

MANUFACTURING

N C  
PROGRAMMING  
THROUGH  
THE  
SPECTRALIGHT<sup>TM</sup>  
LATHE

NAME \_\_\_\_\_  
PERIOD \_\_\_\_\_



GRADE SHEET  
AN INTRODUCTION TO NC PROGRAMMING  
THROUGH THE SPECTRALIGHT LATHE

CRITERIA	POSSIBLE	ACTUAL
WORKSHEET 1	10	_____
WORKSHEET 2	15	_____
CHECK POINT 1 (PART DIAGRAM)		
<u>INS. INITIAL</u>	2	_____
ACTIVITY 1	25	_____
CHECK POINT 2 (FINISH CUT)		
<u>INS. INITIAL</u>	2	_____
CHECK POINT 3 (ROUGH CUT)		
<u>INS. INITIAL</u>	2	_____
CHECK POINT 4 (PROGRAM)		
<u>INS. INITIAL</u>	2	_____
WORKSHEET 3	10	_____
CHECK POINT 5 (HARD COPY)		
<u>INS. INITIAL</u>	2	_____
ACTIVITY 2	15	_____
CHECK POINT 6 (TOOL SEL.)		
<u>INS. INITIAL</u>	2	_____
CHECK POINT 7 (SIMULATION)		
<u>INS. INITIAL</u>	2	_____
CHECK POINT 8 (PROBLEMS)		
<u>INS. INITIAL</u>	2	_____
ACTIVITY 3	25	_____
CHECK POINT 9 (COMPUTER USE)		
<u>INS. INITIAL</u>	2	_____
CHECK POINT 10 (INIT. SETUP)		
<u>INS. INITIAL</u>	2	_____
CHECK POINT 11 (LATHE RUN)		
<u>INS. INITIAL</u>	2	_____
CHECK POINT 12 (FINISH)		
<u>INS. INITIAL</u>	2	_____
TOTAL	126	_____

LETTER GRADING    A-116 TO 126  
                          B-105 TO 115  
                          C- 94 TO 104  
                          D- 83 TO 93



AN INSTRUCTIONS TO THE PROGRAMMER  
 THROUGH THE SPECIALIZED RATE

ACTUAL	ESTIMATED	DESCRIPTION
10	10	ACTIVITY 1
15	15	ACTIVITY 2
20	20	ACTIVITY 3
25	25	ACTIVITY 4
30	30	ACTIVITY 5
35	35	ACTIVITY 6
40	40	ACTIVITY 7
45	45	ACTIVITY 8
50	50	ACTIVITY 9
55	55	ACTIVITY 10
60	60	ACTIVITY 11
65	65	ACTIVITY 12
70	70	ACTIVITY 13
75	75	ACTIVITY 14
80	80	ACTIVITY 15
85	85	ACTIVITY 16
90	90	ACTIVITY 17
95	95	ACTIVITY 18
100	100	ACTIVITY 19
105	105	ACTIVITY 20
110	110	ACTIVITY 21
115	115	ACTIVITY 22
120	120	ACTIVITY 23
125	125	ACTIVITY 24
130	130	ACTIVITY 25
135	135	ACTIVITY 26
140	140	ACTIVITY 27
145	145	ACTIVITY 28
150	150	ACTIVITY 29
155	155	ACTIVITY 30
160	160	ACTIVITY 31
165	165	ACTIVITY 32
170	170	ACTIVITY 33
175	175	ACTIVITY 34
180	180	ACTIVITY 35
185	185	ACTIVITY 36
190	190	ACTIVITY 37
195	195	ACTIVITY 38
200	200	ACTIVITY 39
205	205	ACTIVITY 40
210	210	ACTIVITY 41
215	215	ACTIVITY 42
220	220	ACTIVITY 43
225	225	ACTIVITY 44
230	230	ACTIVITY 45
235	235	ACTIVITY 46
240	240	ACTIVITY 47
245	245	ACTIVITY 48
250	250	ACTIVITY 49
255	255	ACTIVITY 50
260	260	ACTIVITY 51
265	265	ACTIVITY 52
270	270	ACTIVITY 53
275	275	ACTIVITY 54
280	280	ACTIVITY 55
285	285	ACTIVITY 56
290	290	ACTIVITY 57
295	295	ACTIVITY 58
300	300	ACTIVITY 59
305	305	ACTIVITY 60
310	310	ACTIVITY 61
315	315	ACTIVITY 62
320	320	ACTIVITY 63
325	325	ACTIVITY 64
330	330	ACTIVITY 65
335	335	ACTIVITY 66
340	340	ACTIVITY 67
345	345	ACTIVITY 68
350	350	ACTIVITY 69
355	355	ACTIVITY 70
360	360	ACTIVITY 71
365	365	ACTIVITY 72
370	370	ACTIVITY 73
375	375	ACTIVITY 74
380	380	ACTIVITY 75
385	385	ACTIVITY 76
390	390	ACTIVITY 77
395	395	ACTIVITY 78
400	400	ACTIVITY 79
405	405	ACTIVITY 80
410	410	ACTIVITY 81
415	415	ACTIVITY 82
420	420	ACTIVITY 83
425	425	ACTIVITY 84
430	430	ACTIVITY 85
435	435	ACTIVITY 86
440	440	ACTIVITY 87
445	445	ACTIVITY 88
450	450	ACTIVITY 89
455	455	ACTIVITY 90
460	460	ACTIVITY 91
465	465	ACTIVITY 92
470	470	ACTIVITY 93
475	475	ACTIVITY 94
480	480	ACTIVITY 95
485	485	ACTIVITY 96
490	490	ACTIVITY 97
495	495	ACTIVITY 98
500	500	ACTIVITY 99
505	505	ACTIVITY 100
510	510	ACTIVITY 101
515	515	ACTIVITY 102
520	520	ACTIVITY 103
525	525	ACTIVITY 104
530	530	ACTIVITY 105
535	535	ACTIVITY 106
540	540	ACTIVITY 107
545	545	ACTIVITY 108
550	550	ACTIVITY 109
555	555	ACTIVITY 110
560	560	ACTIVITY 111
565	565	ACTIVITY 112
570	570	ACTIVITY 113
575	575	ACTIVITY 114
580	580	ACTIVITY 115
585	585	ACTIVITY 116
590	590	ACTIVITY 117
595	595	ACTIVITY 118
600	600	ACTIVITY 119
605	605	ACTIVITY 120
610	610	ACTIVITY 121
615	615	ACTIVITY 122
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635	635	ACTIVITY 126
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660	660	ACTIVITY 131
665	665	ACTIVITY 132
670	670	ACTIVITY 133
675	675	ACTIVITY 134
680	680	ACTIVITY 135
685	685	ACTIVITY 136
690	690	ACTIVITY 137
695	695	ACTIVITY 138
700	700	ACTIVITY 139
705	705	ACTIVITY 140
710	710	ACTIVITY 141
715	715	ACTIVITY 142
720	720	ACTIVITY 143
725	725	ACTIVITY 144
730	730	ACTIVITY 145
735	735	ACTIVITY 146
740	740	ACTIVITY 147
745	745	ACTIVITY 148
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760	760	ACTIVITY 151
765	765	ACTIVITY 152
770	770	ACTIVITY 153
775	775	ACTIVITY 154
780	780	ACTIVITY 155
785	785	ACTIVITY 156
790	790	ACTIVITY 157
795	795	ACTIVITY 158
800	800	ACTIVITY 159
805	805	ACTIVITY 160
810	810	ACTIVITY 161
815	815	ACTIVITY 162
820	820	ACTIVITY 163
825	825	ACTIVITY 164
830	830	ACTIVITY 165
835	835	ACTIVITY 166
840	840	ACTIVITY 167
845	845	ACTIVITY 168
850	850	ACTIVITY 169
855	855	ACTIVITY 170
860	860	ACTIVITY 171
865	865	ACTIVITY 172
870	870	ACTIVITY 173
875	875	ACTIVITY 174
880	880	ACTIVITY 175
885	885	ACTIVITY 176
890	890	ACTIVITY 177
895	895	ACTIVITY 178
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905	905	ACTIVITY 180
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925	925	ACTIVITY 184
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935	935	ACTIVITY 186
940	940	ACTIVITY 187
945	945	ACTIVITY 188
950	950	ACTIVITY 189
955	955	ACTIVITY 190
960	960	ACTIVITY 191
965	965	ACTIVITY 192
970	970	ACTIVITY 193
975	975	ACTIVITY 194
980	980	ACTIVITY 195
985	985	ACTIVITY 196
990	990	ACTIVITY 197
995	995	ACTIVITY 198
1000	1000	ACTIVITY 199
1005	1005	ACTIVITY 200
1010	1010	ACTIVITY 201
1015	1015	ACTIVITY 202
1020	1020	ACTIVITY 203
1025	1025	ACTIVITY 204
1030	1030	ACTIVITY 205
1035	1035	ACTIVITY 206
1040	1040	ACTIVITY 207
1045	1045	ACTIVITY 208
1050	1050	ACTIVITY 209
1055	1055	ACTIVITY 210
1060	1060	ACTIVITY 211
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1070	1070	ACTIVITY 213
1075	1075	ACTIVITY 214
1080	1080	ACTIVITY 215
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1090	1090	ACTIVITY 217
1095	1095	ACTIVITY 218
1100	1100	ACTIVITY 219
1105	1105	ACTIVITY 220
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1125	1125	ACTIVITY 224
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1170	1170	ACTIVITY 233
1175	1175	ACTIVITY 234
1180	1180	ACTIVITY 235
1185	1185	ACTIVITY 236
1190	1190	ACTIVITY 237
1195	1195	ACTIVITY 238
1200	1200	ACTIVITY 239
1205	1205	ACTIVITY 240
1210	1210	ACTIVITY 241
1215	1215	ACTIVITY 242
1220	1220	ACTIVITY 243
1225	1225	ACTIVITY 244
1230	1230	ACTIVITY 245
1235	1235	ACTIVITY 246
1240	1240	ACTIVITY 247
1245	1245	ACTIVITY 248
1250	1250	ACTIVITY 249
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1260	1260	ACTIVITY 251
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1275	1275	ACTIVITY 254
1280	1280	ACTIVITY 255
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1290	1290	ACTIVITY 257
1295	1295	ACTIVITY 258
1300	1300	ACTIVITY 259
1305	1305	ACTIVITY 260
1310	1310	ACTIVITY 261
1315	1315	ACTIVITY 262
1320	1320	ACTIVITY 263
1325	1325	ACTIVITY 264
1330	1330	ACTIVITY 265
1335	1335	ACTIVITY 266
1340	1340	ACTIVITY 267
1345	1345	ACTIVITY 268
1350	1350	ACTIVITY 269
1355	1355	ACTIVITY 270
1360	1360	ACTIVITY 271
1365	1365	ACTIVITY 272
1370	1370	ACTIVITY 273
1375	1375	ACTIVITY 274
1380	1380	ACTIVITY 275
1385	1385	ACTIVITY 276
1390	1390	ACTIVITY 277
1395	1395	ACTIVITY 278
1400	1400	ACTIVITY 279
1405	1405	ACTIVITY 280
1410	1410	ACTIVITY 281
1415	1415	ACTIVITY 282
1420	1420	ACTIVITY 283
1425	1425	ACTIVITY 284
1430	1430	ACTIVITY 285
1435	1435	ACTIVITY 286
1440	1440	ACTIVITY 287
1445	1445	ACTIVITY 288
1450	1450	ACTIVITY 289
1455	1455	ACTIVITY 290
1460	1460	ACTIVITY 291
1465	1465	ACTIVITY 292
1470	1470	ACTIVITY 293
1475	1475	ACTIVITY 294
1480	1480	ACTIVITY 295
1485	1485	ACTIVITY 296
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1500	1500	ACTIVITY 299
1505	1505	ACTIVITY 300
1510	1510	ACTIVITY 301
1515	1515	ACTIVITY 302
1520	1520	ACTIVITY 303
1525	1525	ACTIVITY 304
1530	1530	ACTIVITY 305
1535	1535	ACTIVITY 306
1540	1540	ACTIVITY 307
1545	1545	ACTIVITY 308
1550	1550	ACTIVITY 309
1555	1555	ACTIVITY 310
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1575	1575	ACTIVITY 314
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1590	1590	ACTIVITY 317
1595	1595	ACTIVITY 318
1600	1600	ACTIVITY 319
1605	1605	ACTIVITY 320
1610	1610	ACTIVITY 321
1615	1615	ACTIVITY 322
1620	1620	ACTIVITY 323
1625	1625	ACTIVITY 324
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1655	1655	ACTIVITY 330
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1665	1665	ACTIVITY 332
1670	1670	ACTIVITY 333
1675	1675	ACTIVITY 334
1680	1680	ACTIVITY 335
1685	1685	ACTIVITY 336
1690	1690	ACTIVITY 337
1695	1695	ACTIVITY 338
1700	1700	ACTIVITY 339
1705	1705	ACTIVITY 340
1710	1710	ACTIVITY 341
1715	1715	ACTIVITY 342
1720	1720	ACTIVITY 343
1725	1725	ACTIVITY 344
1730	1730	ACTIVITY 345
1735	1735	ACTIVITY 346
1740	1740	ACTIVITY 347
1745	1745	ACTIVITY 348
1750	1750	ACTIVITY 349
1755	1755	ACTIVITY 350
1760	1760	ACTIVITY 351
1765	1765	ACTIVITY 352
1770	1770	ACTIVITY 353
1775	1775	ACTIVITY 354
1780	1780	ACTIVITY 355
1785	1785	ACTIVITY 356
1790	1790	ACTIVITY 357
1795	1795	ACTIVITY 358
1800	1800	ACTIVITY 359
1805	1805	ACTIVITY 360
1810	1810	ACTIVITY 361
1815	1815	ACTIVITY 362
1820	1820	ACTIVITY 363
1825	1825	ACTIVITY 364
1830	1830	ACTIVITY 365
1835	1835	ACTIVITY 366

OBJECTIVES  
AN INTRODUCTION TO NC PROGRAMMING  
THROUGH THE SPECTRALIGHT LATHE

Upon completion of this package the student will be able:

1. To understand the relationship of the standard engine lathe to the CNC lathe.
2. To understand the use of math in particular Cartesian coordinates in relationship with the CNC programming.
3. To be able to create a soft and hard copy program for a manufactured part on the CNC lathe.
4. To be able to understand various G and M code commands using standards from industry.
5. To show on hard copy the G and M codes for spindle on, spindle off, feed rate, circular interpolation (arcs) and any other codes other than the normal X and Z location lines (blocks).
6. To set up and run programs on the CNC Spectralight lathe.

INTRODUCTION  
AN INTRODUCTION TO NC PROGRAMMING  
THROUGH THE SPECTRALIGHT LATHE

The typical engine lathe has reached the point of dramatic change in both the classroom and industry. With the introduction of relatively inexpensive micro-computers, computer numerically controlled (CNC) machines have become readily available to large industries down to local job shops and the technical education classroom.

With the introduction into our classroom and local industries of the CNC lathe, a basic understanding of the similarities and differences between the engine lathe and CNC lathe must be achieved. A basic understanding of NC programming associated with the CNC lathe is a necessary to achieve the final operation of the machine.

The following material will provide a brief introduction to the CNC lathe and programming involved with the lathe.

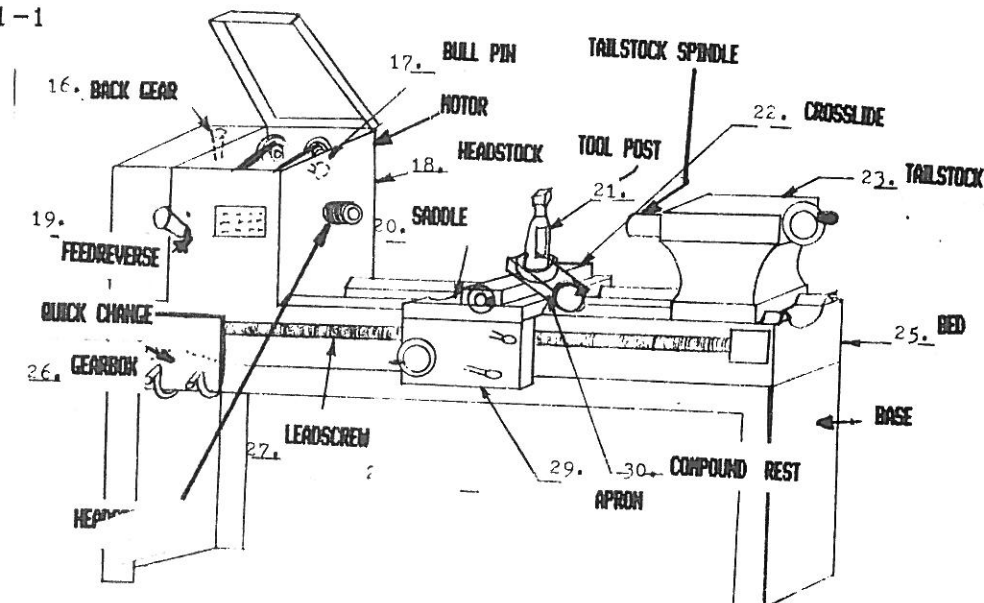
## INFORMATION 1

### FAMILIARIZATION OF THE ENGINE LATHE AND CNC LATHE

The following information on the engine lathe has already been provided to you in the study guides on basic engine lathe parts and operations. If you need anymore information on the engine lathe, please refer to those guides.

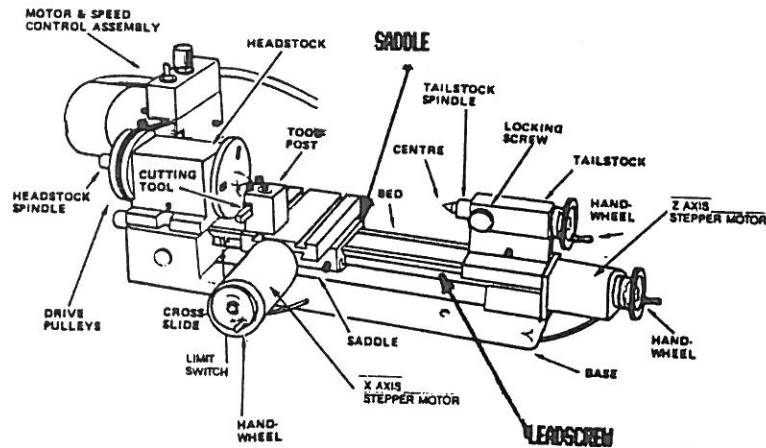
All lathes are sized by swing (largest diameter of material to be turned over the bed) and the longest amount of material that can be turned between centers. The lathe components are broken into 5 major sections which are: headstock, tailstock, carriage, bed, and power plant. Included in these sections are smaller parts that are essential to lathe operation. Below is a diagram of the typical engine lathe with the main parts labeled.

Fig. 1-1



The Spectralight CNC lathe has a 3 1/2" swing with a major length of 8" between centers. Its basic components are shown in the figure 1-2.

Fig. 1-2



You will note that the 2 lathes have parts that are both approximately the same and parts that don't exist on one or the other lathe. By interfacing (connecting) the computer with the Spectralight lathe, the computer has taken over the need for some of the engine lathe parts.



WORKSHEET 1 (10 PTS)

NAME \_\_\_\_\_

DIRECTIONS:

1. Using information from figures 1-1 and 1-2, place in column 1 all common parts of the standard engine lathe and the CNC.
2. Using information from figures 1-1 and 1-2, place in column 2 all parts that are not in common between the 2 lathes.

COMMON PARTS

UNCOMMON PARTS

COLUMN 1

COLUMN 2

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_
8. \_\_\_\_\_
9. \_\_\_\_\_
10. \_\_\_\_\_
11. \_\_\_\_\_
12. \_\_\_\_\_
13. \_\_\_\_\_

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_
8. \_\_\_\_\_
9. \_\_\_\_\_
10. \_\_\_\_\_
11. \_\_\_\_\_
12. \_\_\_\_\_
13. \_\_\_\_\_

Not all spaces will necessarily be used. After finishing, tear out and hand in answers.



10/16

11/22/08

1. Using information from figures 1-1 and 1-2, place in column 1 all common parts of the standard engine parts and the full name of the part.
2. Using information from figures 1-1 and 1-2, place in column 2 all parts that are not in common between the 2 engines.

COMMON PARTS	UNCOMMON PARTS
COLUMN 1	COLUMN 2
1. _____	1. _____
2. _____	2. _____
3. _____	3. _____
4. _____	4. _____
5. _____	5. _____
6. _____	6. _____
7. _____	7. _____
8. _____	8. _____
9. _____	9. _____
10. _____	10. _____
11. _____	11. _____
12. _____	12. _____
13. _____	13. _____

Put all parts with necessary be used, after finishing, test out and hand in answers.

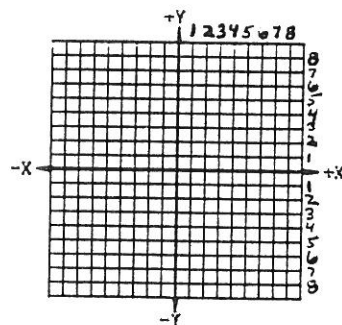
## INFORMATION 2

### PROGRAMMING USING MATH (CARTESIAN COORDINATES)

CNC programming involves the use of the mathematical system (geometry) called Cartesian coordinates. In this system, any point in space or on any object maybe located by using a collection of lines that are perpendicular to each other (like on a graph).

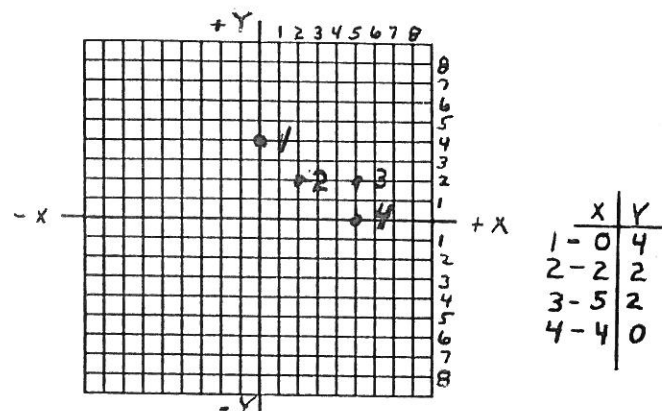
In using a graph, the graph is broken into a coordinate system. It will contain 2 axes (X and Y) for finding a point on a flat surface or 3 axes (X, Y and Z) for finding a point on any 3 dimensional (real life) object. For our purposes, we will work with the 2 axis (2 dimensional on flat object) X and Y coordinates. See figure 2-1

Figure 2-1.



In the above graph, you will notice that there is a plus and minus sign attached to the X and Y axis. Numbers found in these areas will contain either plus or minus signs. In figure 2-2 you will see point location and how numbers are assigned for locating purposes. For our purpose we will remain with positive numbers for both axes.

Fig. 2-2



Numerically controlled machines like our lathe, always have a spindle axis (the part that turns). This spindle axis is always labeled Z. Z will now replace the Y letter axis since we are still working on 2 dimensions. See figure 2-3 to understand how the axes X and Z will be represented on our lathe.

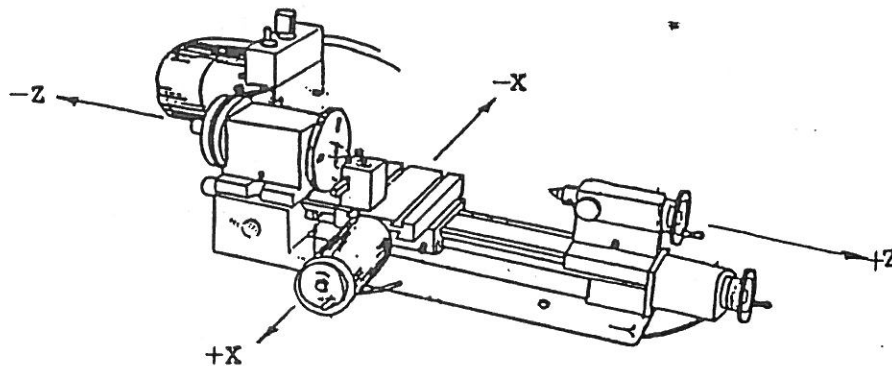
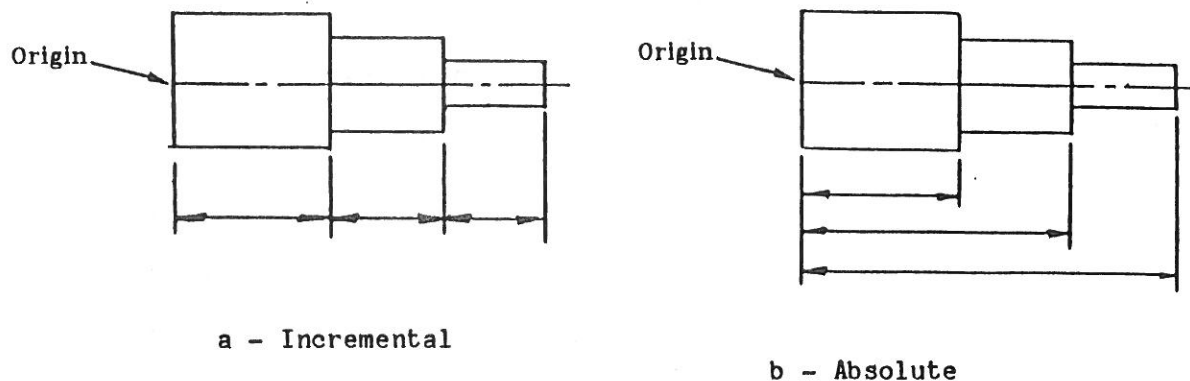


Figure 2-3 Relationship Between Axes And Lathe Components

Dimensioning of a part in an NC program is done in 1 of 2 ways. One is called absolute and the other is called incremental. In figure 2-4 you will see an example of both types of dimensioning.

Fig. 2-4



For our purposes, we will use absolute dimensioning for ease of point location and programming.

If any arcs are to be used in your design, you must locate the beginning, end and center point of the arc.

Below in fig. 2-5 is a simple part placed on the graph with points located according to the absolute coordinate system. You will notice that the coordinates start from the right end and proceed to the left end. The use of straight lines (cutting tool movements) on this diagram is called linear interpolation while using arcs or curves (cutting tool movements) is called circular interpolation.

Fig. 2-5

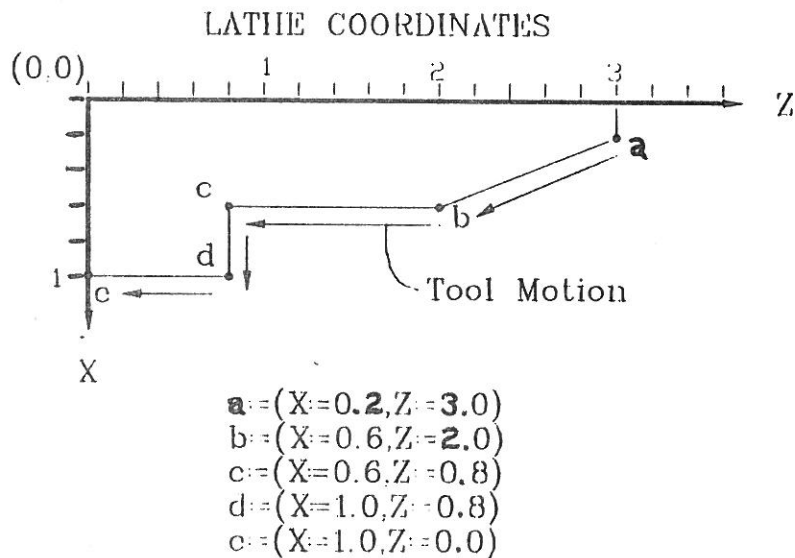


Figure 2-5 Two-Dimensional View Of Absolute Dimensioning Of Coordinate Points On A Workpiece





WORKSHEET 2 (15 PTS)

NAME \_\_\_\_\_

**DIRECTIONS:**

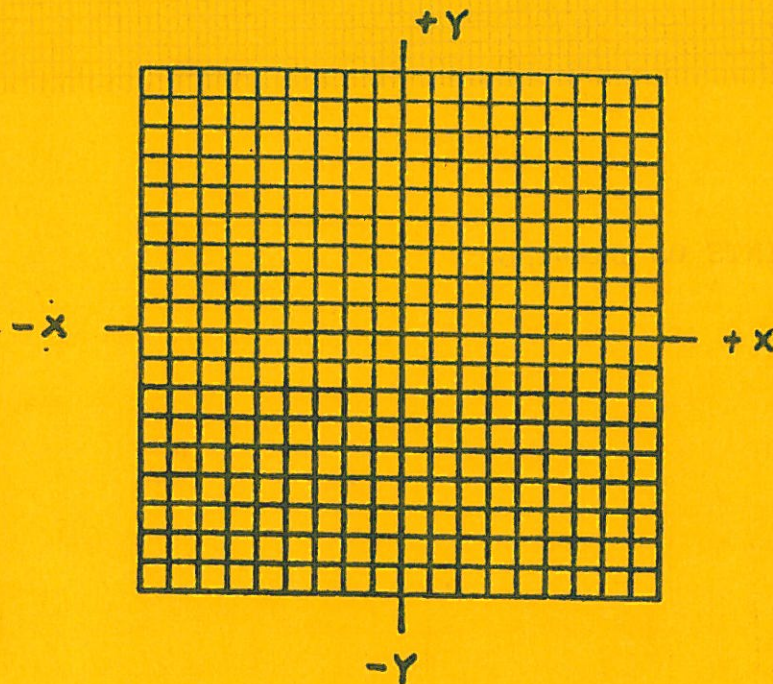
1. LOCATE POINTS GIVEN ON THE GRAPH BELOW

**A =  $x = +4, y = +6$**

**B =  $x = -1, y = -5$**

**C =  $x = +7, y = -3$**

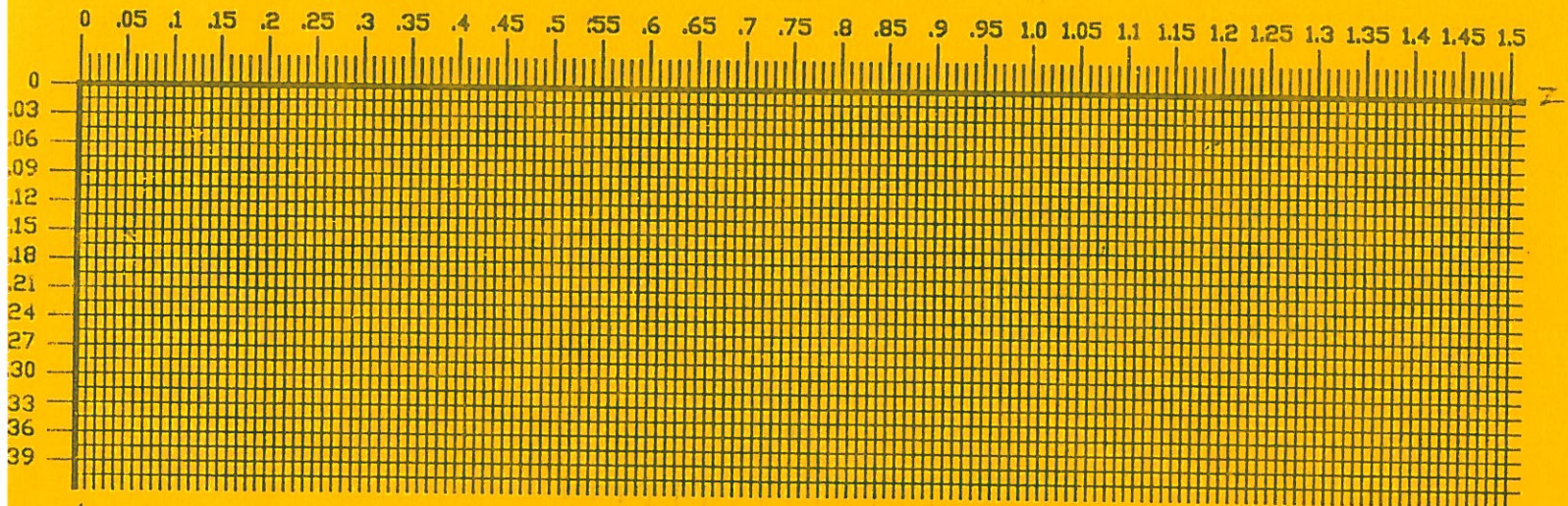
**D =  $x = -8, y = +7$**



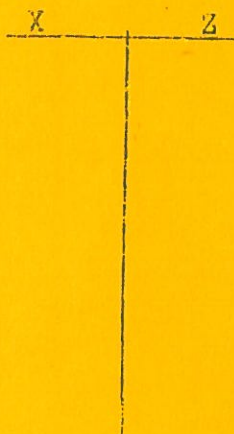
OVER



2. A. ON THE GRAPH BELOW, DRAW A PART THAT YOU WOULD LIKE TO PRODUCE ON THE CNC LATHE. KEEP IT SIMPLE WITH STRAIGHT LINES IF POSSIBLE. DRAW HALF THE PART SINCE IT WILL BE A CYLINDER. IF NECESSARY, REFER TO THE PART IN FIG. 2-5  
MAXIMUM DIAMETER IS .5      MAXIMUM LENGTH IS .75
- B. LOCATE ON THE GRAPH ALL POINTS (X AND Z) THAT MAKE UP THE PART. LOCATE THE BEGINNING, END, AND CENTER POINTS IF ARCS ARE USED.
- C. PLACE ALL POINTS STARTING FROM THE RIGHT END IN THE APPROPRIATE COLUMN BELOW THE GRAPH.



LOCATE ALL X AND Z POINTS ON DRAWING



CHECK POINT 1