ASSUMPTIONS/DEFINITIONS

Production Schedule

Initial Production - For first three months of production the equivalent production (i.e. units built x progress factor) is held constant and cumulative production for period equals approximately 300 units.

Maximum Production - 750 units per month for base case, reached 12 months after FCS.

Ramp - Approximately linear from end of Initial Production to Maximum Production with equivalent production increasing, not to exceed peak production.

Program Quantities

Base Case	34,009 units (750 units/month)
Low Quantity	20,509 units (375 units/month)
High Quantity	59,884 units (1,500 units/month)

Direct Material Expenditures

Pipe Line - Three full months from receipt of goods to finished product (ship).

Equivalent Build Schedule - Build Schedule x Progress Factor (obtained from learning curve).

Cost - Estimate from ultimate material cost and progress factor increased at 3% per year after 1974. Same learning curve used for material and labor.

Floor Loss - 4% and included in Material Cost Estimate.

Direct Manpower/Expenditures

Requirements - Based upon direct labor hours per machine, progress factor, and production schedule normalized to 150 productive hours per month per man.

Manpower = Ultimate Labor Hours per Machine X Progress Factor X Build Schedule/ 150 hours per month.

3.1.1

Pipe Line - See Direct Labor hours by Function Schedule.

Salary Levels - 10% increase over present employment level for 176 hours/month and 5% per year increase after 1974.

Expenses - No expenses anticipated for direct employees.

Indirect Costs

Requirements - See Indirect Skill Schedule.

Salary Levels - No salary increase over present level for 1973 and 7% per year increase thereafter.

Expenses - Expenses through May are exact and equal to preliminary budget. After May expenses are estimated at $400/mm for Engineering and Process Development, and $50/mm for Production Support and Administration. Expenses include hardware costs for three (3) prototype drives.

Capital Equipment

Depreciation Schedule - 5-year straight line depreciation is assumed, except for Cost Summary, where Capital Equipment is fully depreciated.

Warranty

Warranty Period - Three months.

Warranty Costs - $9.50 direct labor and material cost per incident (adjusted for Progress) plus Indirect Support at 22% of direct cost and $2.00 per incident for shipping.

Unit Costs

Average Unit Cost - Calculated from Cumulative Manufacturing Expenditures normalized to cumulative units shipped. Average Unit Costs are given in Total Manufacturing Cost/Expenditure Schedule as a function of time. (These costs do not include capital equipment expenditures.) The Average Unit Costs for the program is obtained by dividing the total Program Costs by the total Program Quantity--see Product Cost Summary

3.1.1

Instantaneous Unit Cost - See Unit Cost - Non-Cumulative. This is an estimate of what the product is costing as a function of time (or unit number). The direct material and labor is calculated from the ultimate material and labor cost (progress factor = 1) and the learning curve. Indirect Costs are the total indirect costs incurred during the month that these units were shipped. EC Scrap and Rework is obtained from the EC Scrap and Rework Costs schedule for the period 3 months prior to the ship date. Capital Depreciation is for the month the units are shipped.

Sensitivity Analysis

High Program Quantity - 1973 and 1974 production quantity remains constant. The 1975 production is twice the base case (i.e. 1,500 units/month) with a three month ramp from 750 units to 1,500 units/month. The remainder of the program is held at a production level of 1,500 units/month.

Low Program Quantity - 1973 and 1974 production quantities remain constant. 1975, 1976, and 1977 production quantities are reduced by half over the base case (i.e. 375 units/month). No ramp down is assumed.

3.1.2 PRODUCTION SCHEDULE

3.1.2

Production Schedule - Base Case

		Ship Schedule	Ship Cumulative	Ship By Quarter	Ship By Year
73	1				275
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9	0	0	0	
	10	65	65		
	11	95	160	275	
	12	115	275		
74	1	190	465		6,734
	2	280	745	840	
	3	370	1,115		
	4	460	1,575		
	5	550	2,125	1,587	
	6	577	2,702		
	7	625	3,327		
	8	682	4,009	2,057	
	9	750	4,759		
	10	750	5,509		
	11	750	6,259	2,250	
	12	750	7,009		
75		9,000	16,009	2,250	9,000
76		9,000	25,009	2,250	9,000
77		9,000	34,009	2,250	9,000

3.1.3 SUMMARY

3.1.3.1

Product Cost Summary - Base Case

	PROGRAM	UNIT	
Direct Material Costs	6,298,234	185.19	68.2%
Direct Labor Costs	964,214	28.35	10.5%
Total Direct Manufacturing Costs	7,262,448	213.54	78.7%
Indirect Labor Costs	1,462,370	43.00	15.8%
Indirect Expense Costs	140,100	4.12	1.5%
Total Indirect Costs	1,602,470	47.12	17.3%
EC Scrap & Rework Costs	137,980	4.06	1.5%
Total Manufacturing Costs	9,002,898	264.72	97.5%
Capital Equipment/Tooling	227,000	6.67	2.5%
Total Product Cost	9,229,898	271.39	100.0%
Warranty Cost	158,738	4.67	

3.1.3.2

Total Manufacturing Costs - Base Case
Expenditure Schedule

		Ship Sched.	Cum. Ship Sched	Direct Mfg. Costs	Indirect Costs	Scrap/ Rework Costs	Total Mfg. Cost	Cum. Mfg. Cost	Average Unit Cost
73	1	0	0	0	0	0	0	0	
	2	0	0	0	4,240	0	4,240	4,240	
	3	0	0	0	17,900	0	17,900	22,140	
	4	0	0	0	20,980	0	20,980	43,120	
	5	0	0	0	24,650	0	24,650	67,770	
	6	0	0	0	42,050	0	43,050	109,820	
	7	0	0	54,275	42,050	8,141	104,466	214,286	
	8	0	0	57,019	38,950	7,983	103,952	318,238	
	9	0	0	61,145	36,450	7,704	105,299	423,537	
	10	65	65	85,467	36,450	9,658	131,575	555,112	8,540
	11	95	160	103,240	36,450	10,427	150,117	705,229	4,407
	12	115	275	116,464	36,450	10,365	163,279	868,508	3,158
	1	190	465	129,081	38,740	9,681	177,502	1,046,010	2,249
	2	280	745	135,362	38,740	9,610	183,712	1,229,722	1,650
	3	370	1,115	142,260	38,740	9,247	190,247	1,419,969	1,275
	4	460	1,575	143,070	38,740	8,154	189,964	1,609,933	1,023
	5	550	2,125	143,880	38,740	7,337	189,957	1,799,890	848
	6	577	2,702	143,880	38,740	6,330	188,950	1,988,840	736
	7	625	3,327	143,880	35,030	5,467	184,377	2,173,217	654
	8	682	4,009	143,880	35,030	5,035	183,945	2,357,162	588
	9	750	4,759	143,880	35,030	4,460	183,370	2,540,532	534
	10	750	5,509	143,880	30,460	3,884	178,224	2,718,756	494
	11	750	6,259	143,880	30,460	3,453	177,793	2,896,549	463
	12	750	7,009	143,880	30,460	3,021	177,361	3,073,910	439
75		9,000	16,009	1,782,828	304,190	8,023	2,095,041	5,168,951	323
76		9,000	25,009	1,841,005	287,960	0	2,128,965	7,297,916	291
77		9,000	34,009	1,460,192	244,790	0	1,704,982	9,002,898	265

TOTAL: 34,009 7,262,448 1,602,470 137,980 9,002,898

3.1.3.3

Unit Cost - Non Cumulative

Unit	Progress Factor	Dir. Mfg. Cost	Indirect Mfg. Cost	EC Scrap/ Rework	Capital Deprec.	Total Unit Cost
0-65	5.0	959.20	560.75	125.25	49.20	1,694.40
66-160	3.4	652.25	383.70	85.00	34.90	1,154.85
161-275	2.8	537.15	317.00	67.00	29.70	950.85
276-465	2.4	460.40	203.90	50.80	18.40	733.50
466-745	2.0	383.70	138.35	37.25	12.70	572.00
746-1115	1.7	326.15	104.70	28.00	9.80	468.65
1116-1575	1.5	287.75	84.20	21.00	8.00	400.95
1576-2125	1.4	268.60	70.45	17.50	6.70	363.25
2126-2702	1.3	249.40	67.15	16.00	6.30	338.85
2703-3327	1.2	230.20	56.00	13.00	5.80	305.00
3328-4009	1.1	211.00	51.45	10.75	5.40	278.60
4010-4759	1.0	191.85	46.70	8.45	4.90	251.90
4760-5509	1.0	191.85	40.60	7.30	4.90	244.65
5510-6259	1.0	191.85	40.60	6.70	4.90	244.05
6260-7009	1.0	191.85	40.60	5.95	4.90	243.30
7010-16,009	1.0	198.10	33.80	2.00	4.90	238.80
16,010-25,009	1.0	204.50	32.00	0.00	4.90	241.40
24,010-34,009	1.0	211.17	27.20	0.00	4.90	243.27

3.1.4 DIRECT COSTS

3.1.4.1

Total Direct Manufacturing Costs - Base Case

3500 1000
2700

1850 900

Average = 213.55
Ultimate = 191.84

		Ship	Cum.	Labor	Material	Total	Total Cum
73	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
	6	0	0	0	0	0	0
	7	0	0	0	54,275	54,275	54,275
	8	0	0	3,078	53,941	57,019	11,294
	9	0	0	7,371	53,774	61,145	172,439
57	10	65	65	9,315	76,152	85,467	257,906
	11	95	160	9,720	93,520	103,240	361,146
	12	115	275	11,421	105,043	116,464	477,610
74	1	190	465	13,851	115,230	129,081	606,691
	2	280	745	15,957	119,405	135,362	742,053
	3	370	1,115	17,010	125,250	142,260	884,313
	4	460	1,575	17,820	125,250	143,070	1,027,383
	5	550	2,125	18,630	125,250	143,880	1,171,263
	6	577	2,702	18,630	125,250	143,880	1,315,143
	7	625	3,327	18,630	125,250	143,880	1,459,023
	8	682	4,009	18,630	125,250	143,880	1,602,903
	9	750	4,759	18,630	125,250	143,880	1,746,783
	10	750	5,509	18,630	125,250	143,880	1,890,663
	11	750	6,259	18,630	125,250	143,880	2,034,543
	12	750	7,009	18,630	125,250	143,880	2,178,423
75		9,000	16,009	234,738	1,548,090	1,782,828	3,961,251
76		9,000	25,009	246,475	1,594,530	1,841,005	5,802,256
77		9,000	34,009	228,418	1,231,774	1,460,192	7,262,448
TOTAL:		34,009		964,214	6,298,234	7,262,448	

3.1.4.2

Direct Material Expenditures - Base Case

Ultimate = $167.00/unit
Average = $185.19/unit

		Build Schedule	Progress Factor	Equiv. Build Schedule	Material Cost	Cum. Material Costs
73	1	0				
	2	0				
	3	0				
	4	0				
	5	0				
	6	0				
	7	65	5.0	325	54,275	54,275
	8	95	3.4	323	53,941	108,216
	9	115	2.8	322	53,774	161,990
	10	190	2.4	456	76,152	238,142
	11	280	2.0	560	93,520	331,662
	12	370	1.7	629	105,043	436,705
74	1	460	1.5	690	115,230	551,935
	2	550	1.4	715	119,405	671,340
	3	577	1.3	750	125,250	796,590
	4	625	1.2	750	125,250	921,840
	5	682	1.1	750	125,250	1,047,090
	6	750	1.0	750	125,250	1,172,340
	7	750	1.0	750	125,250	1,297,590
	8	750	1.0	750	125,250	1,422,840
	9	750	1.0	750	125,250	1,548,090
	10	750	1.0	750	125,250	1,673,340
	11	750	1.0	750	125,250	1,798,590
	12	750	1.0	750	125,250	1,923,840
75		9,000	1.0	9,000	1,548,090	3,471,930
76		9,000	1.0	9,000	1,594,530	5,066,460
77		6,750	1.0	6,750	1,231,774	6,298,234
TOTAL:		34,009	----	----	6,298,234	

3.1.4.3

Direct Manpower/Expenditures - Base Case

Ultimate = 24.84/unit
Average = 28.35/unit

		Manpower					Expenditures	
		Asm.	Test	Head Asm.	QC & RI	Total	Total	Cumulative
73	1	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0
	6	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0
	8	0	0.5	2.3	1.0	3.8	3,078	3,078
	9	2.3	1.5	3.0	2.3	9.1	7,371	10,449
	10	3.0	2.5	3.0	3.0	11.5	9,315	19,764
	11	3.0	2.0	3.0	3.0	12.0	9,720	29,484
	12	3.8	3.2	3.8	3.3	14.1	11,421	40,905
74	1	4.8	4.0	4.3	4.0	17.1	13,851	54,756
	2	5.5	4.7	5.0	4.5	19.7	15,957	70,713
	3	6.0	5.0	5.0	5.0	21.0	17,010	87,723
	4	6.5	5.5	5.0	5.0	22.0	17,820	105,543
	5	7.0	6.0	5.0	5.0	23.0	18,630	124,173
	6	7.0	6.0	5.0	5.0	23.0	18,630	142,803
	7	7.0	6.0	5.0	5.0	23.0	18,630	161,433
	8	7.0	6.0	5.0	5.0	23.0	18,630	180,063
	9	7.0	6.0	5.0	5.0	23.0	18,630	198,693
	10	7.0	6.0	5.0	5.0	23.0	18,630	217,323
	11	7.0	6.0	5.0	5.0	23.0	18,630	235,953
	12	7.0	6.0	5.0	5.0	23.0	18,630	254,583
75		7.0	6.0	5.0	5.0	23.0	234,738	489,321
76		7.0	6.0	5.0	5.0	23.0	246,475	735,796
77		6.3	5.4	4.2	4.4	20.3	228,418	964,214

3.1.4.4

Direct Labor Hours by Group - Base Case

		Assembly/ Ship	Test	Head Assembly	Quality Control/ Receiv'g Inspect
73	1	0	0	0	0
	2	0	0	0	0
	3	0	0	0	0
	4	0	0	0	0
	5	0	0	0	0
	6	0	0	0	0
	7	0	0	0	0
	8	0	49	325	163
	9	325	211	323	325
	10	437	373	322	323
	11	435	391	456	389
	12	568	473	560	508
74	1	719	602	629	595
	2	825	699	690	660
	3	910	767	715	703
	4	957	816	750	733
	5	1,000	846	750	750
	6	1,013	863	750	750
	7	1,013	863	750	750
	8	1,013	863	750	750
	9	1,013	863	750	750
	10	1,013	863	750	750
	11	1,013	863	750	750
	12	1,013	863	750	750
75		12,150	10,350	9,000	9,000
76		12,150	10,350	9,000	9,000
77		11,400	9,749	7,500	7,875
TOTAL:		48,967	41,717	36,270	36,274

3.1.4.5

Direct Labor Hours by Function - Base Case

		Ship Sched.	Equiv. Ship Sched.	Final Test	PCB Test	Comp Test	Elect Sub	Mech. Sub	Final Asm.	Head Asm.	QC	RI	Ship
73	1	0	0	0	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0	0	0	0
	6	0	0	0	0	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0	0	0	0	0	0
	8	0	0	0	0	49	0	0	0	325	0	163	0
	9	0	0	0	163	48	260	65	0	323	163	162	0
	10	65	325	163	162	48	258	65	49	322	162	161	65
	11	95	323	162	161	68	258	64	48	456	161	228	65
	12	115	322	161	228	84	365	91	48	560	228	280	64
74	1	190	456	228	280	94	448	112	68	629	280	315	91
	2	280	560	280	315	104	503	126	84	690	315	345	112
	3	370	629	315	345	107	552	138	94	715	345	358	126
	4	460	690	345	358	113	572	143	104	750	358	375	138
	5	550	715	358	375	113	600	150	107	750	375	375	143
	6	577	750	375	375	113	600	150	113	750	375	375	150
	7	625	750	375	375	113	600	150	113	750	375	375	150
	8	682	750	375	375	113	600	150	113	750	375	375	150
	9	750	750	375	375	113	600	150	113	750	375	375	150
	10	750	750	375	375	113	600	150	113	750	375	375	150
	11	750	750	375	375	113	600	150	113	750	375	375	150
	12	750	750	375	375	113	600	150	113	750	375	375	150
75		9,000	9,000	4,500	4,500	1,350	7,200	1,800	1,350	9,000	4,500	4,500	1,800
76		9,000	9,000	4,500	4,500	1,350	7,200	1,800	1,350	9,000	4,500	4,500	1,800
77		9,000	9,000	4,500	4,125	1,124	6,600	1,650	1,350	7,500	4,125	3,750	1,800
TOTALS		34,009	36,279	18,137	18,137	5,443	29,016	7,254	5,443	36,	18,137	18,137	7.254

TOTAL: 163,228

3.1.5 INDIRECT COSTS

3.1.5.1

Total Indirect Costs - Base Case

Average = $47.19/unit

		Labor	Expense	Total
73	1	0	0	0
	2	4,190	50	4,240
	3	11,750	6,150	17,900
	4	13,830	7,150	20,980
	5	22,000	2,650	24,650
	6	37,500	4,550	42,050
	7	37,500	4,550	42,050
	8	34,800	4,150	38,950
	9	32,700	3,750	36,450
	10	32,700	3,750	36,450
	11	32,700	3,750	36,450
	12	32,700	3,750	36,450
74	1	34,990	3,750	38,740
	2	34,990	3,750	38,740
	3	34,990	3,750	38,740
	4	34,990	3,750	38,740
	5	34,990	3,750	38,740
	6	34,990	3,750	38,740
	7	32,080	2,950	35,030
	8	32,080	2,950	35,030
	9	32,080	2,950	35,030
	10	27,960	2,500	30,460
	11	27,960	2,500	30,460
	12	27,960	2,500	30,460
75		284,390	19,800	304,190
76		268,760	19,200	287,960
77		226,790	18,000	244,790
TOTAL:		1,462,370	140,100	1,602,470

3.1.5.2

Indirect Labor Expenditures - Base Case

		Admin.	Eng'g	Process Dev.	Product Support	Total
73	1	0	0	0	0	0
	2	0	4,190	0	0	4,190
	3	0	11,750	0	0	11,750
	4	0	13,830	0	0	13,830
	5	8,250	8,100	2,750	2,900	22,000
	6	11,850	12,200	4,350	9,100	37,500
	7	11,850	12,200	4,350	9,100	37,500
	8	11,850	9,500	4,350	9,100	34,800
	9	11,850	7,400	4,350	9,100	32,700
	10	11,850	7,400	4,350	9,100	32,700
	11	11,850	7,400	4,350	9,100	32,700
	12	11,850	7,400	4,350	9,100	32,700
74	1	12,680	7,920	4,650	9,740	34,990
	2	12,680	7,920	4,650	9,740	34,990
	3	12,680	7,920	4,650	9,740	34,990
	4	12,680	7,920	4,650	9,740	34,990
	5	12,680	7,920	4,650	9,740	34,990
	6	12,680	7,920	4,650	9,740	34,990
	7	12,680	6,340	3,320	9,740	32,080
	8	12,680	6,340	3,320	9,740	32,080
	9	12,680	6,340	3,320	9,740	32,080
	10	10,140	4,760	3,320	9,740	27,960
	11	10,140	4,760	3,320	9,740	27,960
	12	10,140	4,760	3,320	9,740	27,960
75		97,680	40,340	21,310	125,060	284,390
76		68,980	43,160	22,800	133,820	268,760
77		36,910	46,180	24,400	119,300	226,790
TOTAL:						1,462,370

3.1.5.3

Indirect Expense Expenditures - Base Case

		Admin.	Eng'g	Process Dev.	Product Support	Total
73	1	0	0	0	0	0
	2	0	50	0	0	50
	3	0	6,150	0	0	6,150
	4	0	7,150	0	0	7,150
	5	150	1,600	800	100	2,650
	6	250	2,800	1,200	300	4,550
	7	250	2,800	1,200	300	4,550
	8	250	2,400	1,200	300	4,150
	9	250	2,000	1,200	300	3,750
	10	250	2,000	1,200	300	3,750
	11	250	2,000	1,200	300	3,750
	12	250	2,000	1,200	300	3,750
74	1	250	2,000	1,200	300	3,750
	2	250	2,000	1,200	300	3,750
	3	250	2,000	1,200	300	3,750
	4	250	2,000	1,200	300	3,750
	5	250	2,000	1,200	300	3,750
	6	250	2,000	1,200	300	3,750
	7	250	1,600	800	300	2,950
	8	250	1,600	800	300	2,950
	9	250	1,600	800	300	2,950
	10	200	1,200	800	300	2,500
	11	200	1,200	800	300	2,500
	12	200	1,200	800	300	2,500
75		1,800	9,600	4,800	3,600	19,800
76		1,200	9,600	4,800	3,600	19,200
77		600	9,600	4,800	3,000	18,000
TOTAL:		8,350	80,150	35,600	16,000	140,100

Expense Rates:		
	Engineering	400/man-month
	Process Development	400/man-month
	Production Support	50/man-month
	Administration	50/man-month

3.1.5.4

Indirect Cost Breakdown

Definitions:

Development Costs	Defined as all labor and expense costs for Engineering and Process Development plus Engineering and Process Development Managers and Secretary for period 2/15/73 to 10/1/73 (FCS).
Start-Up Costs	Defined as all Indirect Costs for period 2/15/73 to 10/1/73 (FCS) less Development Costs.
Production Support Costs	Defined as all Indirect Costs for period 10/1/73 (FCS) to end of program.

Cost Summary:

Development Costs	161.5K
Start-Up Costs	65.8K
Production Support Costs	1,375.2K
	1,602.5K

.1.5.5

Indirect Skill Schedule - Base Case

	73												74				75	76	77
	1	2	3	4	5	6	7	8	9	10	11	12	1-3	4-6	7-9	10-12			
Administration																			
Operation Manager	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	.8	.6	.4	.2
Engineering Manager	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	.8	.6	.4	.2
Process Development Manager	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	.8	.6	.4	.2
Manufacturing Manager	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	.8	.6	.4	.2
Secretary	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	.8	.6	.4	.2
Engineering																			
M.E. #1	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
M.E. #2	0	0	0	0	1	1	1	1	1	1	1	1	1	1	.8	.6	.4	.4	.4
E.E. #1	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
E.E. #2	0	0	0	0	0	1	1	1	1	1	1	1	1	1	.8	.6	.4	.4	.4
Mfg. Engineer	0	0	0	0	0	1	1	1	1	1	1	1	1	1	.8	.6	.4	.4	.4
Electrical Tech.	0	0	0	1	1	1	1	1	1	1	1	1	1	1	.8	.6	.4	.4	.4
Draftsman/Mech. Tech.	0	0	0	0	0	1	1	1	1	1	1	1	1	1	.8	.6	.4	.4	.4
Process Development																			
Head Engineer	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	.5	.5	.5
Process Engineer	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	.5	.5	.5
Model Maker	0	0	0	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
Product Support																			
Assembly/Test Manager	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	.8
Q.E.	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	.8
Purchasing & RI	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	.8
Production Control	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	.8
Manufacturing	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	.8
Machinist	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	.8
TOTAL		4	5	7	11	21	21	20	19	19	19	19	19	19	17	15	12	11	9

3.1.5.6

Indirect Salary Levels

Administration

Operations Manager	2,800/month
Engineering Manager	2,800/month
Process Development Manager	2,750/month
Manufacturing Manager	2,700/month
Secretary	800/month
	11,850/month

Engineering

Mechanical Engineer #1	2,700/month
Mechanical Engineer #2	2,200/month
Electrical Engineer #1	2,100/month
Electrical Engineer #2	1,600/month
Manufacturing Engineer	1,600/month
Electrical Tech	1,100/month
Draftsman	1,000/month
	12,200/month

Process Development

Head Engineer	1,500/month
Process Engineer	1,600/month
Model Maker	1,250/month
	4,350/month

Product Support

Assembly/Test Manager	1,600/month
Quality Engineer	1,500/month
Purchasing & R.I.	1,500/month
Production Control	1,400/month
Documentation Control	2,000/month
Machinist	1,100/month
	9,100/month

3.1.6 EC SCRAP & REWORK

3.1.6.1

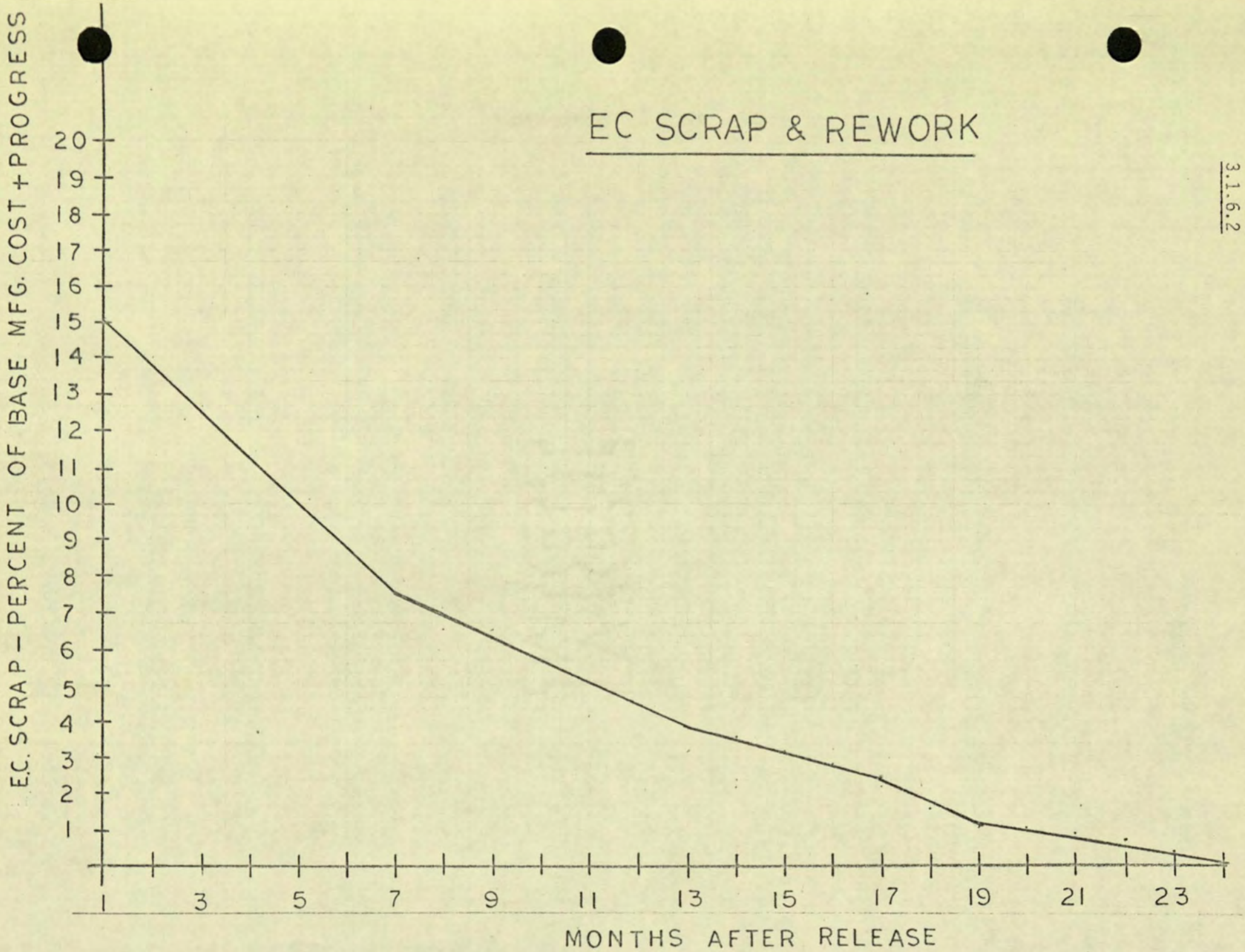
EC Scrap & Rework Costs - Base Case

Average = 1.9% = 4.05/unit

		Ship Schedule	Total Direct Mfg. Costs	% EC* Scrap/ Rework	Total Scrap & Rework Costs
73	1	0	0	0	0
	2	0	0	0	0
	3	0	0	0	0
	4	0	0	0	0
	5	0	0	0	0
	6	0	0	0	0
	7	0	54,275	15	8,141
	8	0	57,019	14	7,983
	9	0	61,145	12.6	7,704
	10	65	85,467	11.3	9,658
	11	95	103,240	10.1	10,427
	12	115	116,464	8.9	10,365
74	1	190	129,081	7.5	9,681
	2	280	135,362	7.1	9,610
	3	370	142,260	6.5	9,247
	4	460	143,070	5.7	8,154
	5	550	143,880	5.1	7,337
	6	577	143,880	4.4	6,330
	7	625	143,880	3.8	5,467
	8	682	143,880	3.5	5,035
	9	750	143,880	3.1	4,460
	10	750	143,880	2.7	3,884
	11	750	143,880	2.4	3,453
	12	750	143,880	2.1	3,021
75		9,000	1,782,828	0.45	8,023
76		9,000	1,841,005	0	0
77		9,000	1,460,192	0	0
TOTAL:		34,009	7,262,448		137,980

*EC Scrap and Rework as a percentage of total direct manufacturing costs (base manufacturing cost + progress).

EC SCRAP & REWORK



3.1.7 CAPITAL EQUIPMENT

3.1.7.1

Capital Equipment Expenditures Schedule - Base Case

		Fab. Shop	R&I	Process Dev	Eng'g	Assembly & Test						Tool'g	Total
						Osc.	FTR*	PCB Test	Head Test	Misc.	Bench/ Cab.		
73	1	0	0	0	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0	0	0	0
	6	22K	0	25K	17K	0	0	0	0	0	0	15K	79K
	7	5K	9K	25K	3K	0	0	1K	5K	0	0	15K	63K
	8	3K	3K	10K	0	2K	2K	0	0	1K	2K	15K	38K
	9	2K	0	5K	0	2K	0	0	0	1K	2K	5K	17K
	10	0	0	0	0	2K	0	0	0	1K	2K	2K	7K
	11	0	0	0	0	2K	0	0	0	1K	2K	1K	6K
	12	0	0	0	0	2K	0	0	0	1K	0	1K	4K
74	1	0	0	0	0	2K	2K	1K	0	5K	0	0	10K
	2	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	2K	1K	0	0	0	0	3K
	4	0	0	0	0	0	0	0	0	0	0	0	0
		32K	12K	65K	20K	12K	6K	3K	5K	10K	8K	54K	227K

*FTR = Final Test Robot

7.2

Capital Equipment Depreciation Schedule - Base Case

		EXPENDITURE DATE																	TOTAL DEPREC.	DEPREC / UNIT
		1973							1974											
		6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10-12		
73	1																			
	2																			
	3																			
	4																			
	5																			
	6	(79K)																		
	7	1.32	(63K)																1.32K	
	8	1.32	1.05	(33K)															2.37K	
	9	1.32	1.05	.55	(17K)														2.92K	
	10	1.32	1.05	.55	.28	(7K)													3.20K	49.2
	11	1.32	1.05	.55	.28	.12	(6K)												3.32K	34.9
	12	1.32	1.05	.55	.28	.12	.10	(4K)											3.42K	29.7
74	1	1.32	1.05	.55	.28	.12	.10	.07	(4K)										3.49K	18.4
	2	1.32	1.05	.55	.28	.12	.10	.07	.07	(4K)									3.56K	12.7
	3	1.32	1.05	.55	.28	.12	.10	.07	.07	.07	(2K)								3.63K	9.8
	4	1.32	1.05	.55	.28	.12	.10	.07	.07	.07	.03	0							3.66K	8.0
	5	1.32	1.05	.55	.28	.12	.10	.07	.07	.07	.03	0	0						3.66K	6.7
	6	1.32	1.05	.55	.28	.12	.10	.07	.07	.07	.03	0	0	0					3.66K	6.3
	7	1.32	1.05	.55	.28	.12	.10	.07	.07	.07	.03	0	0	0	(1K)				3.66K	5.8
	8	1.32	1.05	.55	.28	.12	.10	.07	.07	.07	.03	0	0	0	.02	(1K)			3.68K	5.4
	9	1.32	1.05	.55	.28	.12	.10	.07	.07	.07	.03	0	0	0	.02	.02	(1K)		3.70K	4.9
	10	1.32	1.05	.55	.28	.12	.10	.07	.07	.07	.03	0	0	0	.02	.02	.02	0	3.72K	4.9
	11	1.32	1.05	.55	.28	.12	.10	.07	.07	.07	.03	0	0	0	.02	.02	.02	0	3.72K	4.9
	12	1.32	1.05	.55	.28	.12	.10	.07	.07	.07	.03	0	0	0	.02	.02	.02	0	3.72K	4.9
75		15.8	12.6	6.6	3.40	1.4	1.2	.80	.80	.80	.40	0	0	0	.20	.20	.20	0	44.6K	4.9
76		15.8	12.6	6.6	3.40	1.4	1.2	.80	.80	.80	.40	0	0	0	.20	.20	.20	0	44.6K	4.9
77		15.8	12.6	6.6	3.40	1.4	1.2	.80	.80	.80	.40	0	0	0	.20	.20	.20	0	44.6K	4.9
TOTAL:																			194.21	5.71

3.1.7.3

Capital Equipment Requirements - Base Case

3.1.7.3.1	Fabrication Shop	($-K)
	Lathe	7.0
	Vertical Mill	3.0
	Horizontal Mill	3.0
	Bandsaw	1.0
	Cutt-Off Saw	1.0
	Drill Press	.5
	Hole Punch	.5
	Shear	1.5
	Brake	1.0
	Surface Plates	.5
	Spot Welder	.3
	Gas Welder	.2
	Jo Blocks	.4
	Bench Grinder	.2
	Belt Sander	.3
	Work Benches	1.0
	Misc. Hand Tools & Equip	10.6
		32.0K

3.1.7.3.2	Receiving & Inspection	
	Surface Plates (4)	2.0
	Inspection Microscope	1.0
	Optical Comparator	3.0
	Misc. Tools & Fixtures	5.0
	Work Benches (4)	1.0
		12.0K

3.1.7.3.3	Engineering	
	Osciloscope (2)	6.0
	Sine Wave Generator	.5
	RMS Voltmeter	.5
	Digital Voltmeter	.5
	Counter	.5
	Pulse Generator	1.0
	Power Supplies	2.0
	Camera	.5
	Work Benches	1.0
	Probes	1.0
	Hand Tools	1.0
	Miscellaneous	5.0
		19.5 K

3.1.7.3

1.7.3.4 Assembly & Test

Oscilloscopes	12.0
Final Test Robots	6.0
PCB Tester	3.0
Hand Tester	5.0
Benches/Chairs	8.0
Misc. Tools & Equipment	9.0
	43.0K

3.1.7.3

3.1.7.3.5 Process Development

I. Tooling

Lamination Thickness	Guage	.2
Lamination Bonding	Platen Press	2.0
Cut Frets	Grinder	8.0
Core/Body Assembly	Special Fixtures	1.0
Terminal Bonding	Special Fixtures	.5
Solder Coil Leads	Microscope	.3
Pot Body	Special Fixture	.5
Cure Epoxy	Oven	.5
Lap Body	Lap	2.0
Lap Cores	Special Fixture	.5
Center Section Assembly	Special Fixture	1.0
Lap Center Section	Planetary Lap	4.0
Stack Assembly	Special Fixture	1.0
Chamfer Head	Grinder	---
Grind Radius	Grinder plus Fixture	10.0
Cut Slots	Grinder	2.0
Polish	Lens Lap	2.0
Pigtail Length	Special Fixture	.1
Strip & Tin	Wire Stripper	.5
Crimp Terminals	Crimper	.5
Drill Plug	Drill	.2
Crimp Strain Relief	Crimper	.1
Head/Carriage Assembly	Special Fixture	.5
Wear Test	Special Drives	.6
Inspection	Microscopes(5)	1.5
Gap Inspection	Microscope	2.0
Bonding	Epoxy Dispenser	.3
Soldering	Solder Irons (2)	.1
Tinning	Solder Pon	.1
Cleaning	Ultra-Sonic Cleaner	.3
		42.3K

II. Miscellaneous

Brush Cleavite	17.5
Laminar Bench	1.2
Fume Hood	.5
Benches/Chairs (10)	3.0
Cabinets (5)	.5
	22.7K

III. Summary

Tooling	42.3K
Miscellaneous	22.7K
	65.0K

3.1.7.3.6 Manufacturing Engineering Tooling

Base Plate	18.0
LED Mount	.5
Detector Mount	1.4
Clamp/Clamp Support	2.0
Rotor	.6
Carriage	2.6
Jamb Nut	1.1
Cartridge	4.5
Pressure Arm	1.2
Belt	.5
Door & Frame	5.5
Stepper Motor	2.3
Armature Extrusion	.5
Bail	.3
Capacitor Strap	.5
Plate, Connector	.6
Latch	.7
Slide Bracket	.5
Switch Mount	.6
Bracket Connector	.5
Belt Guard	.5
Cover	.5
Miscellaneous*	8.6
	54.0K

*Miscellaneous includes soft tooling and rework.

3.1.8 WARRANTY COSTS

3.1.8

Warranty Costs - Base Case

		Ship Schedule	UI Rate	Number of Incidents	Direct Mat'l & Labor/ Incident	Total Direct Mat'l & Labor	Burden	Ship'g	TOTAL
73	1	0		0	00.00	0	0	0	0
	2	0		0	00.00	0	0	0	0
	3	0		0	00.00	0	0	0	0
	4	0		0	00.00	0	0	0	0
	5	0		0	00.00	0	0	0	0
	6	0		0	00.00	0	0	0	0
	7	0		0	00.00	0	0	0	0
	8	0		0	00.00	0	0	0	0
	9	0		0	00.00	0	0	0	0
	10	65	.25	17	47.50	807	178	34	1,019
	11	95	.21	37	32.30	1,195	263	72	1,530
	12	115	.17	57	26.60	1,516	334	114	1,964
74	1	190	.16	70	22.80	1,597	351	140	2,088
	2	280	.14	89	19.00	1,691	372	178	2,241
	3	370	.13	117	16.15	1,889	416	234	2,539
	4	460	.13	147	14.25	2,095	461	294	2,850
	5	550	.12	174	13.30	2,314	510	348	3,172
	6	577	.12	195	12.35	2,408	530	390	3,228
	7	625	.11	209	11.40	2,383	524	418	3,325
	8	682	.11	218	10.45	2,278	501	436	3,215
	9	750	.10	224	9.50	2,128	468	448	3,044
	10	750	.10	225	9.50	2,137	470	450	3,057
	11	750	.10	225	9.50	2,137	470	450	3,057
	12	750	.10	225	9.50	2,137	470	450	3,057
75		9,000	.10	2,700	9.50	25,650	5,643	5,400	36,693
76		9,000	.10	2,700	9.50	25,650	5,643	5,400	36,693
77		9,000	.10	2,700	9.50	25,650	5,643	5,400	36,693
78		0		675	9.50	6,512	1,411	1,350	9,173
TOTAL:		34,009		11,004		112,075	24,658	22,008	158,738
Average:				.32		3.30	.72	.65	4.67
Per Incident:						10.18	2.24	2.00	14.42

ASSUMPTIONS:

1. UI Breakdown: 70% PCB; 20% Head; 10% Miscellaneous
2. Direct Mat'l and Labor Cost per UI - $9.50 x Progress Factor
3. Indirect - Estimate at 22% of Direct Mat'l and Labor
4. Shipping = $2.00/Incident

3.1.9 QUANTITY SENSITIVITY ANALYSIS

3.1.9.1

Product Cost Summary - Low, Base and High Program Quantities

	Low Program Quantity 20K Units			Base Case 34K Units			High Program Quantity 60K Units		
	Program	Unit	%	Program	Unit	%	Program	Unit	%
Direct Material Cost	4,242.3K	206.85	62.3	6,298.2K	185.19	68.2	10,051.4K	167.85	72.1
Direct Labor Cost	609.8K	29.73	8.9	964.2K	28.35	10.5	1,714.0K	28.62	12.3
Total Direct Mfg. Cost:	4,852.1K	236.48	71.2	7,262.4K	213.54	78.7	11,765.3K	196.47	84.4
Indirect Labor Cost	1,462.4K	71.31	21.5	1,462.4K	43.00	15.8	1,618.3K	27.02	11.6
Indirect Expense Cost	140.1K	6.83	2.0	140.1K	4.12	1.5	151.5K	2.53	1.1
Total Indirect Cost:	1,602.5K	78.14	23.5	1,602.5K	47.12	17.3	1,769.8K	29.55	12.7
EC Scrap/Rework Cost	131.4K	6.41	1.9	138.0K	4.06	1.5	145.2K	2.42	1.0
Total Manufacturing Cost:	6,586.0K	321.13	96.7	9,002.9K	264.72	97.5	13,680.3K	228.45	98.2
Capital Equipment/ Tooling	227.0K	11.07	3.3	227.0K	6.67	2.5	254.0K	4.24	1.8
TOTAL PRODUCT COST	6,813.0K	332.20	100.0	9,229.9K	271.39	100.0	13,934.3K	232.69	100.0

Capital Equipment Increment for High Program Quantity--Add 50% of Manufacturing Engineering Tooling for Base Case.

3.1.9.2

Total Manufacturing Cost - High Program Quantity
Expenditure Schedule

	Ship	Cum. Ship	Direct Material	Direct Labor	Total Direct Mfg. Cost	Indirect Costs	Scrap/ Rework	Total Mfg. Cost	Cumulative Mfg. Cost	Average Unit Cost
73	275	275	436.7K	40.9K	477.6K	336.6K	54.3K	868.5K	868.5K	3,160
74	6,734	7,009	1,487.1K	213.7K	1,700.8K	428.9K	75.7K	2,205.4K	3,073.9K	439
75	16,875	23,884	2,757.5K	462.1K	3,219.6K	365.0K	15.2K	3,599.8K	6,673.7K	279
76	18,000	41,884	3,029.6K	517.6K	3,547.2K	345.6K	0	3,892.8K	10,566.5K	252
77	18,000	59,884	2,340,4K	479.7K	2,820.1K	293.7K	0	3,113.8K	13,680.3K	228
TOTAL:			10,051.4K	1,713.9K	11,765.3K	1,769.9K	145.2K	13,680.3K		

Assumptions:
1. 6% material cost decrease over base case.
2. 20% indirect cost increase in 1975, 1976, and 1977.
3. 10% second shift premium for direct labor.

3.1.9.3

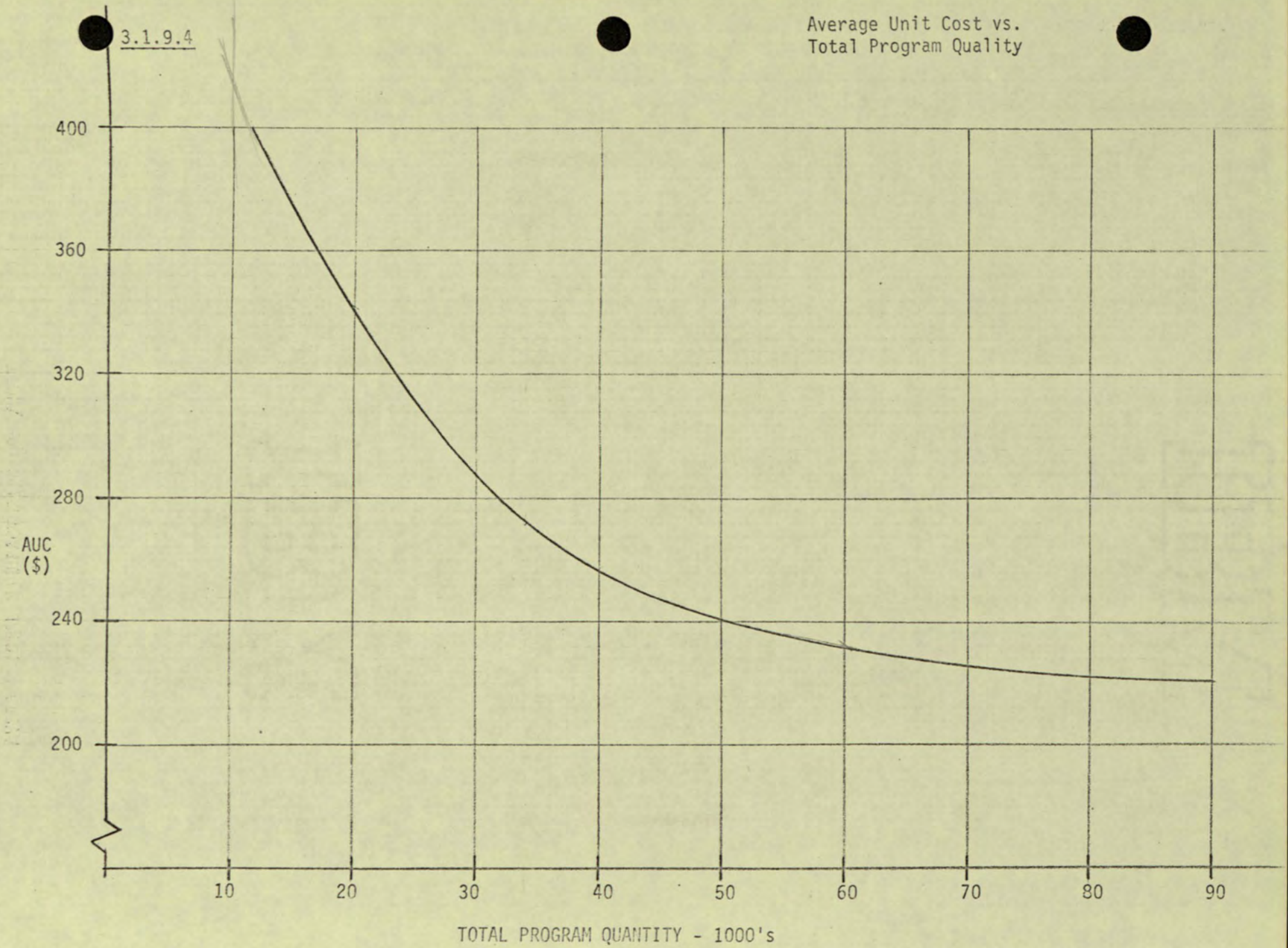
Total Manufacturing Cost - Low Program Quantity
Expenditure Schedule

	Ship	Cum. Ship	Direct Material	Direct Labor	Total Direct Mfg. Cost	Indirect Cost	Scrap/ Rework	Total Mfg. Cost	Cumulative Mfg. Cost	Average Unit Cost
73	275	275	436.7K	40.9K	477.6K	336.6K	54.3K	868.5K	868.5K	3,160
74	6,734	7,009	1,487.1K	213.7K	1,700.8K	428.9K	75.7K	2,205.4K 1,477.35	3,073.9K	439
75	4,500	11,509	820.5K	117.7K	938.2K	304.2K	1.4K	1,243.8K	4,317.7K	375
76	4,500	16,009	845.1K	123.3K	968.4K	288.0K	0	1,256.4K	5,574.1K	348
77	4,500	20,509	652.9K	114.2K	767.1K	244.8K	0	1,011.9K	6,586.0K	321
TOTAL:			4,242.3K	609.8K	4,852.1K	1,602.5K	131.4K	6,586.0K		

Assumptions: 1. 6% material cost increase over base case.
2. No decrease in indirect expenditures.

3.1.9.4

Average Unit Cost vs.
Total Program Quality



3.1.10 APPENDIX

3.1.10.1

Direct Labor Estimate - Ultimate

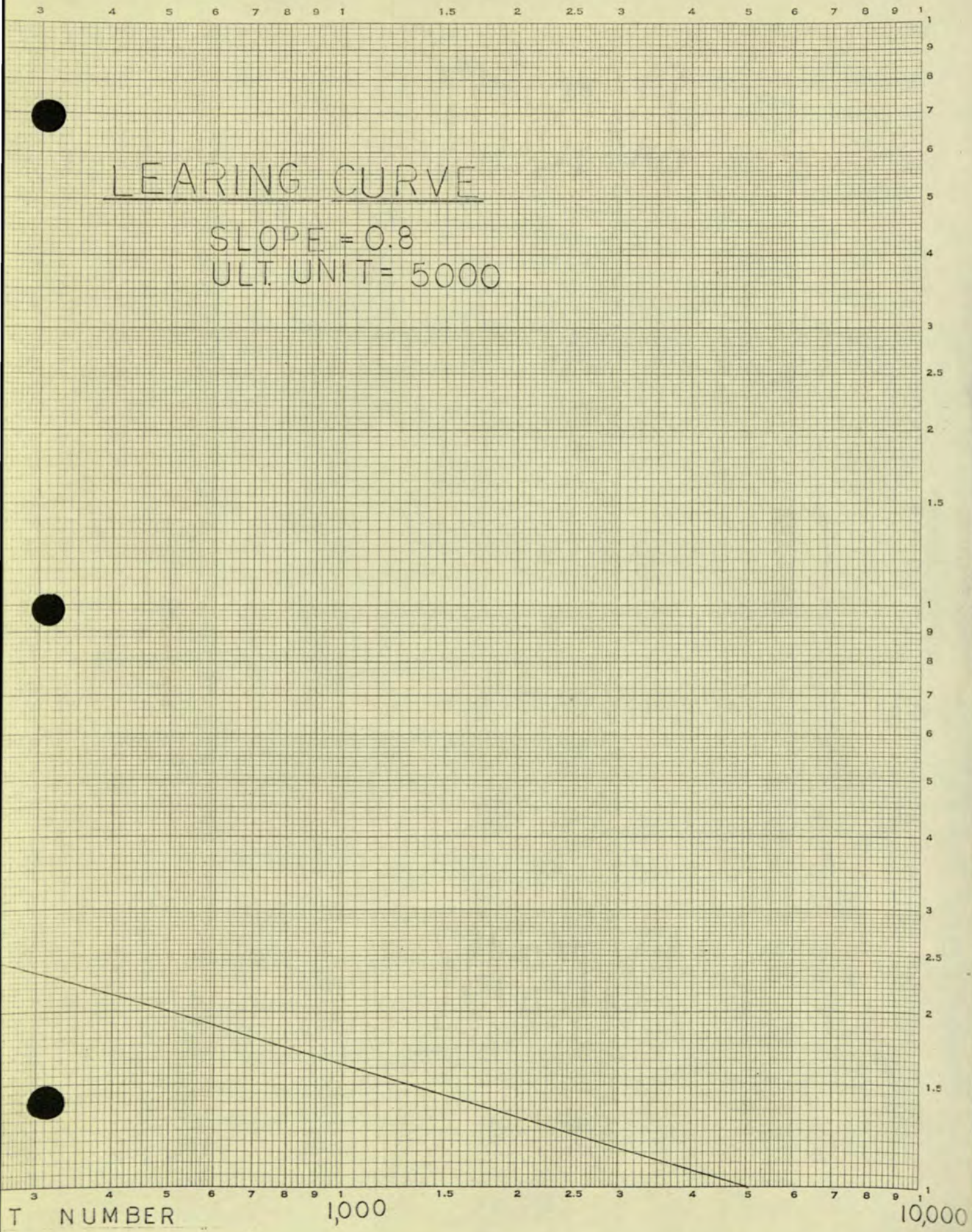
	Hrs.	Cost/ Hour	Cost/ Unit
Final Test	.50	5.65	2.825
PCB Test	.50	5.00	2.500
Component Test	.15	5.65	.848
Electrical Subassembly	.80	4.00	3.200
Mechanical Subassembly	.20	4.30	.860
Final Assembly	.15	4.75	.713
Quality Control	.50	4.90	2.450
Receiving Inspection	.50	4.90	2.450
Head Assembly	1.00	4.00	4.000
Shipping	.20	4.30	.860
	4.50		20.706

Labor Hours - 4.5
Labor Cost - $20.706
Average Labor Cost = $4.60/hour = $810/month

3.1.10.2

Material Cost Estimate - Base Case

Function	Assembly/Component	Ultimate Cost/Unit
Electronics	Printed Circuit Board	45.00
	Harness Assembly	1.00
	Phototransducer Assembly	2.15
	Switches	1.20
Drive System	Drive Motor	16.50
	Spindle Assembly	5.75
	Cartridge Guide Assembly	7.50
Head	Head Assembly	8.00
Actuator	Stepper Motor	27.50
	Carriage Assembly	3.50
Base	Base Plate	25.00
	Door Assembly	1.00
	Covers	2.50
Miscellaneous		11.40
Manual		2.50
Sub-Total:		160.50
Floor Loss @ 4%		6.42
TOTAL:		166.92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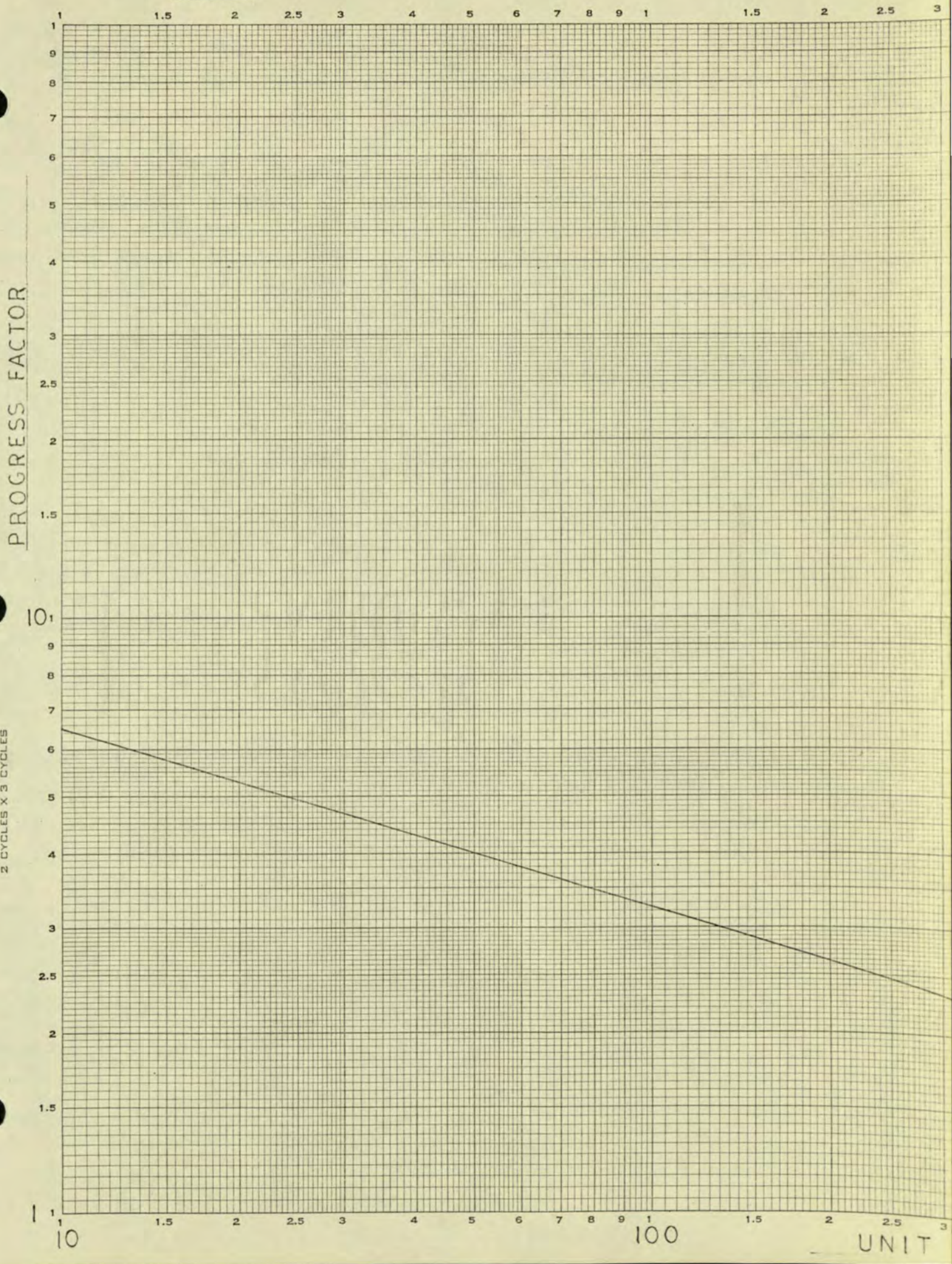
ULT. UNIT = 5000
T NUMBER
1,000
10,000

3.1.10.3


PROGRESS FACTOR
UNIT
10
100
EUGENE DIETZGEN CO.
MADE IN U. S. A.
NO. 340DR-L23 DIETZGEN GRAPH PAPER
LOGARITHMIC
2 CYCLES X 3 CYCLES

3.2 PRODUCT COST ANALYSIS

PRINTER PROGRAM

S/A 300

S/A 302

INDEX

Section 3.2

3.2.1 Assumptions/Definitions

3.2.2 Production Schedule

3.2.3 Summary

- 3.2.3.1 Product Cost Summary
- 3.2.3.2 Total Manufacturing Cost/Expenditure Schedule
- 3.2.3.3 Unit Cost vs. Unit Number - Complete Machine
- 3.2.3.4 Unit Cost vs. Unit Number - Basic Machine

3.2.4 Direct Costs

- 3.2.4.1 Total Direct Manufacturing
- 3.2.4.2 Direct Material Expenditures- Complete Machine
- 3.2.4.3 Direct Material Expenditures - Basic Machine
- 3.2.4.4 Direct Manpower/Expenditures - Complete Machine
- 3.2.4.5 Direct Manpower/Expenditures - Basic Machine

3.2.5 Indirect Costs

- 3.2.5.1 Total Indirect Costs
- 3.2.5.2 Indirect Labor Expenditures
- 3.2.5.3 Indirect Expense Expenditures
- 3.2.5.4 Indirect Cost Breakdown
- 3.2.5.5 Indirect Skill Schedule

3.2.6 EC Scrap and Rework

- 3.2.6.1 EC Scrap and Rework Costs
- 3.2.6.2 EC Scrap and Rework Projections

3.2.7 Capital Equipment

- 3.2.7.1 Capital Equipment Expenditure Schedule
- 3.2.7.2 Capital Equipment Deprecitaion Schedule
- 3.2.7.3 Capital Equipment Requirements
  - 3.2.7.3.1 Tooling & Fixtures

3.2.8 Warranty Costs

- 3.2.8.1 Total Warranty Costs
- 3.2.8.2 Warranty Costs - Complete Machine
- 3.2.8.3 Warranty Costs - Basic Machine

3.2.9 Quantity Sensitivity Analysis

3.2.9.1 Product Cost Summary - High Program Quantity
3.2.9.2 Product Cost Summary - Low Program Quantity
3.2.9.3 Total Manufacturing Cost/Expenditure Schedule - High Program Quantity
3.2.9.4 Total Manufacturing Cost/Expenditure Schedule - Low Program Quantity
3.2.9.5 Average Unit Cost vs. Total Program Quantity

3.2.10 Appendix

3.2.10.1 Direct Labor Estimate - Ultimate
3.2.10.2 Material Cost Estimate - Ultimate
3.2.10.3 Learning Curve

3.2.1 ASSUMPTIONS/DEFINITIONS

3.2.1

ASSUMPTIONS/DEFINITIONS

Production Schedule

Maximum Production - 160 units per month, for base case, reached 12 months after FCS. Mix on 160 units is 50/50--Complete/Basic Machines.

Ramp - Approximately linear for total production (basic and complete machines) after first three months until peak production with equivalent production not exceeding peak production.

Program Quantities

	Total	Complete Machine	Basic Machine
Base	7,090	3,862	3,228
High	12,610	6,622	5,988
Low	4,210	2,422	1,788

Mix - For first six months 100% of all production is complete machine; in the second six months 25% of all production is basic machines and 75% is complete machines. After one year of production and through the end of the program there is an equal mix (50/50).

Direct Material Expenditures

Pipe Line - Three full months for receipt of good to finished product (ship).

Equivalent Build Schedule - Build Schedule x Progress Factor (obtained from learning curve).

Cost - Estimate from ultimate material cost and progress factor increased at 3% per year after 1974. Same learning curve used for material and labor.

Floor Loss - 4% and included in Material Cost Estimate.

3.2.1

Direct Manpower/Expenditures

Requirements - Based upon direct labor hours per machine, progress factor, and production schedule normalized to 150 productive hours per month per man.

Manpower = Ultimate Labor Hours per Machine X Progress Factor X Build Schedule/ 150 hours per month.

Pipe Line - Two months.

Salary Level - 10% increase over present employment level for 176 hours/month and 5% per year increase after 1974.

Expenses - No expenses anticipated for direct employees.

Indirect Costs

Requirements - See Indirect Skill Schedule.

Salary Levels - No salary increase over present employment level for 1973 and 7% per year increase thereafter.

Expenses - Estimated at $50 per man per month for Administration and Production Support, and $200 per man per month for Engineering. Prototype hardware was broken out and estimated at 100K for three (3) machines.

Allocation - Indirect costs are divided between the complete machine and the basic machine in proportion to the program quantity for each machine (i.e. Indirect Cost/Units=constant).

Capital Equipment

Depreciation Schedule - 5-year straight line depreciation is assumed, except for Cost Summary where Capital Equipment is fully depreciated.

Tooling & Fixtures Breakdown - Tooling and fixtures cost for basic machine was estimated at one-half of total tooling and fixture cost for Basic Mechanism; all other tooling and fixture costs were allocated to Complete Machine.

3.2.1

Warranty

Warranty Period - Three months.

Warranty Costs - $10 direct labor and material cost per incident (adjusted for Progress) plus indirect support (burden) at 22% of direct cost and $2.00 per incident for shipping--applies to complete and basic machines.

Unit Costs

Instantaneous Unit Cost - See Unit Cost - Non-Cumulative. This is an estimate of what the product is costing as a function of time (or unit number). The direct material and labor is calculated from direct expenditures, adjusted for pipe line time (this is possible to do since the labor pipe line was simplified to be a uniform 2 months). Indirect Costs and Capital Depreciation are spread evenly over the basic machine and complete machine, and therefore will not equal the allocation in the cost summary*. EC Scrap and Rework is allocated directly as a function of direct material & labor.

Quantity Sensitivity Analysis

High Program Quantity - 1974 and 1975 production quantities remain constant and the 1976 production is twice the base case with a three month ramp at the front end. 1977 and 1978 production quantities are twice the base case--applies to both the Complete Machine and the Basic Machine.

Low Program Quantity - 1974 and 1975 production quantities remain constant and the 1976, 1977, and 1978 production quantities are reduced by one-half the base case.

*Also Capital Equipment is not fully depreciated.

3.2.2 PRODUCTION SCHEDULE

3.2.2

Production Schedule

		Complete Machine				Basic Machine				TOTAL
		Ship Sched.	Ship Cum	Ship/ Qtr.	Ship/ Year	Ship Sched	Ship Cum	Ship/ Qtr.	Ship/ Year	Ship Sched.
74	7	0	0		15	0	0		0	0
	8	0	0	0		0	0	0		0
	9	0	0			0	0			0
	10	0	0			0	0			0
	11	5	5	15		0	0			5
	12	10	15			0	0			10
75	1	30	45		967	0	0		348	30
	2	52	97	148		0	0	0		52
	3	66	163			0	0			66
	4	80	243			0	0			80
	5	80	323	240		23	23	49		103
	6	80	403			26	49			106
	7	90	493			30	79			120
	8	100	593	299		33	112	99		133
	9	109	702			36	148			145
	10	120	822			40	188			160
	11	80	902	280		80	268	200		160
	12	80	982			80	348			160
76		960	1,942	240	960	960	1,308	240	960	1,920
77		960	2,902	240	960	960	2,268	240	960	1,920
78		960	3,862	240	960	960	3,228	240	960	1,920
TOTAL:		3,862			3,862	3,228			3,228	7,090

3.2.3 SUMMARY

.3.1

Product Cost Summary - Base Case

Program Quantities: Basic - 3,228
Complete - 3,862
Combined - 7,090

	Basic Machine			Complete Machine			Combined		
	Program	Unit	%	Program	Unit	%	Program	Unit	%
Direct Material Cost	2,042.0K	632.59	53.5	4,492.0K	1,163.13	62.6	6,534.0K	921.58	59.5
Direct Labor Cost	450.8K	139.65	11.8	967.6K	250.54	13.5	1,418.4K	200.05	12.9
Total Direct Mfg. Cost:	2,492.8K	772.24	65.3	5,459.7K	1,413.70	76.1	7,952.4K	1,121.63	72.4
Indirect Labor Cost	860.7K	266.63	22.6	1,029.7K	266.63	14.4	1,890.4K	266.63	17.2
Indirect Expense Cost	93.0K	28.83	2.4	111.4K	28.83	1.5	204.4K	28.83	1.9
Total Indirect Cost:	953.7K	295.46	25.0	1,141.1K	295.46	15.9	2,094.8K	295.46	19.1
EC Scrap/Rework Cost	61.5K	19.04	1.6	125.5K	32.50	1.8	187.0K	26.37	1.7
Total Manufacturing Cost:	3,508.0K	1,086.74	91.9	6,726.3K	1,741.66	93.8	10,234.2K	1,443.47	93.2
Capital Equip/Tooling	307.5K	95.26	8.1	442.5K	114.58	6.2	750.0K	105.78	6.8
TOTAL PRODUCT COST:	3,815.5K	1,182.00	100.0	7,168.8K	1,856.24	100.0	10,984.2K	1,549.25	100.0
Warranty Costs:	50.3K	15.60	1.3	115.2K	29.83	1.6	165.5K	23.34	1.5

3.2.3.2

Total Manufacturing Costs - Base Case
Expenditure Schedule

		Ship Sched.	Cum. Ship Sched.	Direct Mfg. Costs	Indirect Costs	Scrap/ Rework Costs	Total Mfg. Cost
73	7	0	0	0	15.6K	0	15.6K
	8	0	0	0	15.6K	0	15.6K
	9	0	0	0	15.6K	0	15.6K
	10	0	0	0	19.0K	0	19.0K
	11	0	0	0	27.8K	0	27.8K
	12	0	0	0	27.8K	0	27.8K
74	1	0	0	0	30.4K	0	30.4K
	2	0	0	0	30.4K	0	30.4K
	3	0	0	0	30.4K	0	30.4K
	4	0	0	0	43.7K	0	43.7K
	5	0	0	0	43.7K	0	43.7K
	6	0	0	0	43.7K	0	43.7K
	7	0	0	0	41.2K	0	41.2K
	8	0	0	33.3K	41.2K	3.0K	77.5K
	9	0	0	50.0K	41.2K	4.5K	95.7K
	10	0	0	105.9K	40.4K	9.5K	155.8K
	11	5	5	147.2K	40.4K	11.8K	199.4K
	12	10	15	155.3K	40.4K	12.4K	208.1K
75	1	30	45	165.0K	41.6K	13.2K	219.8K
	2	52	97	170.6K	41.6K	11.9K	224.1K
	3	66	163	159.4K	41.6K	9.6K	210.6K
	4	80	243	163.6K	41.6K	8.2K	213.4K
	5	103	346	167.3K	41.7K	6.7K	215.7K
	6	106	452	174.0K	41.7K	7.0K	222.7K
	7	120	572	175.3K	41.7K	7.0K	224.0K
	8	133	705	158.7K	41.7K	4.8K	205.2K
	9	145	850	155.8K	41.7K	4.7K	202.2K
	10	160	1,010	155.8K	41.7K	4.7K	202.2K
	11	160	1,170	155.8K	41.7K	4.7K	202.2K
	12	160	1,330	155.8K	41.7K	4.7K	202.2K
76		1,920	3,250	1,931.7K	352.7K	38.6K	2,323.0K
77		1,920	5,170	1,996.8K	376.8K	20.0K	2,393.6K
78		1,920	7,090	1,575.1K	276.8K	0	1,851.9K
TOTAL:		7,090		7,952.4K	2,094.8K	187.0	10,234.2K

3.2.3.3

UNIT COST - NON CUMULATIVE - BASIC MACHINE

UNIT	PROGRESS	DIRECT MT'L COST	DIRECT LABOR COST	DIRECT MFG. COST	E.C. SCRAP & REWORK	CAPITAL DEPRECIATION	INDIRECT COST	TOTAL PRODUCT COST
0- 23	1.31	909	187	1096	44	100	405	1695
24- 49	1.35	804	165	969	39	100	393	1501
50- 79	1.25	757	157	914	37	80	348	1379
80- 112	1.15	688	142	830	25	80	313	1248
113- 148	1.10	664	142	806	24	80	288	1198
149- 188	1.00	597	128	725	22	69	260	1076
189- 268	1.00	597	128	725	22	69	260	1076
269- 348	1.00	597	128	725	22	69	260	1076
349-1308	1.00	610	133	743	15	70	184	1012
1309-2268	1.00	628	138	766	8	73	196	1043
2269-3228	1.00	642	143	785	0	75	144	1004

3.2.3.4

UNIT COST - NON CUMULATIVE COMPLETE MACHINE

UNIT	PROGRESS	DIRECT MT'L COST	DIRECT LABOR COST	DIRECT MFG. COST	E.C.SCRAP & REWORK	CAPITAL DEPRECIATION	INDIRECT COST	TOTAL PRODUCT COST
0- 5	6.80	6684	1380	8044	728	993	8080	17845
6- 15	4.40	4312	890	5202	468	993	4040	10703
16- 45	3.30	3234	660	3894	350	176	1386	5806
46- 97	2.50	2450	498	2948	236	176	800	4160
98- 163	2.00	1960	418	2378	190	176	630	3374
164- 243	1.70	1717	356	2073	166	100	520	2859
244- 323	1.51	1525	314	1839	129	100	405	2473
342- 403	1.35	1363	281	1644	99	100	393	2236
404- 493	1.25	1262	264	1526	76	80	348	2030
494- 593	1.15	1162	242	1404	56	80	313	1853
594- 702	1.10	1111	230	1341	54	80	288	1763
703- 822	1.00	1010	209	1219	49	69	260	1597
823- 902	1.00	1010	212	1222	37	69	260	1588
903- 982	1.00	1010	212	1222	37	69	260	1558
983-1942	1.00	1032	220	1252	28	70	184	1534
1943-2902	1.00	1063	228	1291	16	73	196	1576
2903-3862	1.00	1092	236	1328	0	75	144	1547

3.2.4 DIRECT COSTS

3.2.[illegible]1

Total Direct Manufacturing Cost - Base Case

		Complete Machine				Basic Machine				Combined			
		Ship	Mat'l	Labor	Total	Ship	Mat'l	Labor	Total	Ship	Mat'l	Labor	TOTAL
74	1	0	0	0	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0	0	0	0
	6	0	0	0	0	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0	0	0	0	0	0
	8	0	33.3K	0	33.3K	0	0	0	0	0	33.3K	0	33.3K
	9	0	43.1K	6.9K	50.0K	0	0	0	0	0	43.1K	6.9K	50.0K
	10	0	97.0K	8.9K	105.9K	0	0	0	0	0	97.0K	8.9K	105.9K
	11	5	127.4K	19.8K	147.2K	0	0	0	0	5	127.4K	19.8K	147.2K
	12	10	129.4K	25.9K	155.3K	0	0	0	0	10	129.4K	25.9K	155.3K
75	1	30	137.4K	27.6K	165.0K	0	0	0	0	30	137.4K	27.6K	165.0K
	2	52	121.2K	28.5K	149.7K	0	20.9K	0	20.9K	52	142.1K	28.5K	170.6K
	3	66	109.0K	25.1K	134.2K	0	20.9K	4.3K	25.2K	66	130.0K	29.4K	159.4K
	4	80	114.1K	22.5K	136.6K	0	22.7K	4.3K	27.0K	80	136.8K	26.8K	163.6K
	5	80	116.1K	23.8K	139.9K	23	22.7K	4.7K	27.4K	103	138.8K	28.5K	167.3K
	6	80	121.2K	24.2K	145.4K	26	23.9K	4.7K	28.6K	106	145.1K	28.9K	174.0K
	7	90	121.2K	25.1K	146.3K	30	23.9K	5.1K	29.0K	120	145.1K	30.2K	175.3K
	8	100	80.8K	25.1K	105.9K	33	47.8K	5.1K	52.9K	133	128.6K	30.2K	158.7K
	9	109	80.8K	17.0K	97.8K	36	47.8K	10.2K	58.0K	145	128.6K	27.2K	155.8K
	10	120	80.8K	17.0K	97.8K	40	47.8K	10.2K	58.0K	160	128.6K	27.2K	155.8K
	11	80	80.8K	17.0K	97.8K	80	47.8K	10.2K	58.0K	160	128.6K	27.2K	155.8K
	12	80	80.8K	17.0K	97.8K	80	47.8K	10.2K	58.0K	160	128.6K	27.2K	155.8K
76		960	998.4K	214.3K	1,212.7K	960	590.4K	128.6K	719.0K	1,920	1,588.8K	342.9K	1,931.7K
77		960	1,027.2K	225.0K	1,252.2K	960	609.6K	135.0K	744.6K	1,920	1,636.8K	360.0K	1,996.8K
78		960	792.0K	196.9K	988.9K	960	468.0K	118.2K	586.2K	1,920	1,260.0K	315.1K	1,575.1K
TOTAL:		3,862	4,492.0K	967.6K	5,459.7K	3,228	2,042.0K	450.8K	2,492.8K	7,090	6,534.0K	1,418.4K	7,952.4K

3.2.4.2

Direct Material Expenditures - Base Case
Complete Machine

		Ship Schedule	Progress Factor	Equiv. Prod.	Mat'l Cost/ Unit	Mat'l Cost
74	1	0	0.00	0	0	0
	2	0	0.00	0	0	0
	3	0	0.00	0	0	0
	4	0	0.00	0	0	0
	5	0	0.00	0	0	0
	6	0	0.00	0	0	0
	7	0	0.00	0		0
	8	0	0.00	0	980	33.3K
	9	0	0.00	0		43.1K
	10	0	0.00	0		97.0K
	11	5	6.80	34	980	127.4K
	12	10	4.40	44		129.4K
75	1	30	3.30	99		137.4K
	2	52	2.50	130	1,010	121.2K
	3	66	2.00	132		109.1K
	4	80	1.70	136		114.1K
	5	80	1.51	120	1,010	116.1K
	6	80	1,35	108		121.2K
	7	90	1.25	113		121.2K
	8	100	1.15	115	1,010	80.8K
	9	109	1.10	120		80.8K
	10	120	1.00	120		80.8K
	11	80	1.00	80	1,010	80.8K
	12	80	1.00	80		80.8K
76		960	1.00	960	1,040	998.4K
77		960	1.00	960	1,070	1,027.2K
78		960	1.00	960	1,100	792.0K

TOTAL: 3,862 4,492.9K

Average = 1,163/unit
Ultimate = 1,010/unit

3.2.4.3

Direct Material Expenditures - Base Case
Basic Machine

		Ship Schedule	Progress Factor	Equiv. Prod.	Material Cost/Unit	Material Cost
74	1	0	0.00	0	0	0
	2	0	0.00	0	0	0
	3	0	0.00	0	0	0
	4	0	0.00	0	0	0
	5	0	0.00	0	0	0
	6	0	0.00	0	0	0
	7	0	0.00	0		0
	8	0	0.00	0	580	0
	9	0	0.00	0		0
	10	0	0.00	0		0
	11	0	0.00	0	580	0
	12	0	0.00	0		0
75	1	0	0.00	0		0
	2	0	0.00	0	597	20.9K
	3	0	0.00	0		20.9K
	4	0	0.00	0		22.7K
	5	23	1.51	35	597	22.7K
	6	26	1.35	35		23.9K
	7	30	1.25	38		23.9K
	8	33	1.15	38	597	47.8K
	9	36	1.10	40		47.8K
	10	40	1.00	40		47.8K
	11	80	1.00	80	597	47.8K
	12	80	1.00	80		47.8K
76		960	1.00	960	615	590.4K
77		960	1.00	960	635	609.6K
78		960	1.00	960	650	468.0K

TOTAL: 3,228 2,042.0K

Average = 633/unit
Ultimate = 597/unit

3.2.4.4

Direct Manpower/Expenditures - Base Case
Complete Machine

		Ship Schedule	Equiv. Prod.	Labor Hours	Man-Power	Labor Rate	Labor Cost
74	1	0	0	0	0		0
	2	0	0	0	0		0
	3	0	0	0	0		0
	4	0	0	0	0		0
	5	0	0	0	0		0
	6	0	0	0	0		0
	7	0	0	0	0		0
	8	0	0	0	0	810/mm	0
	9	0	0	0	0		6.9K
	10	0	0	0	0		8.9K
	11	5	34	1,258	8.5	810/mm	19.8K
	12	10	44	1,628	11.0		25.9K
75	1	30	99	3,663	24.5		27.6K
	2	52	130	4,810	32.0	850/mm	28.5K
	3	66	132	4,884	32.5		25.1K
	4	80	136	5,032	33.5		22.5K
	5	80	120	4,440	29.5	850/mm	23.8K
	6	80	108	3,996	26.5		24.2K
	7	90	113	4,181	28.0		25.1K
	8	100	115	4,255	28.5	850/mm	25.1K
	9	109	120	4,440	29.5		17.0K
	10	120	120	4,440	29.5		17.0K
	11	80	80	2,960	20.0	850/mm	17.0K
	12	80	80	2,960	20.0		17.0K
76		960	960	35,520	20.0	11,716/my	214.3K
77		960	960	35,520	20.0	11,252/my	225.0K
78		960	960	35,520	20.0	11,815/my	196.9K
TOTAL:		3,862					967.6K

Average = 250/unit
Untimate = 212/unit

3.2.4.5

Direct Manpower/Expenditures - Base Case
Basic Machine

		Ship Schedule	Equiv. Prod.	Labor Hours	Man-Power	Labor Rate	Labor Cost
74	1	0	0	0	0		0
	2	0	0	0	0		0
	3	0	0	0	0		0
	4	0	0	0	0		0
	5	0	0	0	0		0
	6	0	0	0	0		0
	7	0	0	0	0		0
	8	0	0	0	0		0
	9	0	0	0	0		0
	10	0	0	0	0		0
	11	0	0	0	0		0
	12	0	0	0	0		0
75	1	0	0	0	0		0
	2	0	0	0	0		0
	3	0	0	0	0		4.3K
	4	0	0	0	0		4.3K
	5	23	35	770	5	850/mm	4.7K
	6	26	35	770	5		4.7K
	7	30	38	836	5.5		5.1K
	8	33	38	836	5.5	850/mm	5.1K
	9	36	40	880	6.0		10.2K
	10	40	40	880	6.0		10.2K
	11	80	80	1,760	12.0	850/mm	10.2K
	12	80	80	1,760	12.0		10.2K
76		960	960	21,120	12.0	10,716/my	128.6K
77		960	960	21,120	12.0	11,252/my	135.0K
78		960	960	21,120	12.0	11,815/my	118.2K
TOTAL:		3,228					450.8K

Average = 140/unit
Ultimate = 128/unit

3.2.5 INDIRECT COSTS

3.2.5.1

Total Indirect Costs - Base Case

		Labor	Expense	TOTAL
73	7	9.9K	5.7K	15.6K
	8	9.9K	5.7K	15.6K
	9	9.9K	5.7K	15.6K
	10	12.9K	6.1K	19.0K
	11	16.3K	11.5K	27.8K
	12	16.3K	11.5K	27.8K
74	1Q	56.2K	35.1K	91.3K
	2Q	93.8K	37.3K	131.1K
	3Q	115.6K	8.0K	123.6K
	4Q	114.0K	7.1K	121.1K
75		472.6K	27.5K	500.1K
76		336.5K	16.2K	352.7K
77		360.6K	16.2K	376.8K
78		265.9K	10.8K	276.7K
TOTAL:		1,890.4K	204.4K	2,094.8K

Average = 295/unit

3.2.5.2

Indirect Labor Expenditures - Base Case

		Administration	Engineering	Production Support	TOTAL
73	7	2.7	7.2	0	9.9
	8	2.7	7.2	0	9.9
	9	2.7	7.2	0	9.9
	10	3.5	9.4	0	12.9
	11	3.5	12.8	0	16.3
	12	3.5	12.8	0	16.3
74	1Q	11.2	45.0	0	56.2
	2Q	16.4	54.6	22.8	93.8
	3Q	21.5	53.6	40.5	115.6
	4Q	21.5	42.7	49.8	114.0
75		83.8	182.7	206.1	472.6
76		47.0	94.0	195.5	336.5
77		50.8	100.6	209.2	360.6
78		53.8	62.3	149.8	265.9

TOTAL: 1,890.4K

3.2.5.3

Indirect Expense Expenditure - Base Case

		Administration	Production Support	Engineering	Hardware	TOTAL
73	7	.1	0	.6	5	5.7
	8	.1	0	.6	5	5.7
	9	.1	0	.6	5	5.7
	10	.1	0	1.0	5	6.1
	11	.1	0	1.4	10	11.5
	12	.1	0	1.4	10	11.5
74	1Q	.3	0	4.8	30	35.1
	2Q	.5	.8	6.0	30	37.3
	3Q	.6	1.4	6.0	0	8.0
	4Q	.6	1.7	4.8	0	7.1
75		2.0K	6.3	19.2	0	27.5
76		1.2K	5.4	9.6	0	16.2
77		1.2K	5.4	9.6	0	16.2
78		1.2K	3.6	6.0	0	10.8
TOTAL:		8.2K	24.6	71.6	100	204.4

Expense Rates:

Administration	50/mm
Production Support	50/mm
Engineering	200/mm

3.2.5.4

Indirect Cost Breakdown

Definitions:

Development Costs	Defined as all labor and expense costs for Engineering, Engineering Manager, and Secretary for period 7/1/73 to 11/1/74 (FCS).
Start-Up Costs	Defined as all Indirect Costs (labor and expense) for period 7/1/73 to 11/1/74 (FCS) less Development Costs.
Production Support Costs	Defined as all Indirect Cost (labor and expense) for period 11/1/74 (FCS) to end of program.

Cost Summary:

Development Costs	405.5K
Start-Up Costs	103.1K
Production Support Costs	1,586.2K
	2,094.8K

3[illegible]5.5

Indirect Skill Schedule - Base Case

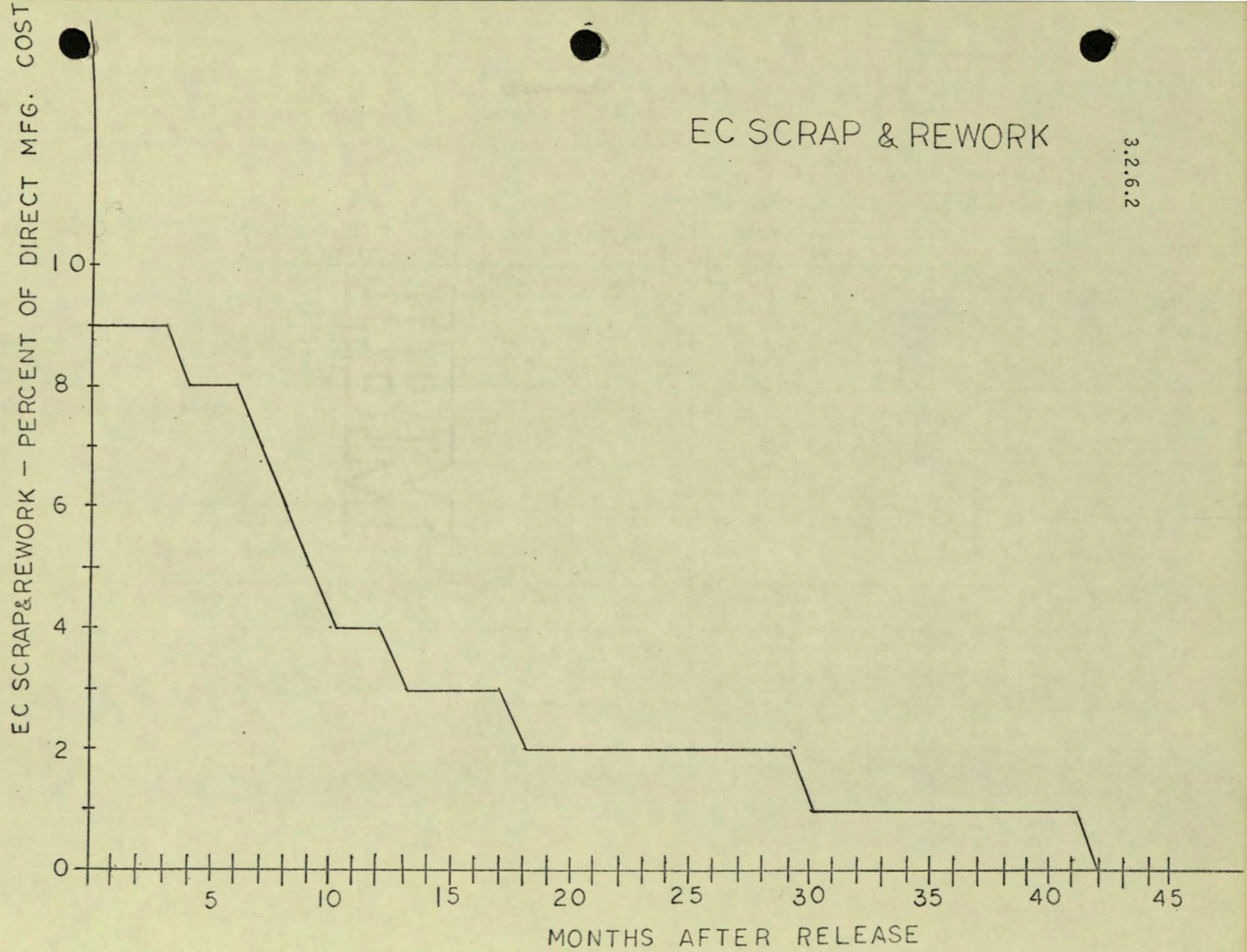
	73						74				75	76	77	78	Salary Levels
	7	8	9	10	11	12	1Q	2Q	3Q	4Q					
Administration															
Engineering Manager	1	1	1	1	1	1	1	1	1	1	1	0	0	0	2,700
Sub-Assembly Manager	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1,600
Final Assembly/Test Manager	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1,600
Secretary	0	0	0	1	1	1	1	1	1	1	.25	0	0	0	800
TOTAL:	1	1	1	2	2	2	2	3	4	4	3.25	2	2	2	
Engineering															
Mechanical Engineer	2	2	2	2	2	2	2	2	1	1	1	0	0	0	2,500
Electrical Engineer	1	1	1	1	2	2	2	2	2	1	1	.5	.5	0	2,200
Manufacturing Engineer	0	0	0	0	0	0	0	2	4	4	4	3	3	2	1,600
Designer	0	0	0	1	2	2	3	2	2	1	1	0	0	0	1,200
Technician	0	0	0	1	1	1	1	1	1	1	1	.5	.5	.5	1,000
Analyst	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1,000
TOTAL:	3	3	3	5	7	7	8	10	10	8	8	4	4	2.5	
Production Support															
Purchasing	0	0	0	0	0	0	0	1	2	2	2	2	2	1	1,500
Production Control	0	0	0	0	0	0	0	1	2	3	3	3	3	2	1,400
Q.E.	0	0	0	0	0	0	0	1	2	3	3	3	3	2	1,500
Fab Shop	0	0	0	0	0	0	0	1	2	2	1.5	0	0	0	1,100
Documentation/Control	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1,600
TOTAL:	0	0	0	0	0	0	0	5	9	11	10.5	9	9	6	
GRAND TOTAL:	4	4	4	7	9	9	10	18	23	23	21.75	15	15	10.5	

3.2.6 EC SCRAP AND REWORK

3.2.6.1

EC Scrap & Rework Costs - Base Case

		Ship Schedule	Total Direct Mfg. Costs	% Scrap/ Rework	Total Scrap/ Rework Costs
74	1	0	0		0
	2	0	0		0
	3	0	0		0
	4	0	0		0
	5	0	0		0
	6	0	0		0
	7	0	0		0
	8	0	33.3K	9	3.0K
	9	0	50.0K	9	4.5K
	10	0	105.9K	9	9.5K
	11	5	147.2K	8	11.8K
	12	10	155.3K	8	12.4K
75	1	30	165.0K	8	13.2K
	2	52	170.6K	7	11.9K
	3	66	159.4K	6	9.6K
	4	80	163.6K	5	8.2K
	5	103	167.3K	4	6.7K
	6	106	174.0K	4	7.0K
	7	120	175.3K	4	7.0K
	8	133	158.7K	3	4.8K
	9	145	155.8K	3	4.7K
	10	160	155.8K	3	4.7K
	11	160	155.8K	3	4.7K
	12	160	155.8K	3	4.7K
76		1,920	1,931.7K	2	38.6K
77		1,920	1,996.8K	1	20.0K
78		1,920	1,575.1K	0	0
TOTAL:		7,090	7,952.4K		187.0K


EC SCRAP & REWORK
EC SCRAP&REWORK – PERCENT OF DIRECT MFG. COST
10
8
6
4
2
0
5
10
15
20
25
30
35
40
45
MONTHS AFTER RELEASE

3.2.7 CAPITAL EQUIPMENT

3.2.7.1

Capital Equipment Expenditures Schedule - Base Case

		Ship Schedule	Receiving Inspect.	Fab Shop	Tooling	Eng'g	Assembly & Test					TOTAL
							Osc.	FTR*	PCB	Misc.	B/C**	
73	3Q	0	0	0	0	10K	0	0	0	0	0	10K
	4Q	0	0	10K	0	10K	0	0	0	0	0	20K
74	1Q	0	0	40K	0	0	0	0	0	0	0	40K
	2Q	0	0	0	0	0	0	0	0	0	0	0K
	3Q	0	15K	0	200K	0	0	0	4K	5K	4K	228K
	4Q	15	0	0	200K	0	4K	6K	4K	5K	3K	222K
75	1Q	148	0	0	50K	0	4K	6K	0	0	0	60K
	2Q	289	0	0	50K	0	4K	6K	0	0	0	60K
	3Q	398	0	0	15K	0	2K	3K	0	0	0	20K
	4Q	480	0	0	10K	0	2K	3K	0	0	0	15K
76		1,920	0	0	25K	0	0	0	0	0	0	25K
77		1,920	0	0	25K	0	0	0	0	0	0	25K
78		1,920	0	0	25K	0	0	0	0	0	0	25K
TOTAL:		7,090	15K	50K	600K	20K	16K	24K	8K	10K	7K	750K

*Final Test Robot

**Benches & Chairs

3[illegible]7.2

Capital Equipment Depreciation Schedule - Base Case

		73		74				75				76	77	78	Total Deprec.	Deprec/ Unit
		3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q					
73	3Q	(10K)													0	
	4Q	.5K	(20K)												.5K	
74	1Q	.5K	1K	(40K)											1.5K	
	2Q	.5K	1K	2K	(0K)										3.5K	
	3Q	.5K	1K	2K	0	(228K)									3.5K	
	4Q	.5K	1K	2K	0	11.4K	(222K)								14.9K	993.3
75	1Q	.5K	1K	2K	0	11.4K	11.1K	(60K)							26.0K	175.7
	2Q	.5K	1K	2K	0	11.4K	11.1K	3K	(60K)						29.0K	100.3
	3Q	.5K	1K	2K	0	11.4K	11.1K	3K	3K	(20K)					32.0K	80.4
	4Q	.5K	1K	2K	0	11.4K	11.1K	3K	3K	1K	(15K)				33.0K	68.8
76		2K	4K	8K	0	45.6K	44.4K	12K	12K	4K	3K	(25K)			135.0K	70.3
77		2K	4K	8K	0	45.6K	44.4K	12K	12K	4K	3K	5K	(25K)		140.0K	72.9
78		1.5K	4K	8K	0	45.6K	44.4K	12K	12K	4K	3K	5K	5K	(25K)	144.5K	75.3
TOTAL:		10K	20K	38K	0	193.8K	177.6K	45K	42K	13K	9K	10K	5K	0K	563.4K	79.5

3.2.7.3

CAPITAL EQUIPMENT REQUIREMENTS - Base Case

	Total	Basic	Complete
Assembly & Test	($-K)	($-K)	($-K)
PCB Testers (4)	8		
Final Test Robots (8)	24		
Scopes (8)	16		
Benches/Chairs	7		
Misc Tools & Equipment	10		
	65	32.5	32.5
Fabrication Shop	50	25.0	25.0
Receiving Inspection	15	7.5	7.5
Engineering	20	10.0	10.0
Tooling & Fixtures (see breakdown)	600	232.5	367.5
Total	750K	307.5K	442.5K

TOOLING & FIXTURES

	Die Castings & Int. Molds	Fine Blank & Coin	Punch & Extrusions	Assembly Fixtures	Test Fixtures	Misc.	TOTAL
BASIC MECHANISM							
Hammer Bank	12K	30K	2K	18K	12K	-	74K
Type Unit	30K	40K	8K	20K	10K	-	108K
Form Feed	18K	-	8K	6K	4K	-	36K
Ribbon Units	5K	-	4K	1K	-	-	10K
Intem. Elect.	-	-	2K	-	-	-	2K
Assembly	50K	8K	14K	8K	12K	10K	102K
							332K
					40% Contingency	Rework	133K
CONTROL ELECT./P.S.						Total	465K
Power Supply	12K	-	4K	2K	2K	-	20K
Encl. & Cables	7K	-	4K	2K	2K	-	15K
							35K
FRAME/COVERS							
Covers & Ctl. Pnl.	36K	-	8K	4K	2K	-	50K
Stand Assm.	18K	-	3K	2K	2K	-	25K
Paper Tray	5K	-	2K	-	-	-	7K
Shipping Group	-	-	3K	-	5K	10K	18K
							100K
						TOTAL	600K

BREAKDOWN:

Basic Machine - 232.5K
Complete Machine - 367.5K

3.2.8 WARRANTY COSTS

3.2.8.1

Total Warranty Costs - Base Case

		Warranty Costs Basic Machine	Warranty Costs Complete Machine	Warranty Costs TOTAL
74	10	0	0	0
	11	0	0	0
	12	552	0	552
75	1	1,086	0	1,086
	2	2,472	0	2,472
	3	3,705	0	3,705
	4	4,514	0	4,514
	5	4,730	0	4,730
	6	4,432	246	4,678
	7	3,898	449	4,347
	8	3,468	643	4,111
	9	3,127	611	3,738
	10	3,069	603	3,672
	11	2,911	575	3,486
	12	2,670	802	3,472
76		21,409	14,512	35,921
77		24,538	14,717	39,255
78		24,538	14,717	39,255
79		3,090	2,453	6,543
TOTAL:		115,209	50,328	165,537

3.2.8.2

Warranty Costs - Base Case
Complete Machine

		Ship Sched	UI Rate	Number of Incidents	Direct Mat'l & Labor/ Incident	Total Direct Mat'l & Labor	Burden	Ship'g	TOTAL
74	10	0		0	0.00	0	0	0	0
	11	5	1.30	0	0.00	0	0	0	0
	12	10	1.30	6.5	68.00	442	97	13	552
75	1	30	1.30	19.5	44.00	858	189	39	1,086
	2	52	1.20	58.5	33.00	1,930	425	117	2,472
	3	66	1.06	114	25.00	2,850	627	228	3,705
	4	80	.95	171	20.00	3,420	752	342	4,514
	5	80	.88	208	17.00	3,536	778	416	4,730
	6	80	.80	217	15.10	3,277	721	434	4,432
	7	90	.73	211	13.50	2,849	627	422	3,898
	8	100	.65	201	12.50	2,513	553	402	3,468
	9	109	.62	195	11.50	2,243	494	390	3,127
	10	120	.60	199	11.00	2,189	482	398	3,069
	11	80	.60	205	10.00	2,050	451	410	2,911
	12	80	.60	188	10.00	1,880	414	376	2,670
76		960	.60	1,752	10.00	17,520	3,854	3,504	21,409
77		960	.60	1,728	10.00	17,280	3,802	3,456	24,538
78		960	.60	1,728	10.00	17,280	3,802	3,456	24,538
79				288	10.00	2,880	634	576	4,090

TOTAL: 115,209

Average = $29.38/unit

ASSUMPTIONS:
1. Direct Material & Labor Costs per UI = $10.00 x Prog. Factor
2. Indirect Costs (burden) = 26% of Direct Mat'l and Labor
3. Shipping = $2.00/Incident

3.2.8.3

Warranty Costs - Base Case
Basic Machine

		Ship Sched	UI Rate	Number of Incidents	Direct Mat'l & Labor/ Incident	Total Direct Mat'l & Labor	Burden	Ship'g	TOTAL
74	10	0		0	0.00	0	0	0	0
	11	0		0	0.00	0	0	0	0
	12	0		0	0.00	0	0	0	0
75	1	0		0	0.00	0	0	0	0
	2	0		0	0.00	0	0	0	0
	3	0		0	0.00	0	0	0	0
	4	0		0	0.00	0	0	0	0
	5	23	.51	0	0.00	0	0	0	0
	6	26	.46	11.7	15.10	177	46	23	246
	7	30	.42	23.6	13.50	319	83	47	449
	8	33	.38	36.2	12.50	453	118	72	643
	9	36	.36	37	11.50	426	111	74	611
	10	40	.35	38	11.00	418	109	76	603
	11	80	.35	39.4	10.00	394	102	79	575
	12	80	.35	54.9	10.00	549	143	110	802
76		960	.35	994	10.00	9,940	2,584	1,988	14,512
77		960	.35	1,008	10.00	10,080	2,621	2,016	14,717
78		960	.35	1,008	10.00	10,080	2,621	2,016	14,717
79				168	10.00	1,680	437	336	1,453

TOTAL: 50,328

Average = $15.60/unit

ASSUMPTIONS:
1. Direct Material & Labor Costs per UI = $10.00
2. Indirect Costs (burden) = 26% of Direct Mat'l and Labor
3. Shipping = $2.00/Incident

3.2.9 QUANTITY SENSITIVITY ANALYSIS

9.1

Product Cost Summary - High Program Quantity

Program Quantities: Basic - 5988
Complete - 6622
Combined - 12,610

	Basic Machine			Complete Machine			Combined		
	Program	Unit	%	Program	Unit	%	Program	Unit	%
Direct Material Cost	3,440.4K	574.55	59.1	6,854.2K	1,035.06	66.3	10,294.6K	816.38	59.9
Direct Labor Cost	853.1K	142.47	14.7	1,638.0K	247.36	15.8	2,491.1K	197.55	12.9
Total Direct Mfg. Cost:	4,293.5K	717.02	73.8	8,492.2K	1,282.42	82.1	12,785.7	1,013.93	72.8
Indirect Labor Cost	984.1K	164.34	16.9	1,088.3K	164.34	10.5	2,072.4	164.34	16.9
Indirect Expense Cost	106.4	17.77	1.8	117.7K	17.77	1.1	224.1	17.77	1.9
Total Indirect Cost:	1,090.5	182.11	18.7	1,206.0K	182.12	11.6	2,296.5	182.11	18.8
EC Scrap/Rework Cost	77.7K	13.00	1.4	158.5K	23.94	1.5	236.2K	18.73	1.7
Total Manufacturing Cost:	5,461.7K	912.11	93.9	9,856.7K	1,488.48	95.2	15,318.4K	1,214.78	93.3
Capital Equip/Tooling	357.5K	59.70	6.1	492.5K	74.37	4.8	850.0K	67.41	6.7
TOTAL PRODUCT COST:	5,819.2	971.81	100.0	10,347.6K	1,562.85	100.0	16,168.4K	1,282.18	100.0

Capital Equipment Increment for
High Program Quantity -
Double tooling costs for 3rd & 4th
Quarter of 75 and 76, 77, 78.

9.2

Product Cost Summary - Low Program Quantity

Program Quantities: Basic - 1788
Complete - 2422
Combined - 4210

	Basic Machine			Complete Machine			Combined		
	Program	Unit	%	Program	Unit	%	Program	Unit	%
Direct Material Cost	1,258.0K	703.58	44.8	3,167.7K	1,307.89	57.8	4,425.7K	1,051.23	53.4
Direct Labor Cost	259.9K	145.36	9.3	649.5K	268.16	11.9	909.4K	216.01	11.0
Total Direct Mfg. Cost:	1,517.9K	848.94	54.1	3,817.2K	1,576.05	69.7	5,335.1K	1,267.24	64.4
Indirect Labor Cost	860.7K	481.37	30.7	1,029.7K	425.14	18.8	1,890.4K	449.03	22.8
Indirect Expense Cost	93.0K	52.01	3.3	111.4K	46.00	2.0	204.4K	48.55	2.5
Total Indirect Cost:	953.7K	533.38	34.0	1,141.1K	471.14	20.8	2,094.8K	497.58	25.3
EC Scrap/Rework Cost	50.2K	28.08	1.8	102.3K	42.24	1.9	152.5K	36.22	1.8
Total Manufacturing Cost:	2,521.8	1,410.40	89.9	5,060.6K	2,089.43	92.4	7,582.4K	1,801.04	91.5
Capital Equip/Tooling	282.5K	158.00	10.1	417.5K	172.38	7.6	700.0K	166.27	8.5
TOTAL PRODUCT COST:	2,804.3	1,568.40	100.0	5,478.1K	2,261.80	100.0	8,282.4K	1,967.31	100.0

Capital Equipment Increment for
Low Program Quantity -
Half tooling costs for 3rd & 4th
Quarter of 75 and 76, 77, 78.

3.[illegible].3

TOTAL MANUFACTURING COSTS - HIGH PROGRAM QUANTITY

EXPENDITURE SCHEDULE

	BASIC MACHINE				COMPLETE MACHINE				COMBINED			
	Ship	Direct Mat'l.	Direct Labor	Total Direct Mfg. Cost	Ship	Direct Mat'l	Direct Labor	Total Direct Mfg. Cost	Total Direct Mfg. Cost	Indirect Costs	Scrap & Rework	Total Mfg. Costs
73	0	0	0	0	0	0	0	0	0	121.4	0	121.4
74	0	0	0	0	15	430.2	61.5	491.7	491.7	467.1	41.2	1000.0
75	348	374.0	69.0	443.0	967	1,244.2	269.9	1514.1	1957.1	500.1	87.2	2544.4
76	1800	1040.6	252.4	1293.0	1800	1,759.7	420.6	2180.3	3473.3	423.7	69.5	3966.5
77	1920	1146.0	283.5	1429.5	1920	1,931.1	472.5	2403.6	3833.1	452.2	38.3	4323.6
78	1920	879.8	248.2	1128.0	1920	1,489.0	413.5	1902.5	3030.5	332.0	0	3362.5
TOTAL	5988	3440.4	853.1	4293.5	6622	6,854.2	1,638.0	8492.2	12,785.7	2796.5	236.2	15318.4

ASSUMPTIONS:
1. 6% material cost decrease over base case.
2. 20% indirect cost increase in 76, 77, & 78.
3. 10% second shift premium for direct labor.

3.2.[illegible].4

TOTAL MANUFACTURING COST LOW PROGRAM QUANTITY

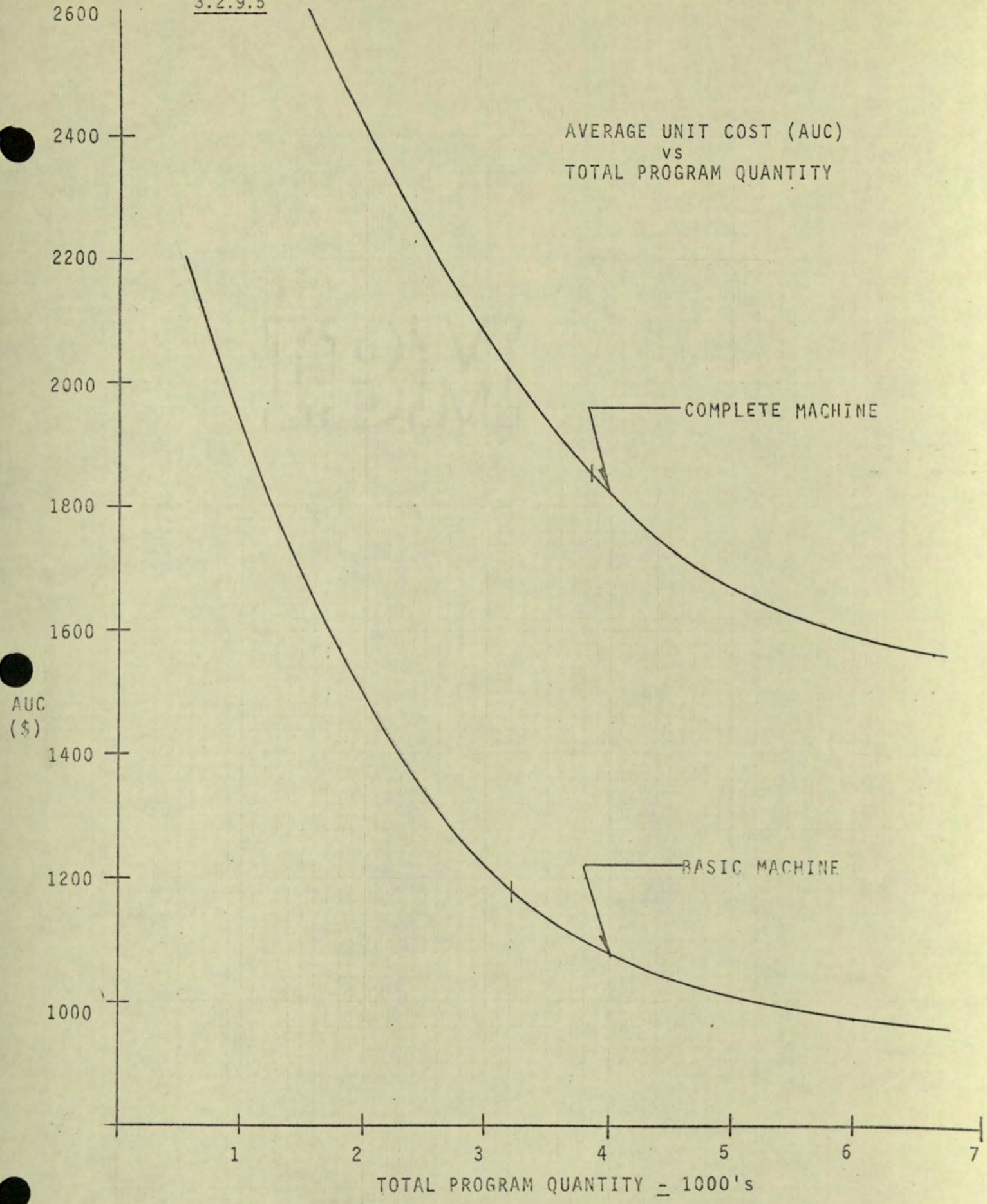
EXPENDITURE SCHEDULE

	BASIC MACHINE				COMPLETE MACHINE				COMBINED			
	Ship	Direct Mat'l.	Direct Labor	Total Direct Mfg. Costs	Ship	Direct Mat'l.	Direct Labor	Total Direct Mfg. Costs	Total Direct Mfg. Costs	Indirect Costs	Scrap & Rework	Total Mfg. Costs
73	0	0	0	0	0	0	0	0	0	121.4	0	121.4
74	0	0	0	0	15	430.2	61.5	491.7	491.7	467.1	41.2	1,000.0
75	348	374.0	69.0	443.0	967	1,244.2	269.9	1,541.1	1,957.1	500.1	87.2	2,544.4
76	480	312.9	64.3	377.2	480	529.1	107.2	636.3	1,013.5	352.7	20.3	1,386.5
77	480	323.1	67.5	390.6	480	544.4	112.5	656.9	1,047.5	376.8	3.8	1,428.1
78	480	248.0	59.1	307.1	480	414.8	98.4	518.2	825.3	276.8	0	1,102.1
TOTAL	1,788	1,258.0	259.9	1,517.9	2,422	3,167.7	649.5	3,817.2	5,335.1	2,094.8	152.5	7,582.5

ASSUMPTIONS:

1. 6% material cost increase over base case.
2. No decrease in indirect expenditures.

3.2.9.5


AVERAGE UNIT COST (AUC)
VS
TOTAL PROGRAM QUANTITY
COMPLETE MACHINE
BASIC MACHINE
AUC
($)
2600
2400
2200
2000
1800
1600
1400
1200
1000
1
2
3
4
5
6
7
TOTAL PROGRAM QUANTITY - 1000's

3.2.10 APPENDIX

3.2.10.1

Direct Labor Estimate

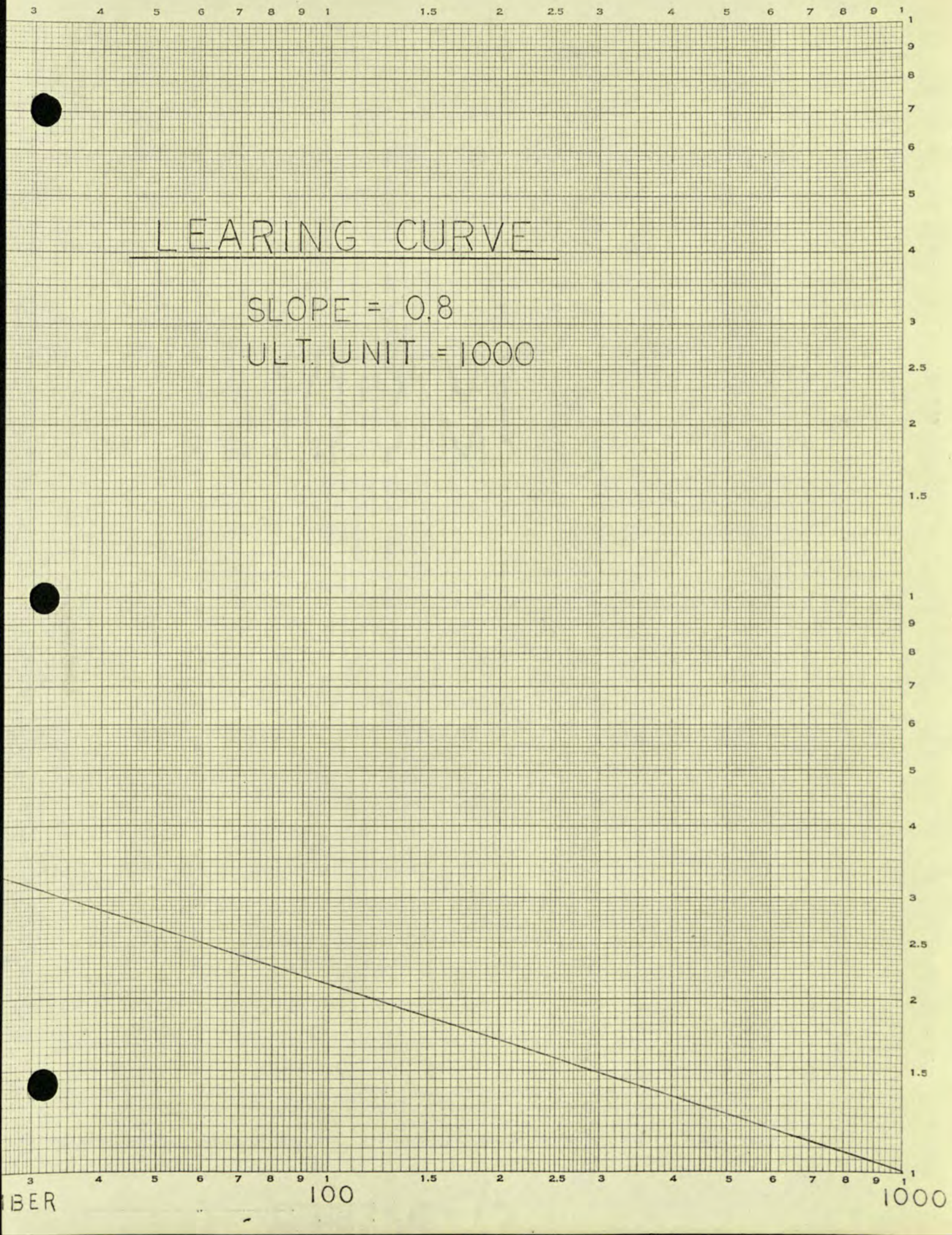
	Basic Machine	Complete Machine
Final Test	2.9	4.1
PCB Test	1.5	4.1
Component Test	.8	1.2
Electrical Subassembly	3.9	6.5
Mechanical Subassembly	5.6	7.4
Final Assembly	1.0	3.7
Receiving Inspection	2.5	4.1
Quality Control	2.8	4.1
Shipping	1.0	1.6
TOTAL:	22.0 hours	36.8 hours

Labor Cost = $4.60/hours = $810/month

3.2.10.2

Material Cost Estimate - Base Case

Function	Assembly/Component	Ultimate Cost/Unit	
Basic Printer	Hammer Bank	150.00	
	Type Unit with Emitter	81.00	
	Form Feed Unit	69.00	
	Ribbon Unit	22.50	
	Intimate Electronics	152.00	
	Miscellaneous & Assembly	96.50	
		569.00	
Control Electronics and Power Supply	I/O Channel	90.00	
	Control Electronics	118.50	
	Power Supply	70.00	
	Enclosures/Cables	38.00	
Frame/Cover	Covers with Control Panel	42.00	
	Stand Assembly	17.00	
	Paper Tray	9.00	
Manual		7.00	
Sub-Total:		960.50	
Basic Machine	Material	569.00	
	Floor Loss @2%	11.38	
	Total:	580.38	580
Complete Machine	Material	960.50	
	Floor Loss @2%	19.21	
	Total:	979.71	980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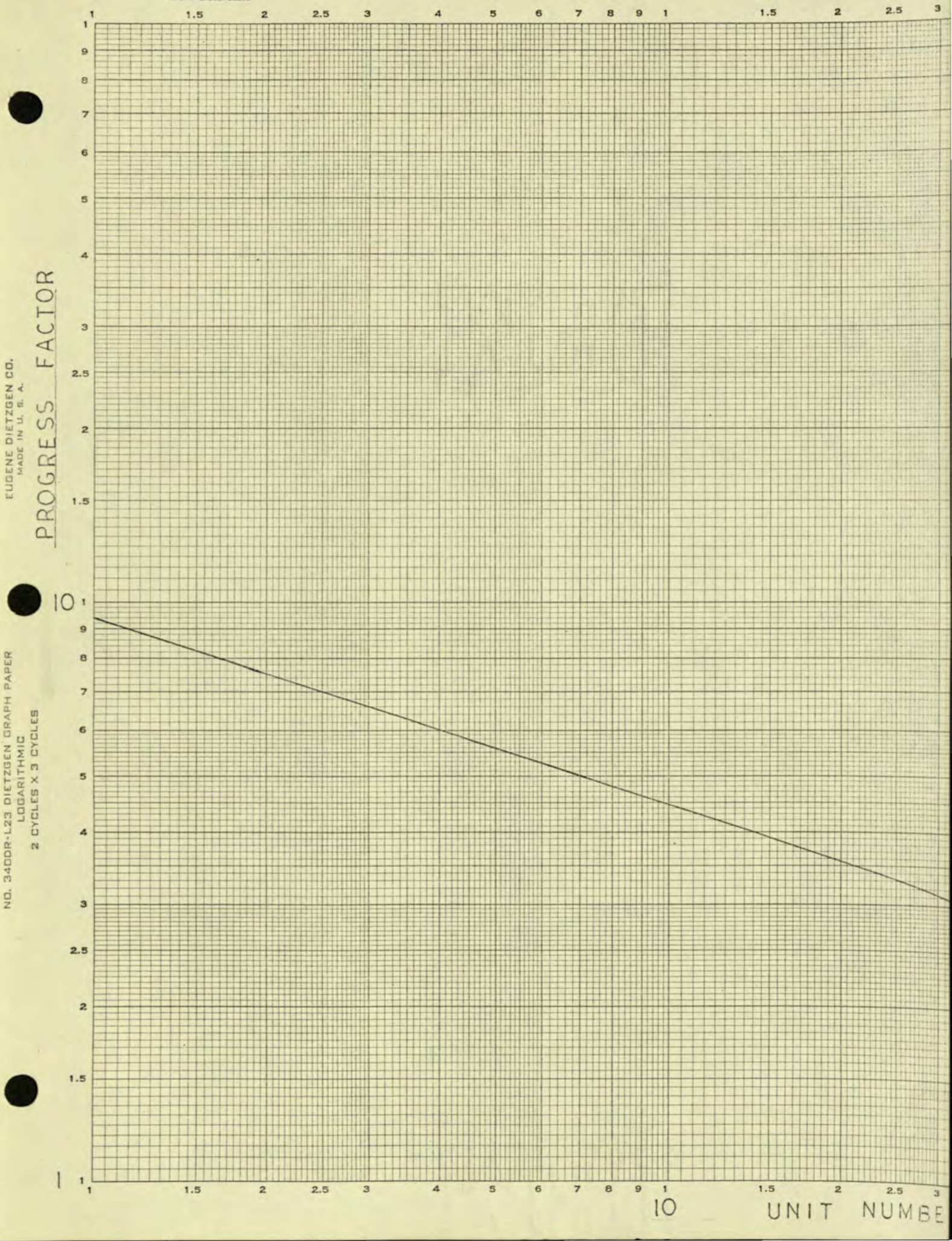
ULT. UNIT = 1000
BER
100
1000

3.2.10.3


PROGRESS FACTOR
10
1
10
UNIT NUMBE
EUGENE DIETZGEN CO.
MADE IN U. S. A.
NO. 340DR-L23 DIETZGEN GRAPH PAPER
LOGARITHMIC
2 CYCLES X 3 CYCLES

3.3 PRODUCT COST ANALYSIS

PROCESSOR PROGRAM

S/A 600

S/A 602

S/A 620

S/A 640

INDEX

Section 3.3

3.3.1 Assumptions/Definitions

3.3.2 Production Schedule

3.3.3 Summary

- 3.3.3.1 Product Cost Summary
- 3.3.3.2 Total Manufacturing Cost/Expenditure Schedule
- 3.3.3.3 Unit Cost vs. Unit Number (Non-Cumulative)

3.3.4 Direct Costs

- 3.3.4.1 Total Direct Manufacturing Costs
- 3.3.4.2 Direct Material Expenditures
- 3.3.4.3 OEM Material Expenditures
- 3.3.4.4 Direct Manpower Expenditures
- 3.3.4.5 Direct Labor Hours by Group
- 3.3.4.6 Direct Labor Hours by Function

3.3.5 Indirect Costs

- 3.3.5.1 Total Indirect Costs
- 3.3.5.2 Indirect Labor Expenditures
- 3.3.5.3 Indirect Expense Expenditures
- 3.3.5.4 Indirect Cost Breakdown
- 3.3.5.5 Indirect Skill Schedule
- 3.3.5.6 Indirect Salary Levels

3.3.6 EC Scrap and Rework

- 3.3.6.1 EC Scrap and Rework Costs
- 3.3.6.2 EC Scrap and Rework Projections

3.3.7 Capital Equipment

- 3.3.7.1 Capital Equipment Expenditure Schedule
- 3.3.7.2 Capital Equipment Depreciation Schedule
- 3.3.7.3 Capital Equipment Requirements
  - 3.3.7.3.1 Engineering
  - 3.3.7.3.2 Receiving Inspection
  - 3.3.7.3.3 Assembly Test
  - 3.3.7.3.4 Tooling

3.3.8 Warranty

3.3.8.1 Warranty Costs
3.3.8.2 Assumptions

3.3.9 Quantity Sensitivity Analysis

3.3.9.1 Product Cost Summary - Low, Base, and High Program Quantities
3.3.9.2 Total Manufacturing Cost/Expenditure Schedule High Program Quantity
3.3.9.3 Total Manufacturing Cost/Expenditure Schedule Low Program Quantity

3.3.10 Appendix

3.3.10.1 Direct Labor Estimate - Ultimate
3.3.10.2 Material Cost Estimate - Ultimate
3.3.10.3 Learning Curve

3.3.1 ASSUMPTIONS/DEFINITIONS

3.3.1

ASSUMPTIONS/DEFINITIONS

Production Schedule

Initial Production - For first three months of production, equivalent production (i.e. units built x progress factor) is held less than 175 units.

Maximum Production - 400 units per month for base case, reached approximately 24 months after FCS.

Ramp - Approximately linear from the end of Initial Production to Maximum Production, with the equivalent production not exceeding peak production.

Program Quantities

Base Case	16,555 units
Low Quantity	6,775 units
High Quantity	29,998 units

Direct Material Expenditures

Pipe Line - Three full months from receipt of goods to finished product (ship).

Equivalent Build Schedule - Build Schedule x Progress Factor (obtained from learning curve).

Cost - Estimate from ultimate material cost and Progress Factor. Display, Keyboard, and Memory assumed not to increase in price while all other materials increased in price 3% per year after 1974. Same learning curve used for material and labor.

Floor Loss - Not estimated

Direct Manpower/Expenditures

Requirements - Based upon direct labor per machine, progress factor, and production schedule normalized to 150 productive hours per month per man.

Manpower = Ultimate Labor Hours per machine x Progress Factor x Build Schedule/150 hours per month.

Pipe Line - See Direct Labor hours by Function Schedule.

3.3.1

Salary Levels - 10% increase over present employment level for 176 hours/month and 5% per year increase after 1974.

Expenses - No expenses anticipated for direct employees.

Indirect Costs

Requirements - See Indirect Skill Schedule.

Salary Levels - No salary increase over present employment level for 1973 and 7% per year increase thereafter.

Expenses - Expenses are estimated at $400/mm for Engineering and $50/mm for Production Support and Administration. Expenses include hardware costs for five prototype microprocessors.

Capital Equipment

Depreciation Schedule - 5 year straight line depreciation is assumed, except for Cost Summary where Capital Equipment is fully depreciated.

Warranty

Warranty Period - Three months.

Warranty Costs - $9.50 direct labor and material cost per incident (adjusted for Progress) plus Indirect Support at 22% of direct cost and $2.00 per incident for shipping.

Unit Costs

Average Unit Cost - Calculated from Cumulative Manufacturing Expenditures normalized to cumulative units shipped. Average Unit Costs are given in Total Manufacturing Cost/ Expenditure Schedule as a function of time. (These costs do not include capital equipment expenditures.) The Average Unit Cost for the program is obtained by dividing the total Program Costs by the total Program Quantity - see Product Cost Summary.

Instantaneous Unit Cost - See Unit Cost - Non-Cumulative. This is an estimate of what the product is costing as a function of time (or unit number). The direct material and labor is calculated from the ultimate material and labor cost (progress factor = 1) and the learning curve. Indirect Costs are the total indirect costs incurred during the month that these units were shipped. EC Scrap and Rework Costs schedule for the period 3 months prior to the ship date. Capital Depreciation is for the month the units are shipped.

Sensitivity Analysis

High Program Quantity - 1974 and 1975 production quantities remained constant. The 1976, 1977 and 1978 production is twice the base case (i.e. 800 units/month) with a three month ramp from 295 units to 800 units/month. The remainder of the program is held at a production level of 800 units/month.

Low Program Quantity - 1974 and 1975 production quantities remained constant. 1976, 1977, and 1978 production quantities are held at 200 units/month.

3.3.2 PRODUCTION SCHEDULE

3.3.2

Production Schedule - Base Case

		SHIP SCHEDULE	SHIP CUMULATIVE	SHIP BY QUARTER	SHIP BY YEAR
74	1				
	2				
	3				
	4				
	5				
	6				
	7	0	0		
	8	0	0	15	200
	9	15	15		
	10	35	50		
	11	60	110	185	
	12	90	200		
75	1	115	315		
	2	130	445	390	
	3	145	590		
	4	160	750		
	5	175	925	525	
	6	190	1,115		2,375
	7	205	1,320		
	8	220	1,540	660	
	9	235	1,775		
	10	255	2,030		
	11	265	2,295	800	
	12	280	2,575		
76		4,380	6,955	1,095	4,380
77		4,800	11,755	1,200	4,800
78		4,800	16,555	1,200	4,800

3.3.3 SUMMARY

3.3.3.1

Product Cost Summary - Base Case

	PROGRAM	UNIT	
Direct Material Costs	9,982,800	603.01	70%
Direct Labor Costs	1,927,519	116.43	13.5%
Total Direct Manufacturing Costs	11,910,319	719.44	83.5%
Indirect Labor Costs	1,711,849	103.40	12%
Indirect Expense Costs	148,560	8.97	1%
Total Indirect Costs	1,860,409	112.37	13%
EC Scrap & Rework Costs	250,119	15.11	1.8%
Total Manufacturing Costs	14,020,847	846.93	98.3%
Capital Equipment/Tooling	241,000	14.56	1.7%
Total Product Cost	14,261,847	861.49	100%
Warranty Cost	271,014	16.37	

3.3.3.2

Total Manufacturing Costs - Base Case
Expenditure Schedule

		SHIP SCHED	CUM MFG SCHED	DIRECT MFG COSTS	INDIRECT COSTS	SCRAP/ REWORK COSTS	TOTAL MFG COST	CUM MFG COST	AVG UNIT COST
	4	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0
	6	0	0	0	7,250	0	7,250	7,250	0
	7	0	0	0	10,300	0	10,300	17,550	0
73	8	0	0	0	14,500	0	14,500	32,050	0
	9	0	0	0	22,700	0	22,700	54,750	0
	10	0	0	0	24,300	0	24,300	79,050	0
	11	0	0	0	25,800	0	25,800	104,850	0
	12	0	0	0	25,800	0	25,800	130,650	0
	1	0	0	0	27,184	0	27,184	157,834	0
	2	0	0	0	24,858	0	24,858	182,692	0
	3		0	0	20,206	0	20,206	202,898	0
	4	0	0	0	23,145	0	23,145	226,043	0
	5	0	0	0	28,460	0	28,460	254,503	0
74	6	0	0	43,027	37,674	4,731	85,432	339,935	0
	7	0	0	66,106	39,329	6,875	112,310	452,245	0
	8	0	0	90,275	40,606	9,024	139,905	592,150	0
	9	15	15	114,126	36,404	10,958	161,488	753,638	50,243
	10	35	50	126,251	36,404	11,667	174,322	927,960	18,559
	11	60	110	131,269	36,404	11,808	179,481	1,107,441	10,068
	12	90	200	135,053	36,404	11,550	183,007	1,290,448	6,452
	1	115	315	139,147	35,747	11,355	186,249	1,476,697	4,688
	2	130	445	143,165	35,747	11,056	189,968	1,666,665	3,745
	3	145	590	149,609	35,747	10,848	196,204	1,862,869	3,157
	4	160	750	155,754	33,298	10,697	199,749	2,062,618	2,750
	5	175	925	162,176	33,298	10,412	205,886	2,268,504	2,452
75	6	190	1,115	165,235	33,298	9,700	208,233	2,476,737	2,221
	7	205	1,320	169,689	30,725	9,151	209,565	2,686,302	2,035
	8	220	1,540	176,184	30,725	8,830	215,739	2,902,041	1,884
	9	235	1,775	185,245	30,725	8,427	224,397	3,126,438	1,761
	10	255	2,030	194,136	30,725	8,081	232,942	3,359,380	1,655
	11	265	2,295	203,708	30,725	7,705	242,138	3,601,518	1,569
	12	280	2,575	213,450	30,725	6,781	250,956	3,852,474	1,496
76		4,380	6,955	3,152,034	334,284	60,201	3,546,519	7,398,993	1,064
77		4,800	11,755	3,333,588	336,144	10,262	3,679,994	11,078,987	942.49
78		4,800	16,555	2,661,092	280,768	0	2,941,860	14,020,847	846.93
TOTAL:		16,555		11,910,319	1,860,409	250,119	14,020,847		