18 months is found. This is substantiated by Source 17, and the curve may be fitted by the Gompertz curve, $y = ka^{bx}$, or preferably the Pearl-Reed curve, $y = k/(1 + e^{a + bx})$. In the Pearl-Reed curve (also known as "logistics" or "population growth" curves), "b" controls the steepness of the curve, and "a" shifts it sideways. The index $B = 1/b$ is suggested, and it is stated that for the UK "B" averages 5.73, varying from 4 to 8.5. For the US, "B" averages 4.79, varying between 2 and 9.5. The German "B" was 3.57, varying between 2.5 and 5.5. Obviously, a low "B" value, or rapid build-up, is desirable. (In the above equations,

y = Aircraft per month,
x = Number of months,
k = Peak number of aircraft per month.)

Correlation should be sought between these values and those for the build-up in Figure 1.

(2) In Source 15 the figure of pounds per square foot per month is likewise handled statistically. Floor spaces will vary according to their contents. Source 18 mentions that, out of a total of 58 aircraft plants, 15 have a foundry, 4 perform diecasting, 8 perform forging, 24 have electroplating facilities, 9 have galvanizing facilities, 33 have heat-treating equipment, 15 use automatic screw machines, 51 have machine shops, 35 have tool and die rooms, 23 have a pattern shop, 32 perform plate or structural fabrication, and 43 perform stamping, blanking, forming, and drawing. In Source 19, ratios of production floor space to total floor space are given as follows: final assembly, 58 percent; metal fabricating, 55 percent; and subassembly, 45 percent (for no subcontracting). ?

Source 20 gives 41 percent, 24 percent, and 35 percent, respectively, as the distribution of the total area for the same functions. Source 21 cites, as general standards for office space, the following:

	Square Feet
Executives	300
Department Head	150 to 250
Division Head, Chief Clerk, etc.	75
Stenographer-secretary	50
Clerical Work	40 to 50

From Source 22 the figure of 150 to 200 square feet of floor area per person is given. A further breakdown in the case of World War II UK plants is as follows:

Correction

The following document has been rephotographed to ensure readibility.

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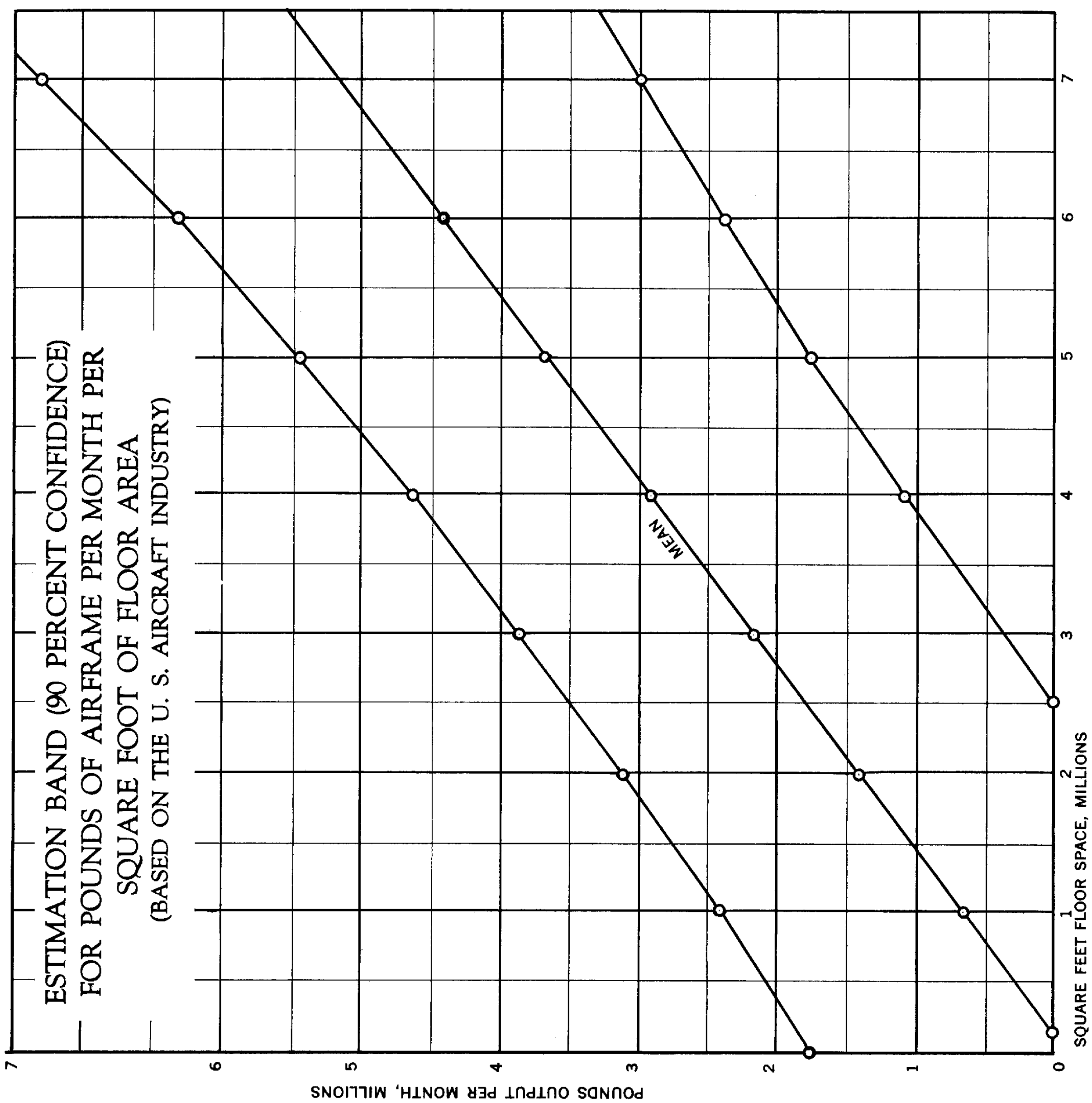
FIGURE 2



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	Percent
Stores	12 to 16
Subassembly	20 to 25
Detail Fabrication	18 to 20
Erection and Flight	15 to 25
Offices, Services, etc.	14 to 35

Source 13 indicates that the floor area per person in Germany was 70 to 230 square feet, with an average of 140 square feet in important plants, and in 20 US plants from 80 to 194 square feet, with an average of 130 square feet.

Source 17 for 22 plants quotes values at from 0.36 pound to 1.35 pounds per square foot per month, with an average of 0.66 pound. A similar spread is reported in Source 15. The variation of output is great, some of the reasons being as follows:

(a) The number of shifts must be explored from the point of view of US industrial figures and from the CIA Industrial Register. The data on the US could not be correlated in Source 23. A method for making allowances for this factor must be developed. Source 13 employs a factor depending on shift-hours and number of shifts and is essentially a sum of the ratios of the shift-hours to the main shift.

(b) The degree of subcontracting in the USSR as compared with the US must be ascertained in order to provide facts upon which a correction to US data may be based. Then a method of correction must be selected. Source 24 uses a method for calculating employee allowances for subcontracting, which might be adopted and refined for floor areas. This method is based on the assumptions that the labor force can be divided into three segments (direct factory, indirect factory, and administrative), that the number of administrative workers is independent of the degree of subcontracting, that the number of direct factory workers is directly proportionate to the amount of subcontracting, and that only half of the number of indirect factory workers varies with subcontracting. Source 19 presents some curves on the percentage of area utilized for various operations, as a function of subcontracting (Fig. 3). The source of these curves should be sought in order to determine a degree of confidence for them. The method used in Source 13 should be ascertained and evaluated.

(c) Spare parts built must be checked for the USSR as compared with the US, and allowances must be worked out. It is mentioned in Source 20 that some plant departments may build no spare parts, while others build more than their share.

(d) Methods of assembly and their effects should be investigated. Source 25 mentions that aircraft in which the wing and fuselage are mated in the last step require less floor area than those in which this assembly is made earlier.

(e) Rejects will have an effect and should be checked. Source 26 mentions an over-all rejection rate of 20 percent for the USSR. Source 27 indicates that US practice is to limit rejects to from 3 to 4 percent for sheet metal parts, 5 percent for machined parts, and 5 percent for pressed and hammered parts.

(f) The degree of inspection can have about 10 percent effect on production per given area, according to Source 27. There are some indications of poor inspection in the USSR plants 26/ and contrary indications of rigid inspection. 28/

(g) Storage space has been considered important in view of poor USSR transport facilities, 13/ but there are indications that US plants need up to 90 days' storage space available for raw materials because of the quarterly allotment system. 27/

(h) With regard to materials of construction, Sources 27 and 28 indicate that Soviet use of 24 ST aluminum alloy may permit fighters to be produced from 5 to 7 percent faster than US aircraft, which are constructed of the

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3. III D, p. 18: 1st table, "Airframe and Bills of Materials Weights of Selected US Aircraft"

4. IV C, p. 28: last sentence of 3d paragraph and C1 through 6 (pp. 28-30)

5. V L, p. 48: L1 through 4 and L6 (pp. 48-49)

25X1A

6. Figure 15, following p. 49

[redacted]

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6. Figure 10, Map, following p. 16: delete the plant shown on the Kamchatka Peninsula.

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9. V C, p. 35, line 3: for is no read may be some

10. Appendix A, p. 54, line 4: for Board read Bureau

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EFFECT OF SUBCONTRACTING ON FLOOR AREA
(BASED ON THE U. S. AIRCRAFT INDUSTRY)

FIGURE 3

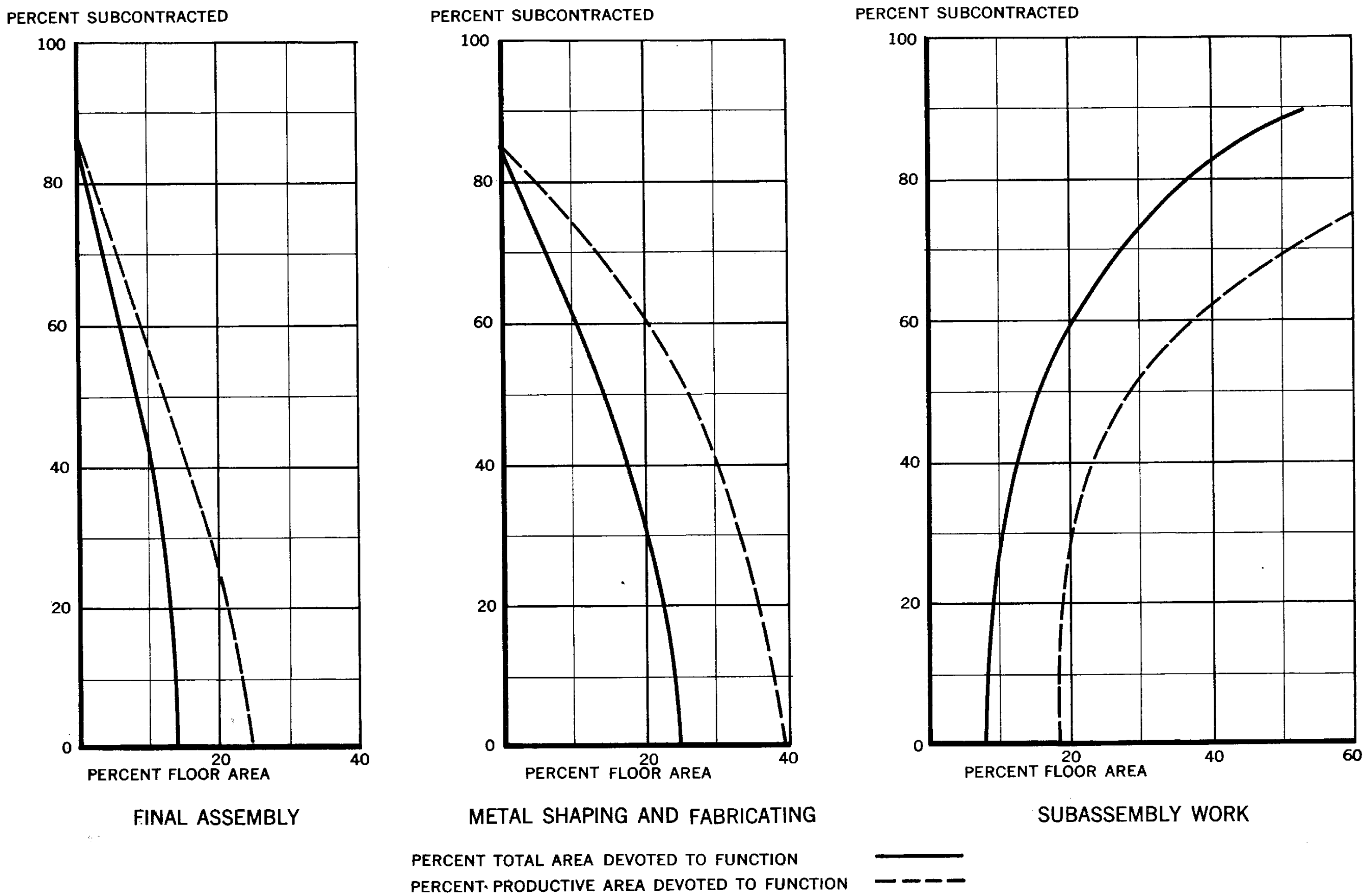

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FIGURE 3

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37 indicates that even for relatively simple functions, such as telegraphy, touch typing, or mirror drawing, the practice curve likewise exhibits a type of "80-percent trend," without change of equipment or methods. Source 24 points out that, as a manpower shortage comes into existence, unskilled labor is used, and the slope of the line may actually reverse. "Labor flow time" is considered: for instance, parts built in April may be used in an aircraft that may not be completed until June, but final assembly work done in June can be counted in June deliveries. Therefore, 3-month averages are used. The index for October would use employment and subcontracting as of August, with average acceptances for August, September, and October. Source 27 indicates a flow time of from 60 to 70 days in the US.

(4) The assumption of airframe weight being available has been made. Evidence points to general employment of an arbitrary percentage of gross weight. There is no evidence as to how gross weight is determined. Figure 4 indicates the possible spread of ratios of airframe to gross weights. Examination of the MIG-15 28/ seems to indicate that previous airframe weight estimates may be as much as 20 percent off. This means a 20-percent error in production estimates. It would seem possible to isolate parameters affecting airframe weight. This has been tried in Sources 38, 39, 40, 41, 42, 43, and 44. Source 43 gives generalized data with information for predicting degree of confidence. In most cases, it has been found necessary to know the gross weight and design load factors, as well as the physical dimensions — sometimes quite detailed — of the aircraft. Source 45 is an effort to generalize the weight problem but is not very successful. Most design offices have their own methods of estimating weight. This problem requires investigation to provide a reasonably accurate method which will employ available parameters.

(5) The assumption is made that floor space is known. Source 13 quotes many floor spaces, without documentation or source. There is old photographic coverage available for a limited number of plants. There are also Industrial Register reports on other plants, but it is extremely difficult to determine from many conflicting reports just what each plant looks like. [redacted] A study of Industrial Register data is being made to ascertain floor area and, if possible, to determine what is on the floors. Concurrently, US data of similar nature are being obtained. 25/

25X1C

25X1C

25X1C

b. Pounds per Month per Direct Worker.

Pounds per month per direct worker (Fig. 5) is a second possible semidetailed method of attack. The main question in this method is the determination of the number of direct workers and the total number of workers in the Soviet aircraft industry and to establish the ratio between the direct and the total workers. In order to solve this, there is considerable information available. However, the data does not plot smoothly, and some method should be found to pull the plotted points together. Source 46, for example, gives the following data for all Soviet manufacturing industries:

	1928	1932	1934	1936	1937	1942
Days per Year of Absenteeism		5.96	0.67		1.05	
Percentage of Direct to Total Workers	85.7			78.8		77.2

Vacations averaged 14 days per year in peacetime. Source 26 mentions vacations in the aircraft industry to be 12 days per year plus 2 days for each 5 years of service. Source 47 gives some evidence in the following table of the ratio of direct to total workers in the Soviet aircraft industry:

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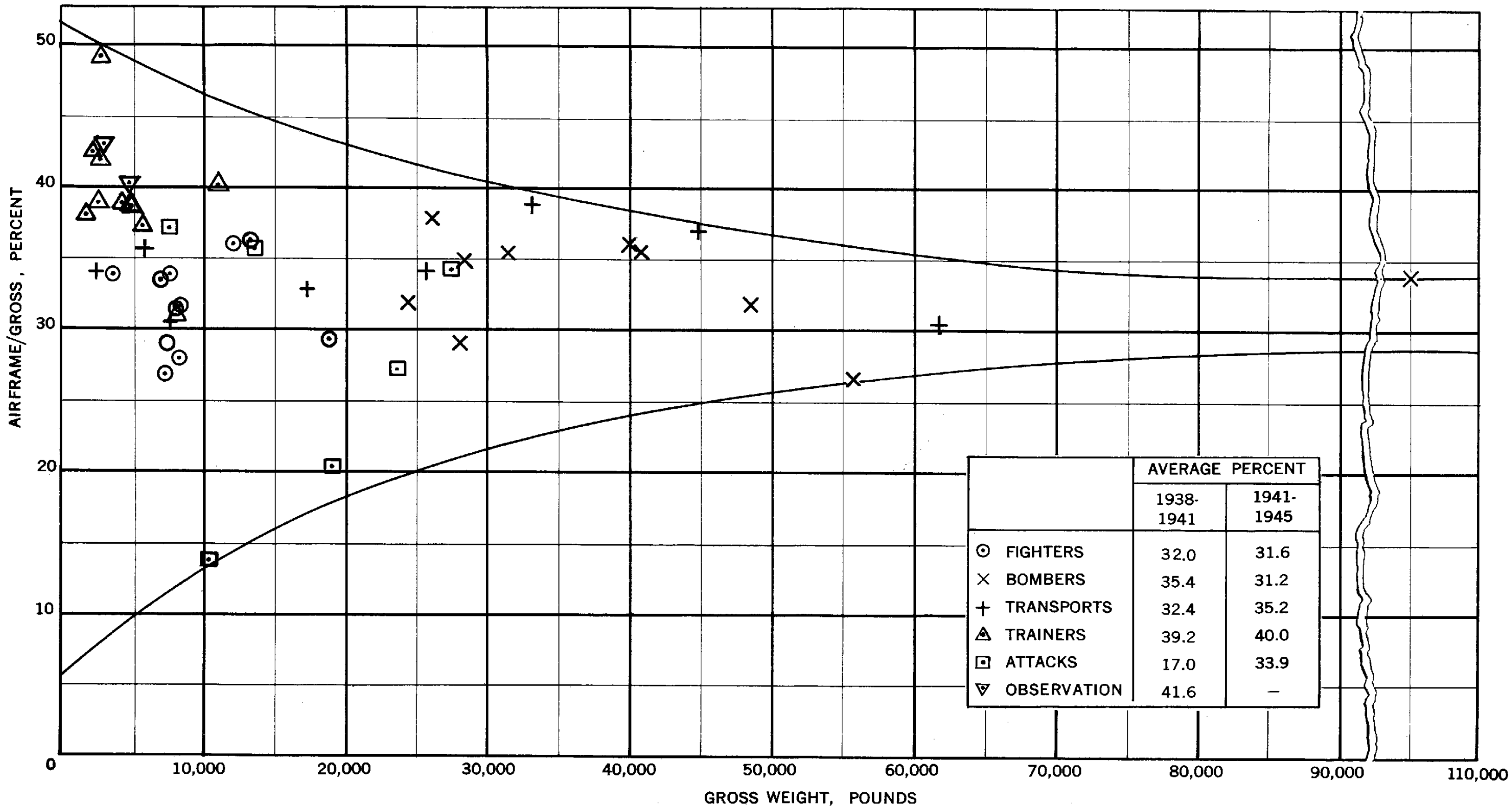
RELATION BETWEEN AIRFRAME AND GROSS WEIGHT USAF AIRCRAFT 1938-1945

(ATSC-TR-4399)

FIGURE 4



	AVERAGE PERCENT 1938-1941	AVERAGE PERCENT 1941-1945
⊙ FIGHTERS	32.0	31.6
× BOMBERS	35.4	31.2
+ TRANSPORTS	32.4	35.2
◬ TRAINERS	39.2	40.0
⊡ ATTACKS	17.0	33.9
▽ OBSERVATION	41.6	–

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FIGURE 5

PRODUCTIVITY VERSUS AIRFRAME WEIGHT

(BASED ON THE U. S. AIRCRAFT INDUSTRY) (Department of Labor Bulletin No. 80)

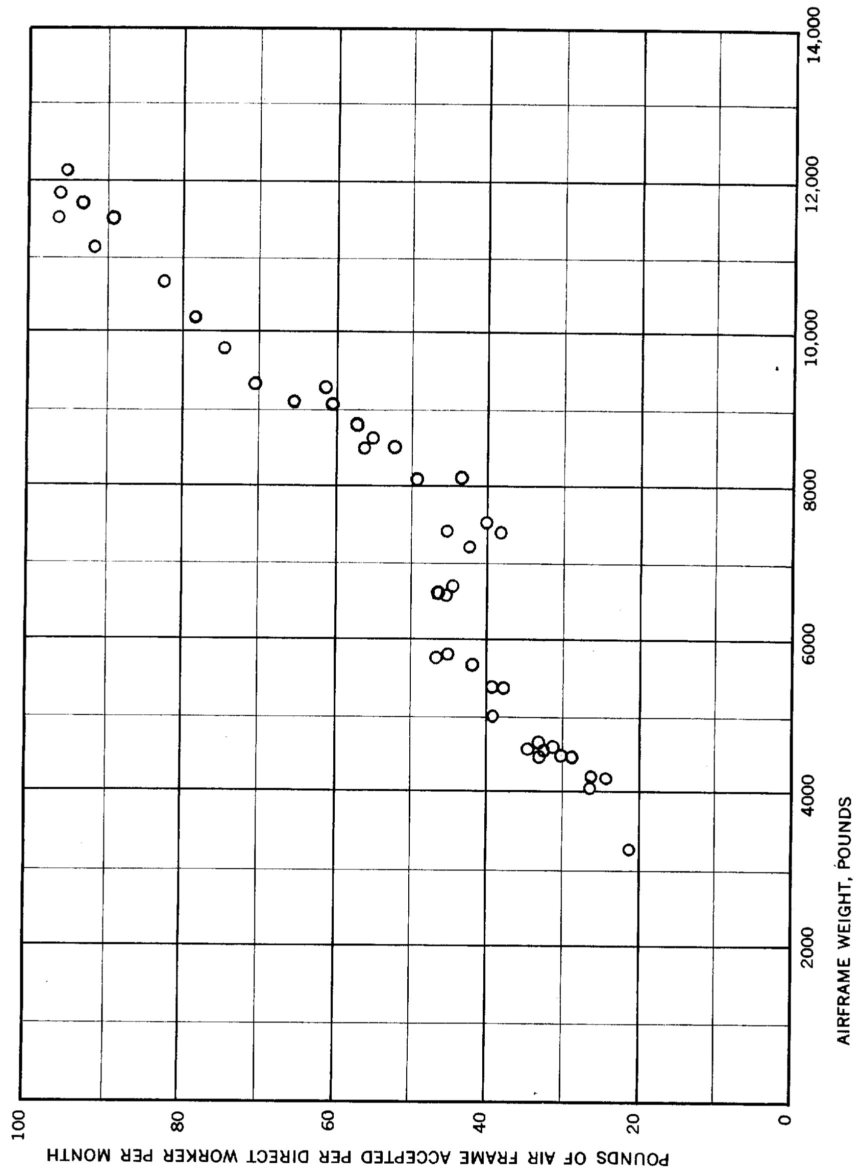

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FIGURE 5

Distribution of Workers in the Soviet Aircraft Industry

- Percent

	Piecework Pay					Annual Pay		
	8	34		48		10		
Type of Work	1. Unskilled	2. Laborers	3. Partly Qualified Laborers	4. Not Completely Qualified	5. Completely Qualified	6. Outstanding	7. Specialized	8. Inspectors, Set-up Men, etc.
Flight Test	0	0	0	25	25	35	15	0
Assembly	0	20	20	20	30	10	0	0
Assembly Rivet	N.A.	25	30	20	15	5	N.A.	N.A.
Fitting and Welding	0	10	23	35	20	10	2	0
Sheet Metal	N.A.	15	20	20	30	10	N.A.	N.A.
Machine Shop	0	10	30	30	18	10	2 (?)	0

Source 48 gives some evidence of the ratio of direct to indirect workers in the US aircraft industry as shown in the following table:

Distribution of Workers in the US Aircraft Industry

	Grades of Workers									
	1	2	3	4	5	6	7	8	9	10
Percent of Total	1.4	1.2	2.8	4.7	2.3	8.5	21	12.1	32.6	13.4
Rough Equivalent USSR Grade Number a/	8	7	6	5	5	4	4	4	3	3
Approximate US Percentage in USSR Grade		5.4				48.6			46	

a/ Determined by inspection.

The indications are that the US has a lower concentration in the skilled brackets than does the USSR. This conclusion is dependent on the accuracy in comparing US and USSR grades. British practice is indicated in Source 22 and can be cross-plotted as follows for comparison against USSR data 57/:

Distribution of Workers in the UK Aircraft Industry

					Percent
Man-hours	Detail Fabrication	Machining	Structural Assembly	Installations	Erection
UK	25 to 30	10 to 14	30 to 35	15 to 20	5 to 12
USSR	31.8	16.5	20.6	13.4	17.7

Source 18 shows as follows the percentage of the production workers in the entire US economy as compared with similar data during certain periods in the USSR. (Check against Source 46.)

Percent of Production Workers in the US and USSR Economics

	1899	1904	1909	1914	1919	1921	1923	1925	1927	1928
US	90	21.5	89.4	87.9	86	85.7	86.4	86.2	86.4	
USSR										85.7

	1929	1931	1933	1935	1936	1937	1939	1942	1947
US	86.6	N.A.	88.1	87.3		87.6	82		83.4
USSR					78.8			77.2	

It may be possible to combine the above figures with US aircraft industry ratios of direct to indirect labor in order to arrive at a figure for the USSR. It is interesting to note from Source 8 that the aircraft engine industry employs about 30 percent as many people as the aircraft industry.

c. Additional Indexes.

Additional indexes may be pertinent. "Pound of airframe per month per ton of machine tools," as indicated in Source 49, and "pound of airframe per 1000 kilowatt-hours" are two possibilities. These indices incidentally would be of direct use to other Branches of the Industrial Division, CRR.

Source 22 indicates that 20 percent of UK World War II machine work was drilling; 22 percent, milling and profiling; 53 percent, turning; and 5 percent, grinding and miscellaneous. Types of machines used were shears; circle cutters; nibblers; router cutters; punch and rubber-platen presses; presses using wood, cast iron, zinc, or concrete dies, sheet-stretching machines; rolling, drawing, and extruding mills and presses; pipe benders; pneumatic, explosive, gang, and automatic reveters; and spot and electric welders.

Source 18 mentions the use in the US aircraft industry of fuels as shown in the following table:

Use of Fuels in the US Aircraft Industry

Item	Quantity	Assumed Heating Value	Million BTU Equivalent
Tons of Bituminous Coal	77,000	13,000 BTU per Pound	2,002,000
Barrels of Fuel Oil	415,000	125,000 BTU per Gallon	2,176,000
Cubic Feet of Natural Gas	2,426,000,000	1,000 BTU per Cubic Foot	2,426,000
Cubic Feet of Manufactured Gas	349,000,000	500 BTU per Cubic Foot	174,500
Kilowatt-hours	611,000,000	3,412 BTU per Kilowatt-hour	2,084,732
Total			8,863,232

These fuels were consumed in 1947 to produce the following aircraft:

Type of Aircraft	Quantity	Pounds of Airframe
Military	2,100	11,402,000
Civil, Two-place	7,534	4,140,000
Civil, Three-to-five-place	8,057	7,344,000
Civil, over Five-place	279	6,452,000
Total	17,970	29,338,000

Assuming 2,000 pounds per ton and 42 gallons per barrel of fuel, applying average heating values, totaling the BTU, and equating to total airframe weight, there were 302,100 BTU required per pound of airframe produced in the US in 1947. Obviously, more work is needed on this subject of using fuel consumption of the aircraft industry as a basis for estimating production. Source 50 and its references might be a good starting point.

3. Detailed Approaches.

a. An equation expressing monthly output 13/ has been devised as follows:

$Y = (ABCDE + G)/F$, where

Y = Monthly output in number of aircraft for the factory under consideration.

A = Total number of workers. This may be observed directly or may be computed from floor space. Direct observations vary widely because of untrained observers. Computation from floor space involves considerations of floor contents explored under B 2a, above.

[redacted]

25X1C

B = Proportion of direct workers to total. This has been discussed in B 2b, above, and runs from 40 to 60 percent.

C = Monthly shift-hours worked. This can be obtained with a reasonable degree of reliability and accuracy (see B 2a, above).

25X1C

[redacted]

E = Effective work factor (breaks, meals, awaiting material or inspection, fatigue, illness, absenteeism, etc.). The value of this factor runs from 60 to 80 percent and is a function of shift length. This factor needs defining.

Source 46 has already been quoted on absenteeism (see B 2b, above). Source 22 gives the following information on absenteeism for the US and UK for the World War II period:

	UK			US		
	Men	Women	All	Men	Women	All
Average Gross Work Week, Hours			54			48
Percent Time Lost	6.5	12.0	8.7 a/			7
Involuntary	4.5	8.8	6.2			N.A.
Avoidable	2.0	3.2	2.5			N.A.
Average Net Work Week, Hours			49.3			44.6
Turnover per Year (Percent)	Small	30	N.A.	Up to 50	80 to 110	

a/ Up to 12 percent in winter.

Source 22 also gives the following information for the UK and US for 1943 and 1944 on workers per aircraft per year and on pounds of airframe per worker per month:

	UK		US	
	1943	1944	1943	1944
Workers per Aircraft per Year	24	21	13	11
Pounds of Airframe per Month per Worker	49	62	69	110

Source 52 reports that the US World War II absence rate ran about 7 percent. During influenza epidemics it went to 10 percent. Even under the best conditions, however, it could not be brought below 6 percent.

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[redacted]

G = Work subcontracted in terms in equivalent direct man-hours. This has been treated in Source 24 and discussed in B 2a, above.

X1C

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b. It is possible that other rigorous or semiempirical equations may be derived, using different sets of parameters. This field should be investigated.

C. Checks on Results from Approaches.

1. Air Order of Battle.

The air Order of Battle can be used only to set a lower limit to production, since it gives no indication of possible stockpiling of aircraft. Investigation indicates the value of working from AOB back to production. This method consists essentially of adding together the monthly increase in AOB, the expected attrition rate (accidents, obsolescence, etc.) for peacetime, and the stockpiling rate, if known.

The attrition rate must be estimated. Discussions with defectors indicate an over-all Soviet Air Force attrition rate of from 5 to 6 percent per month. When jet fighters were introduced in 1948, their rate was 20 percent, which can be expected to have been reduced. Comparable data are found in Sources 54, 55, 56, 57, and 58.

Source 54 describes the German Air Force method of estimating Soviet losses. Losses were divided into (a) front-line (direct and indirect enemy action) and (b) home area (training, transport, depot, written-off). Only (b) is of present concern. The Germans estimated a flat 40,000 aircraft as lost in 1 year out of a total strength of 182,000, or 22 percent per year. Comparable figures 59/ for 1941 in the Royal Air Force show that, out of 30,800 aircraft, there were 2,200 lost to enemy action, 5,400 lost in accidents, and 2,600 in training for a noncombat loss rate of 26 percent per year. Source 56 indicates that the over-all wastage in the RAF in 1917 was 100 percent per year, with training allotted a 20 percent replacement rate. Other types of noncombat losses are not given separately. Source 58 shows that the USAAF from 1940 to 1945 acquired 236,305 aircraft. The combat losses of the USAAF were 22,948, and total losses were 65,164. Thus for the USAAF, total losses minus combat losses and divided by production amount to 17.9 percent for 5 years. Source 58, now being obtained, should tell the current US position.

Soviet stockpiling of aircraft has not been apparent to date but certainly should be carefully watched for.

25X1B [redacted]

3. Production of Accessory Items.

Production of items such as tires, batteries, guns, etc., which are not built in the aircraft plant and which could be counted item by item as received at the plant or whose production is known, may be other keys to estimating aircraft production. This data, which might be obtained in other Branches of the Industrial Division, ORR, might be part of "input data."

4. Input Data.

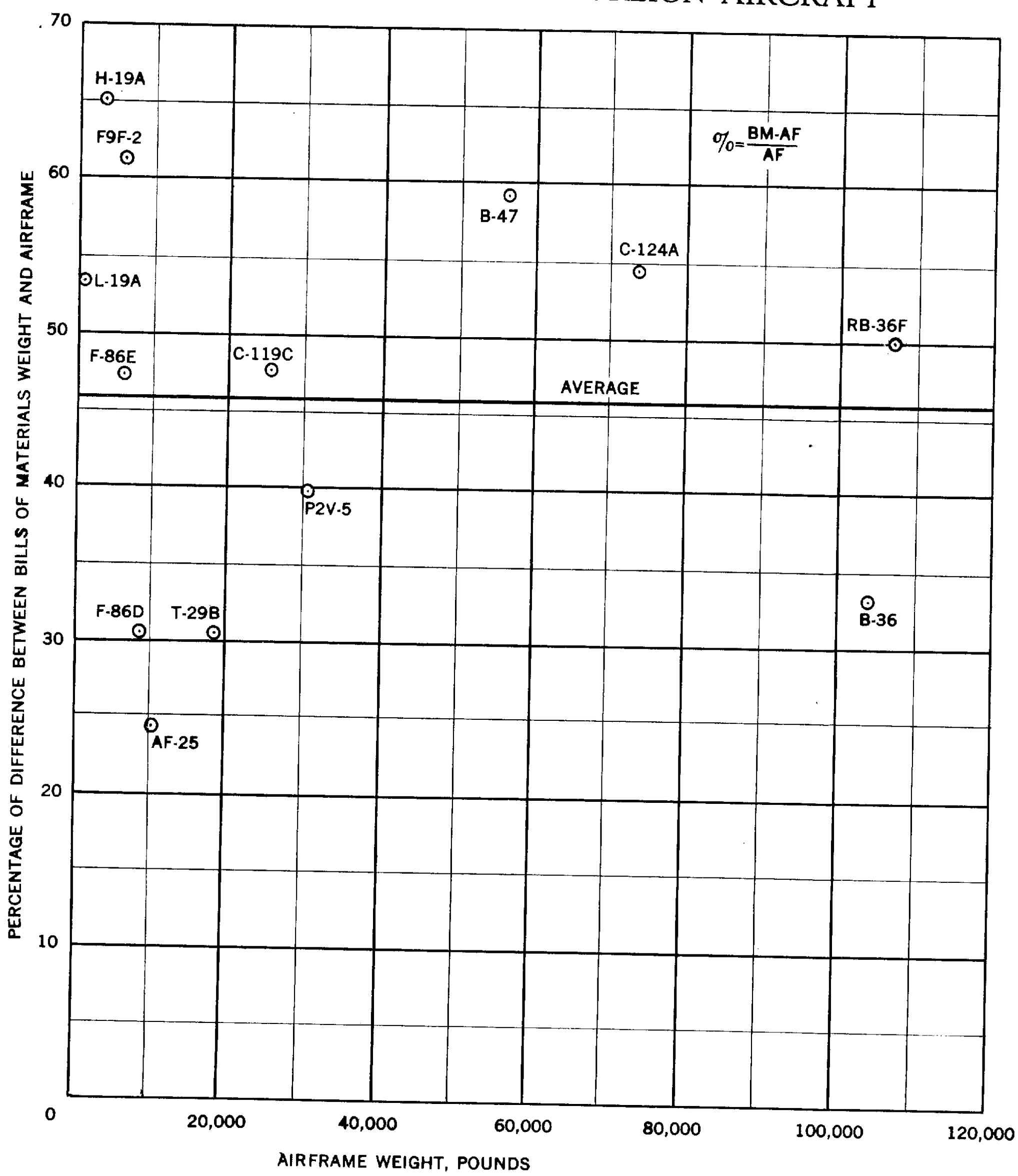
a. Materials.

It is known that more raw materials go into an aircraft factory than come out as airframes. The difference is in scrap and in rejected parts and, on occasion, in consumer goods. This item was briefly treated in B 2a, above. Figure 7 indicates the variation between ratios of bills-of-materials weight to airframe weight. These ratios average 45.8 percent. The reasons behind this spread, which should be ascertained or at least enumerated, are probably rooted in the detail design of the airplane. Bills of material for the F-84, F-86, B-36, and B-47 aircraft are on hand. Sources 18 and 51 list industry-wide, over-all materials consumption. This entire heading should be more clearly delineated.

b. Manpower.

Manpower is being treated separately, as are materials. Several references have been found on the subject (see B 2b, above).

RELATION BETWEEN BILLS OF MATERIALS AND AIRFRAME WEIGHTS OF U. S. AND FOREIGN AIRCRAFT



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c. Electric Power and Coal (see B 2c, above).

d. Rail Service.

Rail service has not been investigated, except insofar as to ascertain the capacities of various Soviet railroad cars. This was prompted by the mention of "four-wheel" and "eight-wheel" freight cars in IR reports.

Sources 60, 61, and 62 indicate that, in order to remain within the right-of-way clearance diagram, goods cannot be piled more than 13 feet above the bed of either flatcar or gondola. Bed-width of gondola or flatcar is about 10 feet, and perhaps a 2-foot overhang on each side of a flatcar could be allowed in an emergency. Normally, a consignment would stay within bed limits. Drop-center flatcars of large capacity are available.

The capacities and dimensions of various types of Soviet railroad cars are given as follows:

Capacities and Dimensions of Soviet Railroad Cars

Car Type	Number of Axles	Capacity (Metric Tons)	Length (Feet)	Capacity (Cubic Feet)	Door (Width/Feet)	Door (Height/Feet)
Box	4	50.0	44.0	3,170	6.42	6.56
Box	2	20.0	21.9	1,605	6.42	6.56
Box	2	16.5	21.2	1,380	5.75	5.75
Flat	4	60.0	42.7			
Flat	4	50.0	42.6			
Flat	2	20.0	30.2			
Flat	2	16.5	21.7			
Gondola	4	60.0		2,360		
Hopper	4	50.0		2,100		
Tank	4	50.0		1,770		
Tank	2	25.0		883		
Tank	2	15.9		N.A.		

As a yardstick for calculating what can be carried in these Soviet railroad cars, the dimensions and weights of various US aircraft engines crated for shipping are given as follows:

Engine	Dimensions (Inches)			Weight (Pounds)
J-33	63.5	67.8	118	3,400
J-35	54.0	55.0	128	3,400
V-1650	39.0	57.0	104	2,600
R-3350	62.0	67.0	90	4,000
R-4360	76.0	73.0	165	6,000
R-2800	58.0	58.0	89	3,300

D. Possibilities of Using Matrix.

It is desirable that input items, such as manpower (B 3a, above), parts (C 3, above), and other input data (C 4, above), be summed up for all Soviet industrial enterprises, each item being checked to see that the sum does not exceed the total available amount of each commodity. If the Industrial Division, ORR, has checked the items accurately, then the task of summing up is simple. If discrepancies are found, however, it will require the juggling of hundreds of manufactured items to get each of the basic commodities to balance out. This is best done by preparing a series of simple simultaneous equations and solving them, using a matrix and a digital computer. An alternate method of balancing commodities would involve the use of a simulator or analog-type computer.

3. Continuity of Data.

Trends are disclosed only by data which is continuous over a period of time. Instantaneous rates of production do not disclose whether production is accelerating, is constant, or is declining. Some of the continuous data required are aircraft types produced, their airframe weights and dimensions, and man-hour requirements. Plant 23 in Moscow, for example, is reported to have built the following types:

Year	Model	Airframe Weight	Man-hours
1936	SB (ANT-39)	N.A.	N.A.
1941	PE-2	6,170 63/	N.A.
1942	DB-22	N.A.	N.A.
1942	DB-3	6,900 63/	N.A.
1943	IL-2	4,400 63/	N.A.
1947	TU-2	8,600 63/	N.A.

Plant 21 in Gorki is reported to have built the following types:

Year	Model	Airframe Weight	Man-hours
1933	I-17	N.A.	N.A.
1933	DI-6	N.A.	N.A.
1936	I-16	N.A.	N.A.
1940	LAGG-3	N.A.	N.A.
1942	LA-5	3,150 63/	N.A.
1944	LA-4	N.A.	N.A.
1944	LA-7	2,520 63/	N.A.
1949	YAK-15	3,150 63/ 63/	N.A.
1949	MIG-15	3,000 to 3,740 63/ 26/	N.A.

25X9

[redacted]

There are several weaknesses in this method, some of which are as follows:

1. Although all observed points are used, fairing of the lines of "reported aircraft per month" versus "years" is still somewhat unsatisfactory. Not much can be done about getting more points, but the shape of the curves can be studied in more detail and the results applied.

2. The errors doubtless existing in the values assumed for the constants in the production formula are unevaluated. Errors should be ascertained, corrected if possible, and an over-all degree of assurance assigned.

3. The distribution of the points through which the curve of Figure 9 has been drawn is not satisfactory. Steps to improve this

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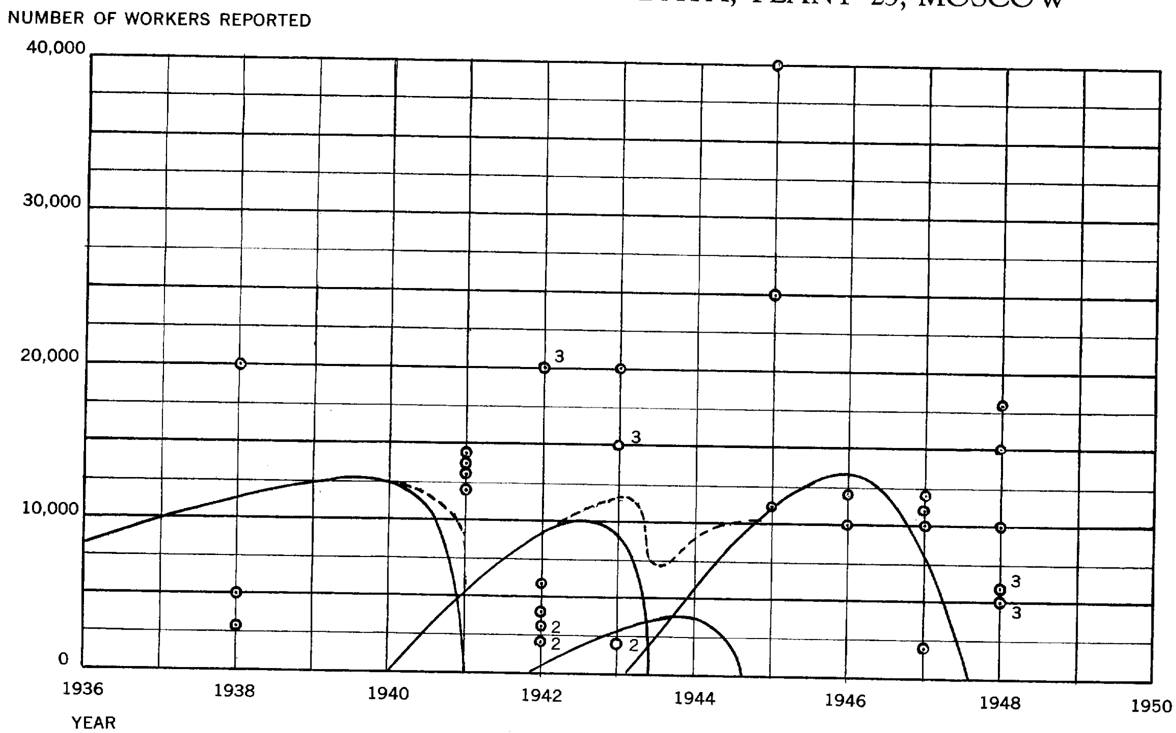
REDUCTION OF OBSERVED DATA, PLANT 23, MOSCOW



NUMBERS INDICATE NUMBER OF SHIFTS REPORTED

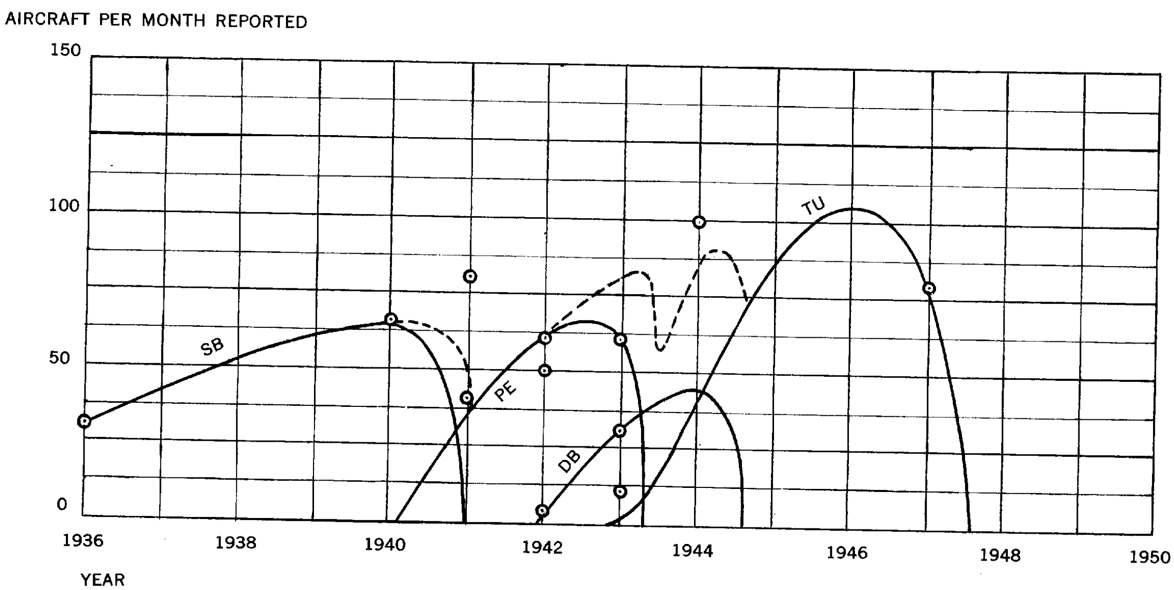


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FIGURE 8

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DISTRIBUTION OF OBSERVED DATA (DIRECT AND CONVERTED), PLANT 23, MOSCOW

FIGURE 9

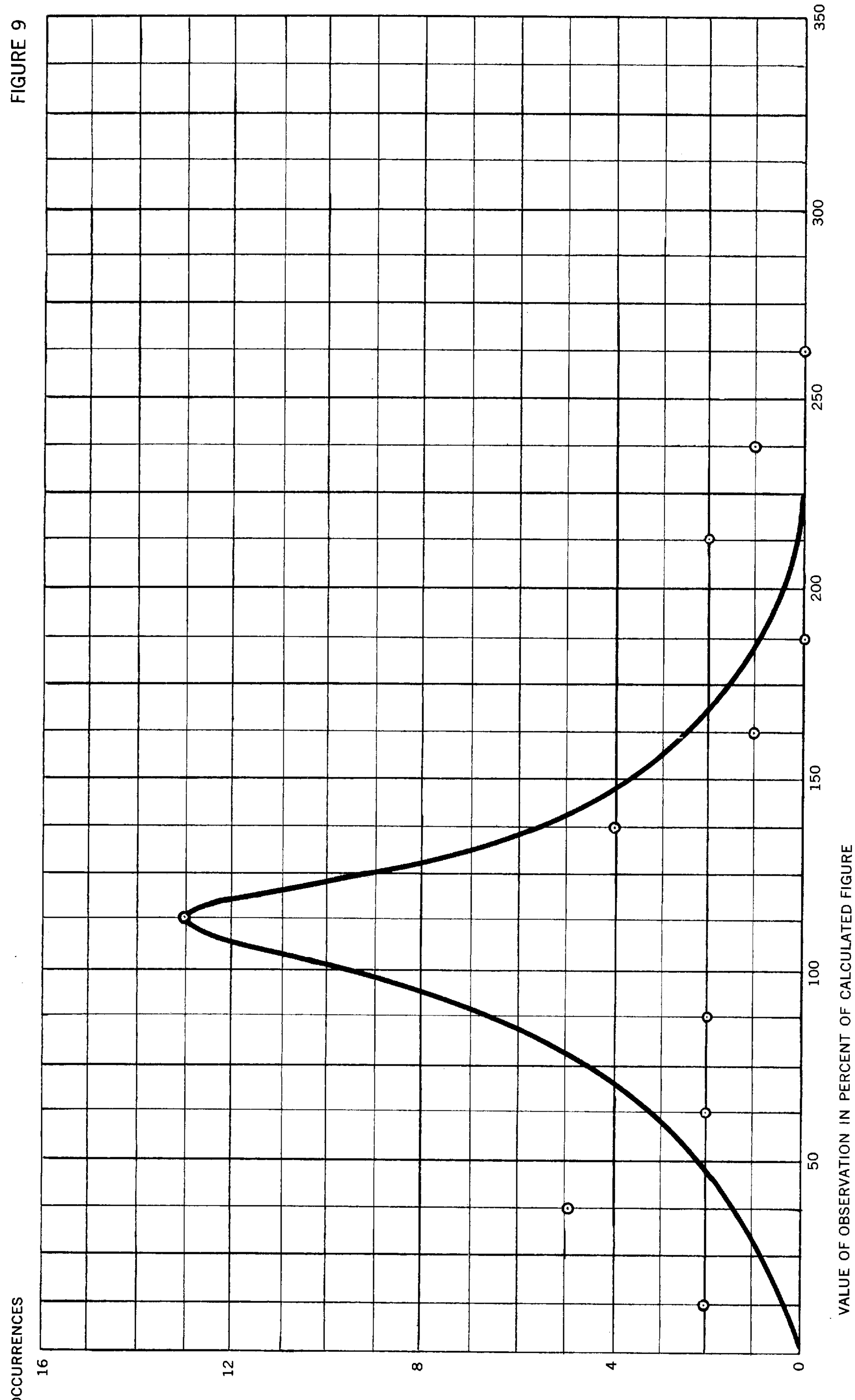

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FIGURE 9

distribution might well be taken.

4. While this method can be used to interpolate data, it cannot extrapolate with any accuracy. Thus, since there is little recent data, this method cannot supply up-to-date information.

F. Sources.

1. World Almanac, 51.
2. Gorrell Report.
3. Encyclopedia Britannica.
4. Winged Mars, Cuneo.
5. Beginnings of Organized Airpower, Spaight.
6. Storia della Guerra Italiana, Vol. II.
7. All the World's Aircraft, Jane's, 19.
8. US Dept. of Labor Bulletin No. 800.
9. USSBS Aircraft Division Industrial Report (Germany).
10. L'Aeronautica Italiana nella II Guerra Mondiale, Santoro.
11. Their Finest Hour, Churchill.
12. Statistical Digest of the War, His Majesty's Stationery Office.
25X1C 13. [redacted]
14. USSBS Japanese Aircraft Industry.
15. Air Targets Branch No. 611, USAF.
16. Aircraft Production, Nov-Dec 49, Peak Output.
17. Rand Report RM-503, Predicting Output from Floor Space.
18. Census of Manufacturers, 47.
19. Photographic Study of the Aircraft Industry.
20. Aero Digest, Projecting Labor Loads in Aircraft Production, Oct 43.
21. Plant Layout, Shubin & Madeheim.
22. Aircraft Production, Sep-Oct 47, Airframe Production.
23. Rand Report RM-563, Estimating Output from Floor Space.
24. Aircraft Production Board Report 17A, TP Wright, Nov 43.
25X1A 25. OSS, R & A No. 2415a, Utilization of Floorspace.
26. [redacted]
27. Report of Visit to Republic and Grumman Plants.
28. Report of Visit to MIG-15.
29. Rand Report RM-536, Cost-Quality Relations in Bomber Airframes.
30. Source Book of WW II Basic Data, Vols I and II, AMC, USAF.
31. Rand Report RM-260-1, Reliability of Progress Curves.
32. Rand Report RM-464, Comments on Modified Aircraft Progress Function.
33. Bureau of Labor Statistics Serial R-1776, Wartime Production Changes in Aircraft Industry.
34. Rand Report P-108, An Airframe Production Function.
35. Aircraft Production, Building a New Type, Jan 49.
36. North American Aviation Inc, Comparison F-51 and F-86.
37. Industrial Psychology, Viteles.
38. Rand Report R-172, Structural Weight Analysis - Fuselage.
39. J. Aero, Sci., Mar 49 Principles of Structural Design, Shanley.
40. Rand Report RM-437, Improved Equations for Estimating Wing Structural Weight.
41. Rand Report R-100, Structural Weight Analysis - Wing.
42. Rand Report R-198, Wing Weight.
43. Strauss Report (unpublished), Air Materiel Command.
44. Air Technical Service Command - TR - 4399.
45. Aero Digest, Determination of Gross Weight, Dec 47.
46. Rand Report P-126, Russian Labor Productivity Statistics.
47. 7707 ECIC, ID 677603.
48. Bureau of Labor Statistics Bulletin 746.
49. Lockheed Aircraft Corporation Report, Tons of Machine Tools and Pounds of Airframe, 18 Aug 50, Hansberger & Crawford.
50. Rand Report R-194, Electric Energy Resources of the USSR.
51. Aviation Week, p. 29, 26 Feb 51.
52. Bureau of Labor Statistics Bulletin No. 800.
25X1A 53. Current Aircraft Manufacturers' Production Report.
54. [redacted]
55. War in the Air, Vol. 6, Jones.
56. Aircraft Yearbook, 46.
57. US Air Force Manual 400-5.
58. US Air Force Letter 150-10.

59. The Hinge of Fate, Churchill.
60. Ustroistvoe: Remont Vagonov, Shentiakov.
61. Vagony, Vinokyrov.
62. Vagono Stroyeniye, Dadyko.
63. Characteristics and Performance Handbook, USSR Aircraft.

III. Materials Input Requirements of the Soviet Airframe Industry.

A. Introduction.

An attempt is made here to estimate Soviet airframe input requirements by making a comparative study of the input requirements of two captured Soviet MIG-15 jet fighters and of certain US aircraft and by establishing the applicability of such requirements to the Soviet aircraft industry. If similarities are discovered, and if the bills of materials are found to be applicable to the similar types, a basis on which to estimate the raw materials input requirements of the Soviet aircraft industry will be established. Detailed and particularized bills of materials, related to output, are essential. Critical points in production lines should be identified. (For airframe assembly plants in the USSR in 1949, see Appendix A and Fig. 10.)

B. Input Requirements for the MIG-15 Fighter.

A provisional bill of materials for the MIG-15 was derived from a hasty survey of an MIG-15 which crashed in Korea in the fall of 1950. (See Appendixes B and C.) Analysis of the structural components of another MIG-15, which crashed in Korea in July 1951, showed that steel was used for such parts as structural beam caps, brackets, control fittings, tubing, tube ends, rivets, bolts, nuts, and other applications where aluminum alloys, particularly extrusions and forgings, might have been used. The largest steel parts were the caps on the diagonal beam extending from the landing gear to the fuselage and on the connecting beam through the fuselage.* (For a diagram of the MIG-15, see Fig. 11, and for additional analyses, see Appendixes B and C.)

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[redacted]

Figure 10

AIRFRAME ASSEMBLY PLANTS IN THE U.S.S.R. (1949)

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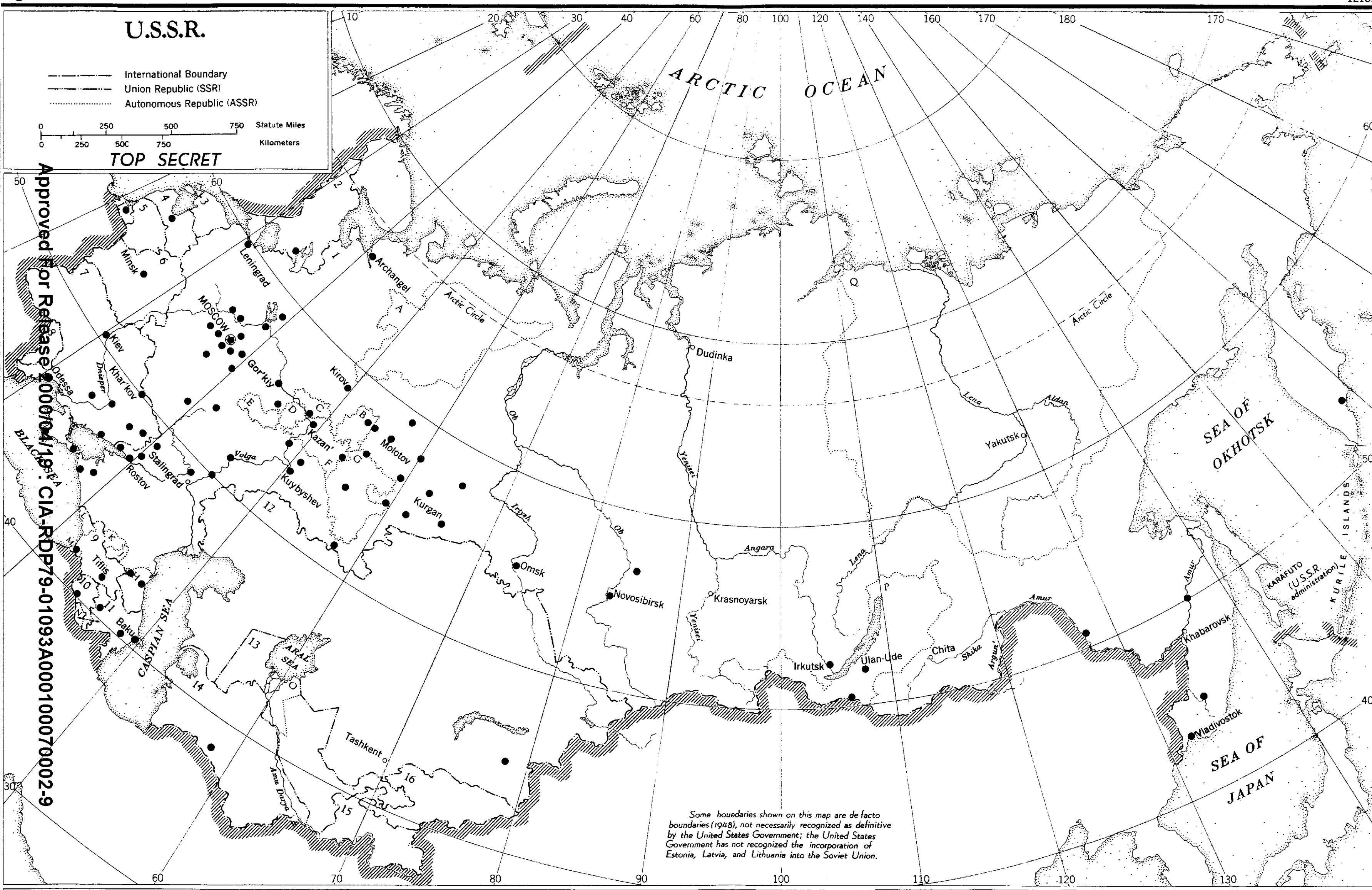

ADMINISTRATIVE DIVISIONS

S.S.R.

1. R.S.F.S.R
2. Karelo-Finnish S.S.R.
3. Estonian S.S.R.
4. Latvian S.S.R.
5. Lithuanian S.S.R.
6. White Russian S.S.R.
7. Ukrainian S.S.R.
8. Moldavian S.S.R.
9. Georgian S.S.R.
10. Armenian S.S.R.
11. Azerbaydzhan S.S.R.
12. Kazakh S.S.R.
13. Uzbek S.S.R.
14. Turkmen S.S.R.
15. Tadzhik S.S.R.
16. Kirgiz S.S.R.

A.S.S.R.

A. Komi ASSR
B. Udmurtskaya ASSR
C. Mariyskaya ASSR
D. Chuvashskaya ASSR
E. Mordovskaya ASSR
F. Tatarskaya ASSR
G. Bashkirskaya ASSR
H. Dagestanskaya ASSR
J. Severo-Osetinskaya ASSR
K. Kabardinskaya ASSR
L. Abkhazskaya ASSR
M. Adzharskaya ASSR
N. Nakhichevanskaya ASSR
O. Kara-Kalpakskaya ASSR
P. Buryat-Mongol'skaya ASSR
Q. Yakutskaya ASSR

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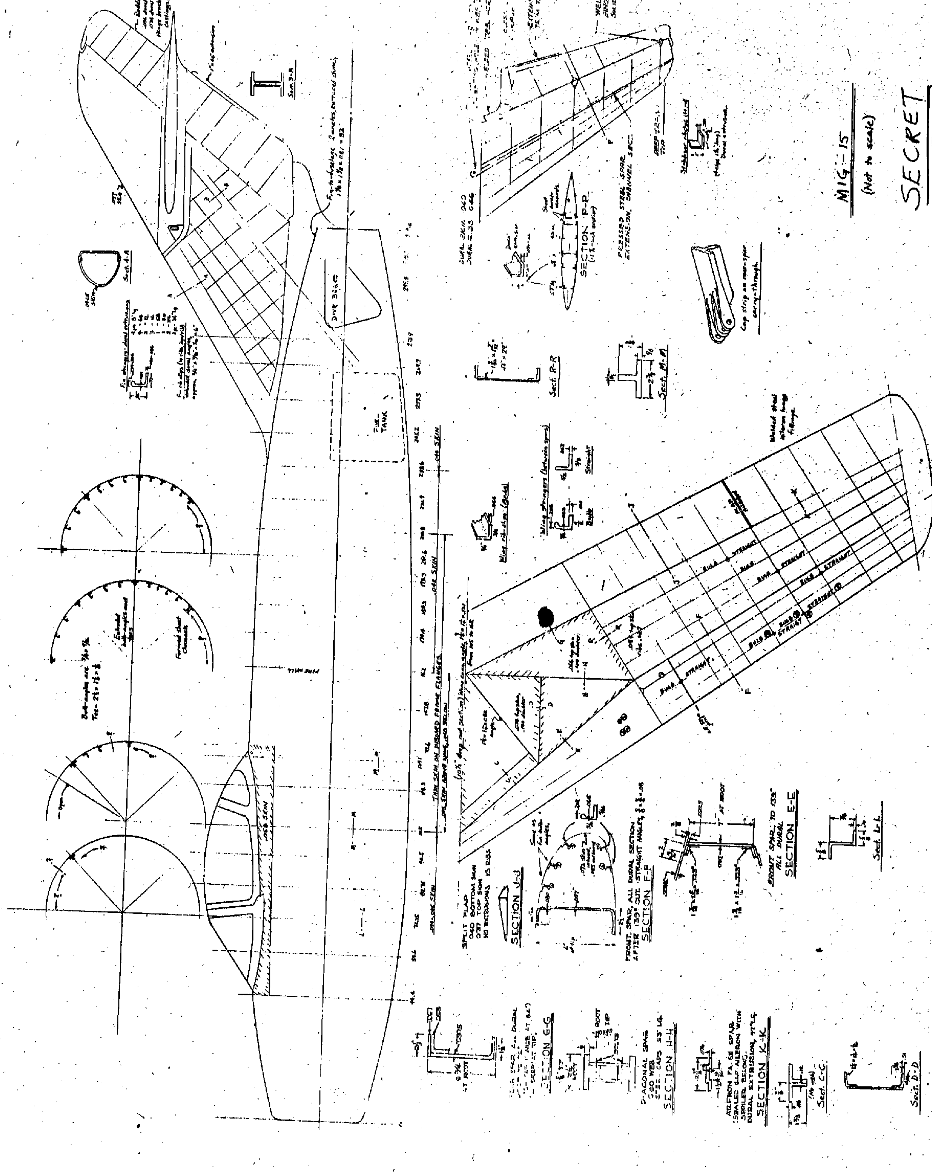

FIGURE 11

CIA/RR PROJECT 38-51 PR-8

C. Input Requirements for the TU-4 Medium Bomber.

In an effort to determine the similarities between the US B-29 and the Soviet TU-4, engineers of the Boeing Aircraft Corporation, manufacturers of the B-29, examined photographic data on the TU-4 and identified 19 specific external similarities, the most significant of which were as follows:

1. Neither dimensional differences nor material substitutes were discerned.

2. The wing production breakdown of the TU-4 did not vary from that of the B-29.

3. The size and shape of the TU-4 engine nacelles appeared to be identical with the B-29 nacelle configuration.

4. The landing lights appeared to be the same.

5. The bombardier glass and framings and the side blister sighting stations were identical, and bomb bay doors appeared to be identical.

6. The landing gear also appeared to be identical.

While the isolated examples cited above may not seem to be conclusive evidence of the similarity between the two aircraft, the complete study made by the Boeing engineers evidently convinced them that the aircraft were essentially similar. 2/ In addition, all Soviet aircraft electrical systems appear to be, with minor exceptions, equivalent to the systems used in US and UK aircraft of the same period. 3/

25X1A

[redacted]

D. Input Requirements for Comparable USAF Aircraft.

The following tables giving airframe and bills of materials weights of selected USAF aircraft may assist in further relating US and USSR requirements as a means of estimating USSR requirements. The US F-84 and C-47 are similar to the Soviet Type-7 and the LI-2 or IL-12 aircraft, respectively.

[redacted]

Average Airframe Weight of US Military Aircraft 4/
1940-50

In Pounds

Year	Weight	Year	Weight
1940	3,800	1946	7,100
1941	4,000	1947	5,400
1942	5,300	1948	11,000 a/
1943	7,500	1949	12,000 a/
1944	10,000	1950	12,000 a/
1945	11,000		

a/ Estimated.

Further study of this trend toward increased airframe weight must be made in order to determine whether or not a correlation with Soviet aircraft production can be made. Several additional factors must be taken into consideration in drawing any conclusions from the above figures, such as alterations in production (that is, varying production emphasis on trainers, fighters, and bombers) and the changing weights of types produced.

[redacted]

[redacted]

E. Soviet Aluminum Requirements.

Total Soviet production of aluminum in 1949 was estimated at 200,000 metric tons, of which from 130,000 to 135,000 tons were primary aluminum. 6/ In 1951 an estimated 275,000 metric tons, including secondary aluminum , 7/ will be produced.

Soviet requirements of aluminum for aircraft in 1949 was estimated at from 60,000 to 70,000 metric tons. 8/ At least half of the aircraft produced in that year, or 7,000 out of 14,000, were believed to be military, about 1,500 being bombers and 5,500 fighters, and it was estimated that only 10,000 tons of aluminum were used for civil aircraft production. Thus from 50,000 to 60,000 tons of aluminum probably were used in the construction of military aircraft. 9/

In view of the low per capita allocation of aluminum for civilian consumption, expanding production will make greater amounts available for aircraft production. The extensive use of steel in the MIG-15, however, indicates that sparing use is being made of available aluminum despite increased production.

F. Machine Tool Requirements for the US C-47.

Kinds and quantities of machine tools needed and their replacement and useful life factors require further investigation. A study of US C-47 production made by the Lockheed Aircraft Corporation in August 1950 reveals the following machine tool requirements for C-47 production:

[redacted]

Sources.

1. Ordnance Magazine, Jul-Aug 51.
2. ID Study No. 102-AC-50/36-34.
3. ID Study No. 102-AC-51/4-34.
4. Aviation Week, 26 Feb 51.
5. K. R. Jackman, Metal Progress, Vol. 40, No. 1, Jul 51.
6. OIR Report No. 5104, 9 Dec 49.
7. [redacted]
8.
9. OIR Report No. 5104, 9 Dec 49.

25X1C

V. Materials Input Requirements of the Soviet Aircraft Engine Industry.

A. Introduction.

An attempt is made here to establish an initial approximation of the materials input requirements of the Soviet aircraft engine industry and to determine, through detailed analysis of known input requirements, some upper limits as to capabilities and some of the vulnerabilities in Soviet aircraft engine production. As in the Soviet airframe industry, almost total secrecy veiled aircraft engine production in the USSR from the beginning of World War II until some of the engines used in Korea became available. Wherever possible, estimates of input requirements have been based on the study of actual Soviet engines. Where such information is not available, analogies and ratios have been employed. This procedure is facilitated by the knowledge that the aircraft engines most important to the Soviets are essentially copies of UK and US power plants, an assumption that has been confirmed by examination of two different captured Soviet engines, the VK-1 and the RD-45, both of which are centrifugal-flow turbojets developed from the British NENE I turbojet engine. The US Pratt and Whitney J-48P6 (TAY) engine, which was used for comparative estimates, likewise was developed from the NENE I. The ASH-90 reciprocating engine, used in the Soviet version of the B-29, is believed to be an almost exact copy of the US Wright R-3350-26W engine.

The VK-1 and RD-45 turbojet engines can be expected to power a large percentage of the Soviet aircraft currently being produced, while the Soviet ASH-90 engine probably is vital to the Soviet medium bomber program. These three engine types probably comprise the most important share of Soviet aircraft engine production. It is not yet known, however, what engine powers the Soviet Type-31 heavy bomber (estimated to be one-third larger than the USAF B-29) or in what quantities this type may have been manufactured.

The following Soviet aircraft engines or their components have been available for examination by US technicians:

1. Parts of a Soviet-built scaled-up copy of the British Rolls-Royce NENE I centrifugal-blow turbojet, recovered from a crashed MIG-15 in Korea (fall of 1950), designated as the VK-1. 1/

2. A Soviet-built copy of the original British Rolls-Royce NENE I centrifugal-flow turbojet, purchased from the UK in January 1947, recovered almost intact from a crashed MIG-15 in Korea (July 1951), designated as the RD-45. 2/

3. Miscellaneous samples of metals picked up in Soviet engine plants and parts recovered from crashed aircraft. 3/

The following engines of lesser importance have been recovered intact:

1. A 12-cylinder, VEE-type liquid-cooled engine, the type used in the YAK-3 and YAK-9 single-engine fighters, designated as the VK-107.

2. A 12-cylinder, VEE-type liquid-cooled engine, designated as the AM-38, used in the IL-10 single-engine, ground-attack airplane.

3. A 7-cylinder radial engine, designated as the ASH-21, used in the YAK-11 single-engine trainer and the YAK-16 twin-engine transport. 4/

The Soviet tendency to copy aircraft and engine designs developed by other countries and the likelihood that engineering data on the more powerful US axial-flow turbojets are available to the Soviets may indicate that their next development in the jet engine field will be an axial-flow type, perhaps similar to the J-47-GE-19, the Wright J-57 "Sapphire," or even the British "Olympus" type. (Input requirements of these new US engines are available.) The Soviets also have had German technical assistance and prototypes to help them in the development of an axial-flow turbojet engine.

B. Jet Engines.

The USSR is known to be producing two jet engines, the VK-1 turbojet and the RD-45 turbojet, both of which are used in the MIG-15 jet fighter and possibly in the Soviet Type-27 twin-jet light bomber. These two engines are Soviet versions of the British NENE I engine. In addition, the Soviets also may have in production the RD-36, a development of the German Junkers JUMO-004B; the RD-20, developed from the German BMW-003; and the RD-26. Under a British-Soviet trade agreement the following British jet engines were supplied to the USSR in 1947: 30 Rolls-Royce DERWENT V turbojets and 25 Rolls-Royce NENE I turbojets. 5/

1. Soviet VK-1 Turbojet Engine.

The first Soviet turbojet engine components to be examined in the US consisted of four major pieces from a MIG-15 which crashed in Korea in the fall of 1950. These fragments were identified as parts of a Soviet VK-1 centrifugal turbojet and were compared with similar parts from the US Pratt and Whitney J-48P6 engine. Both the VK-1 and the Pratt and Whitney engines are scaled-up versions of the British NENE I. 6/ The parts consisted of two complete combustion chambers, one with fuel nozzle; two turbine blades ("buckets"); and one airplane tail pipe. After examining these parts the Pratt and Whitney Company reached the following conclusions:

a. The basic mechanical construction of the Soviet engine was that of the NENE I, with Soviet modifications and improvements that had increased the static thrust from approximately 5,000 to 6,000 pounds.

b. Soviet workmanship and quality were comparable to US and UK standards. There were no indications of any concessions being made in this respect in order to facilitate production.

c. The engine accessory section of the VK-1 is an exact duplicate of the NENE I (J-42) accessory section and includes two fuel pumps, one electric starter, one tachometer, one generator, one oil sump two-stage pump with filters, one low-pressure fuel filter, one barometric pressure control, and one auxiliary gear box drive. 7/

d. The conventional 28-volt direct current system is used for primary power supply. One or more inverters supply alternating current for the radio equipment and for some of the instruments. The exact type of aviation kerosene used for fuel has not yet been established. 8/

e. Production methods and processes appear to be similar to those used by Pratt and Whitney and Rolls-Royce.

The following table presents an estimate of critical materials — that is, critical in US engine production — used in the Soviet VK-1 engine and is based on an analysis of the recovered parts and a comparison with the Pratt and Whitney J-48P6 engine 9/:

25X1A

[redacted]

Experience up to now has pointed to the fact that the Soviets attempt to keep from specifying columbium and molybdenum in their alloys, as both materials are critically short in the USSR. All Soviet-stabilized 18-8 stainless steel samples examined recently have been stabilized with titanium instead of columbium, and no columbium has been found to date in the few high-temperature alloys that have been examined.

Most of the 11 pounds of molybdenum in the above breakdown of the J-48P6 materials requirements are accounted for by low-alloy steel forgings. Experience to date has shown that in many applications of low-alloy steels the Soviets use chromium-silicon-manganese steels of hardness and impact resistance inferior to the US chromium-nickel-molybdenum steels used in similar applications. In general, Soviet use of molybdenum in low-alloy high-strength steels appears to be very limited. It may be assumed that little if any molybdenum or columbium will be found in those Soviet jet engine parts which have not been examined to date, being replaced by less critical materials such as chromium, not in short supply in the USSR. In 1946, for example, the Soviets had a quantity sufficient for export.

The following tables present detailed comparative analyses of the composition of the burner liner of the VK-1 and the J-48P6 engines:

25X1A

[redacted]

25X1A

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information from Pratt and Whitney, a model of the J-48P6 engine now in the test stand incorporates a reduction in tungsten-bearing alloys.

[redacted]

Fuel Nozzle Assembly — Externally, apparently exact duplicate of original NENE I duplex nozzle of stainless steel.

2. Soviet RD-45 Turbojet Engine.

The second Soviet turbojet engine to be examined in the US was recovered in Korea from a crashed MIG-15 in July 1951. This engine, which apparently had not been operated for more than 25 hours, including production acceptance tests, was a direct copy of the original British Rolls-Royce NENE I (J-42) 11/ and was wholly adaptable to mass production methods as employed by Rolls-Royce. [redacted]

25X1B

It is estimated that the first of this series became available from Plant 45, Moscow, between January and July 1949.

Quality and workmanship were of high standard and generally acceptable when judged by US aircraft industry standards, with respect to both manufacturing processes and materials, including the proper processing of high-temperature alloys. A description of the component parts of the RD-45 engine, as learned in an examination made by Pratt and Whitney, follows:

Compressor — Single-stage double-entry centrifugal impeller, 28.8 inches outer diameter with 29 radial vanes on each side. 12/

Combustion System — Nine combustors ("cans") of straight-through flow type.

Number and Location of Combustion Chambers — Nine conical chambers.

Turbine — Single-stage axial-flow reaction type, 16-inch machined disc, apparently a steel-alloy forging; 24.5 inches outer diameter; and 54 blades ("buckets") with the roots of the blades keyed into V-shaped slots in the outer edge of the disc.

25X1A

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C. Reciprocating Engines.

The USSR is known to produce at least 13 types of reciprocating engines, most of which are based on US designs, but Soviet development in this field is limited by their lack of certain design features such as the forged aluminum cylinder head and by the fact that their engines are not designed to utilize lean mixtures at high speeds. 18/

The Soviet reciprocating engines are designated as follows:

1. VK-107 — 12-cylinder, V-type, liquid-cooled.
2. AM-38 — 12-cylinder, V-type, liquid-cooled.
3. ASH-21 — 7-cylinder, radial.
4. ASH-90 (M-90) — probably 18-cylinder, twin-row, supercharged radial.
5. M-71 — 9-cylinder, single-row, geared-drive, air-cooled, charged, radial; a copy of US Wright R-1830.
6. AM-42 — 12-cylinder, V-60-degree, liquid-cooled; developed from US Curtiss Conqueror and German BMW VI engines.
7. M-11.
8. VK-105.
9. VK-105PF.
10. M-63.
11. ASH-82.
12. ASH-62.
13. M-12.

No ASH-90 (M-90) engine, which probably powers the Soviet TU-4 (B-29 type) medium bomber, has been examined in the US. This engine, however, is believed to be very similar to the US Wright R-3350-26W, an 18-cylinder, twin-row, supercharged, radial engine. [redacted]

25X1A

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[redacted]

7. Spares and Spare Parts.

For every 100 reciprocating engines supplied for military aircraft during World War II, from 50 to 150 or more engines for replacement spares and spare parts equivalent in dollar value to about 15 engines were required. 20/

8. Fuel.

Soviet fuel technology improved greatly as a result of US assistance during World War II. Much of the recent Soviet published information on fuel technology duplicates work performed earlier by the US. For example, the Soviets are just beginning to exploit 100/130 grade gasoline for reciprocating engines, whereas the US is working on 115/145 grades. 21/

D. Soviet Aircraft Engine Plants.

The floor space area of Soviet aircraft engine plants whose construction started in each Five Year Plan period from 1928 to 1941 has been reported as follows 22/:

Period	Area (Square Feet)
First Five Year Plan, October 1928-32	4,920,000
Second Five Year Plan, 1933-37	2,805,000
Third Five Year Plan, 1938-June 1941	2,585,000

It has been estimated that in the postwar period from August 1945 through June 1949 the total floor space of Soviet factories producing aircraft engines, or being equipped for such activity, amounted to 15.2 million square feet.

[redacted]

[redacted] 25X1C

25X1C [redacted] This plant also may be producing the VK-1, a Soviet scaled-up version of the NENE I. Plant 45 is believed to have previously produced the Soviet AM-42 reciprocating engine and diesel engines for motor vehicles. 25X1C

On the basis of German photography dated prior to 1944, [redacted] and the US Air Force have estimated that approximately 1.485 million square feet of floor space were available in this plant as of June 1949.

Information on other Soviet aircraft engine plants is derived from German photography before 1944, World War II intelligence reports of varying reliability, and postwar information of generally poor reliability. The best tabulation available from these sources at this time [redacted] 25X1C

Soviet Aircraft Engine Plants

25X1C

Location	Plant Number and Name	[redacted]	Possible Engine Types Oct 1951	[redacted]
Moscow	45 (Formerly 24)		VK-1	
Ufa (Chernikova)	26 (384)		Possibly axial-flow?	
Kuybyshev (Krasnaya-Glinka, Plant 2, Nearby)	24 "Lenin" "Frunze"		AM-42 RD-45 VK-1?	
Zaporozhe	478 (Formerly 29)		?	
Kazan	16		?	
Leningrad (including Branch Plants)	466 (Formerly 381 "Red October" or "Flugor"		?	
Molotov	19		?	
Moscow (Testing)	165		Possibly axial-flow?	

25X1C

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Soviet Aircraft Engine Plants
(Continued)

25X1C

25X1C

Location	Plant Number and Name		Engine Types Jun 1949	Possible Engine Types Oct 1951	
Moscow (Experimental)	300	[redacted]	25X1C	?	[redacted]
Moscow-Tushino	500 (Formerly 82)	[redacted]	?	[redacted]	
Shcherbakov (Rybinsk)	36 (Formerly 26)	[redacted]	ASH-62? M-12	?	[redacted]
Omsk	29	[redacted]	ASH-82	?	[redacted]
Andizhan	154	[redacted]	?	?	[redacted]
Gorki	466	[redacted]	?	?	[redacted]
Voronezh	154 (Formerly 16)	[redacted]	M-11	?	[redacted]
Moscow	41	[redacted]	M-11	?	[redacted]
Total		[redacted]			[redacted]
		[redacted]	Yearly Total		[redacted]

Five Soviet plants producing reciprocating engines have been positively identified through captured equipment, as follows:

25X1C

Location	Plant Number	Engine	Aircraft Used In
Ufa (Chernikova)	26	VK-107	YAK-9
Kuybyshev	24	AM-42	IL-10
Zaporozhe	478	M-11	(YAK-8 (UT-2 (YAK-18 (PO-2 (UTKA (YAK-12 (YAK-14 (OMEGA Helicopter
Kazan	16	VK-105PF	(PE-2 (PE-3
Leningrad	466	VK-105	(YER-2 (YER-4 (AR-2 (YAK-7

E. Sources.

1. IDS 102-AC-51/10-34, AMC, 28 Apr 51; ATIC 102-AE-51/5-34, 30 Jun 51.
2. AIB, DI/USAF, 3 Aug 51; ATIC 102-AC-51/31-34, 31 Aug 51.
3. ID Study No. 102-AE-51/2-34, AMC.
4. ATIC 102-AC-51/18-34, Jun 51.
5. [redacted]
6. Pratt and Whitney, ATIC, Analysis of Foreign Material Submitted, 23 Apr 51; ATIC 102-AE-51/5-34, 30 Jun 51.
7. AID, DI/USAF, Sep 51.
8. ATIC 102-AC-51/31-34, 31 Aug 51.
9. ATIC 102-AE-51/5-34, 30 Jun 51.
10. ATIC 102-AE-51/5-34, 30 Jun 51.
11. ATIC 102-AC-51/31-34, Soviet MIG-15 Power Plant Analysis, 31 Aug 51.
12. Ibid.
13. AID, DI/USAF, Sep 51.
14. ATIC 102-AC-51/31-34, 31 Aug 51.
15. AID, DI/USAF, Sep 51.
16. ATIC 102-AC-51/31-34, 31 Aug 51.
17. Ibid.
18. Ibid.
19. Wright Aeronautical Corporation letter, Manufacturing Information concerning R-3350 Engines, 29 Aug 51.
20. Aircraft Production Problems of the War, L-51-101, Industrial College of the Armed Forces.
21. ATIC 102-AC-51/11-34, 20 Aug 51.
22. [redacted]

25X1C

25X1C

V. Manpower Input Requirements of the Soviet Aircraft Industry.

A. Introduction.

All Soviet aircraft workers and the factories in which they work, as well as aviation trade schools and technical institutes, are controlled by the Ministry of Aviation Industry (Ministerstvo Aviatsionnoy Promyshlennosti — MAP) located in Moscow. MAP is responsible to the Council of Ministers of the USSR and to the Politburo of the Communist Party. 1/

One of the sections of the MAP is the Office of Personnel, which is charged with the assignment of high-ranking personnel and the allotment of workers throughout the entire aircraft industry. 2/ In addition, it is believed that there is another section of the MAP called the Office of Labor, which is on the same level as the Office of Personnel and is responsible for recruiting and mobilizing workers for the aircraft industry.

B. General.

1. Recent Background.

The Soviets did not begin serious aircraft production until 1924, when the Junkers factory in Moscow was built. 3/ This factory was taken over by the State in 1926, and, except for this one and a smaller one at Kiev, no airframe or aircraft engine plants of importance were built between 1922 and 1928. During that time, total aircraft workers numbered only a few hundred. With the beginning of the Five Year Plans in 1928 the USSR made known its intention of creating an air force capable of fighting the air forces of any probable combination of capitalist countries. Much of the new construction during the three Five Year Plans before World War II remained unused, however, partly because of a shortage of skilled personnel. A considerable reserve capacity thus was available for future expansion.

At the time of close collaboration between Yugoslavia and the USSR, Yugoslav Air Force officers were studying in the Soviet Air Force Academy. Some of the information which they collected indicates that in 1940 the Soviet aircraft industry consisted of upward of 350 factories employing about 400,000 workers and turned out a total of about 6,000 combat aircraft of all types plus an unknown number of training and transport types. 4/

2. Future Manpower Prospects.

Considerable emphasis is certain to be given to the training of skilled workers and of engineers of all types for the Soviet aircraft industry. Deferments from military draft for young men who have been trained or are in training for skilled and semiskilled jobs in the aircraft industry will be given greater consideration than for those in nondefense industries.

C. Manpower Analysis.

1. Actual and Potential Labor Force.

Priority for the assignment of personnel in the Soviet aircraft industry is established according to the following category classification of the plants: 5/

Category I. Engine or airframe plants employing more than 7,000 workers.

Category II. Assembly plants employing from 4,000 to 6,000 workers.

Category III. Component parts and accessories plants employing from 1,500 to 3,000 workers.

Category IV. Component parts and accessories plants employing from 1,000 to 1,500 workers.

The present total of personnel now employed in the Soviet aircraft industry probably numbers about 450,000 or more. 6/ Of this number, roughly from 250,000 to 300,000 are engaged in direct and indirect aircraft production, and from 150,000 to 200,000 are in research and development and in repair.

Formerly, it was believed that some of this latter group were engaged in the production of consumer goods during model change-overs and shutdowns, but recent information indicates that there is no production of consumer goods at aircraft plants. Should the industry go on a war basis, it is likely that within 2 years the research and development group would be absorbed into the production of aircraft, thus increasing production about 50 percent without further recruitment. In addition, 500,000 more persons would be required for full mobilization of the industry.

Total 1951 employment by primary aircraft engine and airframe contractors for the US armed forces (excluding Westinghouse Electric) has been estimated at 310,210. 7/

There are 143,000 persons employed in the aircraft manufacturing and repair industries of the UK as compared with 413,200 in the total US aircraft industry. 8/ The ratio of the number of persons engaged in the production of airframes and engines in the UK and the US compares closely with the relative populations of the two countries.

As in the US, the Soviet aircraft plants are in or adjacent to major industrial concentrations. (For major industrial concentrations in the USSR and aircraft industry concentrations, see Figs. 13 and 14).

2. Proportion of Skilled and Unskilled Labor.

There is a higher proportion of handwork and a higher percentage of unskilled and semiskilled workers in the Soviet aircraft industry than in that of the US and the UK. 9/ There is a corresponding lower percentage of skilled labor and technicians, which is somewhat compensated for, however, by the transfer of skilled labor crews and technicians from one plant to another to ease bottlenecks.

3. Job Distribution within the Aircraft Plant.

The plant organizations and the job descriptions of personnel employed in the Soviet aircraft industry are similar to those of the US aircraft industry. (For a complete organizational breakdown of a typical US aircraft manufacturing plant, see Appendix D.) With information now available and with considerable effort, it should be possible to reconstruct the organization of many of the departments in numerous Soviet aircraft plants.

a. Direct Labor.

Soviet workers are graded into eight categories according to their degree of skill. The category of a worker is established by the foreman of his group in the individual shop. If a new employee makes claim for a new designation of his category, he is given an examination to determine his suitability. This trial period generally lasts about 2 weeks, and the foreman then makes the final decision.

The eight categories are as follows:

(1) Unskilled.

(2) Laborers.

(3) Laborers with some experience and qualifications.

(4) Workers competent to work without continuous supervision but not completely qualified for all phases of the job.

(5) Workers completely qualified for the job.

(6) Qualified personnel with outstanding abilities.

(7) Specialized and highly qualified personnel (not on piece work).

(8) Highly specialized personnel requiring a high degree of training rarely found in the aircraft industry: that is, inspectors, specialized machine setup men, etc. (not on piece work).

The categories are divided roughly into two main groups. In the first group are categories 2 and 3, which cover about 35 percent of all direct laborers. Workers in these categories are employed largely as apprentices or, as in the machine shops, to operate the machine tools or on simple assemblies. In the second group are categories 4 and 5, which include about 48 percent of the workers. These categories correspond to the semiskilled class in the US. Workers in these two categories, who themselves are given apprentices or assistants, work in the riveting assembly and the sheet-metal and airframe assembly shops. In the machine shops they work on simple operations and the machining of simple parts. Workers in categories 2 through 5 total about 83 percent. Of this number, about two-thirds are ordinary workers, and the remainder are assistants, on-the-job trainees, or assembly-line workers. On the basis of total number of employees of all categories in a typical factory, the average of production workers falls between category 2.8 and category 3.

The following table gives a percentage breakdown of categories of labor employed in a typical aircraft factory:

Distribution of Direct Labor
in Soviet Aircraft Plant No. 381, Moscow

Percent

Designation of Shop	Categories					
	2	3	4	5	6	7
Flight Test Shop	0	0	25	25	35	15
Assembly Line	20	20	20	30	10	0
Riveting Assembly	25	30	20	15	5	5(?)
Fitting and Welding	10	23	35	20	10	2
Sheet-metal Shop	15	20	20	30	10	5(?)
Machine Shop	10	30	30	18	10	2

b. Test Pilots.

Since World War II the majority of Soviet plant test pilots have been military personnel. Before World War II, most of the test pilots were civilians. A large number of these civilians later were given military status and continued to serve as test pilots. 10/

Test pilots at Soviet plants usually test-fly the airplanes twice, each flight lasting about 30 minutes, before turning them over to Air Force test pilots. The high standing and influence of test pilots at the plants are reflected in the fact that any malfunctions reported by them on their test checks are cleared on a priority basis.

4. Geographic Distribution of Industrial Labor.

(See Figs. 13 and 14.)

5. Employment and Unemployment.

There has been no chronic unemployment in the Soviet aircraft industry. As the industry expanded there were, however, temporary suspensions in production because of construction, change-overs in aircraft models, and shortages of parts. Allowance was made for these interruptions by scheduling the production of consumer goods by the plant so that extensive idleness or lay-offs would not occur.

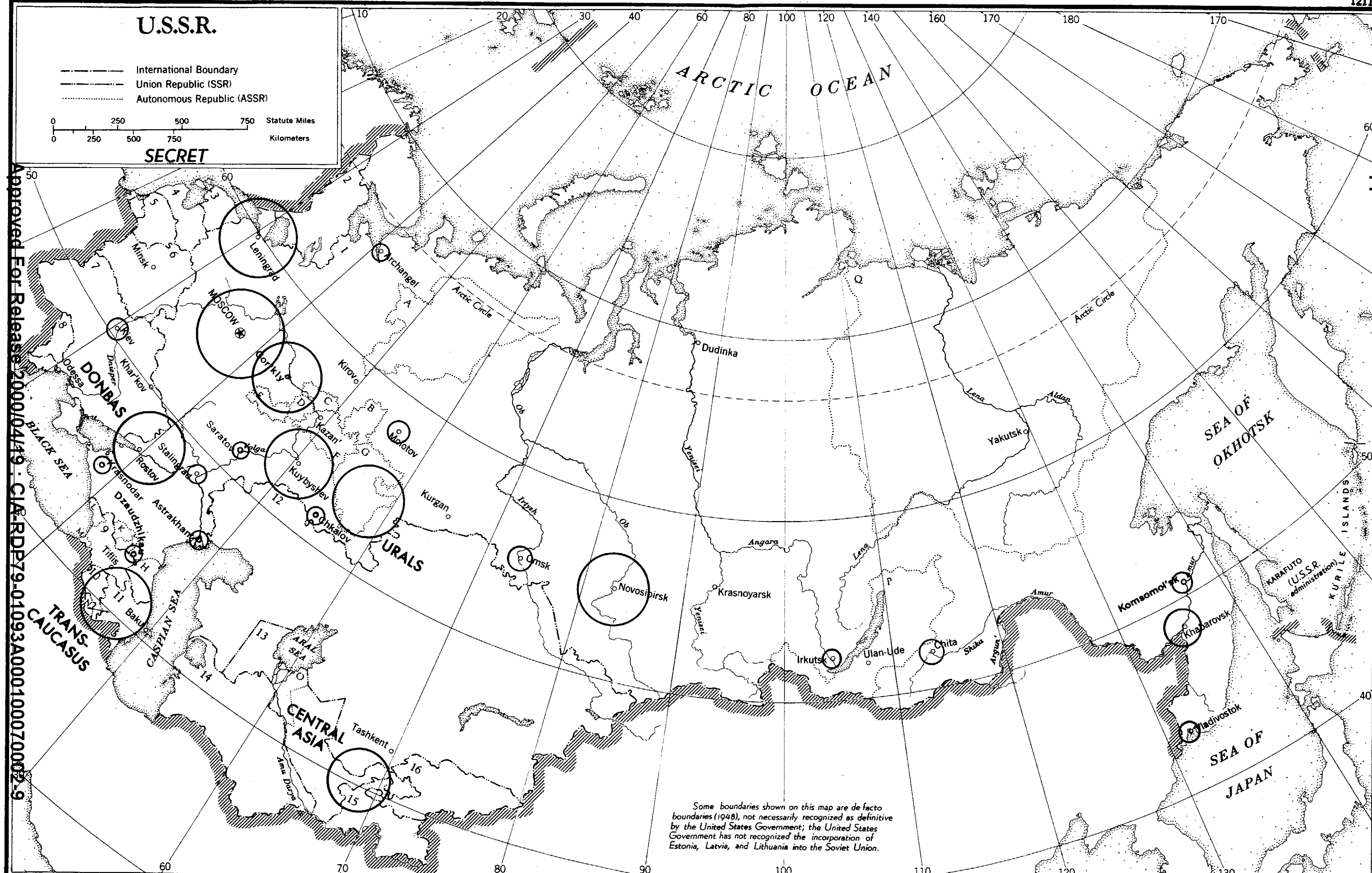
6. Employment of Women.

Women are employed in the Soviet aircraft plants in almost every type of job held by men. Exceptions are the more dangerous and unhealthy jobs such as engine testing, welding, acetylene cutting, and painting. 11/ If total mobilization for war should occur, it is presumed that greater use would be made of women in the aircraft plant and that they would be assigned to jobs now performed chiefly by men. In some plants, women already constitute 50 percent of the total employment.

MAJOR INDUSTRIAL CONCENTRATIONS IN THE U.S.S.R. (1948)

Figure 13

12111



Note: The size of each circle represents the approximate relative size of the industrial concentration. Important regions as well as cities are shown. It has not been possible to assign exact percentage values to each circle.

ADMINISTRATIVE DIVISIONS

S.S.R.

1. R.S.F.S.R
2. Karelo-Finnish S.S.R.
3. Estonian S.S.R.
4. Latvian S.S.R.
5. Lithuanian S.S.R.
6. White Russian S.S.R.
7. Ukrainian S.S.R.
8. Moldavian S.S.R.
9. Georgian S.S.R.
10. Armenian S.S.R.
11. Azerbaydzhan S.S.R.
12. Kazakh S.S.R.
13. Uzbek S.S.R.
14. Turkmen S.S.R.
15. Tadzhik S.S.R.
16. Kirgiz S.S.R.

A.S.S.R.

A. Komi ASSR
B. Udmurtskaya ASSR
C. Mariyskaya ASSR
D. Chuvashskaya ASSR
E. Mordovskaya ASSR
F. Tatarskaya ASSR
G. Bashkirskaya ASSR
H. Dagestanskaya ASSR
J. Severo-Osetinskaya ASSR
K. Kabardinskaya ASSR
L. Abkhazskaya ASSR
M. Adzharskaya ASSR
N. Nakhichevanskaya ASSR
O. Kara-Kalpakskaya ASSR
P. Buryat-Mongol'skaya ASSR
Q. Yakutskaya ASSR

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Figure 14

CONCENTRATIONS OF THE AIRCRAFT INDUSTRY IN THE U.S.S.R.
(BASED ON AIRFRAME WEIGHT DURING PEAK WORLD WAR II PRODUCTION)

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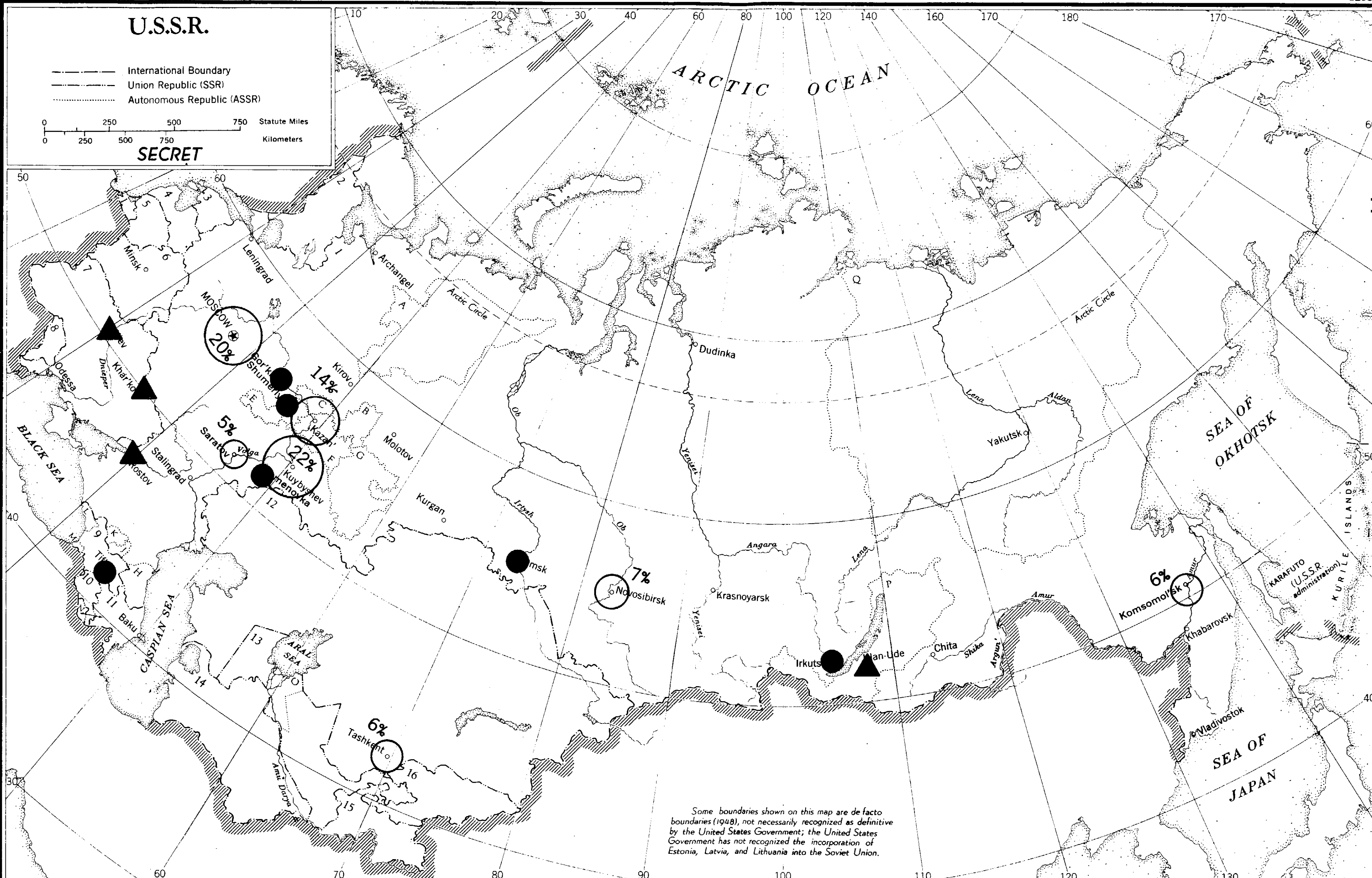

○ Larger center of production of aircraft

● Four percent or less of total Soviet wartime airframe production

▲ New or rebuilt postwar plant of unknown capacity

Percentage figures refer to percent of total wartime production of aircraft in the USSR (in terms of airframe weight) in centers indicated on map.

Peak Yearly Production, World War II: 260 million lbs. airframe weight.

CIA/RR Project 38-51 PR-8

ADMINISTRATIVE DIVISIONS

S.S.R.

1. R.S.F.S.R
2. Karelo-Finnish S.S.R.
3. Estonian S.S.R.
4. Latvian S.S.R.
5. Lithuanian S.S.R.
6. White Russian S.S.R.
7. Ukrainian S.S.R.
8. Moldavian S.S.R.
9. Georgian S.S.R.
10. Armenian S.S.R.
11. Azerbaydzhan S.S.R.
12. Kazakh S.S.R.
13. Uzbek S.S.R.
14. Turkmen S.S.R.
15. Tadzhik S.S.R.
16. Kirgiz S.S.R.

A.S.S.R.

A. Komi ASSR
B. Udmurtskaya ASSR
C. Mariyskaya ASSR
D. Chuvashskaya ASSR
E. Mordovskaya ASSR
F. Tatarskaya ASSR
G. Bashkirskaya ASSR
H. Dagestanskaya ASSR
J. Severo-Osetinskaya ASSR
K. Kabardinskaya ASSR
L. Abkhazskaya ASSR
M. Adzharskaya ASSR
N. Nakhichevanskaya ASSR
O. Kara-Kalpakskaya ASSR
P. Buryat-Mongol'skaya ASSR
Q. Yakutskaya ASSR

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7. Employment of Foreign Workers.

Since the end of World War II the supply of foreign slave labor in the Soviet aircraft industry, comprised chiefly of German and other prisoners of war, has almost stopped. Almost the only foreigners now in the aircraft industry are German scientists and technicians working in research and development laboratories but having virtually no direct connection with the aircraft plants.

8. Productivity of Labor.

Measured in terms of manual effort, labor productivity in the Soviet aircraft plants probably is higher than in the US. This is principally a result of coercion by disciplinary action against individual workers and groups of workers for their failure to meet assigned production quotas or for their delaying the operations of other units, although incentive rewards in the form of bonuses and such special privileges as paid vacations and extra food rations also have some effect. Productivity with reference to technological factors is considered to be lower in the USSR than in the US, possibly on a level with the UK.

Managerial ability likewise is not so high in the USSR as in the US. One reason for the comparatively low level of managerial ability is that the aircraft industry, as well as the engineering industry in general, is not so old as that of the US, with a consequent lack of experience. Another very important reason is the fact that the selection of managers is based upon political reliability rather than upon managerial ability. 12/ As a result, these managers generally are young and enthusiastic but frequently are unprepared to assume their responsibilities. Periodic purges of managerial personnel since the beginning of Soviet aviation industry likewise have handicapped its efficiency.

9. Supervisory Personnel.

All plant directorate personnel in the USSR are appointed by either the MAP or by the Central Committee of the Communist Party, but in either case, appointments must be approved by the Central Committee. 13/ Lower supervisory positions are filled by persons nominated by the plant directorate or by the plant Party organization, but all appointments must be approved by the plant Party organization. There are three distinct classes of Soviet workers who make up the ranks of foremen:

a. Those who attain this rank by their own merit and political stability (20 percent).

b. Those who are recommended to the position of foremen by the plant Party organization, regardless of experience and ability (60 percent). (Workers who are very active members of the Party are promoted to the rank of foremen.)

c. Professionals who are graduates of technical schools sponsored by the MAP, which assigns them to various aircraft plants (20 percent).

10. Key Personnel.

The names and positions of key personnel in the Soviet aircraft industry can be obtained. The chances of causing their disaffection or liquidation , and any resulting adverse effect on aircraft production, is slight.

D. Wages.

Job standards are set by the technicians in each factory shop on the basis of the technical norms derived from past experience. In case of disagreement over the norm, a trusted Party member is given a time-study test to check the norm. Each worker is given a card which defines his job, the category of the job, the number of hours worked, and the sum of his earnings. Upon completion of a job the worker records upon his card the actual time he spent on the job. If a worker constantly overfulfills his norm of production in the range of 150 to 200 percent, his norm possibly will be readjusted, thus depriving him of the premium production award. Therefore, the worker adds all his idle time, for which he would normally receive only 50 percent pay, to the time actually spent on operations.

1. Systems of Pay.

There are three systems for the payment of wages in the Soviet aircraft industry: piece work, time, and salary.

a. Piece Work.

At least 90 percent of the factory workers in the Soviet aircraft industry are paid on a piece-work basis. Piece workers receive their pay according to the established rates, provided they produce 100 percent of the production quota as set by time-study and production men.

b. Time.

The types of workers generally paid on a time (hourly, weekly, etc.) basis are janitors, firemen, warehouse workers, utility workers, repairmen, and workers in similar jobs. Such workers as stationary engine operators and boiler operators also are paid on a time basis.

c. Salary.

Noncategory employees such as executives, office workers, and auxiliary and maintenance personnel are paid on a monthly salary basis.

2. Government Wage Policy.

The wage scale of the defense industries, particularly for the aircraft industry, is higher than that of the nondefense industries.

3. Wage Rates for Executives and Noncategory Workers.

The wage rates for executives and noncategory workers are as follows 14/:

Wage Rates for Executive and Noncategory Workers in the Soviet Aircraft Industry

1949 Rubles
(5 Rubles = $1 US)

Position	Average Monthly	Average Monthly Bonus	Total
1. Director	3,500-4,000	4,000-6,000	7,500-10,000
2. Chief Engineer	3,000-3,600	3,500-5,000	6,500-8,600
3. Deputy Director	2,000-3,000	3,000-3,500	5,000-6,500
4. Chief, Production	2,000-2,600	2,500-3,500	4,500-6,100
5. Chief, Mechanic, Utilization Technical Control and Other Section Chiefs	2,000-2,300	2,000-3,000	4,000-5,300
6. Chief Plant Bookkeeper	2,300-2,500	2,000-2,500	4,300-5,000
7. Plant Production Engineer	700-900	300-500	1,000-1,400
8. Supervising Aircraft Engineer	950-1,250	500-700	1,450-1,950
9. Aircraft Engineers, Categories 1, 2, 3 a/	750-1,050	(Overtime and Piece Work)	
10. Office Workers of Plant Directorate	300-500	100-150	400-650
11. Accountants	500-700	100-150	600-850
12. Bookkeepers	280-500	50-100	330-600
13. Laboratory Technicians	350-550	50-100	400-650
14. Supply Foremen	500-750	100-150	600-900
15. Inside Supply Expeditors or Dispatchers	600-1,000	100-400	700-1,400
16. Outside Supply Expeditors	800-1,000	100-350	900-1,350
17. Timekeepers	250-350	50-100	300-450
18. Outside Maintenance Personnel	240-300	?	240-300
19. Inside Maintenance Personnel	200-236	20-50	220-286

a/ Aircraft engineers are paid on a monthly and overtime basis.

4. Wage Rates for Shop Administrative Personnel.

The wage rates for shop administrative personnel are as follows 15/:

Wage Rates for Shop Administrative Personnel
in the Soviet Aircraft Industry

1949 Rubles
(5 Rubles = $1 US)

	Position	Average Monthly Rate	Average Monthly Bonus	Total
1.	Shop Supervisor	1,200-1,700	1,000-2,000	2,200-3,700
2.	Deputy Shop Supervisor	1,100-1,500	1,000-1,500	2,100-3,000
3.	Shift Supervisor	1,250	800-1,000	2,050-2,250
4.	Section Chiefs	950-1,150	600-1,000	1,550-2,150
5.	1st, 2d, and 3d Class Foremen (Chiefs)	750-950	500-1,000	1,250-1,950
6.	Senior Inspector Foremen	750-950	300-500	1,050-1,500
7.	Assembly Inspectors	750-950	300-500	1,150-1,450
8.	Inspectors	600-700	250-400	850-1,100
9.	Material Handlers	420-475	70-150	490-625
10.	Chief, Shop Engineering	1,100	500-700	1,600-1,800
11.	Chief, Shop Production	800-1,000	300-500	1,100-1,500
12.	Production Flow Men	550-1,000	250-350	800-1,350
13.	Shop Planning	500-700	200-300	700-1,000
14.	Chief, Shop Planning Section	800-1,000	200-400	1,000-1,400

5. Additional Income and Emoluments Received by Aircraft Workers.

a. Bonuses.

Bonuses are granted to entire Soviet aircraft plants for the fulfillment of their production schedules or quotas. If part of a plant fails to meet its quota, the entire plant loses eligibility. Bonuses also are given to individuals as well as to groups within a plant for exceptionally high production accomplishments. Competition between plants is much stronger in the USSR than it is in the US.

b. Awards.

Awards and decorations generally are given to Soviet employees in reward for long periods of continued high production which establish precedents that may be set up as future goals. The awards become part of the employee's permanent record, and as a result, he acquires a certain higher distinction.

c. Per Diem and Travel Expenses.

When Soviet employees are required to travel on business from their normal place of employment, they are paid per diem. The benefiting factory must agree to pay the per diem wages as well as the travel expenses and also must reimburse the lending factory for the borrowed employees. This temporary duty usually is restricted to specialists, trouble shooters, and special machine setup men and operators. Sometimes, however, entire crews are sent. It is illegal for any employee to refuse a temporary duty assignment. Air travel customarily is employed.

d. Other Emoluments.

Extra rations of food, clothing coupons, and paid expenses at rest centers are typical premiums for exemplary production achievements.

e. Special Incentive Pay.

Special incentive pay is used when quotas cannot be achieved through usual means. 16/ This type of pay usually is introduced toward the ends of months, quarters, or years, when it is apparent that the Plan goal is not going to be fulfilled. Special incentive pay must be authorized by the MAP and is granted only for limited periods. For example, the installation of an engine by the technical norm requires that two workers, one in category 6 and one in category 4, work 10 hours each to complete the job. Suppose that during the last 2 days of the month it becomes necessary to install 10 engines, an obviously impossible task within the allotted time. In such a case the management will offer a temporary wage increase to the extent of 100 percent, 200 percent, or even higher to get the job done.

Special temporary payment for quality production also is made in situations where the prescribed standards of quality have not been met. An entry is made on the individual's time card to indicate that he is to be paid 100 percent above normal for distinguished work or perhaps 50 percent above normal for better-than-average work.

f. Overtime Pay.

The first 1½ hours over 8 hours is paid at a rate of time and a half. Time over 9½ hours is considered double time. A job is assigned to a worker after it has been determined how long it should take. If the worker completes a 20-hour job in 11 hours, he receives normal pay for the first 8 hours. For the additional 3, he receives time-and-a-half for the first 1½ hours of overtime and double-time for the remaining 1½ hours. Double-time is paid for work on Sundays. Triple-time is paid for work on Revolutionary holidays. Eighteen percent over the base pay is paid for work after midnight. 17/

g. Stand-by Pay.

Stand-by pay is given when the worker, if through no fault of his own as a result of no project assignment or a faulty machine, remains on the job without producing anything. If it is the fault of the administration of the plant, he receives 50 percent of his pay. If his idleness is his own fault, he receives no pay. In special cases, where workers have been standing idle by their machines for an extended period of time through no fault of their own, the administration may pay them as much as 100 percent of their pay. Permission to make payments in these special cases must be obtained from the MAP.

h. Increased Pay for Increased Skill.

When a new aircraft is put into series production, the time-study men work out new norms based on an ideal production process. Since an ideal process does not occur in the early stages, the workers do not fulfill the norms. Therefore, a system of increased pay is introduced to encourage the attainment of the skill necessary to fulfill the quotas. The pay is agreed upon by the Labor Department of the factory but must be authorized by the MAP. The increased pay normally runs from 20 to 100 percent but sometimes is as high as 150 percent. 18/

6. Length of Working Day.

The customary working day in the Soviet aircraft industry is 8 hours. Additional hours of overtime, making the working day 16 or even 24 hours, however, are not rare during certain critical times near the expiration of a quota period. One, two, and three shifts are worked. The number of hours per shift and number of shifts within a plant may vary depending upon production requirements and quotas.

7. Programming and Procedures.

In the USSR before 1937, limited-series aircraft were produced in small aircraft plants. Since then, however, the limited series have been made in the plants where the full-series production was to be accomplished. The usual number of aircraft produced in the Soviet limited series is 5 in the first series and 10 in the second.

Upon the assignment to a plant of a new series or type of aircraft, representatives of the MAP visit the plant which is producing the prototype aircraft, confer with plant representatives, and check the plans and drawings. The plant management generally prepares the plant for full-series production in order to get a head start on its quota.

The plant responsibilities for carrying out full-series production break down approximately as follows:

a. Production Planning Section. Plans the necessary output of aircraft per day to fulfill the production schedule.

b. Technical Department. Determines the man-hours necessary for the manufacture of each part. Sets up the sequence of work for each item by shift, section, and work group in order to assure full utilization of both machines and workers.

c. Plant Labor Department. Sets up a time schedule for the manufacture of parts in accordance with the over-all production schedule and allocates the work for each shop as well as the time necessary to assemble the completed aircraft.

There is no production during the first week, at which time the workers recover from preceding exhaustive efforts. Production starts during the second week, but it is insufficient for the operation of the assembly line. Although assembly-line workers are idle, they are required to stand by. By the end of the first week and a half, however, the pace has increased to the extent that overtime is required.

In periods of pressure workers are not permitted to leave their jobs until their assignments are completed, even if they must work two, three, or even four continuous shifts, and no rest is permitted. If a worker makes an unauthorized departure from the plant during such periods of pressure, even because of physical exhaustion, a plant vehicle is sent for him, and he is returned to the plant foreman, who is responsible for the accomplishment of the prescribed production quotas regardless of the condition of his personnel.

E. Organized Labor.

1. Trade Union Movement.

Considerable information exists on the organization of the trade union movement in the USSR, and it is probable that a more accurate picture of its activities in the aircraft industry and the percentage of workers belonging to the union can be worked out with further research. The role of the trade union in the USSR is vastly different from that of the US trade unions. Although one function of the Soviet union is to protect workers' rights against infringement by management, it operates primarily as an organ of the Government to stimulate production.

The highest authority of the Soviet trade union movement is the All Union Congress of Trade Unions. Between the meetings of the congresses, union activity is directed by the All Union Central Council of Trade Unions, elected by each Congress. 19/ Each industrial trade union has its own by-laws reflecting the peculiarities of the industry but conforming to the rules of the All Union Central Council of Trade Unions. The industrial union of the aircraft industry is known as the Trade Union of the Workers of the Aviation Industry. The basic unit of the industrial trade union is the trade union local, which comprises all trade union members employed at one enterprise or institution.

According to the Soviet press the Soviet trade union movement is to unite factory and office workers of all professions regardless of race, nationality, sex, or religion on a "voluntary" basis and conduct all their activity under the leadership of the Communist Party, the organizing and guiding force of Soviet society. 20/ Membership in the trade union movement is not compulsory, but strong pressure is exerted on the workers to join their industrial union. The majority of workers belong to the union and pay an initiation fee and about 1 percent of their salary in dues. Supervisory personnel are not organized.

2. Aims of Organized Labor.

The most important tasks of the trade union movement are to induce the highest production efforts from the workers and to indoctrinate and propagandize the workers and their families. Thus the industrial trade unions are responsible for maintaining discipline; enforcing decrees restricting worker mobility; reducing idling and absenteeism; recruiting all engineers, technical workers, and other employees; and organizing "Socialist competitions" to speed up production. The industrial trade unions also are responsible for ensuring that their industry completely fulfills the Five Year Plan commitments in the mechanization of both heavy and light industry. 21/

According to a Soviet press release, "today the basic factor in organizing and improving the entire work of the trade unions is the Socialist competition and its offspring, the shock brigades. The trade unions must organize fraternal contests between the best members of the shock brigades in order to make the necessary impression on persons who violate labor discipline. In serious disciplinary matters and security violations the Ministry of the Interior (MVD) through its field representatives (MGB) takes charge of the case." 22/

3. International Affiliations and Influence.

The Soviet trade union movement is affiliated with the World Federation of Trade Unions, formed in 1945. The trade unions are encouraged to develop friendly relations with trade unions in other countries to assist the cause of Communism throughout the world. 23/

4. Key Personnel.

The names of key trade union personnel who have or are likely to have a vital role in Soviet manpower matters are not known. It is possible, however, to learn the names and positions of some of these persons. Their disaffection or liquidation probably would have little effect on the production of the aircraft industry.

F. Labor Relations and Their Effect on Aircraft Production.

1. Role of the Government in Labor Relations.

The Central Committee of the All Union Communist Party, reporting directly to the Politburo, determines the mission of the MAP in accordance with the strategic plans of the USSR. The MAP in turn regulates labor in the aircraft industry so as to attain the goals set for the industry. So long as production goals are being fulfilled or overfulfilled at all aircraft plants, the MAP receives awards and financial premiums. In the event that the plants have no assigned tasks, the MAP, whose governmental standing is rated on the output of the aircraft industry, tries to obtain orders so that the plants will not be idle. As a result of this emphasis on high numerical output, the MAP avoids introducing design modifications and new models, as such changes result in production slowdowns and hence a lower efficiency rating for the MAP. Should the Politburo and Central Committee conclude that the efficiency of the MAP has decreased, the MAP chief and his assistants are likely to be classed as traitors to the USSR and imprisoned. Fear of imprisonment extends from the top personnel down to the unskilled laborers, as someone always is held personally responsible for production difficulties not immediately solved.

2. Labor Management Relations.

The foremen, responsible for the workers assigned to their ships, must remain in their shops, as must the inspectors, who are responsible for the acceptability of the work upon its completion. In order to insure that the inspectors remain in the shops, the plant's chief of technical control checks on the inspectors. Foremen are checked on by head foremen, who in turn are checked on by the plant supervisor. Shop executives likewise are required to be present in the shop. The chief of production must stay in the shop during time of pressure in order to check on the personnel under him. The plant director and his executive personnel also must remain in the plant in order to insure the presence of the lower echelons. The chief directorates of the MAP keep very accurate checks on the plant directors in order to keep them on the job. 24/

Soviet workers have very few rights, and their sole responsibility is the completion of their assignments. Should their jobs interfere with their personal lives, the job requirements must be given primary consideration.

3. Collective Bargaining.

Since the trade union in the USSR is an agency of the Government operating only to protect the interests of the State-owned plant by obtaining the maximum amount of effort from the workers, collective bargaining as it is known in the US does not exist. Although work stoppages sometimes occur, they are not caused by labor as in the US but generally result, for example, from the failure of the Ministry of Finance to forward the credits required for wages and purchases of materials and parts from other plants to maintain production. 25/ Major industrial disputes do not occur in the USSR. It is true that minor disputes between individuals or groups and the plant management do occur, but these generally are settled by arbitration among the individuals or groups, the union, and the management concerned. The extent of the development of industrial councils and workshop organizations is unknown at present, but information presumably can be obtained by additional research. 26/

G. Labor Legislation Affecting the Aircraft Industry.

Although there are laws governing wages, hours, and working conditions in the USSR, their interpretation is loose. Measures restricting freedom to seek other employment confine workers to assigned jobs whether they like them or not. During World War II, labor laws were not so easily enforced as before and after, and this laxity resulted in workers migrating to employment offering higher pay and better working conditions. Plants which were desperate for more help were willing to overlook the law requiring that a worker be released by his former employer before being hired by another.

H. General Welfare and Standards of Living.

1. General.

Since the USSR is placing heavy emphasis upon developing air strength, it must have efficient and reliable workers in its aircraft industry. As a result, the Soviet aircraft industry is considered to be an elite industry, and employees generally receive better treatment than do the workers in the nondefense or other defense industries, a greater abundance of the common necessities of life, and higher rates of pay and bonuses. The aircraft industry employs a higher caliber of personnel, who are comparatively more skilled than employees in other industries. Present increasing production of military and industrial goods, however, probably will depress the standard of living because of greater work demands upon the workers and decreased availability of consumer goods.

2. Hygienic Facilities.

Lavatories, toilets, and baths are available for workers in Soviet aircraft plants. Apartments in housing projects belonging to aircraft plants also are equipped with such facilities.

3. Food and Nutrition.

Workers may buy their meals at plant cafeterias. The food served is grown by special agricultural labor groups and, whenever possible, on tracts of land belonging to the aircraft plants.

4. Industrial Diseases.

Information concerning the existence of industrial diseases in the Soviet aircraft industry is not available. It might be assumed that the situation is similar to that found in the US or the UK aircraft industry.

5. Medical Care.

Doctors and nurses are on duty at Soviet aircraft plants. Whether medical service includes out-patient treatment of injuries and illnesses incurred as a result of employment in the aircraft plant and treatment of injuries and illnesses incurred outside the plant is not known. Dispensaries are located in the Soviet aircraft plants, but how well-stocked they are is not known.

6. Social Security for Employees.

a. Trade Unions as Administrators of Social Security.

The trade unions administer State social insurance, allocate and issue benefits to employees in case of temporary incapacity for work, seek better organization of medical assistance for the workers, attempt to safeguard the health of women and children, establish sanatoria and rest homes, organize mutual assistance offices, take part in the allocation of housing space in apartment houses of enterprises and institutions, and exercise control over plans for housing, plant dining rooms, stores, public utility enterprises, and municipal transport. 27/

b. Advantages Enjoyed by Trade Union Members.

Trade union members enjoy the following advantages:

(1) Larger benefits from State social insurance funds than nonunion members.

(2) First priority on passes for rest homes, sanatoria, and resorts; also passes for children to day nurseries, kindergartens, and camps.

(3) Material aid from union funds in the event of necessity.

(4) Free legal aid.

(5) Cultural and sporting institutions sponsored by the unions.

(6) Sick leave.

c. Nonparticipants of Trade Union Social Benefits.

At least 90 percent of the employees in the aircraft industry belong to the trade union and participate in trade union social benefits. The nonparticipants generally are disenfranchized persons, political prisoners, and prisoners of war.

d. Sick Leave.

Sick leave is available only to union members. An employee must have at least 1 year's service, however, to be eligible to collect sick pay. If he has had from 1 to 2 years' service, he may collect 50 percent of his normal pay, and if he has had over 2 years' service, he may collect 100 percent as computed on the average of his last 3 months' pay. 28/ Another source reports that the sick leave pay is based on the average of the last 12 months' pay.

e. Pensions.

For 20 years' work at the same plant, workers receive pensions. These are so small, however, that it is impossible to live on them, and consequently employees work for as many years as possible. 29/

f. Vacations.

A worker receives 12 days' paid vacation a year and receives 2 additional days at the end of each 5-year period. Vacation pay is computed on the basis of the average of his last 3 months' pay. 30/

I. Security and Discipline.

1. Security Police.

a. MVD.

The function of the Ministry of Internal Affairs (Ministerstvo Vnutrennikh Del--MVD) is to check on management and labor in order to insure that security measures are being carried out. The MVD has offices in all aircraft plants but is not subordinate to the plant management, nor is the plant management subordinate to the MVD personnel on duty at the plant. MVD personnel at the plants, however, exert considerable influence, even in matters concerning aircraft production. Fire chiefs, inspectors, and firemen are MVD personnel. MVD personnel sometimes also are disguised as menial laborers, such as sweepers, in order to check on plant personnel. It is believed that most MVD personnel have been rejected from active military duty for physical reasons.

b. Plant Protection Police.

Civilian guards are hired from among local residents in the vicinity of the aircraft plant. They check passes of workers who enter and leave the plant, perform patrol functions, and guard special operations.

c. Military Guard.

To protect very special operations and restricted areas, the aircraft plant management calls upon the local military detachment for the assistance of soldiers and military equipment.

2. Disciplinary Measures.

Forced labor is the major disciplinary measure enforced against Soviet workers. Legislation dealing with forced labor is part of the basic law of the USSR. The Corrective Labor Codex of the Russian Soviet Federal Socialist Republic, confirmed by decree of 1 August 1933 of the All Union Central Executive Committee and Council of Peoples' Commissars of the Russian Soviet Federal Socialist Republic, is printed in Volume 9 of the "Chronological Collection of Laws, Decrees of the Praesidium of the Supreme Soviet, and Ordinances of the Government of the Russian Soviet Federal Socialist Republic up to 1 March 1940." Disclaimers that forced labor is not recognized in the USSR are therefore valueless.

Under the Codex a statute of 8,500 words and 147 clauses (of which only five have been repealed), three main categories of forced labor are established:

a. Forced labor at the worker's normal place of employment. The worker is given a lower rate of pay or extra duty. He returns home after work.

b. Forced labor at the worker's normal place of employment (the same as in a, above) but with the worker living at a disciplinary barracks.

c. Forced labor in a place of detention. The worker is sent to a work camp. The type and place depend upon the seriousness of the worker's crime.

Thus there is forced labor both with and without loss of freedom, and there are graded stages of compulsion whereby people can be made to do work which they do not want to do, or to work in places where they do not wish to go, or to work for lower wages than they have hitherto received.

The most important breach of labor discipline, because of the economic factor, is absenteeism, which the worker must make up by extra work at no extra pay. 31/ A Soviet worker is guilty of absenteeism if he loses more than 20 minutes' working time by arriving late, leaving early, or extending his dinner break, or if he commits any of these offenses three times in 1 month or four times in 2 consecutive months, even if the loss of time in each case is less than 20 minutes. 32/ During World War II, absenteeism was greater than at present because of the increase in hours and work load. Management was reluctant to enforce such disciplinary measures that would cause loss of labor by absence from the job or would cause him to seek other employment.

In the US aircraft industry today, as during World War II, increased hours of work are tending to increase absenteeism. Aircraft firms on the 40-hour week average 4 percent of their workers away from the job, while those with a 6-day week find that their absentee rate runs between 6 and 8 percent. 33/

In the event that a part is found to be defective, 40 percent of the blame generally is placed on the worker, 30 percent on the foreman, and 30 percent on the supervisor. If it can be shown that the inspector has tested the accuracy of the tools in an inefficient manner, the entire blame is placed upon him. In the event that the entire blame is placed upon the worker, and the defective part must be scrapped, the cost of the part is deducted from the worker's pay.

J. Ability of the Aircraft Industry to Meet Manpower Requirements.

1. Aviation Institutes.

Aviation institutes in the USSR are conducted on both a full-time and a part-time basis. There are minimum academic and training qualifications required for entrance. The following is a list of several of the larger aviation institutes:

a. Kazan' Aviation Institute, Kazan', Tatar ASSR. 34/

b. Kharkov Aviation Institute, Kharkov, Ukrainian SSR. 34/

c. Kuybyshev Aviation Institute, Kuybyshev, Kuybyshev Oblast. 34/

d. Leningrad Institute of Aviation Instrument Building, Leningrad. 34/

e. Moscow Order of Lenin Aviation Institute imeni Sergo Ordzhonikidze, Moscow. Training courses: aircraft construction, aircraft engine construction, electromechanical installations, radio engineering, aviation equipment and instrument manufacture, and engineering economics. 35/

f. Moscow Aviation Technical Institute, Moscow. Training courses: metal processing, heat processing of metals and alloys, pressure processing of metals, casting, welding, technology of machinery construction, technology of aircraft manufacture, and technology of instrument manufacture. Evening division: metal processing, heat processing of metals and alloys, technology of machinery construction, and technology of instrument manufacture. 36/

g. Ufa Aviation Institute imeni Sergo Ordzhonikidze, Ufa, Bashkir ASSR. 34/

From 1932 to 1937, requirements for attendance at the Moscow Aviation Technical Institute were either 10 years of primary school or 7 years of primary school plus graduation from the Aviation Industry School for Designer-Draftsmen.

It is improbable that there will be enough technicians and skilled workers to satisfy the requirements of the aircraft industry. In the event of war the situation will worsen.

2. On-the-Job Training.

On-the-job training of many thousands of aircraft workers is expected to supply the demand for semiskilled workers.

K. Military Draft of Aircraft Industry Workers.

Because of the high priority given to the aircraft industry, nearly all employees except unskilled laborers can be expected to receive deferments from military draft if full mobilization for war should occur. Male employees taken from the aircraft industry probably will be replaced by women. It can be expected that many skilled and semiskilled workers will be transferred from non-defense industries if the USSR should mobilize for war at a greater rate than at present.

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[redacted]

[redacted]

5. Man-hours Required to Build the Soviet MIG-15 Airframe.

The direct man-hours required to produce the MIG-15 airframe have been estimated as excessive by US standards. The extra direct man-hours are the result of more handwork and built-up sections than in US aircraft. The following was noted from examination of the MIG-15 fuselage at the Air Technical Intelligence Center:

a. Extensive handwork and hand fittings were noted throughout the airframe.

b. Wing and tail spars and the diagonal beam were built-up sections rather than forged members.

c. Extensive machining and hand grinding were noted on steel forgings and castings.

d. Steel welds were used quite extensively and varied from poor to excellent.

This method of building the MIG-15 airframe is not altogether undesirable from the Soviet point of view, since there are certain production features which tend to overbalance the disadvantages of excess direct man-hours, as follows 39/:

a. Over-all simplicity of the airframe design.

b. Ability to use universal rather than special machine tools.

c. Relatively few castings, forgings, and extrusions.

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d. Comparatively fewer skilled workers required.

e. Adaptability to quantity production because of ease of break-down for subassembly operations.

[redacted]

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M. Sources.

25X1C
1. Aircraft Industry of the USSR, ORR Project 3-51, 9 Apr 51, p. 8.
2. [redacted]
25X1A
3. Ibid., p. 26.
4. [redacted]
5. OSI, USAFE, IR-49-3-7/4-0450, 28 Apr 50 and ATLO-4-50, Categories of USSR Aero Zavods, 15 Feb 50.
25X1C
6. [redacted]
7. Aviation Week, 26 Feb 51, p. 29.
25X1C
8. American Aviation, 17 Sep 51.
9. [redacted]
10. The USSR Aircraft Industry, OSI, USAFE Report No. 49-3-7/1-21-0450, 28 Apr 50, F-2.
11. Temple, Plant 64, Voronezh, and Plant 84, Tashkent, AFOIN-T/IR, Jul 51.
25X1C
12. [redacted]
13. OSI, USAFE Report No. 49-3-7/1-21-0450, 28 Apr 50, F-2, p.15.
14. OSI, USAFE Report No. 49-3-7/6-0450, p. 22.
15. Ibid., p. 23.
16. OSI, USAFE Report No. 49-3-7/1-21-0450, 28 Apr 50, F-2.
17. Ibid.
18. Ibid.
19. Moscow, Tass, Soviet Press Service, 12 May 49, FBIS, 13 May 49.
20. Soviet News, Press Dept., Soviet Embassy, London, 18 May 49.
21. Moscow, USSR Home Service, 20 Apr 49.
22. Communism in Action, US Library of Congress, US Government Printing Office, 46.
23. AA 11, European Section, USSR Home Service, FBIS, 21 Apr 49.
24. OSI, USAFE Report No. 49-3-7/1-21-0450, 28 Apr 50, F-2.
25. OIR, State, "Soviet Trade Unions," Soviet Affairs Notes, No. 54, 1 Apr 49.
26. Ibid.
27. USSR, Trud, "By-laws of the Trade Unions," 11 May 49.
28. OSI, USAFE Report No. 49-3-7/1-21-0450, 28 Apr 50, F-2.
29. Ibid.
30. Ibid.
31. State, "Forced Labor at Normal Place of Employment," The Forced Labor Codex of the RSFSR, no date, CIA 344764.
32. Ibid.
33. "A Look at the Week," American Aviation, 16 Jul 51.
34. Spravochnik dlya postupayush v vysshiye uchebniye zavediniya Soyuza SSR v 1950 g (Handbook for Entrants into Higher Educational Institutions of the USSR in 1950), Ministry of Higher Education, USSR, Sovetskaya Nanka Publishing House, 50.
35. Moscow, Vechernyaya Moskva, 13 Jun 51.
36. Moscow, Moskovskiy Komsomolets, 8 Jun 50.
37. Industrial College of the Armed Forces, Aircraft Production Problems for War, L-51-101.
38. Illustrated Pamphlet, Comparison of P-51 and F-86, North American Aviation, Inc., 50.
39. ATIC Study No. 102-AC-51/28-34.
40. Industrial College of the Armed Forces, Aircraft Production Problems for War, L-51-101.

VI. Provisional Field Collection Requirements.

The following essential elements represent some of the types of information on the Soviet aircraft industry necessary for determining more accurately the economic input capabilities and vulnerabilities of this industry.

A. Airframe Manufacture.

Essential Information Needed	Possible Sources
1. What is the detailed bill of materials for the MIG-15 airframe?	Analysis of captured MIG-15's and parts.
2. What is the detailed bill of materials for the TU-4 airframe?	Obtain by comparison with USAF B-29.
3. How much aluminum will be available to the USSR in 1951; in 1952?	
4. How much aluminum will be available to the Soviet airframe industry in 1951; in 1952?	Unaccounted-for balance after other requirements. US requirements for current aircraft production program.
5. How much steel will be available to the USSR in 1951; in 1952?	
6. How much steel will be available to the Soviet airframe industry in 1951; in 1952?	Unaccounted-for balance after other requirements.
7. How much magnesium will be available to the USSR in 1951; in 1952?	
8. How much magnesium will be available to the Soviet airframe industry in 1951; in 1952?	Unaccounted-for balance after other requirements. US requirements for current aircraft production program.
9. How much copper will be available to the USSR in 1951; in 1952?	
10. How much copper will be available to the Soviet airframe industry in 1951; in 1952?	Unaccounted-for balance after other requirements. US requirements for current aircraft production program.
11. How many and what types and sizes of aluminum sheet stretchers will be available to the Soviet airframe industry in 1951; in 1952?	

B. Aircraft Engine Manufacture.

Essential Information Needed	Possible Sources
1. What is the detailed bill of materials for the Soviet VK-1 turbojet engine?	Analysis of captured parts. Comparison with Pratt and Whitney J-48 P6.
2. What is the detailed bill of materials for the Soviet RD-45 turbojet engine?	Analysis of captured engines. Comparison with Pratt and Whitney J-42.
3. What is the detailed bill of materials for the Soviet ASH-90 reciprocating engine?	Comparison with Wright R-3350-26W.
4. How much nickel will be available to the USSR in 1951; in 1952?	
5. How much nickel will be available to the Soviet aircraft engine industry in 1951; in 1952?	Unaccounted-for balance after other requirements. US requirements for current aircraft engine production program.

Essential Information Needed	Possible Sources
6. How much chromium will be available to the USSR in 1951; in 1952?	
7. How much chromium will be available to the Soviet aircraft engine industry in 1951; in 1952?	Unaccounted-for balance after other requirements. US requirements for current aircraft engine production program.
8. How much cobalt will be available to the USSR in 1951; in 1952?	
9. How much cobalt will be available to the Soviet aircraft engine industry in 1951; in 1952?	Unaccounted-for balance after other requirements. US requirements for current aircraft engine production program.
10. How much tungsten will be available to the USSR in 1951; in 1952?	
11. How much tungsten will be available to the Soviet aircraft engine industry in 1951; in 1952?	Unaccounted-for balance after other requirements. US requirements for current aircraft engine production program.
12. How much molybdenum and columbium will be available to the USSR in 1951; in 1952?	
13. How much molybdenum and columbium will be available to the Soviet aircraft engine industry in 1951; in 1952?	Unaccounted-for balance after other requirements. US requirements for current aircraft engine production program.
14. How many and what types and sizes of Swiss "REISHAUER" or "MAAG" tooth-forming machines for jet engine gears will be available to the USSR in 1951; in 1952?	Soviet imports. Swiss exports. Soviet manufacture.
15. How many and what types and sizes of electric contour followers (similar to General Electric and Pratt and Whitney machines for making turbine blade masters) will be available to the USSR in 1951; in 1952?	Soviet imports. US exports. Soviet manufacture.
16. How many and what types and sizes of "Cincinnati HYDROTEL" (or similar) milling machines will be available to the USSR in 1951; in 1952?	Soviet imports. US exports. Soviet manufacture.
17. How many and what types and sizes of abrasive belt contour machines (similar to those used by Hamilton Standard Propeller in World War II and suitable for mass production of turbine and compressor blades) will be available to the USSR in 1951; in 1952?	Soviet imports. US exports. Soviet manufacture.
18. What is the Soviet replacement spare factor per engine in 1951; in 1952?	Replacement spare factor per US engine for the current aircraft engine production program?
C. Manpower.	
1. What will total employment in the Soviet aircraft industry be in 1951; in 1952?	US employment for current aircraft production program.
2. How many personnel will be engaged in the airframe industry in 1951; in 1952?	US employment for current aircraft production program.

Essential Information Needed	Possible Sources
3. How many personnel will be engaged in the aircraft engine industry in 1951; in 1952?	US employment for current aircraft production program.
4. What will be the proportions of skilled, semiskilled, and unskilled labor in the Soviet aircraft industry in 1951; in 1952?	US proportions for current aircraft production program.
5. How does the technological productivity of the Soviet aircraft worker compare with that of the US aircraft worker?	
6. How many members belong to trade unions concerned with the Soviet aircraft industry?	
7. What is the degree of absenteeism in the Soviet aircraft industry?	US degree of absenteeism?

25X1C

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APPENDIX B

25X1A

REPORT ON INSPECTION OF AN MIG-15
10-11 SEPTEMBER 1951

[redacted]

1. The airplane was somewhat battered, as was to be expected. The fin, rudder, stabilizer, elevators, and right wing were practically intact. The left wing seemed to have been flame-cut, just outboard of the landing gear, in recovery. The outer panel was not in evidence. The fuselage was badly crumpled. The bottom quarter was gone, and the upper portion is in three main sections: tail (except for the last foot or so) up to rear of cockpit; cockpit, to front of where windshield would start; nose section. The nose section is crumpled up into a ball. The cockpit is badly torn, the instrument panel pulled loose but still hanging on, and the floor gone. This airplane probably could be restored, but the effort involved would be exorbitant.

2. Before the trip was taken, requirements had been laid [redacted] the following are partial answers.

25X1A

a. Airframe weight will be given in a later report from Cornell or Batelle. Some partial data were gathered. It may be pointed out that thickness was micrometered, but paint, sand, corrosion, and inaccessibility could easily put the readings a few thousandths off. Lengths of extrusions, for preliminary bill of materials, were measured to nearest half-inch but in inaccessible spots might be up to 1 inch off. These errors would tend to compensate. About 360 lbs. of dural extrusions were found, and an estimated 20 to 40 lbs. of magnesium castings (mostly rusted away). Sheet dural in wings and tail is estimated at 840 lbs. In the fuselage, with low degree of certainty, about 570 lbs. of sheet dural. There are about 300 lbs. of steel (guessed at) which would normally be dural forgings (at about 100 lbs. saving). This totals to about 2,100 lbs. Assuming the same weight distributions (adjusted for use of steel) as for the F-86D, the airframe weight is estimated at 2,750 lbs. as compared with ATI estimate of 3,750 lbs. The low degree of assurance should be noted. [redacted] will elaborate this item in the future.

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b. Estimated man-hours to build airframe also will be reported on [redacted] at a later date. Producibility studies are being subcontracted to an aircraft company.

(1) Extrusions to the amount of about 360 lbs. are used. They break down as follows:

Inches	Angles (16 Sizes, Probably Cut from Below): 1.25 x 0.084	1 x 0.084	1.56 x 1.19 x 0.118	1.22 x 0.12	1.13 x 0.82 x 0.31	1 x 0.064	0.56x0.045
Wing	114	544	161	672	56	569	
Fin	164	160					
Rudder							192
Stabilizer						796	100

Inches	Tee 2½ x 1 1/8 x 1/8	Bulb 0.75 x 0.56 x 0.063	Angles 1 x 0.75 x 0.085	Channel 2 x 4 x 1/8	Wing Channel 2-7/8 x	Zee 5/8 x 7/8 x 0.10
Wing		1,730	1,456		94	72
Fin			616			
Rudder						
Stabilizer						
Fuselage	3,360	6,432		57		180

(2) There are no profound double curvatures, nothing which would cause us to look for Hufford stretchers, etc.

(3) There seems to be a lack of forgings. Machined or welded-up steel parts, aluminum or magnesium castings were used instead.

(4) Method of assembly unknown. Wing and fin ribs are made in halves along the cord line, with overlap for riveting. This riveting was not the closing-up process of the wing but seemed to have been done before subassembly. Perhaps the ribs were stamped on small presses, lacking capacity for a whole rib. (Gravity drop hammer?)

25X1B

[redacted]

d. Engine was a [redacted]

25X1B

e. Service life is estimated as comparable with US types. The markings on this one indicated parts built from 1945 to 1948; so the service life had been at least 3 years before it was lost. There was evidence of field repair on one elevator, at the center-hinge leading edge area. The work was crude but adequate.

25X1A

f. Load factors will follow [redacted] The structure appeared to be light, and reports of MIG-15's flying apart under one burst of caliber .50's seem to indicate low load factors.

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[redacted]

h. Bill of materials may be approximated from the airframe weight data and extrusion data given above.

Extrusions	Pounds		Gauge (Inches)	Pounds
Angles	62.8	Sheet Dural	0.036	171
Tee	152.4	(Increase by	0.041	167
Zee	23.8	40% for Bill	0.046	203
Channel	7.4	of Material)	0.050	258
Wing Channel	2.5		0.055	217
Bulb angle	105.4		0.073	217
			0.099	175

Steel, bar and sheet: approximately 540 lbs.
Also dural-tube for control runs, steel hydraulic tubing and engine mounts.
About a half dozen each, Dzus and Simmonds-type fasteners (Wing root fairing, ammo doors).
About 20 lbs. magnesium castings.
Some Cherry-type rivets. Many csk rivets, with 154-degree heads (after driving).
Round-head rivets are almost identical in shape with the AN-430.
About a dozen single-row unsheilded 1/4" ball bearings (SKF).

SAE type expansion tube joints (sleeves) for hydraulic system.
A 65-lb. weight (steel?) in each wing tip.

3. General Comments.

a. Fastenings. Rivets or staked bolts. No explosive rivets. A few of the various Western types of patented fasteners (Dzus, Simmonds, Cherry).

b. Workmanship and Design. Workmanship excellent. Mechanical design seemed to do things the hard way (split ribs, milled spars, etc.) perhaps because of limitations imposed by available production methods. Serviceability had been carefully considered. The multitude of inspection stamps indicates a fairly rigorous inspection system.

c. Corrosion. The magnesium alloys had corroded quite away. On the other hand, steel and dural riveted or bolted together with no visible separator showed no sign of corrosion.

d. Control, Stability, Flutter. The elevator trim tab and rudder have been extended (a not unusual fix). A 65-lb. weight is added in each wing tip, apparently for aeroelastic reasons. A saddle-shaped fuel tank is believed to fit in the rear part of the fuselage, around the tail pipe. A guess is that the fuel in the tank is used to trim the airplane as ammunition is expended. (BuAer had balance trouble with FJ-1 and FJ-2 and solved it by catching the spent brass. The MIG-15 does not have room for such an expedient.)

e. Fuel Tanks. Main tank is a Mareng-type cell between the center-section spars. The saddle tank mentioned above is unprotected aluminum.

f. Structure. The front spar carry-through is an extruded dural channel. The rear spar carry-through has steel caps and dural web. The spar caps are very smooth, show no machine marks, no draft angle. The corners are sharp, not round, as a rolled section might be. The hinge extends beyond possible roll contours but could have been upset. There are no indications of casting (draft, parting line, sand marks, riser, etc.). These parts may have been forged and coined or ground but probably were hogged out of bar stock. The smooth finish could be accounted for by the desire to avoid starting points for fatigue failure, particularly in view of the flutter problems which seem to have been present. Skin-rib joints are shimmed in many places with paper or metal. Milled skin was not used. The engine mount is a welded steel tube structure, with no forgings on the end fittings.

4. Recommendations.

a. English and US tire standards should be inspected, to see if the tire is a copy, so that the design static load (hence the airplane weight) may be determined.

b. Pratt and Whitney report on the engine should be obtained.

c. Steps should be taken to determine if extrusions are from Lend-Lease stockpile, or German or Czechoslovak, or made on captured German or Czechoslovak extrusion presses.

25X1A

APPENDIX C

REPORT [redacted] ON INSPECTION OF AN MIG-15
10 SEPTEMBER 1951

25X1A

[redacted]

The primary purpose of this report is to discuss productibility of the aircraft. This report will not be concerned with numerical measurements or detailed descriptions of the aircraft, since presumably such material will be made available by the [redacted] in much more explicit form than could be obtained in a few short hours' examination.

25X1A

General Impressions.

The MIG-15 is a small interceptor fighter armed with one 23-mm and one 37-mm cannon. The airplane is a swept midwing monoplane with a true circular fuselage. It appears to be the result of advanced design skill and is planned to avoid shortcomings of the industry available to construct the airplane. Seemingly, the most impressive feature of the airplane was its excellent contour control without the use of heavy special skins in any part of the airplane. It is believed that from the parts available a good estimate of the gross weight of the airplane and the aerodynamic shape can be obtained. With this information, accurate performance calculations can be made. Construction of a replica airplane by some US contractor to evaluate performance is not warranted.

Sheet Metal Construction.

The wings, fuselage, vertical and horizontal stabilizers, and control surfaces were all semimonocoque construction, utilizing thin skins, formed frames or ribs, and extruded angle longitudinal or span-wise stiffeners. The vast majority of the sheet metal employed is similar to US 24S material. All skin is attached with flush rivets in countersunk holes which would tend to indicate drilling on assembly in main assembly jigs. Fabrication tooling could be simple in nature. Very few parts would require hydropress forming. Lightening holes, which are extensively used, are all circular and could be made on a punch press. Double contouring of a severe nature is not present to any extent, indicating that skin panels could be formed largely on Farnham rolls. Where double contouring is severe (duct entrances, etc.), the parts appear to have been formed on drop hammers. All spar caps, with the exception of the vertical stabilizer, are machined steel. The vertical stabilizer spar, while of conventional aluminum alloy construction, is tied into a canted fuselage frame that is made up of welded steel.

In general, it is believed that high production could be maintained on sheet metal components only by utilization of excessive manpower by US standards. The number of hand operations in each main assembly jig also is high by US standards. The tooling employed, while probably elemental in nature, must be of high quality to permit the excellent contour control that is maintained.

Weld Assemblies.

Throughout the airplane, fittings and brackets made from steel-weld assemblies are far more common than in contemporary US military aircraft. In many cases, weld assemblies have been used to avoid what would otherwise require forgings or complicated machining operations. The landing gear is constructed in this manner and employs a short-stroke oleo acting on a link similar to some British practice. The welding technique and workmanship appear to be excellent.

Machine Work.

Machine work has been held to a minimum, and no efforts have been made to present a smooth surface for the sake of appearances. Where required for operational purposes or for reasons of strength, the quality of machine work is very high.

Castings and Forgings.

Relatively few castings have been used, and no forgings were observed.

Electrical Installations.

Considerable effort has been expended to cut down the installation time of electrical and electronic equipment and wiring. This was one of the outstanding high production (also easy maintenance) features of the airplane. Excessive bonding is common, which would present a production problem. Quality of workmanship in radio chassis, etc., appeared to be very high, better than some Telefunken German equipment inspected during the war. One spur gear actuator was used to operate the elevator trim tab.

Instruments.

Basic flight gyro instruments and engine instruments were all utilized. These included a remote compass and an elemental radio compass. The fuel gauge was electrical but of the old float type rather than the capacitor type used on contemporary US aircraft. An interesting feature of the fuel gauge was that the transmitter was equipped with a gauge which could be read directly by the man filling the tank, in addition to the gauge in the cockpit. The instruments were attached to the panel by rather clever clamps which permitted removal or replacement by merely loosening one screw. Soviet practice apparently is to equip each instrument with a pigtail with the plug on the end instead of merely having a receptacle on the instrument case. The main advantage of the Soviet system is that it would tend to save space directly forward of the panel, but this would be offset by having to mount receptacles elsewhere in the airplane.

Plumbing.

Piping for the pneumatic system (landing gear, flaps, speed brakes, wheel brakes) was, in general, similar to US hydraulic practice with the exception that all "B" nuts were safety wired. Bulkhead fittings to the pressurized cockpit area were merely sealed with flat rubber washers. This has the merit of simplicity. Piping material used was aluminum alloy seamless tube. The use of flexible hoses is comparable to US practice. Quick disconnect fittings are used at appropriate locations. Tubing for the oxygen system was chrome-plated copper.

Power Plant. 25X1A

25X1A [redacted] was either identical or practically identical to the British NENE. Fuel was carried in one large bladder cell aft of the cockpit closing bulkhead and forward of the main spar bulkhead. The earlier YAK-9 propeller fighter was equipped with four self-sealing tanks and an exhaust gas-purging system. The only apparent reason for merely using a bladder cell on the MIG-15 was to save weight. Plumbing for a drop tank at about midspan of each wing was present. A smaller metal kidney-shaped tank was located aft of the engine wrapped around the tail pipe, which probably is used for water injection fluid. Stainless steel was used for the tail pipe and also was used at various other locations around the airplane. Inlet ducting to the plenum chamber was constructed integrally with the fuselage structure, and great care had been exercised to insure smooth flow and prevention of duct losses.

Mechanical System and Bearings.

All flight controls were of the combined push-pull and torque-tube type. Use of ball bearings in rotating joints was common. Very few of these bearings were equipped with dust or dirt seals. Except for this one deficiency, the bearings were of good quality. Push-pull tubes, where used, had large diameter tubes with swaged-down ends to insure good column properties with light weight. Cable systems were used only as a cross control for the Fowler flaps, for the throttle, and for the ranging throttle grip to the computing sight. (The actual sight was not present.) No evidence of power boosts for any of the flight controls had been found.

Magnesium.

It is probable, from the advanced state of corrosion of some parts, that magnesium had been used in minor amounts for some relatively small fittings, mostly in the cockpit area.

Finish.

No external paint was used except for insignia. Thin coats of zinc chromate were used internally in some places. Nearly all of the extruded angle stiffener material had been primed before assembly.

Production Breakdown.

Subassembly technique, at least to the following extent, was indicated:

1. Forward fuselage.
2. Aft fuselage, including vertical fin up to horizontal stabilizer.
3. LH wing.
4. RH wing.
5. Horizontal stabilizer.
6. Vertical fin above horizontal stabilizer.
7. Landing gear.
8. Engine mount.
9. Flaps.
10. Control surfaces.
11. Wing tips.
12. Gun fairings.

Interchangeability apparently is maintained on the above items. There probably are more items than the above that are subassembled, but those listed constitute the major and obvious items.

Summary.

The Soviets appear to be building a high-performance airplane with methods and structural design changed but little from those common in the US 10 years ago. High production could be maintained at the expense of high manpower hours. It is probable that Soviet design criteria are less stringent than US. From an operational point of view the airplane should rate high with pilots. It is simple and excellent from a maintenance point of view. Non-stressed access plates and hand holes are provided in far greater abundance than is common on US airplanes. The presence of 65 pounds of lead forward of the main spar, near the tip in each wing, would tend to indicate that some flutter trouble has been experienced. Close inspection has been followed, as evidenced by the inspection stamps present on all minor components as well as major assemblies. Soviet quality control may be rated as excellent.

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