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U N I T E D N A T I O N S

Department of Economic and Social Affairs

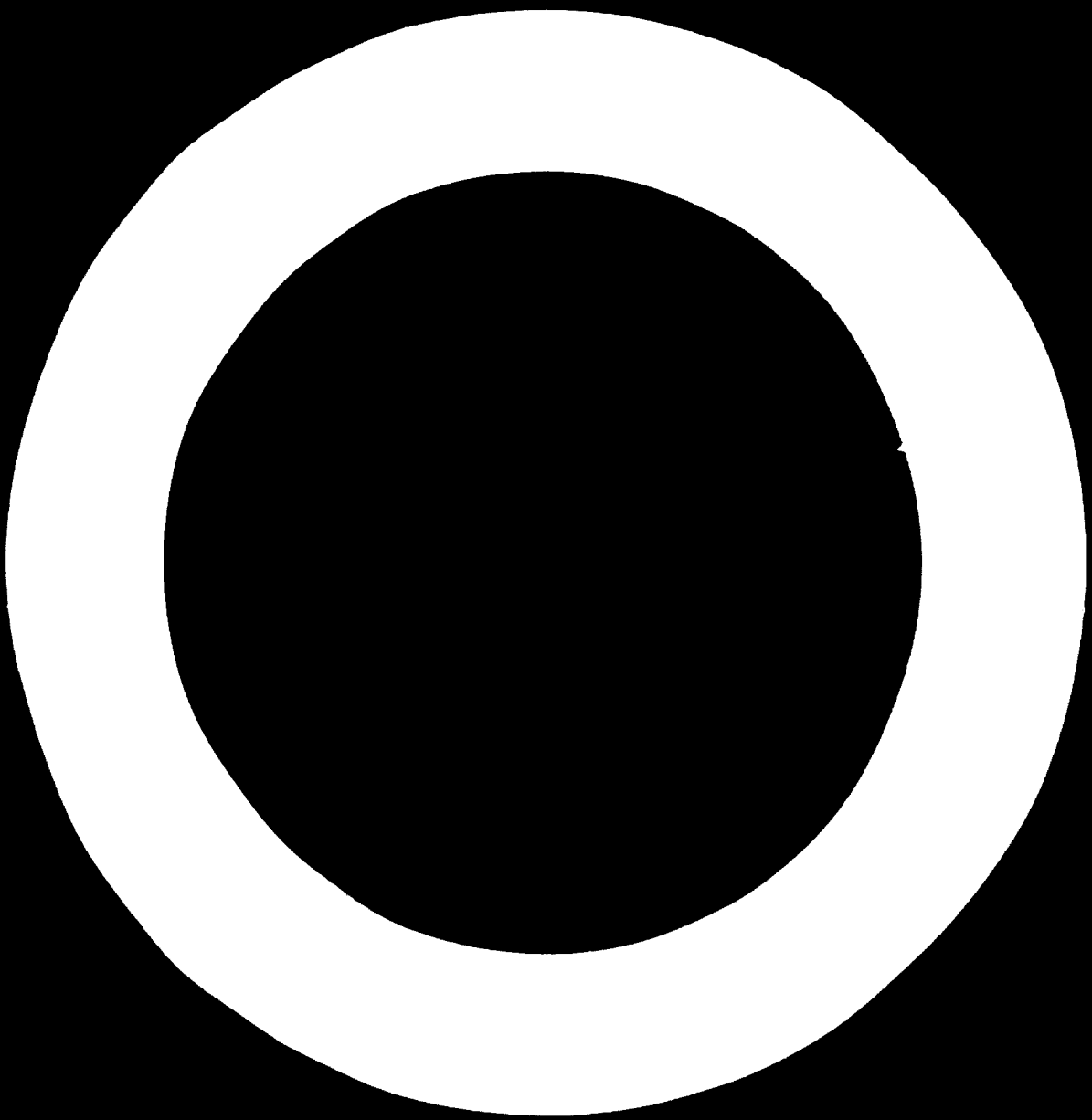
Centre for Industrial Development

EXPERTS GROUP ON SECOND-HAND MACHINERY
FOR DEVELOPING COUNTRIES,
7 - 14 December 1965

THE USE OF SECOND-HAND EQUIPMENT IN THE INDUSTRIALIZATION OF DEVELOPING COUNTRIES

Report by

Prof. A. Wiener



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THE POTENTIAL OF SECOND HAND EQUIPMENT IN THE INDUSTRIALIZATION OF DEVELOPING COUNTRIES

PREPARED FOR:

Centre for Industrial Development
United Nations
New York, New York

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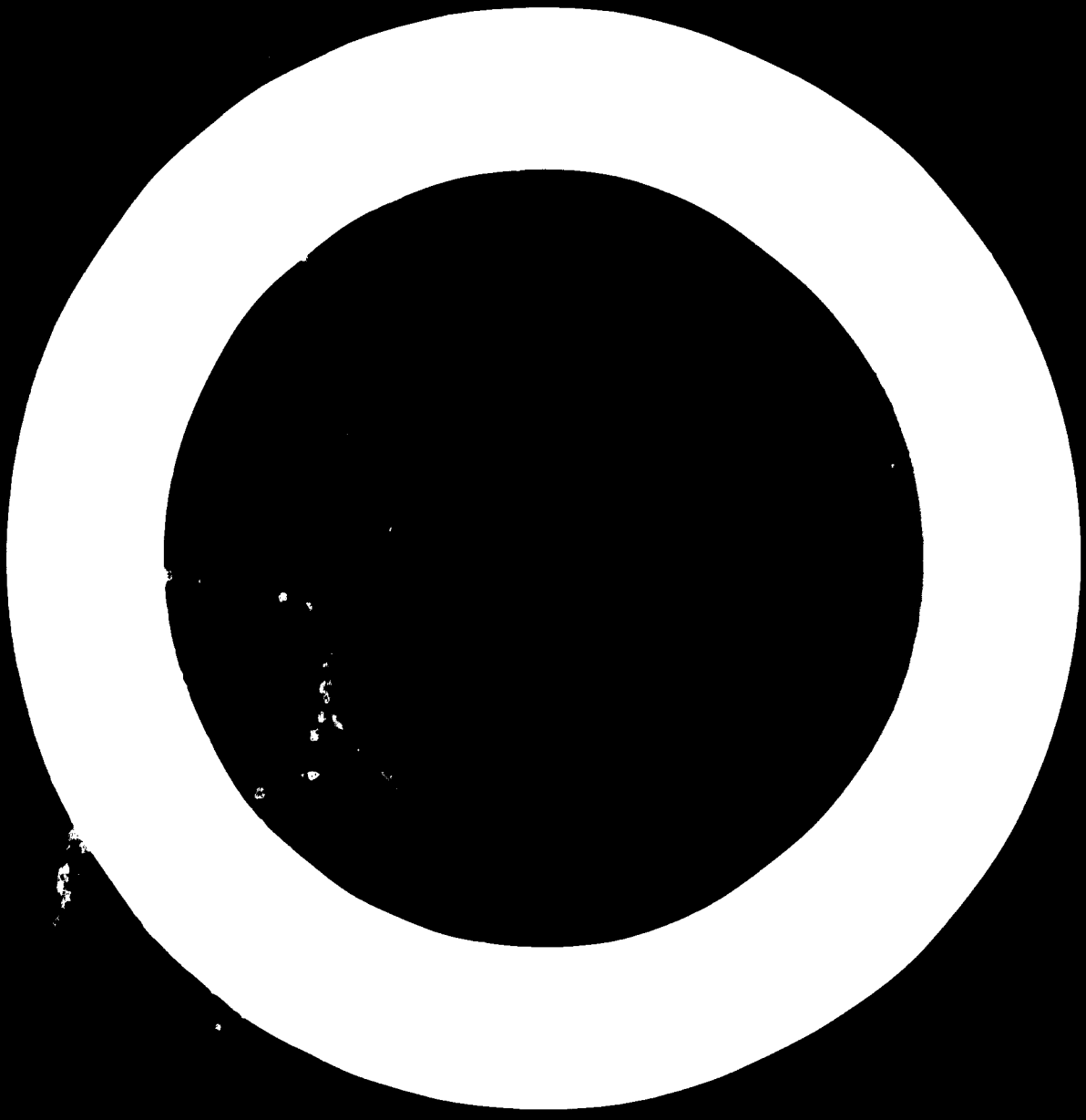
October 1965



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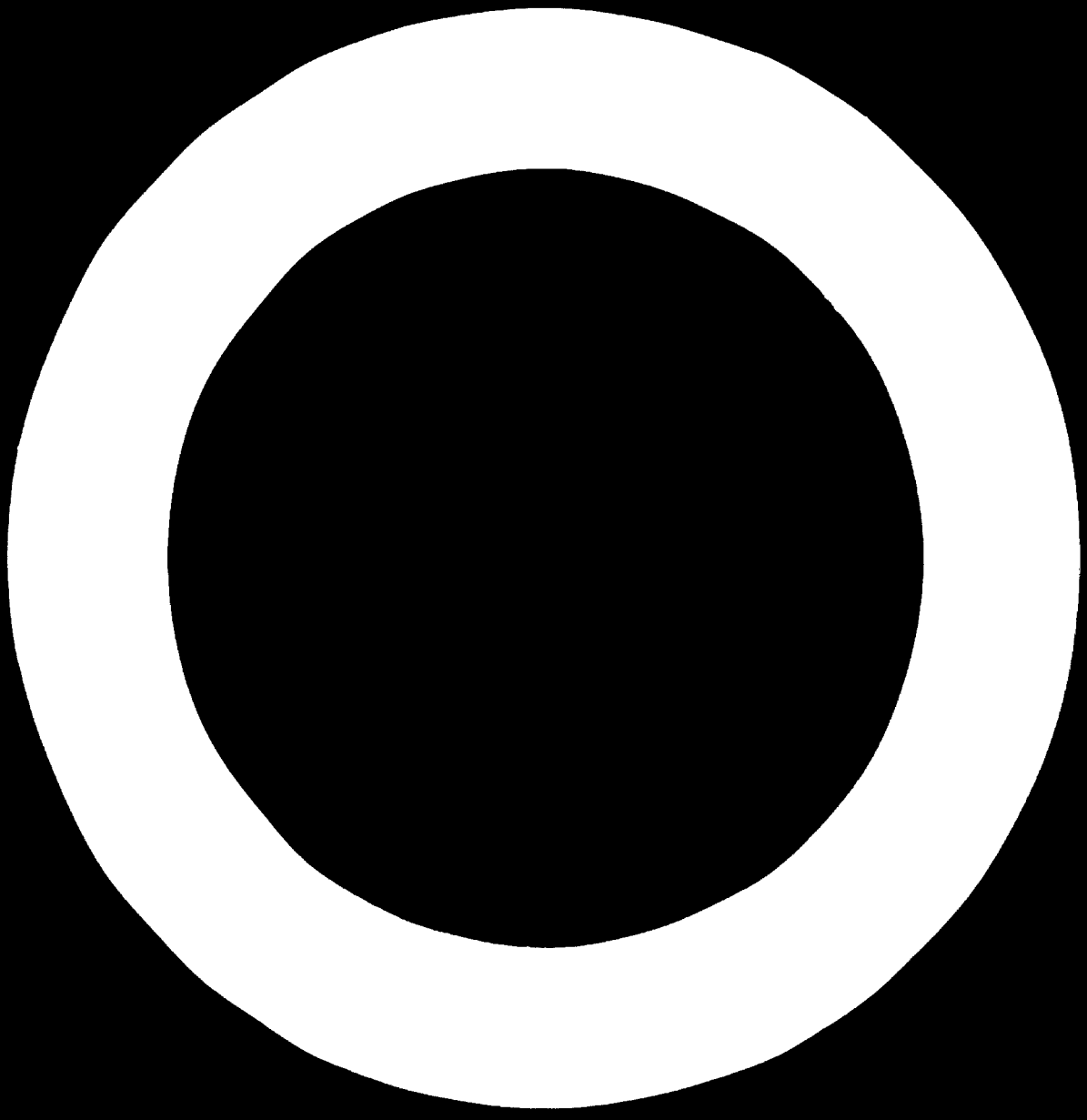
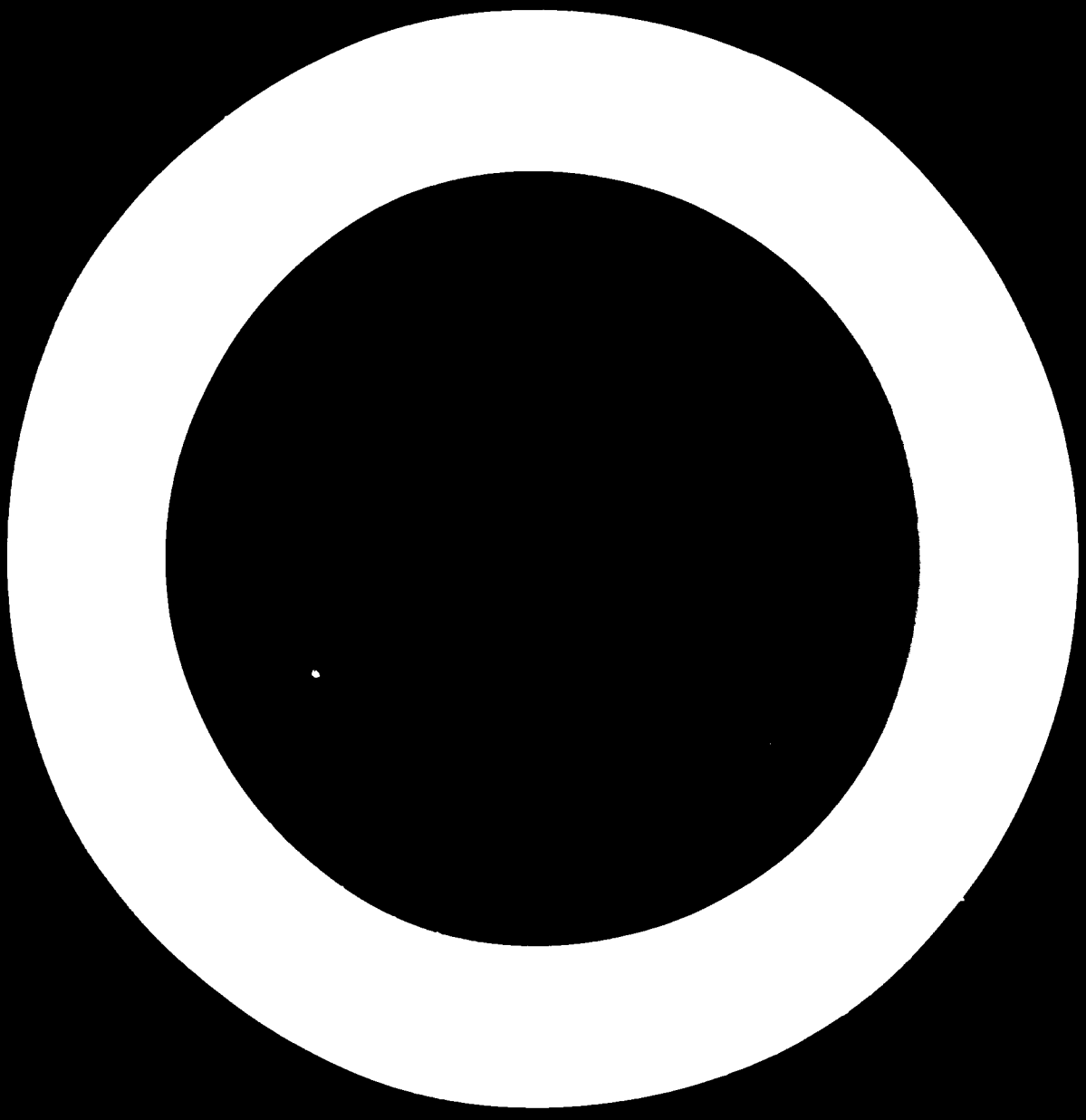


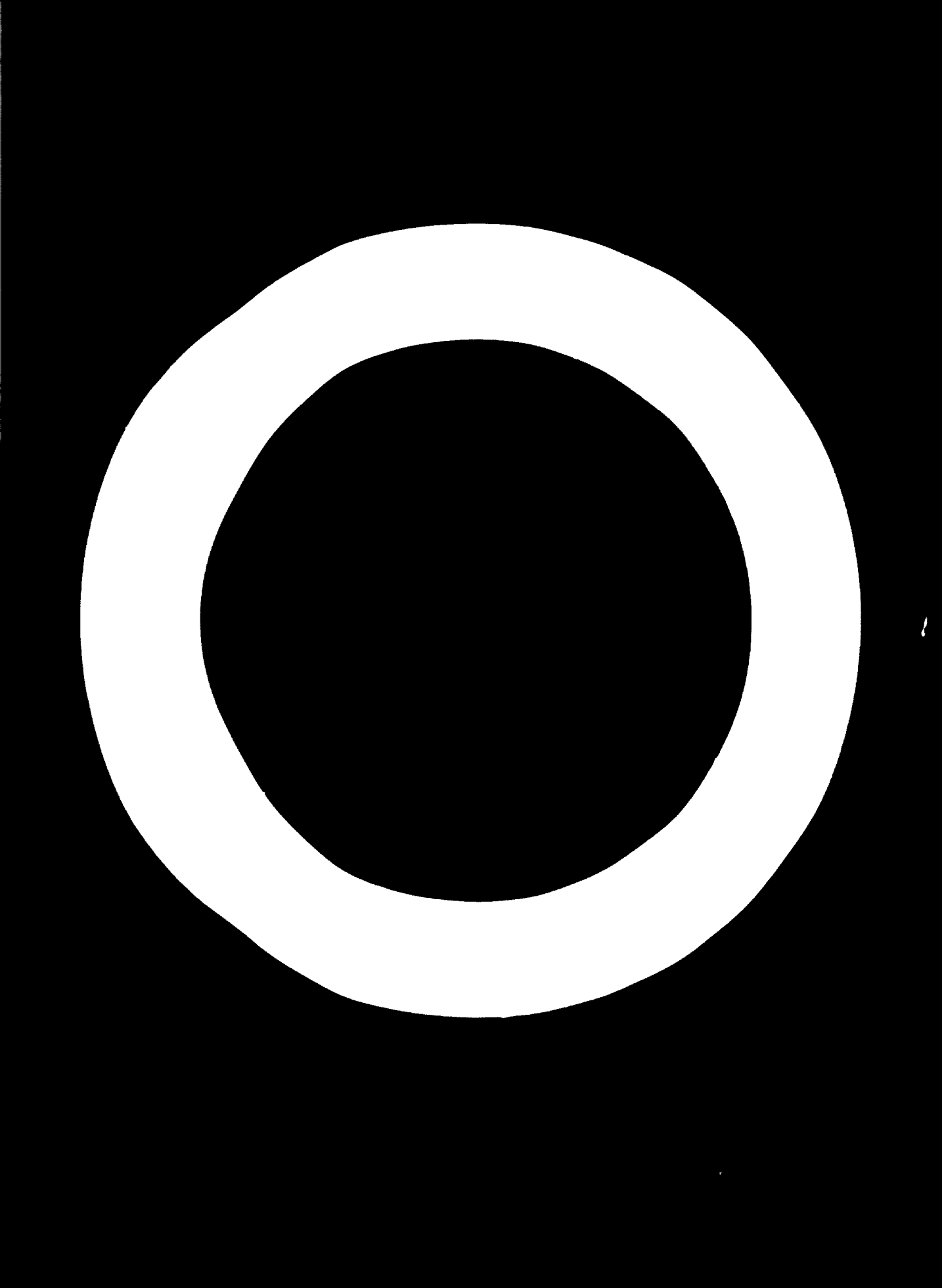


Introduction

I.1 Statement of Problem

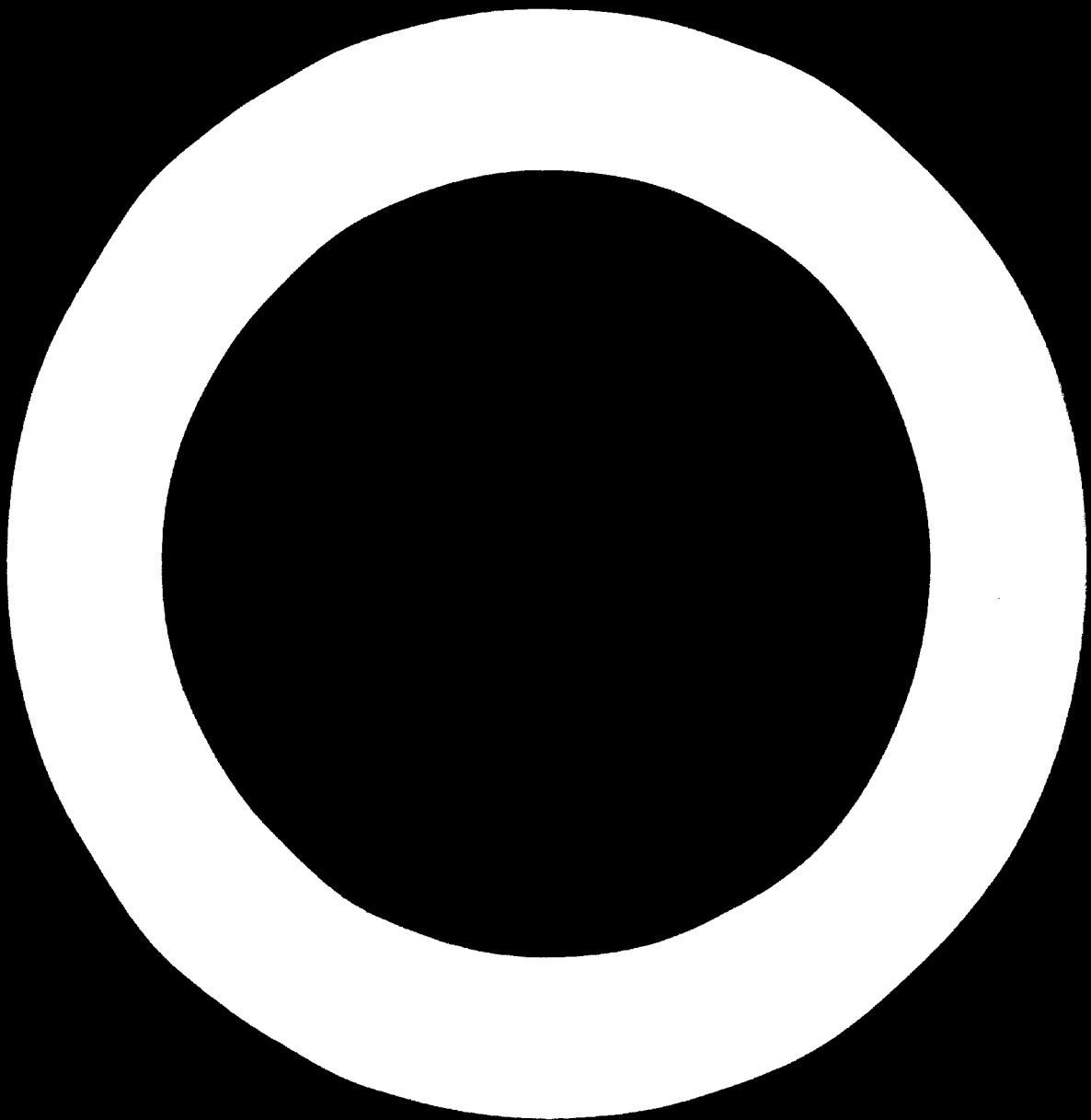
Accelerating economic development of the developing countries is one of the dominant themes of our time. The aspiration of the developing countries to early industrialization is recognized as necessary to peace, stability, and economic well being of all nations. Study of practical measures for implementing industrial development must be accorded major importance in the plans of national and international organizations.

One measure increasingly put forth has been the utilization of second hand equipment generated in economically advanced countries. The use of this second hand equipment is proposed as a method of economizing on scarce capital; enabling the developing countries to obtain more capital equipment with the same capital expenditure. Many other methods of economizing on scarce capital are under investigation by organizations assisting industrialization. These other methods include economies of scale, use of labor intensive techniques, increasing productivity of labor, standardization, extending the life of equipment by improved maintenance, more intensive use of capital equipment, and development of "autonomous technologies" using techniques and materials particularly suitable to local conditions.



Although there is some relation between these various methods of economizing on scarce capital, for purposes of analysis they must be clearly differentiated and considered individually.

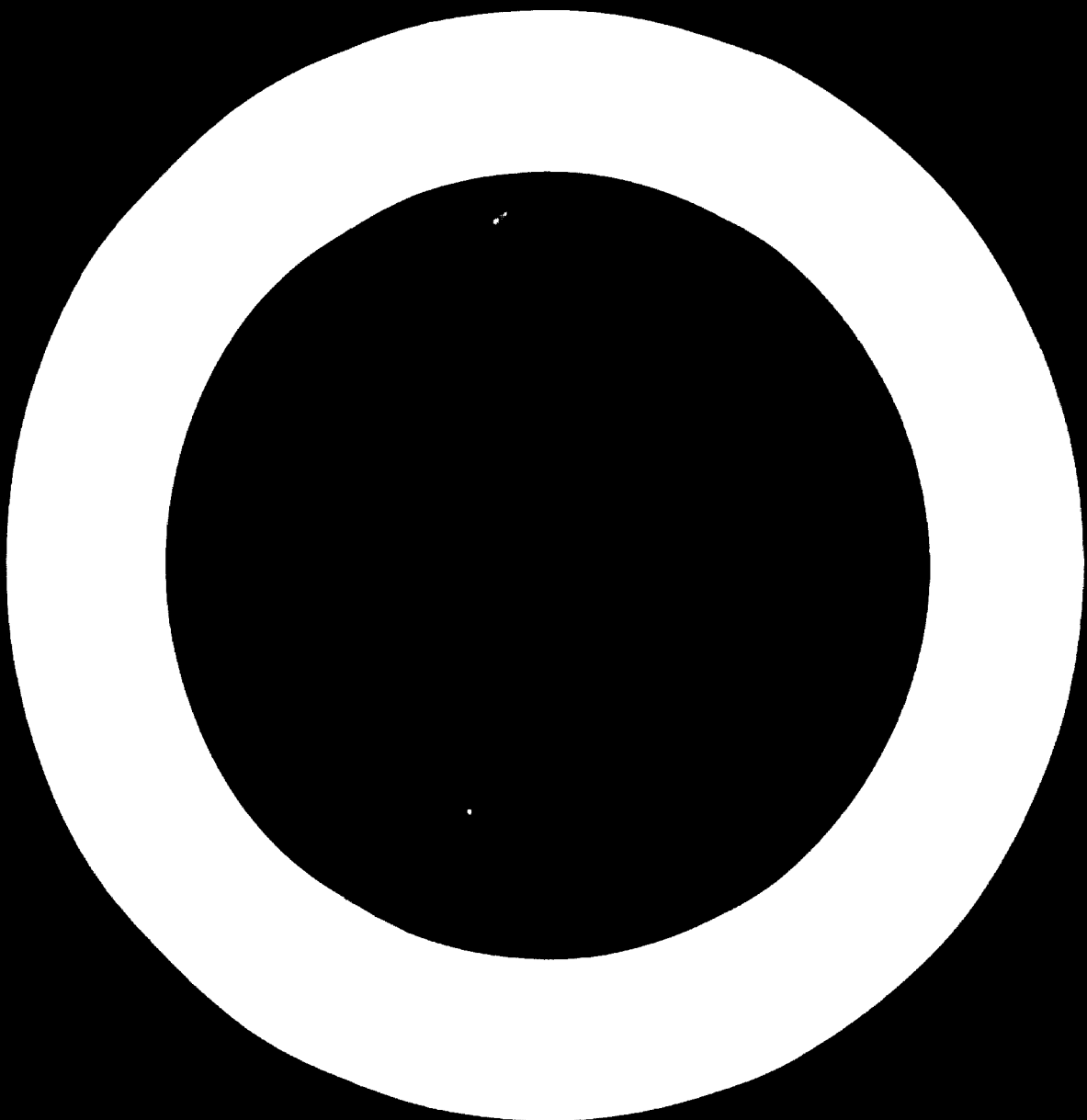
The controversy between the advocates and critics of the use of second hand equipment is in the last analysis reduced to the question "Does the use of second hand equipment, in fact, economize on scarce capital when compared with new equipment?" This is the problem to which the report that follows is addressed.



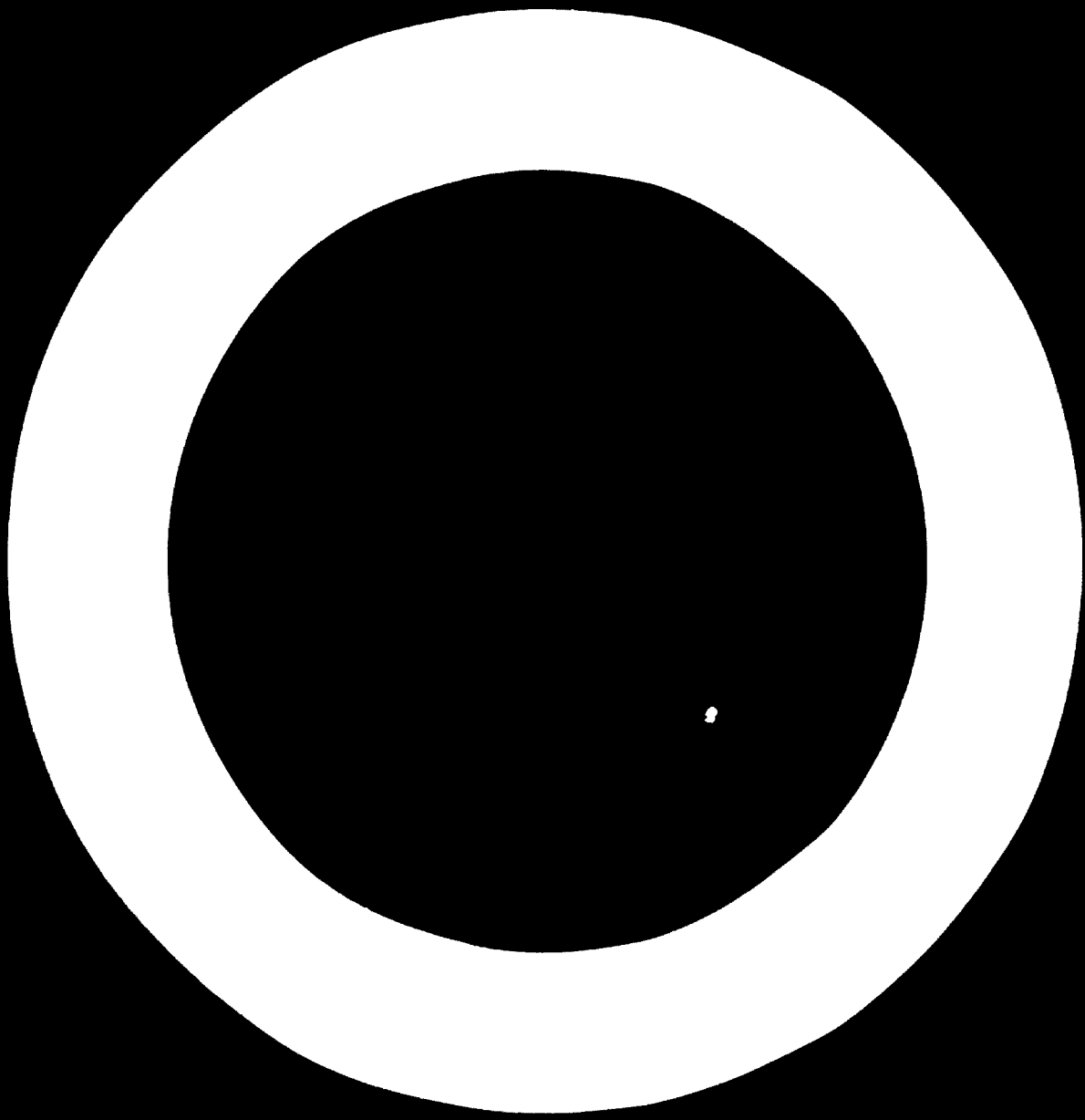
1.2 The Purpose of the Report

The potential of second hand equipment to economize on scarce capital depends on three factors: the present and future supply in the industrially advanced countries, the net cost of second hand versus new equipment, and the mechanisms for transferring this equipment to the developing countries. It is the purpose of this report to analyze these three factors and thus provide a better basis for answering the question, "Does second hand equipment, in fact, economize on scarce resources when compared with new equipment?"

The answer to this question may be different for each category of equipment. The answer for textile equipment may not apply to electrical equipment. The report will investigate the three factors as they operate in the case of metalworking equipment. This category is estimated[1] to account for 27.4 percent of all equipment required in 1975 by the manufacturing industries of the developing countries, more than 4 times as much as the next largest category. A second purpose of the report is to develop an analysis for metalworking equipment which will apply to every type of equipment.



On the basis of this analysis of metalworking equipment, it is the third purpose of the report, to make recommendations that would enable second hand equipment to best reach it's potential in economizing on the scarce resources of the developing countries.



1.3 The Demand for Capital Equipment in the Developing Countries

The demand for imported industrial equipment by manufacturing industries of the developing countries is estimated[2] to rise from $3.9 billion in 1961 to $7.5 billion in 1975. This is the potential market for second hand equipment discussed in this report.

Some indication of the geographic distribution of the demand for industrial equipment may be gained from Table 1.

Table 1.

Projections of total value added by manufacturing industries, 1975.

Region	Billions of 1953 U.S. Dollars	%
Africa (excluding South Africa)	6.8	5.1
Asia (excluding Japan and centrally planned economies).	35.4	26.8
Middle East	5.6	4.2
Latin America	57.2	43.3
Europe (Greece, Spain, Portugal, Turkey, Yugoslavia)	27.1	20.6
Total, ~~Underdeveloped~~ Developing Countries	132.1	100.0

The composition of the requirements for industrial equipment can be seen in Table II.

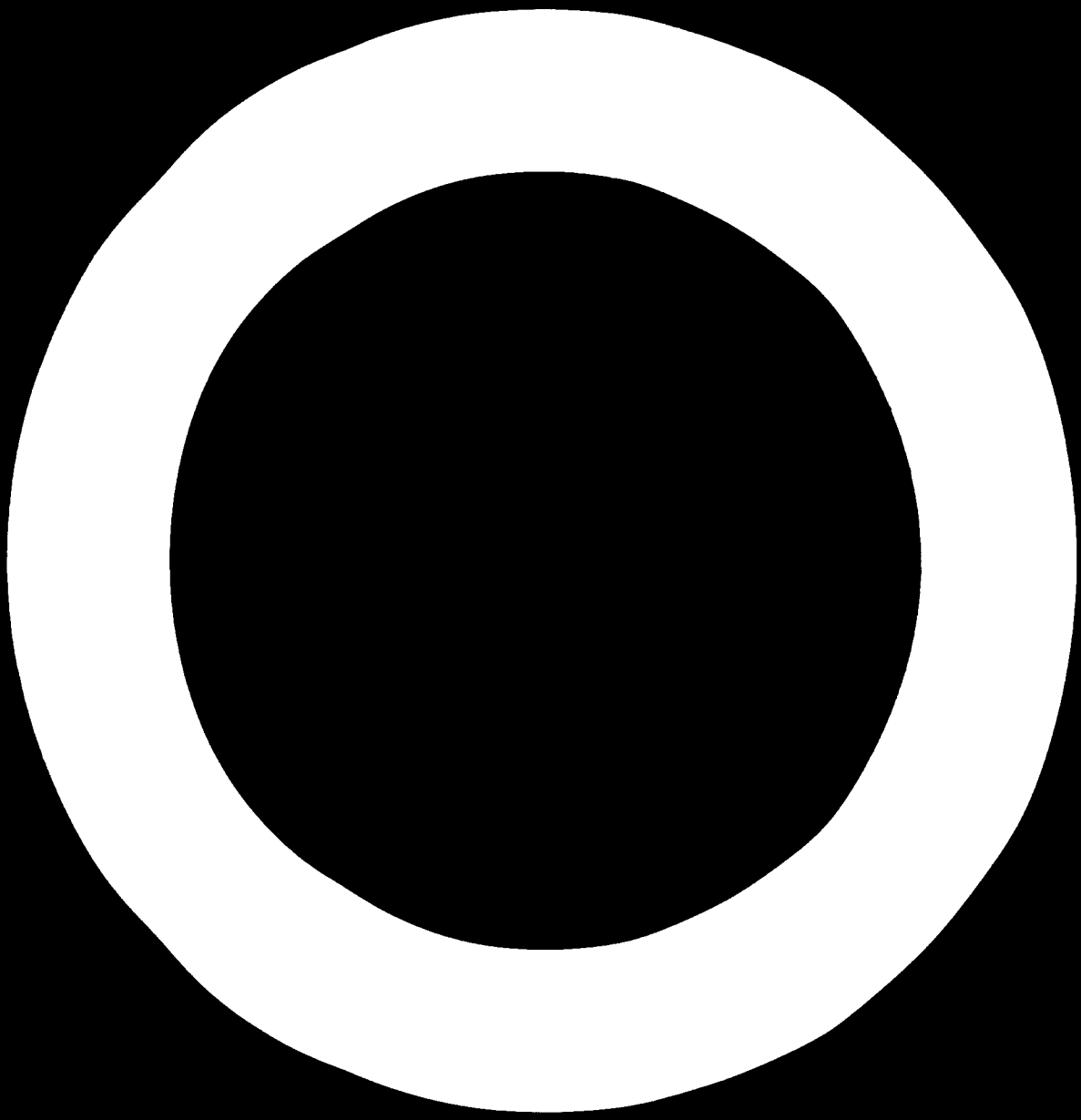
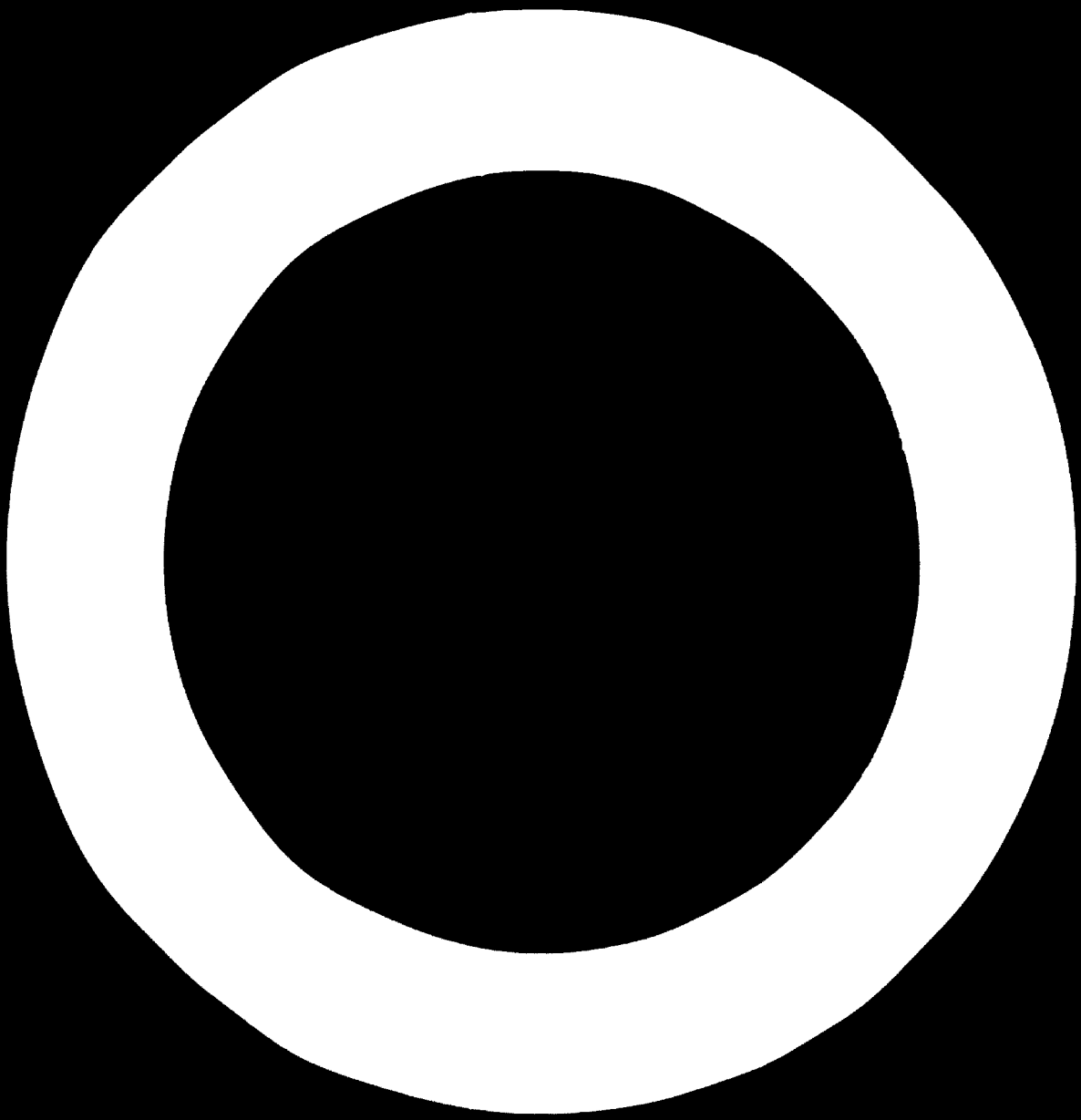


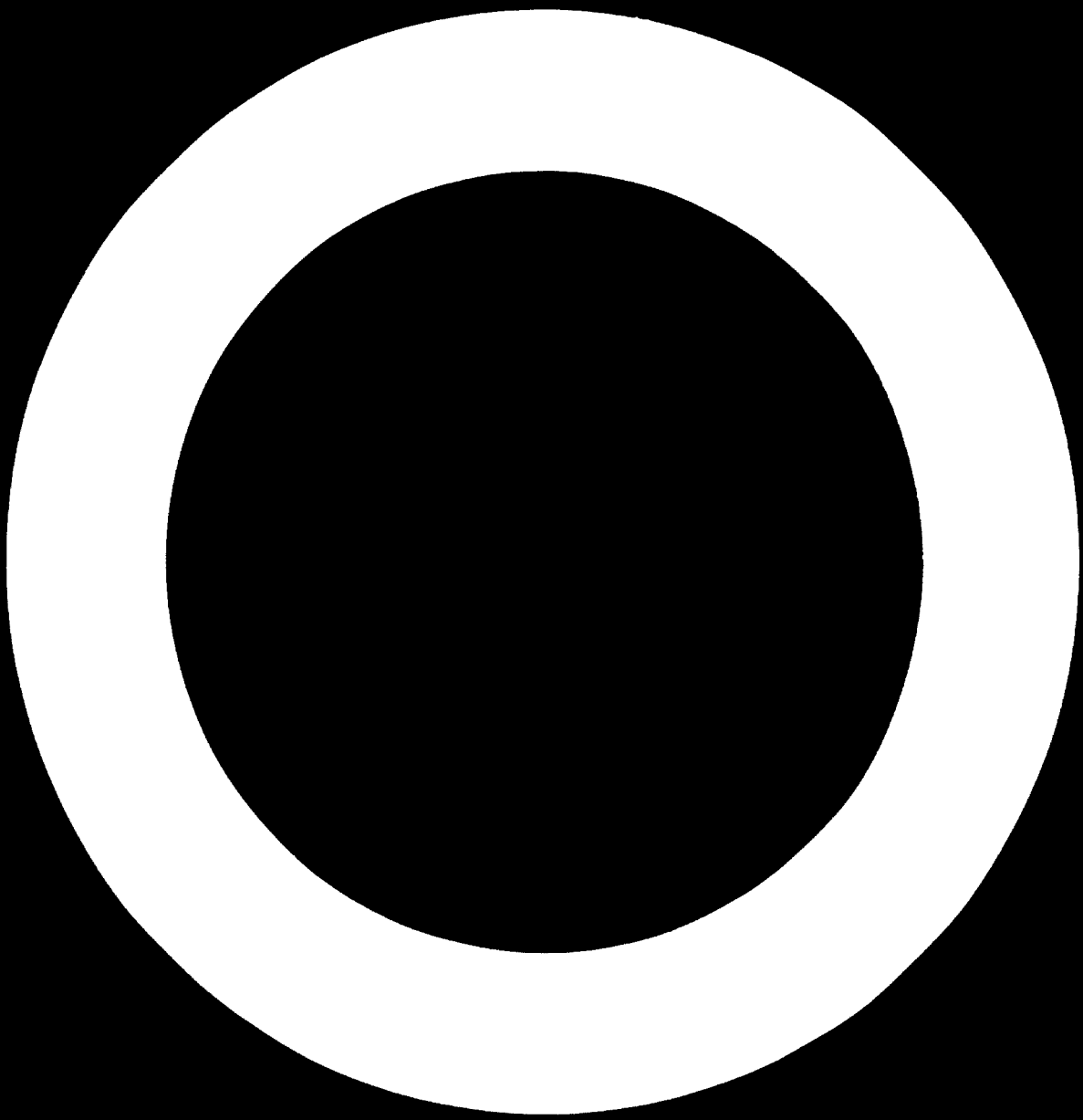
Table II.

1975 Estimated Percentage Distribution of Equipment Requirements of Manufacturing Indistries in Developing Countrias.

I. Non-electrical machinery	
Engines and turbines	0.7
Machina tools, metal-working machinery	27.4
Cutting tools, jigs and fixtures	1.7
Special industrial machinery	34.5
Pumps and compressors	2.9
Elevators and conveyors	6.8
Blowers and fans	1.8
Power transmission	0.5
Refrigarator equipment	1.8
Industrial machinery n.e.s.	4.8
Total, manufacturing equipment proper	82.9
Tractors	1.0
Construction machinery	1.7
Commercial machinery	1.4
Total, non-electrical machinery	4.1
II. Electrical industrial machinery	
Motors and ganerators	3.3
Transformers	0.8
Electrical control apparatus	2.2
Electrical Welding	1.4



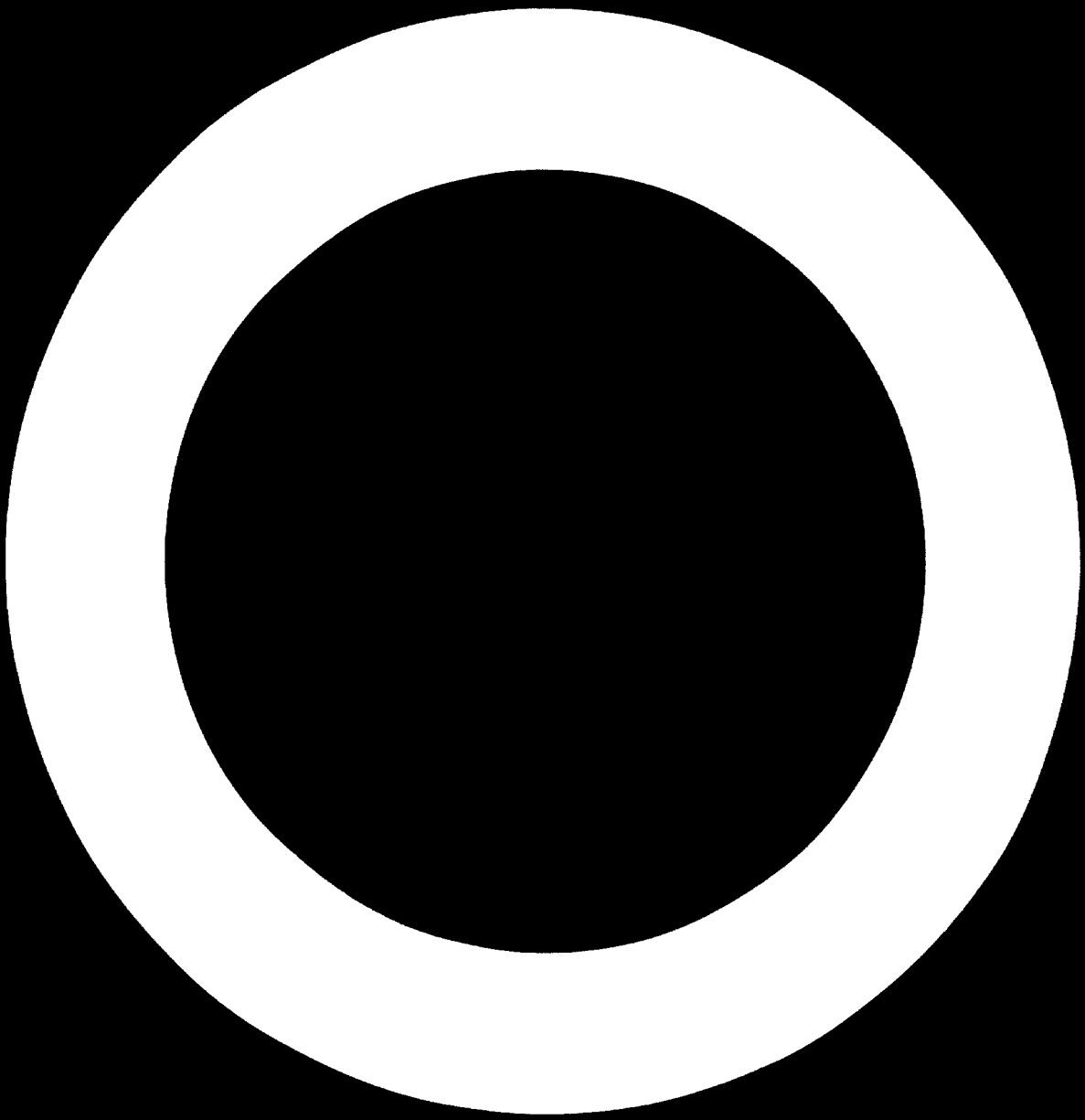
Electrical appliances	0.5
Total, electrical machinery	8.2
III. Transportation equipment	
Motor vehicles	3.0
Locomotives and railroads	1.8
Total, Transportation Equipment	4.8
Total	100.0



1.4 Examples of the Use of Second Hand Equipment

There is e small but active international trade in second hend of every type. This trade may be conveniently divided into 3 categories; 1. individual pieces of equipment thet are part of a complete plant such as a diesel driven generetor, a lethe, e welder, a pump, or lift fork. 2. major components that form the core of a complete plant, such as e sheet rolling mill, a cigarette making machine, or a forging hammer. These require only ancillary equipment to form productive unit. 3. Complete Plents - For every example of the successful use of second hand equipment there is another example where it proved uneconomic and technically unsultable. The two examples cited below illustrete some of the difficulties in establishing e clear answer to the question, "when is second hend equipment more economical than new?"

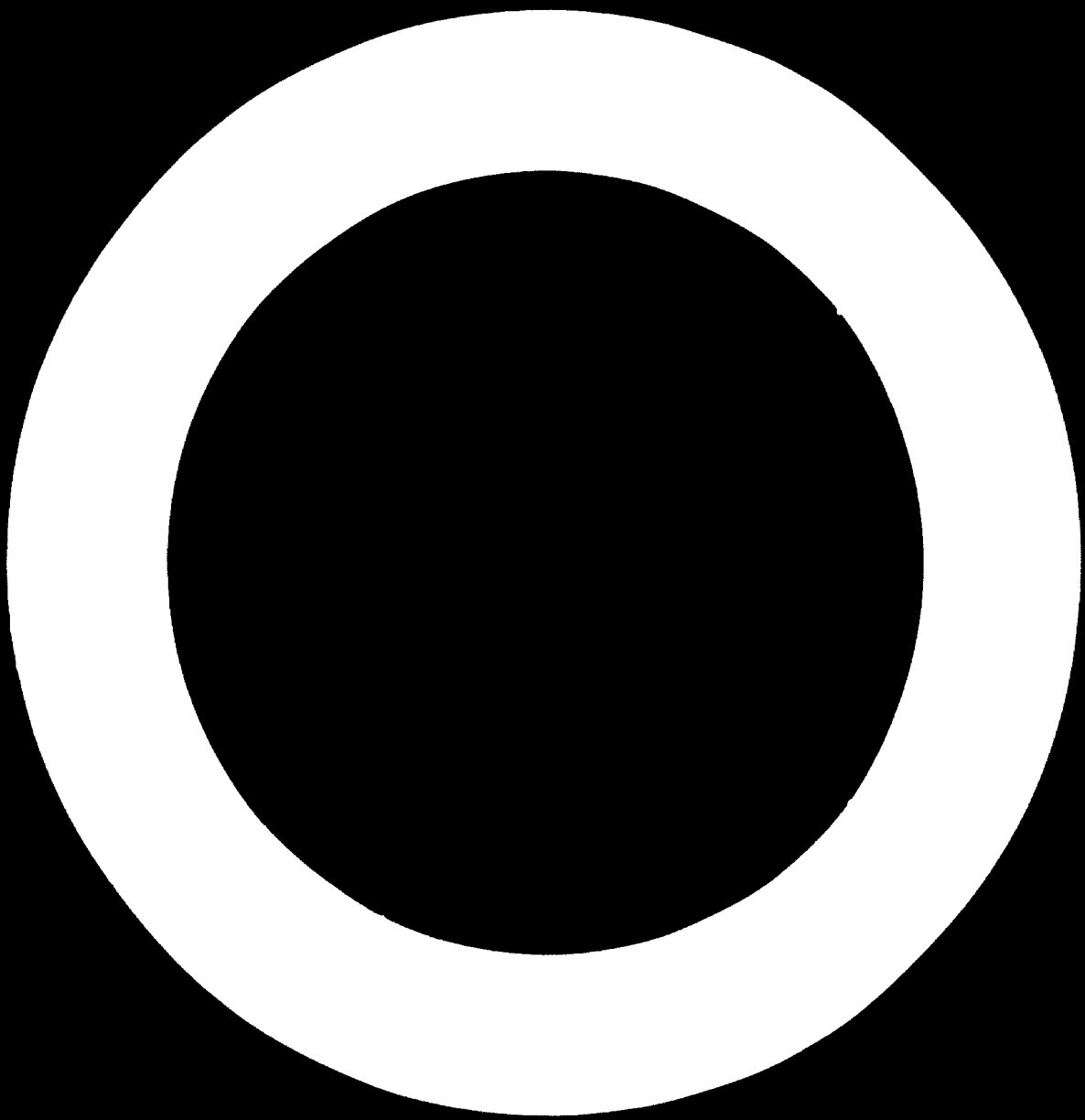
In the first case, e complete synthetic rubber plent was transferred from the U.S.A. to indie. The process used, had become entirely obsoleted in the U.S.A. by e cheaper process using refinery gases as raw materiel. In Indie, the older raw materiel, ethyl elcohol, was cheap end in plentiful supply. Even though 15 years old when purchesed, the plant had operated only 3 1/2 years. A major U.S. rubber company held an equity position in the Indien firm. A commerciel bank loan was evelleble end the purchase price was low due to the obsolescence of the process. A firm of



experienced engineers was available to dismantle and reassemble the plant on a turnkey basis. Moreover, the original designers, erectors, and operators of the plant also owned the process and thus had a vested interest in its proper operation. Through their cooperation, a plant was found still using the process where Indian personnel could be sent for training. After inspection of the plant and its operating records which showed the plant had consistently out produced its design capacity, the decision was made to purchase the plant. The plant was put into operation a year sooner than if it were new. It has operated profitably and without any special operating or maintenance problems since its construction.

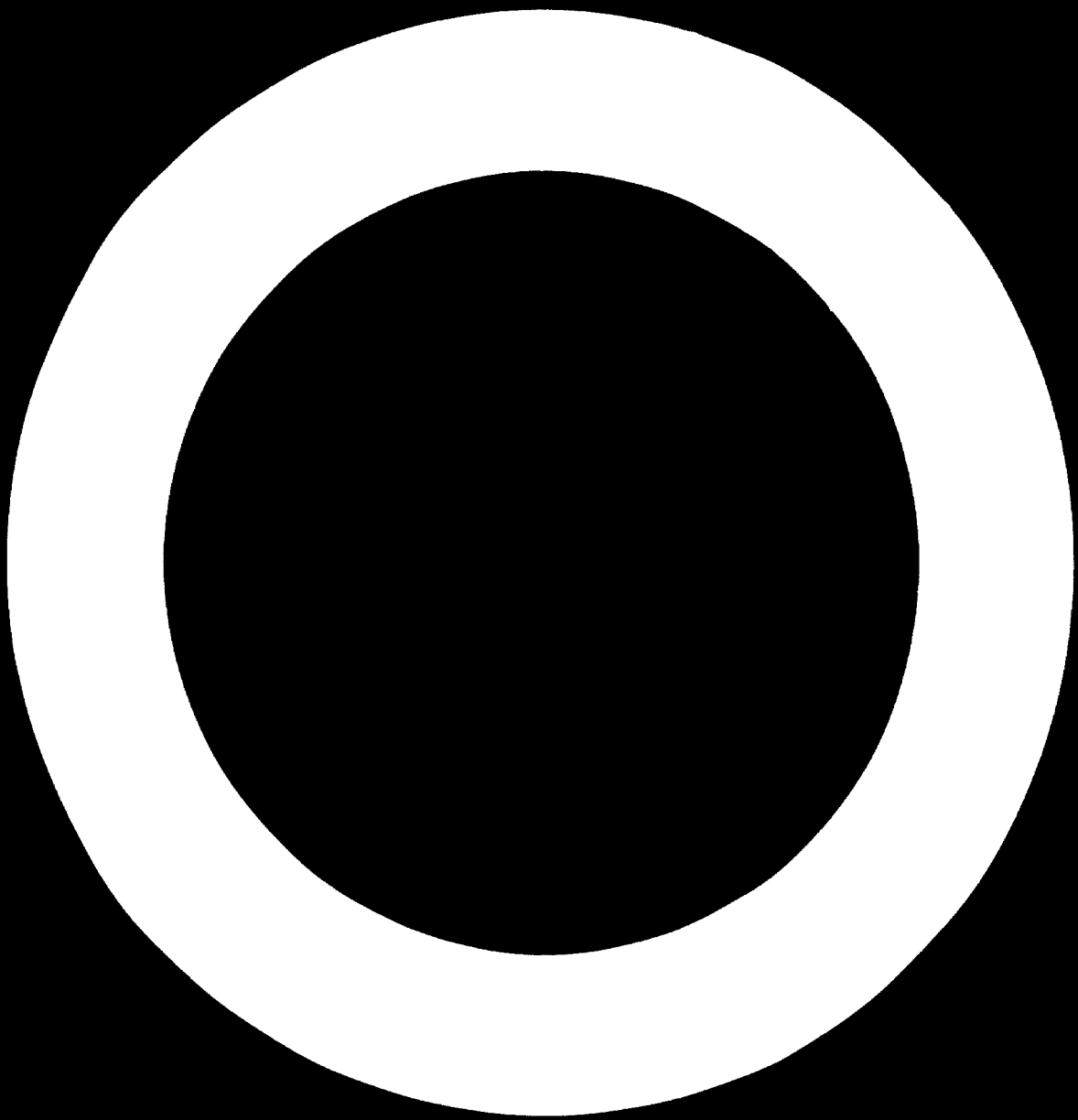
This example demonstrates the importance of a feasability study that shows the price and local availability of a raw material adapted to an obsolete process, the domestic market and price for the final product, and the ability of the plant to pay for itself long before the raw material for the more efficient process would be available. The engineering of the plant on a turnkey basis, the equity and royalty interest of major U.S. firms, and the prior training of personnel were all factors in ensuring the efficient performance of the second hand equipment.

The second case is that of a steel mill in a Latin American country which required a sheet rolling mill. The choice was between an expensive semi-continuous mill of



which additional strands could be purchased as demand increased and an inexpensive second hand reversing mill with a rather high capacity. The decision to buy the second hand mill proved a costly mistake. The mill produced an uneven product of fixed width. The cost of e rolled sheet was some 60% more expensive per ton than the international price. The installed sheet rolling mill had an excess capecity which could not be exported because of prohibitive price. By 1975, the local demand will enable the mill to operate at capacity. Even then, the local sheet steel user will be penalized for this mistake by paying an exorbitant price for an inferior product.

This example shows the danger that the original low price paid for second hand equipment is very expensive indeed if it results in high unit cost of final product and poor quality. If the feasability study was e fault, surely some of the blame is shared by the lure of low original cost of second hand equipment.



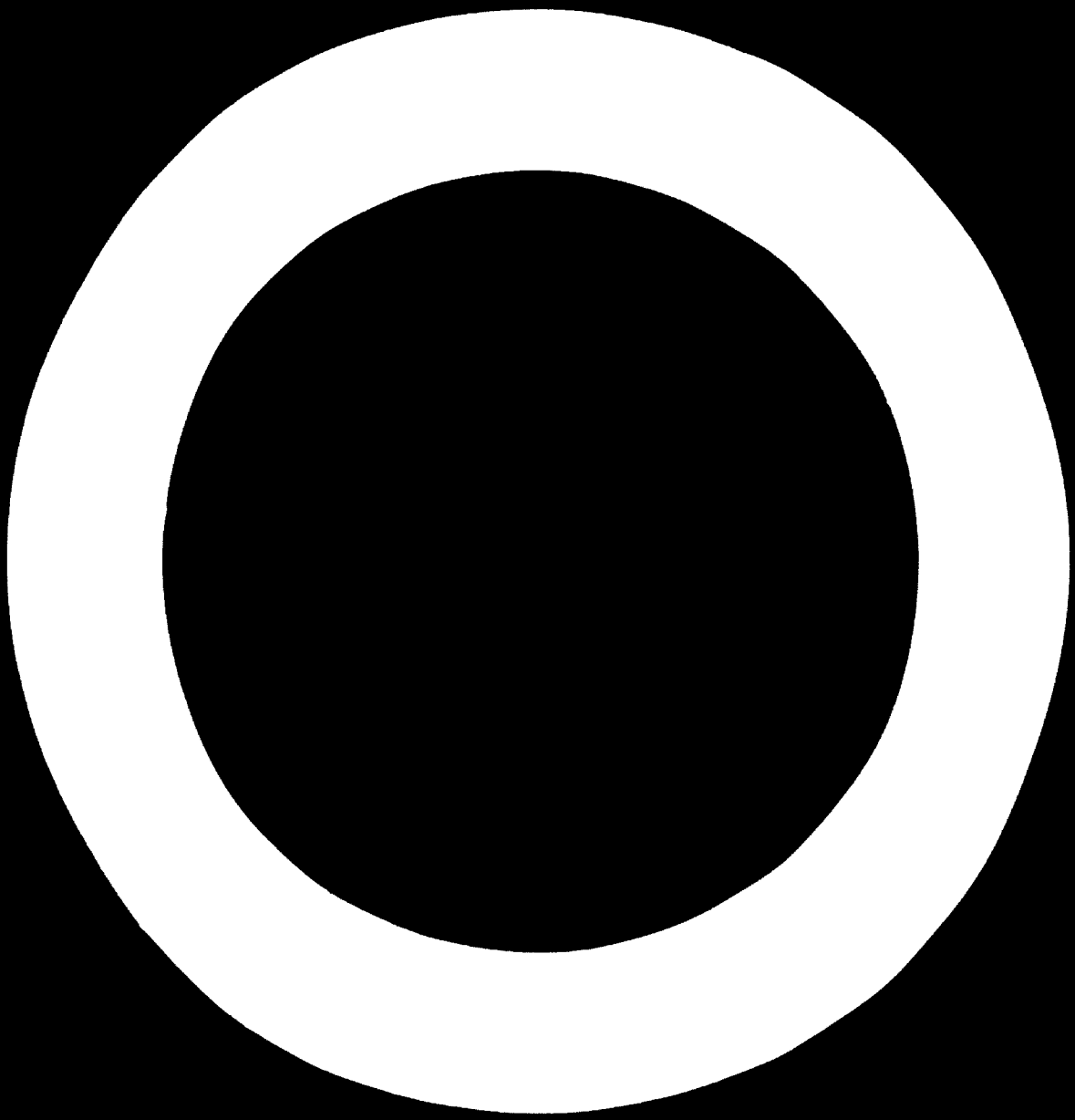
1.5 Outline of the Report

Three terms of reference form the next section of the report. The U.S.A. second hand market is used as the basis of analysis because the U.S.A. is the largest potential source. Second hand equipment: Second hand equipment should be considered an alternative to new equipment whenever it meets specifications determined on the basis of function. The third assumption is that any analysis contains elements of uncertainty that make it indicative rather than precise.

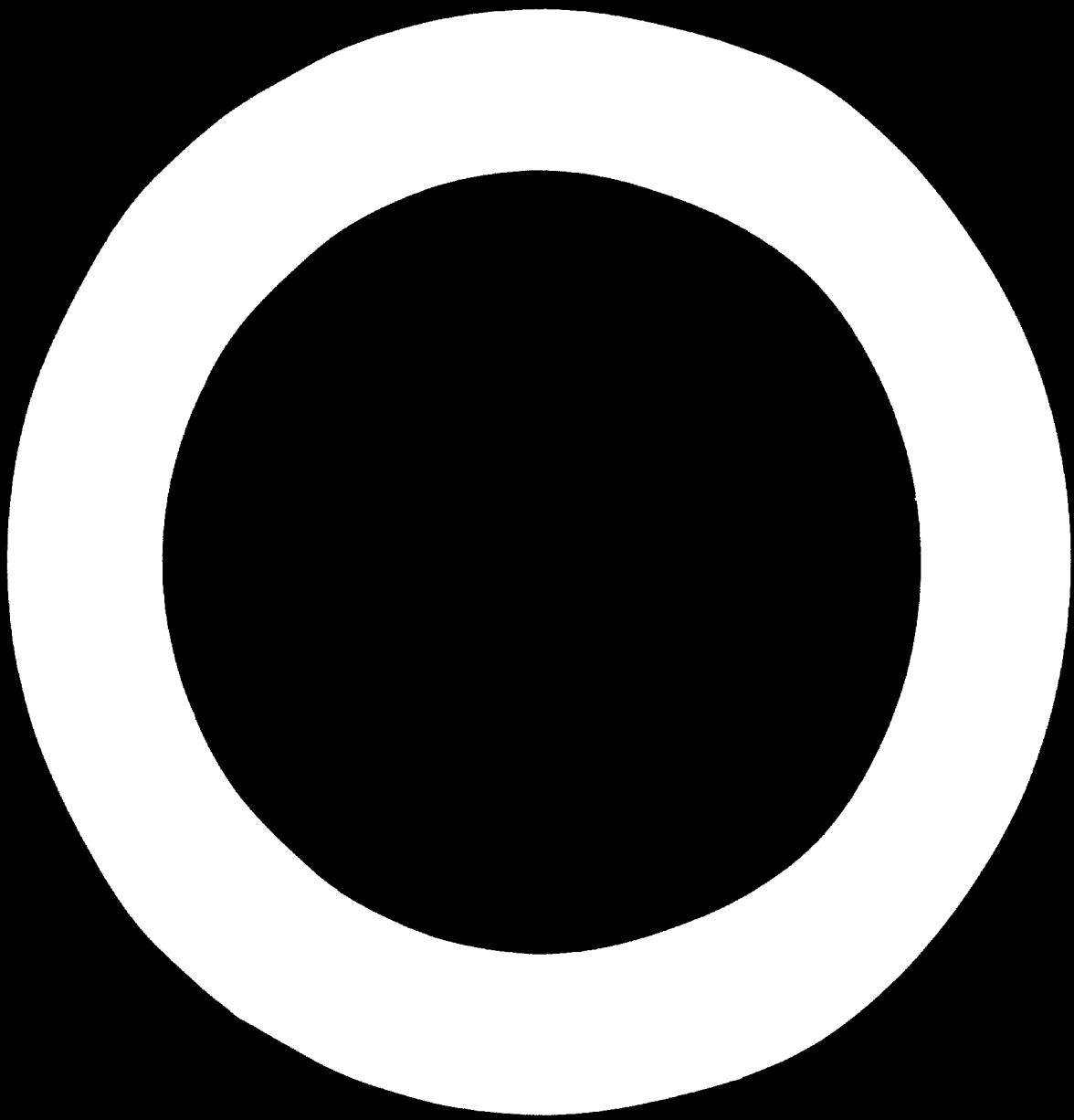
Present and future supply forms the third section. Topics duscussed include generation of equipment, the second hand market, the trends in technological innovation. This section is supported by published material that forms the attachments to the report.

The factors entering into the net cost of equipment are discussed next. These factors are the original and operating costs. An example of the data and calculations needed to obtain net cost is presented.

The mechanisms of transfer form the fifth section. These include exporting, importing and financing organizations and what are termed conditions of transfer. Conditions of transfer considers inspection, classification,



appraisal, repair, spare parts, operating know-how, servicing, and guarantees that accompany second hand equipment on its journey to the developing countries.

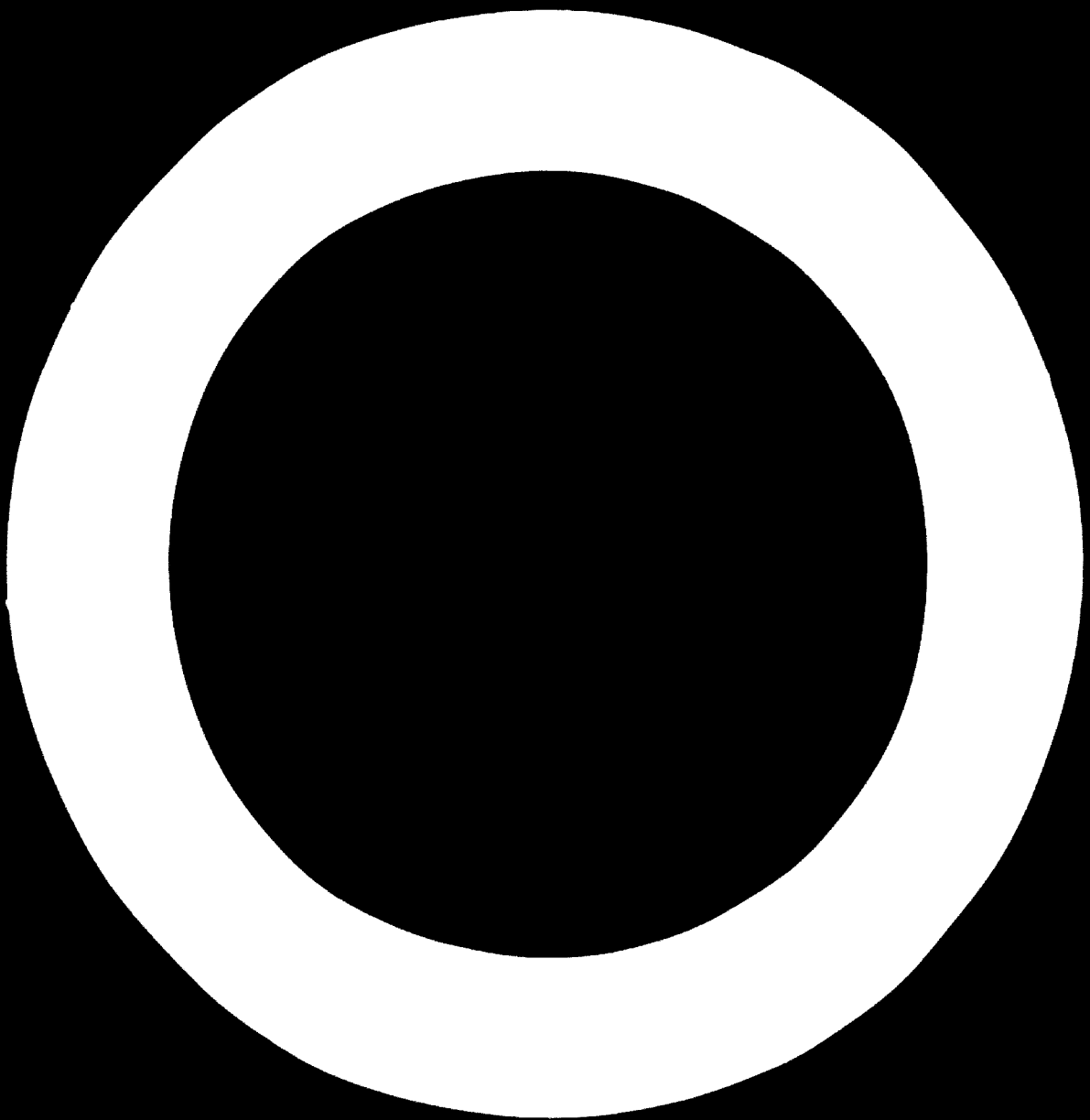


Terms of Reference

2.1 The U.S.A. as the Largest Potential Source

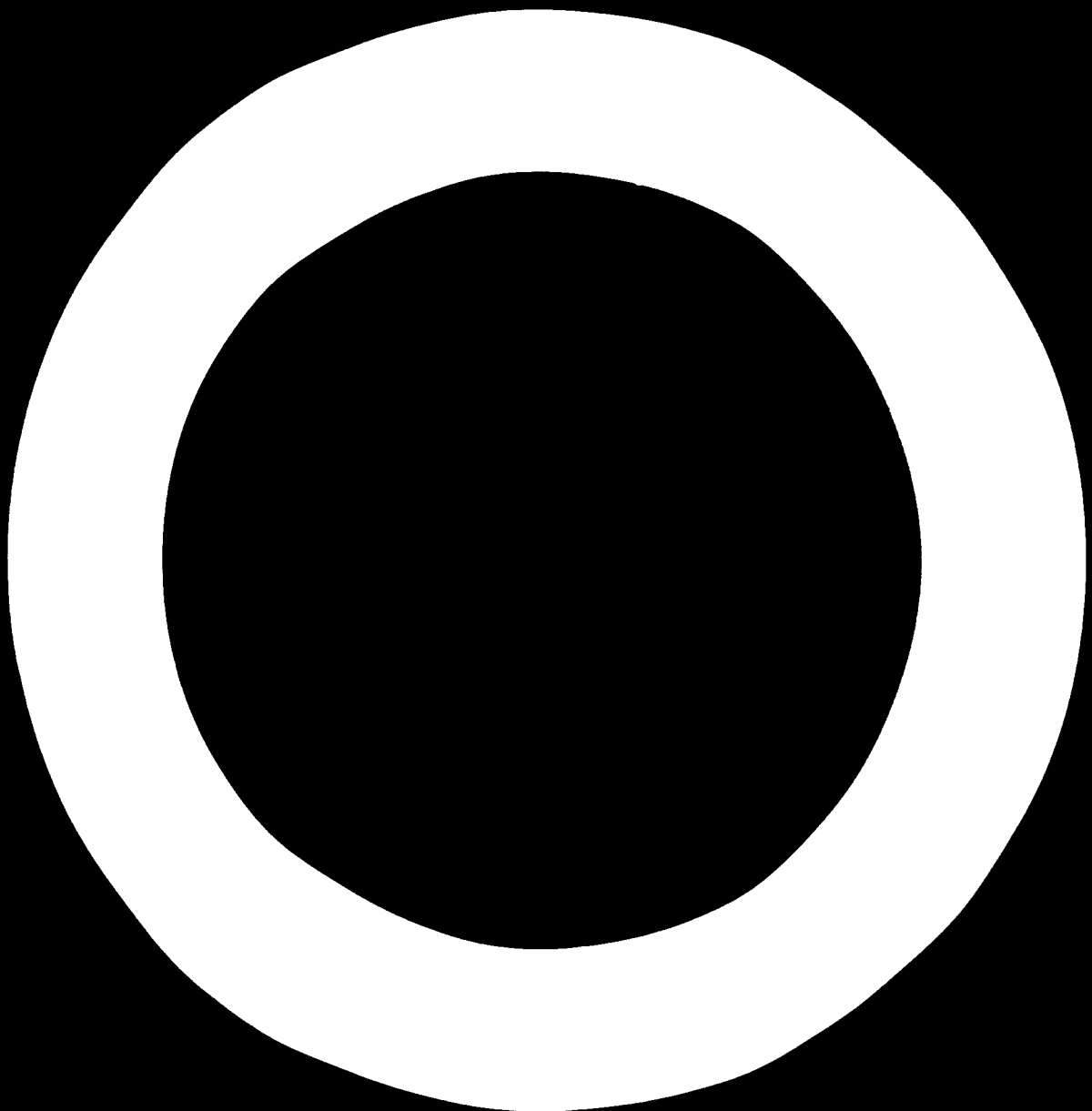
Almost every country has a market in second hand equipment. The West European countries have an active export trade of many years standing. They have relatively new plant facilities and an emphasis on the export of new equipment. In the Federal Republic of Germany, the Government, under its foreign aid program, supports the export of second hand equipment to developing countries by providing financing and through its tax policy. The Government's policy is to ensure that the equipment under this programme is technically and economically efficient and that the constant availablitiy of spare parts is assured.[3] The German machine tool manufacturers are opposed to the plan. They are concerned this programme will destroy their reputation for quality products and service.[4]

The U.S.S.R. and the newly industrialized countries of Eastern Europe are also intensifying their export of new machinery and complete plants to the developing countries. Thus far, it has not included second hand equipment.



The U.S.A., with an industrial production almost equal to that of the rest of the world, must remain the largest potential source of second hand equipment. In the U.S.A., the trend to a larger proportion of over-age equipment has excited general concern in both industrial and government circles. This was one of the major factors that led to the adoption of tax incentives of shorter depreciation on capital equipment. In a speech before the National Industrial Conference Board in February 1961, President Kennedy presented his position in the following way: "Gleaming new factories and headlines about automation have diverted our attention from an ageing industrial plant. Obsolescence is slowing down our growth, handicapping our productivity and worsening our competitive position abroad. The available evidence on the age of our industrial equipment is unofficial and fragmentary; but the trend is unmistakeable - we are falling behind...We must start now to provide additional stimulus to the modernization of American industrial plants."[5]

The potential of 1,300,000 overage metal-working machines, determination to modernize its industrial plant through tax measures, and a second hand equipment market of $.5 billion annually in metal-working equipment make the U.S.A. a logical starting point in any investigation of second hand equipment.

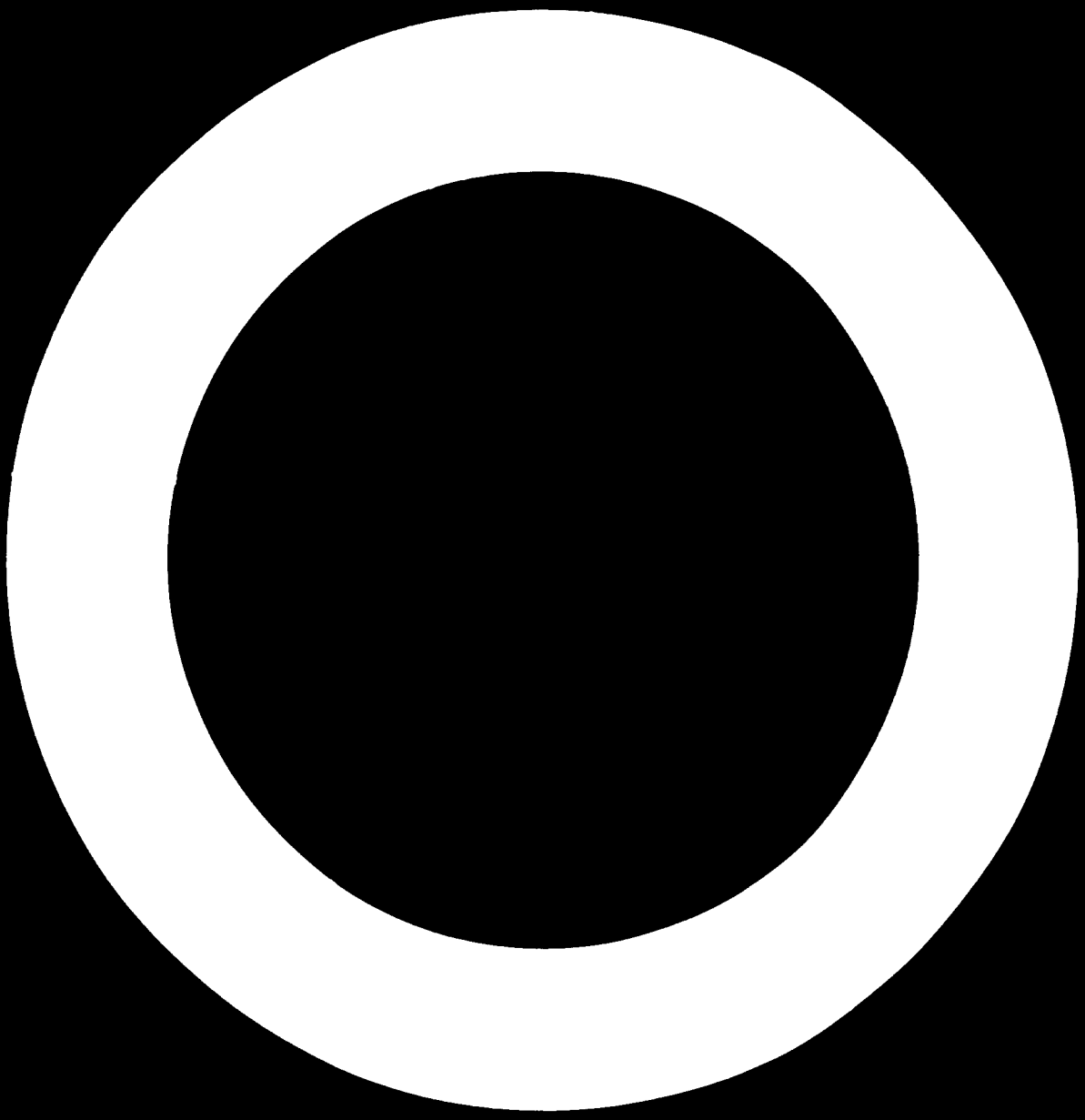


2.2 Choice of Technology and Size of Plant

Some advocates of small scale units and labor intensive technology have pointed to the special suitability of second hand equipment. It is quite true, the principle reason given for the disposal of equipment is that it has become obsoleted by equipment having either much greater capacity or much greater capital intensity and most frequently both. Older equipment is usually of smaller capacity and more labor intensive than new equipment. This however should have no influence in a decision to use second hand equipment.

The procedure suggested by Tinbergen[6] is making the choice between say labor and capital intensive development projects is to use the criterion of "national economic profitability." This criterion involves adjusting market prices of factors of production to reflect their real costs to the economy. He calls these adjusted market prices, "Shadow or accounting prices."

The use of second hand machinery should be considered when computing costs of both the labor intensive and capital intensive project. In short, the decision to use new or second hand equipment is independent of any consideration of choice of technology or size of plant. It is the position of this paper that second hand equipment meeting functional specifications should be an alternative to new equipment in the decision to purchase equipment. The decision of new versus second hand to be made on the basis of economic analysis.



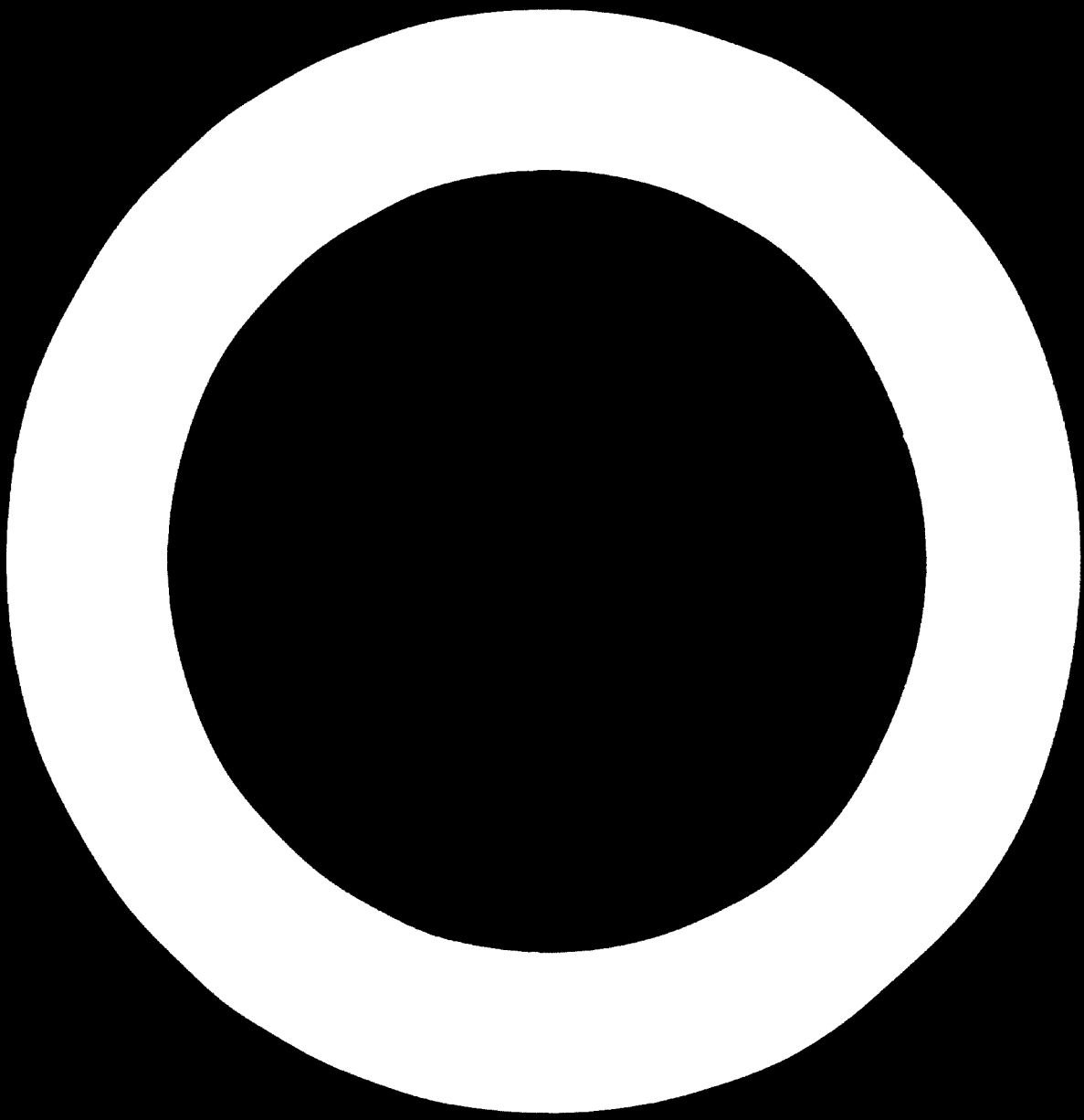
2.3 The Indicative Approach

Economic analysis of second hand vis-a-vis new equipment is a necessery calculation in making e decision. It is nevertheless important to note that certain of the factors that should enter into any economic analysis ere difficult to establish for e period of time as long as the economic life of the average machine. The economic life may be as short es 11 years for chemical machinery and as long as 20 years for metelworking machinery. The factors which cen only be imperfectly escertained include:

1. Utilizetion factor which often depends on product demand. When trensistors repleced rectifier tubes in many electrical curcuits, speciel machinery used in making tubes wes put on a stand-by basis or screppad.

2. Downtime of a machine due to weakness of design or deterioration may force the shutdown of en entire plant or require costly subcontracting. In either case, the machine would be charged with high costs difficult to foresee. This could occur in eny process plant.

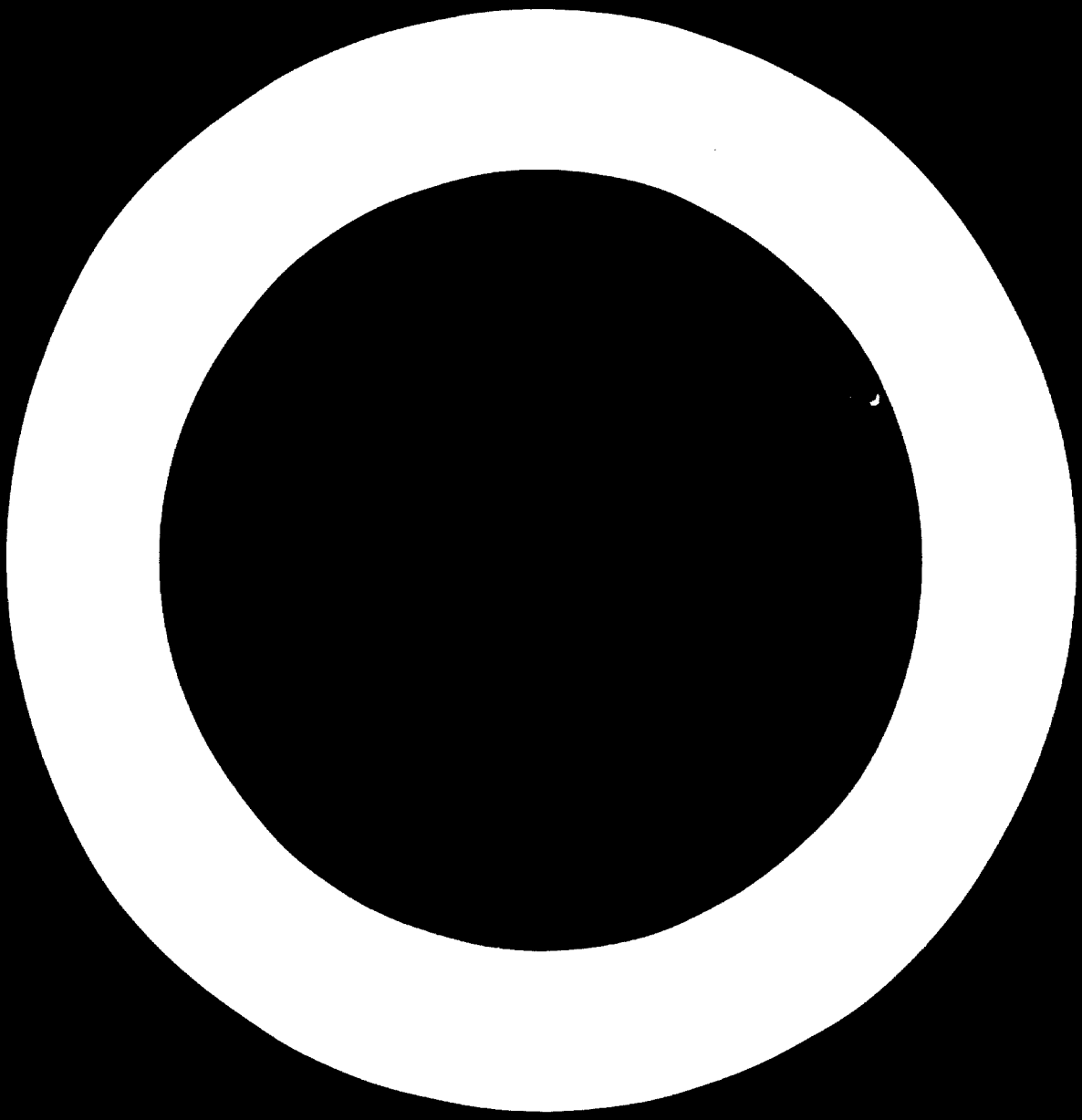
3. The economic life itself is subject to obsolescence due to the introduction of new processes or machines. The introduction of a superior militery fighter plane ends the economic life of the previous model. Within a few years, the precess of making synthetic rubber from refinery gases



made every U.S.A. plant using ethyl alcohol obsolete.

4. Future labor costs are likely to rise due to such factors as unionization, labor laws, dismissal policy in a manner that defies prediction. The U.S. textile plants that moved from New England to the Southern states largely because of wage differentials are now finding this differential narrowing rapidly.

Therefore, any economic analysis is to be considered indicative rather than precise. It is worth noting that factors 1, 3, and 4, would apply equally to new and second hand equipment. However, on the average, a second hand machine may be more subject to downtime than a new one. For this reason, any analysis should show a <u>considerable</u> economic advantage of the second hand machine before a decision is made in its favor.



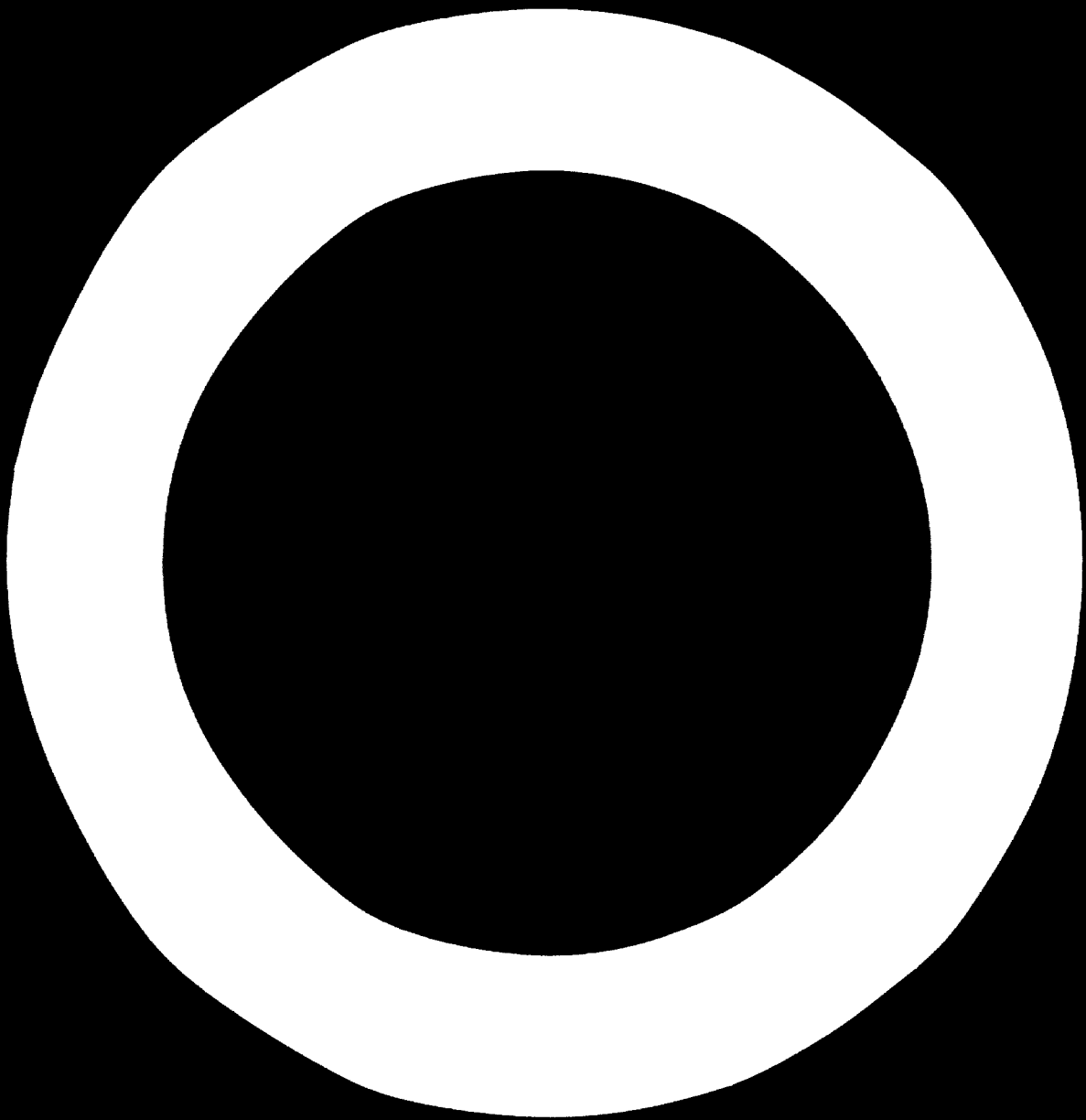
The Supply

3.1 Projections of Supply

The demand by manufacturing industries of the developing countries for capital equipment is expected to increase from $3.5 billion in 1961 to $7.5 billion in 1975.[7] If the 27.4 percent share of the metalworking equipment shown in Table II is assumed as correct, the imports of metalworking equipment will rise from $.96 billion in 1961 to $2.06 billion in 1975. This is the potential market for second hand equipment.

The purpose of this part of the report is to determine what portion of the total demand for imported machinery can be potentially supplied from second hand equipment. Clearly any expansion in the use of second hand equipment in the developing countries depends on an adequate supply in the developed countries. Moreover, any proposed expansion of the use of second hand equipment would incur certain costs that are inflexible. These costs are discussed under mechanisms of transfer. Apportioning these costs to a small volume of second hand imports, would have a substantial effect on the net cost of second hand versus new equipment.

There are no reliable figures on the amount of used equipment in the United States which is at present surplus to requirements, nor, a fortiori, is there any satisfactory

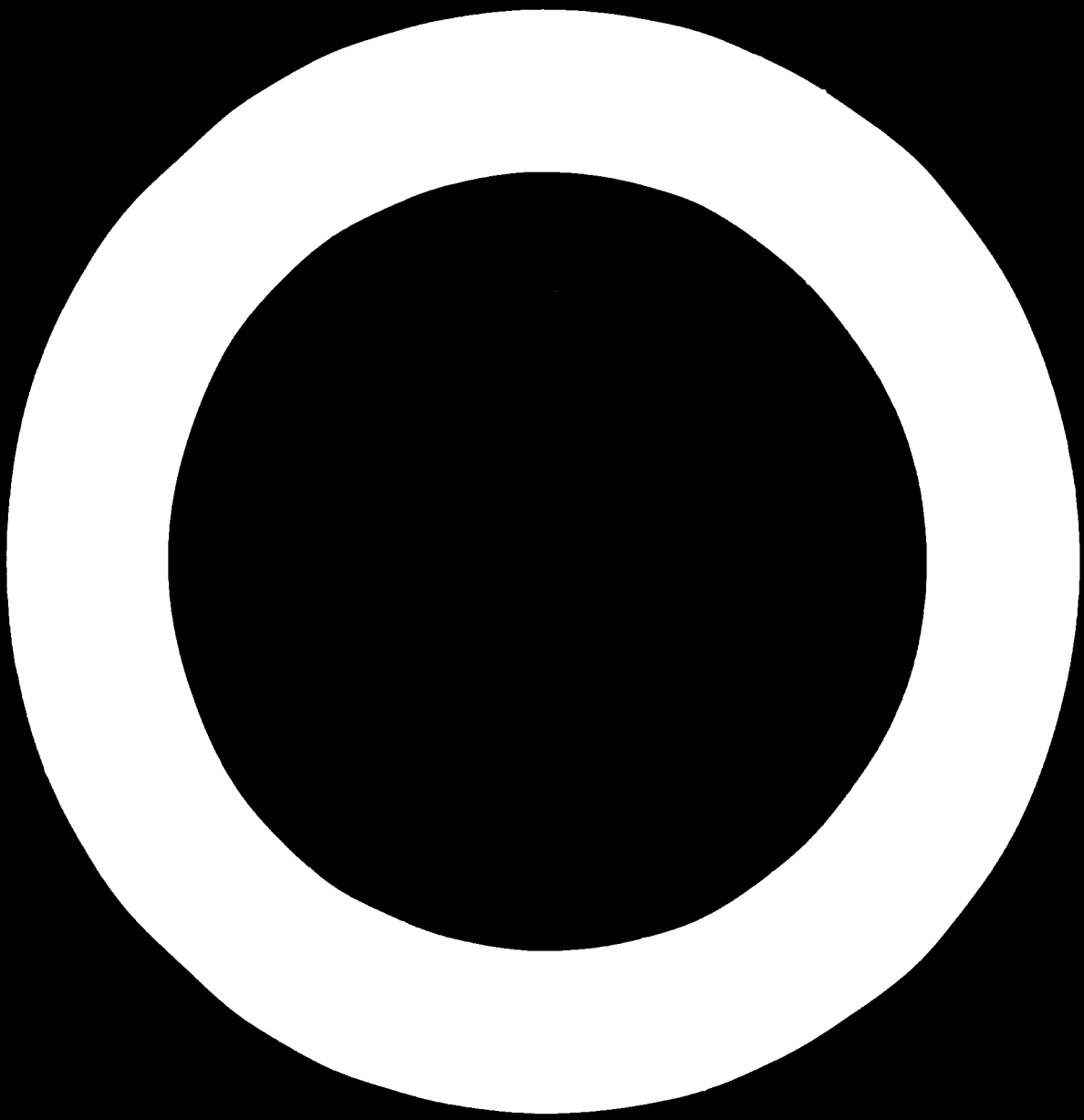


data on the amount of equipment which should be replaced to secure the most efficient operation.

Much of the concern about obsolescent machinery followed a McGraw-Hill survey based on responses of businessmen who were asked: "What would be the cost to replace all obsolete facilities with the best new plant and equipment?" The answer - covering all manufacturing and mining, the petroleum industry, transportation and communications, electric and gas utilities and all of finance, trade, and service - was $95,000,000,000.

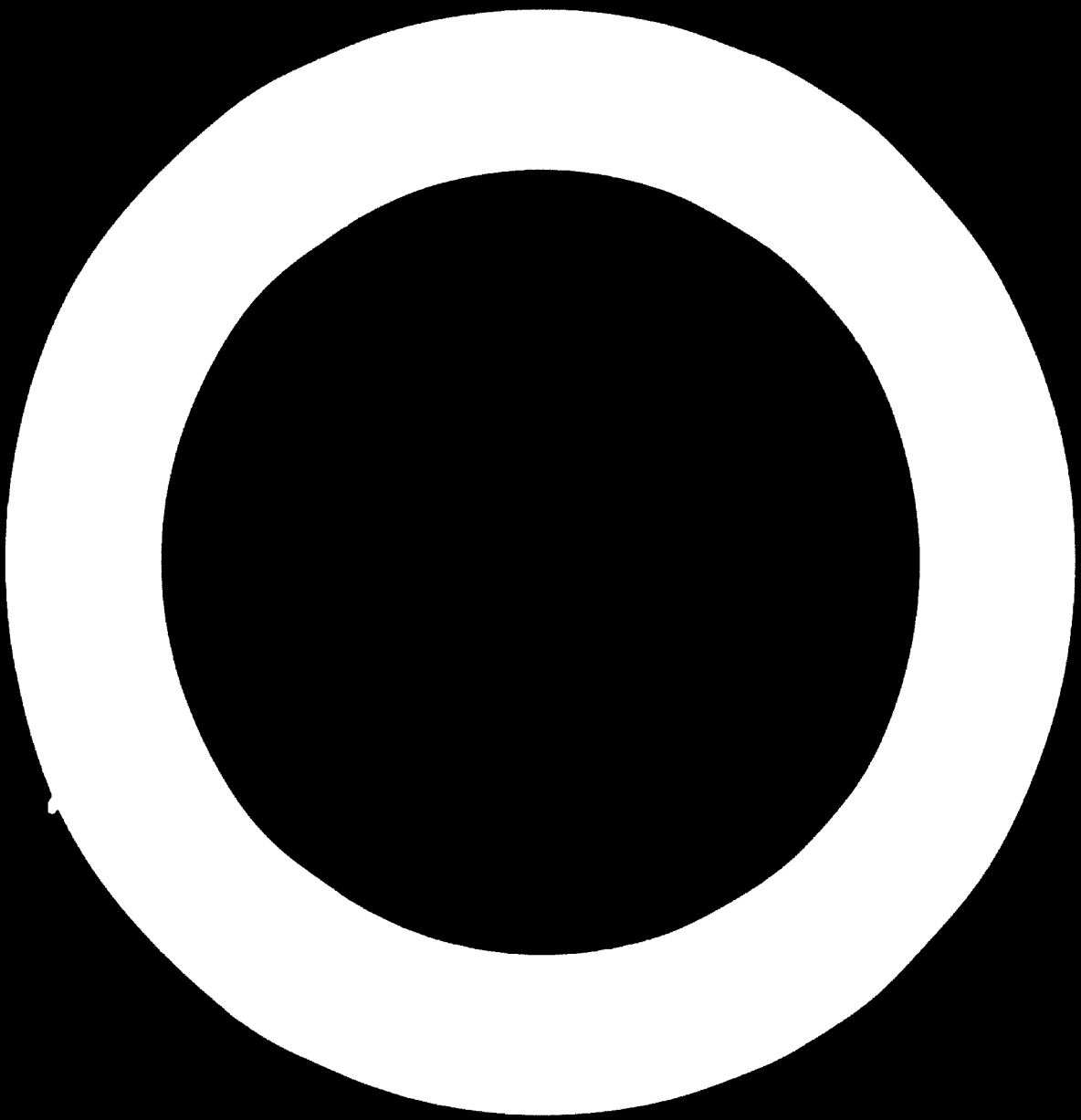
Another survey which has attracted much attention was the eighth American Machinist Inventory of Metalworking Equipment which showed that there had been a continuous rise in the age of machine tools in the post-war years. The primary conclusions of this latter study were: "More machine tools are over-age (more than 10 years old) than at any time since the depression days of the 1930's: 60 percent of metal cutting machines and 62 percent of metal forming machines are over 10 years old...the bulk of them are of 1939 design."[8] On the next two pages the tables give more detailed information from the American Machinist's Inventory.

The $95 billion figure cited by the McGraw Hill accounted in 1958 for 14 percent of the total U.S.A. value of all



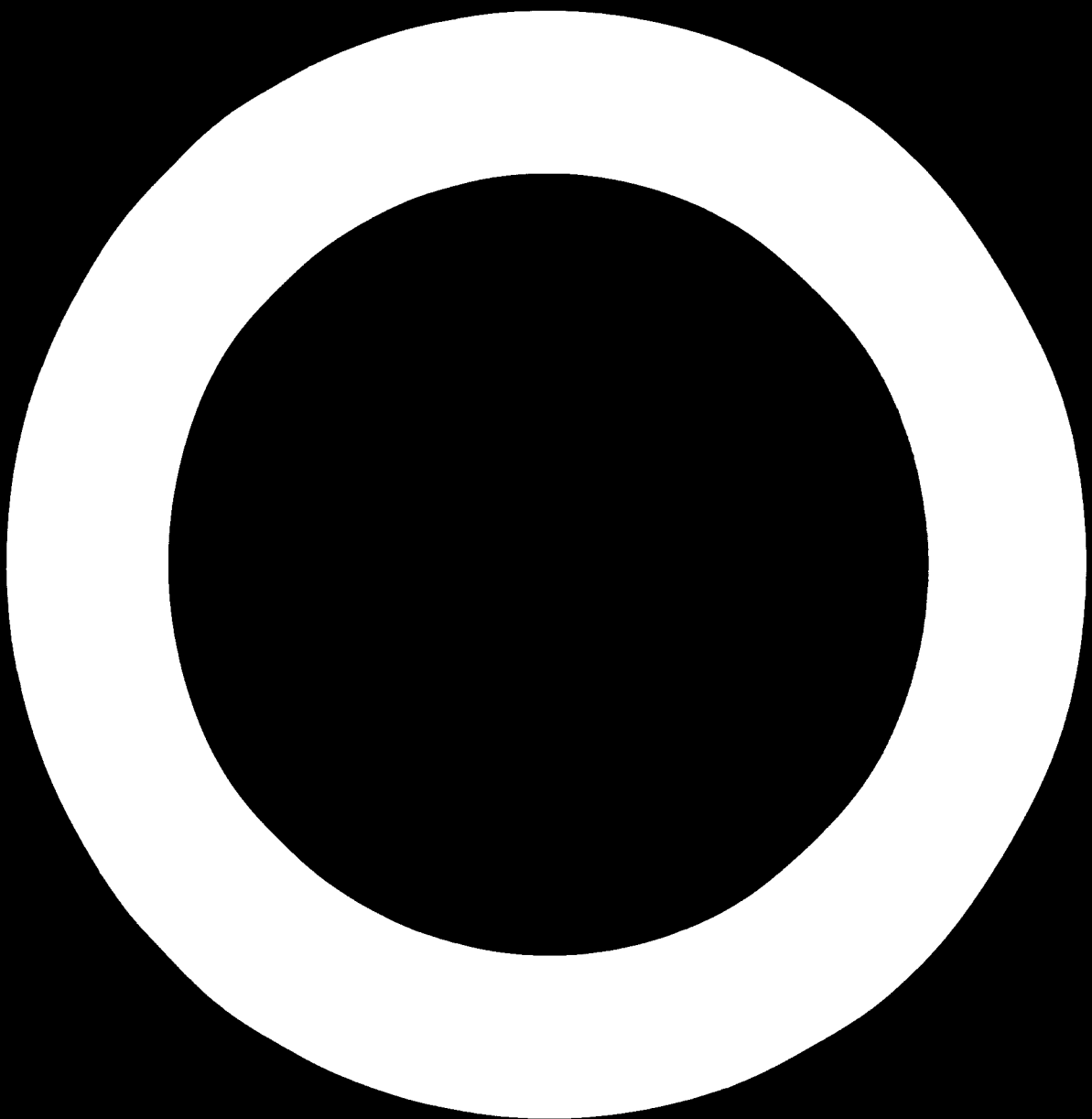
Equipment Available in Various Industries and Percentage Over-Age

	Totals, Machine Tools			Metal Cutting			Metal Forming			% of Total Equip. in each Industry
	Units	10 yr and Over	Over 20 yr	Units	10 yr and Over	Over 20 yr	Units	10 yr and Over	Over 20 yr	
Farm Machinery	56,989	72%	27%	45,329	72%	26%	11,660	72%	29%	2.6
Construction, Mining, Mat. Hdlg.	74,599	63	21	62,496	64	20	12,103	59	24	3.4
Metalworking Machine.y	178,884	62	17	169,304	62	17	9,580	60	23	8.1
Special-Industry Machinery	91,273	71	23	81,472	71	24	9,801	69	31	4.1
General Industrial Equipment	160,612	67	19	145,926	66	18	14,686	70	29	7.3
Fabricated Metal Products	517,860	61	19	326,317	59	16	191,543	65	25	23.3
Office and Service Machines	94,622	65	24	71,351	66	23	23,271	63	27	4.3
Electrical Equipment	164,665	57	18	111,406	57	16	53,259	58	21	7.4
Household Appliances	40,082	64	17	28,830	66	16	11,252	57	17	1.8
Communications Equipment	72,520	42	7	53,524	42	6	16,996	42	9	3.3
Motor Vehicles & Parts	163,885	47	20	124,874	46	18	39,011	50	25	7.4
Complete Aircraft	34,122	51	1	24,962	50	1	9,160	52	1	1.5
Aircraft Parts	131,323	50	4	116,076	50	3	15,247	49	6	5.9
Precision Mechanisms	98,091	59	16	81,216	59	15	16,875	60	21	4.4
Ordnance, Shipbldg., Rways.	92,287	73	20	81,543	72	19	10,744	78	30	4.2
Forge Shops, F-dries, Misc	245,928	60	17	182,358	59	16	63,570	63	21	11.0
	2,217,742	60	18	1,706,984	60	16	510,758	62	23	100.0

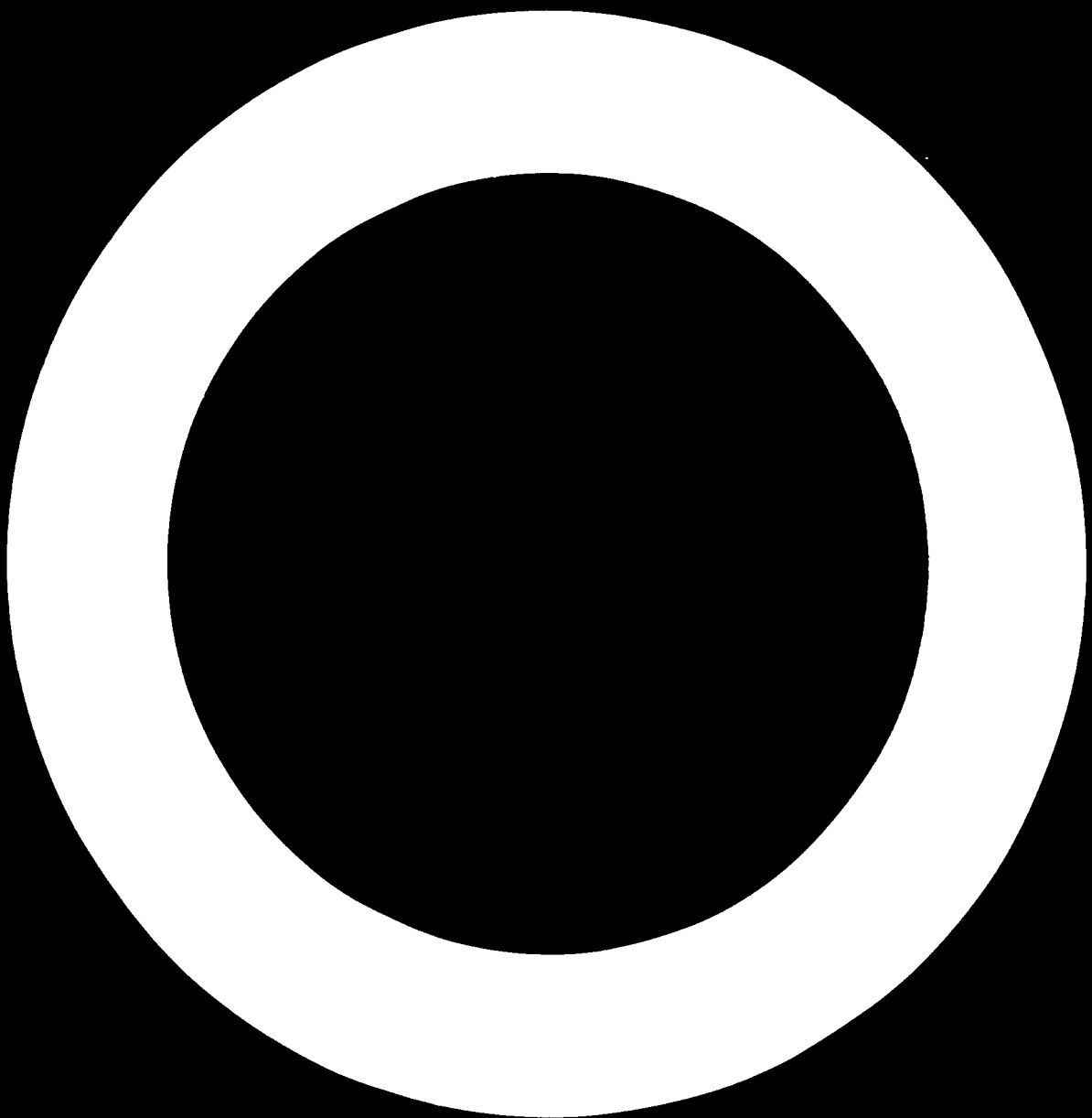


	Welding Equipment			Heating Equipment			Cleaning and Finishing			Industrial Trucks			Other Shop Equipment		
	Units	10 yr and Over	Over 20 yr	Units	10 yr and Over	Over 20 yr	Units	10 yr and Over	Over 20 yr	Units	10 yr and Over	Over 20 yr	Units	10 yr and Over	Over 20 yr
Farm Machinery	8,053	49%	7%	2,951	66%	18%	1,423	59%	20%	4,180	48%	5%	1,750	63%	15%
Construction, Mining, Mat. Hdlg.	20,997	38	3	3,017	53	14	1,971	46	7	4,545	26	3	2,313	52	11
Metalworking Machinery	5,411	46	7	6,617	63	13	2,641	41	7	2,893	36	2	4,382	49	9
Special-Industry Machinery	8,324	48	5	2,405	64	16	1,848	50	19	2,103	37	5	2,612	56	11
General Industrial Eqpt.	11,330	47	7	7,055	54	14	5,111	48	10	4,255	31	1	5,245	50	9
Fabricated Metal Products	112,755	50	5	18,024	55	14	18,225	51	14	20,541	36	4	17,043	48	9
Office & Service Machines	9,767	47	9	2,616	50	10	2,956	55	21	5,080	37	6	2,004	49	8
Electrical Equipment	14,044	48	10	8,721	42	10	6,241	42	7	5,214	31	2	4,780	40	6
Household Appliances	6,190	43	6	1,475	58	11	1,714	50	11	2,074	28	2	1,004	52	12
Communications Equipment	7,443	18	2	6,047	17	2	3,537	30	3	1,594	15	1	1,904	30	3
Motor Vehicles & Parts	34,906	28	5	8,930	42	15	5,970	27	7	9,395	21	4	4,615	35	13
Complete Aircraft	2,584	49	0	772	47	1	756	51	1	2,468	18	0	564	27	0
Aircraft Parts	9,877	30	1	6,123	46	2	4,647	41	1	3,225	25	0	3,317	40	1
Precision Mechanisms	3,858	51	6	4,772	38	9	3,962	48	9	1,155	27	1	2,330	40	2
Ordnance, Shipbldg. Rways.	22,973	59	4	5,316	74	21	3,470	63	6	6,781	52	11	1,534	63	10
Forge Shops, F-dries, Misc.	21,199	53	5	14,183	62	15	16,513	52	15	7,392	40	6	8,935	50	11
	299,711	46	5	99,024	52	12	80,985	47	11	82,895	34	4	64,332	47	9

SOURCE: American Machinist



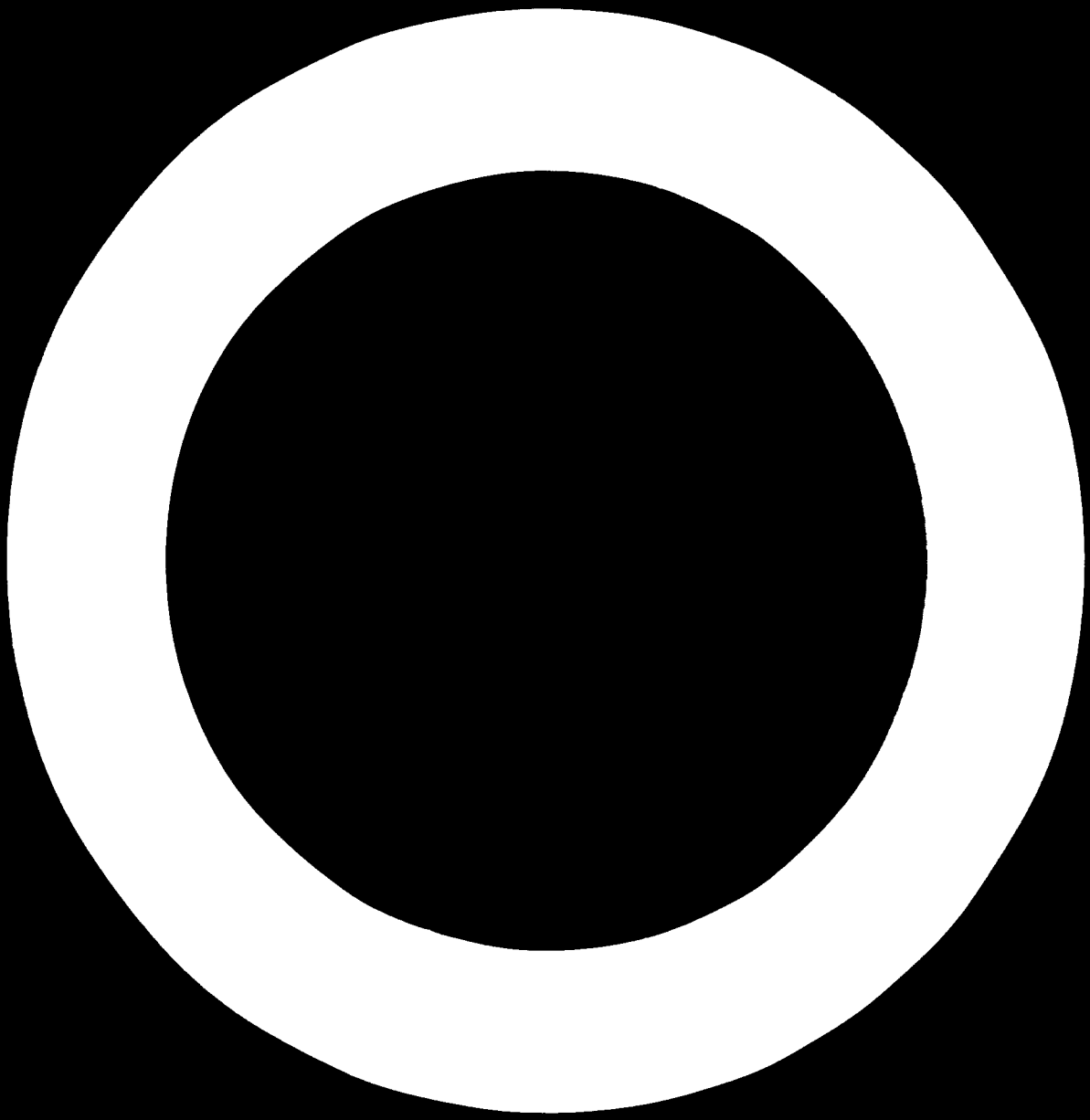
privately owned plant and equipment of $683 billion. Assuming an equal division between plant and equipment, this gives $47 billion in over-age equipment. If this modernization is achieved over 10 years, $4.7 billion of second hand equipment will be generated annually. It must be added that U.S.A. industry remains largely unconcerned and that the tax incentives providing for shorter tax write-off of equipment have had only very limited effect.



3.2 Generation of Equipment

Equipment is generated in the developed countries by 1. obsolescence 2. chenge in product demand 3. liquidations end 4. deterioretion. Obsolescence may teke the form of new designs, new processes, or new materiels. The new design of basically the same machine has typically a higher initiel cost end lower operating costs due to greater capacity, higher speed, automatic control, lower maintenance, spoilage, reliebility, etc. A new process such es welding of parts has replaced castings in many machine components. Pertielly es e result, 1,500 foundries of 3,200 have gone out of business in the last 10 years.[9] Offset presses using e photographed plete have largely repleced letterpresses, using manuelly set metel type, in the printing industry. New materials such as beryilium end titenium in the eerospace industry heve led U.S. Air Force to plan the disposal of $521 million of machine tools it lends to its contractors. Plestics have replaced many metel stampings with en ettendant obsolescence of much stamping equipment.

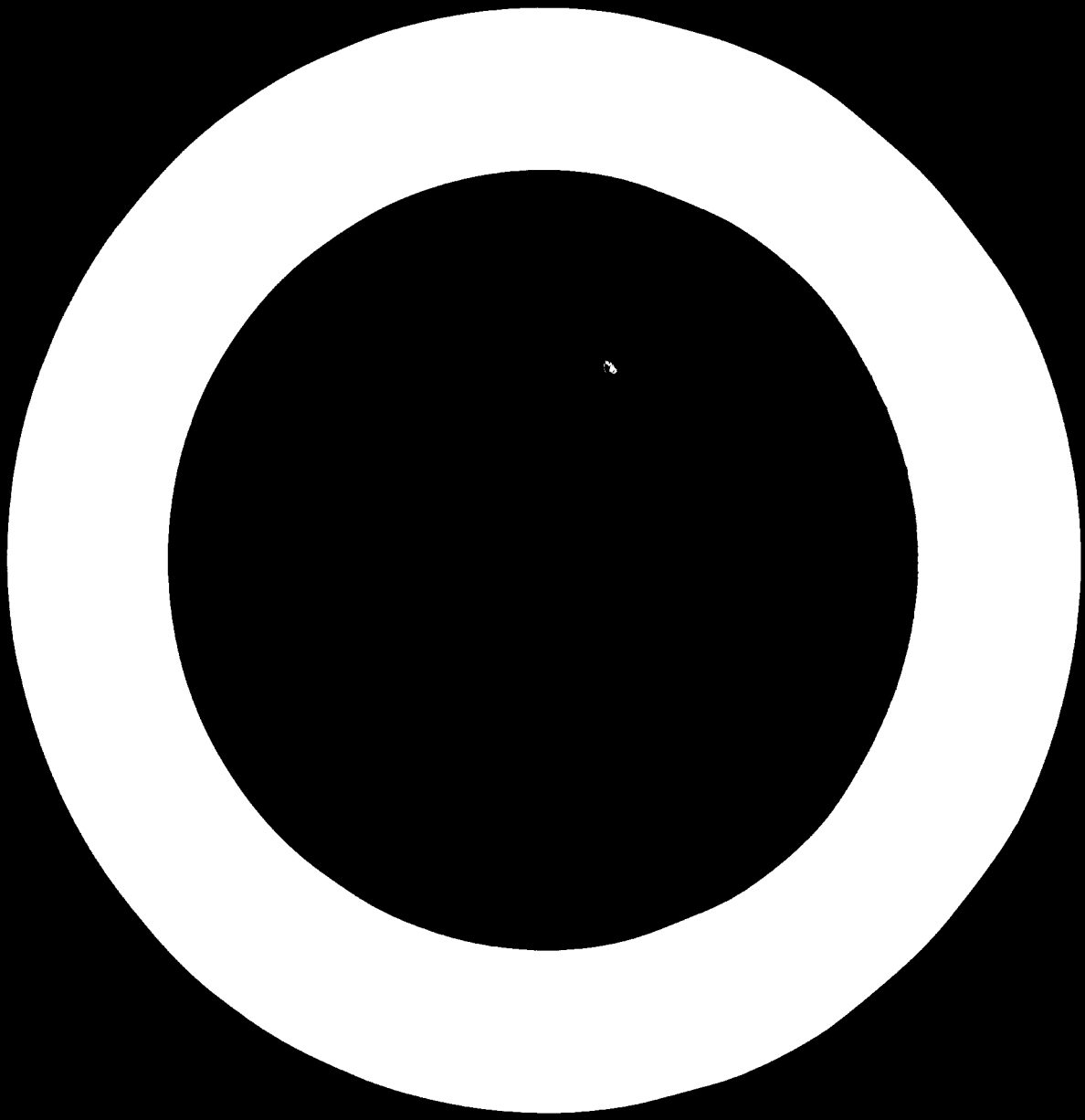
A drop in product demand generetes equipment used in manufacturing the product. A whole veriety of U.S. consumer products such as textiles end household appliances are subject to wide fluctuations in product demand.



Liquidations occur when an entire plant is shut down and usually sold at auction. The decision to liquidate may be due to bankrupcy, discontinuance of a plant or a division by a multiplant corporation or a merger consolideting production in one plant. One recent liquidation was ceused by the decision of a large manufacturer of metal office furniture to contract out his entire production. In 1964, there were 2,254 business failures in the mining and manufacturing industries in the U.S.A.[10] The principle underlying cause in 93.6 percent of cases was reported as inexperience and incompetance. No estimate of the value of plant and equipment was included.

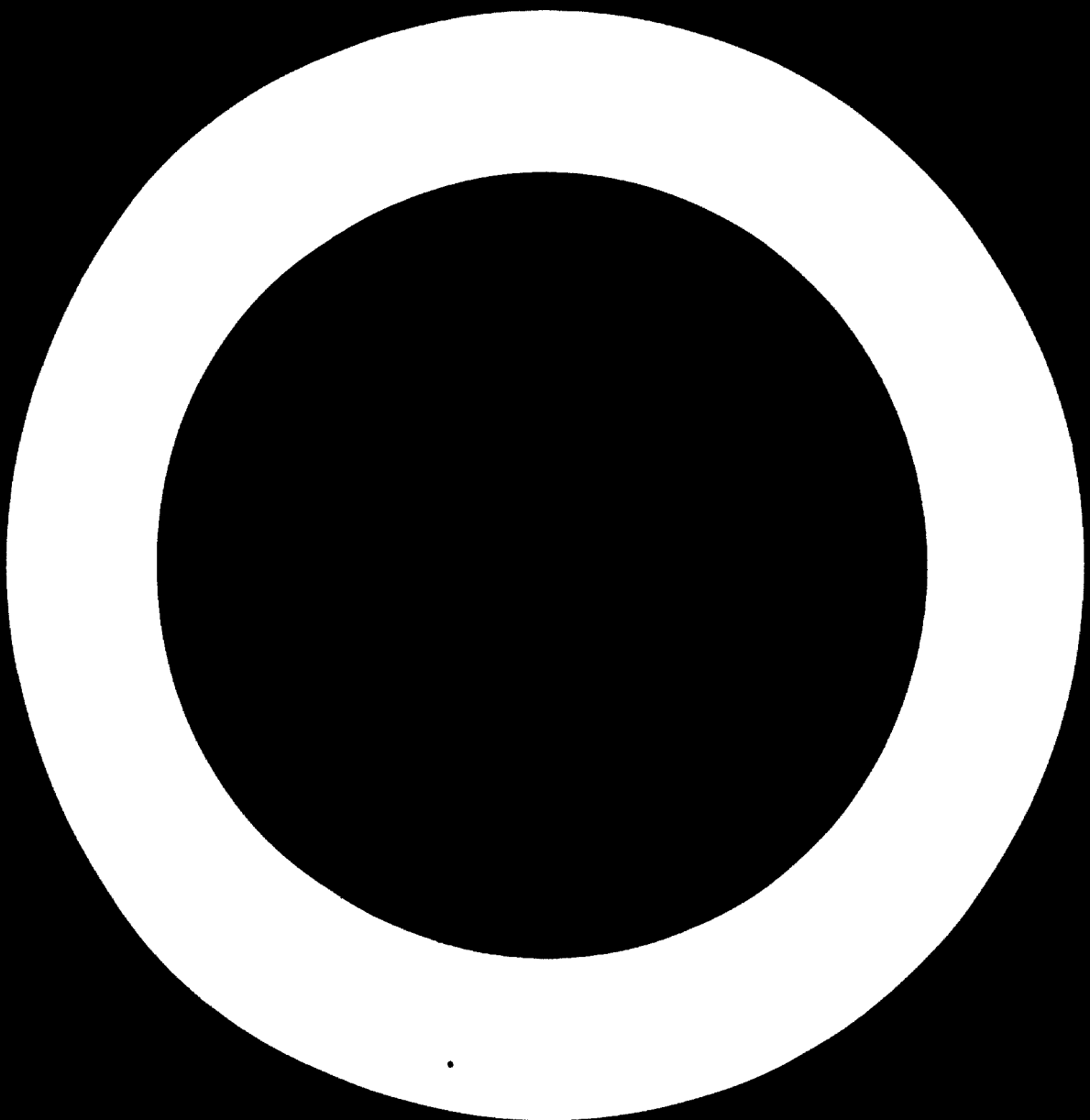
Deterioration refers to equipment worn out due to age or use. This equipment is sometimes relegated to secondary function or sold for scrap value to dealers. This equipment is not suitable for use in developing countries and is not considered in any potential supply of second hand equipment.

Equipment is generated from private corporations, governmental agencies, and liquidations. Many large multiplant corporations including Union Carbide Corporation, General Electric Company, American Machine and Foundry Company, Radio Corporation of America, and E.I. duPont de Nemours & Company operate central surplus equipment departments. Equipment not required by a division is placed on a surplus list and circulated to all other divisions who have first call



on the equipment. If no division of the company requests the equipment, bids are solicited from prospective buyers, chiefly dealers. Divisions usually prefer if their equipment is sold rather than claimed by other divisions of the company because, in most cases the selling price is greater than the book value which is the basis of transfer to other divisions. Divisions compete with each other on the basis of independent profit and loss statements. A monthly list of idle equipment of a large chemical company includes the following categories of equipment:

1. Electrical Equipment
2. Material Handling
3. Machine Tools & Shop Equipment
4. Instrumentation
5. Laboratory Equipment
6. Air Compressors, Blowers, & Fans
7. Process Equipment
   - A. Crushing, Grinding, Screening & Separating
   - B. Centrifuges, Filters, Strainer, Collectors
   - C. Heat Exchange Equipment
   - D. Extruders
   - E. Tanks, Columns, Kettles
   - F. Pumps
   - G. Mixing Equipment
8. Construction Equipment
9. Pipe, Valves & Fittings
10. Transportation Equipment
11. Office Equipment



Sample lists of surplus equipment generated by corporations form Attachment "A". No estimate of the total value of equipment generated from this source is available. One large corporation is estimated to generate $6 million in surplus equipment per year.

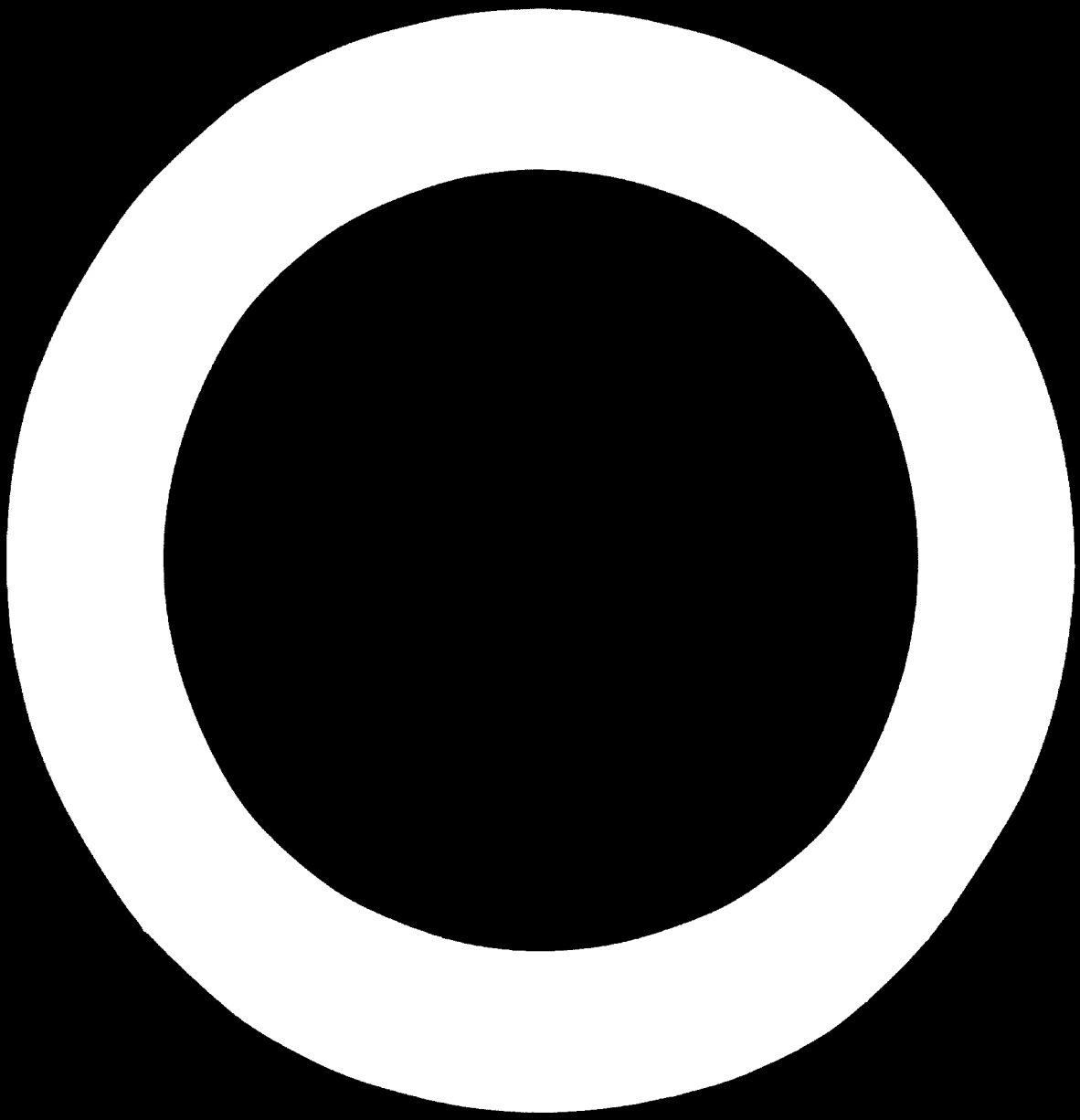
The U.S. Department of Defense owns industrial equipment which it makes available to contractors (private corporations) for manufacturing and development. This equipment is of special interest for 2 reasons: 1. it has a high rate of obsolescence due to very rapid changes in arms demand and technology and 2. through the U.S. Agency for International Development, developing countries have a high priority and an established channel for obtaining it. The industrial equipment under the juristiction of the Defense Industrial Plant Equipment Center is shown in the following table:

Table III

Invehtory of Plant Equipment of the U.S.A.[11]

Defense Industrial Plant Equipment Center, June 30, 1965

Equipment	Number	Value in $ Million
Machine Tools metal cutting & forming	150,700	2,305.5
Testing & Measuring	23,116	193.6
Welding	12,329	63.8
Heat Treating Furnaces	11,541	172.9
Woodworking	4,793	13.0
Foundry	3,686	26.6



Special industries	10,733	89.2
Other	4,703	64.7
Total	221,601	2,928.9

This is industrial equipment having an original value of at least $1,000 per item. It is divided about equally among the three services. About 66 percent is in use with the remainder idle. All of the Air Force equipment is in the hands of contractors, of the Navy equipment half is in the custody of contractors, and of the Army, equipment 70 percent is in the hands of contractors.

A good indication of the future of this equipment is contained in a recent Air Force study.[12] The study states that of the 1964 inventory of 31,800 machine tools aquired at the cost of $653 million, only 1,700 worth $59 million will be retained in 1975. Applying this rate of obsolescence to the Army and Navy, the U.S. Defense Department will generate about $270 million in excess industrial equipment for each of the next 10 years of which $210 million will be metalworking machinery. The table on the following page is taken from the Air Force study and details the obsolescence of various categories of equipment.

Liquidations consist of auctions at which usually contents of entire plants are sold to the highest bidder.

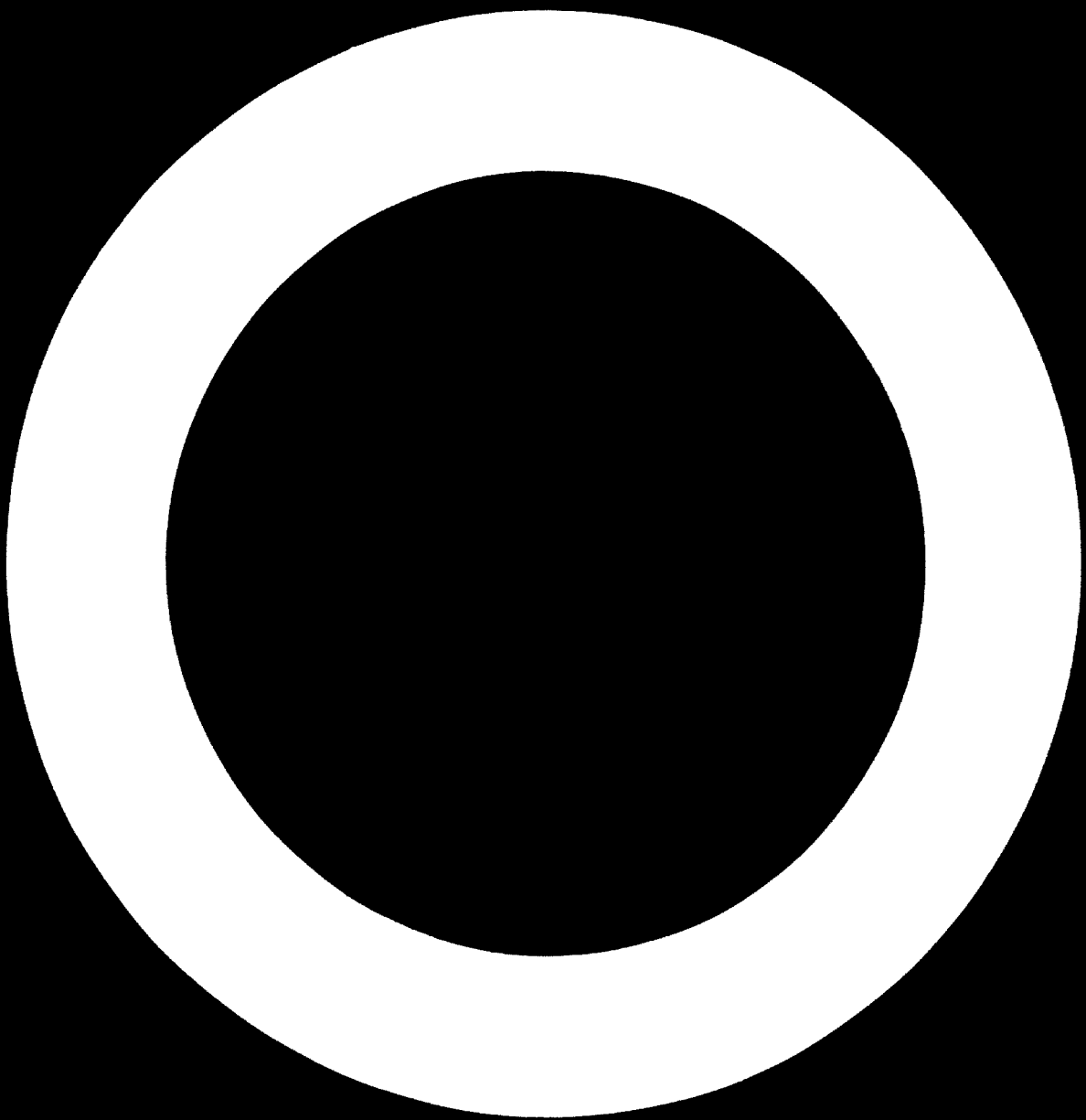


TABLE 5

OBSOLESCENCE OF 1964 DIPEC INVENTORY FOR ACTIVE AIR FORCE EQUIPMENT FOR SIX MAJOR CATEGORIES OF PRODUCTION EQUIPMENT (1)

Category	Data For Year (End of FY – June 30)											
	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Estimated Remaining 1964 Inventory (1,000's of Items)												
Material Removal (2)	28.5	23.9	19.5	15.2	11.5	8.8	6.6	5.3	3.9	2.9	2.0	1.2
Metal Forming (3)	3.3	2.9	2.6	2.2	1.9	1.6	1.4	1.2	1.0	0.8	0.6	0.5
Welding (4)	3.2	2.8	2.5	2.2	1.9	1.7	1.5	1.2	1.1	0.9	0.7	0.5
E. M. Test (5)	14.0	10.5	8.0	6.0	4.7	3.5	2.7	2.0	1.5	1.1	0.8	0.6
Mech. Meas. (6)	9.2	8.9	8.6	8.1	7.7	7.3	6.8	6.4	6.0	5.5	5.2	4.9
Heat Treat (7)	2.2	2.0	1.8	1.7	1.5	1.2	1.0	0.8	0.7	0.6	0.5	0.3
Total	60.4	51.1	44.9	35.4	29.2	24.1	20.0	18.8	14.0	11.7	9.7	7.9
Estimated Av. Cost-Item Remaining in 1964 Inventory ($1,000's)												
Material Removal	19.9	21.6	23.2	25.0	26.6	28.3	29.9	31.6	33.3	34.9	36.6	38.3
Metal Forming	25.9	26.0	26.1	26.3	26.5	26.7	26.8	27.0	27.2	27.3	27.5	27.7
Welding	5.1	5.4	5.6	5.9	6.2	6.5	6.7	7.2	7.3	7.8	7.8	8.1
E. M. Test	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3
Mech. Meas.	7.5	7.7	8.0	8.2	8.4	8.6	8.9	9.1	9.3	9.5	9.8	10.0
Heat Treat	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7
Weighted Average Estimated Total Value of Remaining 1964 Inventory ($1,000,000's)	13.6	14.7	15.4	16.1	16.3	16.6	16.7	17.0	16.9	16.7	16.3	15.1
Material Removal	567	516	451	380	309	248	198	166	130	100	74	46
Metal Forming	86	77	67	58	51	44	37	31	26	21	17	13
Welding	16	15	14	13	12	11	10	9	8	7	5	4
E. M. Test	45	36	27	21	17	13	10	9	6	5	3	3
Mech. Meas.	69	69	68	67	65	62	61	58	56	52	50	49
Heat Treat	40	37	34	31	27	22	18	14	13	10	8	6
Total	823	749	662	570	476	400	334	288	238	196	159	120

(1) Based on data obtained from Defense Industrial Production Equipment Center on July 15, 1964, which was processed by Computer Section of WPAFB, and further evaluated by Task Force.

(2) Material Removal Equipment
(3) Sheet Metal Forming Equipment
(4) Welding Equipment
(5) Electromagnetic Test Equipment
(6) Mechanical Measuring and Testing Equipment
(7) Heat Treating Furnaces

TABLE 4

SUMMARY OF DIPEC INVENTORY FOR ACTIVE AIR FORCE EQUIPMENT IN ELECTROMAGNETIC TEST EQUIPMENT, MECHANICAL MEASURING AND TESTING EQUIPMENT, AND HEAT TREATING FURNACES CATEGORIES* (AS OF JULY 15, 1964)

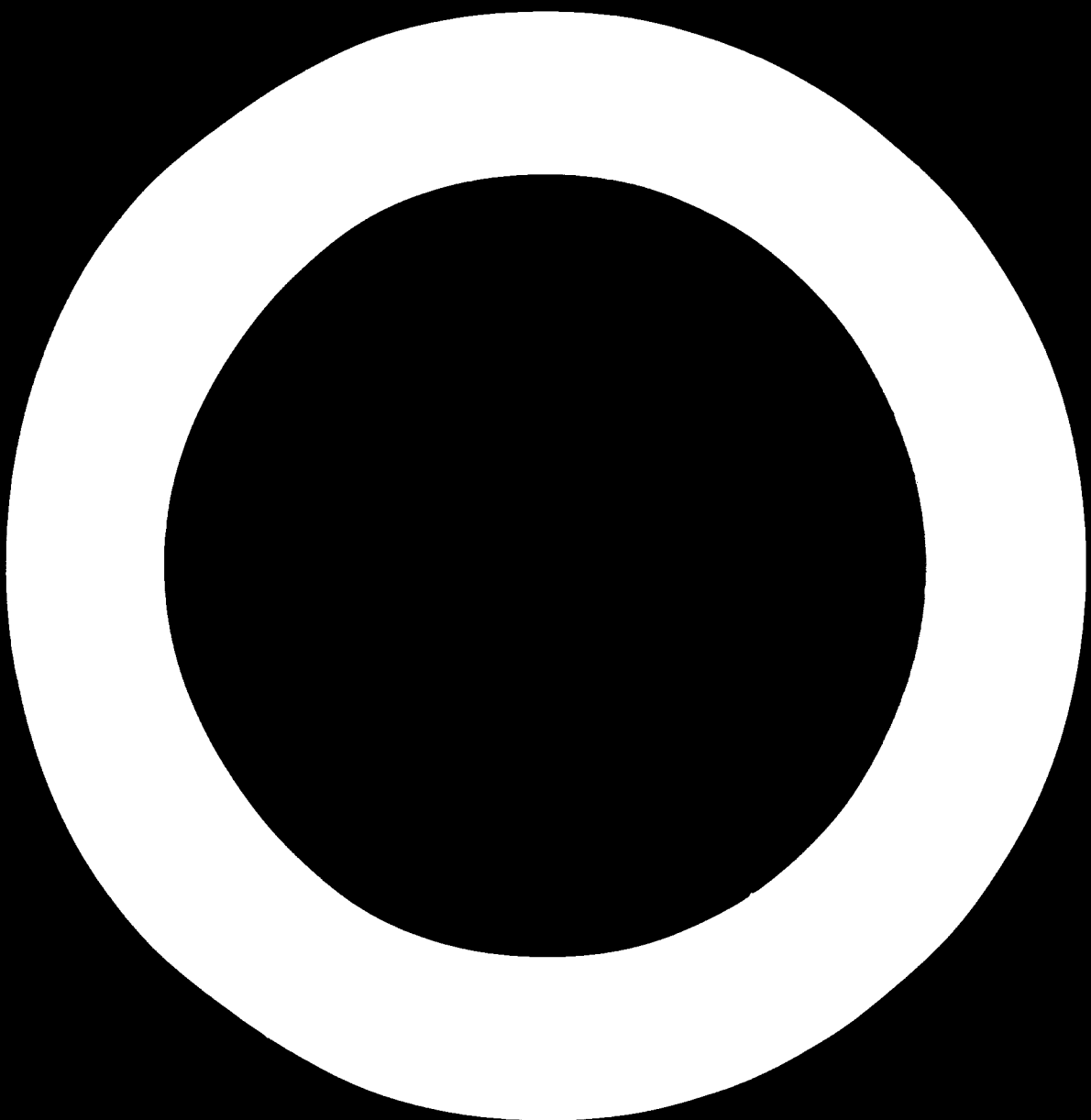
Nomenclature	Quan. in Active Inventory: Total No. Items	Quan. in Active Inventory: Mfrd. Recently**	Value of Inventory: Est. Total ($ Billions of $)	Value of Inventory: Cost/Item Mfrd. Recently** ($1,000's)
ELECTROMAGNETIC TEST EQUIPMENT CATEGORY				
Misc. aircraft and nautical instruments and apparatus, incl. navigational instruments	105	79	1.49	.12
Voltmeters and millivoltmeters	140	107	2.04	.21
Radio and radar test equipment	3,253	1,906	1.86	4.40
Misc. electrical quantity measuring instruments	3,000	2,104	3.63	17.10
Electronic computing equipment (AF assigned code)	300	130	59.84	15.68
General electromagnetic testing equipment	3	0	.	.
Power supplies (for electronic testing and measuring)	1,941	911	1.20	1.11
Complete industrial X-ray units	300	73	31.70	5.81
Total Electromagnetic Test Equipment Category	14,000	5,300	3.74	44.84
MECHANICAL MEASURING AND TESTING EQUIPMENT				
Temperature measuring instruments	90	94	1.61	.15
Pressure and vacuum measuring instruments	42	40	3.06	.13
Misc. measuring instruments except aircraft and electrical quantity measuring instruments	835	288	5.78	3.62
Hardness testing machines	300	178	1.38	.85
Strength of materials testing machines	1,200	844	31.62	21.00
Pressure testing machines	600	455	14.86	7.70
Spring testing and checking machines	54	50	1.86	.07
Wear, abrasion, and aging testing machines	101	60	3.60	.32
Balancing machines	313	168	11.36	1.80
Inspection, testing, and measuring machines	8,700	970	7.60	15.86
Misc. physical properties testing equipment, industrial production types, except X-ray and gamma ray equipment	800	707	15.00	13.87
Microscopes and magnifiers	300	155	3.01	.50
Laboratory and industrial optical instruments	901	720	6.31	4.00
Misc. mechanics measuring tools, incl. plumb bobs, templates, templets, and vernier tools	197	80	1.00	.11
Total Mechanical Measuring and Testing Equipment	9,000	4,017	10.01	69.36
HEAT TREATING FURNACES CATEGORY				
Metal heat treating furnaces and ovens	2,501	1,000	10.00	60.00
Total Heat Treating Furnaces Category	2,501	1,000	10.00	60.00

TABLE 3

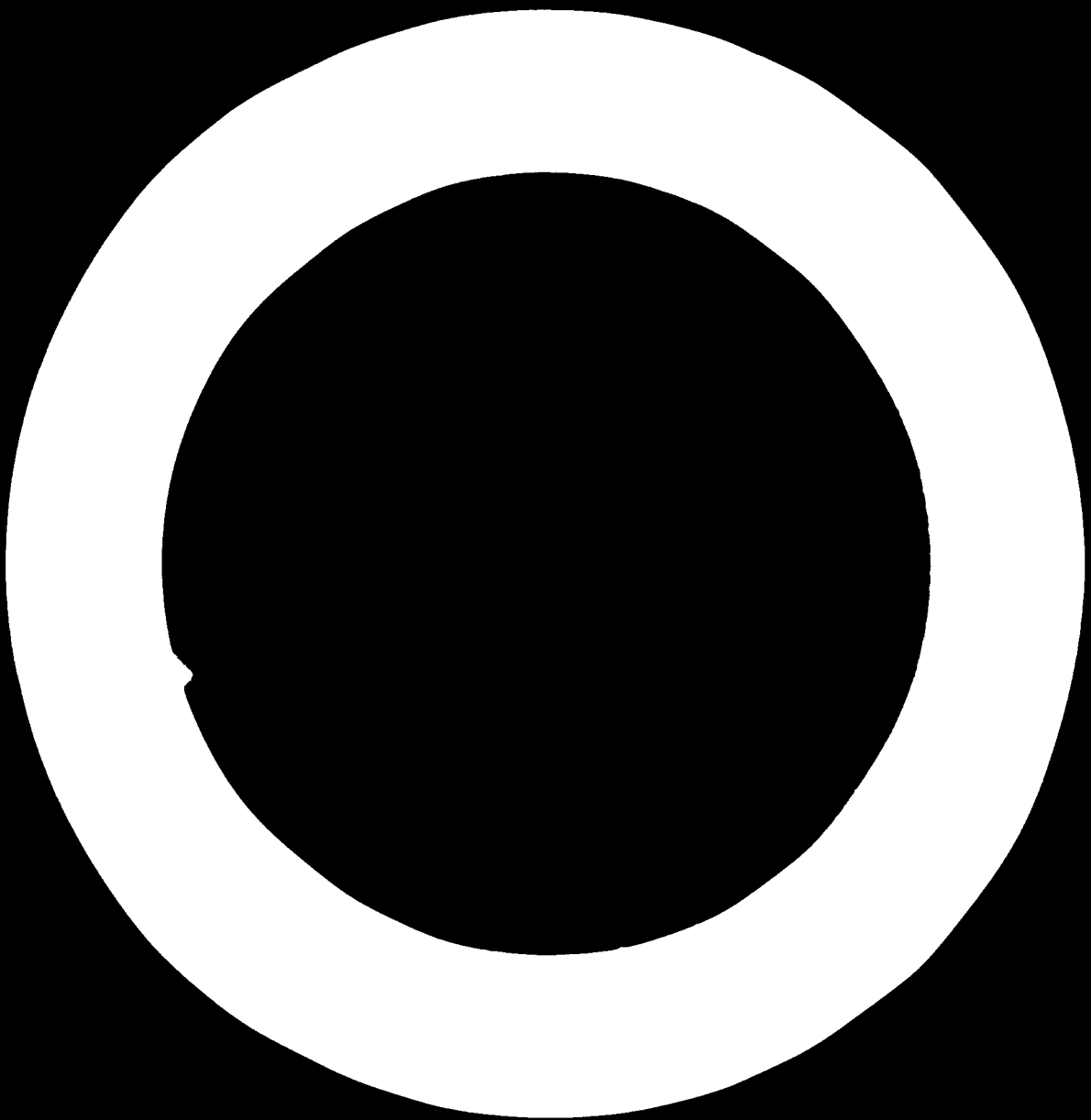
SUMMARY OF DIPEC INVENTORY FOR ACTIVE AIR FORCE EQUIPMENT IN MATERIAL REMOVAL, SHEET METAL FORMING AND WELDING CATEGORIES* (AS OF JULY 15, 1964)

Nomenclature	Quantity in Active Inventory: Total No. Items	Quantity in Active Inventory: No. Mfrd. in Last 10 Yrs.**	Av. Cost/Item Mfrd. Last 10 Yrs ($1,000's)	Est. Value for Total Number Items ($1,000,000's)
MATERIAL REMOVAL CATEGORY				
Boring machines	2,490	740	55.8	104.5
Drilling machines	3,745	850	13.1	36.7
Grinding machines	8,917	1,051	18.2	78.4
Lathes	8,995	1,270	19.1	85.8
Milling machines	5,819	1,818	62.1	227.5
Miscellaneous machine tools, incl. electrochemical machining, etc.	4,570	1,000	8.5	32.5
Total Material Removal Category	38,496	6,631	29.9	566.4
SHEET METAL FORMING CATEGORY				
Bending and forming machines	1,277	585	7.5	7.2
Hydraulic and pneumatic presses, power driven	744	211	63.2	36.2
Forging machinery and hammers	600	118	36.5	24.8
Miscellaneous secondary forming and cutting machines	880	41	61.2	12.9
Total Sheet Metal Forming Category	3,200	991	27.0	86.0
WELDING CATEGORY				
Electric arc welding equipment	1,772	1,181	2.5	3.3
Electric resistance welding equipment	900	545	10.8	9.6
Gas welding and heat cutting and metallizing equipment	104	32	7.5	0.6
Welding positioners and manipulators	364	182	0.4	2.3
Miscellaneous welding equipment	15	14	86.1	0.4
Total Welding Category	3,160	1,966	6.5	16.2

*Limited to select classes based on priorities established in Phase I study. Relatively unimportant classes are not included.
**1954 to date.



There is a separate bid for each piece of equipment. The principle buyers at these auctions are machinery dealers who resell the equipment to manufacturers. The bulk of liquidations involve a multiplant corporation disposing of one plant. In about half of liquidations the product line is available for sale which means the company is discontinuing the manufacture of the product entirely. Since the plant is usually worth more as a unit, a company makes efforts to sell it to one buyer before resorting to liquidation. The net sales of equipment at auctions are estimated at $50 million annually. Attachment C contains several notices of liquidations and more detailed catalogues are among the enclosure.



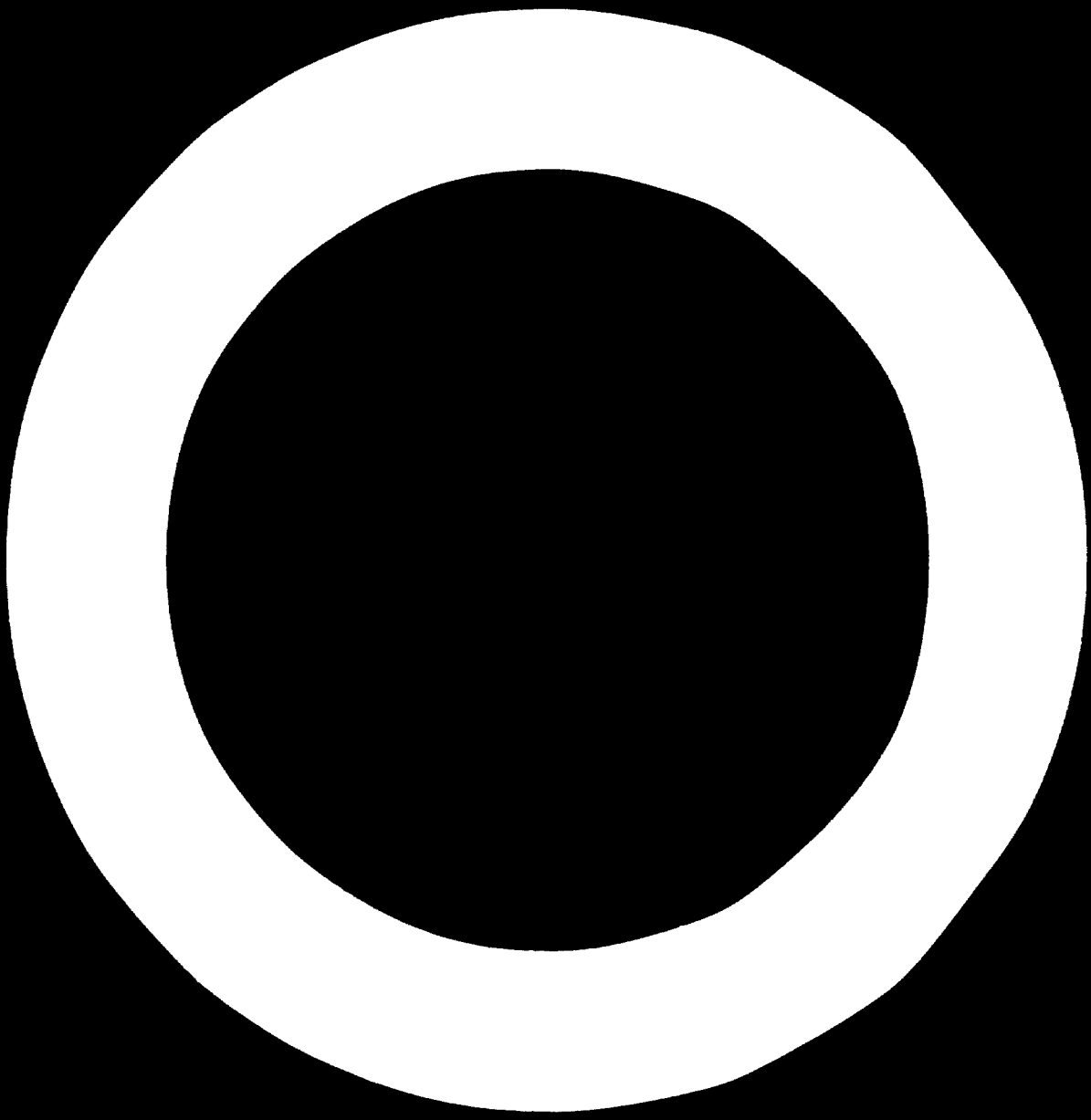
3.3 The Second Hand Market

There is an established second hand market in virtually every type of industriel equipment. In the September 1965 issue of Used Equipment Directory, the largest of severel monthly megazines in the field, 576 dealers list 17,000 pieces of equipment for sale.

The Directory lists the following categories of equipment:

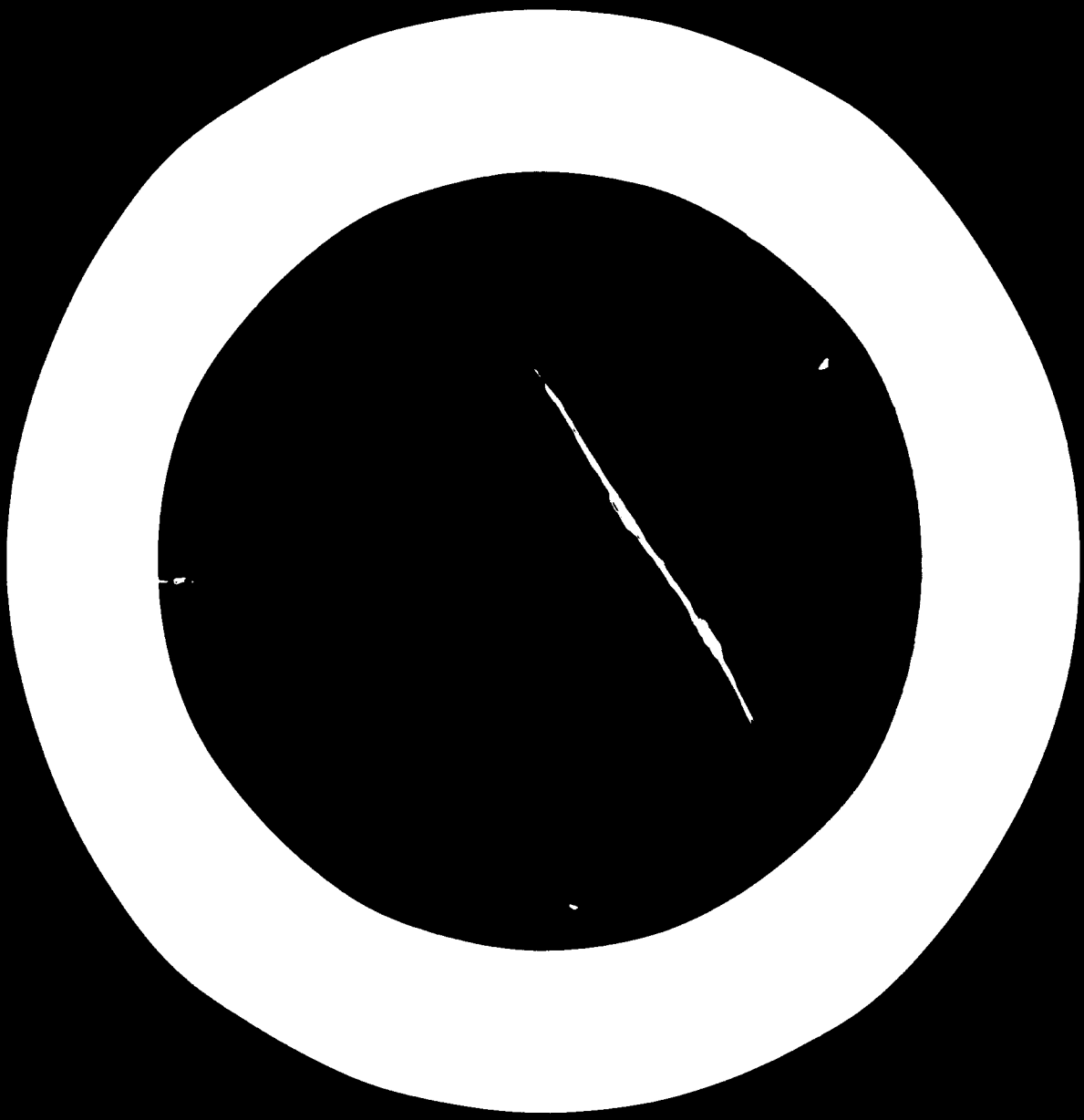
Air Moving	Inspection	Refinery
Chemical	Machine Tools	Rock Products
Controls	Maintenance	Rubber
Construction	Material Handling	Steel Mill
Electrical	Metal Forming	Testing
Fabricating	Mining	Tooling
Food	Plastic	Welding
Foundry	Plating	Wire
Heat Treating	Power	Woodworking

Frequently dealers specielize in one or two categories of equipment. Dealers locate buyers by advertizing in second hand equipment megazines which are distributed free to manufacturers,(See Attachment D), by mailing brochures of available equipment to prospective buyers (See Attachment E), and by establishing personal relationships with manufacturers who come to regard the dealer as a trusted source of supply.

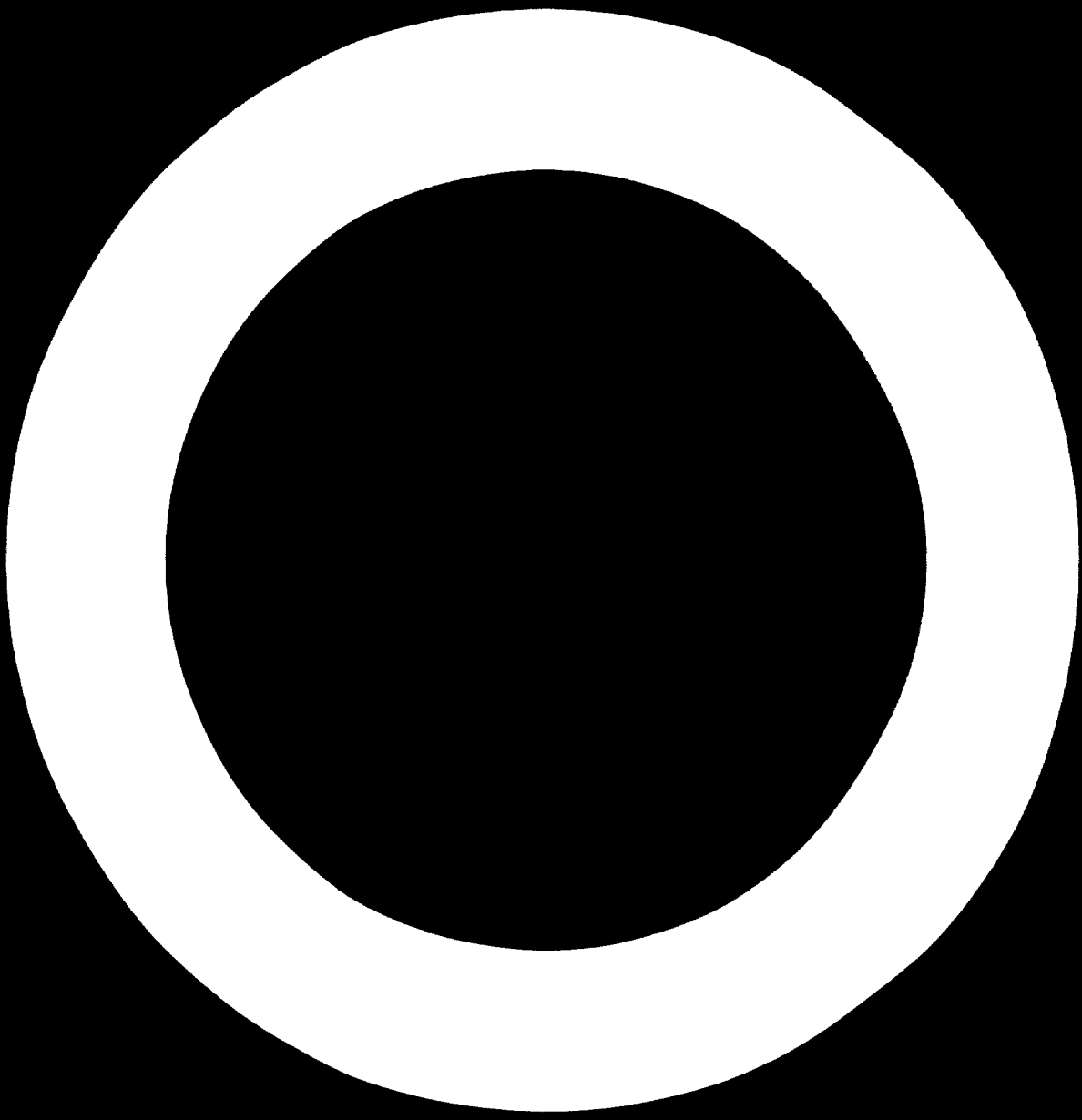


Dealers obtain equipment by bidding at liquidations, U.S. Department of Defense auctions, offerings of surplus equipment departments of large corporations, and again by personal relationship with manufacturers who rely on dealers to dispose of plant equipment that becomes surplus from time to time. Most dealers have small warehouses where equipment is cleaned, painted, repaired, and exhibited for sale. There are usually facilities where a buyer can test the equipment in operation. A few of the largest dealers have facilities for completely rebuilding a machine, but most rely on independent rebuilding companies or new equipment manufacturers for this service. Dealers will arrange for financing or leasing of equipment. The members of the Machinery Dealers National Association give a 30 day money back guarantee on most sales with the buyer paying the cost of the return transportation. Only a few dealers do a sizeable export trade although one reports 30% of his sales are overseas, chiefly in Europe. A list of the leading second hand equipment dealers appears on the next page.

The usual pattern is for large corporations to dispose of their excess equipment to dealers who in turn sell it to smaller companies. The pattern is not inviolable. Large corporations frequently turn to second hand dealers when seeking standby equipment, equipment for short runs, equipment



with low utilization factor, and for any equipment when the delivery time of new equipment is long. The price level fluctuates widely with the business cycle. As lead time for new equipment lengthens, large manufacturers eager to increase production enter the second hand market and push prices up. The necessity to get into production fast makes the price of equipment secondary. At this same point in time, most large manufacturers hold on to their excess equipment. With the increased demand and decreased supply prices skyrocket. In the spring of 1965, this situation existed in the U.S.A. machine tool market. As an example, a 14" x 120" Norton Cylindrical Grinder was purchased new in 1937 for $8,004. The company estimates it was used continuously since then for about 3 hours per day with equal time for set-ups. The machine was never rebuilt. It was sold in March, 1965 to a dealer for $4,300. In July 1965, he was asking $12,500 for the machine. At this time, a similar new machine was selling for $30,000 with 18 month delivery. In such a fluctuating market the machinery dealer is apt to be an astute businessman.



MACHINE TOOL DEALERS

Botwinik Brothers, Inc.
3 Welton Parkway, New Haven, Connecticut

Eastern Machinery Company
1005 Tennessee Avenue, Cincinnati, Ohio

Goldberg - Emerman Corporation
877 W. 120th Street, Chicago, Illinois

Given Machinery Company
3855 Santa Fe Avenue, Los Angeles, California

Johnson Machinery Company
249 Frelinghuysen Avenue, Newark, New Jersey

Laurens Bros., Inc.
2778 Highland Avenue, Cincinnati, Ohio

The MacDell Corporation
232 No. Morgan Street, Chicago, Illinois

Machinery Trading Corporation
544 Oakwood Avenue, West Hartford, Connecticut

Morey Machinery Co.
4-69 26th Avenue, Astoria, New York, N.Y.

Noll Equipment Co.
3913 St. Clair Avenue, Cleveland, Ohio

Tippins Machinery Co., Inc.
1001 Washington Blvd., Pittsburgh, Pennsylvania

O'Connell Machinery Co., Inc.
1699 Genesee St., Buffalo, New York

Pearl Equipment Co., Inc.
843 7th Avenue, N. Nashville, Tennessee

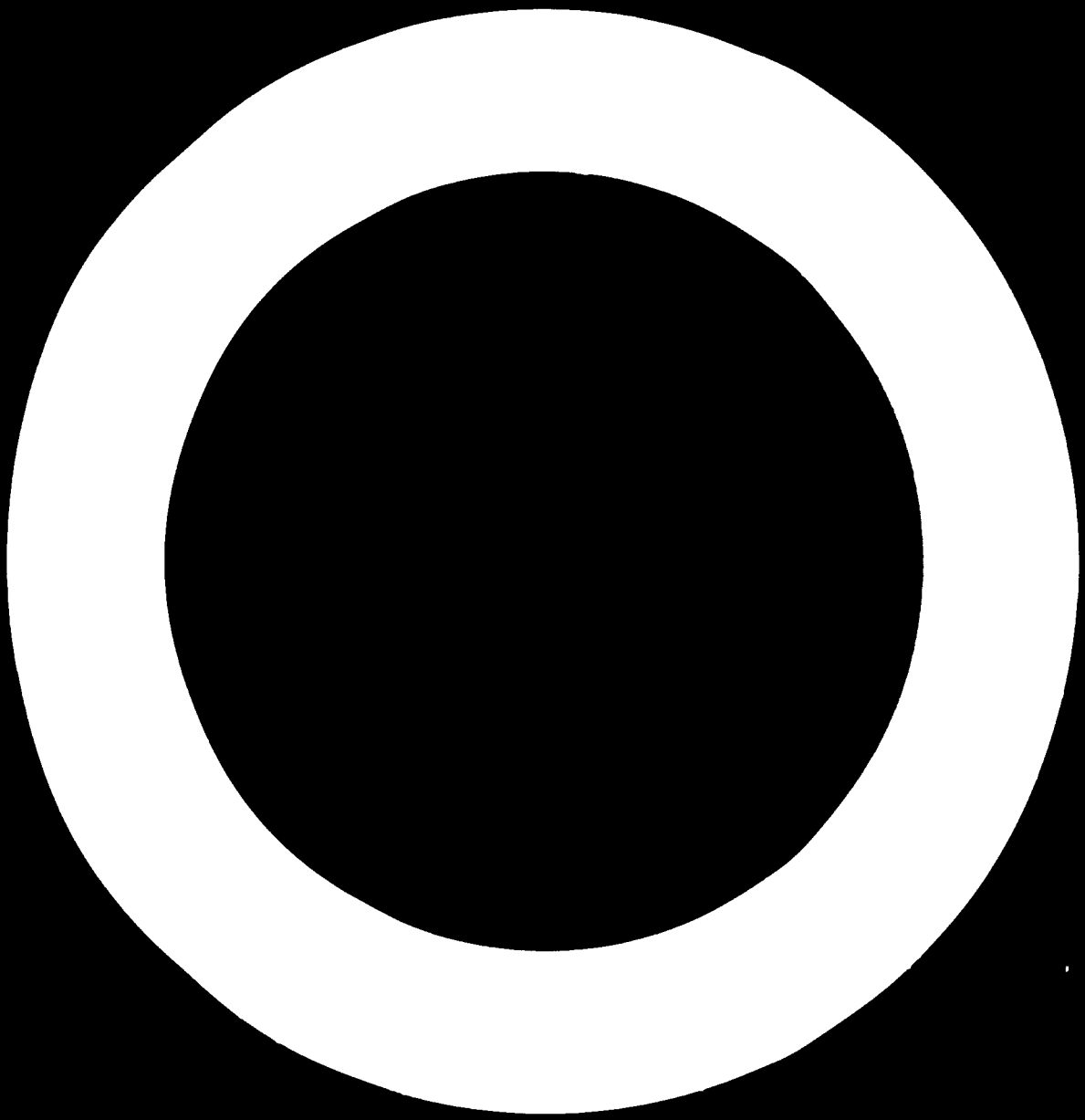
S & S Machinery Co.
134 53rd Street, Brooklyn, New York, N.Y.

U.S. Equipment Co.
6546 E. Palmer Avenue, Detroit, Michigan

WELDING EQUIPMENT DEALERS

American Industrial Equipment Corp.
116 49th Street, Union City, New Jersey

Power Press Sales Co.
2701 23rd Street, Detroit, Michigan



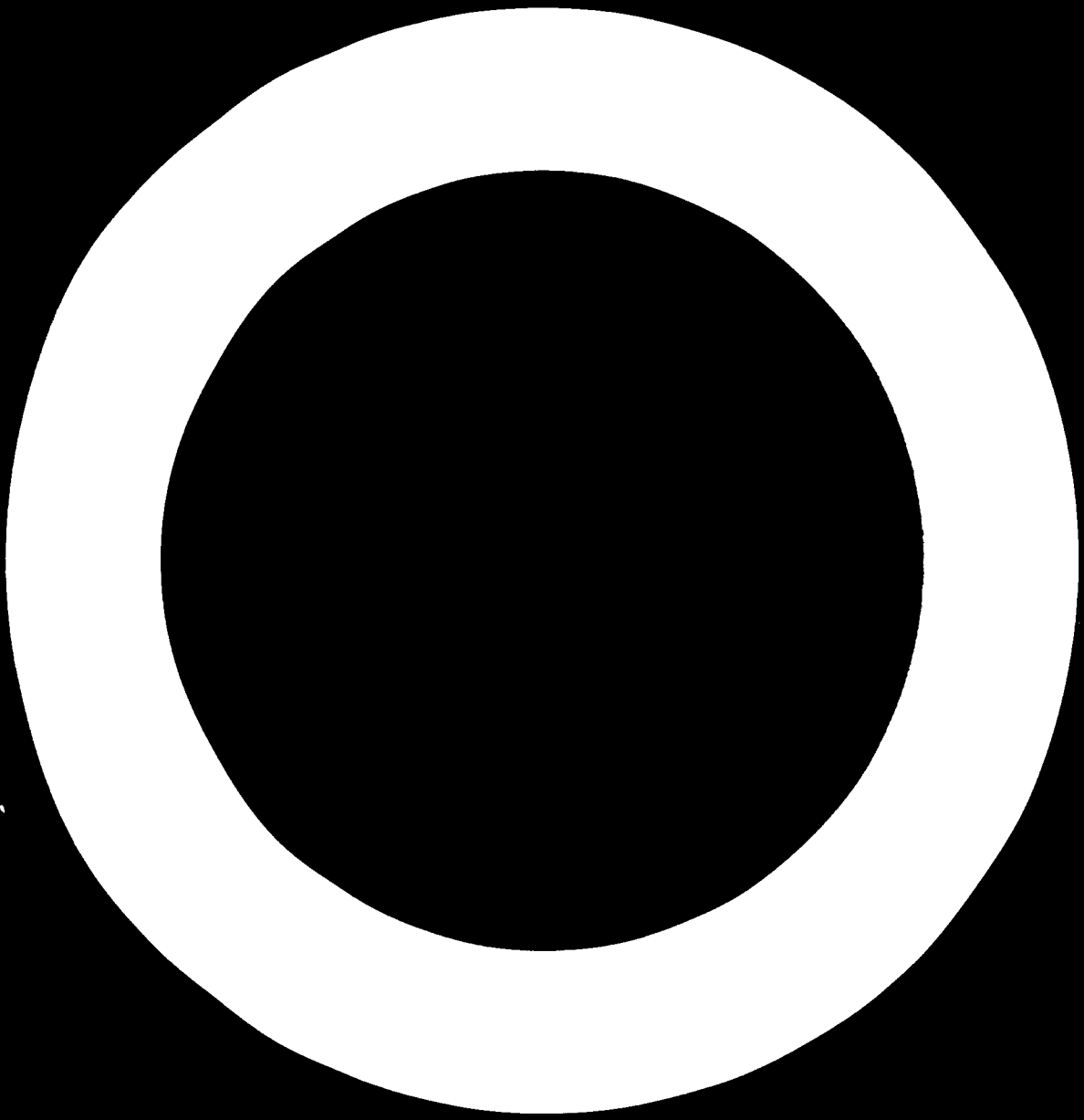
ELECTRICAL EQUIPMENT DEALERS

Belyea Company, Inc.
46 Howell Street, Jersey City, New Jersey

Chicago Electric Company
1319 W. Cermak Road, Chicago, Illinois

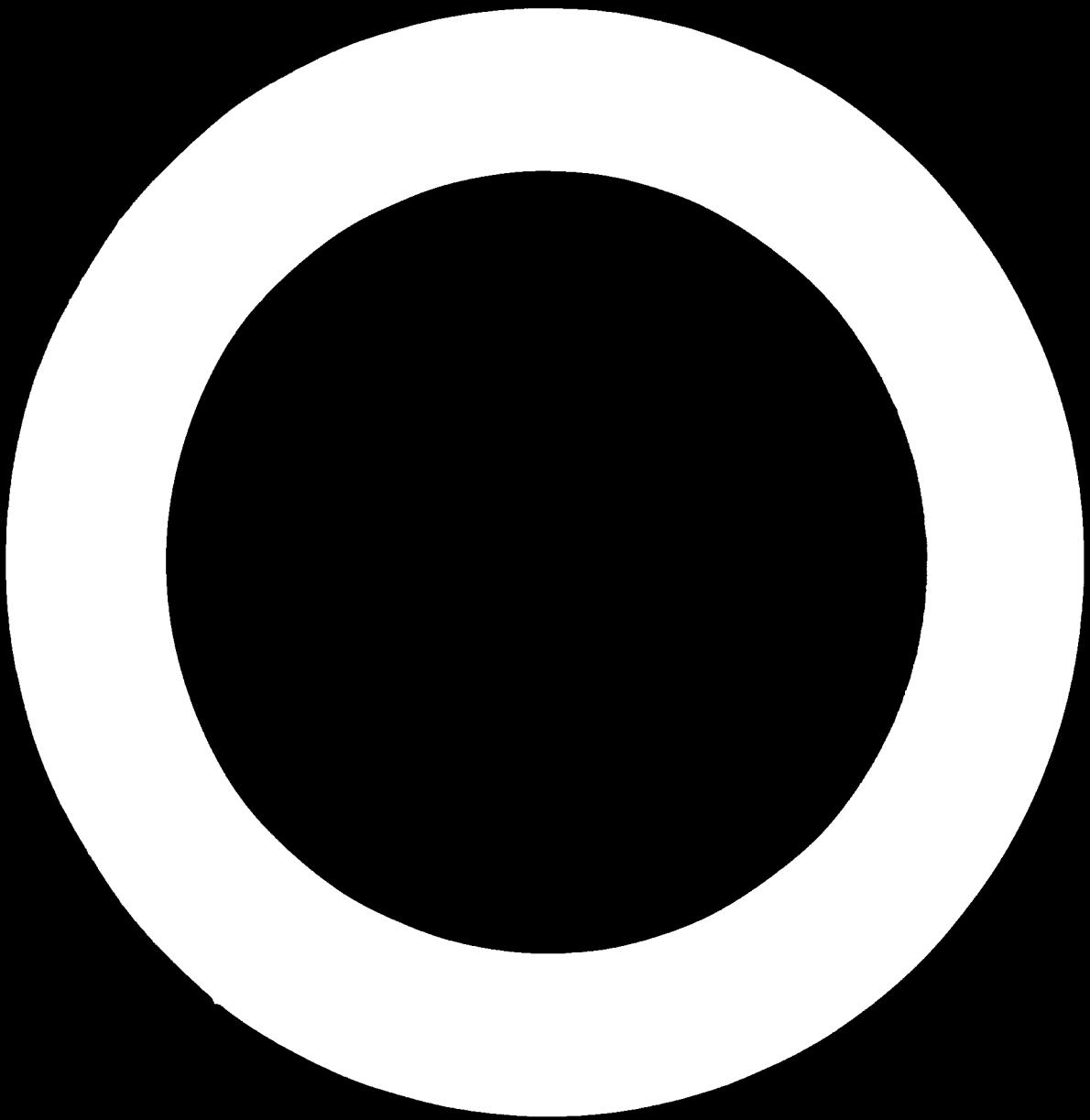
Sandman Electric Co., Inc.
666 Parker Street, Boston, Massachusetts

Arthur Wagner Co.
1426 W. Randolph St., Chicago, Illinois



The market just described is for equipment which may be used in a variety of industries or for which there is a constant demand. The market in highly specialized equipment, such as say cigarette making machinery, is less well organized. Frequently new machinery dealers will sell second hand machinery as a sideline. Distributors of industrial supplies who visit many manufacturers in a given industry will attempt to locate second hand equipment as a service to customers and end up doing a regular small business. Where the special machine is large and expensive as for plate glass, the number of manufacturers is so limited each knows all the others. In this case, second hand equipment may be sold by direct negotiation between principals.

In 1965, The Machinery Dealers National Association estimates member sales of second hand equipment consisting largely of metal cutting and forming machinery at $380 million. Assuming that members of MDNA account for 3/4 of all sales, the U.S.A. second hand metal working machinery market is about $500 million annually. This total includes U.S. Government surplus equipment purchased by dealers at auctions and resold.

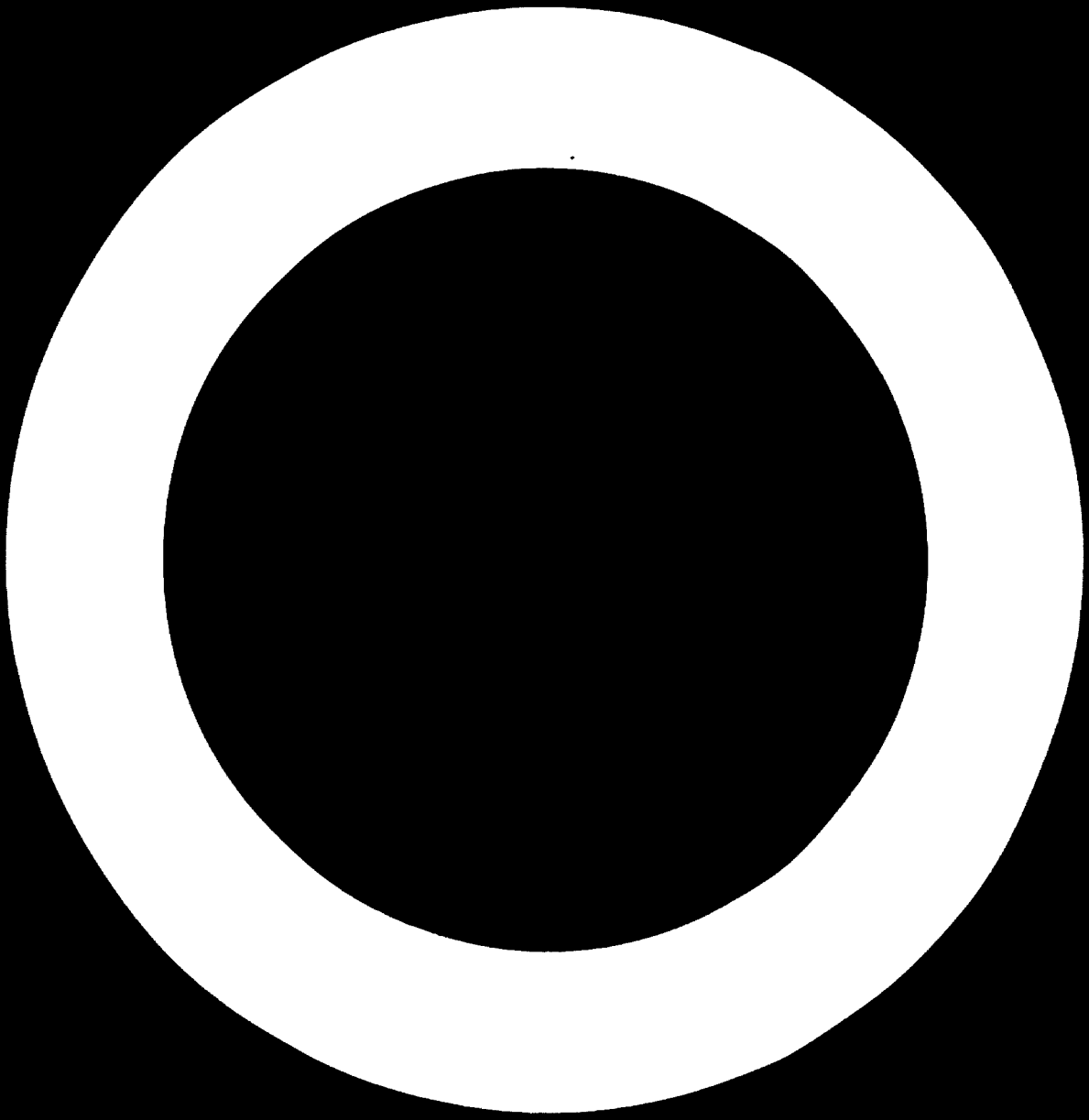


3.4 Trends in Technological Innovation

Every manufacturing industry subject to the so called "profit squeeze" between inflexible prices and rising labor and other costs is looking to technological innovations as a way out of the dilemma. Large appropriations are made for research and development. In some industries, the results of U.S. government research are being applied. Industries composed of small companies are sponsoring research at independent laboratories.

The results have been most spectacular in the field of communications. In manufacturing, the progress has been slow but steady. The future development of new processes and materials will have an effect on both supply and net cost. In general, it will increase the supply and therefore also increase the second hand operating costs. The effect of a few new processes and materials was discussed in 3.2. In the metal working field, several new processes are coming into use. It is beyond the scope of this paper to more than briefly describe them.

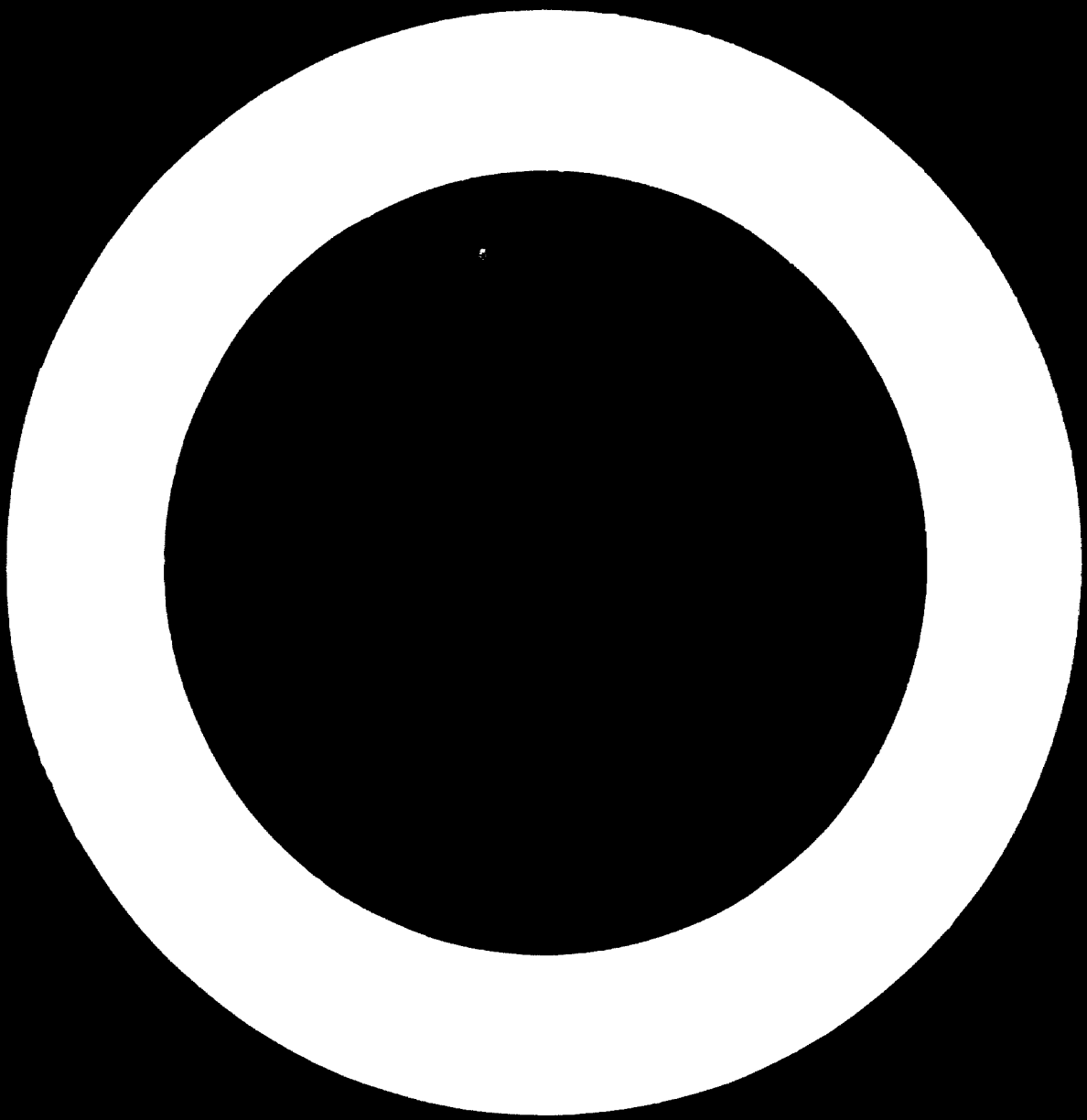
EDM - Electrical Discharge Machining uses controlled vaporization of metal by spark discharges from an electrode. There are several EDM machines on the market and they are increasingly used for finishing of complex die cavities in die casting and forging die industries. They replace expensive and often inaccurate hand work. The high cost of replacing electrodes appears as chief obstacle to wider use.[13]



ECM - Electro Chemical Machining is metal removal by passing direct current via electrolyte between workpiece and shaped tool. Metal removed is flushed away by electrolyte. ECM is the reverse of electroplating where metal is deposited on the work-piece. ECM can perform the mechanical equivalent of turning, milling, grinding, and drilling. A 10,000 amp. machine removes about 60 cu. in. per hour. It is now used on very hard materials for very intricate shapes. The chief drawback is the high power consumption.

CM - Chemical Machining uses etching to dissolve metal that is not coated with photo sensitive film. It is currently used in blanking of metal and plastic sheets, decorative etching, and printed circuit etching.

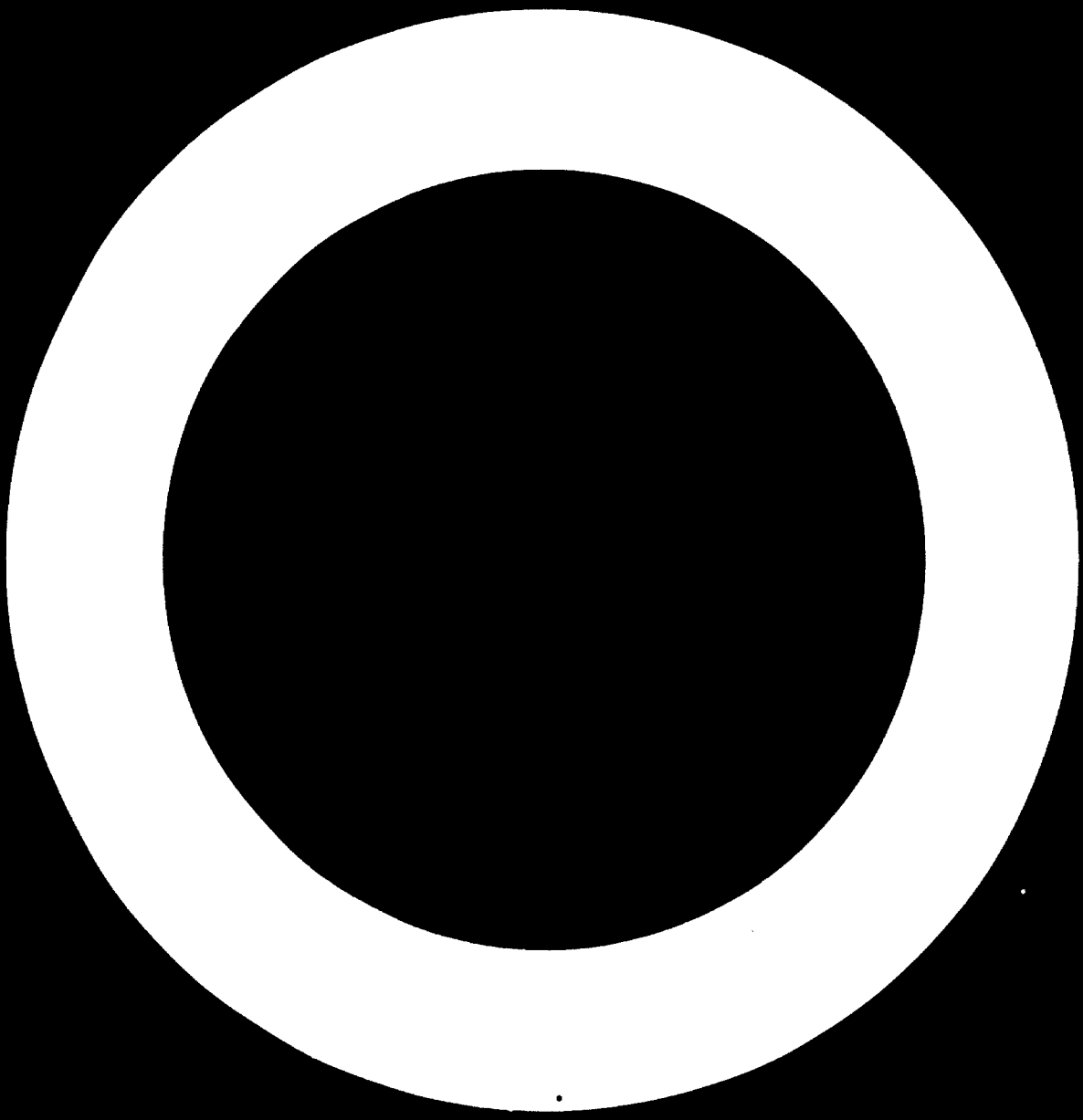
NC - Numerically Controlled machining uses a magnetic tape to control the path of the cutting tool and work piece. It eliminates the need for an operator just as the tape controlled pianola played without a pianist. NC is today an economical way of machining intricate parts in small lots. The tape can be stored and reused whenever the part needs to be made again. NC attachments can be adapted to existing machines. It is estimated NC will account for 10 percent of the value of all new machine tools sold in 1965, and by 1985, 75 percent of all machine tools will be NC operated.



HERF - High Energy Rate Forming uses an explosion to control the deformation of sheet metal. In one type, hydroforming, a low explosive in water is used for contouring, spinning, and drawing of sheet metal.

Ultrasonic machining using sound waves and abrasive machining using grinding are among the other processes commercially feasable in limited applications. Cutting metal with laser beams is in advanced experimental stage. Clearly, the pace in metalworking is very rapid indeed. The U.S. Air Force study that states only 15 per cent of 1964 metalworking equipment will be in use in 10 years may be an extreme position based on their special needs; but the rest of the economy will not be very far behind.

The appendix contains a number of clippings from Metal-Working News detailing the progress in adoption of these innovations. The previously cited U.S. Air Force study forecasts substantial decreases in value of conventional machines and increases in value of new type equipment in its inventory by 1975. Value of boring machines will decrease from 18.5 percent to 10.3 percent, lathes will decrease from 15.2 percent to 5.5 percent. Electrochemical machining equipment, on the other hand, is expected to increase from $.6 million or 0.1 percent in 1964 to $47 million or 8.3 percent in 1975. It is certain these innovations will displace a large range of conventional metal cutting and metal forming machines such as boring mills, grinders, lathes, drills, presses, and forges.



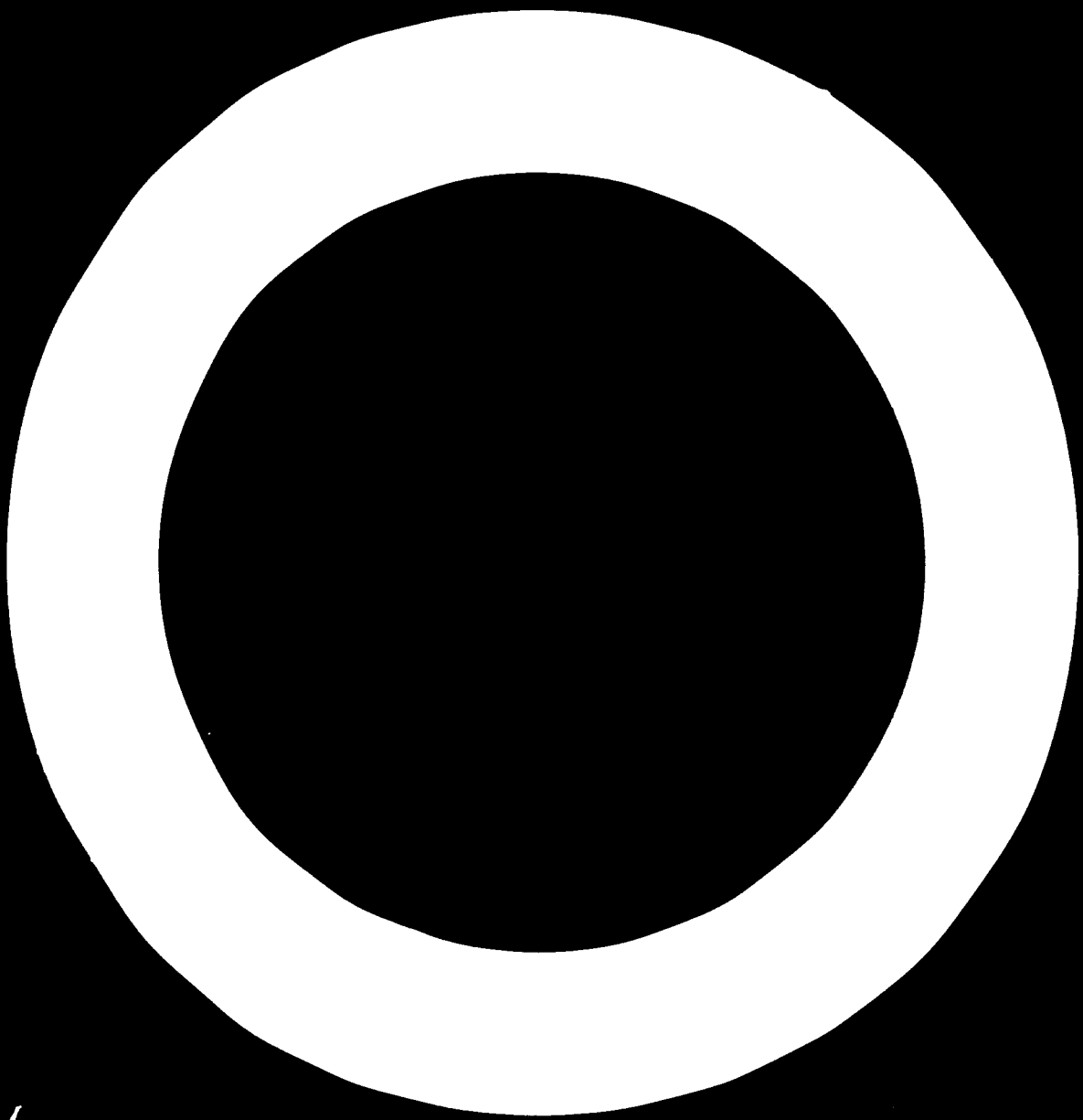
3.5 Conclusion: Supply

The 1965 demand for metal working equipment in the developing countries is approximately $1.2 billion. The U.S. supply of second hand metal working equipment is about $500 million. Assuming the U.S.A. to account for half of the total second hand equipment available, theoretically the second hand market could supply 83 percent of all demand in the developing countries. In practice, the entry of developing countries into the second hand market in strength would undoubtedly push up the price of second hand versus new equipment.

The supply of second hand equipment is sufficiently large to justify a close investigation of its net cost versus new equipment and of the mechenisms for transferring it to the developing countries.

Technological innovations in metalworking in the industrially advanced countries will make available, in the next ten years, a supply of second hand equipment to match thegrowing demand for capital equipment in developing countries.

Due to its very nature, the second hand market is a less reliable source of equipment for the developing countries. Although standard equipment is certain to be available at all times, special or heavy equipment may not be available when needed.



Net Cost

4.1 Cost Analysis

The purpose of this part of the report is to present a method of answering the question "is second hand equipment more economical than new equipment?" The answer takes the form of an economic analysis of alternative equipment. This economic analysis of alternative investments may be based on annual cost comparison, rate of return comparison, or present worth comparison.[14] The annual cost comparison is the most commonly used method in industry and will be used here for illustration purposes. The annual cost comparison involves finding a uniform annual cost of all expenses incurred over the economic life of each alternative equipment. The annual cost is given by:

$$AC = P-L\left[\frac{i\,(1-i)^n}{(1+i)^n-i}\right] + Li + D$$

where P = investment in equipment

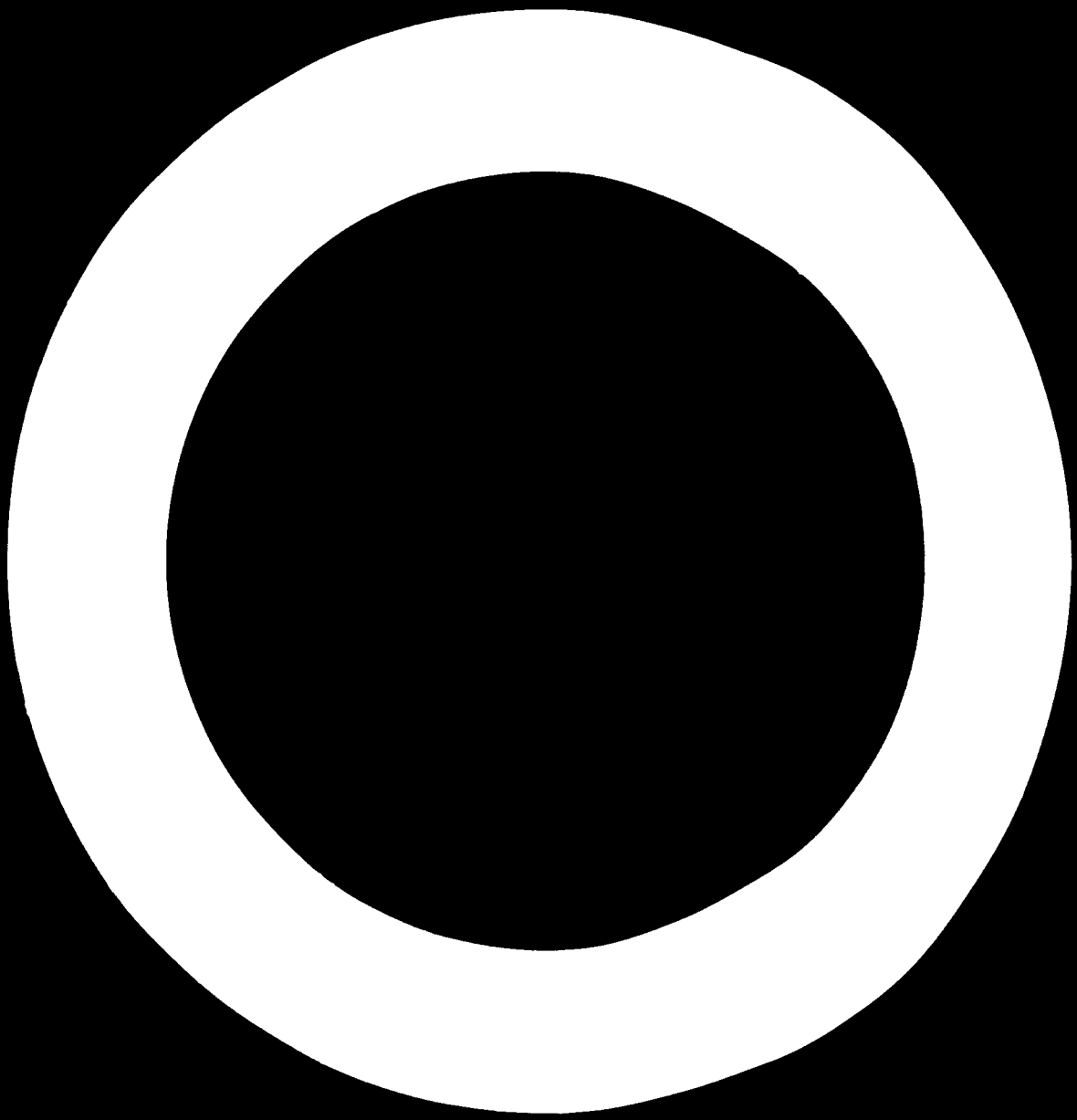
L = salvage value at end of economic life

i = minimum rate of return on capital

n = economic life in years

D = series of equal annual disbursement for operating expenses

The first term represents the uniform amount required for capital recovery of the investment less its salvage value. The capital recovery factor [ ] can be found from tables.



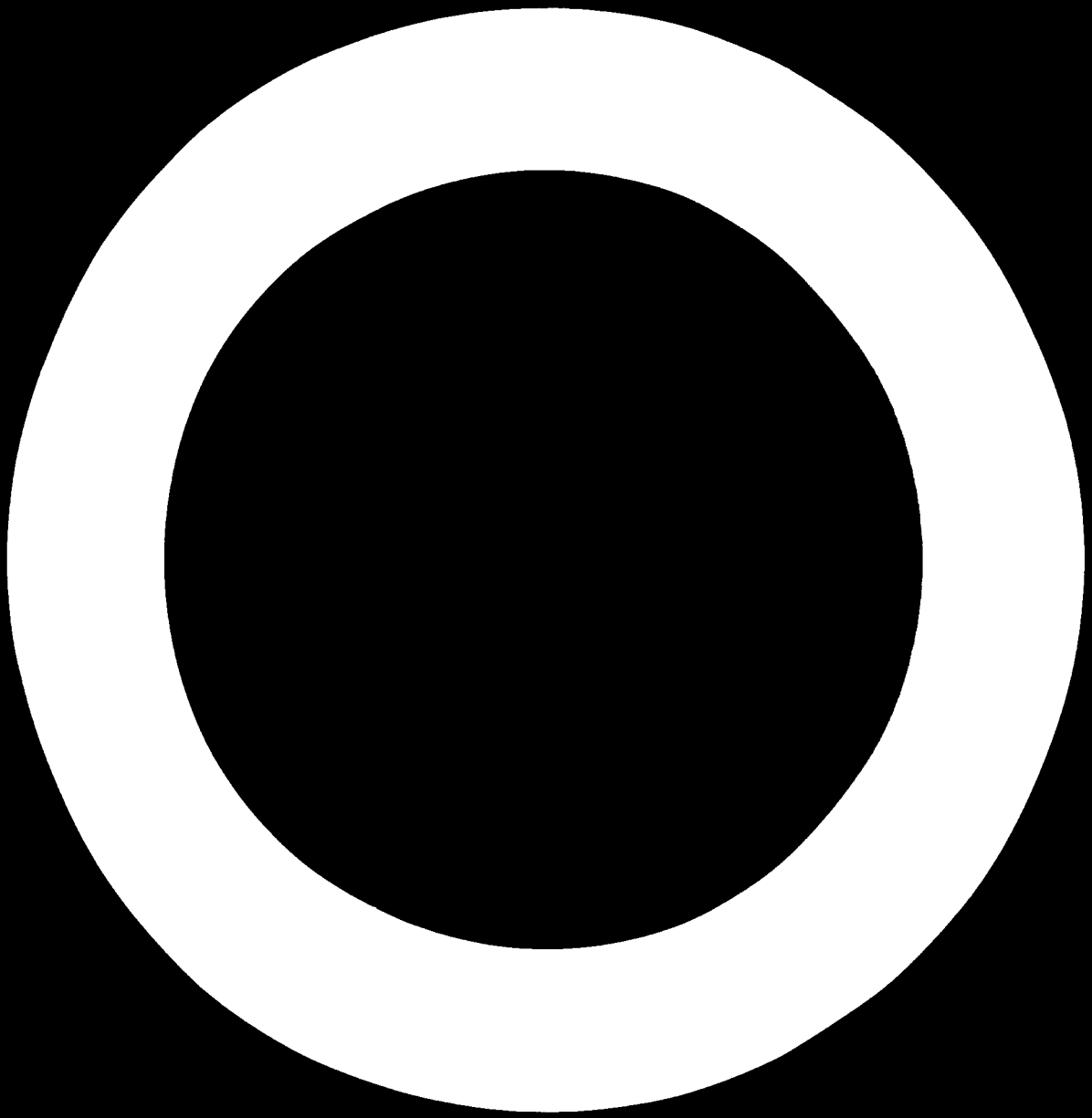
Where in the third term the actual disbursements vary over the years, they can still be mathematically converted into a series of equal annuel disbursements.

As an example, new machine N costs $10,000 with a salvage value of $2,000, an economic life of 10 years, and operating disbursements of $400 a year. Second hand machine S costs $6,000, has an economic life of 5 years, no salvage value, and operating disbursements of $600 a year. The minimum rate of return is 15%.

Annual Cost N = 8,000 x .19925 + 2,000 x .15 + 400
= 1,600 + 300 + 400 =
= 2,300

Annual Cost S = $6,000 x .29832 + 0 + 600
= 1,800 + 600
= 2,400

In this example the annual cost of the second hand machine is $100 greater than of a new one. The comparison disregards the costs that would be incurred after the 5 year life of machine S. It is not easy to forsee what machine will be available at that time, but technological change may be rapid. If a future machine F, costing $5,000, no salvage value, a 5 year economic life, and operating disbursements of only $300 per year is predicted, the annual cost of S + F can be calculated to be $2,200. Now the



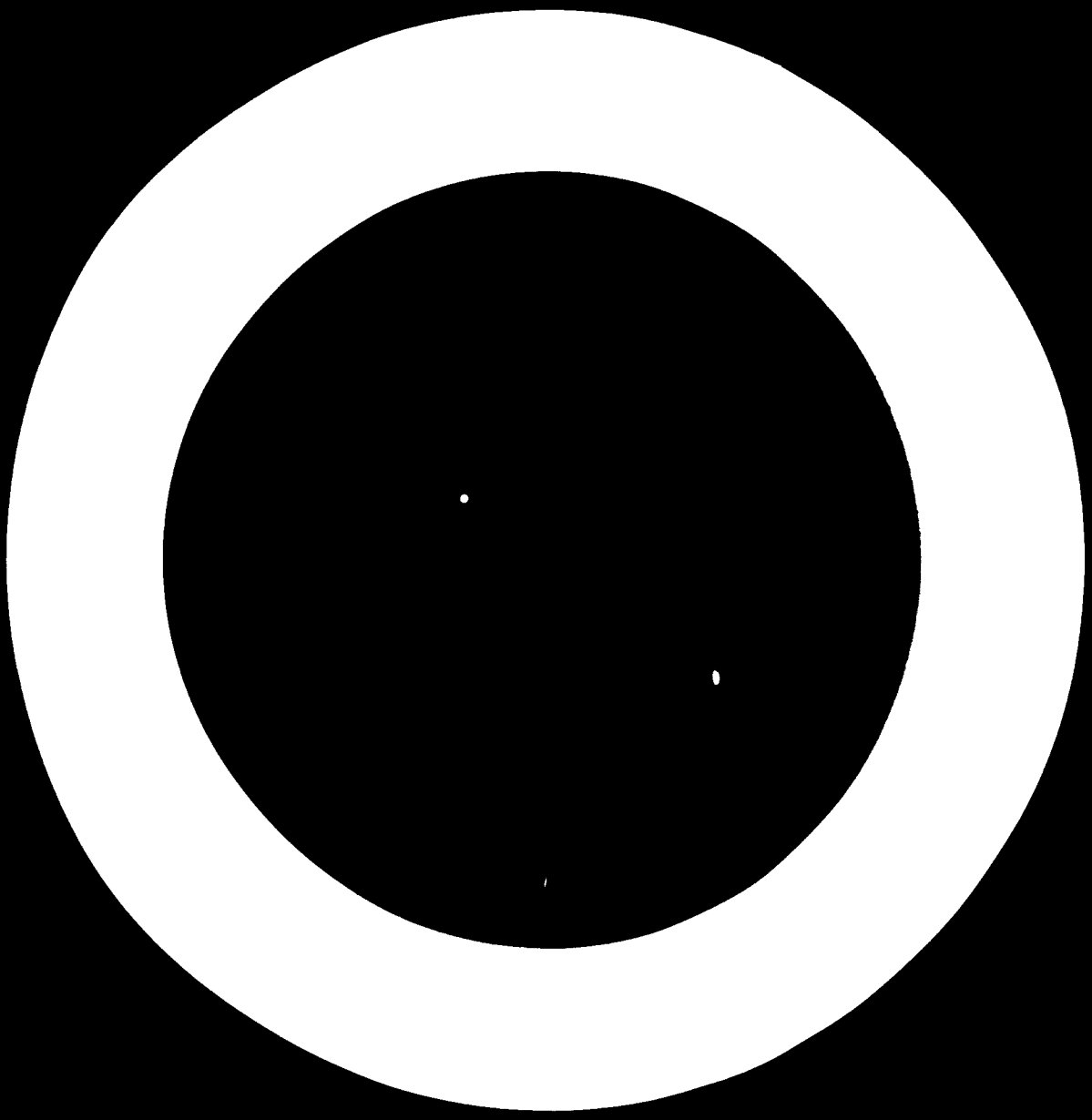
combination of the second hand machine S and the vastly improved machine predicted for 5 years hence have a lower annual cost than the currently available new machine N.

The proper application of all formulas requires accurate data on investment costs and disbursements for both alternatives. In a comparison, any investment costs or disbursements that are equal for both alternatives may be omitted withour affecting the difference between their annual costs. The investment costs include:

1. Equipment & accessories (for second hand include inspection, repair, appraisal)
2. Freight
3. Installation
4. Engineering and planning
5. Salvage
6. Avoided costs

The disbursement should account for the following operating expenses:

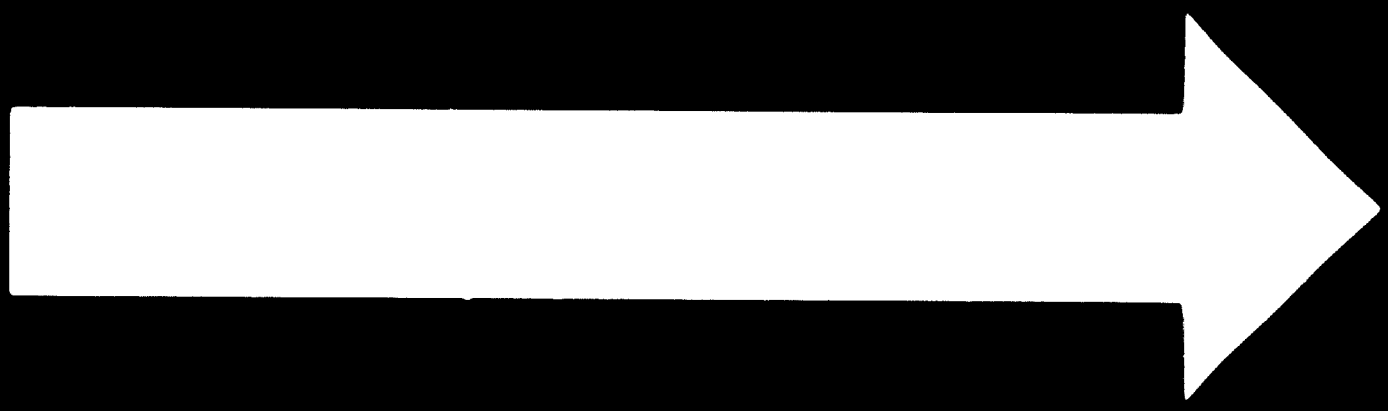
1. Direct labor
2. Indirect labor
3. Productive materials
4. Fuel and Power
5. Auxiliary Equipment and Services
6. Taxes and Insurance
7. Licenses
8. Space Costs
9. Subcontracting
10. Maintenance



4.2 Original Cost

The original cost may be defined as the annual cost to own the equipment. It is roughly calculated as the aquisition cost less the salvage value with the difference divided by the economic life. Any comparison on this basis assumes all equipment meets the same specifications of capacity and accuracy.

Aquisition cost of new equipment must be taken as the lowest price for the equipment available on the international market. The aquisition cost of second hand equipment will vary with type, age, condition, and the fluctuations of the second hand market may be ignored since they are usually accompanied by similar fluctuation in the cost of new equipment. A greater rise in the costs of second hand equipment is compensated by the very long lead time for the purchase of new equipment compared to the immediate availability of second hand. The conclusion of this section 4.6 gives some generalizations regarding aquisition costs of two types of metal-working equipment. The two types are: 1. standard machine tools and 2. heavy or special metal-working equipment. For each type, a comparison was made using 10 year old rebuilt equipment and 10 year old equipment in good working condition.



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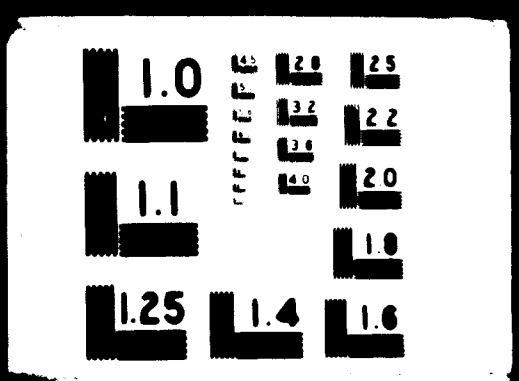
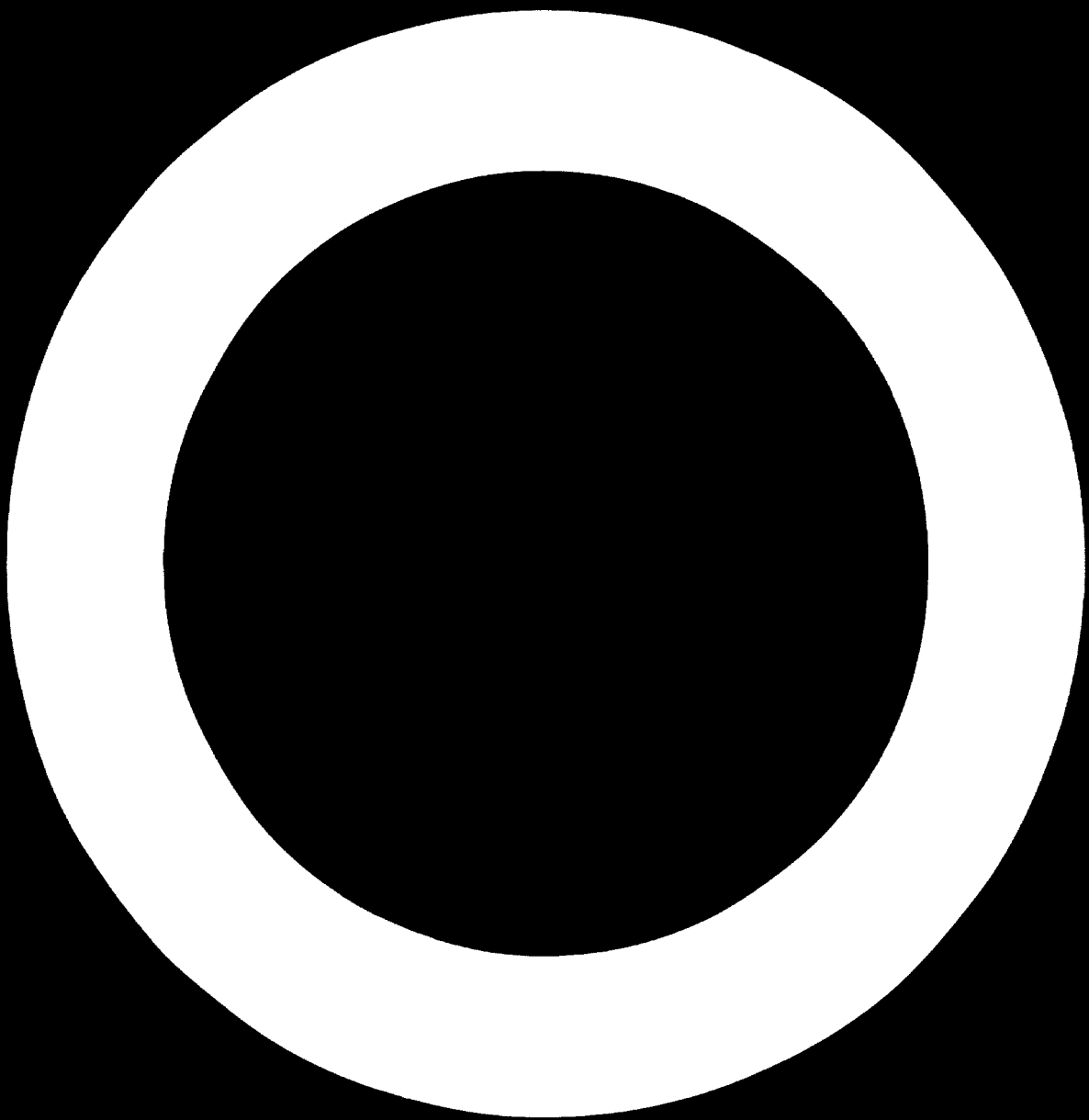




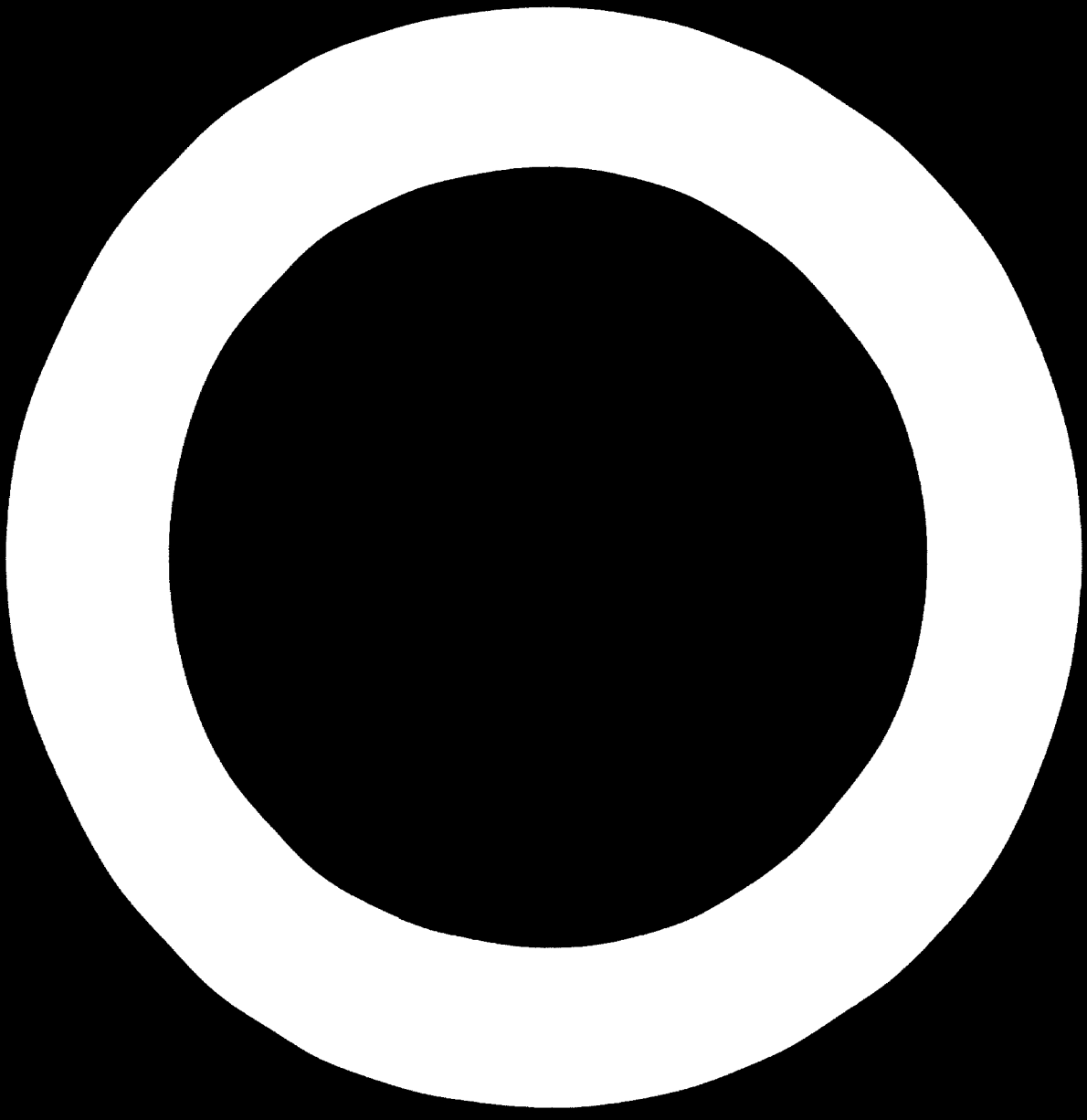
The economic life of equipment is difficult to determine. First equipment may undergo functional degradation. A machine tool may be used on the main production line, then on secondary service, then on occasional service, and finally on stand-by. A generator may be used for base load, then peak load and last on stand-by.

The economic life of equipment on the main production line depends on obsolescence and deterioration. Obsolescence requires the replacement of existing equipment with equipment of improved design. This new equipment may have the following advantages:

1. lower fuel & power consumption due to higher design efficiency
2. higher productivity due to higher productive speeds
3. lower maintenance due to better design
4. fewer breakdown due to better design
5. less spoilage due to more accurate design
6. less floor space due to more compact design
7. less labor and supervision due to more automated design

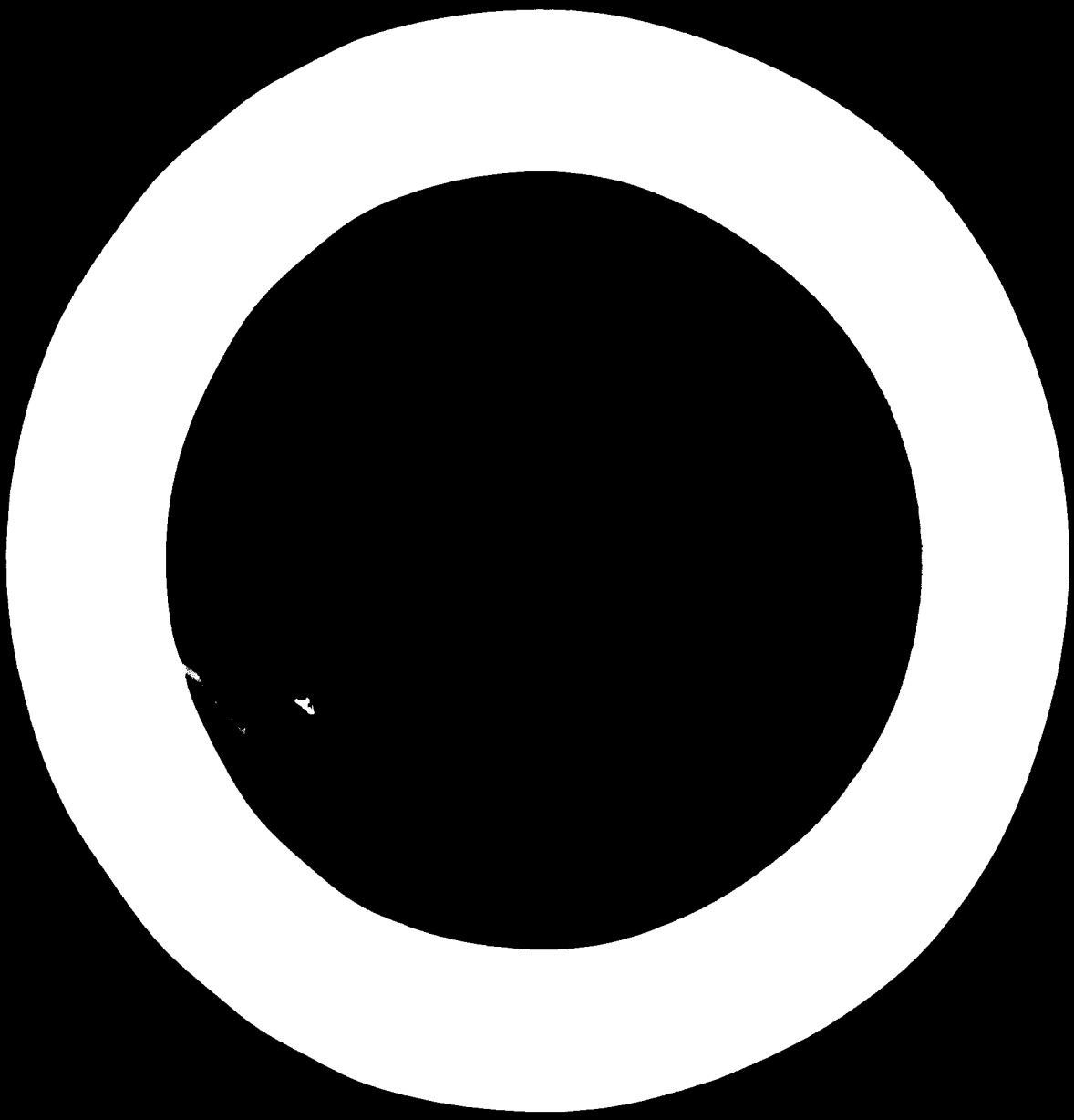
Deterioration requires the replacement of existing equipment with equipment of essentially the same design because of:

1. increased fuel & power caused by lower machine efficiency



2. Increased maintenance & repair due to failure of parts
3. Increased labor idle time due to increased frequency of breakdowns
4. Increased spoilage, labor, & material wastage due to unreliability
5. Increased labor due to reduc ed speed & lower productivity
6. Increased inspection costs due to loss of reliability
7. Increased overhead due to unreliable equipment

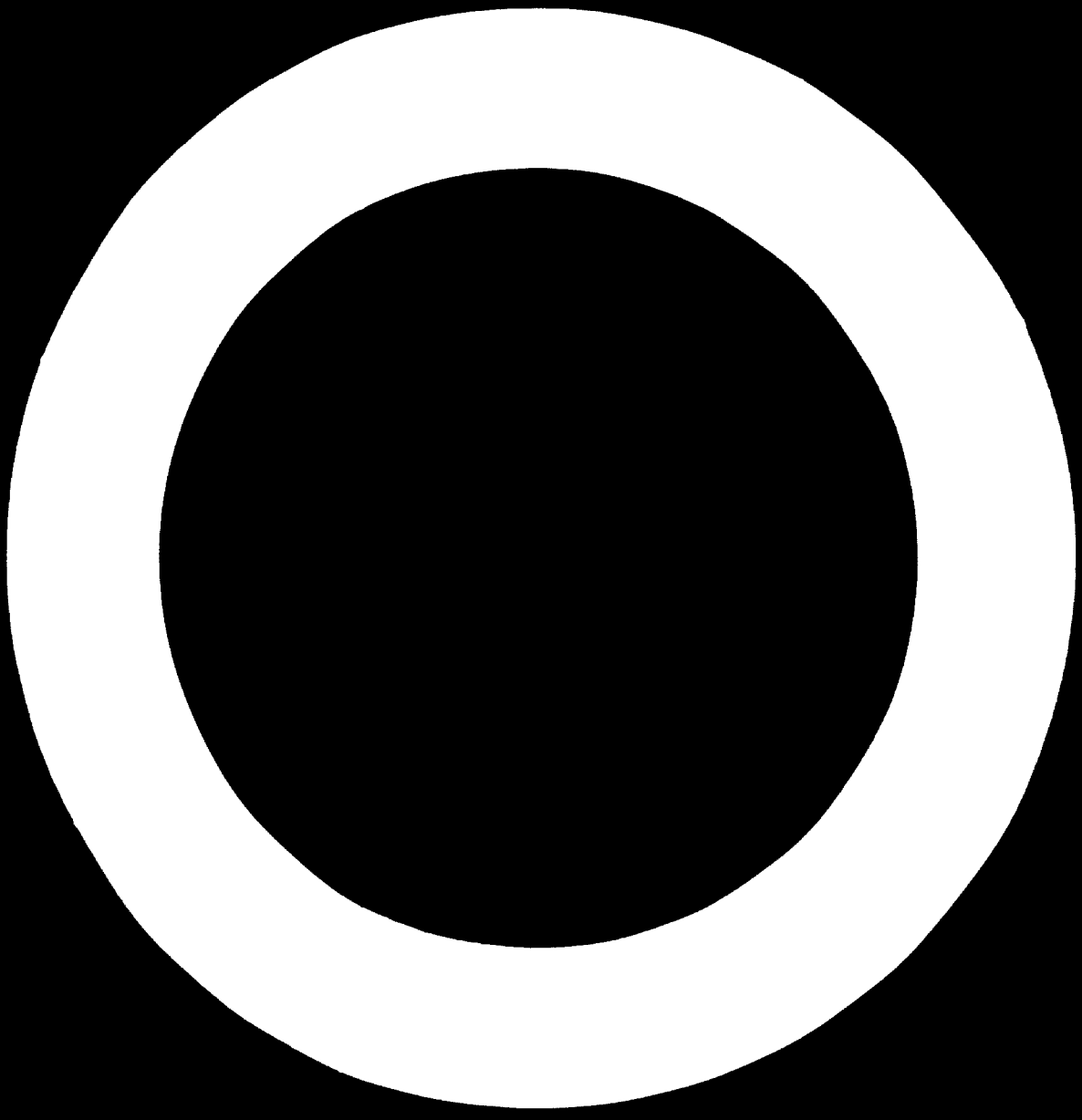
The economic life of so called tool-room equipment used for repairs, making of tooling and prototypes, and production in small lots is long r than of production equipment. Attachment "B" contains a list of economic lives of metal-working machinery as accepted by the U.S. Department of Defense for productive purposes.



4.3 Operating Costs

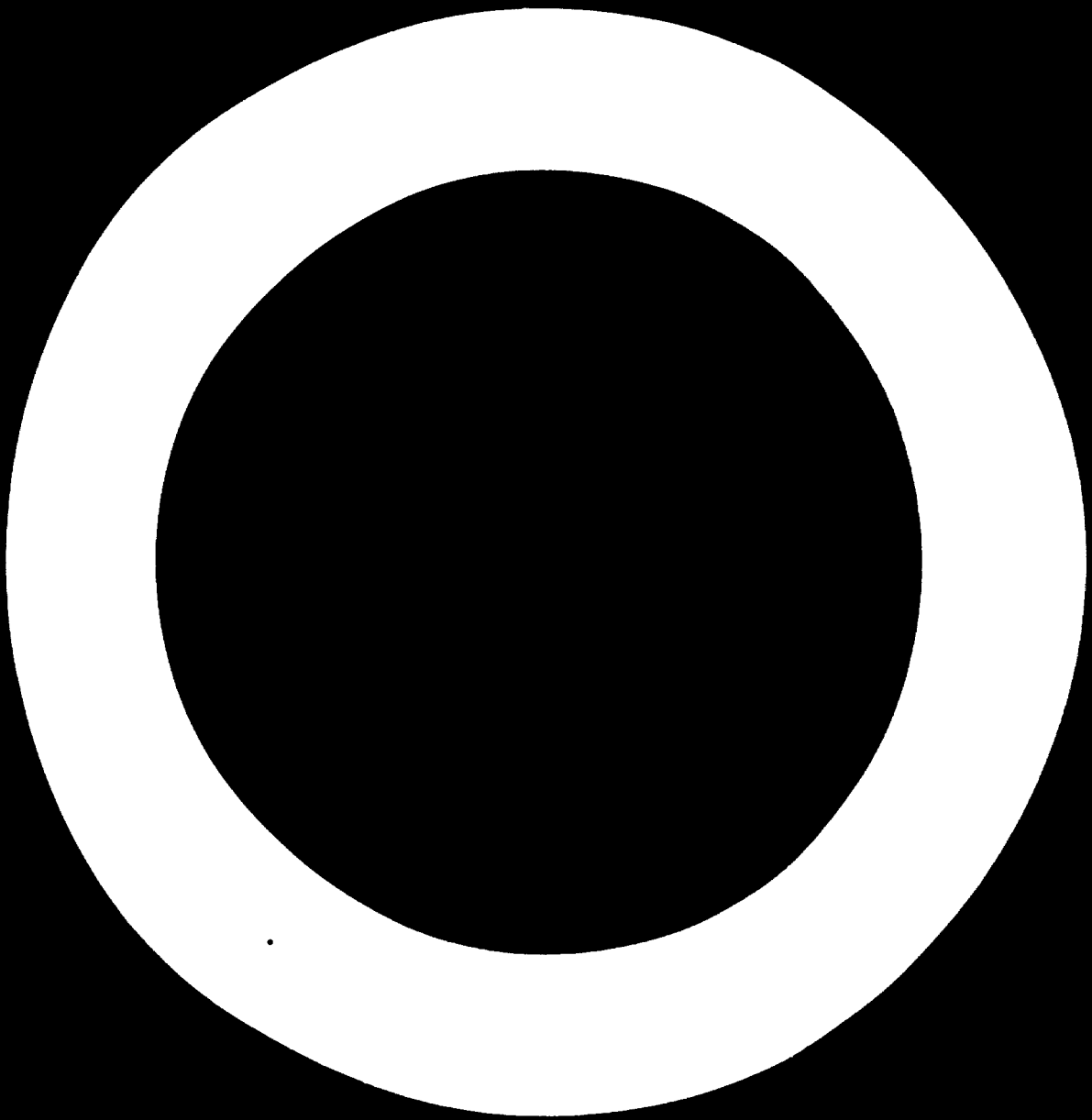
The reports from underdeveloped countries repeatedly cite two difficulties in the operation of second hand equipment: maintenance and spare parts. All equipment requires more maintenance with age. However evidence points to the gradient being very flat. One old study[15] shows the cost of maintenance of textile machinery rising from 1 percent of original cost after 1 year to 2 percent after 10 years. One large chemical company reports it has no record of any piece of equipment being replaced due to cost of maintenance but that replacement due to obsolescence occurs daily. In industries with low obsolescence rate, such as machine building, it is not uncommon to see 40 year old equipment in operation.

The difficulties with maintenance of second hand equipment in underdeveloped countries would appear to stem from 2 sources. First, the level of maintenance[16] is generally low with a tendency to place the blame on equipment being second hand. Secondly, this equipment frequently arrives without the regular lubrication, inspection, and adjustment schedule supplied by the manufacturer of the equipment, the staff is less likely to have been trained in the care and operation of a second hand machine, the seller is less likely to have a staff capable of servicing it, and the machine may have arrived in poor condition to begin with. In short, the difficulty of maintenance is due more to the fact it is second hand than that it is old.



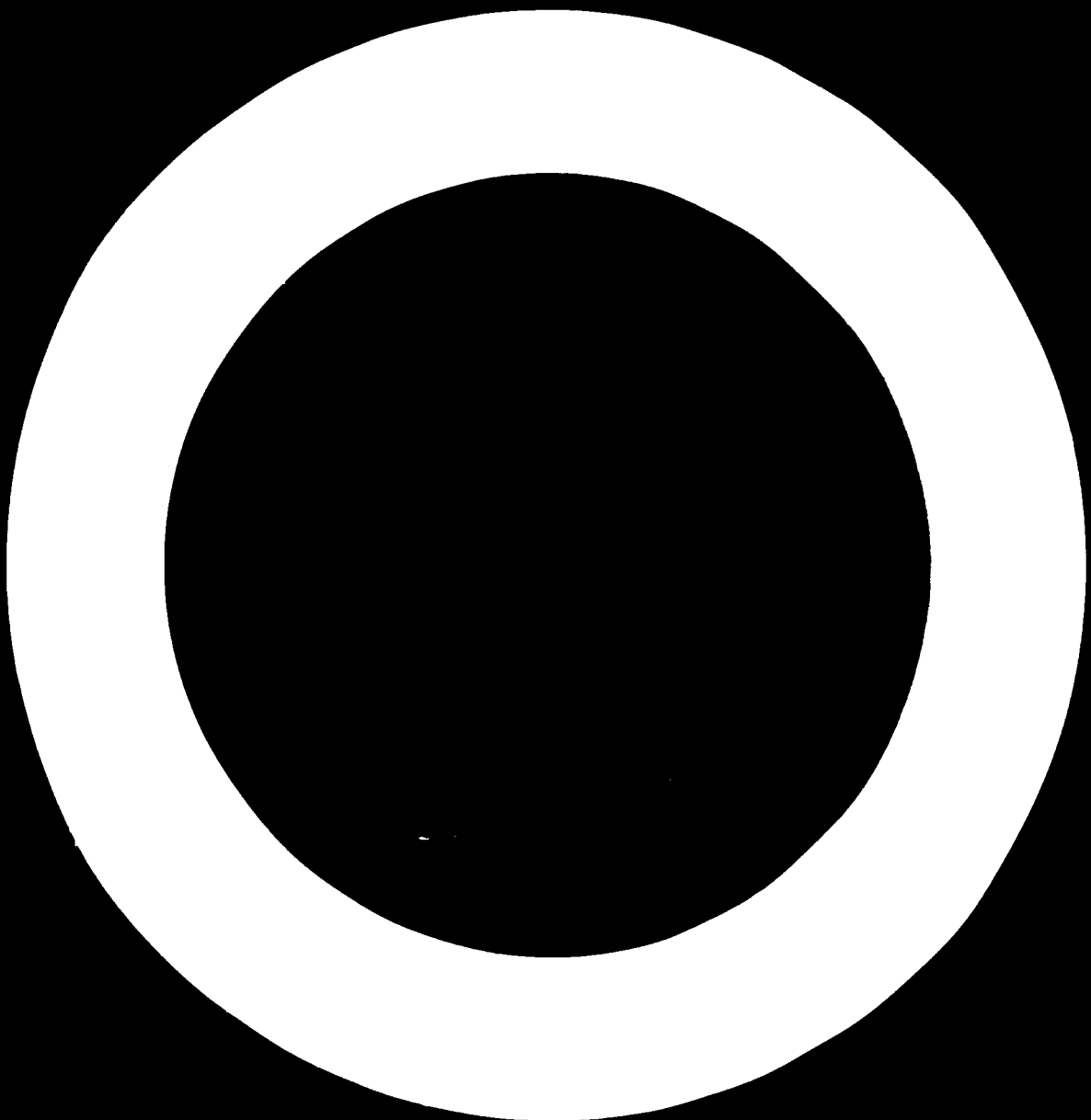
Second hand machines being older require more spare parts. In the U.S.A. where the cost of maintenance if frequently 90 percent labor, this is a minor consideration. Most plants keep minimal stocks of parts. In a large industrial center, a part is usually available the same day. In one case, a telephone call to Claifornia brought a part to New York by air express the next day. Parts for older equipment are made to order and may require from a week to a month for delivery. One lathe manufacturer has templates for parts going back to 1922 and microfilmed blue prints to 1914.

In developing countries, the difficulties of distance, customs procedures, and foreign exchange may extend the one day delivery into 3 months for all spare parts. For second hand equipment, the difficulties are compounded. The lack of operators manuals and parts catalogues may make it difficult to describe the part needed. The lack of an identification plate may make the name of the manufacturer and sarial number unknown, and the local distributor of new equipment is less likely to be of service. When a new machine is purchased in an underdeveloped country 5 to 15 percent of the total cost goes into provision of spares. For second hand equipment spares are seldom available which not only makes for all the previously mentioned problems of delivery but multiplies their cost. A stock of spare parts also enables the user to arrange for their local pro-



duction before they are exhausted. The claims that some manufacturers charge exorbitant prices for spares and use long delays in delivery as a device for selling new machines, would further penalize second hand equipment which being older requires more spares.

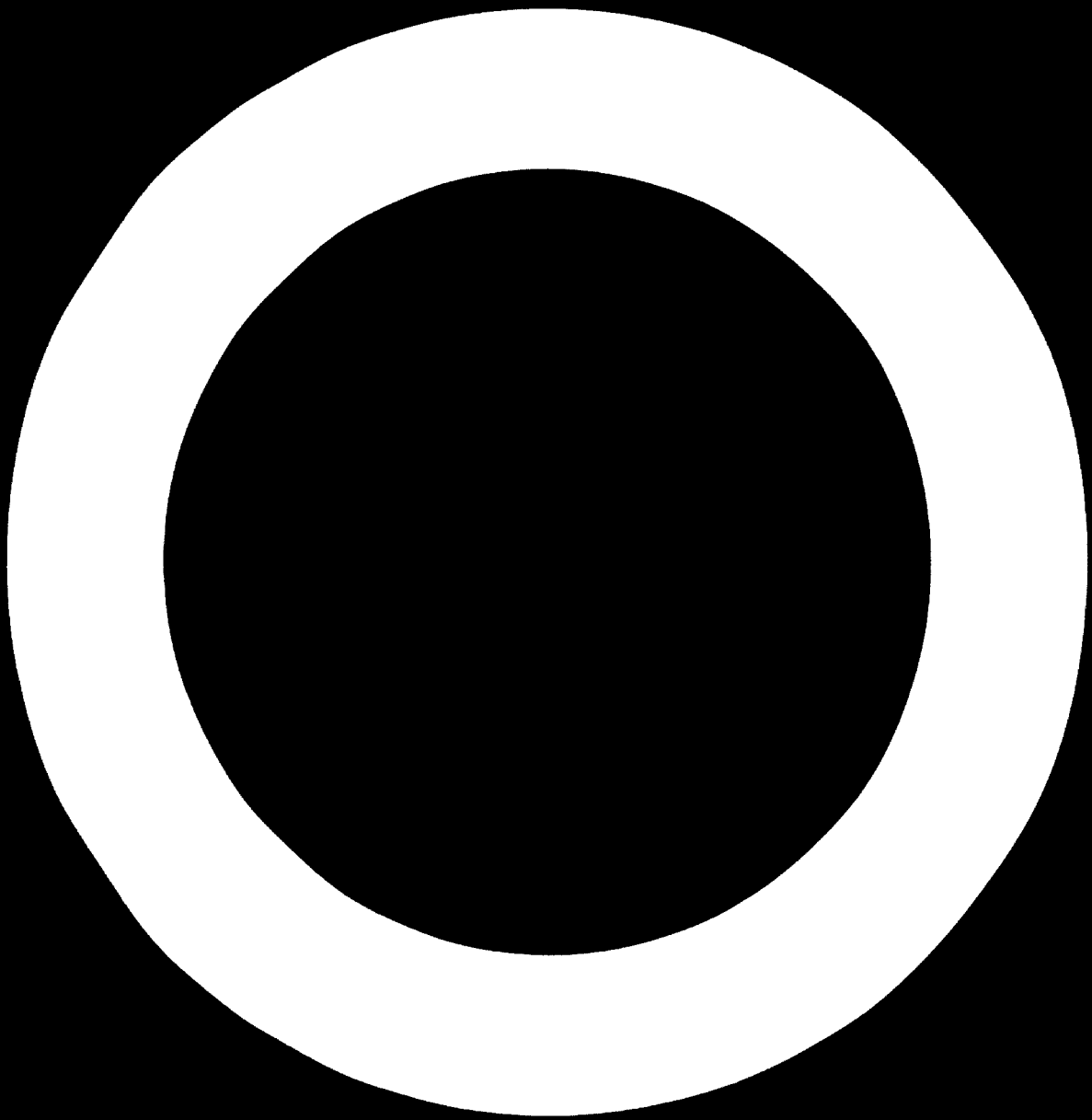
Until channels for procurement of spare parts are assured, second hand equipment must be rated well below new equipment in reliability.



4.4 Unit of Transfer

The transfer of second hand equipment has been in the form of complete plants, major plant components, and standard individual machines. Probably the largest transfer of a complete plant took place when the Kaiser automotive plant was moved from Detroit to Argentina. The more difficult dismantling in Kentucky and reassembly in India of a synthetic rubber plant was referred to in 1.4. A chocolate and biscuit plant from Scotland is operating in Iraq. The transfer of a complete plant has the following advantages: the equipment is known to be compatible, experienced personnel is available for start-up and operation, equipment and production records are available, spare parts are available, and best of all the company providing the equipment usually has an equity interest in the new plant. This company has a vested in making sure the equipment is in good condition to begin with, and continues to operate efficiently. In addition, such a plant can usually be put into production 6 to 18 months before a new plant.

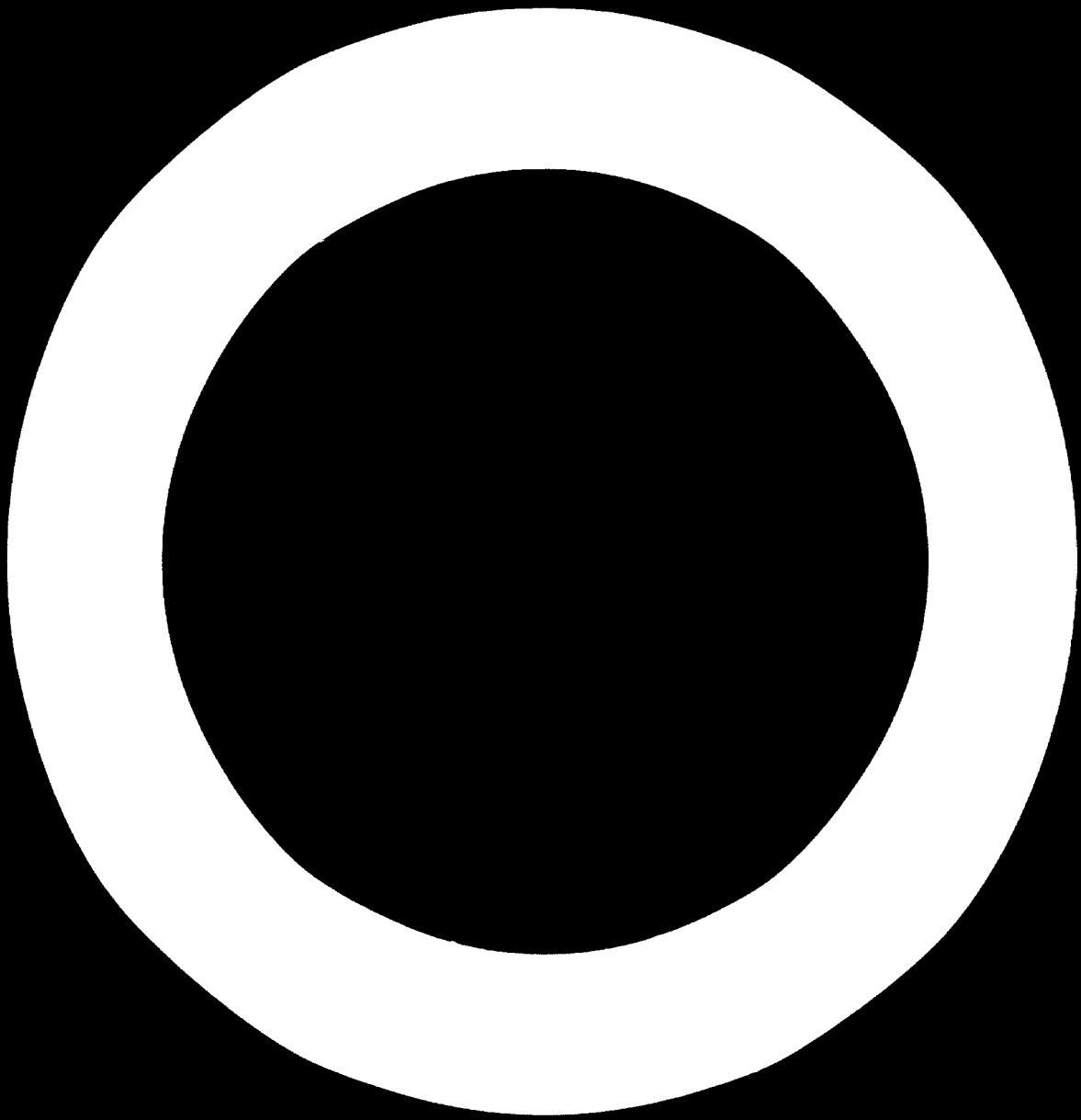
Heavy forging presses were recently sent to India that could become the neucleus of plant producing hand tools, agricultural implements and machine parts. Heavy stamping presses with dies were sent this year to Venezuela where they will become the core of a refrigerator manufacturing plant. The presses will form the refrigerator box. A die casting machine, an extrussion press, and a cigarette making machine are other examples of a major piece of



equipment that becomes the nuclei of complete manufacturing units. Another type of equipment that may be considered major components are ships, locomotives, airplanes, and road paving rigs. The advantage is that they are expensive and can therefore absorb the service costs of inspection, appraisal, rebuilding, and prior procurement of spare parts.

The ability of major components to absorb such service costs will add to their reliability without substantially decreasing their original cost advantage vis a vis new equipment.

Individual units of second hand equipment, even where advantageous by annual cost comparison, may not be advantageous from the point of view of the economy as a whole. This disadvantage stems from lack of standardization. If many models of one category of equipment are imported many of the advantages of standardization are forfeited. This proliferation of models is usually unavoidable in the case of second hand equipment. Some of the advantages of standardization include easier training of operators and maintenance men, interchangeability between plants of both equipment and labor, cannibalizing of equipment, and simpler spare parts procurement and inventory. Standardization with second hand equipment is possible but difficult since there will usually be only a limited number of a given model machine available second hand.



4.5 Calculation of Net Cost

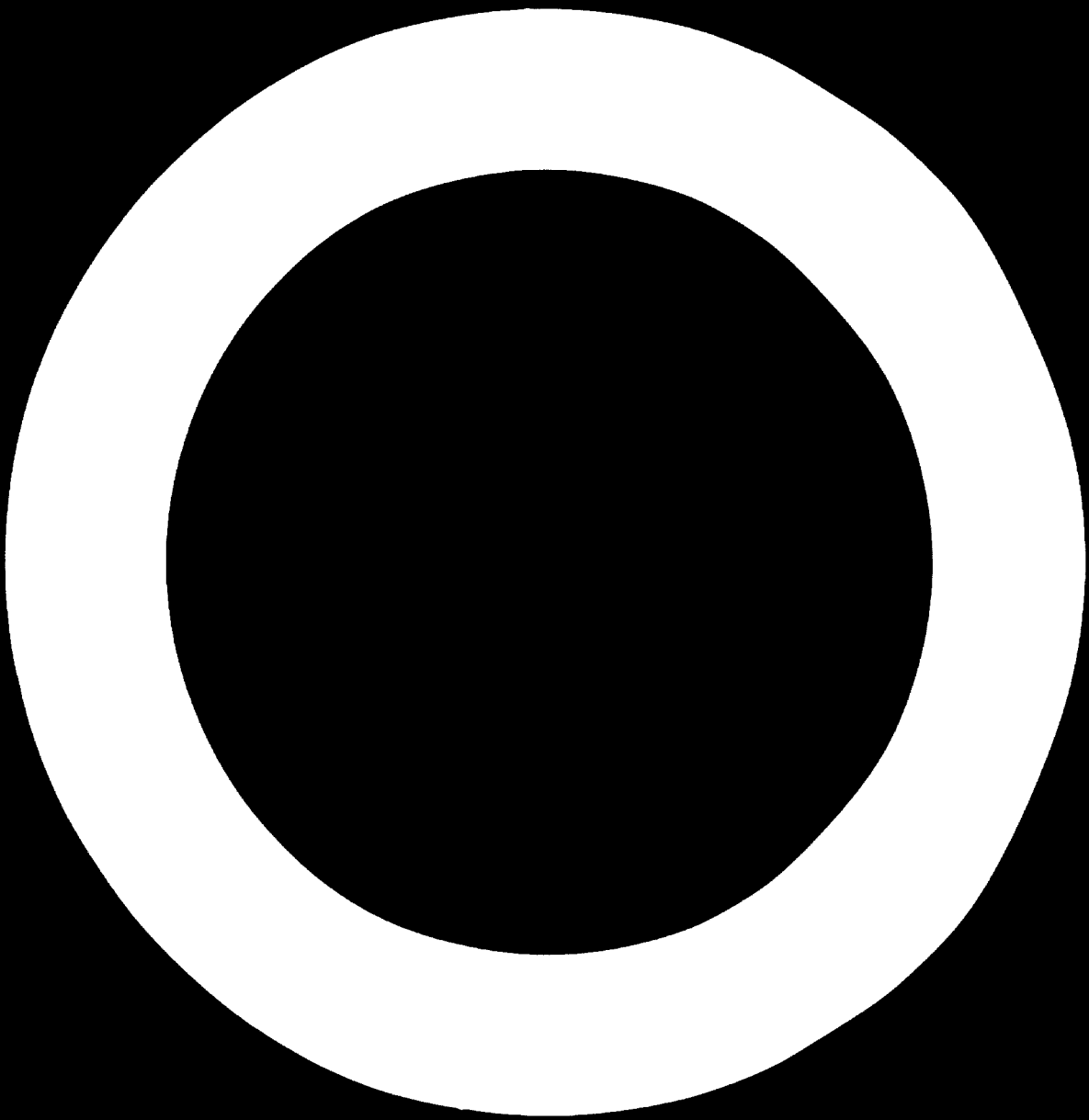
The report by the Netherlands Economic Institute[17] calculates the comperative costs of two machines: One second hand and one new, as follows:

Comparative Costs of New and Used Machines

	Second Hand	New
Price (including installation costs etc.)	40,000.-	100,000.-
Depreciation (i.e. useful) period	10 years	15 years
Rate of interest for loans	10%	10%
Yearly output (maximum)	18,000.-	18,000.-
Normal output level required	16,000.-	16,000.-
Overhaul and repair costs per year	500.-	400.-
Yearly costs of light, floor space, insurance etc.	1,000.-	800.-
Fuel and raw material costs for output of 16,000 units per year	16,000.-	15,000.-
Labour costs for output of 16,000 units per year	32,000.-	30,000.-
Raw material costs for output of 16,000 per year	16,000.-	16,000.-

Since the output to be produced per year by the two alternative machines is to be the same, it will suffice to compare the total costs per year of the two machines.

The first cost item to be calculated, is yearly capital costs, consisting of depreciation + interest charges. For



calculating the annuity representing these costs, an approximate formula can be used instead of an annuity table. According to this formula, the annuities are the following:

Second Hand Machines

$$\frac{1}{10} \times 40{,}000 + \frac{1}{2} \times \frac{1}{10} \times 40{,}000 = 6{,}000$$

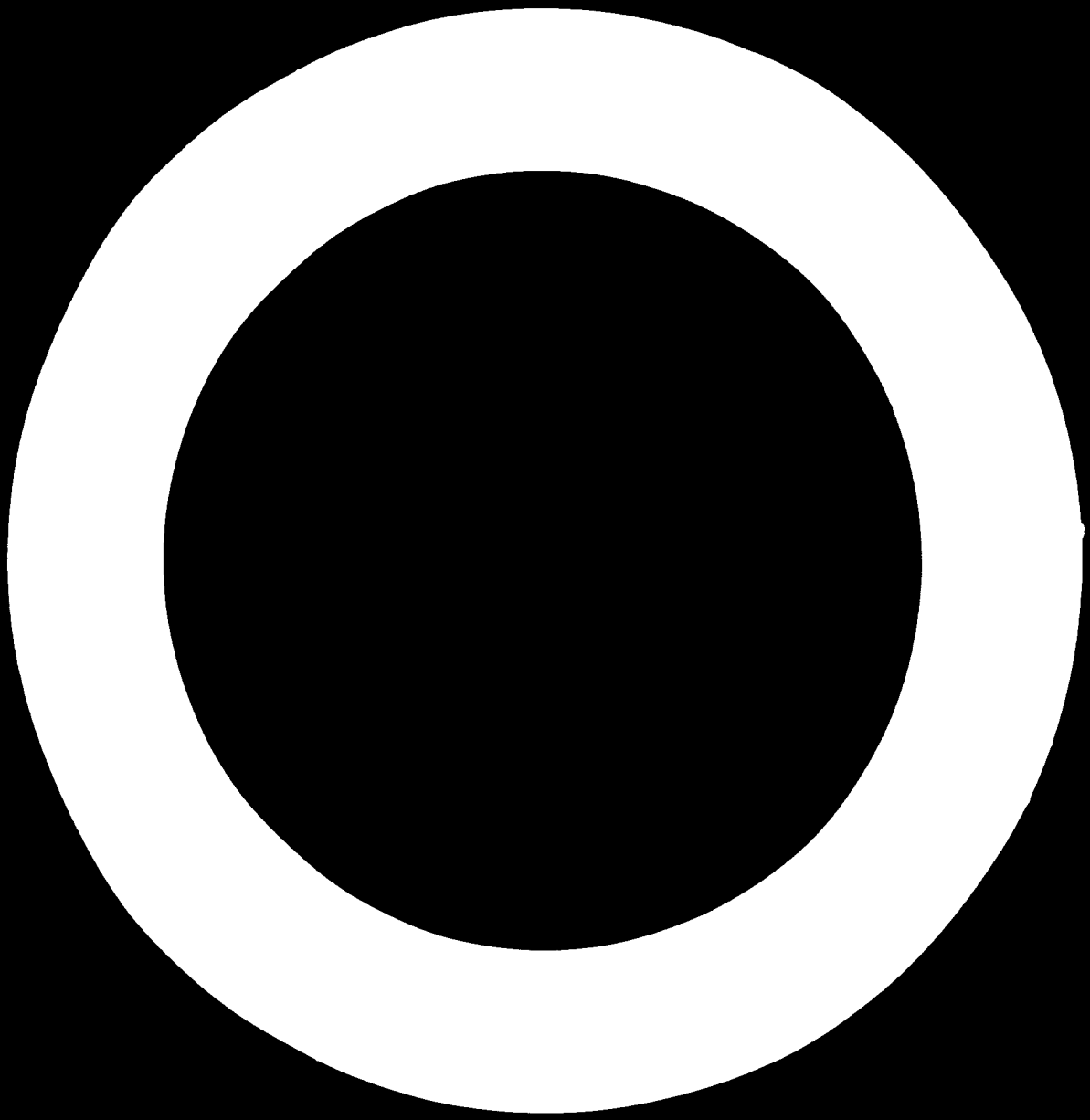
New Machine

$$\frac{1}{15} \times 100{,}000 + \frac{1}{2} \times \frac{1}{10} \times 100{,}000 = 11{,}500$$

Other costs of the two machines are already given in the above table; consequently, total annual costs can be calculated:

Annual Costs for Output of 16,000 Units

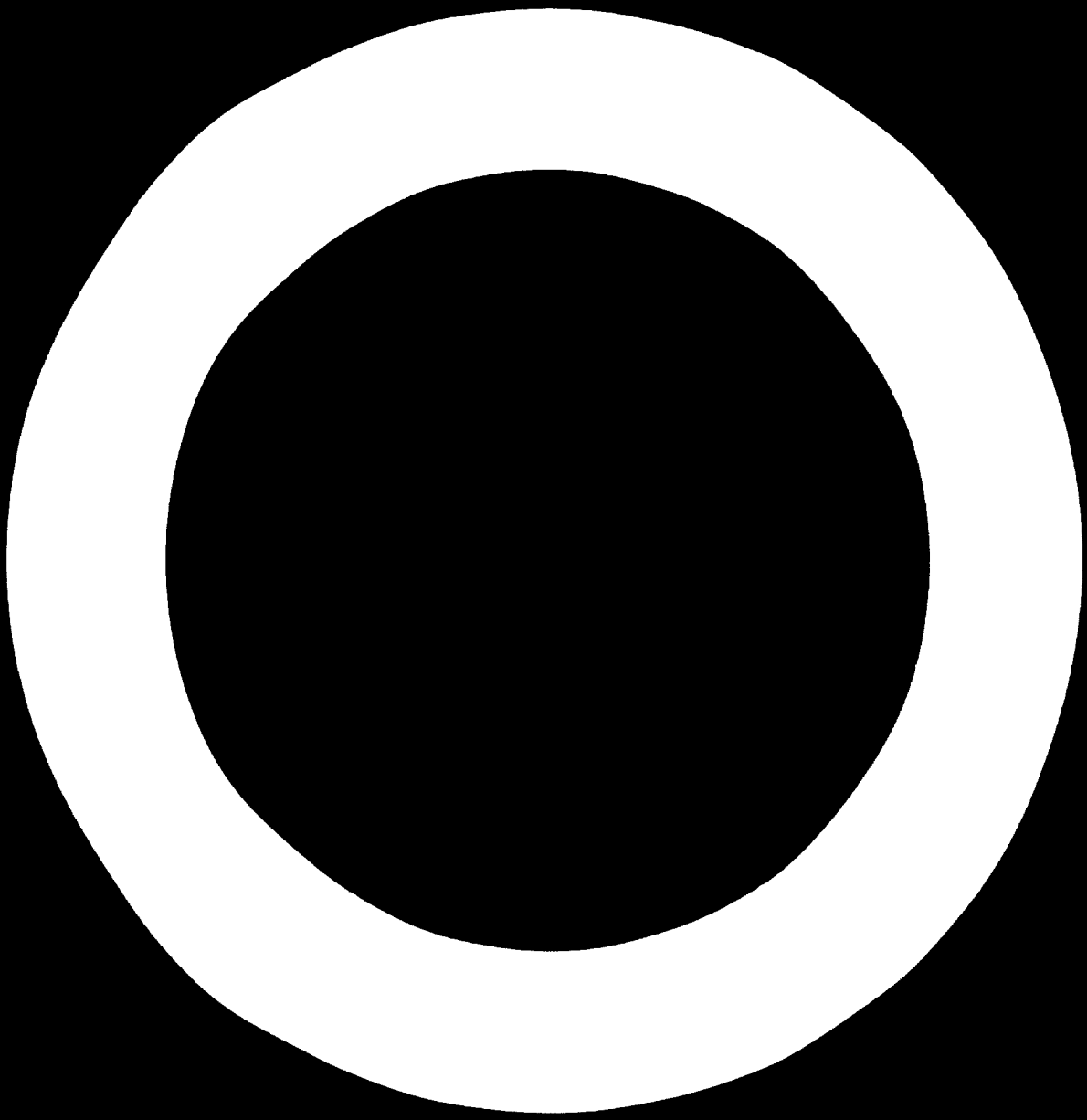
Annuity	Used	New
	6,000.-	11,500.-
Overhaul and repair cost	500.-	400.-
Light, floor space etc.	1,000.-	800.-
Fuel and raw materials	16,000.-	15,000.-
Labour costs	32,000.-	30,000.-
Raw materials	16,000.-	16,000.-
Total Costs	71,500.-	73,700.-



It is apparent that in this case production with the second hand machine is more economical. The cost advantage is due to the lower purchasing price of the second hand machine which results in a lower capital charge per year, not-with-standing the fact that the useful period of the second hand machine is shorter.

The slight advantage of the second hand equipment in this comparison is open to question. The rate of interest on second hand equipment may well be higher than for new. The original cost of second hand equipment may well be higher considering that cost of transportation and installation are the same if not higher for second hand. The repair costs of the second hand also seem understated considering the maintenance and spare parts problem discussed in 5.2. On the other hand; "The depreciation period for second hand equipment is shorter and, thereby, the firm has the possibility of shifting to newer or different equipment at an earlier date in the future than would have been the case with new equipment. This may be an advantage especially in cases where markets are growing or quickly changing."[18]

It may be concluded that the 3 percent advantage of the second hand machine in this comparison is not sufficient to overcome the lower reliability of the second hand equipment.



4.6 Conclusion: Net Cost

There can be no single answer to the question, "Is second hand equipment more economical than new?" However, in any given case the method for determining the answer is available.

For standard metalworking tools such as lathes, grinders, brakes, millers, and drill presses the following ratio of aquisition costs may be considered typical.

New 1965, U.S.A.....100

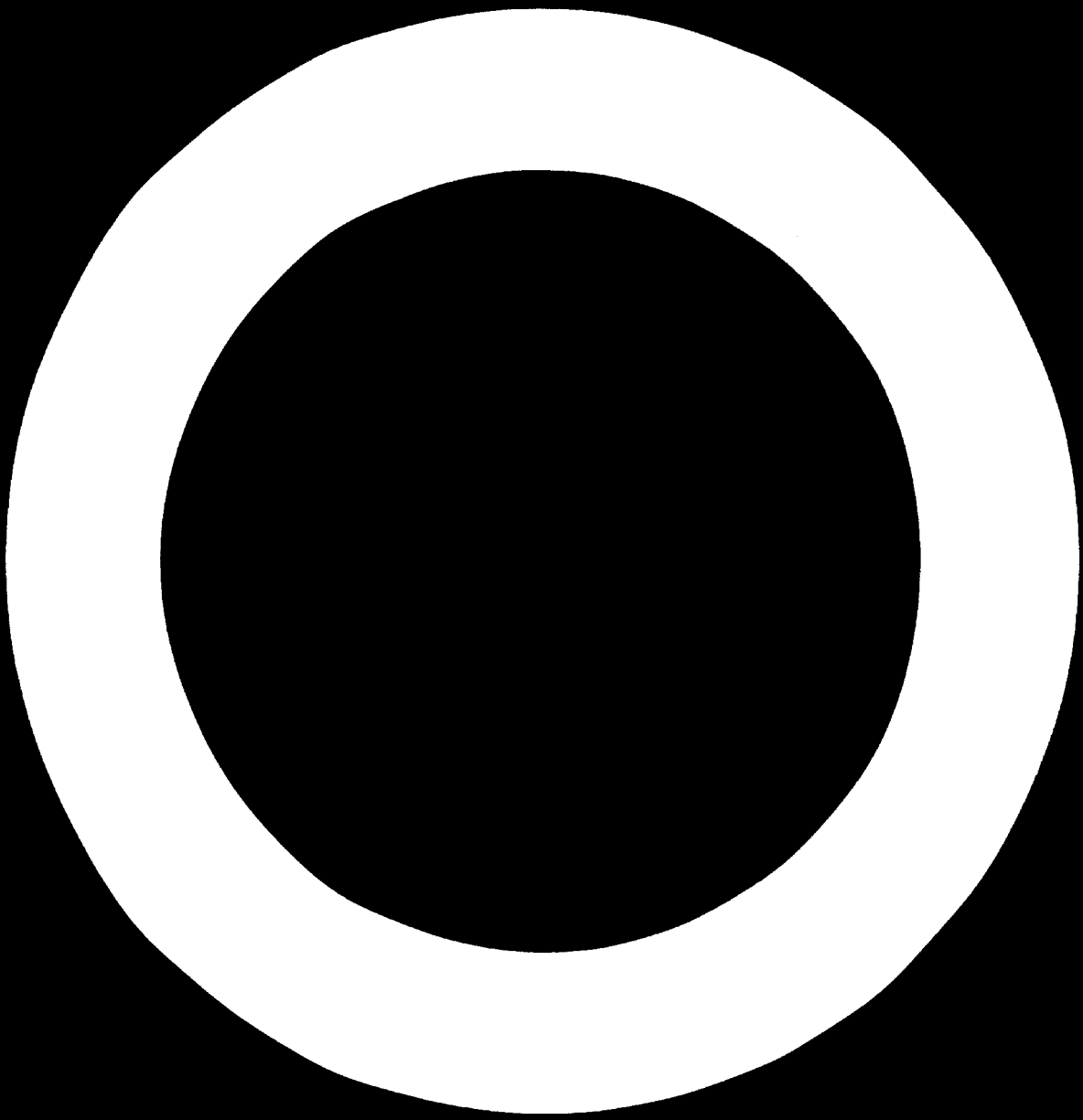
New 1965, Japan..... 70 - 80

Second hand, new 1955, U.S.A., rebuilt..... 65 - 75

Second hand, new 1955, U.S.A. in good operating order..... 25 - 45

Rebuilt standard metalworking tools have an insufficient if any aquisition cost advantage over new machines from Europe and Japan.

Second hand standard metalworking tools in good operating condition have a considerable aquisition cost advantage over new equipment. They also have higher operating costs caused by lower reliability due to difficulty in procurement of spare parts, lack of adequate information about condition and lack of service. This equipment should only be purchased by developing countries capable of making spare parts and with good repair facilities.



For heavy and special metalworking machinery such as boring mills, forging hammers, presses, and vertical turrett lathes the following ratio of aquisition costs may be considered typical:

New 1965, U.S.A.....100

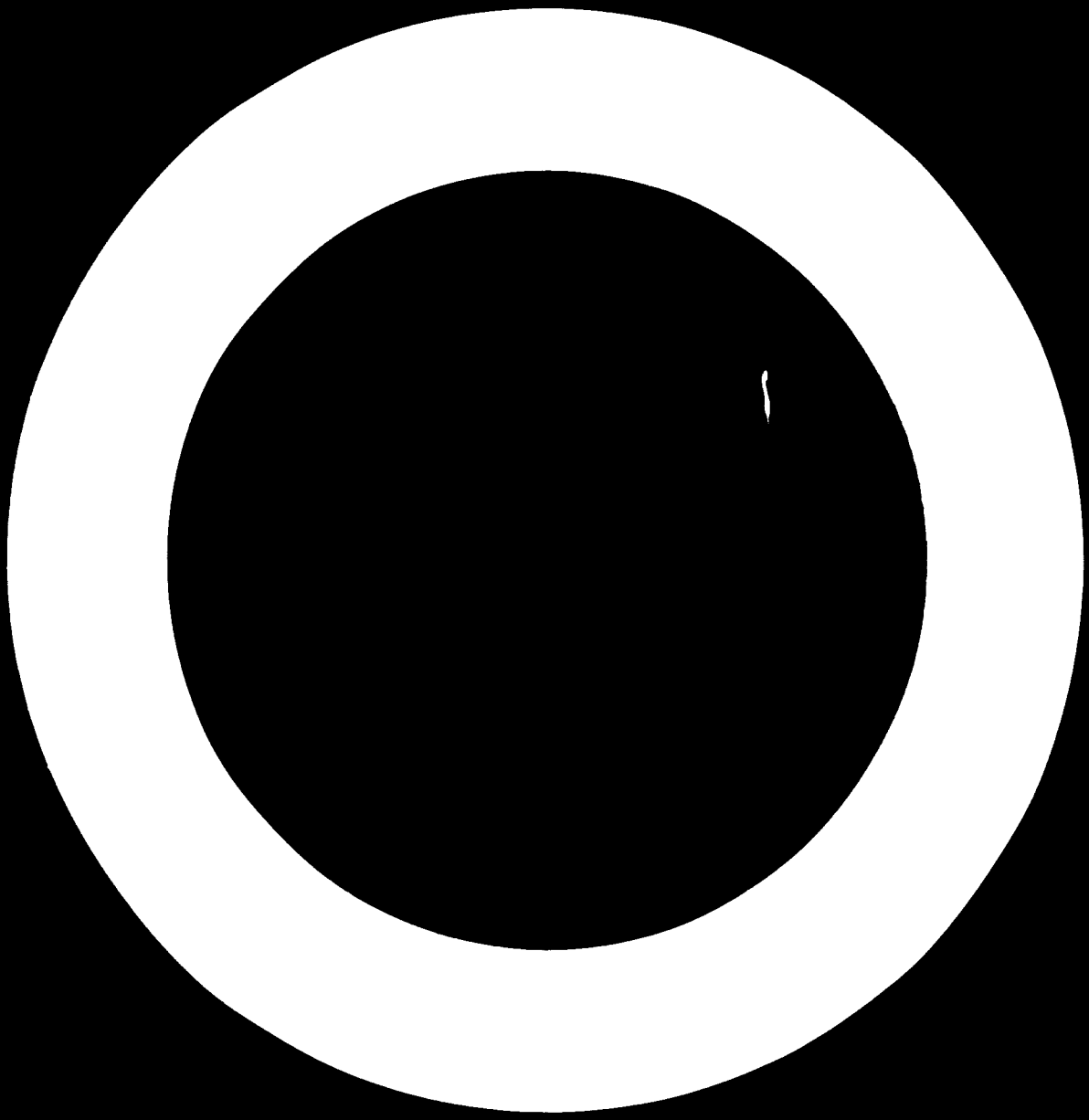
New 1965, Germany..... 70 - 90

Second hand, new 1955, U.S.A. rebuilt..... 40 - 60

Second hand, new 1955, U.S.A., in good operating order..... 30 - 50

Heavy and special metalworking equipment both rebuilt and in good operating condition has a considerable aquisition cost advantage over new. Both rebuilt and properly inspected equipment in good operating condition have higher operating costs due to lower reliability, but the margin of difference is small.

Complete plants of second hand equipment properly engineered on a turnkey basis have considerable aquisition advantage and very small operating disadvantages as compared with costs of new plants.



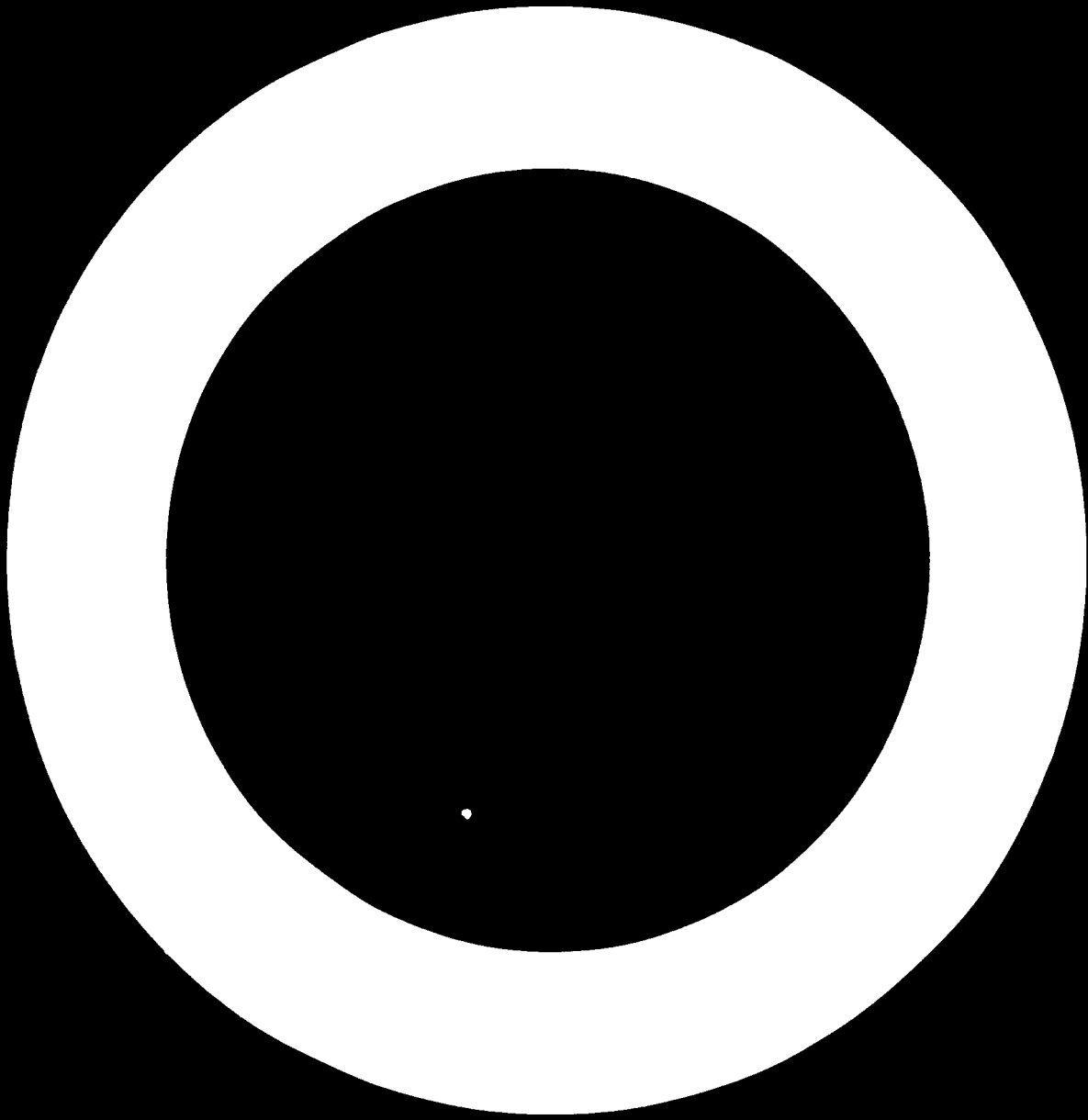
Mechanisms of Transfer

5.1 Functions

The purpose of this section of the report is to evaluate procedures by which second hand equipment is transferred to a developing country. These procedures or mechanisms of transfer include:

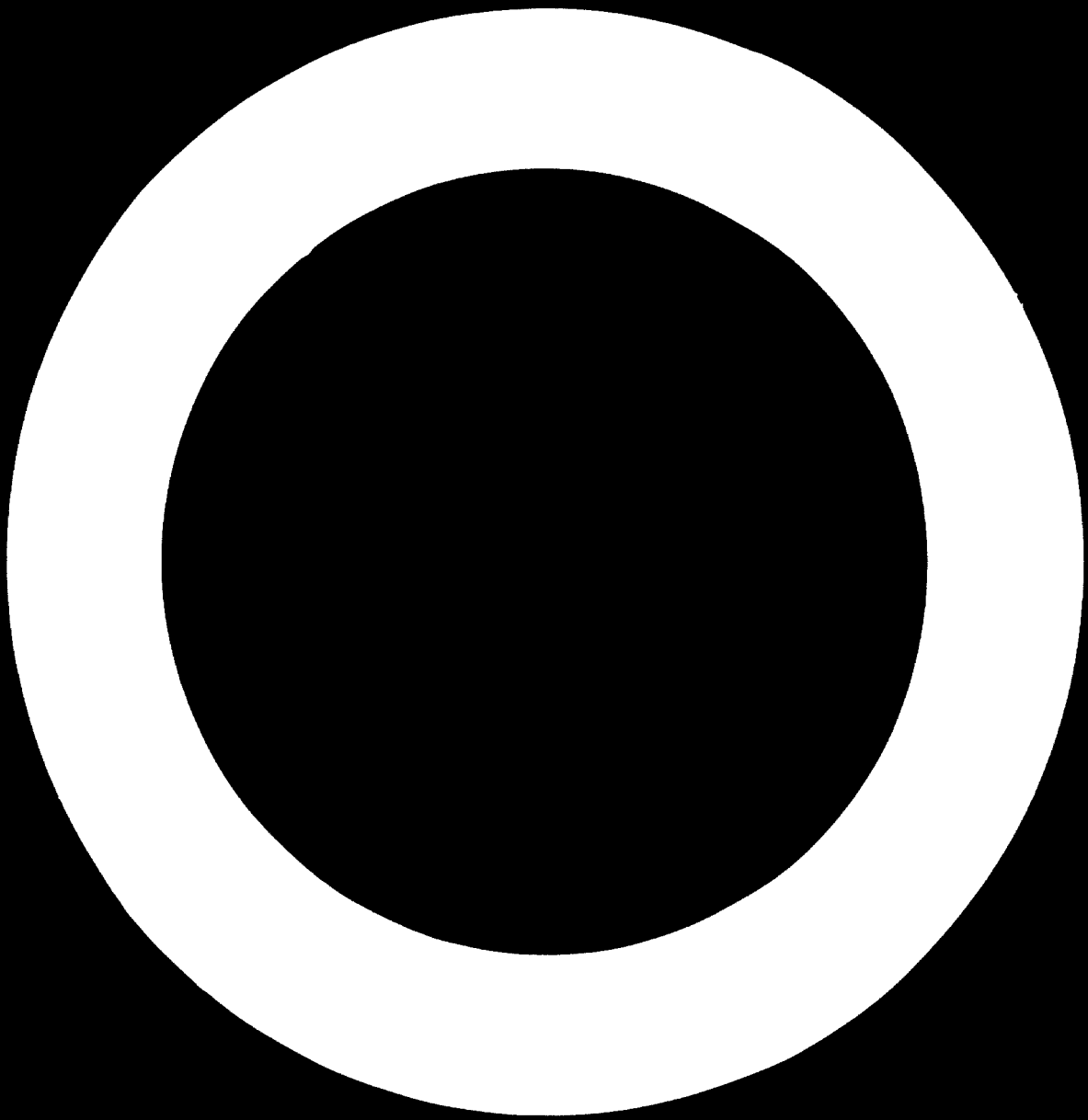
1. Exporting organizations
2. Importing organizations
3. Financing
4. Inspection and classification of condition
5. Repair and rebuilding
6. Appraisal
7. Spares, accessories, and motors
8. Operating know-how
9. Installation and service
10. Performance guarantees

The new equipment manufacturer may perform all these functions himself or contract with an expert corporation to perform the overseas functions. Sometimes, an equipment manufacturer will combine with manufacturers of allied non-competing equipment to form the expert corporation. In second hand equipment, there is no one firm that assumes responsibility for all these functions. Frequently, there is no one to



perform these functions and buyer dissatisfaction gives the trade a bad reputation. The lack of single responsibility for these functions stems from difficulties in trade over long distances and from the small volume of trade.

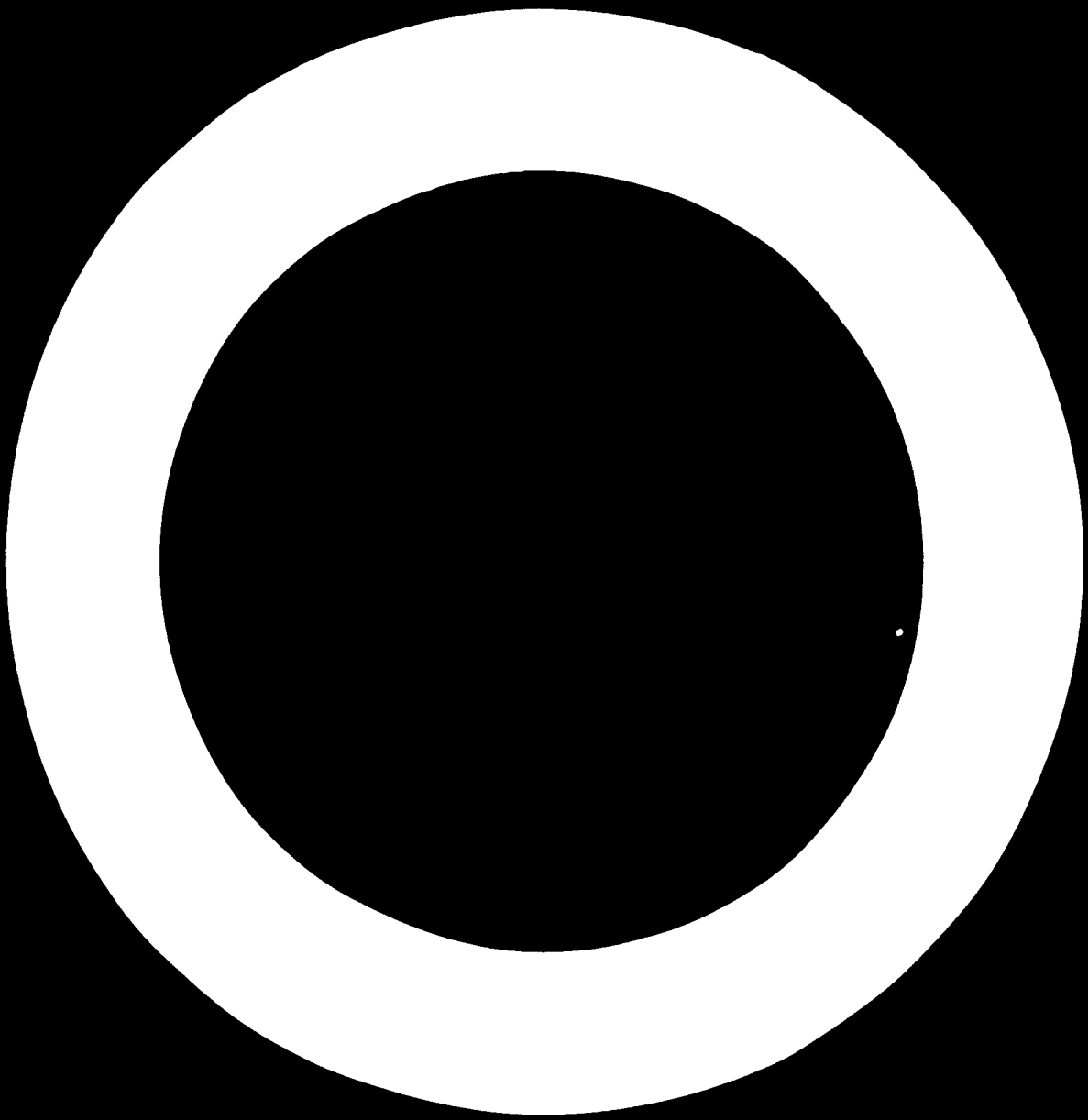
Reports from developing countries, some of whom have banned the import of second hand equipment, repeatedly cite failures in the performance of these functions. A middle-eastern country cites "lack of experience in equisition and evaluation" and a problem of obtaining spare parts. A report from Africa cites "abuses in unloading of unsuitable equipment" and difficulty in locating equipment. A report from Latin America cites 2 cases where unsuitable equipment was obtained. Another African country reports lack of cooperation on the part of dealers in integrating individual items into a complete plant. The frequency with which developing countries have obtained equipment unsuitable for the task points to another difficulty; the determination of the machine most suitable for the job. Although equipment specifications are prepared independently of equipment manufacturers, in practice their advice and assistance is an important factor. Such advice is not regularly supplied by second hand dealers and where it is supplied it tends to be less reliable.



5.2 Exporting Organizations

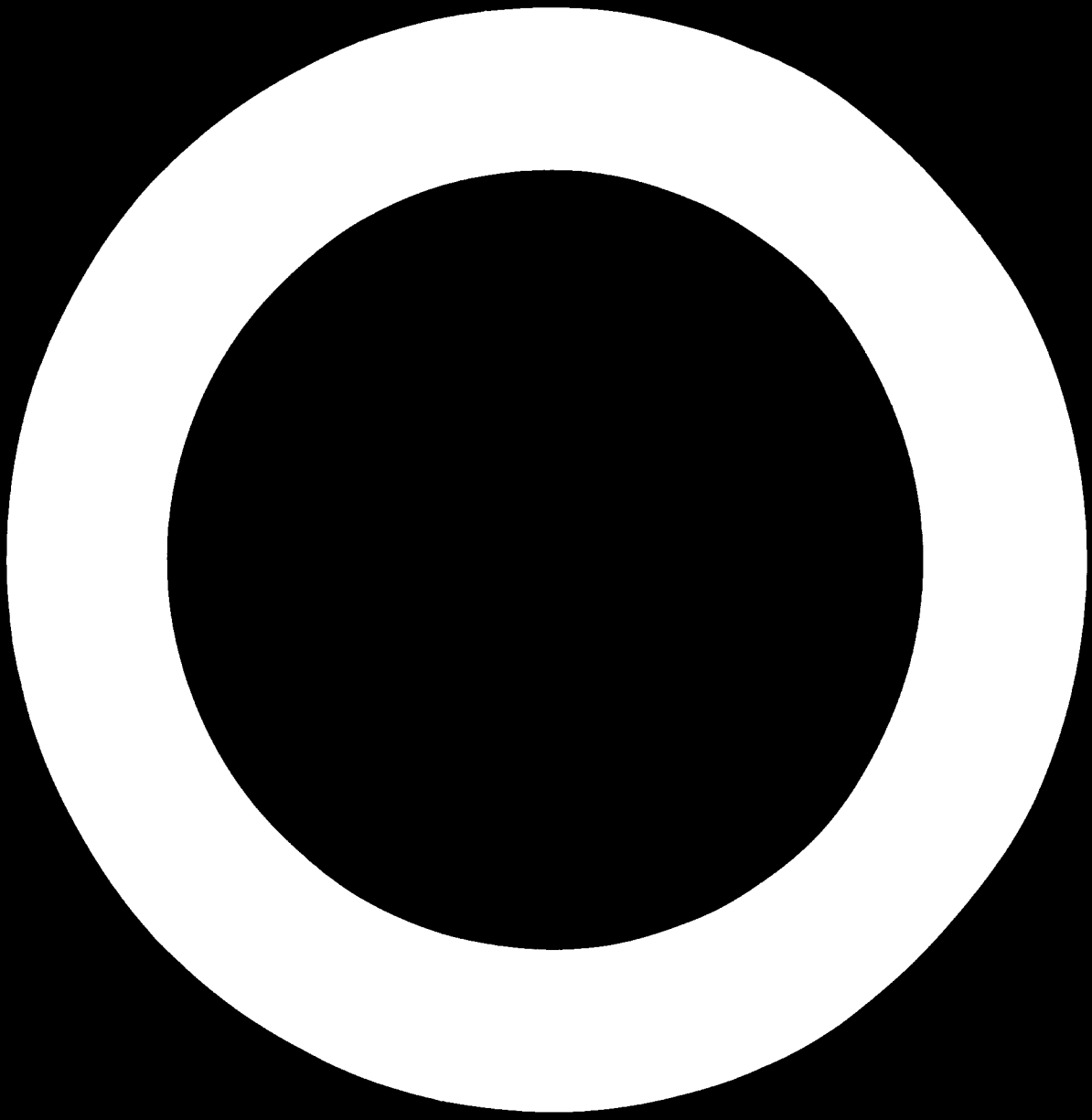
Private corporations, on occasions, use second hand equipment to set up complete plants in the underdeveloped countries as subsidiaries or joint ventures. Individual pieces of equipment may also be sent to subsidiaries. Basically, these corporations have no interest in second hand equipment or its export. The disposal of second hand equipment is seen as an orderly salvage operation.

The larger equipment dealers are very much interested in expanding export to the developing countries. For large orders, they will put together a package; select equipment, arrange for repair, inspection, spare parts, appraisal, crating, shipping and even credit. They may even help install and guarantee the equipment for 90 days. They can only provide these services for major components because a single machine priced at $5,000 cannot absorb these additional costs and dealers seldom have an opportunity to provide these services on a group of such machines because they are not competative with new European and Japanese equipment. There are equipment dealers and engineering companies who will on a contract basis select, install, and operate for a period of time complete plants using second hand equipment. All the larger dealers have facilities for storage and repair.



The U.S. Agency for International Development exports excess U.S. government equipment to underdeveloped countries at no charge to the recipient. In 1964, over $60 million was exported under 3 programs. Under the Advanced Aquisition program, AID selects and overhauls excess equipment in its own repair shops, warehouses it, and circulates an AID catalogue of available equipment to the developing countries. It is available to approved projects. The recipient must be a government agency or a wholly owned corporation. AID calculates the cost of overhauling equipment into good operating condition and handling it at 15 percent of original aquisition cost. Under the Direct Aquisition program, excess equipment is selected by the developing countries from a U.S. General Services Administration catalogue. (See Attachment F) It can be reserved for the recipient who has 30 days in which to inspect and accept the equipment. On acceptance, it is legally taken over from GSA by AID, overhauled, crated, and shipped to the recipient at AID expense. Under the non-AID Financed program, the developing country selects equipment from the GSA catalogue (See Attachment F) and has an opportunity to inspect and accept the equipment. In this case, the recipient must pay AID for overhauling, crating, and shipping or arrange for these services on his own.

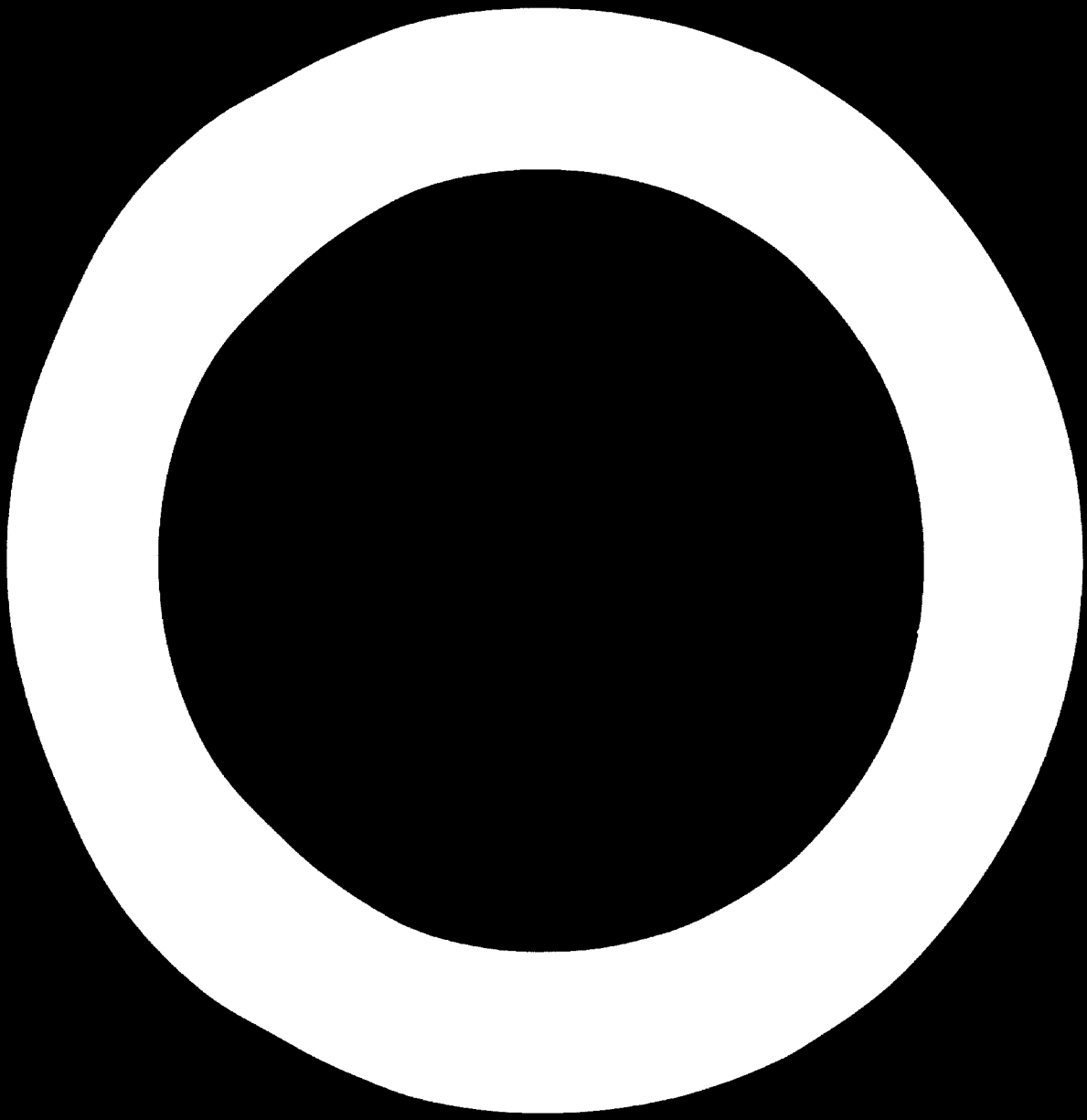
Attachment F also includes the complete regulations governing procurement of AID excess equipment.



5.3 Importing Organizations

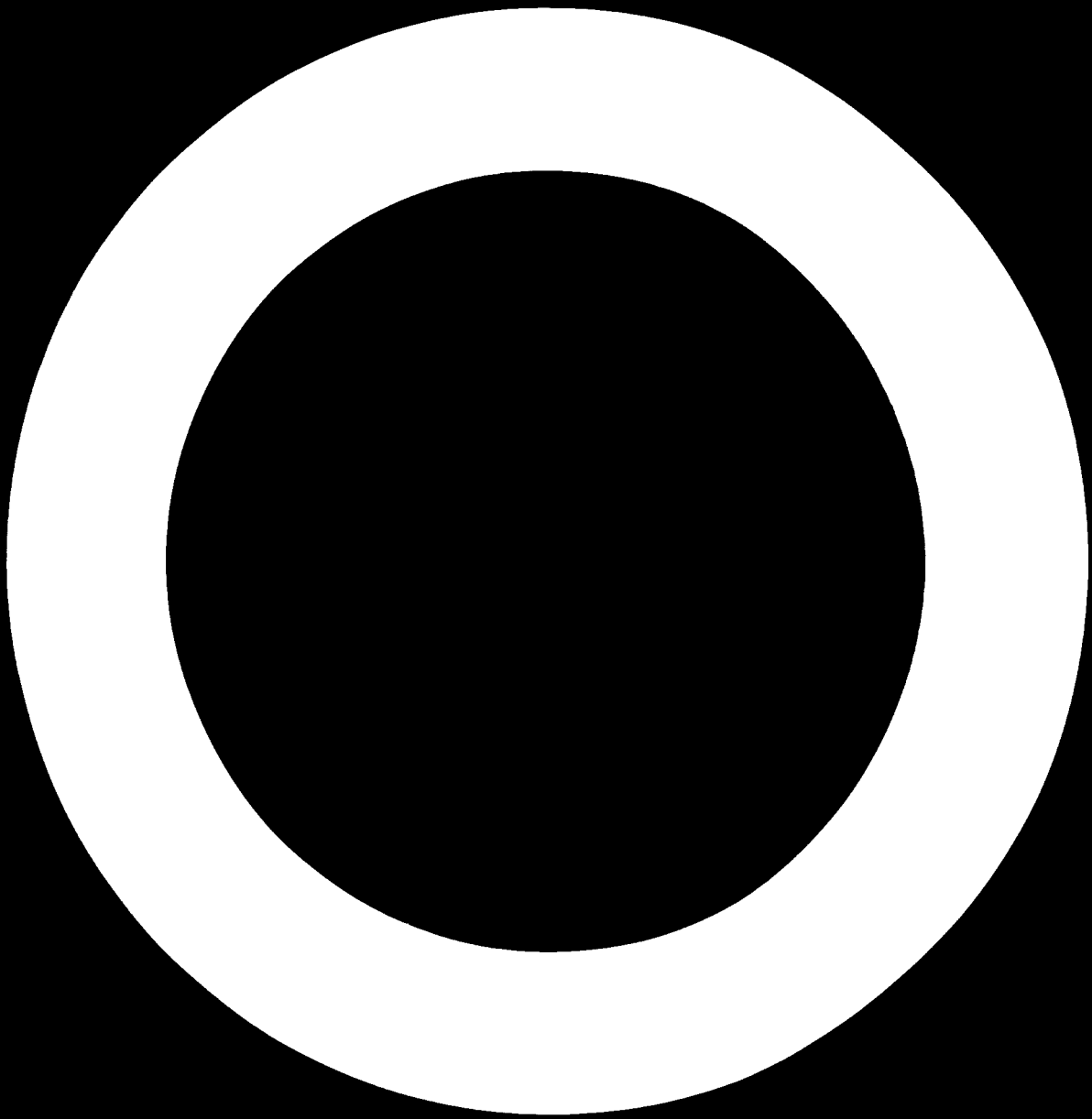
Private companies, usually the small ones, are the most active importers of second hand equipment and the most active advocates of expanding second hand trade. Paradoxically, they are also most vocal in expressing disappointment in this equipment. Frequently, as they grow larger and more prosperous, they sell their second hand equipment and purchase new. Having limited capital and credit, they cannot afford new equipment and buy second hand out of necessity. They rely on second hand dealers in the developed countries. Since their specifications are often not exact, their communication with the dealers imperfect, the results are frequently disappointing. For major components and complete plants where the buyer and seller come into personal contact the results may be better..

Equipment dealers in developing countries buy second hand equipment for which there is a constant demand on their own account. More frequently in the case of individual pieces of equipment and almost always in the case of major components and complete plants, the purchases are made to the account of the buyer. The dealers usually purchase equipment from other dealers in the developed countries. At least in the case of Mexico, some dealers entered the U.S.A. and purchased equipment directly from



manufacturers and at auctions. The larger dealers in Mexico overhaul equipment themselves, install it, and provide continuous service. Generally, however, equipment dealers do not specialize in one type of equipment and lack capital and experience. Their chief function is to locate and import equipment for local buyers rather than provide technical services.

Public sector companies seldom import second hand equipment. In some cases, they are required to at least consider second hand equipment by the terms of the AID Development Loan Fund. In one case, a public sector firm bought second hand forging equipment because the lead time on new equipment was over one year in addition to a wide price differential.

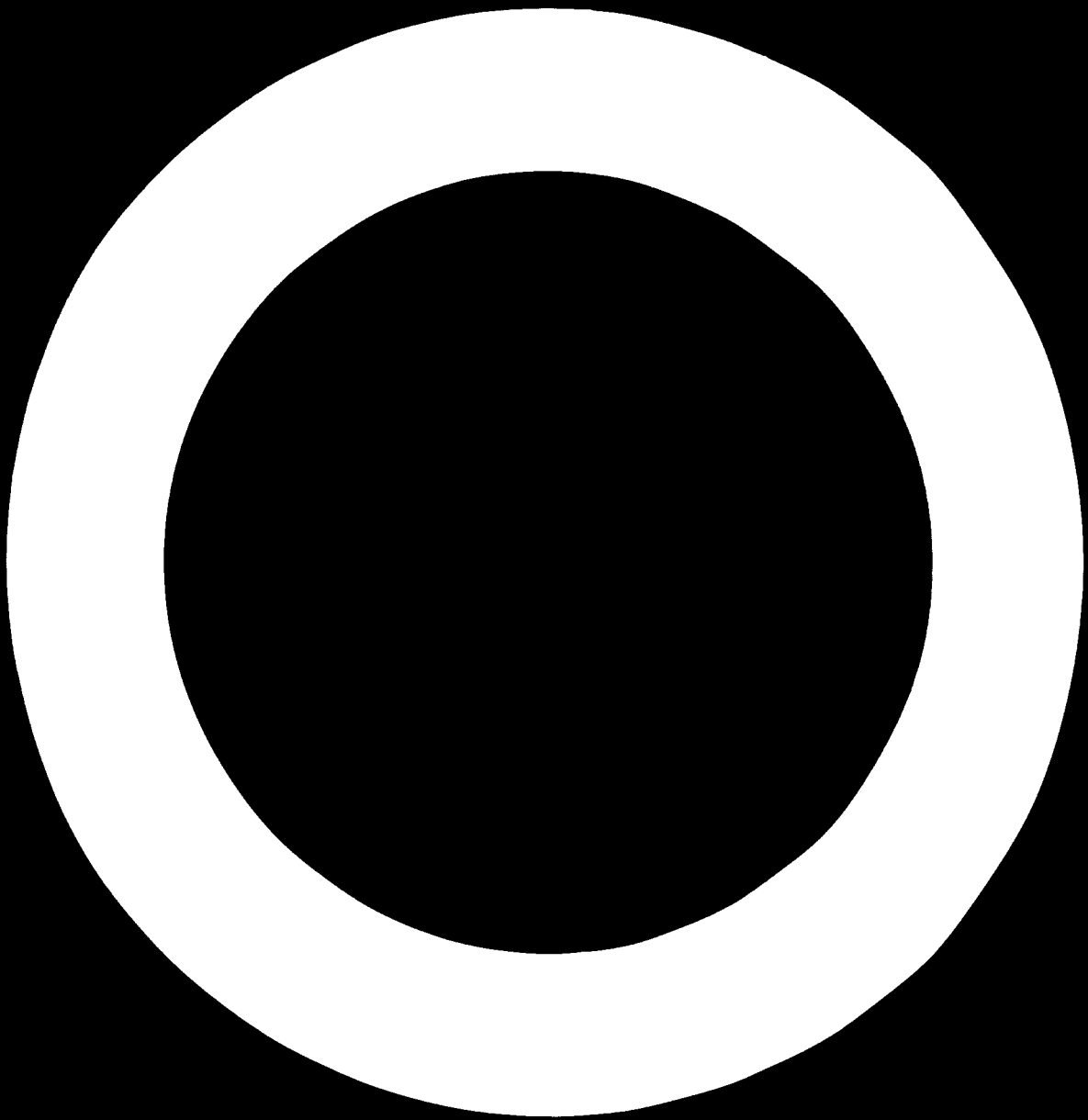


5.4 Financing

Second hand equipment is more difficult to finance because it is second hand and therefore less reliable, but also because of the character of the companies purchasing it. These companies are usually small and with poor credit ratings. The policies of governmental and private banking institutions do not directly prohibit financing of second hand equipment. In effect, their policies discourage it. The international banks usually ask that the exporter have an equity interest in the project, that know-how as well as equipment be exported, that the loan be for a sum of at least, say - $250,000 and that the application be accompanied by very detailed information.

The Export - Import Bank does finance second hand equipment under its short and medium term export credit insurance and guarantee program. For this type of financing, answers must be furnished to the questionnaire reproduced on the next page.

The inadequate credit facilities available for second hand equipment should be contrasted with that available for new equipment from West Germany and East Europe. The financing offered by these countries may be for as long as 15 years and at interest rates as low as 2 percent. This availability of credit is frequently the over-riding consideration with the lower price of second hand U.S.A. equipment a very poor second.



Used Equipment Questionnaire

Where used equipment is included in an export credit sale, Eximbank and FCIA require full information concerning both the equipment and the transaction involved before reaching a decision. As a part of an application involving used equipment, answers to the following questions are required:

1. What is the name of the manufacturer of the used equipment?

2. What is the age of the used equipment?

3. What is the source of the used equipment?

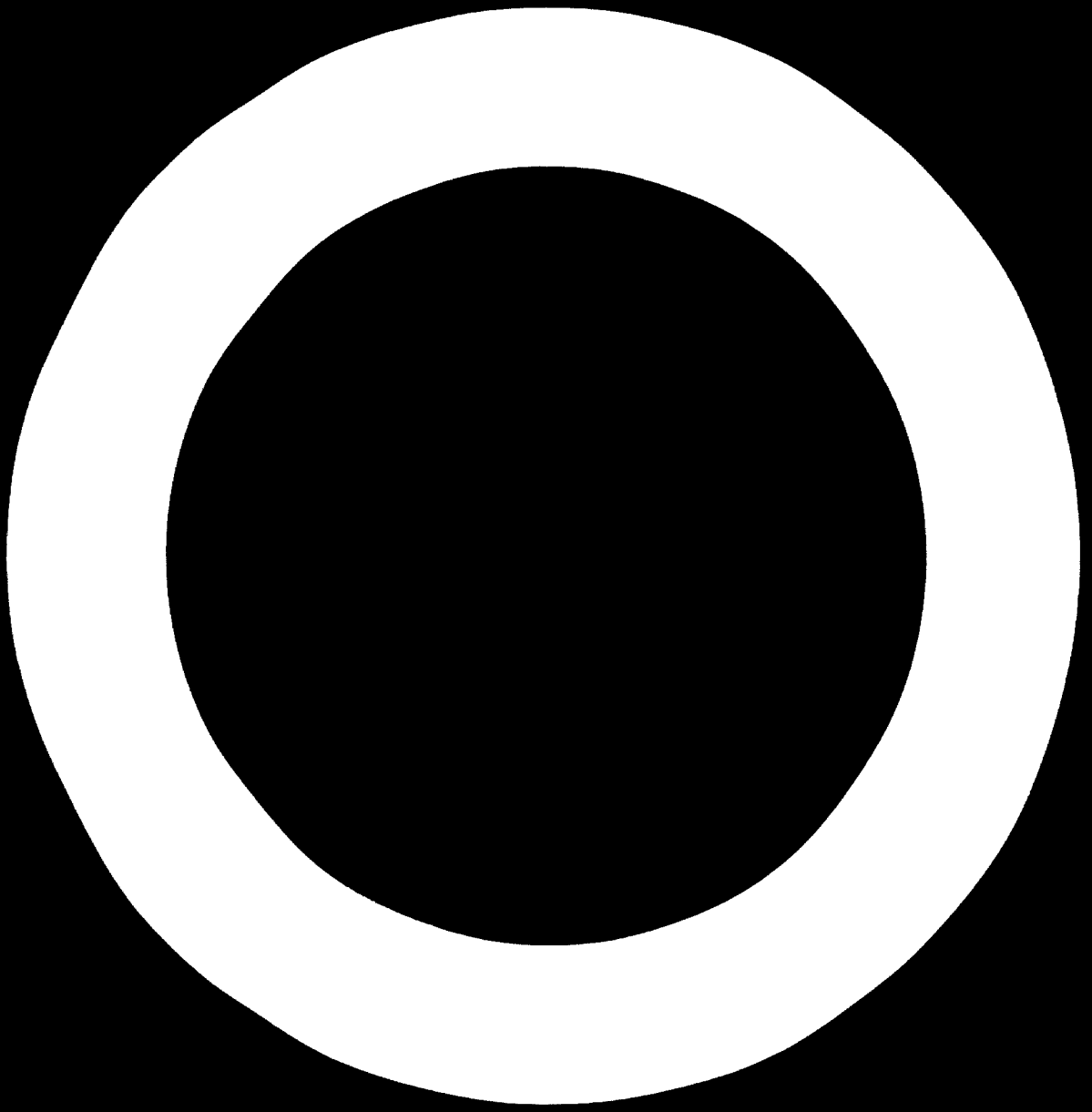
4. Is the used equipment being replaced by new equipment purchased in the United States?

5. What is the extent of rebuilding and reconditioning of the used equipment and by whom performed?

6. What warranties will be given on the used equipment and by whom?

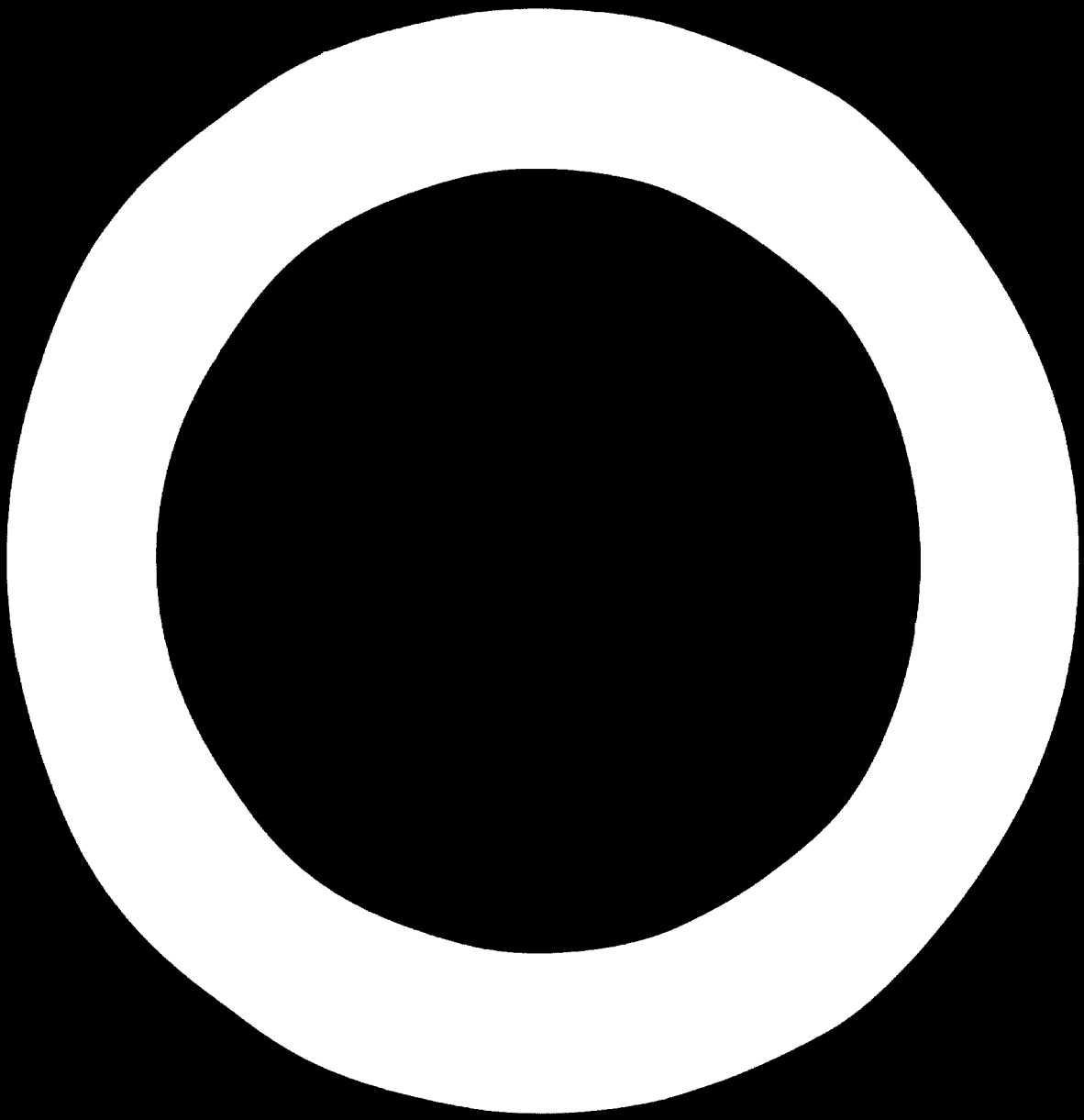
7. How is the value of the used equipment to be determined?

8. What part of the total value of the used equipment will be attributable to rebuilding and reconditioning?



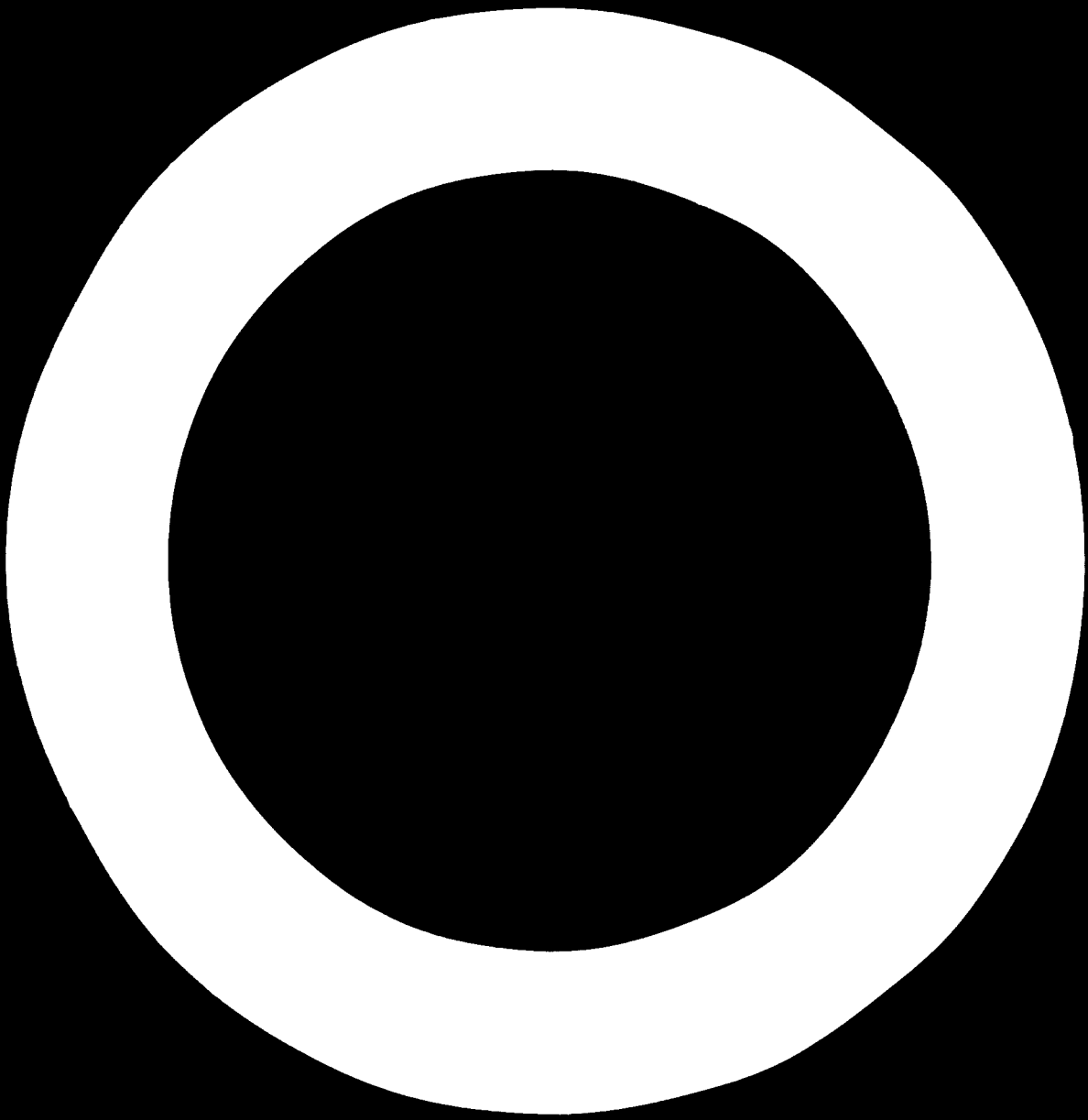
5.5 Conditions of Transfer

Inspection and Classification . For individual pieces of equipment, the second hand dealer is usually the only source of information about its condition. Inspection should be carried out by an independent engineering, inspection service, or appraisal firm. The cost of inspection usually consists of a days pay for the inspector plus transportation. The inspection should be under power and should concern itself with both the suitability of the machine for the desired end use and the condition of the machine. The inspector should have the specifications of the engineering study and state if the machine meets the specification. He shold list the serial number, model, year of manufacture, name of manufacturer, spare parts, accessories and power unit. Where accuracy is a factor, the performance of the machine should be checked against the original manufacturers manual. The next page describes the accuracy of a lathe as given by the manufacturer. The inspector should have a list of component parts and decide the condition of each..Finally, he should make an overall evaluation based on a condition code such as the one used by the U.S.A. General Services Administration. This code is reproduced on the two pages following. Inspection for the domestic trade is usually made by the buyer and the procedures include all those outlined above except for the evaluation by a condition code.



ACCURACY

Bed level – transverse direction – in any 12"	.0005
Bed level – horizontal direction – in any 12"	.0005
Tailstock way alignment – in any 48"	.0005
Spindle center runout	.0004
Spindle nose runout	.0003
Cam action of spindle	.0003
Spindle taper runout	.0003
Headstock alignment – vertical – high at end of 12" bar	.0005
Headstock alignment – horizontal – at end of 12" bar	± .0003
Tailstock alignment – horizontal – towards front at end of spindle when fully extended	.0005
Tailstock alignment – vertical – high at end of spindle when fully extended	.0005
Tailstock taper alignment – vertical – high at end of 12" bar	.0005
Tailstock taper alignment – horizontal – end of 12" bar	± .0005
Vertical alignment of head and tail centers – high at tailstock	.002
Cross slide alignment, may face hollow or concave only on 12" dia.	.0005
Face plate runout on diameter	.0005
Chuck runout	
Face and periphery	.002
Face of steps	.003
Bar test 3" from end of jaw, bar diameter same as hole	.003
Collet chuck runout, 1" from collet chuck	.001
Lathe must turn cylindrical with work between centers on 12" bar	.0004
Lathe must turn cylindrical with work mounted in chuck on 12" bar	.0008
Leadscrew	
Lead per foot (non-cumulative)	± .0015
Lead in any 4"	± .0005
Backlash on cross feed screw	.004
Backlash on compound rest screw	± .004

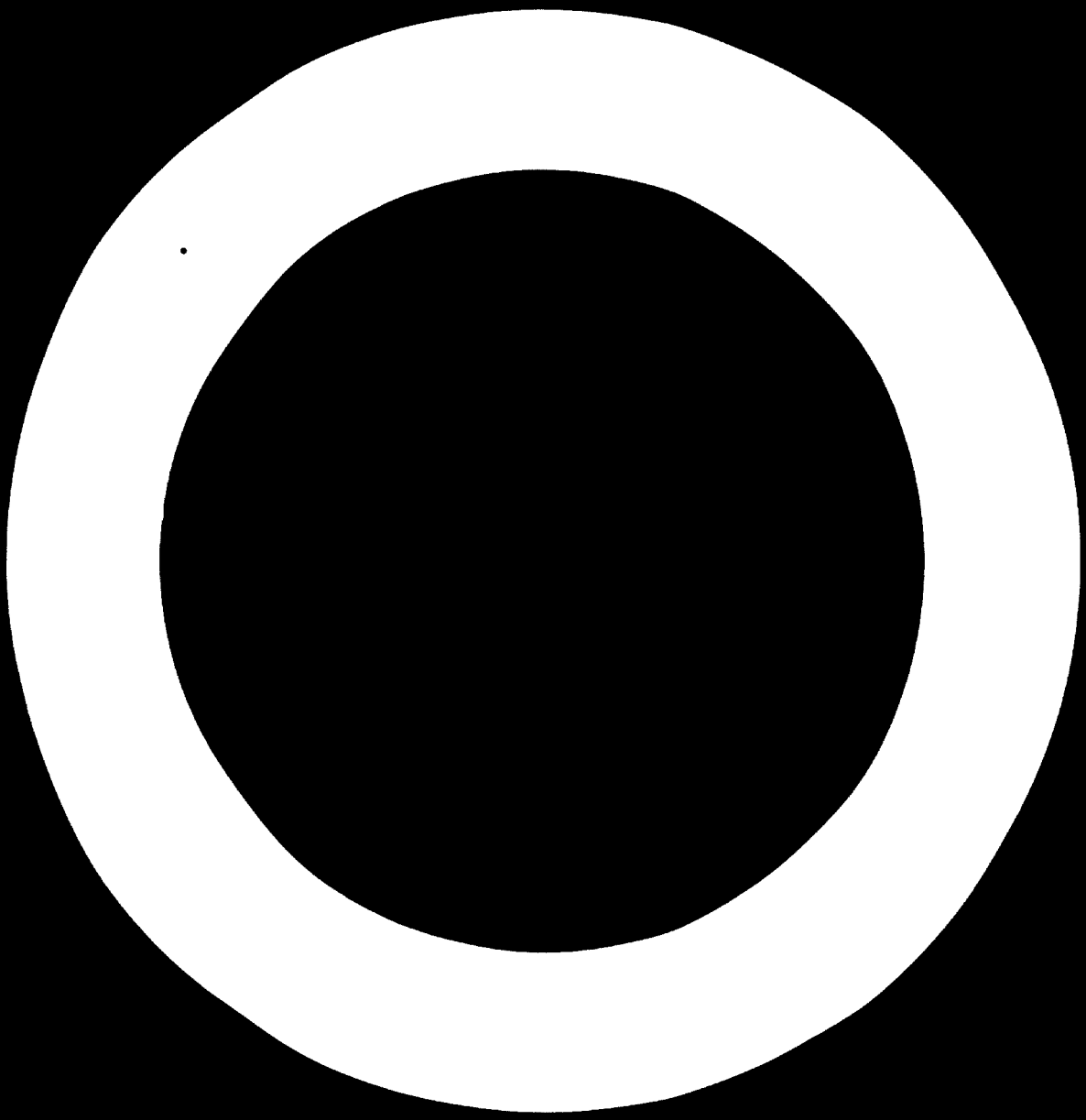


APPENDIX B

CONDITION CODES, AID COMMODITY CODES, AND FEDERAL SUPPLY GROUPS

I. CONDITION CODES AND EXPANDED DEFINITIONS

Condition Code	Expanded Definition
N-1	New or unused property in excellent condition. Ready for use and identical or interchangeable with new items delivered by a manufacturer or normal source of supply.
N-2	New or unused property in good condition. Does not quite qualify for N-1 (because slightly shopworn, soiled, or similar) but condition does not impair utility.
N-3	New or unused property in fair condition. Soiled, shopworn, rusted, or damaged to the extent that utility is slightly impaired.
N-4	New or unused property so badly broken, soiled, rusted, mildewed, deteriorated, damaged, or broken that its condition is poor and its utility seriously impaired.
R-1	Used property but repaired or renovated and in excellent condition.
R-2	Used property which has been repaired or renovated and, while still in good usable condition, has become worn from further use and cannot qualify for excellent condition.
R-3	Used property which has been repaired or renovated but has deteriorated since reconditioning and is only in fair condition. Further repairs or renovation required or expected to be needed in near future.
R-4	Used property which has been repaired or renovated and is in poor condition from serious deterioration such as from major wear and tear, corrosion, exposure to weather, or mildew.
U-1	Property which has been slightly or moderately used, no repairs required, and still in excellent condition.
U-2	Used property, more worn than U-1 but still in good condition with considerable use left before any important repairs would be required.
U-3	Used property which is still in fair condition and usable without repairs; however, somewhat deteriorated, with some parts (or portion) worn and should be replaced.
U-4	Used property which is still usable without repairs but in poor condition and undependable or uneconomical in use. Parts badly worn and deteriorated.
B-1	Used property, still in excellent condition, but minor repairs required (estimated repairs would cost no more than 10% of acquisition cost).
B-2	Used property in good condition but considerable repairs required. Estimated cost of repairs would be from 10% to 20% of acquisition cost.



- R-3.....Used property, in fair condition, but extensive repairs required. Estimated repair costs would be from 26% to 40% of acquisition cost.

- R-4.....Used property, in poor condition, and requiring major repairs. Badly worn, and would still be in doubtful condition of dependability and uneconomical in use if repaired. Estimated repair costs between 41% to 65% of acquisition cost.

- E.....Salvage. Personal property that has some value in excess of its basic material content but which is in such condition that has no reasonable prospect of use for any purpose as a unit (either by the holding or any other Federal agency) and its repair or rehabilitation for use as a unit (either by the holding or any other Federal agency) is clearly impractical. Repairs or rehabilitation estimated to cost in excess of 65% of acquisition cost would be considered "clearly impractical" for purposes of this definition.

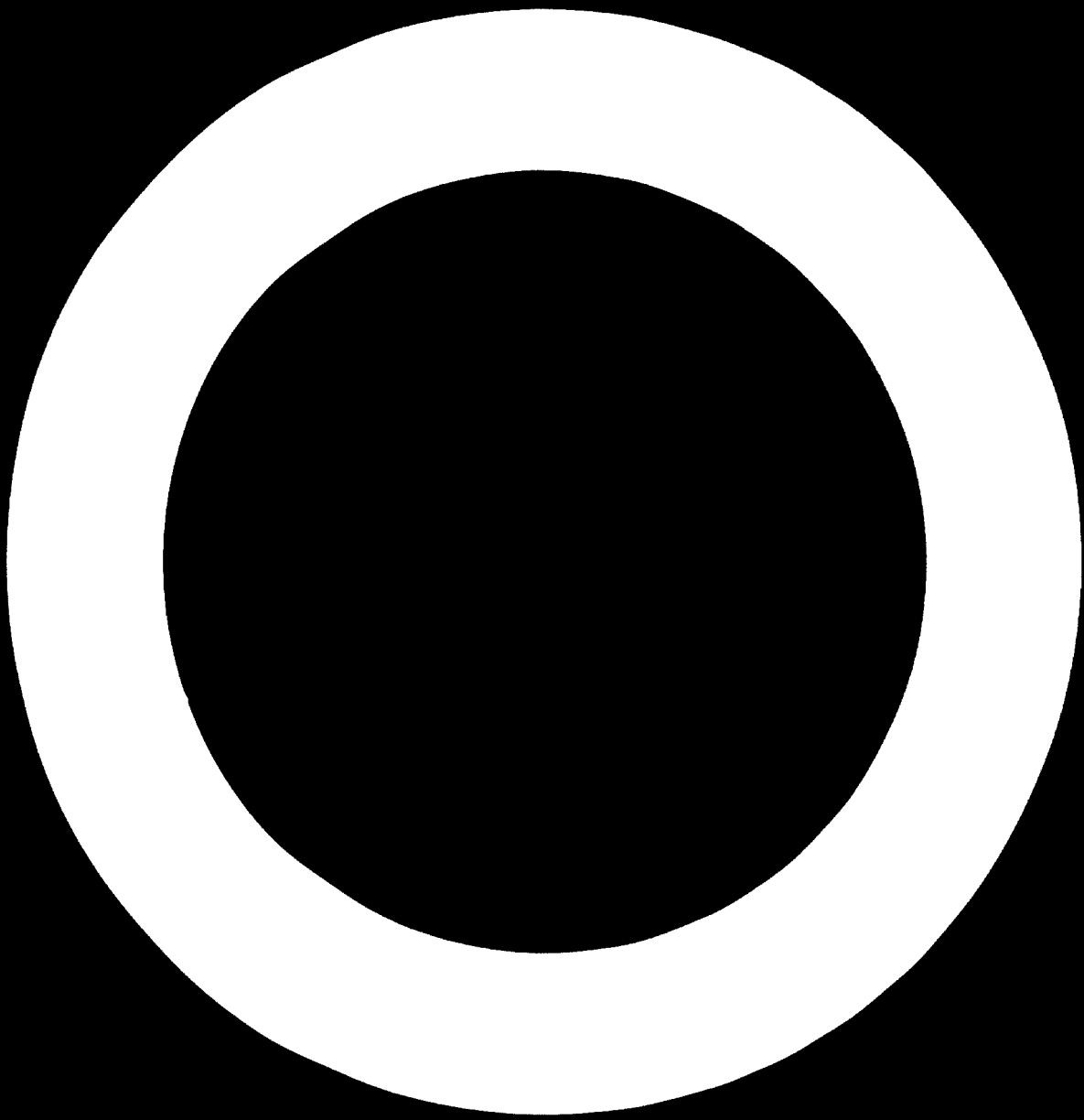
- Scrap....Material that has no value except for its basic material content.

II. AID COMMODITY CODES

AID Commodity Code	Description
500	Domestic U.S. Government-owned excess property
510	Foreign U.S. Government-owned excess property

III. NUMERICAL LISTING OF FEDERAL SUPPLY GROUPS

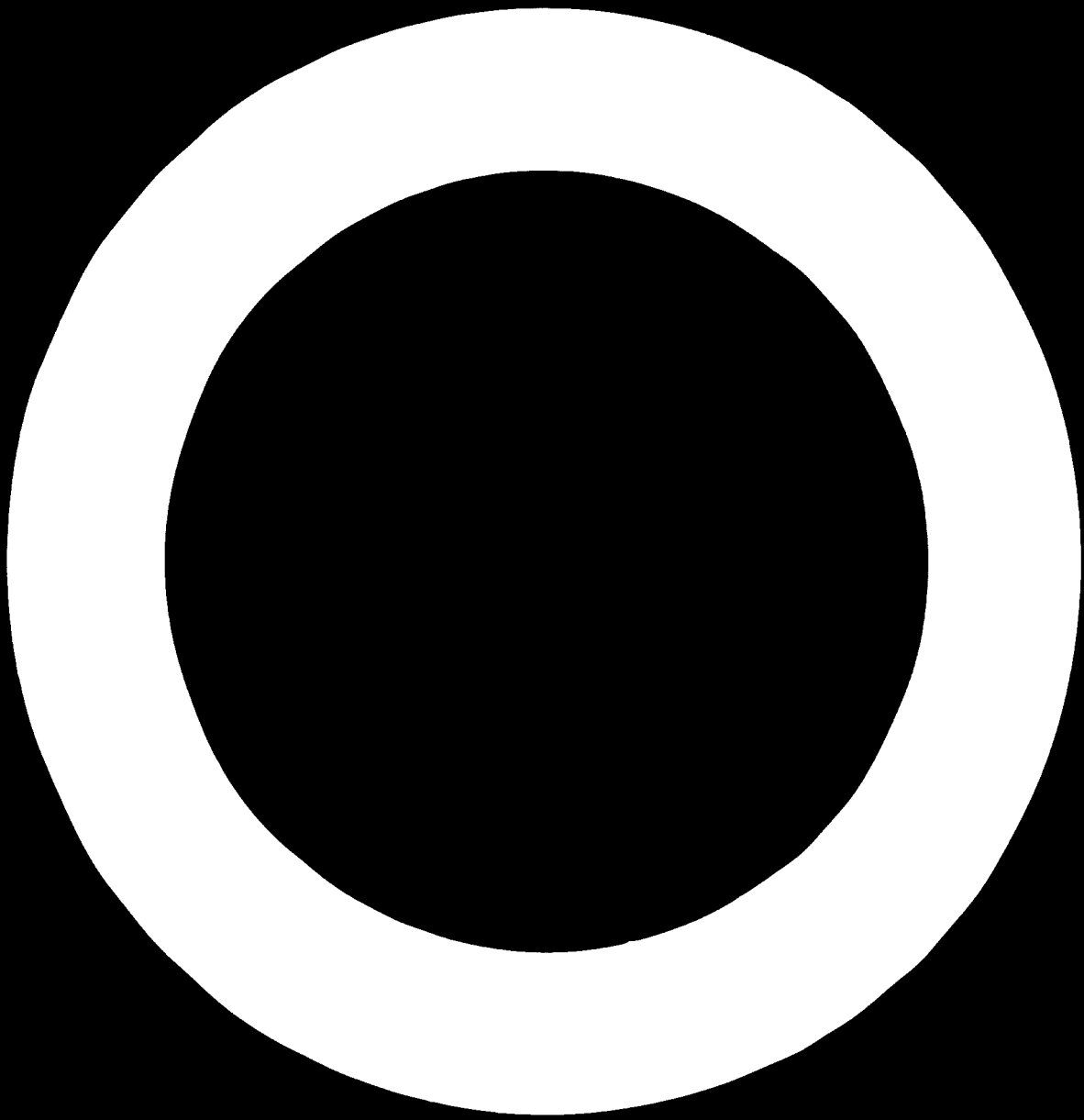
Description	Federal Supply Group
Weapons	10
Nuclear Ordinance	11
Fire Control Equipment	12
Ammunition and Explosives	13
Guided Missiles	14
Aircraft; and Airframe Structural Components	15
Aircraft Components and Accessories	16
Aircraft Launching, Landing, and Ground Handling Equipment	17
Space Vehicles	18
Ships, Small Craft, Pontoons, and Floating Docks	19
Ship and Marine Equipment	20
Unassigned	21
Railway Equipment	22
Motor Vehicles, Trailers, and Cycles	23
Tractors	24
Vehicular Equipment Components	25
Tires and Tubes	26
Unassigned	27
Engines, Turbines, and Components	28
Engine Accessories	29
Mechanical Power Transmission Equipment	30
Bearings	31
Woodworking Machinery and Equipment	32
Unassigned	33
Metalworking Machinery	34
Service and Trade Equipment	35
Special Industry Machinery	36
Agricultural Machinery and Equipment	37
Construction, Mining, Excavating, and Highway Maintenance Equipment	38



For export, the inspection described above may be made for major components and complete plants but is seldom used for individual pieces of equipment.

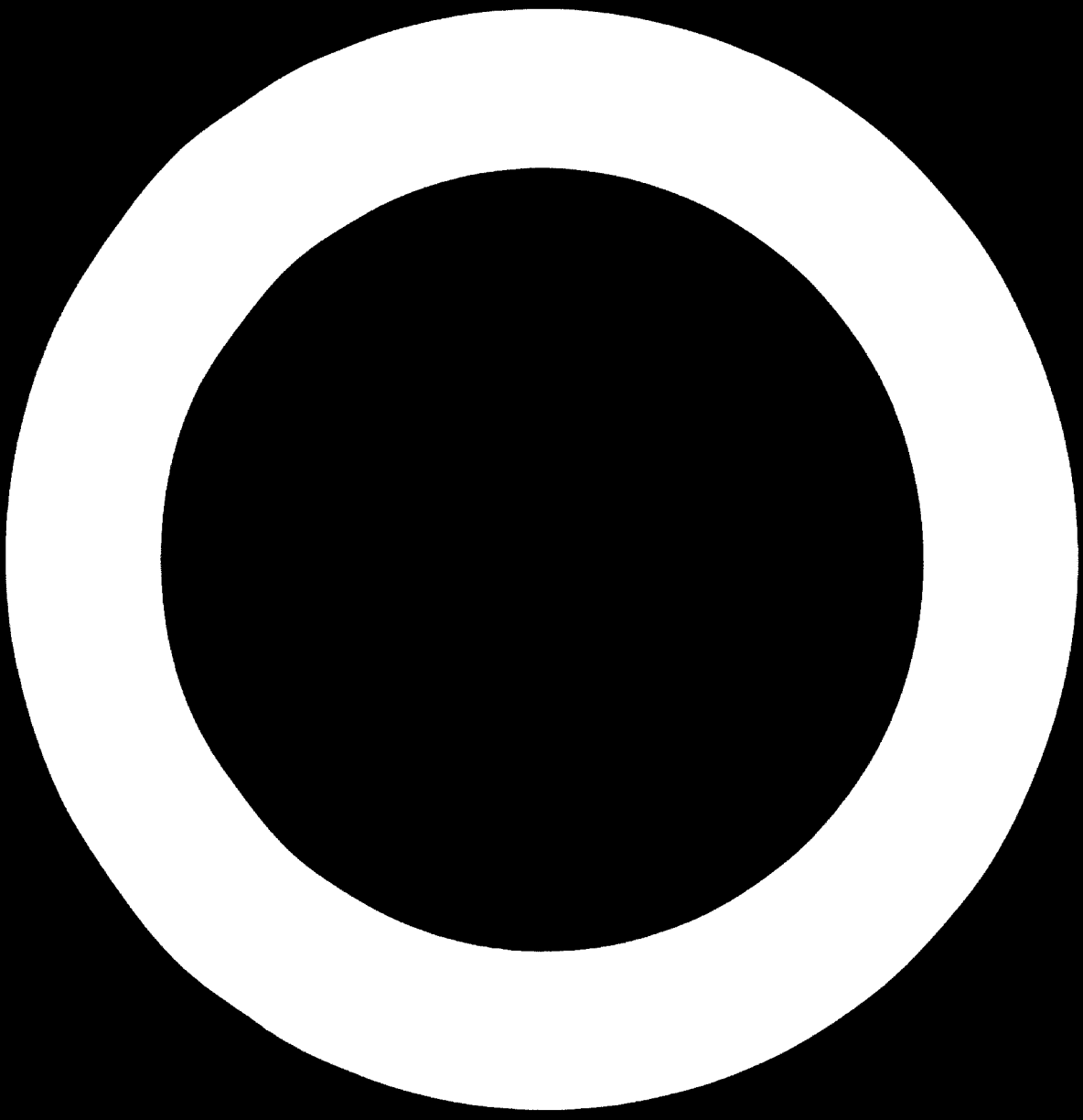
Appraisal. A number of qualified firms specialize in the appraisal of industrial equipment. The valuation is based on both the U.S.A. market price and on the original cost minus depreciation. Where they differ, it is the appraisers job to reconcile them. No appraisal is made or required for the domestic trade. For export, only in case of major components and complete plants is an independent appraisal sometimes obtained. A few of the major appraisal companies include the American Appraisal Co., Inc., Consolidated Appraisal Co. inc., Fidelity Appraisal Co. Inc., Industrial Appraisal Co., Keystone Appraisal Co., The Lloyd Thomas Co., Manufacturers Appraisal Co., and Marshall & Stevens Inc.

Repair. Second hand equipment is sold as is, rebuilt or somplace in between. As is implied, no repairs have been made. Rebuilt equipment is almost equal to the original in accuracy and sometimes better in other respects. However, in general, rebuilt U.S.A. equipment costs 65 to 75 percent of the price of new U.S.A. equipment and 80 to 100 percent of the price of new equipment from Japan and Europe. Individual pieces of standard rebuilt second hand equipment have lost their margin of advantage over new equipment. The term overhaul is used to designate



repairs that put the equipment in good operating condition with no repairs required after overhaul and considerable use left before any important repairs are required. Inspection should assign a condition code to equipment only after repairs are completed.

Spares, Accessories, and Motors. Operating difficulties due to lack of spare parts have already been discussed. A supply of spare parts is usually exported with new equipment. For second hand, this may be done for major components and complete plants but seldom for individual pieces of equipment. Some accessories are absolutely necessary for the operation of the machine, others are necessary for performing specific types of work, still others make the machine faster or more automatic. Since accessories may be even more difficult to obtain than spare parts, it is essential that accessories be selected as carefully as the machine itself. The next page lists the necessary accessories for a few common machine tools. Motors are usually supplied with second hand equipment in domestic trade. In export trade, electric motors are usually omitted because of the differences in electric current. It is easier to purchase these motors locally than in the U.S.A. In a few cases, it is economical to rewind motors in the developing countries for local requirements.



LIST OF NECESSARY ACCESSORIES

1. ENGINE LATHE - 10" to 16" swing
   a. Work holding chuck
   b. Cutting tool post and tool holder
   c. Centers
   d. Face plate
   e. Steadyrest work support

2. CHUCKING TYPE TURRET LATHE
   a. Work holding chuck
   b. Plain tool holders
   c. Plunge mounted tool holders
   d. Plunge mounted slide tool holders
   e. Cross slide square turret tool holders
   f. Tool holder bushings
   g. Multiple turning head

3. BAR TYPE TURRET LATHE
   (Hand Screw Machine)
   a. Work holding collet chuck
   b. Work holding end bar feed collets
   c. Plunge mounted tool holders
   d. Plunge mounted slide tool holders
   e. Tool holders
   f. Cross slide square turret tool holders
   g. Rear slide cut-off tool holder
   h. Tool holder bushings
   i. Backrest turners
   j. Die heads
   k. Centering tool
   l. Boring bar holders
   m. Bar supports and bar feed mechanism
   n. Drill chuck
   o. Reamer holder

4. PLAIN MILLING MACHINE, #2
   a. Milling cutter holders (arbor assem.)
   b. Milling cutter holders (adapters, collets)
   c. Work holding vise
   d. Work holding clamps
   e. Arbor supports

5. HAND MILLING MACHINE
   (Same as #4)

6. VERTICAL MILLING MACHINE, #2
   a. Cutter holders (adapters & collets)
   b. Rotary work table (optional)
   c. Work holding vise
   d. Work holding clamps

7. UNIVERSAL MILLING MACHINE, #2
   (Same as #4 and dividing head - tailstock - drive mechanism & change gears)

8. DRILL PRESS - UPRIGHT
   a. Drill chuck
   b. Work holding vise
   c. Work holding clamps

9. RADIAL DRILL
   a. Drill chuck
   b. Work table
   c. Work holding clamps
   d. Work holding vise

10. SHAPER
   a. Tool holder post
   b. Work holding vise

11. PRODUCTAL SURFACE GRINDER
   (Rotary planer)

12. UNIVERSAL TOOL AND CUTTER GRINDER
   a. Cutter holding workhead
   b. Tailstock
   c. Head and tailstock centers
   d. Cutter holding chuck
   e. Face mill holding chuck

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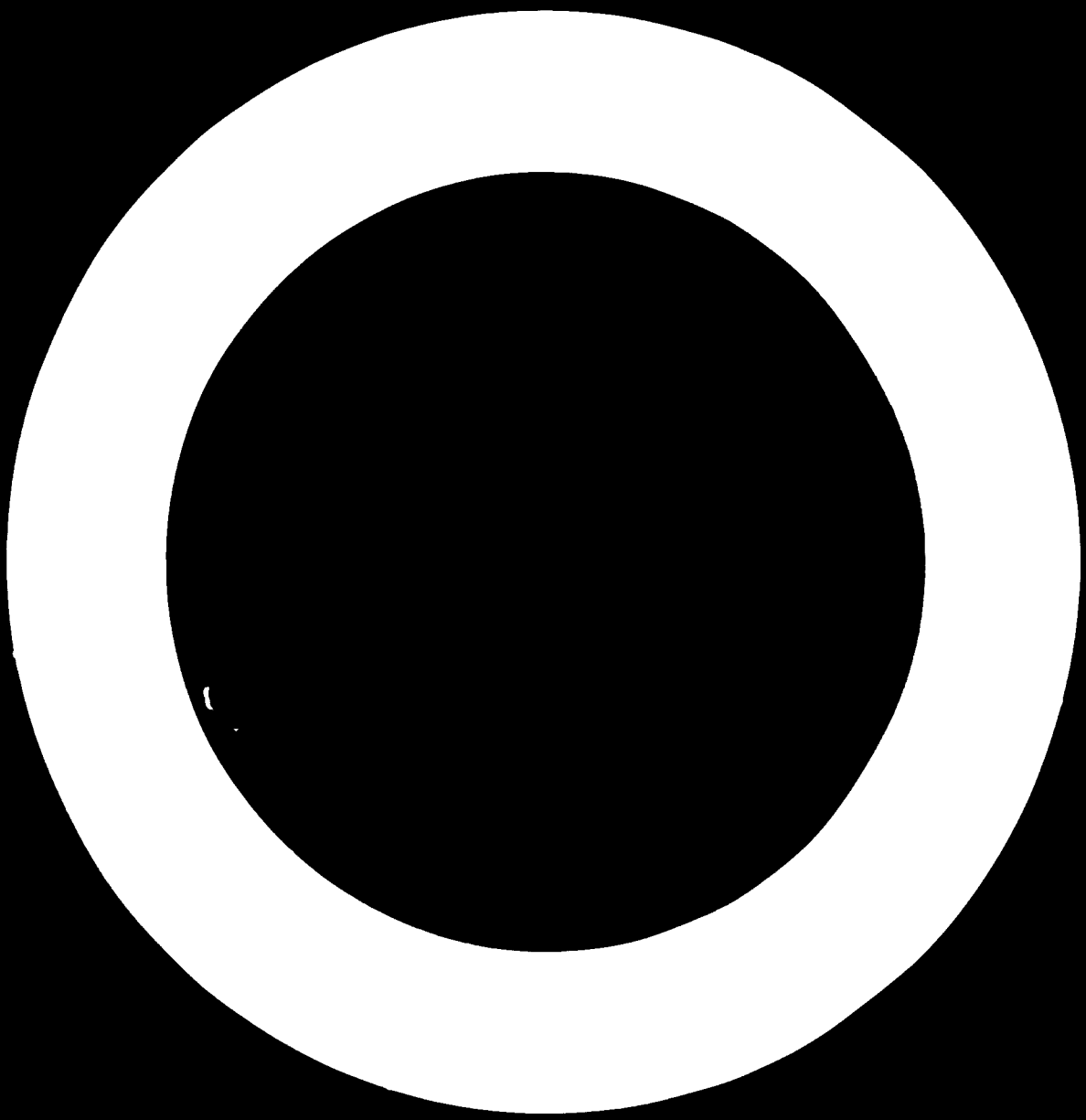
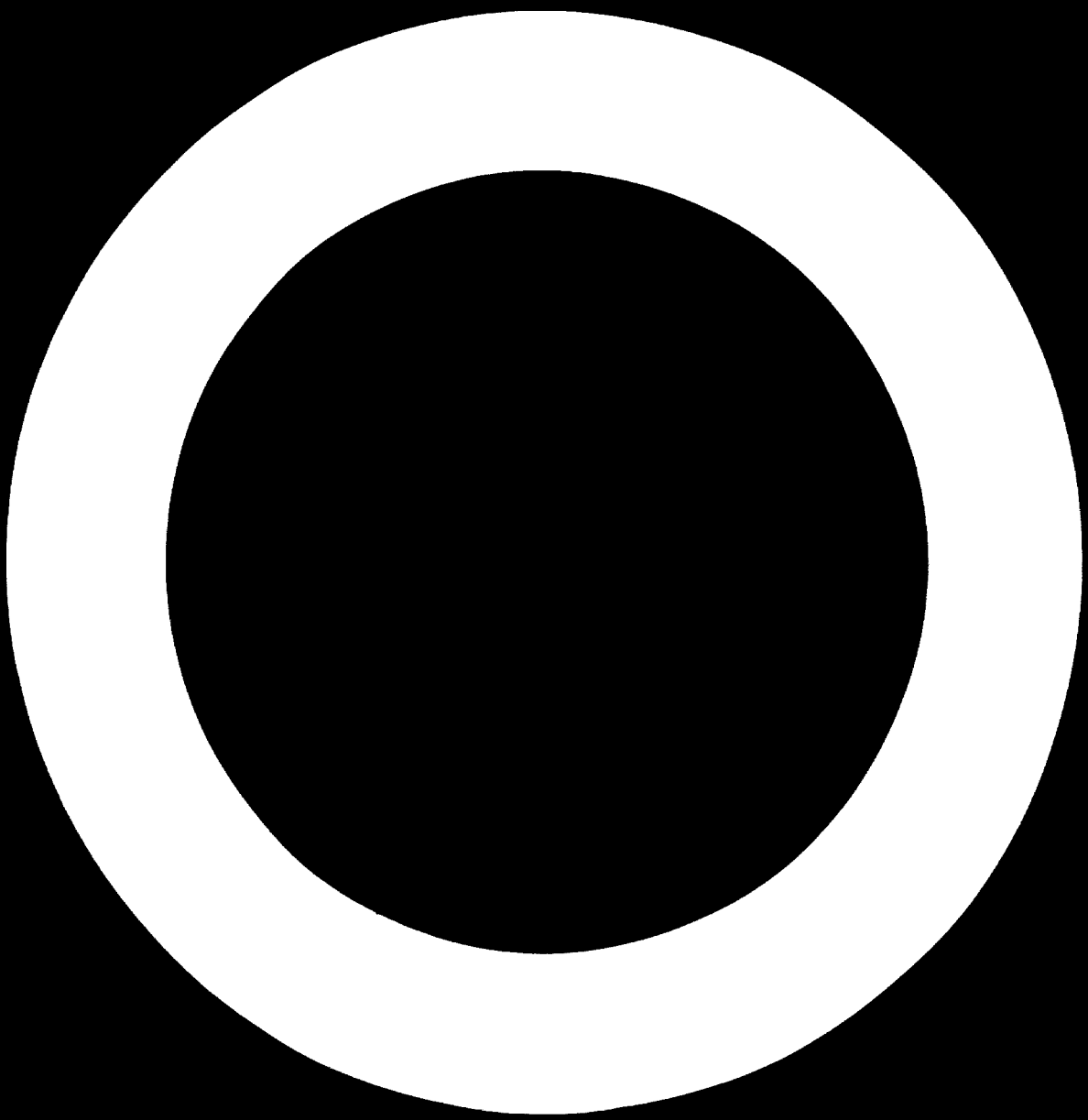
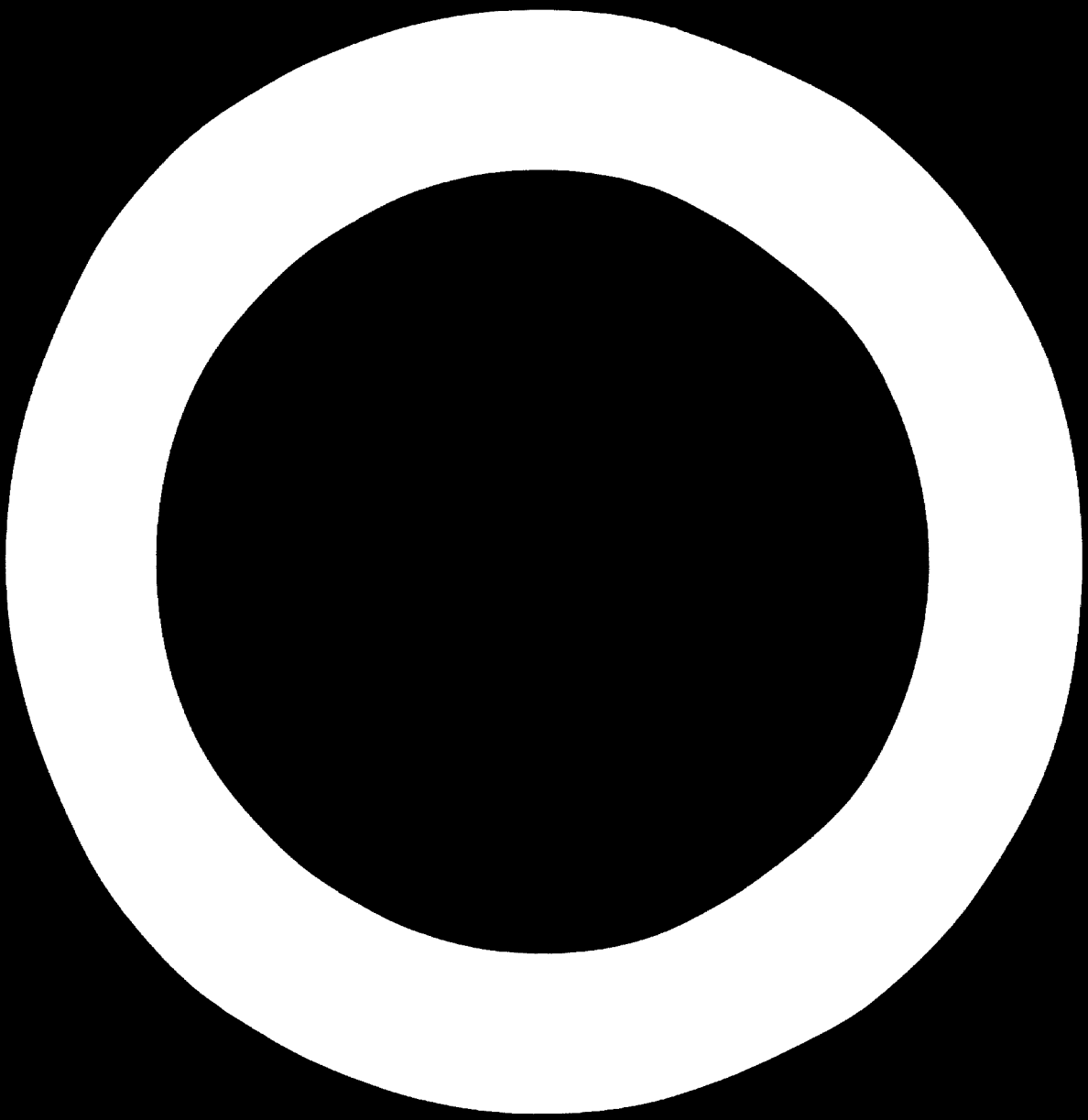


Know-how. For individual pieces of equipment transfer of know-how consists at best of the original manufacturer's instruction and parts manual. For a major component, the buyer's production engineer will be brought to the U.S.A. or the exporter will send a man to install, operate, and maintain the equipment for a limited period of time. For a complete plant, an engineering firm may be hired on a turnkey basis with training of local staff provided for in the contract or the entire supervisory staff will be sent for training to a similar plant which is in operation. The transfer of know-how is superior only in case of individual pieces of new equipment where equipment manufacturers frequently have overseas representatives who assist in installation, operation, maintenance, and training.

Service and Guarantees. With few exceptions, no guarantee or service arrangements are made in export of individual pieces of equipment. For major components, even when a guarantee is provided the servicing arrangements may be haphazard. If a breakdown occurs, the buyer will be asked to make the repair himself and charge the exporter. Next, the exporter may hire a local machinery firm to make the repair, only as a last resort will the exporter send his own staff to make good the guarantee. The exporters servicing responsibilities end with the expiration of the guarantee. For both individual pieces



and major components, new equipment manufacturers generally provide service on a continuous basis. For complete plants, both new and second hand, a turnkey contract may fix thecontractor's responsibility for maintenance of the equipment for a period of time.



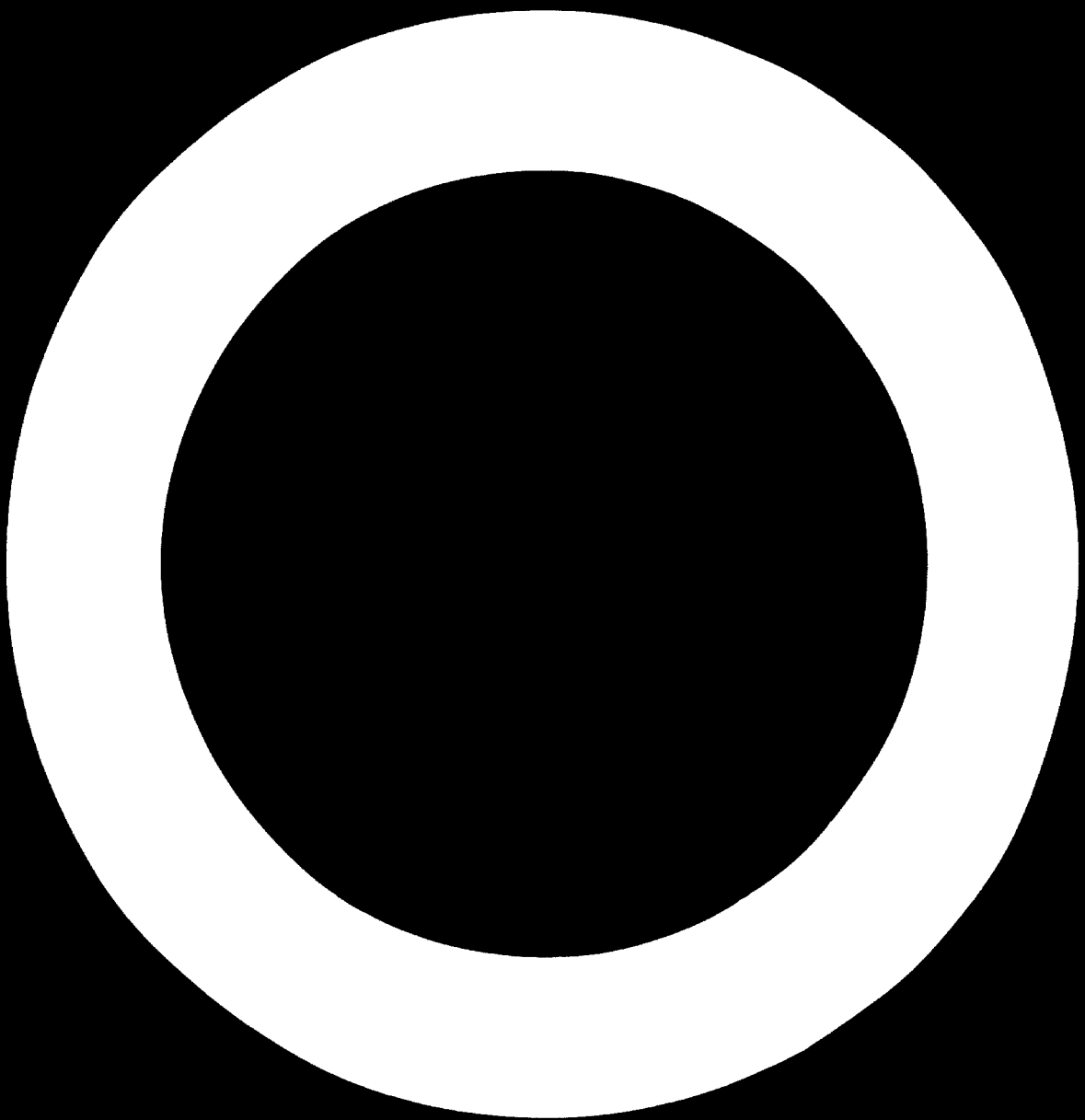
5.6 Conclusion: Mechanisms of Transfer

Individual units of equipment are less reliable and therefore have higher operating costs largely because of poor functioning mechanisms of transfer. No single organization assumes responsibility for selecting the proper machine for the job, determining its condition, providing spares, training personnel, installation and servicing.

Major components are more reliable in performance due to better operation of mechanisms of transfer. Only in service after installation are arrangements for new equipment superior. Expansion in this trade is held back by inadequate credit facilities, government restrictions, and inadequate information about sources.

Complete plants: Except for rare dealer activity, no mechanisms exist for locating or assembly of complete second hand plants to match the demand in developing countries. In fact, only large corporations have used the concept to set up and equipt their subsidieries in developing countries.

Transfer of second hand equipment to developing countries is in the hands of dealers who are reluctant to accept the fact that all transfer of equipment should be accompanied by transfer of know-how.



Conclusions and Recommendations

6.1 Conclusions

Supply

The second hand market can potentially supply some 80 percent of all demand for capital equipment in the developing countries.

The pace of technological innovation in industrially advanced countries assures the supply will continue in the near future.

Standard equipment is almost always available on the second hand market but it is a less reliable source of heavy or special equipment.

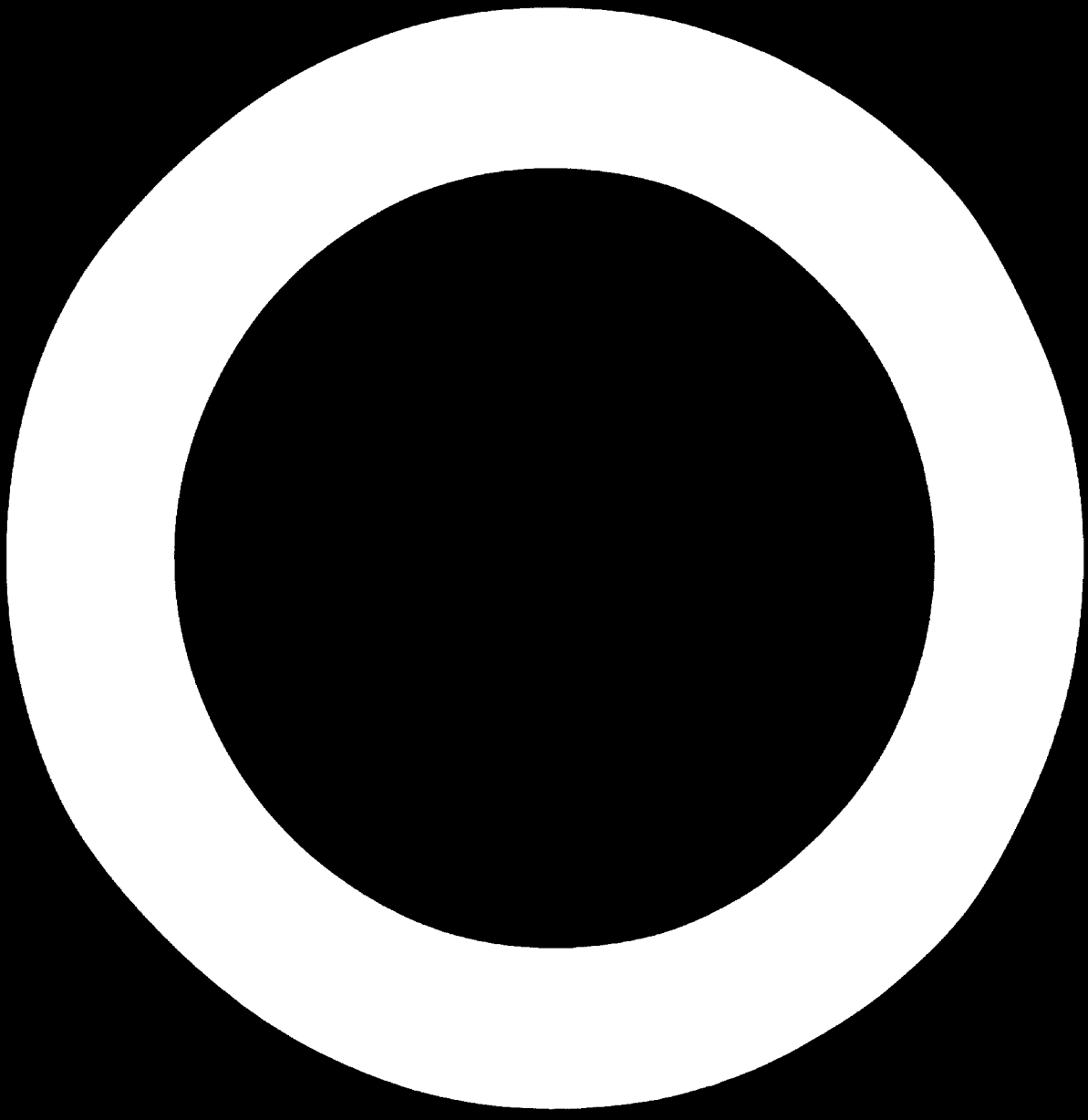
Net Cost

A method for determining the net cost of second hand and new equipment in any given case is available.

Rebuilt standard equipment has an insufficient aquisition cost advantage over new equipment.

Second hand equipment in good operating condition has higher operating costs than new equipment that are overcome by lower aquisition costs only in developing countries with good facilities for repair and making of spare parts.

Heavy or special equipment both rebuilt and in good operating condition has considerable aquisition cost advantage and small operating cost disadvantage vis-a-vis new equipment.



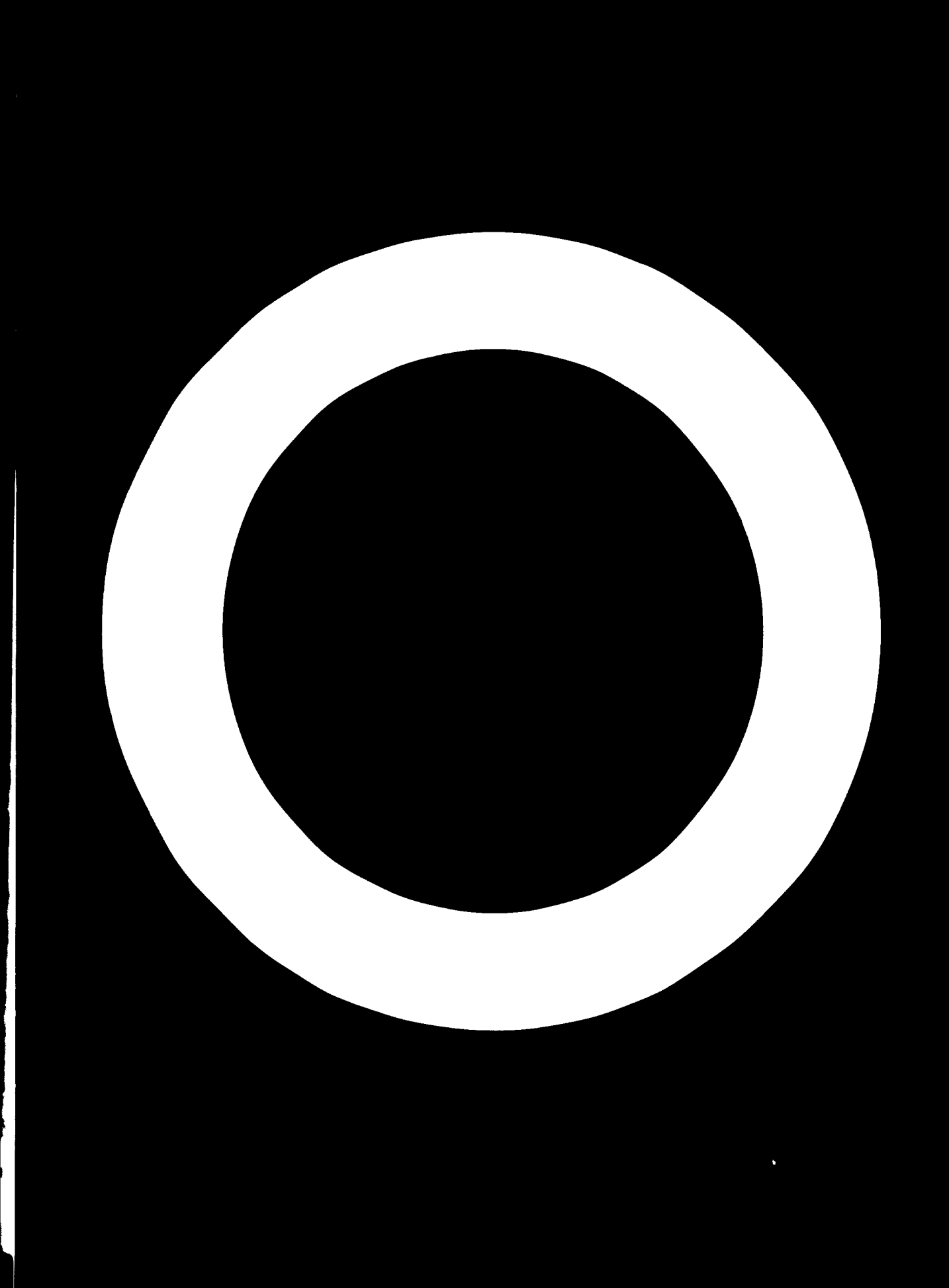
Properly engineered complete plants of second hand equipment have considerable equisition cost advantages and small operating cost disadvantages compared with new equipment.

Mechanisms of Transfer

Malfunction of mechanisms of transfer such as selection of equipment, determining its condition, providing spares, training personnel, installation, and servicing are responsible for lower reliability and higher operating costs of standard units of equipment in good operating condition. No single organization assumes responsibility for these functions.

Only in service after installation are mechanisms of transfer superior for new major components of equipment than for second hand.

Expansion of trade in major components is held back by poor financing facilities, government restrictions, and inadequate information about sources. There is no trade in complete second hand plants because no mechanism exists for locating and transfer of plants for which a demand exists in the developing countries.



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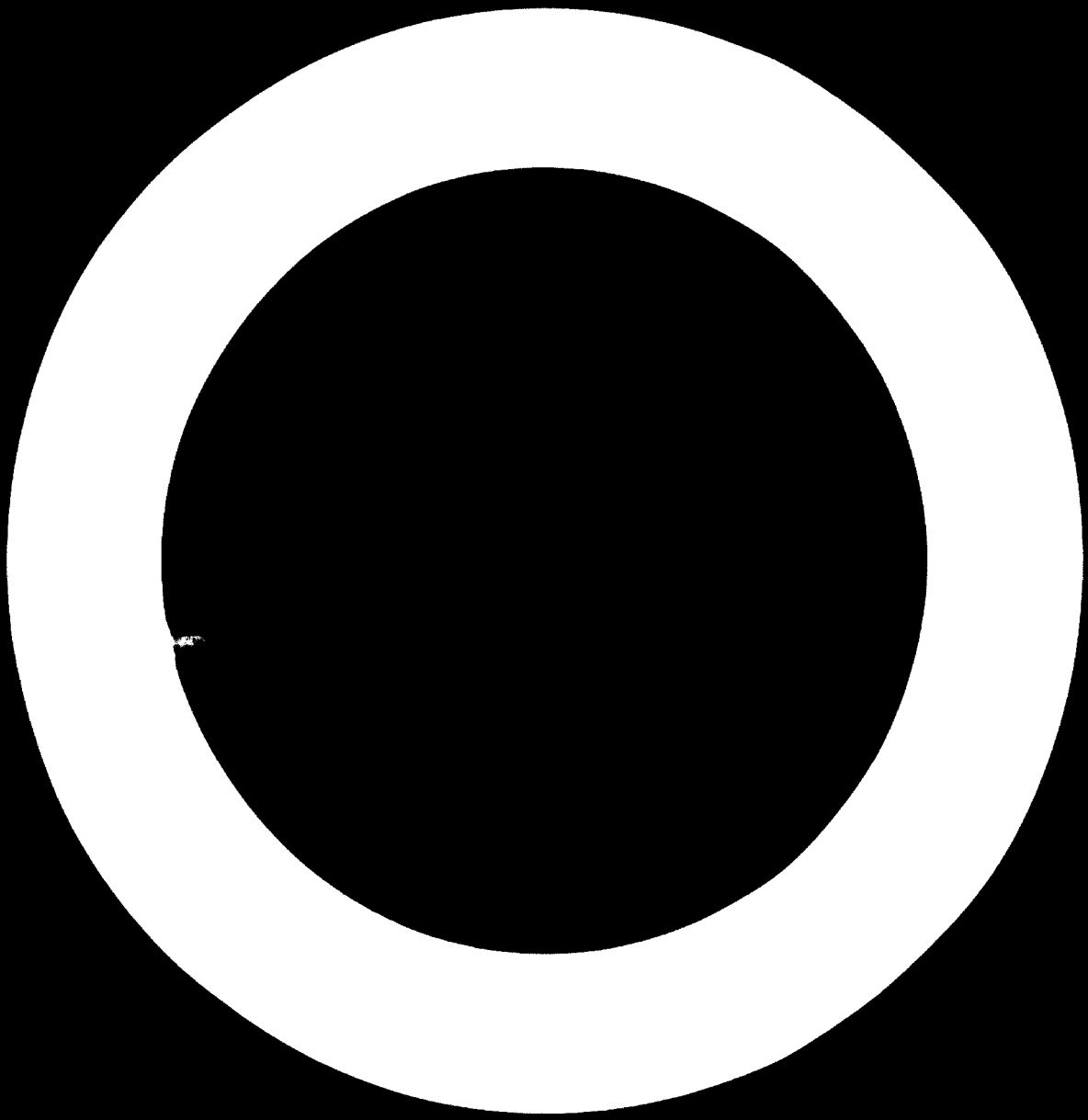
Policies

1. Import of second hand equipment should be subject to regulation but no blanket prohibition should be imposed.

2. The import of individual pieces of second hand equipment should be actively encouraged only when available at no cost.

3. Import of second hand major components and complete plants should be actively encouraged by improving the mechanisms for its location and transfer.



Actions by Developing Countries

1. All imports of second hand equipment should be accompanied by certificate listing.

   a. serial number, model, and year of manufacture (should be manufactured after fixed date)

   b. name and address of manufacturer (manufacturer should still be in business, number of models should be limited to achieve equipment standardization)

   c. classification by independent inspection (only condition codes N1, N2, E1, E2, O1, and O2 should be acceptable)

   d. valuation by independent appraiser

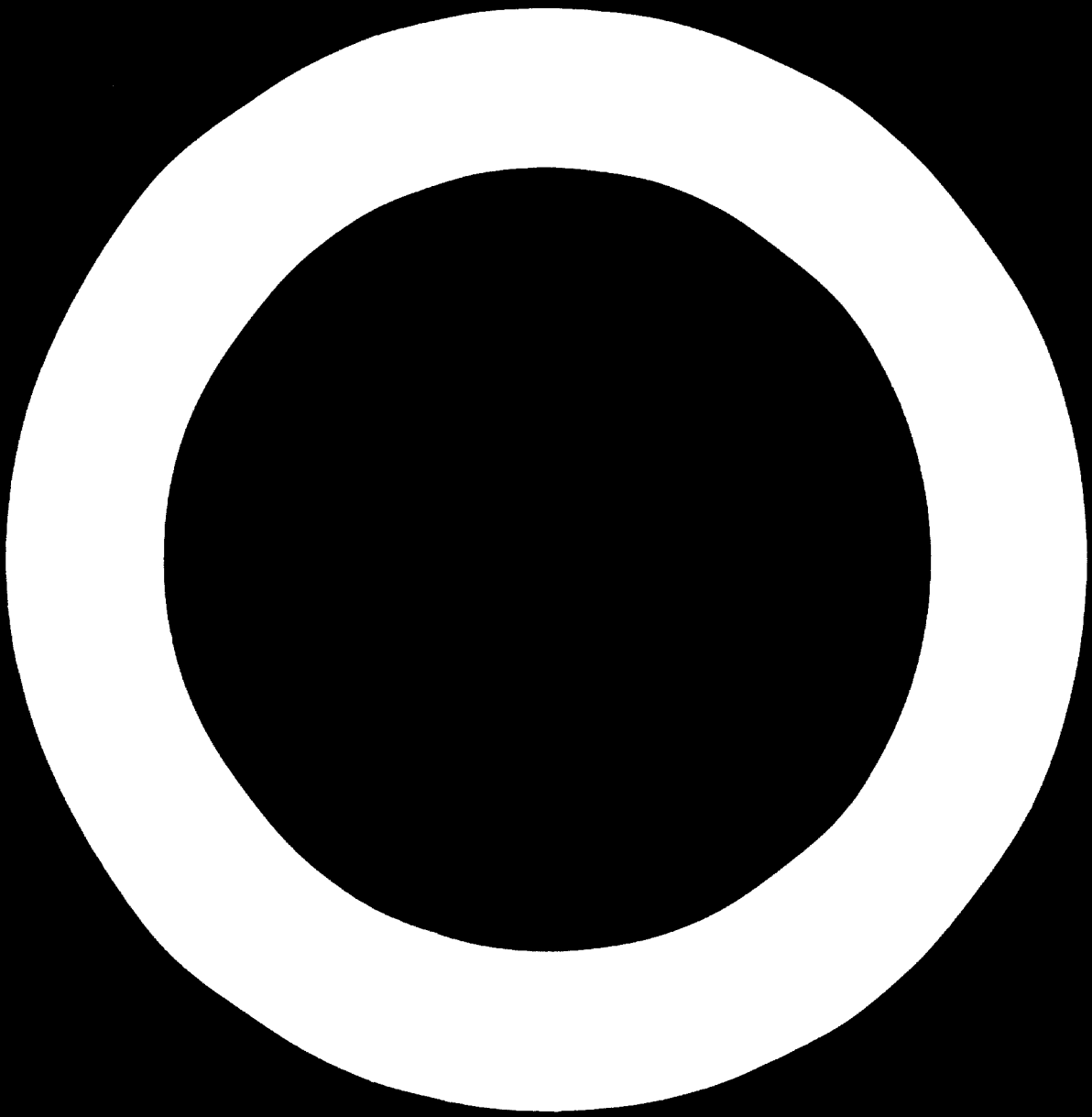
   e. provision of operating instructions, installation instructions, and parts manual of original manufacturer or equal

   f. provision of spare parts, accessories, and electrical motors, if any

   g. proposed end use

2. Imports of heavy or special and complete plants should be accompanied by an economic analysis comparing new and second hand equipment.

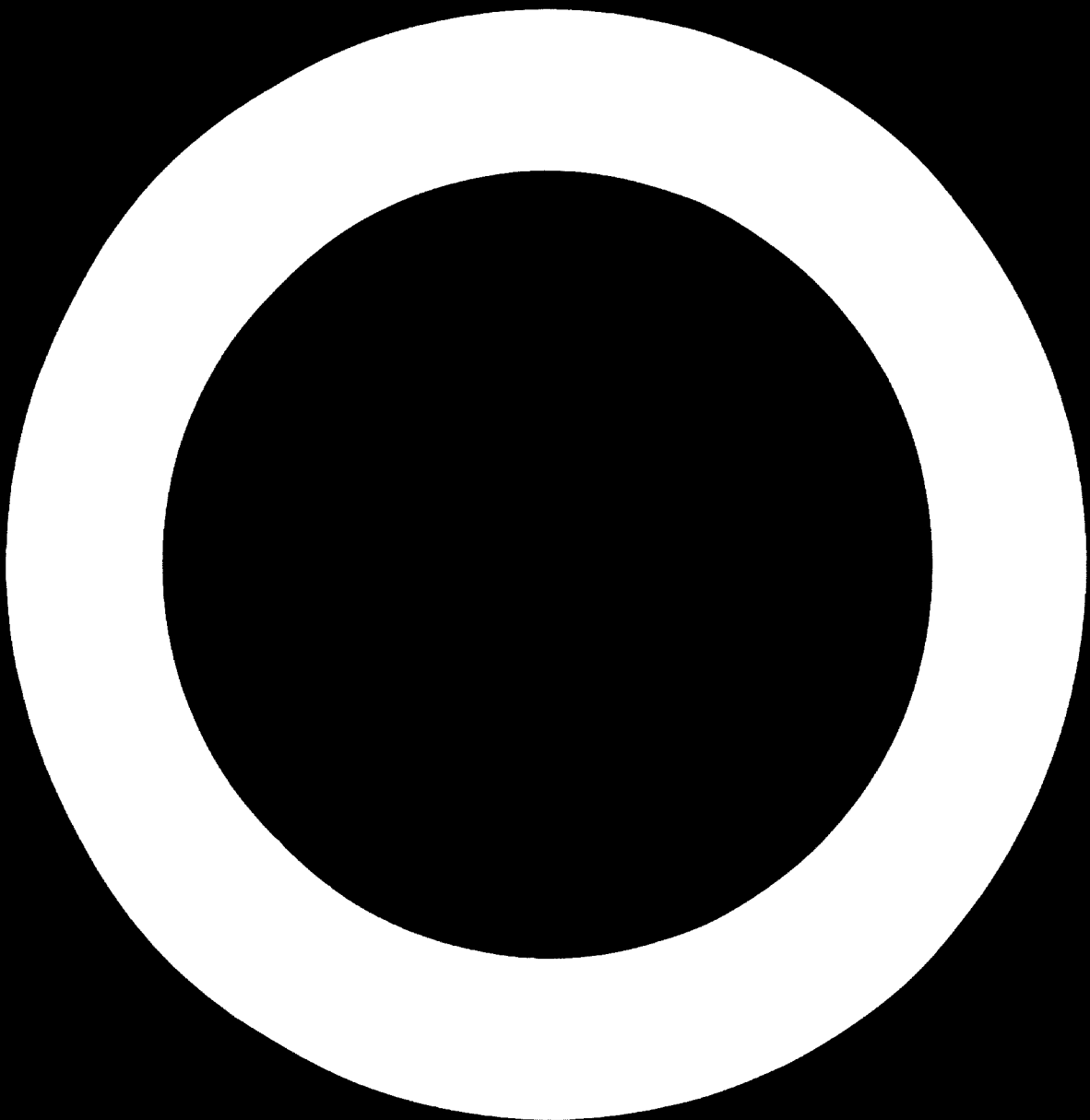
3. Development Banks and Industrial Development Corporations may require the use of second hand equipment



as an alternate in bids for industrial projects. The Development Bank or Industrial Development Corporation should be prepared to provide names of second hand suppliers to be invited to submit bids. These bidders are to meet the same specifications as new equipment suppliers.

4. The technical and vocational education departments should expand their facilities by addition of second hand equipment available at no cost. The selection, overhaul, spare parts, crating, etc., to be arranged by a working party of the departments concerned or by an engineering firm on a contract basis.

5. The Industrial Development Corporations should expand existing and establish additional repair and machine shops. These shops should be equipped with second hand equipment leased from the Industrial Development Corporation, and obtained at no cost. The selection, overhaul, spare parts, installation and training of personnel to be arranged by an engineering firm on a contract basis.



Actions by International Organizations

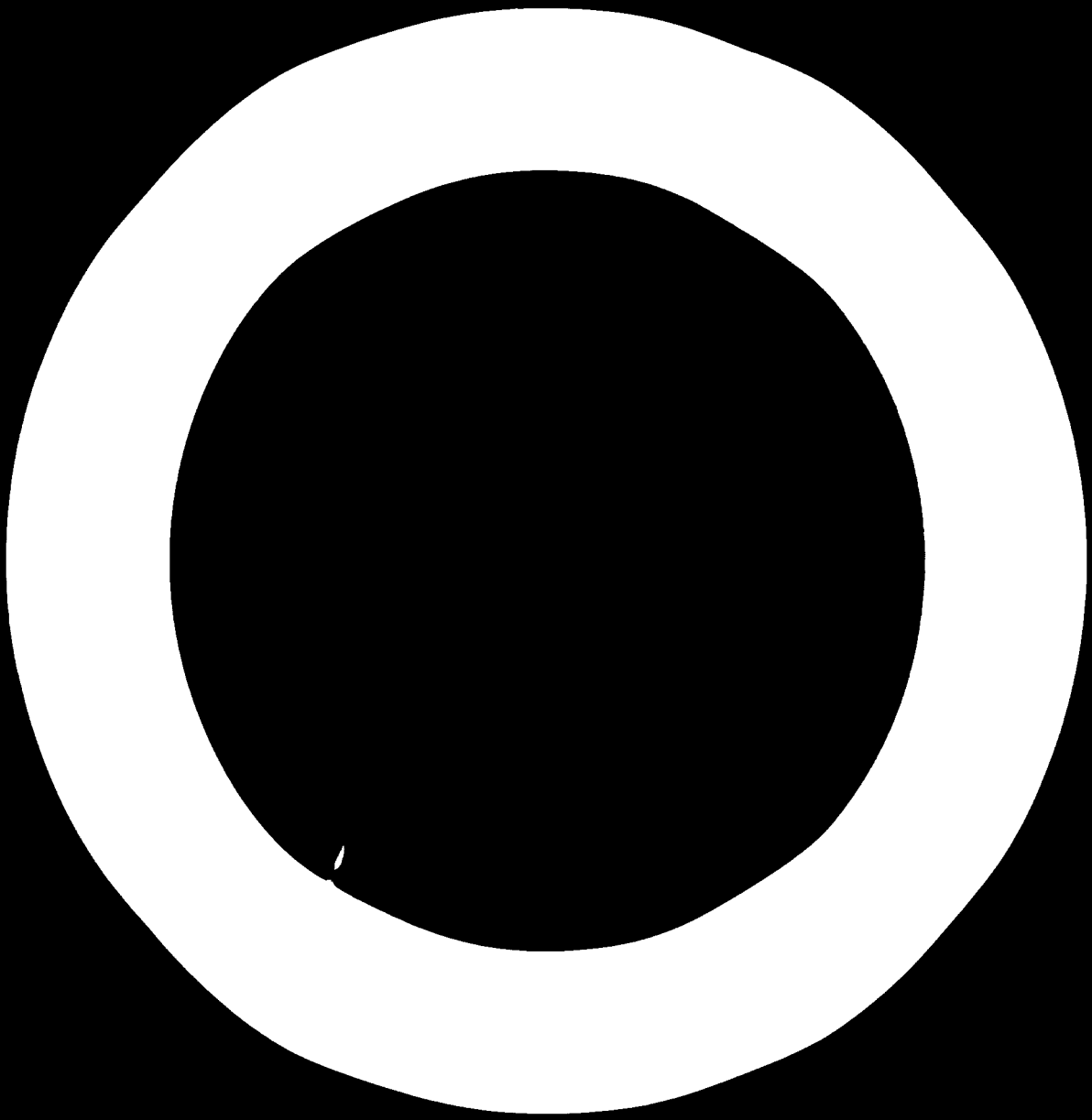
1. The United Nations should provide experts to assist in preparation of industrial feasability and economic analysis studies when requested by Development Banks and Industrial Development Corporations.

2. The United Nations should organize a meeting of national Development Banks, Industrial Development Corporations, The World Bank, interested foundations, and others to encourage their sponsorship of a non-profit Industrial Cooperation Bureau. The functions of the Bureau should include:

a. promoting in developed countries, joint ventures involving transfer of both know-how and new or second hand equipment for projects approved by national Industrial Development Corporations or their equals in the developing countries.

b. Prepare lists of engineering firms and dealers to bid for major components and complete plants on turnkey basis using second hand equipment. These lists to be supplied to national Industrial Development Corporations and Banks.

c. Purchase of second hand major components and complete plants for the account of national Industrial Development Corporations from "shopping list" provided by these corporations. The plants to be put into operation by engineering firms on turnkey basis.



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2. All data on demand based on "Projection of Demand for Industrial Equipment" cited above.

3. Letter to Centre for Industrial Development from Deutsche Gesselschaft fur Wirtschaftliche Zusammenarbeit December 3, 1963

4. International Management, March 1963

5. Cited in "American Industry's Potential for Providing Used Machinery and Technical Assistance for Developing Countries" The Economist Intelligence Unit Limited, New York, 1962

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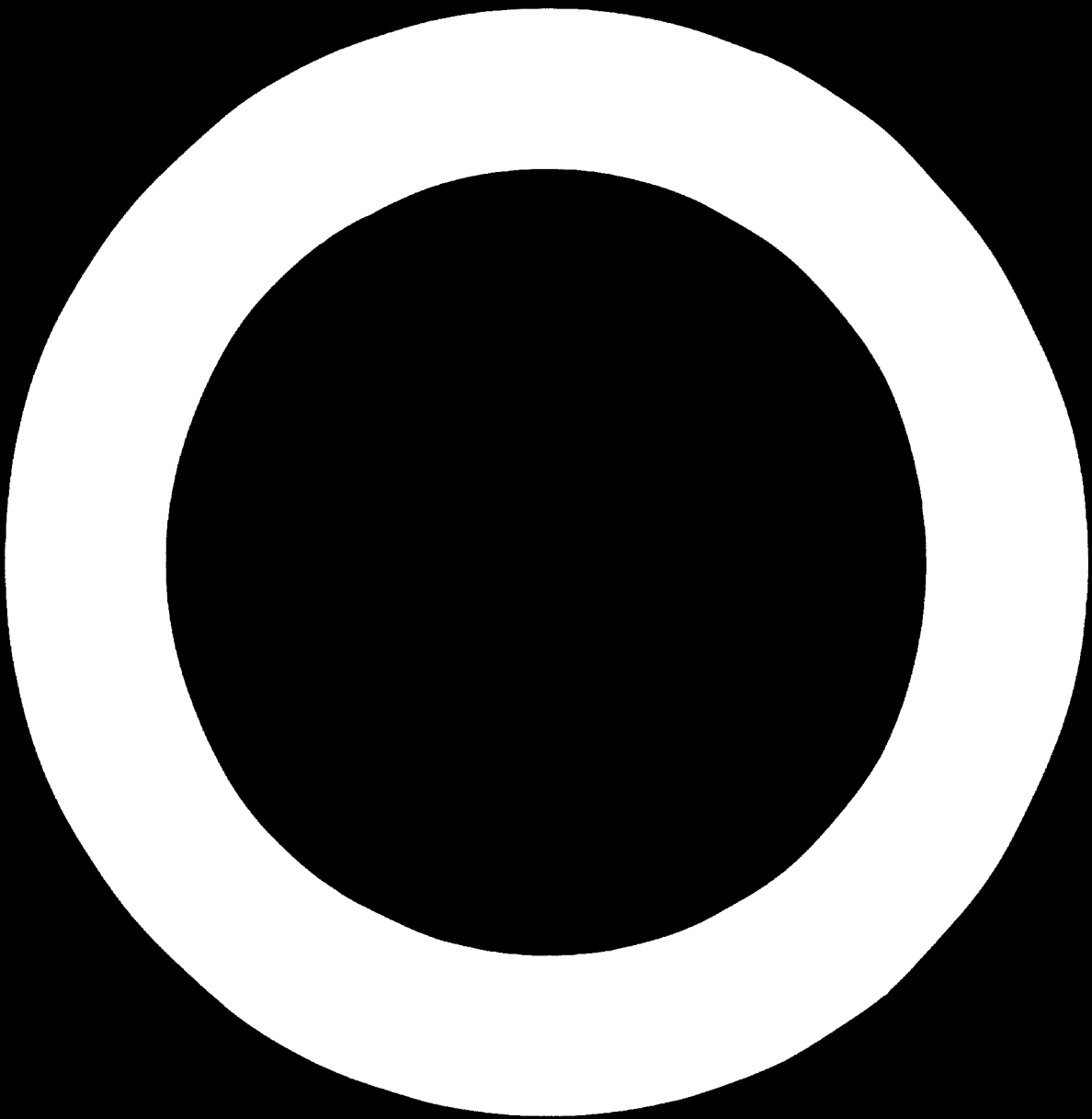

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10. The Failure Record Through 1964. Dun and Bradstreet, Inc. 1965

11. Based on Enclosure to letter from Col. S.F. Langley Defense Supply Agency, Defense Plant Equipment Center, Memphis, Tenn.
Dated September 10, 1965. The enclosure is included in attachment "B"

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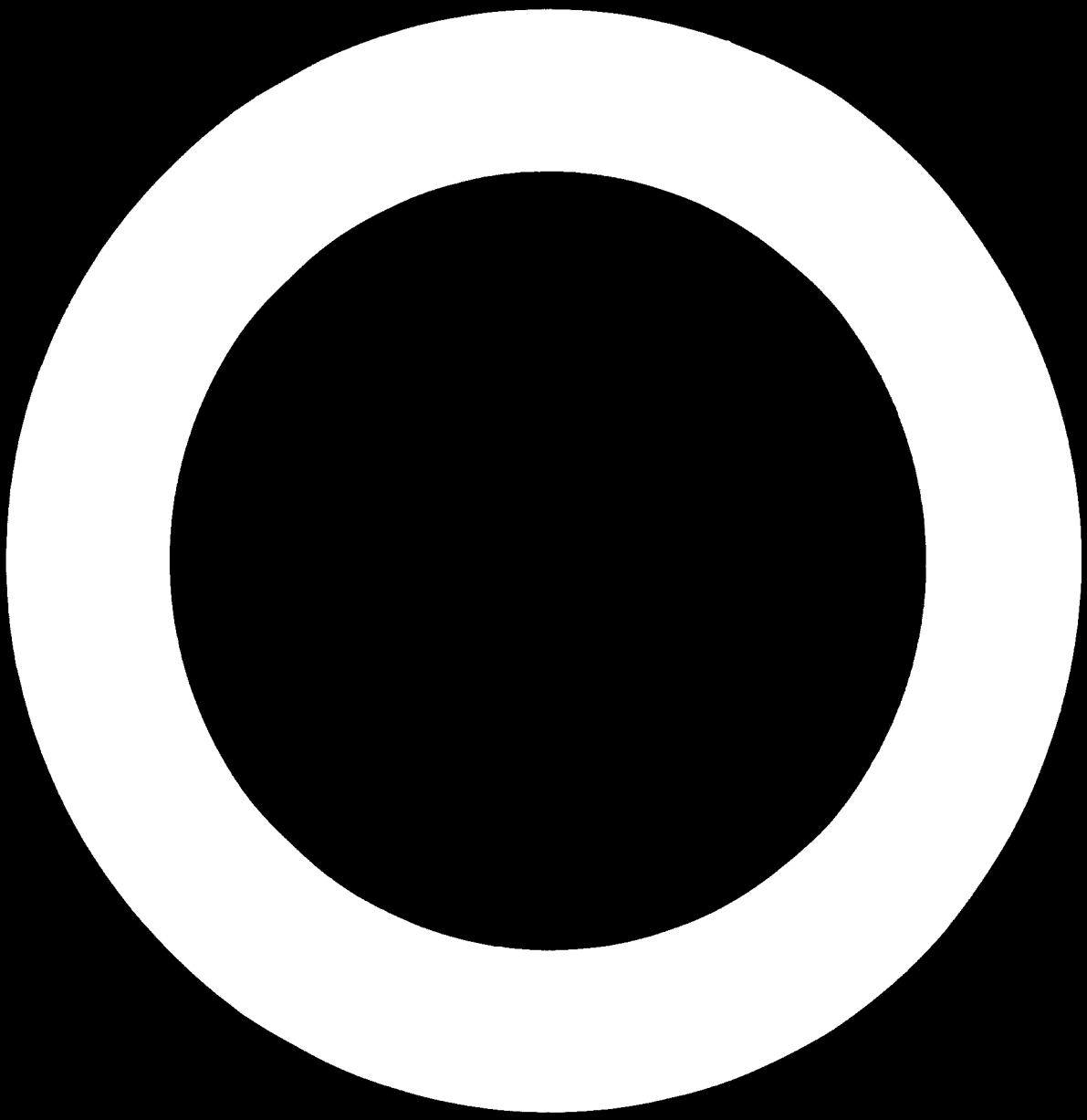

15. Dynamic Equipment Policy, George Terborgh, Machinery and Allied Products Institute, Washington

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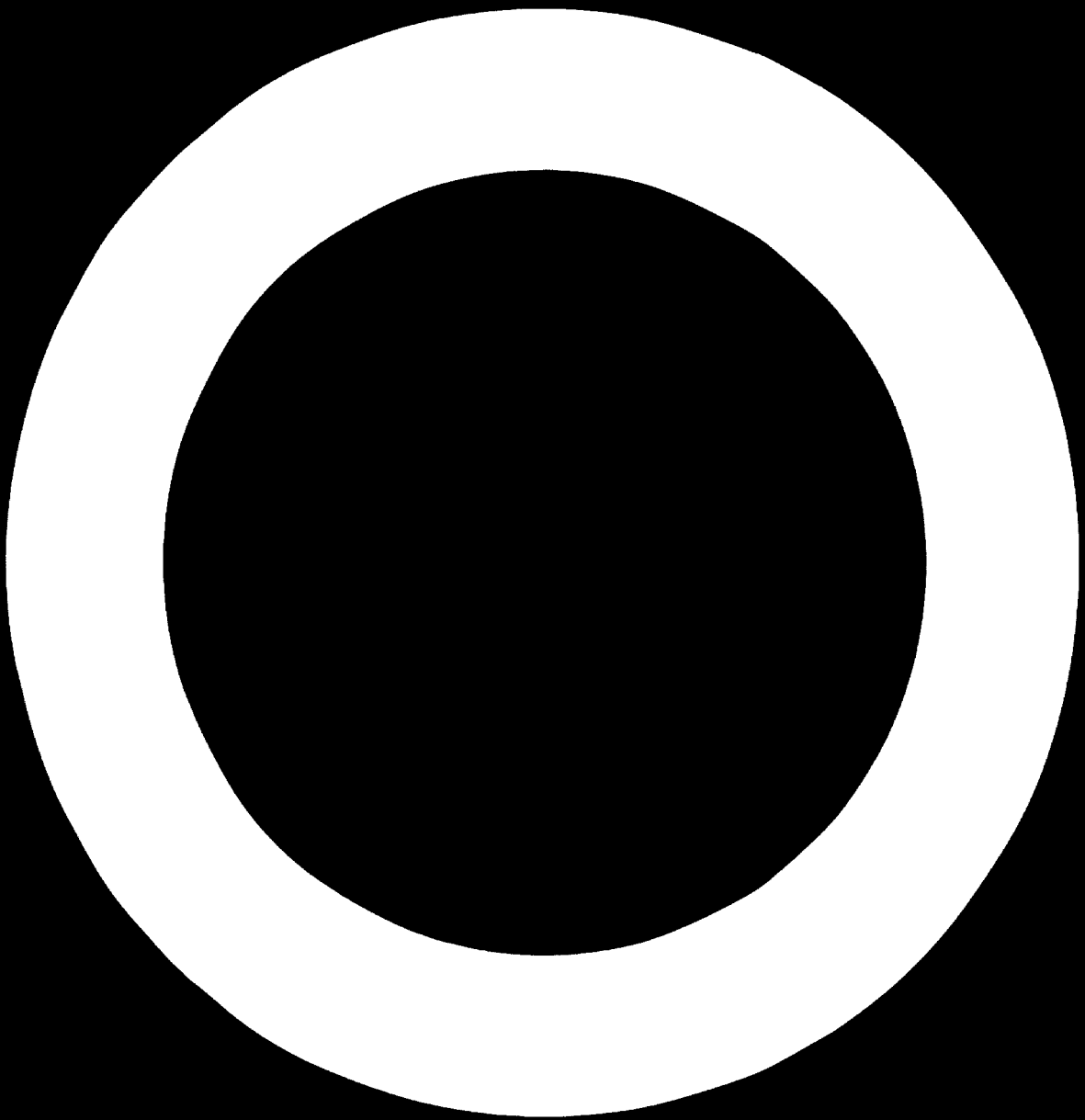
17. "Second Hand Machines and Economic Development," Netherlands Economic Institute, Rotterdam, May 1958

18. "Second Hand Machines and Economic Development," Netherlands Economic Institute, Rotterdam, May 1958



Precision Metals Seeks To Automate HERF Unit

EL CAJON, Calif. – Precision Metals Products, here, a division of Fairchild Camera & Instrument Corp., – with an eye toward the automotive market – is seeking to semi-automate a high energy rate forming (HERF) machine.

The unit, rated at 600,000 foot-pounds, was designed by Joseph Murek, technical assistant to the divisional manager, and built by Maschinenfabrik Weingarten, A.G., Wiengarten, Germany.

A spokesman for Precision Metals, which holds the license to sell the unit throughout the world, except Europe, said the firm plans to start a marketing program in 60 to 90 days.

Typical mechanization that the firm expects to accomplish includes producing parts from an eight pound billet at the rate of 10 per minute, he added.

Accessories are still being developed and tested.

The automation process would be two-dimensional injection and withdrawal through mechanical means – rather than full electronic automation, it was noted.

Other HERF equipment makers and users also are exploring mechanical means of automating production, industry sources noted.

The Fairchild division will use its machine for custom work and part testing. Mr. Murek said discussions have been held with some steel producers in this country to provide a high strength steel as a die material. The special vacuum melted steel used in Fairchild's unit was developed in West Germany and has a strength of around 180,000 PSI.

Precision Metal Products may produce the machines in this country.

A unique aspect of Mr. Murek's design is the independent adjustment of two gas chambers, one on top of the machine and the other on the bottom, as previously reported.

The gas in the chambers is released at the same instant for an adiabatic gas expansion (occurring without loss or gain of heat), which moves the masses, the holder and the ram, against each other at a very high speed, creating kinetic energy in the masses.

At point of impact, both masses are free floating and therefore no shock or impact load is applied to the floor.

5-Year Spurt Seen For N/C in Europe

Cable Fairchild

BRUSSELS – Sales of numerically controlled machine tools in Europe are expected to grow substantially over the next 5 years reaching what the United States level is today.

This was the consensus at the 9th European Machine Tool Exhibition, which closed here Sunday.

On display were 300 n/c machines showing varying degrees of sophistication. The number represents a five fold increase over the number of n/c machines shown 2 years ago at the Milan exhibition.

A total of 35 different n/c control systems were counted, including a handful made for the first time by machinery builders themselves.

Learning Stage Over

There also was general agreement among the manufacturers interviewed that most of the learning stage is over, that they now understand the role of n/c machinery.

Two points stressed by many. One operator could "run" several units at one time thus cutting down the number of workers needed. Smaller and medium sized firms, to survive increased competition, will eventually have to use n/c units to produce at the most economic level.

A number of USCKS, however, indicated they were hesitant to buy n/c units at this time. Many had heard that introduction of integrated circuitry might reduce control costs by as much as 25 per cent within one year.

There are currently 900 n/c machines in operation in Europe. Germany has the greatest number by country – about 100 units. Ferranti, Ltd., Lancashire, England, is the leader among controls producers with 260 installations. Second is Airmec, Ltd., Buckinghamsire, a producer of low cost positioning systems, with 200 installations.

IGE in Third

IGE is at third spot, with 200 installations. IGE entered the European n/c controls field just 2 years ago.

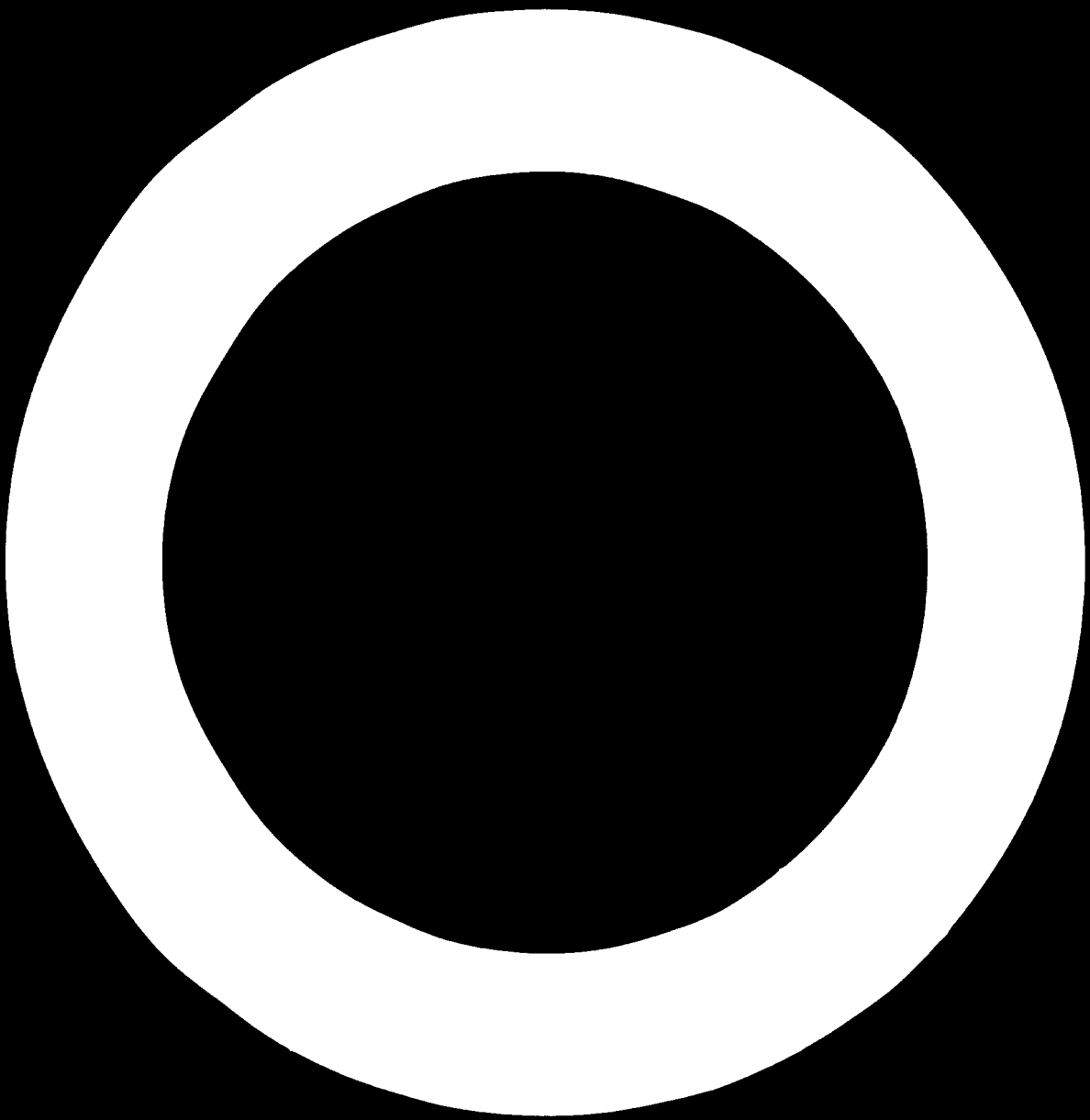
The firm is building plants in Italy and England for the production of n/c systems.

Plesse Co., Ltd., Essex, England, accounts for 80 units. Siemens Schuchert, Werke, AG, Arlanger, W. Germany, has sold 50. Swedish Saab has sold an estimated 25 units, all in Scandinavian countries.

British exhibitors estimated that in the next 3 years there will be a market in England for 300 n/c systems.

Continental builders estimated that sales on the Continent might range from 30 to 100 n/c systems during 1968.

Show attendance, which had been weak during the first days, improved by the end. However, reduced attendance by Americans was especially noted.



METALWORKING NEWS, Sept. 13, 1965

Sharp ECM Increase Forecast in Late '60s

By DAN FRIEDLANDER

ELK GROVE VILLAGE, Ill. – A marked increase in the use of electrochemical machining (ECM) can be expected in the latter part of this decade, according to Lynn A. Williams, president, Anocut Engineering Co.

Mr. Williams, holder of basic patents on the process, said in an interview, "I think all the basic ECM problems have been overcome. Also, I think the basic designs and power supplies have been established.

"The rapid progress today is in tooling in respect to accuracy, to mass production and to make the tooling more durable despite its salt water environment."

He stated tooling is moving into the direction of simplification and into multiple part operation.

Discussing growth of the ECM process, he noted the growth curve for equipment in the metalworking industry usually comes after 400 to 500 machines are in use.

People then come to accept it and products are designed with the process in mind. This should occur to the ECM process well before 1970, he predicted.

There are between 100 and 200 installations of ECM equipment, nearly all of it in the United States. He said the growth curve may already have been established for the aerospace industry.

Mr. Williams said that industries such as office equipment represent a large market for ECM.

While unable to estimate how many orders will be written for ECM equipment this year, he said the amps, or power, in the equipment sold in 1965 would equal the power of all ECM units previously sold.

The first ECM equipment, sold in the fall of 1959, had a power range of [illegible] amps, and power [illegible] up to [illegible].

Mr. Williams [illegible] no limit to the power that could be applied to ECM equipment.

METALWORKING NEWS, Aug 23, 1965

Major Equipment is Set Up For Job, Line Hydroforming

CHICAGO – Major Equipment Co. has set up a hydroforming department for both job and production work.

Robert Major, general manager, said the $150,000 quick acting machine (600 parts per minute capacity) is the only one of its kind in the Midwest and the second one ever made. It was built by Cincinnati Milling Machine Co., Cincinnati.

He said this 5,000 psi unit can take up to a 25-inch blank and draw 10 inches in depth. The unit will be used about 50 per cent of the time for Major's own lighting reflector products and the remainder for outside work.

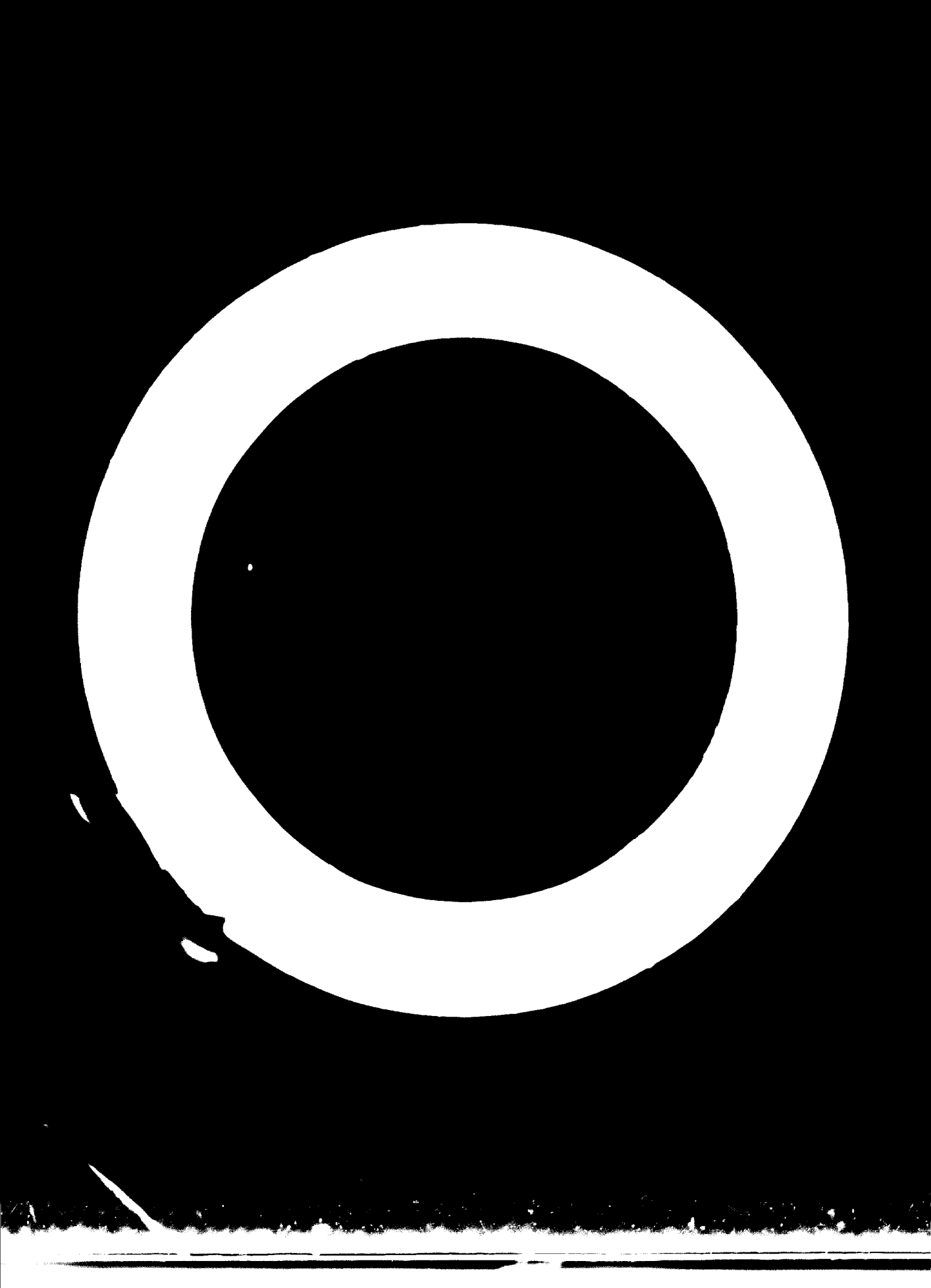
Industries that might be interested in the product are auto, for hub caps and tail lights, lighting, pots and pan, and globe makers.

Cost of hydroforming is comparable to mechanical and hydraulic drawing, Mr. Major said. Hydroforming offers several advantages as it does not force the metal, he said. It wraps the metal and because of that it can be used for intricate shapes.

He indicated that with hydroforming Major has been successful in using plastic epoxy tools for high production runs.

Hydroform tooling costs a great deal less than normal draw tooling, he said. The only die required in hydroforming is the less expensive male die. The machine utilizes a rubber diaphragm which takes the place of the female die.

Mr. Major said that on a job shop basis the facility will be available for short term, one-of-a-kind or high speed monthly volume production. The hydroforming work will be backed up by the firm's polishing, spinning, drawing and metal finishing facilities, he noted.



See EDM Replacing Lamination In Motor Pole Face Construction

By DAN FREEDLANDER

ELROSE, Ill. — Astro Tool Corp. here has applied electrical discharge machining to motor pole face construction, and, according to James R. Vetova, Astro president, the success of this research effort could now mean the replacement of the lamination technique used in standard electric motor pole faces.

In an interview with Metalworking News last week, Mr. Vetova said that as a result of the pole face work done for Westinghouse Electric Co., Lima, O., his firm has received a Westinghouse contract to make said rotors using EDM.

"We expect to have little trouble in making the rotors," he said.

The EDM process could mean greater efficiency for electric motors of all sizes, he explained. Laminated pole faces are composed of alternating layers of metal and insulation. In an operating motor, these layers eventually vibrate, causing heat and eddy current loss. With the EDM process, the pole face would be a solid piece of metal and vibration would be eliminated.

The pole faces made by Astro, a tool and die company specializing in EDM, were 4½ inches long, 3¼ inches wide, 1¼ inches high with a concave shape and an approximate radius of 9 inches.

For the steel bar from which Astro cut the part, there were to be 180 grooves 0.007 to 0.008 inch wide and from 0.069 to 0.071 inch deep. The part is for an inductor generator for space applications.

Mr. Vetova said he first tried to make the EDM electrode of copper but found that this material is not adequate due to rapid erosion.

Used Graphite

Next he went to the traditional EDM material, graphite, and found that by taking the unusual step of using a grinder the electrode could be made. The electrode fins have to be within 1.000-inch accuracy, he noted.

Astro Tool recently purchased two grinders from Boyar-Schultz Corp., Broadview, Ill., because of the accuracy they provide and to fill a growing backlog.

Knowing how to make the electrode in itself is not enough, Mr. Vetova said. A steady feed rate, oil rush, cleanliness of oil, accuracy of electrode and interchange

A little dirt in the oil or a break in the electrode groove was enough to ruin the entire piece, he recalled.

The secret in using the EDM machine, discovered after months of research, was to have the electrode rotating continuously. Continuous rotation provided a continuous coolant on the workpiece.

Mr. Vetova said the new Westinghouse rotor jobs calls for the making of 102 slots per pole, 16 poles per motor with the slots 0.006 to 0.008-inch wide and 0.068 to 0.007 inch deep.

Astro, an 18-month-old firm, in addition to doing some pioneering work in EDM is seeking aerospace and electronic work and also plans to be an electrode supplier to other users of the EDM process.

Continued From Page 1

ting controls costing $40,000 on these machines in the past, despite reduction in setup and tooling costs and increased reliability," he said. "Shops making complicated parts in small quantities with high tooling and setup costs will be forced by competition to use n/c."

Less expensive controls have stimulated a number of machine tool builders to build new, less expensive machines designed for n/c, he said.

"A number of machine tool builders will be exhibiting tools at the machine tool show this month that will sell for less than $100,000. These tools were not available in n/c before," he said.

The n/c division of Bunker Ramo does not release sales and earnings figures, but Mr. Freed said that it is now showing a profit and has a quarter to a third of the contour controls market.

"I don't see the less expensive controls systems growing in sophistication, but the more expensive controls should get considerably more sophisticated as users develop more applications for n/c. Sales of the more expensive controls have not suffered, however, since introduction of the 3100 controls," he noted.

Retrofit sales also should grow, he said, adding that they now account for 20 percent of Bunker-Ramo n/c dollar volume. The percentage is not expected to increase.

He predicted development of integrated or microcircuits which would reduce the price and the size of circuits. He also foresees development of the first direct control (without tape) of machine tools from computer within 3 years on a pilot plant basis. Commercial sales of such systems are 10 years off and will be limited only to large companies with a number of n/c tools.

Lower Price N/C's Seen [illegible] Buyer

CLEVELAND — Numerical control systems that sell for $15,000 to $20,000 will capture at least 75 per cent of the contouring n/c market by 1970, Dean Freed, director of numerical control for Bunker-Ramo Corp. here, told Metalworking News last week.

He estimated total n/c contouring sales this year will be somewhere between 300 and 350 units, and should double or triple by 1970. The lion's portion of this gain will come in the less expensive n/c controls, he added.

"In a little over a year we have sold as many of our 3100 controls ($12,000 to $20,000) as we sold of our more sophisticated 3000 controls ($40,000 to $60,000) in seven years," he said.

"We won't be building any more 3000 controls this year," he added.

The sales gains will come, he stated, as the less expensive controls are applied to the ordinary types of machining tools such as knee type vertical milling machines and lathes.

"You just couldn't justify put-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