

CHAPTER 14

STATISTICAL APPENDIX ON METALWORKING

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The preceding chapters on metalworking refer to data contained in a *Statistical Supplement on Metalworking*. These data are not fully reproduced here because of space and cost considerations. The *Supplement* may be obtained from the Cowles Foundation for Research in Economics, Yale University, New Haven, Connecticut.

Tables A and B present the classification used in Table C. Tables D and E present the classification used in Table F. Chapter 10 (Table 9) and Chapter 11 refer to Table C; Chapter 12 to Table F.

TABLE A (Complete)
INDUSTRIAL CLASSIFICATION AND RESPONSE PERCENTAGES FOR TABLE C

Industry	Response Percentage
19 Ordnance and accessories	20.4
25 Furniture and fixtures	11.8
332 Iron and steel foundries	21.1
336 Nonferrous foundries	18.8
3391 Iron and steel forgings	17.1
3393 Welded and heavy-riveted pipe	2.8
341 Tin cans and other tinware	3.8
342 Cutlery, hand tools, and hardware	21.1
343 Heating and plumbing equipment	10.4
344 Structural metal products	12.8
346 Metal stamping and coating	20.1
347 Lighting fixtures	21.8
348 Fabricated wire products	10.3
349 Metal products, n.e.c.	13.2
351 Engines and turbines	22.5
352 Tractors and farm machinery	34.5
353 Construction and mining machinery	26.5
354 Metalworking machinery	37.6
355 Special-industry machinery, n.e.c.	26.7
356 General industrial machinery	21.3
357 Office and store machines	23.4
358 Service and household machines	39.5
359 Miscellaneous machinery parts	18.1
361 Electrical industrial apparatus	26.0
362 Electrical appliances	36.4
363 Insulated wire and cable	8.5
364 Engine electrical equipment	43.1
365 Electric lamps (bulbs)	2.5
366 Communication equipment	23.0
369 Electrical products, n.e.c.	25.6
371 Motor vehicles and equipment	47.8
3721 Aircraft	12.7
3722-29 Aircraft engines, propellers, equipment, n.e.c.	38.3
373 Ships and boats	12.7
374 Railroad equipment	33.6
375 Motorcycles and bicycles	5.7
379 Transportation equipment, n.e.c.	15.3
381 Scientific instruments	11.1
382 Mechanical measuring instruments	40.0
383 Optical instruments and lenses	46.7
384 Medical instruments and supplies	29.5
385 Ophthalmic goods	39.4
386 Photographic equipment	7.7
387 Watches and clocks	10.0
39 Miscellaneous manufactures	8.7

TABLE B (Extract)
EQUIPMENT CLASSIFICATION USED IN TABLE C

Machine Tools**Boring Machines**

- Horizontal boring, drilling, and milling
- Vertical boring mills including vertical turret lathes
- Precision, horizontal and vertical
- Jig boring, horizontal and vertical
- Other

Broaching Machines

- Horizontal internal
- Horizontal surface
- Vertical internal
- Vertical surface
- Rotary surface and other

Contour Saving and Filing**Cutoff Machines**

- Bandsaw
- Abrasive disk
- Hacksaws
- Rotary, hot or cold
- Other

Drilling Machines

- Sensitive
- Upright (single-spindle gang)
- Radial
- Multi-spindle cluster, adjustable and fixed center
- Unit head and way type, multi-spindle
- Deep-hole drills
- Other

Gear Cutting and Finishing Machines

- Hobbing machines
- Shapers, gear
- Cutters, form-milling type
- Bevel gear cutters (not planer)
- Cutters, planer type
- Grinders, gear
- Shavers, gear
- Burnishing and lapping
- Chamfering, tooth pointing, tooth rounding
- Other

Gear checking machines**Grinding Machines**

- External cylindrical, plain and universal
 - Internal cylindrical
 - Centerless: External
 - Internal
 - Surface: Rotary table type
 - Reciprocating type
 - Disk, horizontal and vertical
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TABLE C (Extract)
EQUIPMENT IN METALWORKING INDUSTRIES, 1953
(NUMBER OF MACHINES)

Industry	353	354	355	356	357	358	359	361
Equipment								
Boring	2454.	7343.	4756.	4738.	577.	1791.	3309.	2376.
Horizontal	840.	3178.	1930.	1351.	51.	633.	829.	660.
Vertical	1149.	1689.	2037.	2533.	30.	215.	1060.	806.
Precision	193.	837.	254.	483.	312.	746.	569.	357.
Jig	121.	1485.	423.	230.	171.	164.	299.	422.
Other	151.	154.	112.	141.	13.	33.	552.	131.
Broaching	292.	802.	579.	853.	172.	345.	817.	296.
Horiz. int.	212.	539.	370.	600.	73.	132.	375.	146.
Horiz. surf.	8.	69.	56.	42.	0.	46.	144.	0.
Vert. int.	49.	88.	112.	192.	56.	48.	182.	54.
Vert. surf.	19.	74.	30.	19.	43.	114.	88.	84.
Rot. othr.	4.	32.	11.	0.	0.	5.	28.	12.
Contour s. f.	238.	1464.	909.	572.	473.	407.	442.	672.
Cutoff	2608.	5053.	4810.	4705.	756.	2158.	3876.	5242.
Bandsaw	722.	1964.	1822.	1590.	320.	794.	1082.	2070.
Abr. disk	310.	651.	681.	525.	90.	291.	535.	445.
Hacksaws	1221.	1965.	1863.	1967.	260.	554.	1635.	1467.
Rotary	215.	308.	236.	356.	30.	324.	359.	749.
Other	140.	165.	209.	267.	56.	195.	265.	511.
Drilling	7464.	23758.	22464.	17759.	9905.	11213.	16048.	19631.
Sensitive	1009.	4416.	3815.	2734.	4522.	3294.	3571.	8744.
Uprt. singl. gang	2998.	9289.	8254.	7692.	1986.	4086.	7204.	6547.
Radial	438.	2960.	3362.	1890.	1977.	1672.	1457.	1379.
MS. clstr.	2171.	4961.	3804.	3138.	214.	956.	1459.	1832.
Uh. wt. ms.	280.	670.	1221.	1428.	777.	466.	850.	434.
Deep hole	231.	364.	295.	244.	339.	180.	376.	142.
Other	72.	165.	142.	75.	0.	78.	193.	61.
Gear	265.	933.	1571.	558.	90.	481.	938.	492.
Hobbing	1443.	4543.	2598.	10224.	1029.	669.	422.	668.
Shapers	480.	1483.	1062.	4104.	576.	417.	149.	449.
Cutters	476.	1042.	677.	1998.	184.	124.	144.	84.
Bevel	306.	547.	411.	882.	162.	18.	72.	31.
Planers	83.	340.	161.	1534.	77.	46.	39.	19.
Grinders	15.	98.	37.	295.	9.	0.	6.	15.
Shavers	8.	340.	64.	295.	0.	3.	6.	12.
Brnsh. lp.	11.	194.	49.	464.	21.	38.	0.	8.
Chamfer	26.	162.	41.	324.	0.	23.	6.	31.
Other	30.	162.	37.	169.	0.	10.	0.	0.
Gear checking	8.	175.	59.	159.	0.	0.	0.	19.
Grinding	113.	1028.	374.	1069.	26.	81.	11.	69.
Ext. cyl.	10239.	40664.	23828.	17930.	7434.	8291.	39738.	14749.
Int. cyl.	949.	7004.	2918.	2471.	864.	1012.	3875.	1221.
Cntrls. ext. int.	688.	2707.	812.	1312.	222.	248.	3616.	549.
Surf. rot. recip.	193.	670.	348.	361.	196.	486.	3650.	250.
Disk	36.	68.	51.	45.	0.	81.	585.	88.
Tool	276.	1897.	808.	949.	90.	496.	1639.	503.
Bench	446.	7238.	2394.	1051.	1410.	1146.	1811.	2726.
Abr. belt	163.	1010.	804.	638.	312.	326.	2208.	818.
Other	2540.	8067.	4417.	3668.	766.	2176.	5360.	4881.
	4150.	7571.	8347.	5981.	2660.	1784.	4033.	2346.
	363.	1222.	1182.	816.	517.	296.	800.	753.
	435.	3210.	1747.	638.	397.	240.	12161.	614.

TABLE D (*Extract*)
MACHINE TOOL CLASSIFICATION FOR TABLE F

Code Number	
	Boring Machines—Horizontal
1	(a) under 3" spindle, under 36" bed
2	(b) 3-5" spindle, 36-120" bed
3	(c) 6-10" spindle, 10-23' and over
	Boring Machines—Vertical
4	(a) under 36" swing
5	(b) 36-120" swing
6	(c) 10-25' swing and over
	Precision Boring Machines
7	(a) under 8" bore, 18" table
8	(b) 8-14" bore, 18" table
	Jig Boring—Horizontal and Vertical
9	(a) under 15" table
10	(b) 15-40" table
11	(c) 40-120" table and over
	Broaching—Horizontal and Vertical—Internal
12	(a) under 15" stroke, under 5 tons
13	(b) 18-36" stroke, 5-35 tons
14	(c) 36-120" stroke, 35-60 tons
	Broaching—External
15	(a) under 15" stroke, under 5 tons
16	(b) 18-36" stroke, 5-25 tons
17	(c) 36-120" stroke, over 25 tons
	Sawing and Cutoff Machines
18	(a) under 12" work
19	(b) 12-30" work
	Bandsaws
20	(a) under 12" work
21	(b) 12-30" work

TABLE E (*Extract*)
 TASK CLASSIFICATION FOR TABLE F

Code Number	
	IV. Cylindrical—External (cont'd.)
52	Medium, Semiprecision, long run
53	Medium, Precision, short run
54	“ “ long run
55	Medium, High Precision
56	Large, Semiprecision, short run
57	“ “ long run
58	Large, Precision
59	Very Large, Semiprecision
60	Very Large, Precision
	V. Cylindrical—Internal
61	Small, Semiprecision, short run
62	“ “ long run
63	Small, Precision, short run
64	“ “ long run
65	Small, High Precision
66	Medium, Semiprecision, short run
67	“ “ long run
68	Medium, Precision, short run
69	“ “ long run
70	Medium, High Precision
71	Large, Semiprecision, short run
72	“ “ long run
73	Large, Precision, short run
74	“ “ long run
75	Very Large, Semiprecision
76	Very Large, Precision
	VI. Drilled Holes
77	Very Small, Semiprecision, short run
78	“ “ “ long run

TABLE F (Extract)
RATE OF OUTPUT OF MACHINE-TASK COMBINATIONS

Machine Number	Task Number	Machine Time	Handling Time	Set-up Time	Pieces per Day
1	61	.58	.90	40.00	230.17
1	62	.58	.90	40.00	257.61
1	63	.58	1.35	45.00	157.08
1	64	.58	1.35	45.00	169.05
1	65	.58	1.55	60.00	114.19
1	66	2.32	1.16	40.00	85.08
1	67	2.32	1.16	40.00	102.24
1	68	2.32	1.63	55.00	63.65
1	69	2.32	1.63	55.00	78.62
1	70	2.32	3.15	70.00	43.11
2	61	.60	.96	42.00	218.54
2	62	.60	.96	42.00	245.89
2	63	.60	1.40	49.00	151.71
2	64	.60	1.40	49.00	163.59
2	65	.60	1.60	64.00	110.90
2	66	2.50	1.16	43.00	80.57
2	67	2.50	1.16	43.00	97.07
2	68	2.50	1.70	59.00	59.86
2	69	2.50	1.70	59.00	74.05
2	70	2.50	3.25	74.00	41.12
3	66	2.70	1.20	45.00	75.88
3	67	2.70	1.20	45.00	91.25
3	68	2.70	1.75	63.00	56.48
3	69	2.70	1.75	63.00	69.98
3	70	2.70	3.35	79.00	39.13
4	1	.41	1.74	30.00	84.20
4	2	.41	1.74	30.00	89.22
4	3	.41	2.03	40.00	64.78
4	4	.41	2.03	40.00	68.01
4	5	.82	3.01	55.00	46.76
4	6	1.60	2.26	35.00	39.93
4	7	1.60	2.26	35.00	46.32
4	8	1.60	2.84	45.00	30.15
4	9	1.60	2.84	45.00	35.36
4	10	3.20	4.71	65.00	16.41
4	46	.41	1.74	30.00	84.20
4	47	.41	1.74	30.00	89.63
4	48	.41	2.03	40.00	64.78
4	49	.41	2.03	40.00	68.01

Note: Machine time and handling time are expressed in minutes per piece; set-up time is expressed in minutes per lot.