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Expert Group on Metalworking Industries as
Potential Export Industries in Developing Countries

THE METALWORKING INDUSTRIES: SEMI-QUANTITATIVE PROGRAMMING DATA[1/]

by

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1/ The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO.

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Annexes

Introduction

1. The data in this paper cover only a small portion of the universe of products and processes which constitute the metalworking sector. This information is a first instalment, a nucleus and a guide for further data collection. The collection and classification of the data begin to fill the "empty economic boxes" of the conceptual scheme originally outlined in a commissioned report to be published by the United Nations on the metalworking industries as potential export industries. The main significance of this scheme is its theme that data collection and planning for the metalworking sector are feasible and efficient only if they proceed hand in hand, according to a multi-level process which progresses step by step from lesser to greater detail, from semi- to fully-quantified data.

2. The primary questions with regard to the economic planning of the metalworking sector have always been if data for the sector can be gathered efficiently, i.e. at reasonable cost, and if the data can be organized and processed in such a way as to penetrate the welter of detail to reveal those features of the sector which are most relevant for further analysis and - ultimately - for economic decisions. The object of the data-gathering process as presented here is to demonstrate that data on the metalworking sector can be gathered and processed efficiently, especially if the data compilers take advantage of the possibility of progressive improvements in data standardization and classification and keep the material constantly updated.

1. Presentation, collection and processing of semi-quantitative programming data

Presentation of data: format and layout

3. The data are organized for use. The products and data sheets are grouped in numerical sequence according to the classification of the products in the four-digit Standard International Trade Classification (SITC). This classification number appears in the upper left-hand corner of each sheet. All the products belonging to a single SITC category appear on the same or successive pages. The data have been so organised that data for additional products in each group can be conveniently transcribed, indexed and footnoted without necessitating a rearrangement of any part of the ordered set of data. The grouping by SITC code is admittedly arbitrary. The products were not grouped according to the International Standard Industrial Classification (ISIC) because it is insufficiently detailed, being only a three-digit

classification.[1] The four-digit SITC code has approximately the same level of detail as the four-digit breakup of the Standard Industrial Classification (SIC) of the United States Department of Commerce.[2] One of the great advantages of the present method of data collection is that it permits the evaluation of the efficacy of any existing industrial classification, i.e. the degree to which a particular industrial classification corresponds to a grouping of products on the basis of a technological similarity that can be ascertained by manipulations of the data matrix.

4. The method of data collection and classification exemplified here will enable a developing country to construct the industrial classification scheme most suited to its own individual needs, so that it need not rely on inappropriate classification categories which may be based more on market orientation than on basic technological manufacturing data.

5. The data have been presented in a matrix format. The columns of the table represent products in which the production resources indicated by the rows of the table are used. An integer number in the matrix cell at the intersection of a row and a column represents the significance of the resource in the manufacture of the product. This integer can be either a zero (or more usually just a blank), a one (1) or a two (2). A zero or blank indicates that the resource is not used. A (1) indicates that the resource is used in the manufacture of the product. The assignment of the integer (2) to a cell signifies that the resource is somehow critical to the manufacturing activity. The term criticality has not been well defined; it may refer to one or several aspects of a production resource, such as seriality, complexity and size of work-piece. The consultants for this report were advised that a resource should be considered critical if the manufacture of the product would be unprofitable without it. The index (2), however, does not imply a numerical measure of criticality; that is, if one resource is assigned a (2) and another a (1), it does not imply that the former is twice as critical as the latter, but only that it is somehow more critical.

1/ For the relationship of the SITC to the ISIC, see United Nations, "Classification of Commodities by Industrial Origin", Statistical Papers, Series M, No. 43, 1966.

2/ United States Government, Bureau of the Budget, "Standard Industrial Classification Manual", US Government Printing Office, 1957.

Data collection

6. The data were collected primarily by professional engineers retained as consultants. As the background and experience of engineers may differ considerably, the problem arises of obtaining reasonably consistent data. There is a certain degree of trade-off between data consistency and data completeness or coverage. While it may be possible to construct specifications that require a consulting engineer to supply data which fit into certain rigid categories, such specifications neutralize the advantage of the engineer's expertise: there is a possibility that by his distinctive experience he may be able to discover unexpected but relevant bits of information. This possibility is partioularly important in a progressive, hierarchical data-collection process in which - at the initial levels - it is impossible to anticipate in full detail all the information that will ultimately be required for planning.

7. The collection of the data presented here has demonstrated the need for some formal but flexible guidelines for the engineers to follow when collecting data. Without such guidelines there would be a considerable problem not only of organizing the data but also of evaluating them after they have been collected. For instance, one of the consulting engineers selected sample products to represent the SIC seven-digit oategories for which statistics are given in the United States Department of Commerce Census of Manufactures - Industry Series.[3/] Another consultant had had considerable practice in setting up manufacturing factories and so the data that he provided for the machines in an ice-cream plant were ooloured by his previous experienoe. It was found that, without guidance, the descriptions of particular products and processes which the engineers provide vary considerably with regard to detail and quality; the engineers may refer as often to manufacturers' catalogues as to standard references. From the experience of garnering the present set of data the following recommendations have been drawn for future work:

(a) Consulting engineers should be required to provide a parts-list or parts-explosion diagramme and an indication of which processes are used to produce which parts. Ultimately, such information would make it possible to develop a more refined and multi-levelled definition of products similar to the present two-level definition of resources.

3/ United States Department of Commerce, "Census of Manufactures, 1963", Industry Series MC63(2)-20A to 39D, US Government Printing Office, Washington, D.C., 1966.

(b) Under "purchased items" (resource category no. 9000) engineers should list only the items not actually produced within the metalworking sector so as not to prejudge the "make-versus-buy" decision within the sector. Another, separate resource category should be established for the enumeration of parts and sub-assemblies which the engineers do not feel competent to evaluate and/or which are not an integral part of the product. In practice, considerable discrimination and expertise may be necessary here, in view of the present trend toward automatic (electronic) control of machines and the use of substitute or composite materials by the more technologically advanced branches of the sector.

(c) Engineers should be instructed to make reference, if possible, to a standard or widely accepted product-engineering handbook which can provide the basic characteristics and parameters of products and processes.

(d) Engineers should provide as much data as possible from the realm of their own experience on the resources (processes) used to produce a given product. This information, even though it may seem superfluous at one level of investigation, may prove useful in refining the definition of resources and may help to establish a higher, more specific level of analysis.

The concept of criticality

8. The experience of this data-collection effort indicates that the introduction of a notion of criticality is not helpful at the present level of analysis. The necessarily imprecise criterion of criticality that has been employed thus far is unfortunate as it requires the engineer to prejudge an economic issue in this case, the cost of a product, but precisely the determination of this cost is one of the hoped-for results of the entire analysis. In practice, the criticality criterion led to difficulties, as each consultant attempted to employ his own interpretation of the rule.

9. There is another problem connected with the use of a concept of criticality. If a simple binary (0,1) index (designating simply use/non-use of a resource) is employed, a remarkably unambiguous interpretation can be attached to the resource/resource and product/product matrices which can be derived from the data table. This clarity is lost when the binary indices are weighted with an index of criticality. Such weighting introduces a higher level of analysis into what, ideally, is a level-by-level analysis and also reduces the ease of manipulation of the data. Tables of resource-criticality weights should be constructed separately, and any sort of data which represents a more detailed level of analysis should be so represented. The result of a complete data-collection effort would thus be a hierarchy of data matrices, each quite simple in itself. After carefully considering various notions of criticality, the definition of a second level of analysis should be the next task.

Machine processing of the data

10. If data of the type presented in this paper are to continue to be collected, some thought must be given to transferring the data to a punch-card file so that it can be machine processed. The advantages of a punch-card data file and of machine processing are so obvious and manifold that a data system of this type must be set up before any other work is done. Data for as many as 67 different products can be recorded on one hundred ten 3-1/4 x 7-3/8" punch cards whose stack height is only about one inch, instead of a one-and-a-half-inch stack of 8-1/2 x 11" data sheets of the type we have been using. The manipulation of the data to show resource or product similarity or clustering can be done quickly and cheaply by machine, whereas time and cost would be prohibitive if men with simple calculators were to do the same job.

11. Figure 1 is a design for a data sheet that will facilitate the feeding of data onto cards for machine processing. Figure 2 is a flow chart of the major logical operations that a computer would have to carry out in order to process the punch cards and to produce a rearranged, "clustered" data matrix. This clustered data matrix, it is hoped, will show how resources and products can be grouped into a reasonable number of resource/product combinations, in terms of which the entire metalworking sector can be described. Some of the logical steps indicated - notably (1), (2), (3), (5) and (6) - can be carried out by "utility" or "package" programmes which are readily available from any major computer manufacturer. The other steps will have to be programmed afresh, but this is a one-time investment in time and money amounting to no more than about $US 700. This price also covers several minor operations necessary to get the whole data system in working order.

Figure 1

Model data sheet for feeding data onto punch-cards

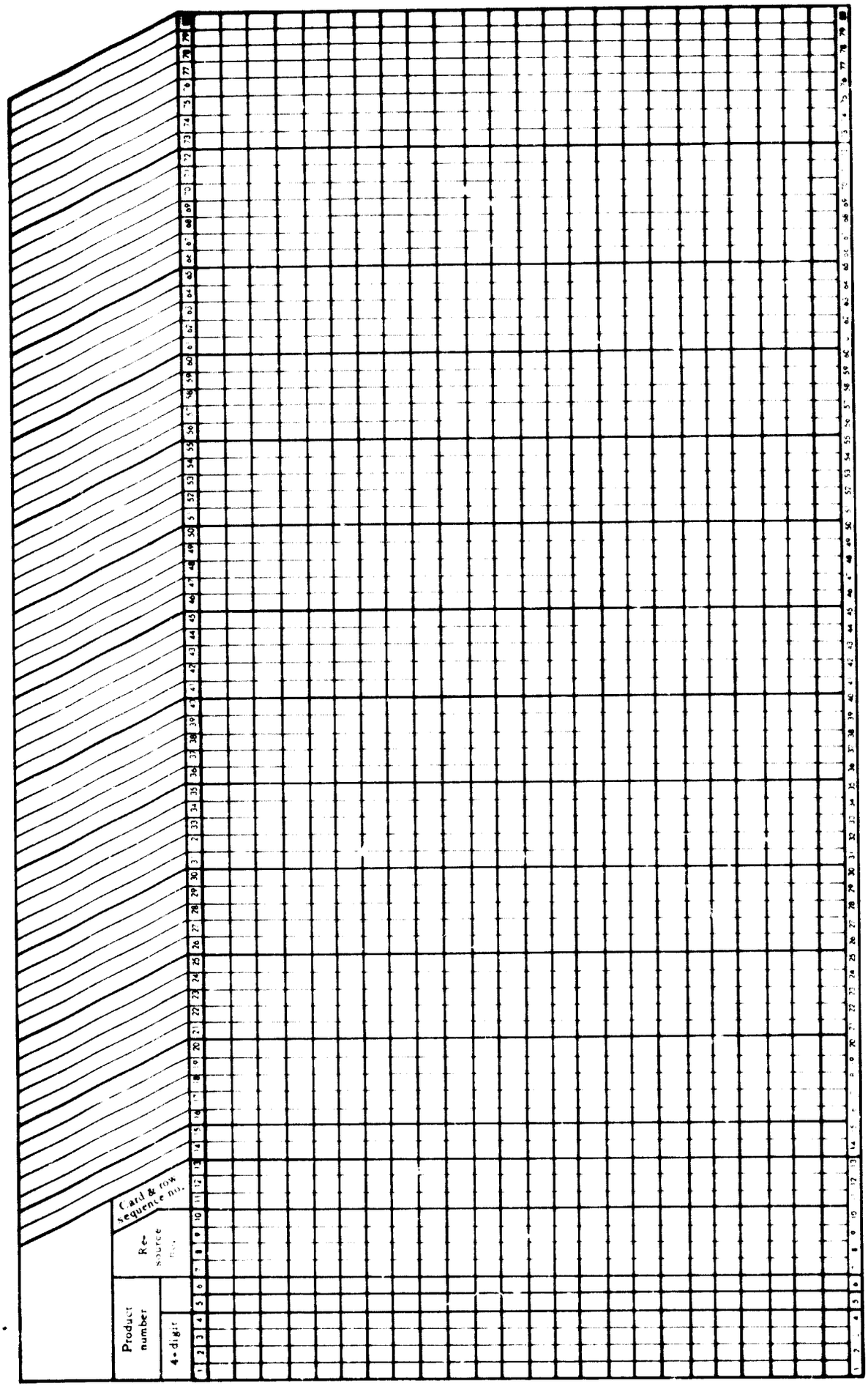
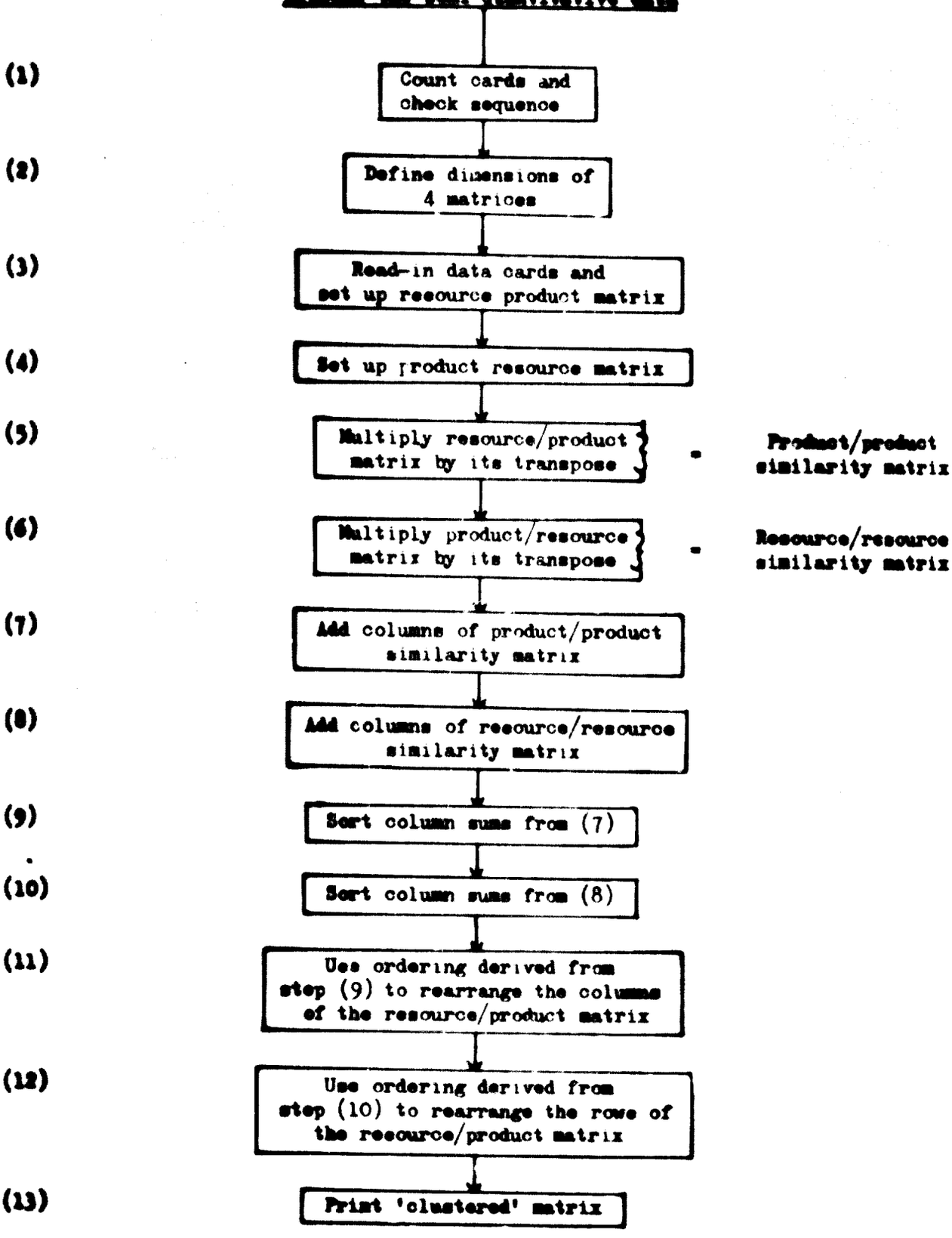


Figure 2

Flow chart of logical operations necessary to process the semi-quantitative data



2. Semi-quantitative programming data tables

Note:

An asterisk indicates that there is an explanatory note in Annex 1 which clarifies the assigned 0, 1, or 2 index. Further notes and addenda are to be found in Annex 1, immediately following the matrix tables. These notes are referenced sequentially according to the number of the matrix cell in which the asterisk appears, e.g. if an asterisk appears beside the index number (0, 1, 2) of resource no. 1710 as used in product no. 729.9-001, then the pertinent note will be found in Annex 1 as note 729.9-001/1710.

All products have been grouped according to the first four digits of their SITC code number. These product-groups appear in increasing SITC sequence. The SITC classification number appears as the first four digits of the commodity code. The remaining three digits of the commodity code are arbitrarily assigned and have been used for reference purposes only.

Only the briefest of labels will identify the product-columns of the data matrix. A more complete description of the products is provided in Annex 1 and may be located in the same way as indicated above.

METAL FORMING

(SITC # 692.1 - tanks, vats, reservoirs)

Resource No.	Resources	Products (commodity no. 692.1-)						
		001 10 gal. can	002 metal tank 550 gal.	003 metal tank 10,000 gal.	004 mixing tank	005 flavouring tank		007 gas cylinder
1000	METAL FORMING							
1100	Forge, free							2
1120	Forge, die							
1130	Forge, mixed free/dis							
1200	Casting, iron							
1205	sand							
1210	mold							
1220	Casting, malleable							
1230	Casting, steel							
1235	sand				1	1		
1240	mold							
1250	Casting, non-ferrous							
1255	sand							
1260	mold							
1265	dis							
1270	Casting, precision							
1275	mold							
1280	die							
1290	Casting, all other							
1300	Upsetting (fasteners etc.)							
1400	Extrusion (tubes, shapes)							
1500	Roll (tubes, shapes)				2			
1600	Draw (tube, wire)							2*
1700	Press, draw (tubs, sinks etc.)	2			2	2		
1710	Press, coin (emboss etc.)							
1720	Press, bend (brake)				1	2		
1730	Press, hydraulic - special		2	2				
1800	Wind (motors, transformers etc.)							
1900	Spinning			2				2

METAL REMOVAL

(SITC # 692.1 - tanks, vats, reservoirs)

Resource No.	Resources	Products (commodity no. 692.1-)						
		001 10 gal. can	002 metal tank 550 gal.	003 metal tank 10,000 gal.	004 mixing tank	005 flavouring tank		007 gas cylinder
2000	METAL REMOVAL							
2100	Turn (lathe)				1			1
2200	Bore (drill)		2	2	1			2
2210	Ream							
2300	Grind		2	2				2
2400	Mill							
2410	Shape (plane)							
2500	Broach							
2600	Tap (inside thread by die)				1			2
2610	Thread (outside thread by die)				1			

METAL CUTTING

(SITC # 692.1 - tanks, vats, reservoirs)

Resource No.	Resources	Products (commodity no. 692.1-)						
		001 10 gal. can	002 metal tank 550 gal.	003 metal tank 10,000 gal.	004 mixing tank	005 flavouring tank		007 gas cylinder
3000	METAL CUTTING							
3100	Press shear					2		
3200	Press punch					1		
3300	Saw							
3400	Torch		2	2				
3900	Other cutting operations							

HEAT TREAT OPERATIONS

(SITC # 692.1 - tanks, vats, reservoirs)

Resource No.	Resources	Products (commodity no. 692.1-)						
		001 10 gal. can	002 metal tank 550 gal.	003 metal tank 10,000 gal.	004 mixing tank	005 flavouring tank		007 gas cylinder
4000	HEAT TREAT OPERATIONS							
4100	Furnace							
4200	Induction							
4300	Quench							
4900	Other heat treat operations							

FASTENING OPERATIONS

(SITC # 692.1 - tanks, vats, reservoirs)

Resource No.	Resources	Products (commodity no. 692.1-)						
		001 10 gal. can	002 metal tank 550 gal.	003 metal tank 10.000 gal.	004 mixing tank	005 flavouring tank		007 gas cylinder
5000	FASTENING OPERATIONS							
5100	Self-tap screws							
5110	Nuts and bolts					1		
5120	Rivets							
5130	Special fasteners							
5200	Weld, spot (short run)							
5210	Weld, spot (long run)							
5220	Weld, continuous	1	2	2	2	2		
5300	Cold flow							
5310	Force fit							
5320	Braze (silver solder)							
5340	Solder							
5400	Designed (catch, interlock, plug)							
5500	Glue							
5900	Other fastening operations							

FINISHING OPERATIONS

(SITC # 692.1 - tanks, vats, reservoirs)

Resource No.	Resources	Products (commodity no. 692.1-)						
		001 10 gal. can	002 metal tank 550 gal.	003 metal tank 10,000 gal.	004 mixing tank	005 flavouring tank		007 gas cylinder
6000	FINISHING OPERATIONS							
6100	Tumble							
6110	Straighten							
6120	Finish grind		1	1	1	1		1
6130	Brush and polish	1	1	1	1	1		
6200	Dip (to clean, prime)	2						2
6210	Dip (to finish)							2
6300	Spray, paint (short run)		2	2				2
6310	Spray, paint (auto line)							2
6320	Spray, vitreous enamel (short run)		2*	2*				2*
6330	Spray, vitreous enamel (auto line)							2*
6390	Spray, other finishes than above							
6400	Electroplate							
6500	Laminate							
6600	Chemical finishes (anodize, etc.)							2
6700	Shot blast - abrasive grit							2
6900	Other finishing methods	2*						

FINAL ASSEMBLY AND PACK

(SITC # 692.1 - tanks, vats, reservoirs)

Resource No.	Resources	Products (commodity no. 692.1-)						
		001 10 gal. can	002 metal tank 550 gal.	003 metal tank 10,000 gal.	004 mixing tank	005 flavouring tank		007 gas cylinder
7000	FINAL ASSEMBLY AND PACK							
7100	Hand (short run, no pace, light)							
7110	Hand (Unit and short run, no pace, heavy)		2	2	1	1		2
7120	Hand (long run, paced)							
7200	Semi-automatic				1			
7300	Fully automatic							
7400	Standard performance test		2*	2*		1		2*
7410	Standard performance test (auto)							
7420	Critical test needed (see Annex 1)		2*	2*				2*
7430	Critical adjustment needed							
7440	Critical assembly equipment needed							
7500	Hand pack (short run, no pace, light)							
7510	Hand pack (unit and short run, no pace, heavy)					1		
7520	Semi-automatic pack							
7530	Fully automatic pack							

MATERIAL HANDLING

(SITC # 692.1 - tanks, vats, reservoirs)

Resource No.	Resources	Products (commodity no. 692.1-)						
		001 10 gal. can	002 metal tank 550 gal.	003 metal tank 10,000 gal.	004 mixing tank	005 flavouring tank		007 gas cylinder
8000	MATERIAL HANDLING							
8050	Manual		1	1				1
8060	Manual (simple wheels and skids)		1	1				1
8100	Cranes (overhead)		2	2				1
8200	Conveyors (manual)							1
8210	Conveyors (automatic)							
8300	Trucks (lift, pallets, bins etc.)		2	2				2
8310	Trucks (on rails)		1	1				
8400	Elevators							
8500	Transfer machine							
8900	Other material handling							

PURCHASED ITEMS

(SITC # 692.1 - tanks, vats, reservoirs)

Resource No.	Resources	Products (commodity no. 692.1-)						
		001 10 gal. can	002 metal tank 550 gal.	003 metal tank 10,000 gal.	004 mixing tank	005 flavouring tank		007 gas cylinder
9000	PURCHASED ITEMS							
9100	Electrical motors		1	1				
9110	Electrical controls (simple)							
9120	Electrical controls (complex)							
9130	Electrical controls (very complex)							
9190	Electrical supplies (other)							
9200	Other		1*	1*				1*

SERVICE FUNCTIONS

(SITC # 692.1 - tanks, vats, reservoirs)

Resource No.	Resources	Products (commodity no. 692.1-)						
		001 10 gal. can	002 metal tank 550 gal.	003 metal tank 10,000 gal.	004 mixing tank	005 flavouring tank		007 gas cylinder
9500	SERVICE FUNCTIONS							
9510	Laboratory (quality)		1	1				2
9520	Laboratory (design)							
9530	Maintenance (critical)							
9540	Inventory level (critical)		2	2				2
9550	Production sequence (critical)		2	2				2
9560	Sub-assembly coordination (critical)		2	2				
9570	Tool and die making				1			
9580	Jigs and fixtures		1	1	1			1
9900	General design and specification		2	2				1
9920	Field tests		2	2				

METAL FORMING

(SITC # 711.1 - steam generating boilers)

Resource No.	Resources	Products (commodity no. 711.1-)						
		001 stationary power boiler	002 etationary power boiler	003 stationary power boiler	004 stationary power boiler	005 steam plant		
1000	METAL FORMING							
1100	Forge, free							
1120	Forge, die	2	2	2	2			
1130	Forge, mixed free/die							
1200	Casting, iron							
1205	sand	2	2	2	2			
1210	mold							
1220	Casting, malleable							
1230	Casting, steel							
1235	sand	2	2	2	2			
1240	mold							
1250	Casting, non-ferrous							
1255	sand							
1260	mold							
1265	die							
1270	Casting, precision							
1275	mold							
1280	die							
1290	Casting, all other							
1300	Upsetting (fasteners etc.)							
1400	Extrusion (tubes, shapes)	1	1	1	1			
1500	Roll (tubes, shapes)							
1520	Bending rolls	2	2	2	2			
1600	Draw (tube, wire)	1	1	1	1			
1700	Press, draw (tube, sinks etc.)					1		
1710	Press, coin (emboss etc.)							
1720	Press, bend (brake)					2		
1730	Press, hydraulic (special)	2	2					
1800	Wind (motors, transformers etc.)							
1900	Spinning	1	1	1	1			

METAL REMOVAL

(SITC # 711.1 - steam generating boilers)

Resource No.	Resources	Products (commodity no. 711.1-) 001 stationary power boiler	002 stationary power boiler	003 stationary power boiler	004 stationary power boiler	005 steam plant		
2000	METAL REMOVAL							
2100	Turn (lathe)	2	2	2	2			
2200	Bore (drill)	2	2	2	2	1		
2210	Ream	2	2	1	1			
2300	Grind	2	2	2	2			
2400	Mill	2	2	2	2			
2410	Shape (plane)	2	2	1	1			
2500	Broach	1	1					
2600	Tap (inside thread by die)	2	2	2	2			
2610	Thread (outside thread by die)	2	2	2	2			

METAL CUTTING

(SITC # 711.1 - steam generating boilers)

Resource No.	Resources	Products (commodity no. 711.1-) 001 stationary power boiler	002 etationary power boiler	003 stationary power boiler	004 stationary power boiler	005 steam plant		
3000	METAL CUTTING							
3100	Press shea-					2		
3200	Press punch							
3300	Saw	1	1	1	1			
3400	Torch	2	2	2	2			
3900	Other cutting operations							

HEAT TREAT OPERATIONS

(SITC # 711.1 - steam generating boilers)

Resource No.	Resources	Products (commodity no. 711.1-) 001 stationary power boiler	002 stationary power boiler	003 stationary power boiler	004 stationary power boiler	005 steam plant		
4000	HEAT TREAT OPERATIONS							
4100	Furnace	2	2	2	2			
4200	Induction	1	1					
4300	Quench							
4900	Other heat treat operations							

FASTENING OPERATIONS

(SITC # 711.1 - steam generating boilers)

Resource No.	Resources	Products (commodity no. 711.1-)						
		001 stationary power boiler	002 stationary power boiler	003 stationary power boiler	004 stationary power boiler	005 steam plant		
5000	FASTENING OPERATIONS							
5100	Self-tap screws							
5110	Nuts and bolts	1	1	1	1	1		
5120	Rivets	2	2					
5130	Special fasteners							
5200	Weld, spot (short run)							
5210	Weld, spot (long run)							
5220	Weld, continuous	2	2	2	2	2		
5300	Cold flow							
5310	Force fit							
5320	Braze (silver solder)							
5340	Solder							
5400	Designed (catch, interlock, plug)	2	2	1	1			
5500	Glue							
5900	Other fastening operations							

FINISHING OPERATIONS

(SITC # 711.1 - steam generating boilers)

Resource No.	Resources	Products (commodity no. 711.1-)						
		001 stationary power boiler	002 stationary power r boiler	003 stationary power boiler	004 stationary power boiler	005 steam plant		
6000	FINISHING OPERATIONS							
6100	Tumble							
6110	Straighten							
6120	Finish grind	2	2	2	2	1		
6130	Brush and polish	1	1	1	1	1		
6200	Dip (to clean, prime)	1	1	1	1			
6210	Dip (to finish)							
6300	Spray, paint (short run)	1	1	1	1			
6310	Spray, paint (auto line)	2	2	2	2			
6320	Spray, vitreous enamel (short run)					1		
6330	Spray, vitreous enamel (auto line)							
6390	Spray, other finishes than above							
6400	Electroplate							
6500	Laminate							
6600	Chemical finishes (anodise, etc.)							
6900	Other finishing methods							

FINAL ASSEMBLY AND PACK

(SITC # 711.1 - steam generating boilers)

Resource No.	Resources	Products (commodity no. 711.1-)						
		001 stationary power boiler	002 stationary power boiler	003 stationary power boiler	004 stationary power boiler	005 steam plant		
7000	FINAL ASSEMBLY AND PACK							
7100	Hand (short run, no pace, light)							
7110	Hand (unit and short run, no pace, heavy)	2	2	2	2	1		
7120	Hand (long run, paced)							
7200	Semi-automatic							
7300	Fully automatic							
7400	Standard performance test	2*	2*	2*	2*	1		
7410	Standard performance test (auto)							
7420	Critical test needed (see Annex 1)	2*	2*	2*	2*			
7430	Critical adjustment needed							
7440	Critical assembly equipment needed							
7500	Hand pack (short run, no pace, light)							
7510	Hand pack (unit and short run, no pace, heavy)					1		
7520	Semi-automatic pack							
7530	Fully automatic pack							

MATERIAL HANDLING

(SITC # 711.1 - steam generating boilers)

Resource No.	Resources	Products (commodity no. 711.1-)						
		001 stationary power boiler	002 stationary power boiler	003 stationary power boiler	004 stationary power boiler	005 steam plant		
8000	MATERIAL HANDLING							
8050	Manual	1	1	1	1			
8060	Manual (simple wheels and skids)	1	1	1	1			
8100	Cranes (overhead)	2	2	2	2			
8200	Conveyors (manual)							
8210	Conveyors (automatic)							
8300	Trucks (lift, pallets, bins etc.)	2	2	2	2			
8310	Trucks (on rails)	2	2	1	1			
8400	Elevators							
8500	Transfer machine							
8900	Other material handling							

PURCHASED ITEMS

(SITC # 711.1 - steam generating boilers)

Resource No.	Resources	Products (commodity no. 711.1-)						
		001 stationary power boiler	002 stationary power boiler	003 stationary power boiler	004 stationary power boiler	005 steam plant		
9000	PURCHASED ITEMS							
9100	Electrical motors	1	1		1			
9110	Electrical controls (simple)	1	1		1			
9120	Electrical controls (complex)	1	1		1			
9130	Electrical controls (very complex)							
9190	Electrical supplies other							
9200	Other	1*	1*		1*			

[redacted]

([redacted] & Till.1 - steam generating boilers)

Resource No.	Resources	Products (commodity no. Till.1-)						
		001 stationary power boiler	002 stationary power boiler	003 stationary power boiler	004 stationary power boiler	005 steam plant		
9500	SERVICE FUNCTIONS							
9510	Laboratory (quality)	2*	2*	1	1			
9520	Laboratory (design)							
9530	Maintenance (critical)							
9540	Inventory level (critical)	2	2	2	2			
9550	Production sequence (critical)	2	2	2	2			
9560	Sub-assembly coordination (critical)	2	2	2	2			
9570	Tool and die making	2	2	1	1			
9580	Jigs and fixtures	2	2	1	1			
9900	General design and specification	2	2	2	2			
9901	Field supervision	2	2	2	2			
9902	Field tests	2	2	2	2			

METAL FORMING

(ISIC # 712.1 - dairy farm equipment)

Resource No.	Resources	Products (commodity no. 712.3-)						
		001 homo-geniser	002 cup filler					
1000	METAL FORMING							
1100	Forge, free							
1120	Forge, die							
1130	Forge, mixed free/die							
1200	Casting, iron							
1205	sand	2	1					
1210	mold							
1220	Casting, malleable							
1230	Casting, steel							
1235	sand		2					
1240	mold							
1250	Casting, non-ferrous							
1255	sand							
1260	mold							
1265	die							
1270	Casting, precision							
1275	mold							
1280	die							
1290	Casting, all other							
1300	Upsetting (fasteners etc.)							
1400	Extrusion (tubes, shapes)							
1500	Roll (tubes, shapes)							
1600	Draw (tube, wire)							
1700	Press, draw (tube, sinks etc.)							
1710	Press, coin (emboss etc.)							
1720	Press, bend (brake)		1					
1800	Wind (motors, transformers etc.)							

METAL REMOVAL

(SITC # 712.3 - dairy farm equipment)

Resource No.	Resources	Products (commodity no. 712.3-) 001 homo-genizer	002 cup filler					
2000	METAL REMOVAL							
2100	Turn (lathe)	1						
2200	Bore (drill)	1	1					
2210	Ream	1	1					
2300	Grind	2	1					
2400	Mill	1	1					
2410	Shape (plane)							
2500	Broach							
2600	Tap (inside thread by die)							
2610	Thread (outside thread by die)							

METAL CUTTING

(SITC # 712.3 - dairy farm equipment)

Resource No.	Resources	Products (commodity no. 712.3-) 001 homo-genizer	002 cup filler					
3000	METAL CUTTING							
3100	Press shear		1					
3200	Press punch							
3300	Saw							
3400	Torch							
3900	Other cutting operations							

HEAT TREAT OPERATIONS

(SITC # 712.3 - dairy farm equipment)

Resource No.	Resources	Products (commodity no. 712.3-) 001 homo-genizer	002 cup filler					
4000	HEAT TREAT OPERATIONS							
4100	Furnace	1						
4200	Induction							
4300	Quench							
4900	Other heat treat operations							

FASTENING OPERATIONS

(SITC # 712.3 - dairy farm equipment)

Resource No.	Resources	Products (commodity no. 712.3-) 001 homo-genizer	002 cup filler					
5000	FASTENING OPERATIONS							
5100	Self-tap screws							
5110	Nuts and bolts		1					
5120	Rivets							
5130	Special fasteners							
5200	Weld, spot (short run)							
5210	Weld, spot (long run)							
5220	Weld, continuous		1					
5300	Cold flow							
5310	Force fit							
5320	Braze (silver solder)		1					
5340	Solder							
5400	Designed (catch, interlock, plug)							
5500	Glue							
5900	Other fastening operations							

FINISHING OPERATIONS

(SITC # 712.3 - dairy farm equipment)

Resource No.	Resources	Products (commodity no. 712.3-) 001 homo-genizer	002 cup filler					
6000	FINISHING OPERATIONS							
6100	Tumble							
6110	Straighten							
6120	Finish grind							
6130	Brush and polish		1					
6200	Dip (to clean, prime)							
6210	Dip (to finish)							
6300	Spray, paint (short run)		1					
6310	Spray, paint (auto line)							
6320	Spray, vitreous enamel (short run)							
6330	Spray, vitreous enamel (auto line)							
6390	Spray, other finishes than above							
6400	Electroplate							
6500	Laminate							
6600	Chemical finishes (anodize etc.)							
6900	Other finishing methods							

FINAL ASSEMBLY AND PACK

(SITC # 712.3 - dairy farm equipment)

Resource No.	Resources	Products (commodity no. 712.3-)						
		001 homo-genizer	002 cup filler					
7000	FINAL ASSEMBLY AND PACK							
7100	Hand (short run, no pace, light)							
7110	Hand (unit and short run, no pace, heavy)							
7120	Hand (long run, paced)							
7200	Semi-automatic							
7300	Fully automatic							
7400	Standard performance test							
7410	Standard performance test (auto)							
7420	Critical test needed (see Annex 1)							
7430	Critical adjustment needed							
7440	Critical assembly equipment needed							
7500	Hand pack (short run, no pace, light)							
7510	Hand pack (unit and short run, no pace, heavy)							
7520	Semi-automatic pack							
7530	Fully automatic pack							

MATERIAL HANDLING

(SITC # 712.3 - dairy farm equipment)

Resource No.	Resources	Products (commodity no. 712.3-)						
		001 homo-genized	002 cup filler					
8000	MATERIAL HANDLING							
8050	Manual							
8060	Manual (simple wheels and skids)							
8100	Cranes (overhead)							
8200	Conveyors (manual)							
8210	Conveyors (automatic)							
8300	Trucks (lift, pallets, bins etc.)							
8310	Trucks (on rails)							
8400	Elevators							
8500	Transfer machine							
8900	Other material handling							

PURCHASED ITEMS

(SITC # 712.3 - dairy farm equipment)

Resource No.	Resources	Products (commodity no. 712.3-)						
		001 homo-genizer	002 cup filler					
9000	PURCHASED ITEMS							
9100	Electrical motors							
9110	Electrical controls (simple)							
9120	Electrical controls (complex)							
9130	Electrical controls (very complex)							
9190	Electrical supplies other							

SERVICE FUNCTIONS

(SITC # 712.3 - dairy farm equipment)

Resource No.	Resources	Products (commodity no. 712.3-)						
		001 homo-genizer	002 cup filler					
9500	SERVICE FUNCTIONS							
9510	Laboratory (quality)							
9520	Laboratory (design)							
9530	Maintenance (critical)							
9540	Inventory level (critical)							
9550	Production sequence (critical)							
9560	Sub-assembly coordination (critical)							
9570	Tool and die making							
9580	Jigs and fixtures							
9900	General design and specification							

METAL FORMING

(SITC # 719.1 - heating and cooling equipment)

Resource No.	Resources	Products (commodity no. 719.1-)						
		001 walk-in cooler-refrigerator	002 freezer	003 cold-hold storage vat	004 surface cooler			007 ice cream delivery unit
1000	METAL FORMING							
1100	Forge, free							
1120	Forge, die							
1130	Forge, mixed free/die							
1200	Casting, iron							
1205	sand							
1210	mold							
1220	Casting, malleable							
1230	Casting, steel							
1235	sand		2	1				
1240	mold							
1250	Casting, non-ferrous							
1255	sand							
1260	mold							
1265	die							
1270	Casting, precision							
1275	mold							
1280	die							
1290	Casting, all other							
1300	Upsetting (fasteners etc.)				1			
1400	Extrusion (tubes, shapes)		2	2				
1500	Roll (tubes, shapes)							
1600	Draw (tube, wire)		1	2				
1700	Press, draw (tube, sinks etc.)		1		2			
1710	Press, coin (emboss etc.)	2	1		1			2
1720	Press, bend (brake)							
1800	Wind (motors, transformers etc.)							

METAL REMOVAL

(SITC # 719.1 - heating and cooling equipment)

Resource No.	Resources	Products (commodity no. 719.1-) 001 walk-in cooler-refrigerator	002 freezer	003 cold-hold storage vat	004 surface cooler			007 ice cream delivery unit
2000	METAL REMOVAL							
2100	Turn (lathe)		1	1				
2200	Bore (drill)	1	1					1
2210	Ream							
2300	Grind		1					
2400	Mill							
2410	Shape (plane)							
2500	Broach							
2600	Tap (inside thread by die)							
2610	Thread (outside thread by die)							

METAL CUTTING

(SITC # 719.1 - heating and cooling equipment)

Resource No.	Resources	Products (commodity no. 719.1-) 001 walk-in cooler-refrigerator	002 freezer	003 cold-hold storage vat	004 surface cooler			007 ice cream delivery unit
3000	METAL CUTTING							
3100	Press shear	2	1					2
3200	Press punch	1			1			1
3300	Saw							
3400	Torch							
3900	Other cutting operations							

HEAT TREAT OPERATIONS

(SITC # 719.1 - heating and cooling equipment)

Resource No.	Resources	Products (commodity no. 719.1-) 001 walk-in cooler-refrigerator	002 freezer	003 cold-hold storage vat	004 surface cooler			007 ice cream delivery unit
4000	HEAT TREAT OPERATIONS							
4100	Furnace							
4200	Induction							
4300	Quench							
4900	Other heat treat operations							

FASTENING OPERATIONS

(SITC # 719.1 - heating and cooling equipment)

Resource No.	Resources	Products (commodity no. 719.1-)						
		001 walk-in cooler-refrigerator	002 freezer	003 cold-hold storage vat	004 surface cooler			007 ice cream delivery unit
5000	FASTENING OPERATIONS							
5100	Self-tap screws	1						1
5110	Nuts and bolts	1	1					
5120	Rivets							
5130	Special fasteners		1					
5200	Weld, spot (short run)							1
5210	Weld, spot (long run)							
5220	Weld, continuous	1	2	2	1			2
5300	Cold flow							
5310	Force fit							
5320	Braze (silver solder)							
5340	Solder							
5400	Designed (catch, interlock, plug)							
5500	Glue							
5900	Other fastening operations							

FINISHING OPERATIONS

(SITC # 719.1 - heating and cooling equipment)

Resource No.	Resources	Products (commodity no. 719.1-)						
		001 walk-in cooler-refrigerator	002 freezer	003 cold-hold storage vat	004 surface cooler			007 ice cream delivery unit
6000	FINISHING OPERATIONS							
6100	Tumble							
6110	Straighten							
6120	Finish grind		1	1				1
6130	Brush and polish	1	1	1				1
6200	Dip (to clean, prime)	1						
6210	Dip (to finish)							
6300	Spray, paint (short run)	1						
6310	Spray, paint (auto line)							
6320	Spray, vitreous enamel (short run)							2
6330	Spray, vitreous enamel (auto line)							
6390	Spray, other finishes than above							
6400	Electroplate							
6500	Laminate							
6600	Chemical finishes (anodize etc.)							
6900	Other finishing methods							

FINAL ASSEMBLY AND PACK

(SITC # 719.1 - heating and cooling equipment)

Resource No.	Resources	Products (commodity no. 719.1-)						
		001 walk-in cooler-refrigerator	002 freezer	003 cold-hold storage vat	004 surface cooler			007 ice cream delivery unit
7000	FINAL ASSEMBLY AND PACK							
7100	Hand (short run, no pace, light)			1				1
7110	Hand (unit and short run, no pace, heavy)	1						
7120	Hand (long run, paced)							
7200	Semi-automatic							
7300	Fully automatic							
7400	Standard performance test							1
7410	Standard performance test (auto)							
7420	Critical test needed (see Annex 1)							
7430	Critical adjustment needed							
7440	Critical assembly equipment needed							
7500	Hand pack (short run, no pace, light)							1
7510	Hand pack (unit and short run, no pace, heavy)	1						
7520	Semi-automatic pack							
7530	Fully automatic pack							

MATERIAL HANDLING

(SITC # 719.1 - heating and cooling equipment)

Resource No.	Resources	Products (commodity no. 719.1-)						
		001 walk-in cooler-refrigerator	002 freezer	003 cold-hold storage vat	004 surface cooler			007 ice cream delivery unit
8000	MATERIAL HANDLING							
8050	Manual							
8060	Manual (simple wheels and skids)							
8100	Cranes (overhead)							
8200	Conveyors (manual)							
8210	Conveyors (automatic)							
8300	Trucks (lift, pallets, bins etc.)							
8310	Trucks (on rails)							
8400	Elevators							
8500	Transfer machine							
8900	Other material handling							

PURCHASED ITEMS

(SITC # 719.1 - heating and cooling equipment)

Resource No.	Resources	Products (commodity no. 719.-)						
		001 walk-in cooler-refrigerator	002 freezer	003 cold-hold storage vat	004 surface cooler			007 ice cream delivery unit
9000	PURCHASED ITEMS							
9100	Electrical motors							
9110	Electrical controls (simple)							
9120	Electrical controls (complex)							
9130	Electrical controls (very complex)							
9190	Electrical supplies other			1*				

[redacted]

([redacted] of 719.1 - heating and cooling equipment)

Resource No.	Resources	Products (commodity no. 719.1-)						
		001 walk-in cooler-refrigerator	002 freezer	003 cold-hold storage vat	004 surface cooler			007 ice cream delivery unit
9500	SERVICE FUNCTIONS							
9510	Laboratory (quality)							
9520	Laboratory (design)							
9530	Maintenance (critical)							
9540	Inventory level (critical)							
9550	Production sequence (critical							
9560	Sub-assembly coordination (critical)							
9570	Tool and die making			1				
9580	Jigs and fixtures			1				
9900	General design and specification							

[illegible]

([illegible])

Resource No.	Resources	Products (commodity no. 719.2-)						
		001 turbine pumps	002 centri-fugal pumps	003 rotary pumps	004 air com-pressor	005 air com-pressor	006 gas com-pressor	007 centri-fugal fans
1000	METAL FORMING							
1100	Forge, free							
1110	Forge, die							
1130	Forge, mixed free/die	1	1	1	1	1	1	1
1400	Casting, iron							
1405	sand	2	2	2	2	2	2	
1410	mold							
1420	Casting, malleable							
1430	Casting, steel							
1435	sand	2		2	2	2	2	1
1440	mold							
1450	Casting, non-ferrous							
1455	sand		2*	2*			2*	
1460	mold							
1465	die							
1470	Casting, precision							
1475	mold							
1480	die							
1490	Casting, all other							
1500	Upsetting (fasteners etc.)							
1400	Extrusion (tubes, shapes)							
1500	Roll (tubes, shapes)							2
1520	Bending rolls							
1600	Draw (tube, wire)							
1620	Drawing - seamless tubing							
1700	Press, draw (tubs, sinks etc.)							
1710	Press, coin (emboss etc.)							
1720	Press, bend (brake)				1	1		2
1800	Wind (motors, transformers etc.)							

METAL REMOVAL

(SITC # 719.2 - pumps, compressors, centrifuges)

Resource No.	Resources	Products (commodity no. 719.2-) 001 turbine pumps	002 centrifugal pumps	003 rotary pumps	004 air compressor	005 air compressor	006 gas compressor	007 centrifugal fans
2000	METAL REMOVAL							
2100	Turn (lathe)	2	2	2	2	2	2	2
2200	Bore (drill)	2	2	2	2	2	2	2
2210	Ream	2	2	2	2	2	2	2
2300	Grind	2	2	2	2	2	2	2
2400	Mill	2	2	2	2	2	2	2
2410	Shape (plane)							
2500	Broach							
2600	Tap (inside thread by die)	1	1	1	1	1	1	1
2610	Thread (outside thread by die)	1	1	1	1	1	1	1

METAL CUTTING

(SITC # 719.2 - pumps, compresseors, centrifuges)

Resource No.	Resources	Products (commodity no. 719.2-) 001 turbine pumps	002 centrifugal pumps	003 rotary pumps	004 air compressor	005 air compressor	006 gas compressor	007 centrifugal fans
3000	METAL CUTTING							
3100	Press shear							2
3200	Press punch							1
3300	Saw							
3400	Torch							
3900	Other cutting operations							

HEAT TREAT OPERATIONS

(SITC # 719.2 - pumps, compressors, centrifuges)

Resource No.	Resources	Products (commodity no. 719.2-) 001 turbine pumps	002 centrifugal pumps	003 rotary pumps	004 air compressor	005 air compressor	006 gas compressor	007 centrifugal fans
4000	HEAT TREAT OPERATIONS							
4100	Furnace	1	1	1	1	1	1	1
4200	Induction							
4300	Quench							
4900	Other heat treat operations							

FASTENING OPERATIONS

(SITC # 719.2 - pumps, compressors, centrifuges)

Resource No.	Resources	Products (commodity no. 719.2-)						
		001 turbine pumps	002 centri-fugal pumps	003 rotary pumps	004 air com-pressor	005 air com-pressor	006 gas com-pressor	007 centri-fugal fans
5000	FASTENING OPERATIONS							
5100	Self-tap screws							
5110	Nuts and bolts	1	1	1	1	1	1	1
5120	Rivets							1
5130	Special fasteners							
5200	Weld, spot (short run)							
5210	Weld, spot (long run)							
5220	Weld, continuous	1			1	1	1	2
5300	Cold flow							
5310	Force fit							
5320	Braze (silver solder)							
5340	Solder							
5400	Designed (catch, interlock, plug)							
5500	Glue							
5900	Other fastening operations							

FINISHING OPERATIONS

(SITC # 719.2 - pumps, compressors, centrifuges)

Resource No.	Resources	Products (commodity no. 719.2-)						
		001 turbine pumps	002 centri-fugal pumps	003 rotary pumps	004 air com-pressor	005 air com-pressor	006 gas com-pressor	007 centri-fugal fans
6000	FINISHING OPERATIONS							
6100	Tumble							
6110	Straighten							
6120	Finish grind	2	2	2	2	2	2	2
6130	Brush and polish							
6200	Dip (to clean, prime)	1	1	1	1	1	1	
6210	Dip (to finish)							
6300	Spray, paint (short run)	1	1	1	1	1	1	1
6310	Spray, paint (auto line)	1	1	1	1	1	1	1
6320	Spray, vitreous enamel (short run)	2*	2*	2*	2*	2*	2*	1*
6330	Spray, vitreous enamel (auto line)	2*	2*	2*	2*	2*	2*	1*
6390	Spray, other finishes than above							
6400	Electroplate							
6500	Laminate							
6600	Chemical finishes (anodize etc.)							
6900	Other finishing methods							

FINAL ASSEMBLY AND PACK

(SITC # 719.2 - pumps, compressors, centrifuges)

Resource No.	Resources	Products (commodity no. 719.2-)						
		001 turbine pumps	002 centri-fugal pumps	003 rotary pumps	004 air com-pressor	005 air com-pressor	006 gas com-pressor	007 centri-fugal fans
7000	FINAL ASSEMBLY AND PACK							
7100	Hand (short run, no pace, light)							
7110	Hand (unit and short run, no pace, heavy)	2	2	2	2	2	2	2
7120	Hand (long run, paced)							
7200	Semi-automatic							
7300	Fully automatic							
7400	Standard performance test	2	2	2	2	2	2	2
7410	Standard performance test (auto)							
7420	Critical test needed (see Annex 1)							
7430	Critical adjuetment needed							
7440	Critical assembly equipment needed							
7500	Hand pack (short run, no pace, light)							
7510	Hand pack (unit and short run, no pace, heavy)							
7520	Semi-automatic pack							
7530	Fully automatic pack							

MATERIAL HANDLING

(SITC # 719.2 - pumps, compressors, centrifuges)

Resource No.	Resources	Products (commodity no. 719.2-) 001 turbine pumps	002 centri-fugal pumps	003 rotary pumps	004 air com-pressor	005 air com-pressor	006 gas com-pressor	007 centri-fugal fans
8000	MATERIAL HANDLING							
8050	Manual	1	1	1	1	1	1	1
8060	Manual (simple wheels and skids)	1	1	1	1	1	1	1
8100	Cranes (overhead)	2*	2*	2*	2*	2*	2*	2*
8200	Conveyors (manual)	1	1	1	1	1	1	1
8210	Conveyors (automatic)							
8300	Trucks (lift, pallets, bins etc.)	2	2	2	2	2	2	2
8310	Trucks (on rails)							
8400	Elevators							
8500	Transfer machine							
8900	Other material handling							

PURCHASED ITEMS

(SITC # 719.2 - pumps, compressors, centrifuges)

Resource No.	Resources	Products (commodity no. 719.2-) 001 turbine pumps	002 centri-fugal pumps	003 rotary pumps	004 air com-pressor	005 air com-pressor	006 gas com-pressor	007 centri-fugal fans
9000	PURCHASED ITEMS							
9100	Electrical motors	1	1	1	1	1	1	1
9110	Electrical controls (simple)	1	1	1	1	1	1	
9120	Electrical controls (complex)	1	1	1	1	1	1	
9130	Electrical controls (very complex)	1	1	1	1	1	1	
9900	Other purchased supplies	1*	1*	1*	1*	1*	1*	1*

SERVICE FUNCTIONS

(SITC # 719.2 - pumps, compressors, centrifuges)

Resource No.	Resources	Products (commodity no. 719.2-)						
		001 turbine pumps	002 centri-fugal pumps	003 rotary pumps	004 air com-pressor	005 air com-pressor	006 gas com-pressor	007 centri-fugal fans
9500	SERVICE FUNCTIONS							
9510	Laboratory (quality)	1	1	1	1	1	1	
9520	Laboratory (design)							
9530	Maintenance (critical)							
9540	Inventory level (critical)	2	2	2	2	2	2	2
9550	Production sequence (critical)	2	2	2	2	2	2	2
9560	Sub-assembly coordination (critical)	2	2	2	2	2	2	2
9570	Tool and die making	2	2	2	2	2	2	1
9580	Jigs and fixtures	2	2	2	2	2	2	2
9900	General design and specification	2	2	2	2	2	2	2
9910	Field supervision	2	1	1	2	2	2	1
9920	Field tests	2	1	1	2	2	2	1

METAL FORMING

(SITC # 729.9 - electrical goods and apparatuses, n.e.s.[a/])

Resource No.	Resources	Products (commodity no. 729.9-)						
		001 specialty transformer	002 single pole switch	003 plug fuse	004 cartridge fuse			
1000	METAL FORMING							
1100	Forge, free							
1120	Forge, die							
1130	Forge, mixed free/die							
1200	Casting, iron							
1205	sand							
1210	mold							
1220	Casting, malleable							
1230	Casting, steel							
1235	sand							
1240	mold							
1250	Casting, non-ferrous							
1255	sand							
1260	mold							
1265	die							
1270	Casting, precision							
1275	mold							
1280	die							
1290	Casting, all other							
1300	Upsetting (fasteners etc.)							
1400	Extrusion (tubes, shapes)							
1500	Roll (tubes, shapes)							
1600	Draw (tube, wire)							
1700	Press, draw (tubs, sinks etc.)				1			
1710	Press, coin (emboss etc.)	1	1					
1720	Press, bend (brake)	2	1	1				
1800	Wind (motors, transformers etc.)	2						

a/ not elsewhere specified.

METAL REMOVAL

(SITC # 729.9 - electrical goods and apparatuses, n.e.s.)

Resource No.	Resources	Products (commodity no. 729.9-) 001 specialty transformer	002 single pole switch	003 plug fuse	004 cartridge fuse			
2000	METAL REMOVAL							
2100	Turn (lathe)							
2200	Bore (drill)	1						
2210	Ream							
2300	Grind							
2400	Mill							
2410	Shape (plane)							
2500	Broach							
2600	Tap (inside thread by die)	1	1					
2610	Thread (outside thread by die)							

METAL CUTTING

(SITC # 729.9 - electrical goods and apparatuses, n.e.s.)

Resource No.	Resources	Products (commodity no. 729.9-) 001 specialty transformer	002 single pole switch	003 plug fuse	004 cartridge fuse			
3000	METAL CUTTING							
3100	Press shear				1			
3200	Press punch	2	1	1	1			
3300	Saw							
3400	Torch							
3900	Other cutting operations	1	1	1				

HEAT TREAT OPERATIONS

(SITC # 729.9 - electrical goods and apparatuses, n.e.s.)

Resource No.	Resources	Products (commodity no. 729.9-) 001 specialty transformer	002 single pole switch	003 plug fuse	004 cartridge fuse			
4000	HEAT TREAT OPERATIONS							
4100	Furnace							
4200	Induction							
4300	Quench							
4900	Other heat treat operations							

FASTENING OPERATIONS

(SITC # 729.9 - electrical goods and apparatuses, n.e.s.)

Resource No.	Resources	Products (commodity no. 729.9-)						
		001 specialty transformer	002 single pole switch	003 plug fuse	004 cartridge fuse			
5000	FASTENING OPERATIONS							
5100	Self-tap screws	1	1					
5110	Nuts and bolts							
5120	Rivets							
5130	Special fasteners							
5200	Weld, spot (short run)							
5210	Weld, spot (long run)							
5220	Weld, continuous							
5300	Cold flow							
5310	Force fit							
5320	Braze (silver solder)							
5340	Solder	1		2	1			
5400	Designed (catch, interlock, plug)							
5500	Glue							
5900	Other fastening operations							

FINISHING OPERATIONS

(SITC # 729.9 - electrical goods and apparatuses, n.e.s.)

Resource No.	Resources	Products (commodity no. 729.9-)						
		001 specialty transformer	002 single pole switch	003 plug fuse	004 cartridge fuse			
6000	FINISHING OPERATIONS							
6100	Tumble							
6110	Straighten							
6120	Finish grind							
6130	Brush and polish							
6200	Dip (to clean, prime)							
6210	Dip (to finish)	2	2					
6300	Spray, paint (short run)							
6310	Spray, paint (auto line)							
6320	Spray, vitreous enamel (short run)							
6330	Spray, vitreous enamel (auto line)							
6390	Spray, other finishes than above							
6400	Electroplate							
6500	Laminate							
6600	Chemical finishes (anodize etc.)							
6900	Other finishing methods							

FINAL ASSEMBLY AND PACK

(SITC # 729.9 - electrical goods and apparatuses, n.e.s.)

Resource No.	Resources	Products (commodity no. 729.9-)						
		001 specialty transformer	002 single pole switch	003 plug fuse	004 cartridge fuse			
7000	FINAL ASSEMBLY AND PACK							
7100	Hand (short run, no pace, light)							
7110	Hand (unit and short run, no pace, heavy)							
7120	Hand (long run, paced)							
7200	Semi-automatic	2	1	1	1			
7300	Fully automatic							
7400	Standard performance test	1						
7410	Standard performance test (auto)							
7420	Critical test needed (see Annex 1)							
7430	Critical adjustment needed							
7440	Critical assembly equipment needed							
7500	Hand pack (short run, no pace, light)							
7510	Hand pack (unit and short run, no pace, heavy)							
7520	Semi-automatic pack	1	1	1	1			
7530	Fully automatic pack							

MATERIAL HANDLING

(SITC # 729.9 - electrical goods and apparatuses, n.e.s.)

Resource No.	Resources	Products (commodity no. 729.9-)						
		001 specialty transformer	002 single pole switch	003 plug fuse	004 cartridge fuse			
8000	MATERIAL HANDLING							
8050	Manual							
8060	Manual (simple wheels and skids)	1	1	1	1			
8100	Cranes (overhead)							
8200	Conveyors (manual)	1	1					
8210	Conveyors (automatic)							
8300	Trucks (lift, pallets, bins etc.)	1	1	1	1			
8310	Trucks (on rails)							
8400	Elevators							
8500	Transfer machine							
8900	Other material handling							

PURCHASED ITEMS

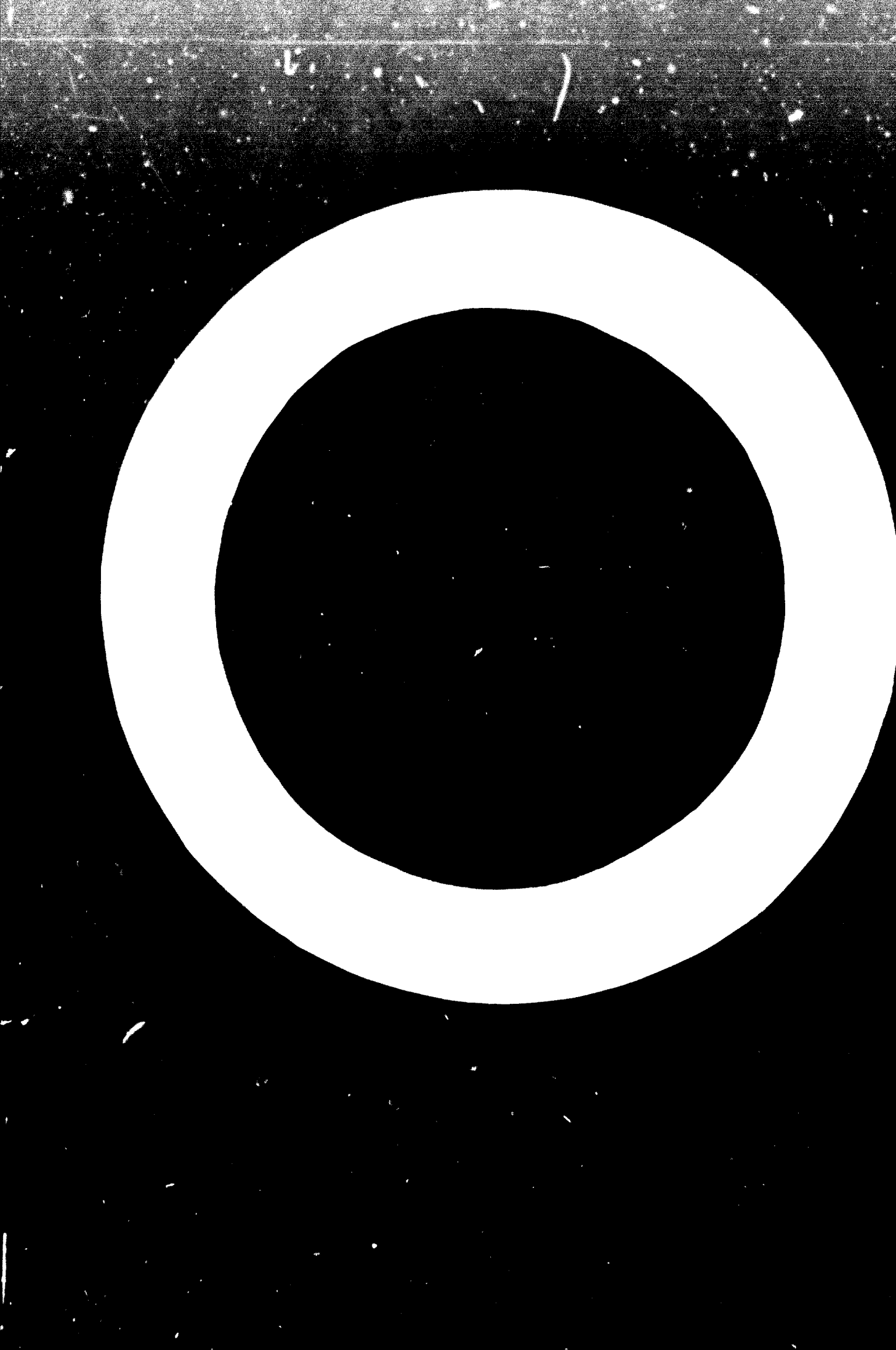
(SITC # 729.9 - electrical goods and apparatuses, n.e.s.)

Resource No.	Resources	Products (commodity no. 729.9-)						
		001 specialty transformer	002 single pole switch	003 plug fuse	004 cartridge fuse			
9000	PURCHASED ITEMS							
9100	Electrical motors							
9110	Electrical controls (simple)							
9120	Electrical controls (complex)							
9130	Electrical controls (very complex)							
9190	Electrical supplies other							
9200	Mechanical supplies		1	1	1			

SERVICE FUNCTIONS

(SITC # 729.9 - electrical cables and apparatuses, n.e.s.)

Resource No.	Resources	Products (commodity no. 729.9-)						
		001 specialty transformer	002 single pole switch	003 plug fuse	004 cartridge fuse			
9500	SERVICE FUNCTIONS							
9510	Laboratory (quality)							
9520	Laboratory (design)							
9530	Maintenance (critical)							
9540	Inventory level (critical)							
9550	Production sequence (critical)							
9560	Sub-assembly coordination (critical)							
9570	Tool and die making	1	1	1	1			
9580	Jigs and fixtures	1	1	1	1			
9900	General design and specification	2	1	1	1			



ANNEX 1

Notes and addenda to semi-quantitative data

Reference no. of matrix cell	
692.1-001/6900	Product description: This product is made of tin-plated steel, with a cover of the same material. Weight - approx. 15 lb. Reference - Penn-Michigan Co. Catalog. SIC no. 3443 (boiler-shop manufactures including tanks and processing and storage vessels).
	Resource notes: 6900 is a hot tin-plate dip process using a minimum of 80 per cent pure tin.
692.1-002/7400	Product description: Complete at factory, a standard-line, non-pressure tank. Reference - Buffalo Tank Corp. Catalog, Tank No. 12.
	Resource notes: The standard performance test is a hydrostatic test.
" " /7420	The critical test needed is an ultrasonic test.
" " /9200	Other purchased items needed are nozzles and flanges.
692.1-003/7400	Product description: Complete at factory, a standard-line, non-pressure tank. Reference - Buffalo Tank Corp. Catalog, Tank No. 69.
	Resource notes: See 692.1-002 above.
692.1-004/——	Product description: 50 gallon unit, stainless steel inside and out, with agitator and 1/6 horsepower motor. Weight - approx. 670 lb. Reference - Creamery Package Mfg. Co. Catalog - Series 40, Multi-Process Tanks.
692.1-005/——	Product description: 50 gallon unit, stainless steel with an agitator and 1/4 horsepower motor. It is used to flavor ice-cream before freezing. Weight - 250 lb. Reference - Cherry-Burrell Corp. Catalog, Univat Mix Flavor Tank.
692.1-007/——	Product description: Capacity - 244 cu. ft. gas at 2200 p.s.i. and 70° F. Reference - Airco General Corp. Catalog.
" " /1600	Resource notes: A pierce and draw process.
" " /7400	A hydrostatic test.
" " /7420	An ultrasonic test.

Prod. No./Res. No.

711.1-001/—— Product description: Water tube, 15 p.s.i. to 449 p.s.i. SIC no. 3443. Reference - Combustion Engineering Co. Catalog, boiler no. VU-10, Sweet's Plant Engineering File no. 10b/co, p. 3, 1967.

" " /7400 Resource notes: A hydrostatic test.

" " /7420 An ultrasonic or X-ray test.

" " /9200 Bearings, seals, lubrication fittings, instruments, fasteners, piping, valves, nozzles, flanges etc., as required.

" " /9510 Metallurgical research - chemical and spectroscopy.

711.1-002/—— Product description: 450 p.s.i. working steam pressure or 250,000 lb. of steam per hr. Reference - Combustion Engineering Co. Catalog, boilers VP-12W and VP-14W, Sweet's Plant Engineering File no. 10b/Co, p. 2, 1967.

Resource notes: Same as above.

711.1-003/—— Product description: Fire tube, horizontal return, tubular. Reference - Federal Boiler Co. Catalog, Series FLR.

Resource notes: Same as above.

711.1-004/—— Product description: Scotch automatic packaged boiler. Reference - Federal Boiler Co. Catalog, Series AST.

711.1-005/—— Product description: Boiler used for pasteurization and cleaning in ice-cream plants. 10 horsepower unit, gas or oil fired. Weight - 500 lb. without burner. Reference - Kisco Boiler and Engineering Co. Bulletin KSA 20-457, "2-Drum Hi-Ef Steamatic Boilers."

712.3-001/—— Product description: 100 gallons per hour capacity. Frame contains pumping and pressure mechanism. V-belt drive. Motor and cylinder block and controls attached. Weight - approx. 1200 lb. Reference - Cherry-Burrell Corp., Model A. SIC no. 3551 (Food Products Machinery).

712.3-002/—— Product description: Consists of frame, hopper, filling mechanism, cup dispenser, capper and positioner. Uses 1/2 horsepower motor. Weight - 900 lb. Reference - Anderson Brothers Model no. 34. SIC no. 3551 (Food Products Machinery).

719.1-001/—— Product description: Aluminized steel walls, top, and outside bottom. Inside bottom is plywood, covered with non-skid mineral coating. Insulation is cork or fibre-glass. Dimensions: 10' x 13' x 8'. Weight - approx. 2500 lb. Reference - American Cooler Co. Bulletin No. A-2. SIC no. 3585 (Refrigeration Machinery).

Prod. No./Res. No.

719.1-002/—— Product description: Ice-cream freezer, 20 quart unit. Produces 30 gallons of ice-cream per hour. Product has self-contained, air-cooled 3 horsepower refrigeration unit. Weight - 960 lb. Reference - Emery Thompson Machinery and Supply Co., Model 20HSC-A. SIC no. 3585.

719.1-003/—— Product description: Vat holds ice-cream mix until needed for freezing. 90 gallon unit with direct expansion refrigeration air-cooled unit. Weight - 586 lb. Reference - Paul Mueller Co., PS Model 90, EM-BEE Tank. SIC no. 3585.

" " /9199 Resource note: Refrigeration controls needed.

719.1-004/—— Product description: Reduces temperature from pasteurising temperature (approx 168° F). to a processing temperature (40-50° F). Exterior is mild steel coated with a heavy-duty vinyl plastic. Tubing and fittings are of stainless steel. Weight - approx.750 lb. Reference - Creamery Package Mfg. Co., Bantam Heat Exchanger. SIC no. 3585.

719.1-007/—— Product description: Dry-ice pushcycle. Painted steel inside and out. Fibre glass insulation. Stainless steel pushhandle. Mounted on air-inflated tires. Bicycle unit attached. Weight - 200 lb. Reference - Workman Trading Corp. Bulletin. SIC no. 3585.

719.2-001/—— Product description: Vertical pump for wells. Reference - Allis Chalmers Co., Vertical Turbine Pumps, Bulletin 52C9409. SIC no. 3561 (Pumps and Compressors).

" " /8100 Resource notes: Overhead cranes needed for very large units only.

" " /9200 Bearings, seals, lubrication fittings, gages, piping, valves etc., as required.

719.2-002/—— Product description: Single stage, single-suction, frame-mounted, with a 1-1/4 x 1-1/2" discharge outlet. Reference - Allis-Chalmers Co., Model F-2L. Sweet's Plant Engineering File no. 4a/AL, Bulletin CP 2.2b, p. 8. SIC no. 3561.

" " /1255 Resource notes: This process needed for bronze-filled or all-bronze pumps.

" " /8100 For very large units only.

" " /9200 Same as 719.2-001.

719.2-003/—— Product description: 100 p.s.i. and less. Reference - Viking Pump Co., Model DK. Sweet's Plant Engineering File no. 4a/Vi, Bulletin 67s, p. 3. SIC no. 3561.

Prod. No./Res. No.	
719.2-003/1255	Cast bronze rotor.
" " /8100	For very large units only.
" " /9200	Same as 719.2-001.
719.2-004/——	Product description: Stationary, 1 and 1/2 horsepower and under. Reference - Ingersoll Rand Co., Type 30, Model HDC 1. Sweet's Plant Engineering File no. 4b/Ing.
" " /8100	Resource notes: For very large units only.
" " /9200	Same as 719.2-001.
719.2-005/——	Product description: Stationary, from 16 to 100 horsepower. Reference - Ingersoll Rand Co., Type 40, Model 100B. Sweet's Plant Engineering File no. 4b/Ing.
" " /8100	Resource notes: For very large units only.
" " /9200	Bearings, seals, lubrication fittings, gages, piping, valves etc., as required.
719.2-006/——	Product description: A centrifugal and axial compressor. Reference - Allis Chalmers Co., Modular "Centri-Stack" Compressor Model no. VT-207. Sweet's Plant Engineering File no. 4b/AL, p. 11. SIC no. 3561.
" " /1255	Resource notes: Cast aluminum impeller.
" " /8100	For very large units only.
" " /9200	Same as 719.2-005.
719.2-007/——	Product description: Reference - Buffalo Forge Co., "Limit-Load" Ventilating Fans Type BL, Bulletin F-105. SIC no. 3564 (Industrial Fans).
" " /8100	Resource notes: For very large units only.
" " /9200	Same as 719.2-005.
729.9-001/——	Product description: Specialty transformer for bells and buzzers. Surface mount, primary - 115 volt, 50/60 cycles, secondary 10 volts and 1/2 amps. Dimensions: 2.375" and 2.31" high. Reference - Eagle Electric Mfg. Co. Catalog no. 207. SIC no. 3643 (Current-carrying Wiring Devices).

Prod. No./Rec.No.

729.9-002/—— Product description: Single pole switch, dust apron with plastic cove, 15 amps/120 volts. Reference - Eagle Electric Manufacturing Catalog no. 1221B. SIC no. 3643.

729.9-003/—— Product description: Plug fuse, 15 amps. Reference - Eagle Electric Mfg. Co. Catalog no. 675. SIC no. 3643.

729.9-004/—— Product description: Non-renewable cartridge fuse, ferrule type, 250 volts, 60 amps. Reference - Eagle Electric Mfg. Co. Catalog no. 655.

ANNEX 2

List of manufacturers

Catalogues of the following manufacturers were used for reference in this paper.

AIR REDUCTION CO., Airco Industrial Gases Div., 1125 Globe Avenue, Mountainside, New Jersey

ALLIS-CHALMERS Manufacturing Co., 100 Church Street, New York, New York

AMERICAN COOLER CO., 3733 Sutherland Street, Indianapolis 18, Indiana

ANDERSON BROTHERS MANUFACTURING CO., 37-25 Veron Boulevard, Long Island City, New York

BUFFALO FORGE CO., Buffalo, New York

BUFFALO TANK CORP, Division of Bethlehem Steel, South Avenue, Dunellen, New Jersey

CHERRY-BURRELL CORP., Cedar Rapids, Iowa

COMBUSTION ENGINEERING CO., 277 Park Avenue, New York, New York

CREAMERY PACKAGE MANUFACTURING CO., 1243 West Washington Boulevard, Chicago 7, Illinois

EAGLE ELECTRIC MANUFACTURING CO., 23-10 Bridge Plaza South, Long Island City, New York

EMERY THOMPSON MACHINE AND SUPPLY CO., 1349 Inwood Avenue, New York 52, New York

FEDERAL BOILER CO., Div. of Federal Hydronics, Inc., Midland Park, New Jersey

INGERSOLL RAND CO., 485 Madison Avenue, New York, New York

KIESCO BOILER AND ENGINEERING CO., 2400 DeKalb Street, St. Louis 4, Missouri

VIKING PUMP CO., 1095 Peterson Lane, Secaucus, New Jersey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