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Research and Analysis Branch

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JAPANESE ALUMINUM PRODUCTION
AND FABRICATION

Analysis of requirements for fabricated
shapes and for ingots; estimates of scrap
recovery and of primary aluminum requirements.

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SUMMARY

Japanese primary aluminum requirements in 1944 are estimated at roughly 120,000 metric tons. Electrolytic reduction capacity is at least 50 percent in excess of this figure. Unless rolling mill and other fabricating capacity has been very considerably enlarged since the start of the Pacific war, it may prove to be a bottleneck in Japanese efforts to increase aluminum consumption. "Pipeline" requirements -- inventory stocks and work in process at various stages between ingots and final products -- are substantial, but they are relatively much smaller than in the United States in recent years because of the slower growth of aluminum consumption in Japan.

JAPANESE ALUMINUM PRODUCTION AND FABRICATION

1. Revised estimates of aluminum requirements for 1943 and 1944

New studies of Japanese aluminum requirements indicate that allowing for "pipeline" expansion, primary ingot requirements will be 118,000 metric tons in 1944, an increase of 18 percent over the estimated 1943 requirements of 100,000 tons. According to these estimates, fabricated aluminum shapes -- including sheet, castings, forgings, rods and bars, etc. -- needed to make both war and civilian products in 1944 will total 123,500 metric tons (up 15 percent from 1943), but actual production of shapes for indicated requirements in 1944 will amount to 142,000 tons (up 20 percent from 1943), in order to permit inventory expansion and building up of work in process for still larger output of final products in 1945. Recovery of scrap from processing wastage will more than make up the difference between 118,000 tons of primary ingots and 142,000 tons of fabricated shapes.

The distribution of fabricated shapes output to consuming groups, comparing with the shipments of fabricated shapes in the United States in 1942, appears to be as follows:

USE DISTRIBUTION OF TOTAL REQUIREMENTS FOR FABRICATED SHAPES

	<u>Japan 1944</u>	<u>U. S. 1942</u>
Aircraft	56 percent	62.6 percent
Army	14 "	12.3 "
Navy	13 "	7.6 "
Export	0 "	8.3 "
Electrical Transmission and Communication	9 "	9.2 "
Civilian and Other	8 "	
	<u>100 percent</u>	<u>100.0 percent</u>

2. Surplus capacity for electrolytic reduction of aluminum

Possible aluminum capacity in Japanese controlled areas has been estimated at 185,000 tons. Scattered evidence indicates that the figure should perhaps be even higher. Excess capacity for primary ingot production in 1944 thus appears to be at least 67,000 tons. 1944 ingots for aircraft will require less than 40 percent of estimated ingot capacity.

The estimates for aluminum requirements are not estimates of production. Insofar as production of ingots whether in the past or present has been accelerated beyond the rate of consumption plus necessary pipeline expansion, stockpiles of bauxite will have been converted to stockpiles of ingots held in reserve which will permit continued output of aluminum products even if total ingot capacity were to be reduced.

The estimated requirements for aluminum shapes and ingots reflect estimates of Japanese output of products using aluminum, such as aircraft, naval ordnance materials, ship construction materials, etc. In certain categories, these products have been increasing -- especially military items -- and this means that the aluminum fabricating system and consuming industries have had to fill up a "pipeline" of inventory stocks and work in process in order to support such increases. Ingot production, even without the building up of a stockpile, has been considerably more than would suffice if output of final aluminum-using products were at a constant rate. Growth requirements will eventually taper off and working inventories will be completed. This will have the effect of releasing more ingot capacity for the production of aluminum for use in final products. For example, after growth has ceased, the production of 118,000 tons of primary ingot (estimated requirements for 1944) will allow, in conjunction with scrap recovery, a current output of fabricated shapes of 164,000 tons a year. This is about a third higher than the 123,500 tons consumed in 1944 and represents a rate of consumption which may not be reached during the course of the war. It appears, therefore, that present annual ingot requirements are close to a peak and that excess capacity will persist.

3. Shortage of capacity for production of fabricated aluminum shapes

Nothing is known about Japanese capacity for making

fabricated shapes except for certain sheet rolling mills. Rolling capacity may constitute a bottleneck for Japanese aircraft production unless the known end-of-1941 capacity of about 45,000 metric tons has been greatly increased. In the United States in 1942, some 42 percent of fabricated shapes were rolled products, mostly sheet. If the same proportion were applied to Japan (which is not unreasonable considering the closely similar proportions of output taken by the aircraft industry) there would be a need for 59,000 tons rolling mill capacity on the average in 1944, rising some time in 1945 to 67,500 tons or 50 percent more than the known capacity. 70-80 percent of all rolled products are probably used for aircraft.

4. Basis of estimates

Aluminum fabricated shapes entering into final products in 1943 and 1944 may be summarized as follows:

<u>Use</u>	<u>1943</u>		<u>1944</u>		
Aircraft	52,500 metric tons		69,000 metric tons		
Army	13,000	" "	16,500	" "	
Navy	14,000	" "	16,000	" "	
Electric Transmission and Communication	18,000	" "	12,000	" "	
Other	10,000	" "	10,000	" "	
Total	107,500	" "	123,500	" "	

Requirements of fabricated shapes, including that needed for pipeline, is broken down as follows:

<u>Use</u>	<u>1943</u>		<u>1944</u>		
Aircraft	65,000	metric tons	83,000	metric tons	
Army	15,000	" "	20,000	" "	
Navy	15,000	" "	19,000	" "	
Electric Transmission and Communication	13,000	" "	10,000	" "	
Other	10,000	" "	10,000	" "	
	<hr/>		<hr/>		
Total	118,000	" "	142,000	" "	

These estimates are based on estimated Japanese output of finished products, with considerable reference to American requirements for fabricated shapes for comparable products. Adjustment has been made for somewhat greater processing wastage in Japanese practice and different rates of growth in output between the United States and Japan affecting the requirements for pipeline (inventories and work in process in consuming industries).

In particular, detailed calculations were made of the production of fabricated shapes to be used in aircraft. The tonnage of shapes required for the weight of planes expected to be produced in 1944 was first estimated on the basis of recent American experience with planes of varying weights. The overall relationship arrived at was 1.20 tons of fabricated shapes for each ton of finished planes, including spare parts and allowance

for processing wastage at American rates. This ratio was then raised 20 percent (which seems liberal) to allow for assumed greater processing wastage in Japan than in the United States.¹ It was then calculated (using U. S. statistics to estimate leads and lags and size of inventory stocks) that total production of shapes in 1944, including requirements for work in process and inventory increments, would be about 20 percent higher than requirements based on current finished output.² Thus total production of shapes was calculated to be 1.73 times the weight of finished planes to be produced in 1944.

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1. U. S. gross wastage in processing aluminum shapes appears to be about 30 percent with scrap recovery eventually of about 25 percent of the metal worked on. It is believed not unreasonable to treat average Japanese gross losses at 40 percent with 28 percent scrap recovery. If a given weight of fabricated shapes is subject to as little as 28 percent wastage in the U. S., it will yield 20 percent more final product than an equal weight that is subject to 40 percent wastage in Japan.
 2. U. S. output of fabricated shapes for aircraft has been much higher than this in relation to the requirements based on current finished output. In 1941, it was about 150 percent higher, in 1942 about 100 percent higher and in 1943 about 33 percent higher. These greater differences are due to the far greater pipeline requirements for growth in the United States as compared with Japan. The year-to-year growth in tonnage output of aircraft in the U. S. has been: 1941-1942 - +240 percent; 1942-1943 - +170 percent; 1943-1944 - expected to be over 60 percent. In Japan, on the other hand, since early 1943 the annual rate of growth has not exceeded and is not expected to exceed 30-35 percent a year.

The following table summarizes (in metric tons) the estimated quantities of aluminum flowing through various stages of production in Japan in 1944.

1.	Net primary ingots required in 1944.	118,000
2.	Secondary aluminum recovered from consuming industries. ¹	<u>34,000</u>
3.	Total available for production of fabricated shapes (excluding scrap recycled within aluminum industry). ²	152,000
<u>Less:</u>	4. Increment in inventories of ingots	5,000
	5. Increment in work-in-process, ingots to shapes	<u>5,000</u>
		<u>10,000</u>
6.	Total shipments of fabricated shapes in 1944.....	142,000
<u>Less:</u>	7. Increment in inventories of fabricated shapes	6,200
	8. Increment in work-in-process, shapes to finished products	<u>12,300</u>
		<u>18,500</u>
9.	Fabricated shapes required for finished products in 1944	<u><u>123,500</u></u>
10.	Gross processing loss in consuming industries (40% of line 9)	49,400
11.	Recoverable scrap from consuming industries (28% of line 9)	34,000 ³

1. It is assumed that no "old scrap" is available (i.e., scrap coming from sources other than recent processing wastage).

2. This table neglects scrap generated in making fabricated shapes, which is believed to be almost entirely recovered for re-use with a very short lag.

3. This figure is used in line 2 to represent scrap recovered in 1944. This generation of scrap actually occurs in the closing months of 1943 and soon enough in 1944 to reappear as recovered secondary metal within 1944. Scrap generated in the closing months of 1944 is included in line 8.

Lines 6 and 9 of this table (total requirements and current requirements for fabricated shapes) were shown broken down by consuming industries in the preceding tables. It will be observed that the total estimated requirements of shapes (line 6) is approximately 20 percent higher than the 1944 requirements of primary ingot (line 1). In the United States, the tonnage of shapes produced has run very close to concurrent supply of aluminum from primary ingot production, imports and old scrap. This difference between Japan and the United States, like that noted in comparing the output of shapes for aircraft with output of aircraft, is due to different rates of expansion. In both countries the recovery of processing scrap provides a supplementary supply of metal, but this has been offset in the United States by heavy pipeline requirements in the stages between supply of metal and output of shapes. In Japan, even though recovery rates are no greater than in the United States, slower expansion of input means that current recovery keeps better pace with current requirements. Moreover, a relatively small fraction of aluminum output (line 3) is needed for pipeline (lines 4 and 5) so that output of shapes (line 6) is estimated to be only 7 percent less than metal input (line 3).¹

1. The corresponding fraction for pipeline in the United States was about one-sixth in 1942 and 1943. Output of fabricated shapes increased 110 percent from 1941 to 1942, 55 percent from 1942 to 1943, and is expected to increase more than 50 percent from 1943 to 1944. Japanese output of fabricated shapes, on the other hand, is estimated to increase only 20 percent between 1943 and 1944 and somewhat less between 1944 and 1945.

Eventually, when production begins to level out, the output of shapes may even exceed the current supply of aluminum if inventories can be reduced.¹ If there were a balanced situation in Japan with no growth and inventories neither increasing nor decreasing, total ingot requirements would equal requirements for fabricated shapes, and approximately 28 percent of the ingot requirements would be met from recovery of processing scrap.

1. This is expected to occur in the United States in 1944.