

AFFDL-TR-76-87
Volume II - Appendix

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ADVANCED COMPOSITE COST ESTIMATING MANUAL

NORTHROP CORPORATION
AIRCRAFT DIVISION
HAWTHORNE, CALIFORNIA 90250

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TECHNICAL REPORT AFFDL-TR-76-87
FINAL REPORT FOR PERIOD APRIL 1975 - MARCH 1976

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AIR FORCE WRIGHT AERONAUTICAL LABORATORIES
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WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

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This technical report has been reviewed and is approved.


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FOR THE COMMANDER


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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This program concentrated on the development of a computerized system that estimates the recurring costs associated with the fabrication of advanced composite detail parts and components. The system employs Industrial Engineering Standard equations developed in the program to calculate standard hours for the detail composite fabrication operations of layup, core preparation, part consolidation and finishing. With these standards as base, recurring costs are derived through the application of variance factors, improvement curve slopes and labor rates.		

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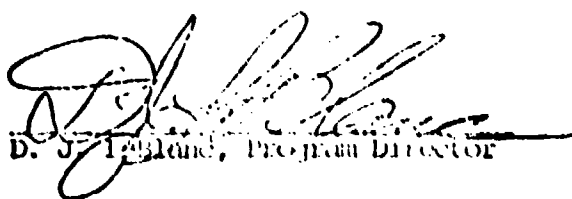
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PREFACE

This Technical Report was prepared by the Aircraft Division of Northrop Corporation under Contract No. F33615-75-C-3103 for the Air Force Flight Dynamics Laboratory, Air Force Wright Aeronautical Laboratories, Air Force Systems Center I, Wright-Patterson Air Force Base, Ohio. Mr. Richard J. Hirt, AFTEC was the Air Force Program Manager. This report covers the period from 1 April 1975 to 31 March 1976.

The work described in the report was carried out by Northrop Corporation, Aircraft Division, D. J. LeBlanc, Program Director. Principal contributors to the Northrop activities described in this report and their areas of responsibility are listed below:

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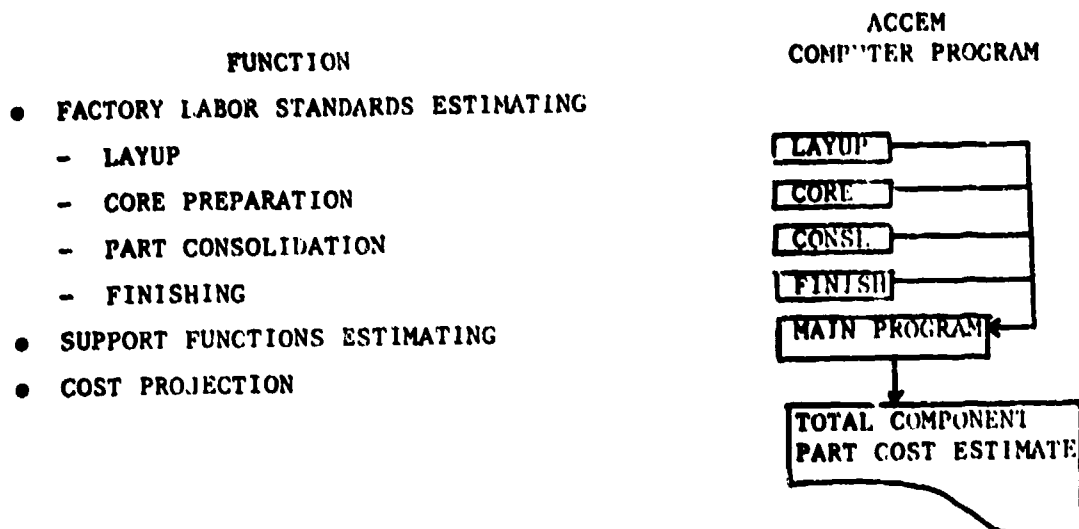
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APPENDIX A. COMPUTER PROGRAM LISTING

The ACCEM computer program listing consists of a main program which calls four subroutines. Each section performs a particular function of the estimating methodology, as identified below.



The program listing contains instructions only. Calculations are made using constants from the Permanent Input Data Sets and information from the Variable Input Data Set (keypunched from Input Form.)


```

38 WRITE(18,10001) (IN(1),1=1,5)
39 1001 FORMAT(/1,,'INPUT FORMS',T50,'QUANTITY',T10,2,'(---)',T50,1,'---',T50,1,7,,'CCU00390
40 ' /16,'LAYOUT',T54,12,'/16,'MONEYCOMB CCKE OPERATION',T54,12,,'CCU00400
41 ' /16,'PART CONSOLIDATIONS',T54,12,,'CCU00410
42 ' /16,'FINISHING OPERATIONS',T54,12,,'CCU00420
43 ' /16,'COST PROJECTIONS',T54,12,,'CCU00430
44 ' COST1=0,,'CCU00440
45 ' COST2=0,,'CCU00450
46 ' COST3=0,,'CCU00460
47 ' COST4=0,,'CCU00470
48 ' COST5=0,,'CCU00480
49 ' COST6=0,,'CCU00490
50 ' COST7=0,,'CCU00500
51 ' COST8=0,,'CCU00510
52 ' COST9=0,,'CCU00520
53 ' COST10=0,,'CCU00530
54 ' COST11=0,,'CCU00540
55 ' COST12=0,,'CCU00550
56 ' COST13=0,,'CCU00560
57 ' COST14=0,,'CCU00570
58 ' COST15=0,,'CCU00580
59 ' COST16=0,,'CCU00590
60 ' COST17=0,,'CCU00600
61 ' COST18=0,,'CCU00610
62 ' COST19=0,,'CCU00620
63 ' COST20=0,,'CCU00630
64 ' COST21=0,,'CCU00640
65 ' COST22=0,,'CCU00650
66 ' COST23=0,,'CCU00660
67 ' COST24=0,,'CCU00670
68 ' COST25=0,,'CCU00680
69 ' COST26=0,,'CCU00690
70 ' COST27=0,,'CCU00700
71 ' COST28=0,,'CCU00710
72 ' COST29=0,,'CCU00720
73 ' COST30=0,,'CCU00730
74 ' COST31=0,,'CCU00740
75 ' COST32=0,,'CCU00750
76 ' COST33=0,,'CCU00760
77 ' COST34=0,,'CCU00770
78 ' COST35=0,,'CCU00780

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```

38 WRITE(18,10001) (IN(1),1=1,5)
39 1001 FORMAT(/1,,'INPUT FORMS',T50,'QUANTITY',T10,2,'(---)',T50,1,'---',T50,1,7,,'CCU00390
40 ' /16,'LAYOUT',T54,12,'/16,'MONEYCOMB CCKE OPERATION',T54,12,,'CCU00400
41 ' /16,'PART CONSOLIDATIONS',T54,12,,'CCU00410
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44 ' COST1=0,,'CCU00440
45 ' COST2=0,,'CCU00450
46 ' COST3=0,,'CCU00460
47 ' COST4=0,,'CCU00470
48 ' COST5=0,,'CCU00480
49 ' COST6=0,,'CCU00490
50 ' COST7=0,,'CCU00500
51 ' COST8=0,,'CCU00510
52 ' COST9=0,,'CCU00520
53 ' COST10=0,,'CCU00530
54 ' COST11=0,,'CCU00540
55 ' COST12=0,,'CCU00550
56 ' COST13=0,,'CCU00560
57 ' COST14=0,,'CCU00570
58 ' COST15=0,,'CCU00580
59 ' COST16=0,,'CCU00590
60 ' COST17=0,,'CCU00600
61 ' COST18=0,,'CCU00610
62 ' COST19=0,,'CCU00620
63 ' COST20=0,,'CCU00630
64 ' COST21=0,,'CCU00640
65 ' COST22=0,,'CCU00650
66 ' COST23=0,,'CCU00660
67 ' COST24=0,,'CCU00670
68 ' COST25=0,,'CCU00680
69 ' COST26=0,,'CCU00690
70 ' COST27=0,,'CCU00700
71 ' COST28=0,,'CCU00710
72 ' COST29=0,,'CCU00720
73 ' COST30=0,,'CCU00730
74 ' COST31=0,,'CCU00740
75 ' COST32=0,,'CCU00750
76 ' COST33=0,,'CCU00760
77 ' COST34=0,,'CCU00770
78 ' COST35=0,,'CCU00780

```

```

79      WRITE(16,44444)
80      FORMAT(12,'FINISHING OPERATIONS STANDARD HOURS COMPUTED')
81      C
82      C
83      55 DO 4905 I=1,4
84          SUM(5,1)=SUM(5,1)+SUM(I,1)
85      4905 SUM(5,2)=SUM(5,2)+SUM(I,2)
86      C
87      C
88      C PART V -- COST PROJECTION
89      C
90      C
91      23000 FORMAT(//16,'FACTORY STANDARD HOURS',14C,'SET-UP',T55,'RUN',
92          ' /10,26(10-),139,6(10-),152,6(10-),/)
93      24000 FORMAT(16,5A4,139,F8.3,152,F8.3)
94      24100 FORMAT(//16,'TOTAL HOURS',139,F8.3,152,F8.3,139,8(10-),152,6(10-))
95      C
96      C
97      DO 510 I=1,5
98      510 READ(9,50001) (OP(I,J),J=1,5),T11(I,1),T11(I,2),SLP1(I,1),
99          SLP1(I,2)
100      50000 FORMAT(11,5A4,131,F8.5,141,F8.5,151,F8.5,161,F8.5)
101      DO 515 I=1,6
102      515 READ(9,50001) (OP(I+5,J),J=1,5),ICD1(I,1),ICD1(I,2),A(I,1),A(I,2),
103          A(I,1),A(I,2),RT1(I)
104      50001 FORMAT(11,5A4,123,11,127,11,131,F8.6,141,F8.5,151,F8.6,161,F8.5,
105          171,F8.5)
106      DO 516 I=1,8
107      516 READ(9,50001) (OP(I+5,J),J=1,5),ICD1(I,1),ICD1(I,2),A(I,1),A(I,2)
108      READ(9,50003) (OP(14,J),J=1,5),AFACT
109      50003 FORMAT(11,5A4,131,F8.6)
110      DO 517 I=1,9
111      517 READ(9,50002) RTOM1(I)
112      50002 FORMAT(11,F8.6)
113      C
114      WRITE(18,49100)
115      49100 FORMAT(11,'//T15,'TOTAL FACTORY LABOR STANDARD HOURS',/T15,
116          341(10-),/)
117      WRITE(18,23000)
118      DO 4910 I=1,4
119      4910 WRITE(18,24000) (OP(I,J),J=1,5),SUM(I,1),SUM(I,2)

```

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120 C      WRJTEB,24(C)SUM(5,1),SUM(5,2)
121 C
122 C      IF (IN(5).EQ.0) GO TO 5999
123 C
124 C      C FOR EACH COST PROJECTION SHEET
125 C      IN=IN(5)
126 C
127 C      DO 5500 L=1,INS
128 C
129 C
130 C
131 C      C INPUT FOR EACH COST PROJECTION SHEET
132 C
133 C      READ(5,50050) IUNIT,ALOT,TEST(1),TEST(2),TEST(3),ICKV
134 C      50050 FORMAT(T1,15,11,F7.0,121,411)
135 C      READ(5,50051) (IOPT(I),I=1,4)
136 C      50051 FORMAT(T1,411)
137 C      READ(5,50060)(T1(I),I=1,5),(SLP(I),I=1,5),(WT(I),I=1,6)
138 C      50060 FORMAT(T1,5(F7.2,3X),/T1,5(F7.2,3X),/T1,6(F7.2,3X))
139 C      READ(5,50100) (ICD(I),I=1,2,6),ICD(8,1)
140 C      READ(5,50100) (ICD(1,2),I=2,6),ICD(6,2)
141 C      50100 FORMAT(T1,611)
142 C      READ(5,50101) (FACT(I),I=2,6),FACT(8)
143 C      READ(5,50102) (HMSL(I),I=2,6),D2(8)
144 C      50101 FORMAT(6(F7.2,3X))
145 C      50102 FORMAT(6F10.2)
146 C      READ(5,50103) (K10M(I),I=1,9)
147 C      50103 FORMAT(6(F7.3,3X),/T1,3(F7.3,3X))
148 C
149 C
150 C      DO 5005 I=1,5
151 C      DO 5005 J=1,3
152 C      5005 TN(I,J)=0.
153 C
154 C      DO 5000 I=1,5
155 C      5000 WK(I)=SUM(I,1)/ALOT+SUM(I,2)
156 C
157 C      C COMPUTE IN HOURS
158 C
159 C
160 C

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161 IF(I*Y(I))=EC-1.0*Y(I)*Y(I)*EQ.2) GO TO 5121
162 IF(I*Y(I))=0.0) GO TO 501C
163 WRITE(6,5011C)
164 501C FORMAT(12,99 ERROR --- INCORRECT PROJECTION FACTOR OPTION CODE USED.99)
165 *U, SET TO 0, DEFAULT VALUES USED.99)
166 IOPT(1)=0
167 C
168 C CURVE AND T1 DEFAULT
169 *C1C CALL TND(1,2)
170 SLPB(12,1)=0.
171 SLPB(12,2)=0.
172 TND(2,1)=Y(I(2,1))+(Y(I(2,2)/FLOA(IJUNIT)))
173 TND(2,1)=TND(2,1)+MK(2)
174 T1=C.
175 DO 5100 I=1,IJUNIT
176 T1T=Y(I(2,2)/FLOA(IJUNIT))
177 5100 T1=I+T1T
178 TND(2,3)=(T1(2,1)+FLOA(IJUNIT)+T1)*MK(2)
179 TND(2,2)=TND(2,3)/FLOA(IJUNIT)
180 SLPB(12)=0.
181 T1(2)=T1(2,1)+T1(2,2)
182 CALL TND(3,5)
183 CALL TND(4,5)
184 ICRV=0.
185 GO TO 5150
186 C
187 5120 IF(I*Y(I))=NE-1) GO TO 5125
188 5121 ISTART=1
189 ISTOP=4
190 GO TO 5150
191 5125 ISTART=5
192 ISTOP=5
193 *130 IF(I*YV.NE-1) ICRV=0
194 IF(I*YV.EU-1) GO TO 5140
195 C
196 C UNIT CURVE
197 DO 5139 I=ISTART,ISTOP
198 SLPB(I)=I*ALC(USLP(I)/100.)/ALOC(12.1)
199 TND(1,1)=T1(1)+MK(1)+FLOA(IJUNIT)*SLPB(I)
200 T1=C.
201 DO 5135 J=1,IJUNIT

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202 TTT=FLOAT(J)*SLPB(I)
203 TT=TT+TTT
204 TN(I,3)=TN(I,1)*HR(I)+TT
205 TN(I,2)=TN(I,3)/FLOAT(IUNIT)
206 GO TO 5150
207 C
208 C CUM CURVE
209 5140 DO 5149 I=1,START,1,STOP
210 SLPB(I)=(ALOG(SLP(I)/LOG(J))/ALOG(2.))
211 TN(I,2)=TN(I,1)*HR(I)+FLOAT(IUNIT)*SLPB(I)
212 TN(I,3)=TN(I,1)*HR(I)+FLOAT(IUNIT)*SLPB(I)+1.
213 5149 TN(I,1)=TN(I,3)-(TN(I,1)*HR(I)+FLOAT(IUNIT)-1)*SLPB(I)+1.
214 C
215 5150 TT1=C.
216 TT2=C.
217 TT3=C.
218 DO 5151 I=1,5
219 TT1=TT1+TN(I,1)
220 TT2=TT2+TN(I,2)
221 TT3=TT3+TN(I,3)
222 TN(5,1)=TT1
223 TN(5,2)=TT2
224 TN(5,3)=TT3
225 C RATE DEFAULT
226 5170 IF(ILOPT(2).NE.1) IOPT(2)=0
227 IF(ILOPT(2).NE.0) GO TO 5200
228 DO 5171 I=1,6
229 5171 RT(I)=RT(I)
230 C
231 5200 ITEST=0
232 DO 5500 LL=1,3
233 C
234 IF(IEST(LL).EQ.0) GO TO 5900
235 DO 5210 I=1,5
236 UI(I)=TN(I,LL)*RT(I)
237 IF(ILOPT(3).NE.1.AND.IOPT(3).NE.2) IOPT(3)=0
238 IF(ILOPT(3).NE.0) GO TO 5300
239 DO 5215 I=1,8
240 ICC(I,1)=ICC(I,1)
241 ICC(I,2)=ICC(I,2)
242 5215 FAC(I)=A(I,1)*FLOAT(IUNIT)*A(I,2)

```

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243 C
244 C FIND SUPPORT LABCK UNIT HOUR FOR DEFAULT CASE
245 IF(ICKV.EQ.1) GO TO 5230
246 C
247 C FOR UNIT CURVE
248 IF(ICPT(1).EQ.2) GO TO 5221
249 TIU=C.
250 DC 5220 I=1,4
251 TIU=HR(I)*T1(I)
252 TIU=TIU+TIU
253 TIU=TIU/HR(5)
254 BB=(ALOG(IN(5,1))-ALOG(TIU*HR(5)))/ALOG(FLOAT(IUNIT))
255 GO TO 5222
256 5221 TIU=T1(5)
257 BB=SLPB(5)
258 5222 DU 5225 I=1,6
259 HRSL(1)=C.
260 AU=TIU*HR(5)*A1(I,1)
261 BU=BB+A1(I,2)
262 HKSL(I)=AU*PLCAT(IUNIT)**BU
263 DC 5224 I=1,IUNIT
264 HH=AU*FLOAT(I)**BU
265 HKSL(I)=HRSL(I)+HH
266 IF(ILL.EQ.2) HRSL(I)=HRSL(I)/FLOAT(IUNIT)
267 IF(ILL.EQ.3) HRSL(I)=HRSL(I)
268 5225 CONTINUE
269 GO TO 5237
270 C
271 C CUM AVE CURVE
272 IF(ILL.NE.1) GO TO 5300
273 IF(ICPT(1).EQ.2) GO TO 5232
274 TIU=0.
275 DC 5231 I=1,4
276 TIU=HR(I)*T1(I)
277 TIU=TIU+TIU
278 TIU=TIU/HR(5)
279 BB=(ALOG(IN(5,1))-ALOG(TIU*HR(5)))/ALOG(FLOAT(IUNIT))
280 GO TO 5233
281 5232 TIU=T1(5)
282 BB=SLPB(5)
283 5233 DC 5235 I=1,6

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00002400
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284 AU=A(1,1)*T1U*HR(5)
285 BU=BB+A(1,2)
286 HRSL(1)=AU*FLCAT(IUNIT)**BU
287 HRSL(1)=IN(5,LL)
288 D2(1)=D1(5)
289 DO 523E I=2,6
290 D2(1)=RT(1)*HRSL(1)
291 GO TO 5315
292 C
293 C FOR 'NORMAL HOUR CALCULATION
294 C
295 5300 HKSL(1)=IN(5,LL)
296 D2(1)=D1(5)
297 IF(10PT(5).EQ.2) GE TO 5340
298 IF(1CD(2,2).EQ.2) GO TO 5310
299 DO 5305 I=2,6
300 HKSL(1)=HRSL(1CD(I,1))*FACT(1)
301 D2(1)=RT(1)*HRSL(1)
302 GO TO 5315
303 5310 DO 5311 I=2,6
304 5311 D2(1)=D2(1CD(I,1))*FACT(1)
305 5315 D2(1)=COST1+COST2
306 IF(1L.EQ.3) D2(7)=D2(7)*FLOAT(IUNIT)
307 IF(1CD(2,2).EQ.1) D2(8)=HRSL(1CD(6,1))*FACT(8)
308 IF(1CD(8,2).EQ.2) D2(8)=D2(1CD(8,1))*FACT(8)
309 D2(9)=D1(5)*AFACT+CSTSCP
310 5317 CONTINUE
311 C
312 GO TO 5350
313 5340 DO 5342 I=2,6
314 5342 D2(1)=HRSL(1)*RT(1)
315 D2(1)=D1(5)
316 D2(7)=COST1+COST2
317 IF(1L.EQ.3) D2(7)=D2(7)*FLOAT(IUNIT)
318 5350 D2T1=0.
319 HRSL1=C.
320 DO 5351 I=2,6
321 HRSLT=HRSLT+HRSL(1)
322 5351 D2T1=D2T1+D2(1)
323 D2T2=0.
324 DO 5353 I=7,9

```

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00003160
00003170
00003180
00003190
00003200
00003210

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325 5353 D2T2=D2T2+D2(1)
326 5400 IF(IOPT(4).NE.1.AND.IOPT(4).NE.2) IOPT(4)=0
327 IF(IOPT(4).NE.0) GO TO 5410
328 DO 5405 I=1,9
329 KTOH(1)=RTCH(1)
330 5410 IF(IOPT(4).EQ.2) GO TO 5420
331 D3(7)=0.
332 DO 5415 I=1,6
333 D3(1)=D2(1)*RTCH(1)
334 5415 D3(7)=D3(7)+D3(1)
335 GO TO 5425
336 5420 D3(7)=(D1(5)+D2(1))*RTCH(7)
337 5425 D3(8)=D2(2)*RTCH(8)
338 DLAB=D2(1)+D3(7)+D1(5)
339 LMTL=D2(2)+D3(8)
340 D3(9)=(DLAB+LMTL)*RTCH(9)
341 DCST=DLAB+LMTL+D3(9)
342 WT(1)=WGT1
343 WT(2)=WGT2
344 IF(LL.EQ.3) WT(1)=WGT1*FLOAT(IUNIT)
345 IF(LL.EQ.3) WT(2)=WGT2*FLOAT(IUNIT)
346 WT(3)=WT(1)+WT(2)
347 C
348 C
349 C
350 C
351 IF(ITER1.GT.0) GO TO 5600
352 C
353 C OUTPUT
354 C
355 C WRITE INPUT DATA
356 C
357 WRITE(6,51000)IUNIT,ALU1
358 51000 FORMAT(1,'',//T26,'COST PROJECTION',//T26,15(' '),//T6,'PRODUCTION
359 *COST ESTIMATE AT UNIT NO.: ',14,7T6,'AVERAGE LOT SIZE: ',F7.0)
360 IF(ICRV.EQ.0) WRITE(6,51001)
361 IF(ICRV.EQ.1) WRITE(6,51002)
362 51001 FORMAT(16,'LINEAR UNIT CURVE')
363 51002 FORMAT(16,'LINEAR CUMULATIVE AVERAGE CURVE')
364 WRITE(6,51060)
365 51060 FORMAT(1//T6,'PROJECTION FACTORS',T41,'T1.VAR',T51,'T51.CURVE SLOPE',

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366      */T6,18(---),T41,6(---),T51,11(---),/)
367      C
368      DO 5515 I=1,5
369      5515 IF(T1(I).NE.0.) WRITE(8,51065) (OP(I,J),J=1,5),T1(I),SLP(I)
370      51065 FORMAT(T6,5A4,T41,F6.2,T52,F6.2,' ')
371      WRITE(8,51070)
372      51070 FORMAT(/T6,'LABOR RATES',T43,'$/HR',/T6,11(---),T41,6(---),/)
373      DO 5520 I=1,6
374      5520 WRITE(8,51072) (OP(I+5,J),J=1,5),RT(I)
375      51072 FORMAT(T6,5A4,T41,F6.2)
376      IF(IOP(T3).EQ.2) GO TO 5524
377      WRITE(8,51074)
378      51074 FORMAT(/T6,'SUPPORT FUNCTIONS',T40,'BASE',T52,'FACTORS',
379      * /T6,17(---),T39,6(---),T52,8(---),/)
380      DO 5525 I=2,6
381      5525 WRITE(8,51075) (OP(I+5,J),J=1,5), (ICD(I,J),J=1,2), FACT(I)
382      5526 WRITE(8,51075) (OP(I+5,J),J=1,5), (ICD(I,J),J=1,2), FACT(I)
383      51075 FORMAT(T6,5A4,T39,11,T44,11,T50,F10.2)
384      GO TO 5529
385      5524 WRITE(8,51076)
386      51076 FORMAT(/T6,'SUPPORT FUNCTIONS',T39,'DOLLARS',
387      * /T6,17(---),T37,10(---))
388      DO 5527 I=2,6
389      5527 WRITE(8,51077) (OP(I+5,J),J=1,5), MRS(I)
390      5528 WRITE(8,51077) (OP(I+5,J),J=1,5), D2(I)
391      51077 FORMAT(T6,5A4,T37,F10.2)
392      5529 WRITE(8,51080)
393      51080 FORMAT(/T6,'OVERHEAD RATES',/T6,14(---),/)
394      DO 5530 I=1,6
395      5530 IF(RTOH(I).NE.0.) WRITE(8,51081) (OP(I+5,J),J=1,5), RTOH(I)
396      51081 FORMAT(T6,5A4,T41,F6.3)
397      IF(RTOH(7).NE.0.) WRITE(8,51082) RTOH(7)
398      WRITE(8,51083) RTOH(8)
399      WRITE(8,51084) RTOH(9)
400      51082 FORMAT(T6,'TOTAL LABOR',T41,F6.3)
401      51083 FORMAT(T6,'MATERIAL',T41,F6.3)
402      51084 FORMAT(T6,'ADMINISTRATIVE',T41,F6.3)
403      C
404      ITEST=ITEST+1
405      560C CONTINUE
406      C

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0000263C
0000364C
0000365C
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0000403C

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407 C
408 C WRITE OUTPUT
409 C
410 WRITE(6,52000)
411 FORMAT(1,/,/T28,*,COST PROJECTION*,/T28,1:('-.'),/)
412 GO TO (5601,5602,5603),LL
413 5601 WRITE(6,52051) IUNIT
414 GO TO 5610
415 5602 WRITE(6,52052) IUNIT
416 GO TO 5610
417 5603 WRITE(6,52053) IUNIT
418 52051 FORMAT(16,*,UNIT COST ESTIMATE AT T*,15)
419 52052 FORMAT(16,*,CUMULATIVE AVERAGE COST ESTIMATE AT T*,15)
420 52053 FORMAT(16,*,CUMULATIVE COST ESTIMATE AT T*,15)
421 5610 WRITE(6,52100) IUNIT
422 52100 FORMAT(1/16,*,COST ELEMENT*,139,*,STD. HRS*,150,*,T*,15,*, HRS*,165,
423 *,DOLLARS*,/T6,12('-.'),139,8('-.'),150,10('-.'),164,10('-.'),/)
424 WRITE(6,52105)
425 52105 FORMAT(1/16,*,FACTORY LABOR*,)
426 IF(1OPT(1).EQ.2) GO TO 5617
427 DO 5615 I=1,4
428 5615 WRITE(6,52110) (UP(I,J),J=1,5),MR(I),TN(I,LL),DI(I)
429 52110 FORMAT(16,5A4,140,F7.2,150,F10.2,164,F10.2)
430 5617 WRITE(6,52110) (OP(5,J),J=1,5),MR(5),TN(5,LL),U1(5)
431 5618 WRITE(6,52120)
432 52120 FORMAT(1/16,*,SUPPORT LABORS*,)
433 IF(1OPT(3).EQ.2) GO TO 5625
434 DO 5620 I=2,6
435 5620 WRITE(6,52125) (OP(I+5,J),J=1,5),MRSL(I),DI(I)
436 52125 FORMAT(16,5A4,152,F8.2,164,F10.2)
437 WRITE(6,52127) D2T1
438 52127 FORMAT(1/16,*,TOTAL SUPPORT LABOR*,164,F10.2)
439 GO TO 5630
440 5625 DO 5626 I=2,6
441 5626 WRITE(6,52130) (OP(I+5,J),J=1,5),D2(I)
442 52130 FORMAT(16,5A4,164,F10.2)
443 WRITE(6,52127) D2T1
444 5630 WRITE(6,52140)
445 52140 FORMAT(1/16,*,LABOR OVERHEAD*,)
446 IF(1OPT(3).EQ.2) GO TO 5637
447 DO 5635 I=1,6

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00004120
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446 5625 WRITE(6,52145) (OP(1+5,J),J=1,5),03(1)
449 52145 FORMAT(18,5A4,164,F10.2)
450 5637 WRITE(8,52147) 03(7)
451 52147 FORMAT(110,'TOTAL OVERHEAD',164,F10.2)
452 5640 WRITE(8,52150) 01AB
453 52150 FORMAT(110,'TOTAL LAB(R',164,F10.2)
454 5640 WRITE(8,52160)
455 52160 FORMAT(16,'MATERIAL')
456 5640 J=7+5
457 5640 WRITE(8,52145) (OP(1+5,J),J=1,5),02(1)
458 5640 WRITE(8,52165) 03(8),0MIL
459 52165 FORMAT(18,'OVERHEAD',164,F10.2,/110,'TICAL MATERIAL',164,F10.2)
460 5640 WRITE(8,52170) 03(9),0CST
461 52170 FORMAT(18,'ADMINISTRATIVE OVERHEAD',164,F10.2,
462 * //110,'TICAL COST',164,F10.2,/164,10(1+5))
463 5640 WRITE(8,52160)
464 5640 WRITE(8,52161) (OP(1,J),J=1,5),WT(1)
465 5640 WRITE(8,52161) (OP(2,J),J=1,5),WT(2)
466 5640 WRITE(8,52162) WT(3)
467 52160 FORMAT(//140,'WEIGHT',/139,2(1+5))
468 52161 FORMAT(16,5A4,139,F8.2)
469 52162 FORMAT(16,'TOTAL',139,F6.2)
470 C
471 5900 CONTINUE
472 5640 WRITE(6,55505)
473 55505 FORMAT(12,'COST PROJECTIONS COMPUTED')
474 C
475 5995 WRITE(6,55555)
476 55555 FORMAT(12,'NORMAL ACCEN COMPLETION')
477 C
478 9999 STOP
479 END
480 C
481 C
482 C
483 C
484 C
485 C
486 C
487 C
488
SUBROUTINE LAVUP(1M)

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489 DIMENSION UP(60,5),S(60),K(60),SUM(5,2),AA(1,2),AP(7,2),
490 * A(6,2),E(6,2),C(6,2),PAKT(2,5),IBK(4),IBK(4),BL(3),
491 * PY(7),IPY(7),BEND2(2),IMT(2),EEND(1,2),IMT(3,2),
492 * IMT(3,2),IMT2(3,2),IMT3(3,2),CT(3,2),CT1(3,2),
493 * DEN(3,2),DEN1(3,2),WT(3,2),WT1(3,2),CST(3,2),CST1(3,2),
494 * SAM(3,2),CC(6,2),IMT2T(3,2)
495 COMMON /X/DP,SUM,K,S,PAKT
496 * /X1/COST1,WT1,CSTSCP
497 C
498 C INITIALIZE
499 DO 21 I=1,3
500 DO 21 J=1,2
501 IMT(I,J)=0.
502 IMT2T(I,J)=0.
503 CST(I,J)=0.
504 WT(I,J)=0.
505 IMT1T=0.
506 CST1=0.
507 CSTSCP=0.
508 WT1=0.
509 C
510 C READ COEFFICIENTS
511 DO 1 I=1,15
512 1 READ(1,1000) (UP(I,1),I=1,5),AA(I,1),AA(I,2)
513 DO 11 I=1,5
514 11 READ(1,1002) (GP(I+15,1),I=1,5),DEN1(I,1),CT1(I,1)
515 DO 12 I=1,2
516 12 READ(1,1002) (OP(I+18,1),I=1,5),DEN1(I,2),CT1(I,2)
517 1000 FORMAT(11,5A4,T31,F8.6,T41,F8.5)
518 DO 2 I=1,7
519 2 READ(1,1001) (AB(I,1),I=1,3)
520 DO 3 I=1,2
521 DO 3 I=1,6
522 3 READ(1,1001) (A(I,1),B(I,1),CC(I,1))
523 1000 FORMAT(11,5A4,T31,F8.6,T41,F8.6)
524 1001 FORMAT(11,F8.5,I11,F8.5,I121,F8.5)
525 C
526 C
527 C FOR EACH LAYUP OPERATION
528 C
529 DO 19000 L=1,INI

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00005270
 00005280
 00005290
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530 C
 531 AREA=0.
 532 BAREA=0.
 533 PAREA=0.
 534 R3=C.
 535 R4=C.
 536 R5=C.
 537 K6=C.
 538 S4=C.
 539 TMTT=0.
 540 IPV1=C
 541 IBK0(1)=2
 542 IBK0(2)=1
 543 IBK0(3)=1
 544 IBK0(4)=1
 545 SUM1=C.
 546 SUM2=C.
 547 SUMT1=0.
 548 SUMT2=0.
 549 DC 25 J=1,15
 550 S(1)=0.
 551 K(1)=0.
 552 UC 26 I=1,2
 553 BENC(1)=0.
 554 BENC(2)=0.
 555 UC 27 I=1,3
 556 BD(1)=0.
 557 DO 27 J=1,2
 558 TMT1(1,J)=C.
 559 TMT2(1,J)=0.
 560 TMT3(1,J)=0.
 561 WT(1,J)=0.
 562 27 C57(1,J)=C.
 563 C
 564 DO 29 I=1,6
 565 DO 29 J=1,2
 566 29 C(1,1)=C(1,1)
 567 C
 568 C
 569 C
 570 C

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571 C
572 C
573 C READ GENERAL INFO FOR EACH PART
574     HEAD(5,1100)(PART(1,1),I=1,5),(PART(2,1),I=1,5),ICT,1A,ITL,
575     * NDR,NDB
576     1100 FORMAT(11,5A4,T2,1,5A4,T4,1,13,151,F7.2,161,11,14,11)
577     REAL(5,1101)SAR,((SAR(I,J),I=1,3),J=1,2)
578     1101 FORMAT(11,7(F7.2,3X))
579     REAL(5,1102) CT(1,1),CT(3,1),CT(1,2),CT(3,2),
580     * DEN(1,1),DEN(3,1),DEN(1,2),DEN(3,2)
581     1102 FORMAT(11,4(F7.2,3X),4(F7.6,3X))
582 C
583 C WRITE HEADING
584     WRITE(8,1400)(PART(1,1),I=1,5),ICT,(PART(2,1),I=1,5),TA
585     1200 FORMAT(11,///T38,'LAYOUT',/T38,'-----',//T6,'PART NAME: ',5A4,T5000005820
586     *,'QTY: ',13,/,16,'PART NUMBER: ',5A4,T50,'TRIM ALLOWANCE: ',F7.200005830
587     *)
588     IF(11L.EQ.0) WRITE(8,1201)
589     IF(11L.EQ.1) WRITE(8,1202)
590     1202 FORMAT(16,'LAYOUT TOOL = CURING TOOL')
591     1201 FORMAT(16,'LAYOUT TOOL NOT = CURING TOOL')
592     IF(NDR.EQ.0) GO TO 7
593     IF(NDB.EQ.1) WRITE(8,1203) NDR
594     IF(NDR.EQ.2) WRITE(8,1204) NDR
595     1203 FORMAT(16,'NO. OF DEBULKING OPERATION: ',13,
596     * T50,'TYPE OF BAG: DISPOSABLE')
597     1204 FORMAT(16,'%0. OF DEBULKING OPERATION: ',13,
598     * T50,'TYPE OF BAG: REUSABLE')
599     7 IF(SAR(10,0)) GO TO 9
600     WRITE(8,1211) SAR
601     1211 FORMAT(/T6,'AREA SEWN: ',F7.2)
602     WRITE(8,1212)
603     1212 FORMAT(16,'TYPE OF SEWING',T40,'LENGTH',T53,'LAYERS',
604     * /T6,14('---'),T39,8('---'),T52,8('---'))
605     DO 8 I=1,3
606     IF(SAR(I,1).NE.0.) WRITE(8,1213)(OP(I+10,J),J=1,5),
607     * SAR(1,1),SAR(1,2)
608     1213 FORMAT(16,5A4,T39,F8.2,T52,F8.2)
609     8 CONTINUE
610 C
611     9 CT(2,1)=CT(1,1)

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612 CT(2,2)=CT(1,2)
613 DEN(2,1)=EN(1,1)
614 DEN(2,2)=DEN(1,2)
615 DO 4 I=1,2
616 DO 4 J=1,3
617 IF (CT(1,1).EQ.0.) CT(1,1)=CT(1,1)
618 IF (DEN(1,1).EQ.0.) DEN(1,1)=DEN(1,1)
619 WRITE(6,1206)
620 1206 FORMAT(10,143,'MATERIAL DATA',/139,21(' '),/140,'DENSITY',
621 * 154,'COST',/155,2(' '),/152,8(' '))
622 DO 30 I=1,3
623 30 WRITE(6,1207) (OP,1+15,11),II=1,5),DEN(1,1),CY(1,1)
624 DO 31 I=1,3
625 31 WRITE(6,1207) (OP,1+18,11),II=1,5),DEN(1,2),CT(1,2)
626 1207 FORMAT(76,5A4,139,F8.6,152,F8.2)
627 5 WRITE(6,1210)
628 1210 FORMAT(154,'PLY DESCRIPTION',/139,47(' '),/123,'BEND DATA',153,
629 * 167, 'NON-RECT',180,'MATL',/118,19(' '),/148,14(' '),164,
630 * 14(' '),/179,7(' '),/
631 * 12,'OLD # LH DT TE LENGTH CR FW OKI CT LENGTH WIDTH
632 * AREA DIST FT MD',/12,5(' '),*
633 * 41' -----),* - - - - -)
634
635 10 READ(5,1300) (12X(1),1=1,4),1PD,(NO(1),1=1,5),1PY(1),
636 1PY(2), (PY(1),1=3,6),1MT(1),1MT(2),PV(7)
637 IF (12X(1).EQ.9) GO TO 900
638 1300 FORMAT(11,11,12,21,11,11,F7.2,121,F7.2,131,F7.2,11,13,121,
639 * 17.2,131,F7.2,141,F7.2,151,F7.2,161,11,11,171,F3.0)
640 WRITE(6,1400) (12X(1),1=1,4),1PD,(NO(1),1=1,5),1PY(1),
641 1PY(2), (PY(1),1=3,6),1MT(1),1MT(2),PV(7)
642 1400 FORMAT(13,5(11,2X),118,F6.2,126,F5.2,133,F4.2,139,13,
643 * 144,12,146,4(F6.2,2X),179,2(11,1X),183,F3.0)
644
645 1PY(1)=1ABS(1PY(1))
646 1PY(1)=FLOOR(1PY(1))
647 1PY(2)=FLOOR(1PY(2))
648 100 IF (12X(1).EQ.0) GO TO 300
649 15 (12X(1).EQ.1.(CR,12X(1).EQ.2) GO TO 110
650 WRITE(6,5000)
651 5000 FORMAT(12,'** ERROR ** -- INCORRECT LAYOUT DESCRIPTION CODE USED.
652 *PROGRAM ENDED')

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653 GO TO 999
654 110 IF(1BK(2).GE.1.AND.1BK(3).LE.5) GO TO 120
655 1BK(3)=1
656 WRITE(6,9100)
657 9100 FORMAT(12,'** ERROR ** -- INCORRECT LAYOUT HANDLING CALL, SET TO MA(0006540
658 *NUAL*)
659 120 IF(1BK(4).LE.1.OR.1BK(4).EQ.2) GO TO 130
660 1BK(4)=1
661 WRITE(6,9110)
662 9110 FORMAT(12,'** ERROR ** -- INCORRECT DEPOSITION TECHNIQUE CALL, SET TO MA(0006590
663 * TO PLY-UN-PLY*)
664 130 IF(1BK(2).EQ.0) 1BK(2)=1
665
666 C COMPUTE BEND FACTOR FOR BOOK
667 C
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MN=1BK(2)
 IF(1BK(1).EQ.2) MN=1BK(2)*IPY1
 BEND2(1BK(1))=BEND2(1BK(1))+BEND(1BK(1))*FLCAT(MN)
 BEND(1BK(1))=0.
 IPY1=0.

BOOK FORMATION CALCULATION

IF(1BK(1).NE.1) GO TO 150

POSITION MYLAR* FOR PLY-UN-PLY
 IF(1BK(4).NE.1) GO TO 140
 Y=AA(3,1)*BAREA**AA(3,2)
 R3=R3+(Y3*FLCAT(1BK(2)))

TRANSFER PLY FOR BOOK
 140 Y=AA(6,1)*BAREA**AA(6,2)
 R2=R2+(Y6*FLCAT(1BK(2)))
 150 DO 151 I=1,4
 151 1BK(I)=1BK(I)
 IF(BAREA.GT.PAREA) PAREA=BAREA

BEND FACTORS

300 IF(1BK(2).EQ.0) GO TO 500
 IF(1BK(2).LE.7) GO TO 305

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694      IBD=0
695      WRITE(6,9120)
696      9120 FORMAT(12,'** ERROR ** -- INCORRECT BEND CODE USED', BEND FACTOR MODULO 930
697      *T COMPUTED FOR THIS LINE')
698      GO TO 500
699      505 IF (IBD.EQ.0.AND.BD(2).LE.2.) IBD=1
700      IF (IBD.EQ.4.AND.BD(2).LE.2.) IBD=2
701      GO TO (310,310,330,330,350,350,370),IBD
702      310 BEND=AB(IBD,1)*BD(1)
703      GO TO 400
704      330 BEND=AB(IBD,1)*BD(2)**AB(IEC,2)*BD(1)
705      GO TO 400
706      350 BEND=AB(IBD,1)*BD(2)**AB(IEC,2)*BD(3)**AB(IEC,3)*BD(1)
707      GO TO 400
708      370 BEND=(AB(IEC,1)*BD(2)**AB(IEC,2)*AB(IEC,3)*BD(1)
709      400 BEND(IEC(1))=BEND
710      C
711      C PLY FACTORS
712      C
713      500 IF (IPY(2).EQ.0) GO TO 10
714      IF (PY(5).EQ.0.) PY(5)=PY(2)*PY(4)
715      PDN=ATAN(1.0)/45.
716      PY(1)=PY(1)*PDN
717      IF (PY(6).EQ.0.) PY(6)=(PY(3)*SIN(PY(1)))+(PY(4)*COS(PY(1)))
718      PY(1)=PY(1)/PDN
719      IF (PY(6).NE.0..AND.PY(7).NE.0..AND.PY(5).NE.0.) GO TO 505
720      WRITE(6,9150)
721      9150 FORMAT(12,'** ERROR ** --MISSING PLY DESCRIPTION DATA, PROGRAM (INC
722      *ED')
723      GO TO 999
724      505 TSN=(PY(6)+2.*TA)/PY(7)
725      ITS=TSN
726      IF (TSN.GT.1.FLCLAT(ITS))) TSN=FLOAT(ITSN)+1.
727      TSL=PY(5)/PY(6)+12.*TA)
728      AREA=TSN*TSL*PY(7)
729      NPB=IBRC(2)*IPY(2)
730      SCP=AREA-PY(5)
731      C
732      C RUN TIME FOR PLY DEPOSITION
733      IF (INT(1).NE.2) GO TO 510
734      C BFOADGOODS

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735 V4=A(3,2)*AKFA**K(3,2)
736 S4=C(3,2)+S4
737 C(3,2)=0.
738 TMT1(3,IMT(2))=TMT1(3,IMT(2))+(AREA*FLOAT(NPE))
739 TMT2(3,IMT(2))=TMT2(3,IMT(2))+(SCP*FL(AT(NPB))
740 GC TC 540
741 C TAPES
742 510 IF(IIMT(1).EQ.1) GO TO 520
743 IMT(1)=1
744 WRITE(6,9151)
745 9151 FORMAT(T2,*,* ERROR ** --INCORRECT MATERIAL FORM CODE USED, SET
746 * TAPET)
747 520 IF(1BKD(3).LE.2.(K.PY(7)).GE.3.) GO TO 521
748 PY(7)=3.
749 WRITE(6,9152)
750 521 J=-1
751 IF(PY(7).EQ.3.) J=1
752 IF(PY(7).EQ.12.) J=2
753 IF(J)525,525,530
754 525 PY(7)=3.
755 J=1
756 WRITE(6,9152)
757 9152 FORMAT(T2,*,* ERROR ** --INCORRECT INPUT FOR TAPE'S MATERIAL MULT
758 *,* SET TO 3*)
759 530 K=1BKD(3)
760 IF(J.EQ.1.AND.1EKD(3).EQ.3.AND.TSL.GE.25.) K=6
761 V4=A(K,J)*TSL**B(K,J)*TSM
762 S4=S4+C(1BKD(3),J)
763 C(1BKD(3),J)=0.
764 TMT1(J,IMT(2))=TMT1(J,IMT(2))+(AREA*FLOAT(NPP))
765 TMT2(J,IMT(2))=TMT2(J,IMT(2))+(SCP*FLCAT(NPE))
766 C
767 540 V4=Y4*FLOAT(NPE)
768 P4=R4*Y4
769 IPY1=IPY1+1PY(2)
770 IF(AKFA.GT.BAREA) PAKLA=AREA
771 C
772 C *POSITION MYLAR* FOR PLY-UN-MYLAR
773 600 IF(1EKD(4).NE.2) GC TC 610
774 Y3=AA(2,1)*AREA**AA(3,2)*FLOAT(NPB)
775 P3=R3*Y3

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776 C
777 C *STACK FLIES* FOR BOOK'S PLY-ON-MYLAK
778 610 IF(IEKU(1).NE.1.CH.IBKU(4).NE.2) GO TO 620
779 Y5=AA(5,1)*AREA**AA(5,2)*FLOAT(INPB)
780 R5=R5+Y5
781 C
782 C *TRANSFER PLY* FOR PLY'S PLY-ON-MYLAK
783 620 IF(IEKU(1).NE.2.CH.IBKU(4).NE.2) GO TO 620
784 Y6=AA(6,1)*AREA**AA(6,2)*FLOAT(INPB)
785 R6=R6+Y6
786 C
787 620 GO TO 10
788 C
789 C END OF ALL INPUT
790 C
791 900 NNN=IEKU(2)
792 IF(IEKU(1).EQ.2) NNN=IBKU(2)*IPY1
793 BEND2(IEKU(1))=BEND2(IEKU(1))+BEND1(IEKU(1))*FLOAT(NNN)
794 IF(IEKU(1).NE.1) GO TO 920
795 IF(IEKU(4).NE.1) GO TO 910
796 Y3=AA(3,1)*HAKA**AA(3,2)
797 R3=R3+(Y3)*FLOAT(IEKU(2))
798 Y6=AA(6,1)*BAKEA**AA(6,2)
799 R6=R6+(Y6)*FLOAT(IEKU(2))
800 910 IF(BAREA.GT.PAKEA) PAKEA=BAKEA
801 7BEND=(BEND2(1))+BEND2(2))*FLOAT(10T)
802 C
803 C COMPUTE FINAL SET-UP AND RUN TIME
804 C
805 K(1)=AA(1,1)*PAKEA
806 IF(1TL.EQ.1) R(2)=AA(2,1)*PAREA
807 R(3)=R3
808 R(4)=R4+R(ND2(2)
809 R(5)=R5
810 K(6)=R6+BEND2(1)
811 IF(1TL.EQ.1) GO TO 950
812 DO 950 I=7,9
813 R(1)=AA(1,1)*PAKEA**AA(1,2)
814 950 S(4)=S4
815 DO 951 I=11,13
816 951 R(I)=(AA(1,1)+AA(1,2))*SAM(I-10,1))*SAM(I-10,2)

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817 IF(K(11).EQ.0..AND.K(12).EQ.0..AND.K(13).EQ.0.) GO TO 957
818 R(10)=A(10,1)*SAK**AA(10,2)
819 S(10)=.10
820 IF(NDB.EQ.1) R(14)=A(14,1)*PAKEA**AA(14,2)*FLCAT(NDB)
821 IF(NDB.EQ.1) S(14)=.02
822 IF(NDB.EQ.2) R(15)=A(15,1)*PAKEA**AA(15,2)*FLOAT(NDB)
823 IF(NDB.EQ.2) S(15)=.02
824 DO 940 I=1,15
825 R(1)=R(1)*FLOAT(IQT)
826 DO 941 I=1,3
827 DO 941 II=1,2
828 TM1(1,II)=TM1(1,II)*FLOAT(IQT)
829 TM2(1,II)=TM2(1,II)*FLOAT(IQT)
830 DO 952 I=1,9
831 SUM1=SUM1+S(1)
832 SUM2=SUM2+K(1)
833 DO 953 I=1,15
834 SUM11=SUM1+S(1)
835 SUM12=SUM2+K(1)
836 SUM(1,1)=SUM(1,1)+SUM11
837 SUM(1,2)=SUM(1,2)+SUM12
838 DO 955 I=1,3
839 DO 955 II=1,2
840 IF(TM1(1,II).EQ.0.) GO TO 955
841 TM3(1,II)=(TM2(1,II)/(TM1(1,II)-TM12(1,II)))*100.
842 955 CONTINUE
843 C
844 DO 956 I=1,3
845 DO 958 II=1,2
846 TM1(1,II)=TM1(1,II)+TM11(1,II)
847 TM2T(1,II)=TM2T(1,II)+TM2(1,II)
848 TM1T=TM1T+TM1(1,II)
849 TM2T=TM2T+TM1T
850 DO 961 I=1,3
851 DO 961 II=1,2
852 WT(1,II)=(TM1(1,II)-TM2(1,II))*DEN(1,II)
853 CST(1,II)=WT(1,II)*CT(1,II)
854 WT(1,II)=WT(1,II)+WT(1,II)
855 CST(1,II)=CST(1,II)+CST(1,II)
856 C
857 C WRITE PART NO. & AREA TO FILE

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901 CONTINUE
2401 FORMAT(16,5A4,T39,F8.2,T52,F8.2,T65,F8.2)
C
902 WRITE(8,2410)
903 FORMAT(//140,'WEIGHT',154,'COST',T39,8(' '),152,8(' '),/)
504 DO 985 I=1,3
905 IF (WT(I,1).NE.0.) WRITE(8,2401) (OP(I+1,1),11),11=1,5),
506 * WT(1,1),CST(1,1)
907 CONTINUE
508 DO 986 I=1,3
909 IF (WT(I,2).NE.0.) WRITE(8,2401) (OP(I+1,1),11),11=1,5),
910 * WT(1,2),CST(1,2)
911 CONTINUE
912 15000 CONTINUE
913 C
514 DO 988 I=1,5
915 DO 988 II=1,2
916 CSTSCP=CSTSCP+(TMT2T(1,11)*DEN(1,11)*CT(1,11))
917 WGT1=WGT1+WT(1,11)
918 COST1=COST1+CST(1,11)
919 C
920 RETURN
921 STOP
922 END
C
923 C
924 C
925 C
926 C
927 SUBROUTINE CORE(IIN2)
928 DIMENSION OP(19,5),PAKT(2,5),A(60,3),K(60),S(60),SUM(5,2),
929 * COR(4),COR1(14),COR2(4)
930 COMMON /X/OP,SUM,R,S,PART
931 * /XX/A
932 * /XZ/CST2,WGT2
933 C
934 WGT2=0.
935 C
936 C READ COEFFICIENTS
937 DO 21 I=1,24
938 21 READ(2,21000) (CP(I,J),J=1,5), (A(I,J),J=1,3)
939 21000 FORMAT(11,5A4,131,F8.6,141,F8.6,151,F8.6)

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940      C
941      DC 2900 L=1,IN2
942      DO 210 I=1,24
943      K(I)=0.
944      ZIC S(I)=0.
945      C READ INPUT FOR EACH PART
946      READ(5,2110) (PAK(I,J),J=1,5),I=1,2),IUY2,(CUR(I),I=1,4),CT,
947      *      CUR(1)
948      REAL(5,2110) ((CUR(I),CUR2(I-1)),I=2,5),(CUR1(I),I=6,14)
949      2110G FORMAT(T1,5A4,5A4,15,T1,F7.5,T1,F7.2,T21,F7.2,T31,F7.2,
950      *T41,F7.2,T51,F7.2)
951      2111G FORMAT(T1,E(F7.2,3X),/T1,F7.2,T11,F4.0,T21,F2.0,T31,F7.2,
952      *      T41,F2.0,T43,F3.0,T46,F3.0,T51,F7.2,T61,F7.2)
953      C
954      C CALCULATE SET-UP AND RUN TIME
955      C
956      K(1)=A(1,1)*CUR(3)**A(1,2)*CUR1(1)
957      IF(R(1).EQ.0.) GO TO 2100
958      K(2)=A(2,1)*CUR(4)**A(2,2)
959      S(1)=A(1,3)
960      2100 R(4)=A(4,1)*CUR1(2)*CUR2(1)+(A(4,2)*CUR2(1))
961      K(6)=A(6,1)*CUR1(3)*CUR2(2)+(A(6,2)*CUR2(2))
962      R(8)=A(8,1)*CUR1(4)*CUR2(3)
963      R(10)=A(10,1)*CUR1(5)*CUR2(4)
964      K(12)=A(12,1)*CUR1(6)
965      K(14)=A(14,1)*CUR1(7)
966      IIT=0
967      DO 21 I=5,15,2
968      IF(R(I).EQ.0.) GO TO 2110
969      R(1)=A(1,1)*CUR(4)**A(1,2)
970      S(I-1)=A(I-1,3)
971      IIT=IIT+1
972      CONTINUE
973      IF(IIT.EQ.1) GO TO 2150
974      R(3)=A(3,1)*CUR(4)**A(3,2)
975      S(3)=A(3,3)
976      2120 IF(CUR1(6).NE.0.) K(16)=A(16,1)*CUR(4)**A(16,2)
977      IF(K(16).NE.0.) S(16)=A(16,3)
978      IF(CUR1(9).EQ.0.) GO TO 2160
979      IF(CUR(1).ET..1250) GO TO 2140
980      I=17

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981      GO TO 2150
982      IF(COR(1).GT..1875) GO TO 2142
983      I=18
984      GO TO 2150
985      IF(COR(1).GT..2500) GO TO 2144
986      I=19
987      GO TO 2150
988      I=20
989      K(1)=A(I,1)+COR(19)
990      S(1)=A((16+IFIX(COR(10))),3)+(COR(11)*A(19,3))+(COR(21)*A(20,3)
991      *)
992      R(21)=A(2,1)*COR(4)**A(21,2)
993      R(22)=A(22,1)*COR(12)
994      IF(R(22).NE.0.) S(22)=A(22,3)
995      R(23)=A(22,1)*COR(14)
996      IF(R(23).NE.0.) S(23)=A(23,3)
997      R(24)=A(24,1)*(COR(3)*COR(4)**A(24,2)
998      S(24)=A(24,3)
999      DO 2161 I=1,24
1000      R(1)=R(1)+FLCAT(1,1,2)
1001      WEIGHT=COR(2)*COR(2)*COR(4)
1002      WEIGHT=WEIGHT/1728.
1003      WEIGHT=WEIGHT*FLCAT(1,1,2)
1004      LTT=LT*LCOR(4)/144.*FLOAT(1,1,2)
1005      COST2=COST2+LTT
1006      WGT2=WGT2+WEIGHT
1007      C
1008      SUMT1=C.
1009      SUMT2=C.
1010      DO 2200 I=1,24
1011      SUMT1=SUMT1+S(1)
1012      SUMT2=SUMT2+R(1)
1013      SUM(2,1)=SUM(2,1)+SUMT1
1014      SUM(2,2)=SUM(2,2)+SUMT2
1015      WRITE(10,2222) (PART(2,J),J=1,5),COR(4)
1016      2222 FORMAT(1X,544,2X,F10.2)
1017      C
1018      C OUTPUT
1019      C
1020      WRITE(10,22000) (PART(1,J),J=1,5),1,1,2,1,CT,
1021      * (COR(1),I=1,4)

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1022 22000 FORMAT(1,'//T23,'ALUMINUM HONEYCOMB CORE PREPARATION',/T23.35(1,'-00010150
1023 1),//T6,'PAK NAME: ',5A4,T50,'QTY: ',I3,/T6,'PART NUMBER: ',5A4CC01C200
1024 2,T50,'COST/50.FT.: ',F7.2,
1025 3//T6,'CORE CELL SIZE: ',F7.5,T50,'CORE DENSITY: ',F7.2,
1026 4/T6,'CORE DEPTH: ',F7.2,T50,'CORE AREA: ',F7.2,/)
1027 IF(COR1(1),NE.0.) WRITE(8,22010) COR1(1)
1028 IF(COR1(2),NE.0.) WRITE(8,22020) COR1(2),COR2(1)
1029 IF(COR1(3),NE.0.) WRITE(8,22030) COR1(3),COR2(2)
1030 IF(COR1(4),NE.0.) WRITE(8,22040) COR1(4),COR2(3)
1031 IF(COR1(5),NE.0.) WRITE(8,22050) COR1(5),COR2(4)
1032 IF(COR1(6),NE.0.) WRITE(8,22060) COR1(6)
1033 IF(COR1(7),NE.0.) WRITE(8,22070) COR1(7)
1034 IF(COR1(8),NE.0.) WRITE(8,22080)
1035 IF(COR1(9),NE.0.,AND,COR1(10).EQ.1.) WRITE(8,22090) COR1(9),
1036 *COR1(11),COR1(12)
1037 IF(COR1(9),NE.0.,AND,COR1(110).EQ.2.) WRITE(8,22091) COR1(15),
1038 *COR1(11),COR1(12)
1039 IF(COR1(13),NE.0.) WRITE(8,22100) COR1(13)
1040 IF(COR1(14),NE.0.) WRITE(8,22110) COR1(14)
1041 22010 FORMAT(16,'SAWING--LENGTH OF CUT(IN.): ',F7.2)
1042 22020 FORMAT(16,'FLAT MACHINING--LENGTH(IN.): ',F7.2,
1043 * T50,'WIDTH(IN.): ',F7.2)
1044 22030 FORMAT(16,'CUTLUG MACHINING--LENGTH(IN.): ',F7.2,
1045 * T50,'WIDTH(IN.): ',F7.2)
1046 22040 FORMAT(16,'STEP CUT MACHINING--LENGTH(IN.): ',F7.2,
1047 * T50,'WIDTH(IN.): ',F7.2)
1048 22050 FORMAT(16,'SCARF MACHINING--LENGTH(IN.): ',F7.2,
1049 * T50,'WIDTH(IN.): ',F7.2)
1050 22060 FORMAT(16,'END MILL MACHINING--LENGTH(IN.): ',F7.2)
1051 22070 FORMAT(16,'CORE CUTOUT--QTY: ',F3.0)
1052 22080 FORMAT(16,'HANEFORMING')
1053 22090 FORMAT(16,'BRAKE FORMING--RADIUS OF CURV(IN.): ',F7.2,
1054 * T50,'DIE SIZE 6"/T21,"NO. OF DIE CHANGE: ',F3.0,
1055 * T50,"NO. OF DIE REPOSITION: ',F3.0)
1056 22091 FORMAT(16,'BRAKE FORMING--RADIUS OF CURV(IN.): ',F7.2,
1057 * T50,'DIE SIZE 6"/T21,"NO. OF DIE CHANGE: ',F3.0,
1058 * T50,"NO. OF DIE REPOSITION: ',F3.0)
1059 22100 FORMAT(16,'LIQUID PUTTING--VOLUME(CU.IN.): ',F7.2)
1060 22110 FORMAT(16,'TAPE FOAMING--VOLUME(CU.IN.): ',F7.2)
1061 WRITE(8,22100)
1062 22000 FORMAT(//T6,'FACTORY STANDARD HOURS',T40,'SET-UP',T55,'RUN',

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1063      *      /T6,28(---),T39,8(---),T52,8(---),/
1064      DD 2300 I=1,24
1065      IF(R(I).NE.C.)WRITE(8,24000) (OP(I,J),J=1,5),S(I),R(I)
1066      2300 CONTINUE
1067      24000 FORMAT(16,5A4,T39,F8.3,T52,F8.3)
1068      WRITE(8,24100) SUMT1,SUMT2
1069      24100 FORMAT(16,5TOTAL FLUXS,T39,F8.3,T52,F8.3,T39,8(---),T52,8(---))
1070      C
1071      WRITE(8,24200)
1072      24200 FORMAT(/T40,WEIGHT,T54,COST,T39,8(---),T52,8(---))
1073      WRITE(8,24201) WEIGHT,CIT
1074      24201 FORMAT(16,5HONEYCOMB CUBE,T39,F8.2,T52,F8.2)
1075      C
1076      2900 CONTINUE
1077      C
1078      RETURN
1079      9999 STOP
1080      END
1081      C
1082      C
1083      C
1084      C
1085      SUBROUTINE CONS1(IN3)
1086      INTEGER*4 IUP(60,2),IECU(60),IN(5)
1087      DIMENSION UP(60,5),PART(2,5),A(60,3),R(60),S(60),SUM(5,2),
1088      *      PNM(10,5),PNO(10,5),PNUM(5),
1089      *      RQIM(5),AP(2),APAK1(10),APAK2(10),IQTY(10)
1090      *      COMMON /X/CP,SUM,R,S,PART
1091      *      /XX/A
1092      *      /X3/APAK1,APAK2,IQTY,NOP
1093      *      /X31/IN
1094      *      /X34/PNUM
1095      C
1096      C
1097      23000 FORMAT(/16,5FACTORY STANCAED HOURS,T40,5SET-UP,T55,5KUN,
1098      *      /T6,28(---),T39,8(---),T52,8(---),/I)
1099      24000 FORMAT(16,5A4,T39,F8.3,T52,F8.3)
1100      24100 FORMAT(16,5TOTAL MDURS,T39,F8.3,T52,F8.3,T39,8(---),T52,8(---))
1101      C
1102      30000 FORMAT(5A4,5A4,T41,13,T51,12)
1103      30020 FORMAT(11,11,12,F7.2,111,3(11),F7.2,121,F7.2,131,F7.2,141,F7.2,

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1145 50101 FORMAT(12,'LEKUK — DATA ON A PART USED IN PART CONSOLIDATION WAS 00011420
1146 *NOT FOUND, PLEASE CHECK PART NO. PROGRAM TERMINATED') 00011430
1147 GO TO 5995 00011440
1148 340 IF(1BAG1-EC-0-OR-ABAG-EC-0-OR-AMER-EC-0.) GO TO 343 00011450
1149 1BAG=1 00011460
1150 GO TO 350 00011470
1151 342 IF(1BLIM1)-EC-0-OR-1BLIM(2)-EC-0-OR-FLIM(3)-EC-0.) GO TO 345 00011480
1152 1BAG=2 00011490
1153 ABAG=2-1(1BLIM(1)+1BLIM(2))+(1BLIM(3)+1BLIM(4)+1BLIM(5)) 00011500
1154 GO TO 350 00011510
1155 345 1BAG=0 00011520
1156 350 DO 351 I=1,60 00011530
1157 K(I)=0. 00011540
1158 351 S(I)=0. 00011550
1159 C 00011560
1160 C COMPUTE ADHESIVE RUN TIME 00011570
1161 C 00011580
1162 IF(1ADH-EC-0) GO TO 360 00011590
1163 IF(1BAG-EC-1) GO TO 353 00011600
1164 K(1)=A(1,1) 00011610
1165 K(2)=A(2,1)+A(ADH 00011620
1166 K(3)=PCON(A(3,1),A(3,2)) 00011630
1167 GO TO 3360 00011640
1168 C 00011650
1169 353 K(6)=A(6,1) 00011660
1170 360 IF(1FAG-NE-1) GO TO 380 00011670
1171 IF(1CUK-NE-1-AND-1CUR-NE-2) 1CUR=1 00011680
1172 IF(1ABAG-1-432.) BQTY=1. 00011690
1173 IF(1ABAG-GE-432.) BQTY=2. 00011700
1174 IF(1EK-EC-0.) BK=3. 00011710
1175 R(4)=A(4,1CUR) 00011720
1176 IF(NP-61-1) R(5)=PCON(A(5,1),A(5,2)) 00011730
1177 IF(NP-61-1) R(7)=PCON(A(7,1),A(7,2)) 00011740
1178 C 00011750
1179 IF(1EAC2-EC-0) GO TO 365 00011760
1180 K(8)=A(8,1)+ABAG 00011770
1181 SPART=0. 00011780
1182 DO 362 I=1,NCP 00011790
1183 SPART=SPART+APAR2(I) 00011800
1184 K(9)=A(9,1)+1SPART/HR 00011810
1185 C 00011820

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1186 365 GO 270 I=10,22
1187 270 IACU(1)=IEAG1
1188 DO 271 I=23,38
1189 371 IBCU(1)=ICUR
1190 DO 372 I=39,46
1191 272 IBCU(1)=IEAG1
1192 ISTART=10
1193 ISTOP=46
1194 GO TO 3000
1195 C
1196 280 IF(IEAG.NE.2) GO TO 3300
1197 IF(ICUR.NE.2.AND..ICUR.NE.3) ICUR=2
1198 ICUR=ICUR
1199 IF(ICUR.EQ.3) ICUR1=1
1200 DO 382 I=47,60
1201 382 IBCU(1)=ICUR1
1202 ISTART=47
1203 ISTOP=60
1204 C
1205 C COMPUTE RUN TIME
1206 C
1207 3000 DC 3100 I=ISTART,ISTOP
1208 ICPI=ICU(1,IBCU(1))+1
1209 GO TO (3100,3010,3020,3030,3040,3050),1(PI)
1210 C
1211 3010 K(1)=A(1,IBCU(1))
1212 GO TO 3100
1213 3020 R(1)=A(1,1)*BQTY
1214 GO TO 3100
1215 3030 K(1)=A(1,1)*APER
1216 GO TO 3100
1217 3040 R(1)=A(1,1)*ABAG**A(1,2)
1218 GO TO 3100
1219 3050 K(1)=PCIN(A(1,1),A(1,2))
1220 3100 CONTINUE
1221 IF(IEAG.NE.1) GO TO 3200
1222 IF (K(25).NE.0) K(25)=K(25)+A(25,3)
1223 P(28)=(A(28,1)*ABAG)+(A(26,2)*APER)+(A(26,3)*BQTY)
1224 IF (K(38).NE.0) R(38)=R(38)+A(38,3)
1225 IF(IEAG2.NE.0) K(44)=R(44)+A(44,3)*ABAG
1226 3200 IF(IEAG.NE.2) GO TO 3201

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00012020
00012030
00012040
00012050
00012060
00012070
00012080
00012090
00012100
00012110
00012120
00012130
00012140
00012150
00012160
00012170
00012180
00012190
00012200
00012210
00012220
00012230

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1227 R(4,1)=R(4,1)+A(4,3)
1228 R(5,1)=R(5,1)+A(5,3)
1229 3201 AP1=C.
1230 AP2=C.
1231 UU 3,10 I=1,NUP
1232 AP1=AP1+APAR1(I)*QTY3
1233 AP2=AP2+APAR2(I)*QTY3
1234 IF(1FAG.LG.2) APER=2.*(ACIM(1)+BLIM(2))
1235 C
1236 C SET POINTER TO END OF FILE
1237 C
1238 3300 KENING 10
1239 IPOINT=IN(1)+IN(2)+L-1
1240 DO 3230 I=1,IPOINT
1241 READ(10,50111)PCINT
1242 30111 FORMAT(IX,A4)
1243 C
1244 WRITE(10,20100)(PART(2,J),J=1,5),AP1,AP2
1245 WRITE(11,30100)(PART(2,J),J=1,5),APER
1246 C
1247 SUMT1=0.
1248 SUMT2=C.
1249 DO 3309 I=2,3
1250 R(1)=R(1)*QTY3
1251 SUMT1=SUMT1+R(1)
1252 DO 3310 I=5,47
1253 R(1)=R(1)*QTY3
1254 SUMT1=SUMT1+R(1)
1255 DO 3320 I=48,60
1256 R(1)=R(1)*QTY3
1257 SUMT1=SUMT1+R(1)
1258 SUMT2=R(1)+R(4)+K(47)
1259 SUM(3,1)=SUMT2+SUM(3,1)
1260 SUM(3,2)=SUMT1+SUM(3,2)
1261 C
1262 C OUTPUT
1263 C
1264 WRITE(6,21000) 1,((PART(1,J),J=1,5),I=1,2),ICTY3
1265 31000 FORMAT('1',//T25,'PART CONSOLIDATION',/T5,18(' '),
1266 //T6,'CYCLE NO.: ',I2,
1267 //T6,'PART NAME: ',5A4,/T6,'PART NUMBER: ',5A4,

```

1268 *TSC, QTY: ',13)
1269 WRITE(8,311001)
1270 31100 FORMAT(/T6,*,COMPONENT DETAIL PARTS',/T6,51(0--0),
1271 *,T11,*,PART NAME',T36,*,PART NO.',T54,*,QTY',
1272 *,T6,20(0--0),T30,20(0--0),T54,3(0--0)/)
1273 GO 2400 1=1,END
1274 3400 WRITE(8,31200) (PNUM(I,J),J=1,5), (PNO(I,J),J=1,5), I(1Y11)
1275 31200 FORMAT(/T6,54,*,T30,54,*,T54,13)
1276 IF(1ADH.EQ.0) GO TO 3410
1277 IF(1ADH1.EQ.1) WRITE(8,31310)AADM
1278 IF(1ADH1.EQ.2) WRITE(8,31311)AADM
1279 31310 FORMAT(/T6,*,ADHESIVE: BONDING',T50,*,APPLICATION AREA: ',F7.2)
1280 31311 FORMAT(/T6,*,ADHESIVE: COKE SPLICING',T50,*,APPLICATION AREA: ',
1281 *,F7.2)
1282 3410 IF(1EAG.EQ.0) GO TO 3500
1283 IF(1FAG.EQ.2) GO TO 3500
1284 IF(1BAG1.EQ.1) WRITE(8,31500)
1285 IF(1EAG1.EQ.2) WRITE(8,31501)
1286 31500 FORMAT(/T6,*,VACUUM BAGGING: DISPOSABLE')
1287 31501 FORMAT(/T6,*,VACUUM BAGGING: REUSABLE')
1288 IF(1BAG2.EQ.1) WRITE(8,31510) BR
1289 31510 FORMAT(/T6,*,RESIN BLEED PLIES-TO-BLEEDER RATIO: ',F3.1)
1290 WRITE(8,31520)ABAG,APER
1291 31520 FORMAT(/T6,*,BAGGING AREA: ',F7.2,
1292 *,T50,*,SEALING/CLAMPING PERIMETER: ',F7.2)
1293 GO TO 3505
1294 3500 WRITE(8,31530) (BUIM(I),I=1,3)
1295 31530 FORMAT(/T6,*,THERMAL EXPANSION MOLD LAGE DIMENSION: ',
1296 *,T6,*,LENGTH: ',F7.2,/T6,*,WIDTH: ',F7.2,/T6,*,DEPTH: ',F7.2)
1297 3505 GO TO 3520,3520,35301,ICUR
1298 3510 WRITE(8,31531)
1299 31531 FORMAT(/T6,*,CURING TOOL: AUTOCLAVE')
1300 GO TO 3600
1301 3520 WRITE(8,31532)
1302 31532 FORMAT(/T6,*,CURING TOOL: OVEN')
1303 GO TO 3600
1304 3530 WRITE(8,31533)
1305 31533 FORMAT(/T6,*,CURING TOOL: HEATING ELEMENT')
1306 3600 WRITE(8,34003)
1307 34003 FORMAT('1',//T25,*,PART CONSOLIDATION',/T25,181(0--0)/)
1308 C

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1309 WRITE(6,23000)
1310 IF(R(1)).NE.0.)WRITE(8,24000)(CP(1,J),J=1,5),R(1)
1311 IF(R(2)).NE.0.)WRITE(8,34000)(CP(2,J),J=1,5),R(2)
1312 IF(R(3)).NE.0.)WRITE(8,34000)(CP(3,J),J=1,5),R(3)
1313 FORMAT(16,5A4,T52,FF.3)
1314 IF(1BAG.EC.0) GO TO 3700
1315 IF(1BAG.NL.1) GO TO 3620
1316 WRITE(8,24001)(CP(4,J),J=1,5),R(4)
1317 FORMAT(16,5A4,T39,FF.3)
1318 WRITE(8,33000)
1319 FORMAT(16,'BEFORE CURE')
1320 GO 3611 I=5,29
1321 IF(R(1)).NE.0.) WRITE(8,34100)(UP(1,J),J=1,5),R(1)
1322 3611 CONTINUE
1323 34100 FORMAT(16,5A4,T52,FF.3)
1324 WRITE(8,33001)
1325 FORMAT(16,'DURING CURE')
1326 GO 3612 I=30,33
1327 IF(R(1)).NE.0.)WRITE(8,34100)(UP(1,J),J=1,5),R(1)
1328 3612 CONTINUE
1329 WRITE(8,33002)
1330 FORMAT(16,'AFTER CURE')
1331 DO 3613 I=34,46
1332 IF(R(1)).NE.0.)WRITE(8,34100)(OP(1,J),J=1,5),R(1)
1333 3613 CONTINUE
1334 GO TO 3700
1335 3620 WRITE(8,34001)(OP(47,J),J=1,5),R(47)
1336 WRITE(8,33000)
1337 GO 3625 I=48,51
1338 IF(R(1)).NE.0.) WRITE(8,34100)(OP(1,J),J=1,5),R(1)
1339 3625 CONTINUE
1340 WRITE(8,33001)
1341 DO 3621 I=52,56
1342 IF(R(1)).NE.0.) WRITE(8,24100)(CP(1,J),J=1,5),R(1)
1343 3621 CONTINUE
1344 WRITE(8,33002)
1345 DO 3622 I=57,60
1346 IF(R(1)).NE.0.) WRITE(8,34100)(OP(1,J),J=1,5),R(1)
1347 3622 CONTINUE
1348 C
1349 3700 WRITE(8,24100)SUMT2,SUMT1

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00013080
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00013100
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00013130
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00013200
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00013250
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00013380
00013390
00013400
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00013430
00013440
00013450
00013460

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```

1350 C          3900 CONTINUE
1351 C
1352 C
1353 C          RETURN
1354 C          STOP
1355 C          END
1356 C
1357 C
1358 C
1359 C
1360 C          SUBROUTINE FINISH(IN4)
1361 C          INTEGER*4 IM(3)
1362 C          DIMENSION UP(60,5),PART(2,5),A(60,3),R(60),S(60),SUM(5,2),
1363 C          *          RH(16),ST(16),B(7),C(16),AB(6,3),DIM(2),PNUM(5)
1364 C          COMMON /X/OP,SUM,K,S,PART
1365 C          /XX/A
1366 C          *          /X54/PNUM
1367 C
1368 C
1369 C          23000 FORMAT(//T6,'FACTORY STANDARD HOURS',T40,'SET-UP',T55,'RUN',
1370 C          *          /T6,28(' '),T39,8(' '),T52,6(' '),/)
1371 C          24000 FORMAT(T6,5A4,T39,F8.3,T52,F8.3)
1372 C          24100 FORMAT(T6,'TOTAL HOURS',T39,F8.3,T52,F8.3,/T39,8(' '),T52,8(' '),)
1373 C
1374 C          READ OPERATION AND COEFFICIENTS
1375 C          DO 400 I=1,9
1376 C          400 READ(4,40000) (OP(I,J),J=1,5),(A(I,J),J=1,2),C(1)
1377 C          40000 FORMAT(T1,5A4,T31,F8.6,T41,F8.6,T51,F8.6,T61,F8.6,T71,F8.6)
1378 C          DO 401 I=10,15
1379 C          401 READ(4,40000) (OP(I,J),J=1,5),(A(I,J),J=1,3),R(I-9),C(1)
1380 C          DO 402 I=1,6
1381 C          402 READ(4,40002) (AB(I,J),J=1,3)
1382 C          40002 FORMAT(T1,F8.6,T11,F8.6,T21,F8.6)
1383 C
1384 C          GO 4900 L=1,IN4
1385 C
1386 C          READ GENERAL INFORMATION FOR EACH FINISHING OPERATION
1387 C          READ(5,40010) ((PART(I,J),J=1,5),I=1,2),IQTY4,AFIN
1388 C          40010 FORMAT(T1,5A4,5A4,T41,I3,T51,F7.2)
1389 C          DO 410 I=1,16
1390 C          R(I)=0.

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1391      RH(1)=0.
1392      ST(1)=0.
1393      410 S(1)=0.
1394      SUMT1=0.
1395      SUMT2=0.
1396      C
1397      WRITE(8,40100)(PART(1,J),J=1,5),IQUY4,(PART(2,J),J=1,5),AFIN
1398      40100 FORMAT('1',//T35,'FINISHING',/T35,9('---'),
1399      *//T6,'PART NAME: ',5A4,150,'QTY: ',I3,
1400      *//T6,'PART NUMBER: ',5A4,150,'PART AREA: ',F7.2)
1401      QTY4=FLUAT(IQUY4)
1402      C
1403      NEWIND 11
1404      415 READ(11,41011,END=420) (PNUM(J),J=1,5),PERM
1405      41011 FORMAT(1X,5A4,2X,F10.2)
1406      GO TO 430
1407      420 WRITE(6,40099)(PART(2,J),J=1,5)
1408      40099 FORMAT(12,'** ERROR ** -- PERIMETER FOR PART NO.: ',5A4,' CANNOT
1409      * BE FOUND, PROGRAM ENDED')
1410      GO TO 9999
1411      430 DO 451 I=1,5
1412      IF(PART(2,I).NE.PNUM(1)) GO TO 415
1413      431 CONTINUE
1414      C
1415      WRITE(8,40120) PERM
1416      40120 FORMAT(16,'PERIMETER: ',F7.2)
1417      C
1418      READ(15,42000) ICCODE,(DIM(1),I=1,2),(TH(1),I=1,2)
1419      IF(ICCODE.EQ.0) GO TO 4100
1420      WRITE(6,41000)
1421      41000 FORMAT(/T14,'NET TRIM OPERATIONS',/T6,36('---'),
1422      *//T14,'MATERIAL(IN.)',/T13,14('---'),
1423      *//T14,'Ave.',/T22,'TRIM',/T6,'CODE',/T13,'THICK. LENGTH FIXT. TEM
1424      *P.',/T6,'-----')
1425      GO TO 4002
1426      C
1427      C NET TRIM OPERATION
1428      C
1429      4000 READ(15,42000) ICCODE,(DIM(1),I=1,2),(IP(1),I=1,2)
1430      42000 FORMAT(11,I1,11,F7.2,121,F7.2,131,211)
1431      IF(ICCODE.EQ.0) GO TO 4100

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1432 4002 WRITE(8,42001) ICOD, (DIM(1), I=1,2), (IH(1), I=1,2)
1433 42001 FORMAT(16,11,112,F7.2,T20,F7.2,T22,11,125,11)
1434 IF(DIM(1).EQ.0.) DIM(1)=1.
1435 IF(ICOD.EQ.9) DIM(2)=1.
1436 RR=AI(ICODE,1)*DIM(2)*DIM(1)**A(ICODE,2)
1437 R(ICODE)=R(ICODE)+RR
1438 RH(ICODE)=RH(ICODE)+(AB(1,1)*AFIN**AB(1,2))
1439 IF(IH(1).EQ.1) RH(ICODE)=RH(ICODE)+(AB(2,1)*AFIN**AB(2,2))+AH(2,1)
1440 IF(IH(2).EQ.1) RH(ICODE)=RH(ICODE)+(AB(4,1)*AFIN**AB(4,2))
1441 IF(IP(1).EQ.1.OR.IH(2).EQ.1) RH(ICODE)=RH(ICODE)+
1442 * AB(5,1)*PERM
1443 GO TO 4000
1444 C
1445 C HOLE OPEATION
1446 C
1447 4100 READ(5,42100) ICODE, IQTY4A, (DIM(1), I=1,2), (IH(1), I=1,3)
1448 IF(ICODE.EQ.0) GO TO 4210
1449 WRITE(8,41100)
1450 41100 FORMAT(//125,'HOLE OPERATIONS',/T6,50(' '),/T20,'HOLE DIM.(IN.)',/COG14470
1451 *T14,'QTY ',T20,14(' '),T52,'NO.',/T6,'CODE PART DIAM. DEPTHCOG1448C
1452 * FIRST. TEMP. INSR',
1453 * /T6,'-----'
1454 GO TO 4201
1455 C
1456 4200 READ(5,42100) ICODE, IQTY4A, (DIM(1), I=1,2), (IH(1), I=1,3)
1457 42100 FORMAT(11,11,111,13,T21,F7.4,T31,F7.4,T41,11,211)
1458 IF(ICODE.EQ.0) GO TO 4210
1459 4201 WRITE(8,42101) ICODE, IQTY4A, (DIM(1), I=1,2), (IH(1), I=1,3)
1460 42101 FORMAT(16,11,113,12,T21,F6.4,T29,F6.4,T39,11,T40,11,T53,11)
1461 QTY4A=FLUAT(IQTY4A)
1462 C
1463 ICOL=1CODE+9
1464 IF(DIM(2).EQ.0.) DIM(1)=1.
1465 IF(DIM(2).EQ.0.) DIM(2)=1.
1466 RR=AI(ICOL,1)*(DIM(1)**A(ICOD,2))*(DIM(2)**A(ICOD,3))+BI(ICODE)
1467 RR=RR*QTY4A
1468 R(ICODE)=R(ICODE)+RR
1469 RH(ICODE)=RH(ICODE)+(AB(1,1)*AFIN**AB(1,2))
1470 IF(IH(1).EQ.1.OR.IH(2).EQ.2)
1471 * RH(ICODE)=RH(ICODE)+(AB(IH(1)+1,1)*AFIN**AB(IH(1)+1,2))+AB(IH(1)+1,3)COG14680
1472 IF(IH(2).EQ.1) RH(ICODE)=RH(ICODE)+(A5(4,1)*AFIN**AB(4,2))

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1472 IF(I(1).EQ.1.OR.I(1).EQ.2.OR.IH(2).LG.1)
1474 *      KH(I(1))=KH(JCUD)+AE(5,1)*PEM
1475 IF(I(1).GT.0) KH(I(1))=KH(I(1))+AE(6,1)*AE(6,2)*FLUAT(1P(5))
1476 GO TO 4200
1477 C
1478 4210 DO 4220 I=1,16
1479 K(I)=K(I)*QTY4
1480 KH(I)=KH(I)*QTY4
1481 IF(K(I).NE.0.) S(I)=C(I)
1482 ST(I)=R(I)+RH(I)
1483 SUMT2=SUMT2+ST(I)
1484 4220 SUMT1=SUMT1+S(I)
1485 SUM(4,1)=SUMT1+SUM(4,1)
1486 SUM(4,2)=SUMT2+SUM(4,2)
1487 C
1488 C OUTPUT
1489 C
1490 WRITE(8,43000)
1491 FORMAT('1',/T35,'FINISHING',/T35,9(' '-))
1492 WRITE(6,43000)
1493 WRITE(8,43010)
1494 FORMAT('16','NET TRIM OPERATIONS')
1495 43003 FORMAT('18,5A4,139,F6.3,152,F8.3)
1496 DO 4300 I=1,9
1497 IF(K(I).EQ.0.) GO TO 4300
1498 WRITE(8,43003) (OP(I,J),J=1,5),S(I),K(I)
1499 WRITE(8,43001) RH(I)
1500 WRITE(8,43002) ST(I)
1501 43001 FORMAT('18','HANDLING',152,F8.3)
1502 43002 FORMAT('110','SUBTOTAL',152,F8.3)
1503 4300 CONTINUE
1504 WRITE(8,43011)
1505 43011 FORMAT('16','HOLE OPERATIONS')
1506 DO 4301 I=10,15
1507 IF(R(I).EQ.0.) GO TO 4301
1508 WRITE(8,43003) (OP(I,J),J=1,5),S(I),R(I)
1509 WRITE(8,43001) RH(I)
1510 WRITE(8,43002) ST(I)
1511 4301 CONTINUE
1512 WRITE(8,43010) SUMT1,SUMT2
1513 4910 CONTINUE

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00014700
00014710
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00014770
00014780
00014790
00014800
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00014870
00014880
00014890
00014900
00014910
00014920
00014930
00014940
00014950
00014960
00014970
00014980
00014990
00015000
00015010
00015020
00015030
00015040
00015050
00015060
00015070
00015080
00015090
00015100

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1514 C
1515 RETURN
1516 9999 STOP
1517 END
1518 C
1519 C
1520 C
1521 C
1522 SUBROUTINE TND(L,K)
1523 DIMENSION TN(5,3),TI(5,2),SLP1(5,2),SLP61(5,2),TI(5),SLP(5),
1524 * SLP6(5),HR(5)
1525 COMMON /X5/TN,TI,TI1,SLP1,SLP61,SLP,SLP6,HR,IUNIT
1526 C
1527 SLP61(L,1)=ALOG(SLP1(L,1)/100.)/ALOG(2.)
1528 SLP61(L,2)=ALOG(SLP1(L,2)/100.)/ALOG(2.)
1529 C
1530 IF(IUNIT.GT.K) GO TO 10
1531 K1=IUNIT
1532 K2=0
1533 IF=1
1534 GO TO 20
1535 C
1536 10 K1=K
1537 K2=K+1
1538 I1=2
1539 C
1540 20 TN(L,1)=TI1(L,1)*FLOAT(IUNIT)**SLP61(L,1)*HR(L)
1541 TI=C.
1542 DO 30 I=1,K1
1543 TTI=TI1(L,1)*FLOAT(I)**SLP61(L,1)
1544 TI=TI+TTI
1545 IF(K2.EQ.0) GO TO 40
1546 DO 35 I=K2,IUNIT
1547 TTI=TI1(L,2)*FLOAT(I)**SLP61(L,2)
1548 TI=TI+TTI
1549 C
1550 40 TN(L,3)=TI*HR(L)
1551 TN(L,2)=TN(L,3)/FLOAT(IUNIT)
1552 TI(L)=TI1(L,I1)
1553 SLP(L)=SLP1(L,I1)
1554

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00015110
00015120
00015130
00015140
00015150
00015160
00015170
00015180
00015190
00015200
00015210
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00015240
00015250
00015260
00015270
00015280
00015290
00015300
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00015370
00015380
00015390
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00015460
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00015480
00015490
00015500
00015510

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1555		SLPR(L)=SLPR1(L,I1)	00015520
1556	C		00015530
1557		RETURN	00015540
1558		END	00015550
1559	C		00015560
1560	C		00015570
1561		FUNCTION PCUN(A,B)	00015580
1562		DIMENSION APAR1(10),APAR2(10),IQTY(10)	00015590
1563		COMMON /X2/APAR1,APAR2,IQTY,NOP	00015600
1564	C		00015610
1565		PARTS=0.	00015620
1566		DO 10 I=1,NOP	00015630
1567		PART=APAR1(I)*B*FLCAT(IQTY(I))	00015640
1568		10 PARTS=PARTS+PART	00015650
1569		PCON=PARTS*A	00015660
1570		RETURN	00015670
1571		END	00015680

APPENDIX B. PERMANENT INPUT DATA SETS

The constants used in calculations performed by the program as well as some of the identifying labels printed in the output are contained in five Permanent Input Data Sets. The organization of Data Sets allows convenient access for reference purposes, or in case changes need to be made. The constants or the labels may be changed by editing the Data Sets, without disturbing the program instructions.

Four of the Data Sets provide the data for Factory Labor Standards Estimating in each of the subroutines; the fifth provides data for Support Functions Estimating and Cost Projection in the main program.

LAYUP DATA SET

POSITION			RECORD
1	CLEAN LAYUP TOOL	0.000006	1.0
2	APPLY RELEASE AGENT	0.000009	1.0
3	POSITION MYLAR	0.000107	0.77006
4	PLY DEPOSITION	0.	0.
5	STACK TO FERN HUCK	0.000145	0.6711
6	TRANS TO LAYUP TOOL	0.000145	0.6711
7	CLEAN CURING TOOL	0.000006	1.0
8	APPLY RELEASE AGENT	0.000009	1.0
9	TRANS TO CURING TOOL	0.000145	0.6711
10	SEWING HANDLING	0.0005	0.4342
11	STRAIGHT SEWING	0.0005	0.0001
12	CONTOUR SEWING	0.0010	0.0001
13	RADIAL SEWING	0.0015	0.0001
14	DEBULKING (DISP MAG)	0.00175	0.6911
15	DEBULKING (REUS BAG)	0.000557	0.6150
16	GRAPHITE--3" TAPE	0.0004	87.
17	GRAPHITE--12" TAPE	0.0004	87.
18	GRAPHITE--WOVEN	0.00086	43.
19	FIBERGLASS--3" TAPE	0.00054	8.7
20	FIBERGLASS--12" TAPE	0.00054	8.7
21	FIBERGLASS--WOVEN	0.00104	9.3
22	00.00007 0.	0.	
23	00.00016 0.	0.	
24	0. 0.	0.	
25	00.00047 -1.35645	0.	
26	00.015 -0.5537	0.7456	
27	00.00041 -0.5374	0.5178	
28	00.00444 -0.54576	0.00007	
29	00.00140 00.6018	00.05	
30	00.00027 00.64654	00.10	
31	00.00057 0.0	00.15	
32	00.00063 00.4942	00.15	
33	00.00058 00.57164	00.15	
34	00.00188 00.3804	0.	
35	00.00145 00.6245	00.05	
36	00.00154 00.58746	00.10	
37	00.00076 00.6245	00.05	
38	0. 0.	0.	
39	0. 0.	0.	
40	0. 0.	0.	

CORE PREPARATION DATA SET

POSITION		RECORD		
1	SAWING	0.000663	0.423	0.03
2	SAWING HANDLING	0.000453	0.381	
3	POLYGLYCOL	0.00257	0.6175	0.02
4	FLAT MACHINING	0.00013	0.0008	0.50
5	FLAT HANDLING	0.002657	0.5051	
6	CONTOUR MACHINING	0.002	0.012	0.60
7	CONTOUR HANDLING	0.002657	0.5051	
8	STEP CUT MACHINING	0.0006		0.11
9	STEP CUT HANDLING	0.002657	0.5051	
10	SCARF CUT MACHINING	0.0006		0.11
11	SCARF CUT HANDLING	0.002657	0.5051	
12	BLENDING MACHINING	0.0009		0.11
13	BLENDING HANDLING	0.002657	0.5051	
14	CUTOUT MACHINING	0.0120		0.01
15	CUTOUT HANDLING	0.002657	0.5051	
16	HAND FORMING	0.000008	1.206	0.03
17	BRAKE FORMING(.1250)	0.0091		0.15
18	BRAKE FORMING(.1875)	0.0065		0.19
19	BRAKE FORMING(.2500)	0.0052		0.12
20	BRAKE F(.3125-.3750)	0.0039		0.03
21	BRAKE FORM HANDLING	0.0008	0.5268	
22	LIQUID PUTTING	0.0105		0.03
23	TAPE FORMING	0.0257		0.03
24	CORE CLEANING	0.00046	0.4257	0.03

PART CONSOLIDATION DATA SET

POSITION		RECORD		
1	SET UP	0.05	0.05	0 0
2	APPLY ADHESIVE	0.000055		0 0
3	HANDLING	0.00150	0.6311	0 0
4	SET UP	0.07	0.05	1 1
5	PREFIT DETAILS	0.001326	0.5252	5 5
6	APPLY ADHESIVE	0.000055		1 1
7	ASSEMBLE DETAILS	0.000145	0.6711	5 5
8	APPLY POROUS FILM	0.000004	1.000000	4 4
9	APPLY BLEEDER PLIES	0.00002		1 1
10	APPLY NONPOROUS FILM	0.000009	1.000000	4 4
11	APPLY VENT CLOTH	0.00002	1.000000	4 4
12	INSTALL VACUUM FTGS	0.0062		2 0
13	INSTALL THERMOCPLS	0.0162		2 2
14	APPLY SEAL STRIPS	0.00016		3 0
15	APPLY DISPOSABLE BAG	0.000006	1.000000	4 0
16	SEAL EDGES	0.00054		3 0
17	APPLY REUSABLE BAG	0.000015	1.000000	0 4
18	CLAMP EDGES	0.00023		0 3
19	CONNECT VACUUM LINES	0.0061	0.0061	1 1
20	SMOOTH BAG DOWN	0.000006	1.000000	4 4
21	CHECK SEALS	0.00017		3 3
22	REMOVE VACUUM LINE	0.0031	0.0031	1 1
23	CHECK CHAMBER INT.	0.05	0.03	1 1
24	LOAD LAYUP IN OVEN	0.000114	0.8566	0 4
25	LOAD LAYUP IN AUTO.	0.000145	0.6711	4 0
26	CONNECT VACUUM LINES	0.0061		2 2
27	CONNECT T.C. LEADS	0.0042		2 2
28	CHECK FOR LEAKS	0.000006	0.00027	4 4
29	CLOSE DOOR	0.0192	0.0192	1 1
30	SET RECORDER	0.0140	0.0035	1 1
31	CYCLE CHECK	0.0800	0.0800	1 1
32	SHUT DOWN	0.00332	0.00063	1 1
33	REMOVE CHARTS	0.00332	0.00063	1 1
34	OPEN DOOR	0.0142	0.0192	1 1
35	RELEASE T.C. LEADS	0.0035		2 2
36	RELEASE VAC. LINES	0.0031		1 1
37	REMOVE PART FR OVEN	0.000114	0.8566	0 4
38	REMOVE PART FR AUTO.	0.000145	0.6711	4 0
39	RELEASE CLAMPS	0.00007	0.120	0 3
40	REMOVE REUS. BAG	0.000006	1.000000	0 4
41	REMOVE DISP. BAG	0.000003	1.000000	4 0
42	REMOVE THERMOCOUPLES	0.0045		2 2
43	REMOVE VACUUM FTGS	0.0029		2 0
44	REMOVE PROCESS MATL	0.000019	1.000000	4 4
45	REMOVE LAYUP & ASIDE	0.000006	1.000000	4 4
46	CLEAN TOOL	0.000006	1.000000	4 4
47	SET UP	0.45	0.05	1 1
48	FIT LAYUPS INTO MOLD	0.00237	0.06083	5 5
49	CHECK OVEN INTERIOR	0.03	0.03	0 1
50	LOAD CAGE INTO OVEN	0.00114	0.8566	0 3
51	CLOSE DOOR	0.0192	0.0192	0 1
52	CURE IN HEATING ELEM	0.00264	0.3207	5 0
53	SET RECORDER	0.0035	0.0035	0 1
54	CYCLE CHECK	0.0800	0.0800	0 1
55	SHUT DOWN	0.0063	0.0063	0 1
56	REMOVE CHARTS	0.0063	0.0063	0 1
57	OPEN DOOR	0.0142	0.0192	0 1
58	REMOVE CAGE FR OVEN	0.00114	0.8566	0 3
59	REMOVE PART FR CAGE	0.000145	0.6711	5 5
60	ASIDE PART	0.000043	0.5465	5 5

FINISHING DATA SET

POSITION	RECORD					
1 HAND ROUTING	0.0067	0.4219	0.09			
2 MACHINE ROUTING	0.0013	0.	0.20			
3 HAND SAWING	0.0046	0.6624	0.02			
4 MACHINE SAWING	0.0022	0.6744	0.09			
5 HAND SANDING	0.0005	0.	0.02			
6 PORT. TOOL SANDING	0.00140	1.	0.02			
7 MACHINE SANDING	0.00046	0.	0.25			
8 GRINDING	0.00046	0.	0.25			
9 SPEARING	0.0016	0.	0.09			
10 DRILLING	0.01643	0.3370	0.4562	0.0006	0.09	
11 REAMING	0.01218	0.2747	0.8338	0.0006	0.09	
12 COUNTERSINKING	0.0045	0.7250	0.	0.0006	0.09	
13 COUNTERBORING	0.00514	0.5466	0.2756	0.0006	0.09	
14 HOLE SAWING	0.01293	0.	1.10151	0.0006	0.09	
15 HOLE PUNCHING	0.	0.	0.	0.0036	0.09	
16 C.000145	0.6711					
17 0.00414	0.3264	C.0044				
18 C.00777	0.2644	0.0044				
19 C.000107	0.77006					
20 C.000322	0.					
21 C.0004	0.0001					

COST PROJECTION DATA SET

POSITION			RECORD				
1	LAYUP		34.03	23.24	65.81	76.63	
2	HONEYCOMB CORE PREP		1.3970	15.4359	0.0	0.0	
3	PART CONSOLIDATION		36.48	25.06	65.77	76.52	
4	FINISHING OPERATIONS		35.19	23.84	65.82	76.77	
5	TOTAL FACTORY LABOR		0.	0.			
6	FACTORY LABOR	1 1	1.	0.	0.	0.	10.
7	QUALITY CONTROL	1 1	0.4243	-0.1737	0.3542	-0.2285	10.
8	TOOLING	1 1	0.703	-0.2594	0.6313	-0.4196	10.
9	MFG ENGINEERING	1 1	0.7227	-0.1826	1.0062	-0.4256	10.
10	ENGINEERING	1 1	0.354	-0.2223	0.3524	-0.3713	10.
11	GRAPHIC SERVICES	1 1	0.0824	-0.2248	0.0432	-0.1840	10.
12	PRODUCTION MATERIAL	1 1	1.	0.			
13	SUPPORT MATERIAL	7 2	0.30	0.			
14	MFG. ALLOWANCE		0.02				
15	1.50						
16	1.50						
17	1.50						
18	1.50						
19	1.70						
20	1.70						
21	0.						
22	0.70						
23	0.15						

APPENDIX C. JOB CONTROL LANGUAGE

The Job Control Language (JCL) for the ACCEM computer program provides allocation of several data sets. The files which are required are described below.

<u>FILE NO.</u>	<u>DESCRIPTION</u>	<u>RECORD LENGTH</u>
1 -- 4	Permanent Input Data Set - May be read in from cards or may be installed as permanent data sets	80
5	Variable Input Data Set	80
6	Output Data Set (program status information)	132
8	Output Data Set (information for printing final output)	132
9	Permanent Input Data Set - May be read in from cards or may be installed as permanent data sets	80
10-11	Scratch Space	80

The JCL used to run the ACCEM program on Northrop's IBM 370/165 computer is presented on the next page.

```

//ACCEM EXEC FØRTXCLG,REGIØN.GØ=100K
//FØRT.SYSIN DD *
    {PRØGRAM LISTING}
//GØ.FT01F001 DD *
    {ACCEM 1 LAYUP DATA}
//GØ.FT02F001 DD *
    {ACCEM 2 CØRE PREPARATIØN DATA}
//GØ.FT03F001 DD *
    {ACCEM 3 PART CØNSOLIDATIØN DATA}
//GØ.FT04F001 DD *
    {ACCEM 4 FINISHING DATA}
//GØ.FT09F001 DD *
    {ACCEM 5 CØST PRØJECTIØN DATA}
//GØ.FT10F001 DD UNIT=SYSDA,SPACE=(CYL,(1,1))
//GØ.FT11F001 DD UNIT=SYSDA,SPACE=(CYL,(L,L))
//GØ.FT08F001 DD SYSØUT=A
//GØ.FT06F001 DD SYSØUT=A
//GØ.FT05F001 DD *
    {INPUT DATA}
/*

```

APPENDIX D. SAMPLE ESTIMATES

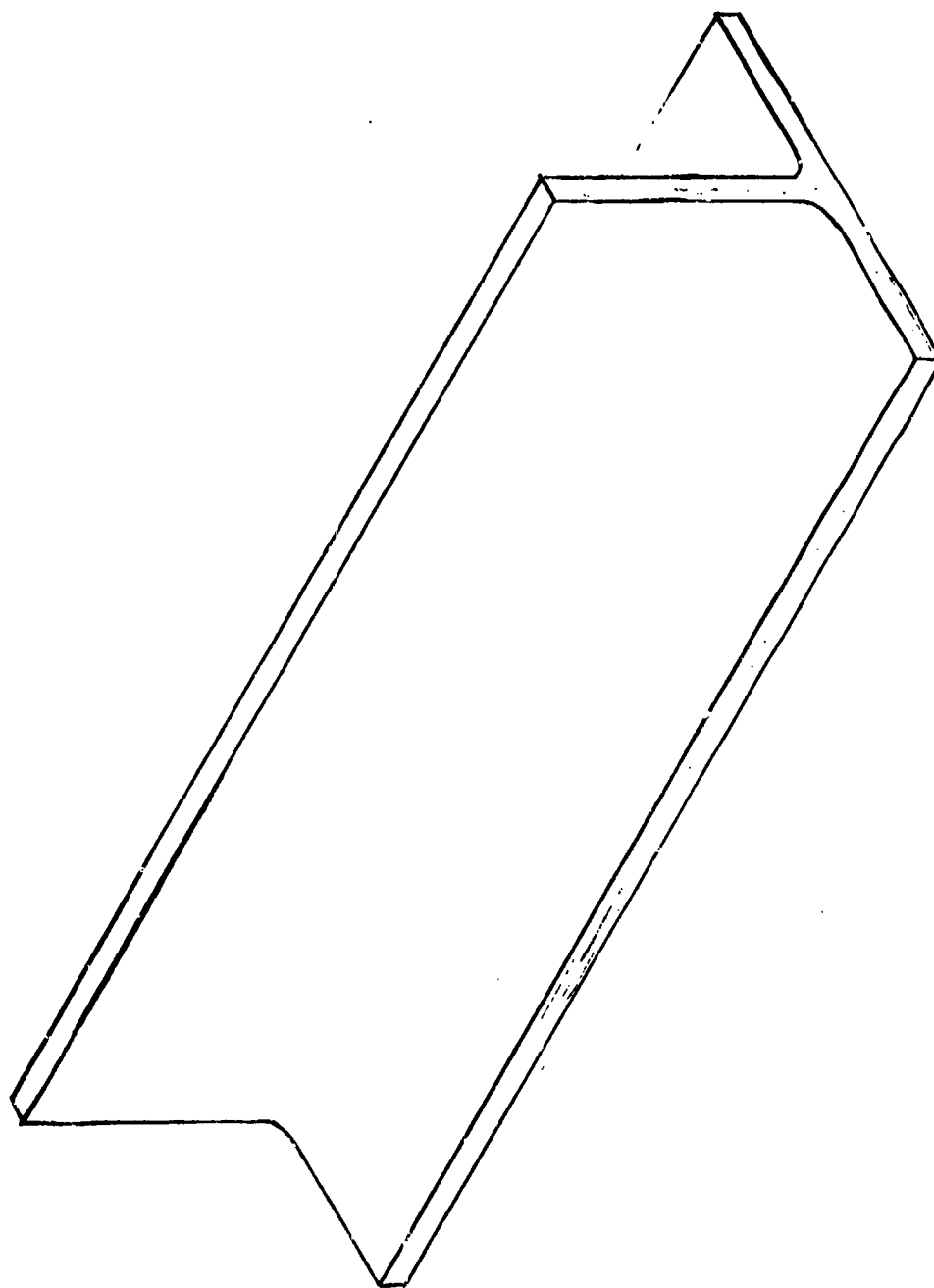
Four sample estimates have been prepared to demonstrate the employment of the ACCIEM computerized system. For each estimate, a sketch of the part and a manufacturing plan supply the part, material, and fabrication process data necessary to fill out the forms. The completed forms and the resulting computer outputs are included to represent complete execution of the estimating cycle.

LOWER LONGERON (SR-001921-19)

DESCRIPTION

The lower longeron component consists of two graphite/epoxy 20 ply thick "L" shaped legs with a moldline contoured 20 ply thick graphite/epoxy strap. Also included in this structure is a wedge shaped precast epoxy filled assembly which acts as a tooling aid and becomes an integral part of the finished lower longeron component. The total longeron structure is formed in one operation through the cocuring of both "L" shaped legs and the graphite strap in one curing cycle as outlined in the detail manufacturing plan, and discussed in the following paragraphs.

The tooling concept utilized in the fabrication of the lower longeron elements consisted of: (1) a thin steel brake formed curing (moldline) surface welded to a steel carriage frame; and (2) two brake formed angle tools for laying up and curing of the "L" shaped leg components. One of the brake formed angles incorporated a top flange to prevent longeron distortion during the cocuring cycle.



LOWER LONGERON (SR-001921-19)

The 20 ply "L" shaped graphite/epoxy components were layed up in the flat in five ply books, subsequently draped and formed over the brake formed angle tools with each succeeding book being layed and formed over the preceding book until the total 20 ply component was layed up. The 20 ply graphite/epoxy moldline strap was then layed up on the contoured moldline cocuring tool and formed to this shape. The precast epoxy assembly was located on the graphite strap and resin tacked in place. The "L" shaped graphite assemblies were positioned on either side of the epoxy casting making intimate contact with this casting and the graphite strap assembly providing a "T" shaped component. No structural adhesive was required between these assemblies as resin bonding was accomplished in these areas during the cocuring operation. The completed assembly was then vacuum bagged using a reusable rubber vacuum bag and cocured in one operation in an autoclave at 50 psi (full vacuum + 35 psi autoclave pressure) for two hours at 300° F with no resin bleeding being accomplished. The assembly after the cocuring cycle exhibited excellent dimensional tolerances and configuration stability. The components were then net trimmed, subjected to quality assurance evaluations and set aside for subsequent joining operations to the lower fuselage and equipment deck assemblies.

MANUFACTURING PLAN

1. The following list of detail parts makes up the lower longeron assembly.
 - a. Upper composite angle (-77).
 - b. Lower composite angle (-77).
 - c. Composite strap (-79).
2. Materials
 - a. Thornel 300/SP288 graphite/epoxy - per NAI-1332.

3. Layup and Cocure of Graphite/Epoxy Lower Longeron

- a. The 20 plies required by drawing SR-001921 shall be layed up in five books. Each book shall be transferred to the brake-formed tool, and layup shall continue until the buildup of all plies is completed and the two composite angles have been layed up.
- b. The -77 composite angles shall be set aside for subsequent cocuring operations.
- c. The No. 1 composite ply (0°) of the composite strap (-79) shall be layed up on the previously released (FreKote 33) lower longeron cocuring tool per drawing SR-001921. This operation shall be repeated until the buildup of all the plies is completed.
- d. The fiberglass reinforced filler casting shall be wrapped with a layer of structural adhesive (FM-123-5), positioned on the -79 composite strap and adhesively tacked in place.
- e. The -77 composite angles shall be positioned on either side of the fiberglass reinforced epoxy filler casting and on top of the -79 composite strap and resin tacked in place. No structural adhesive is required between the -77 composite angles and -79 composite strap as resin bonding is accomplished during the cocuring operation.
- f. Apply a layer of non-porous armalon over the entire layup and drape to shape of component.
- g. Apply two layers of Osnaburg breather cloth over the layup and drape to shape. Do not resin bleed the composite longeron.

- h. The component shall be vacuum bagged using the reusable rubber vacuum bag, and cocured at 50 psi (full vacuum + 35 psi autoclave pressure) with a cure temperature of two hours at 300°F as monitored by thermocouples.
- i. Upon removal of the component from the bag, it will be exposed and checked for conformity to previously determined dimensions; any discrepancy shall be recorded.
- j. The component shall be not trimmed to final dimensions and delivered to Quality Control.
- k. Quality Control shall map all detectable voids and retain this record as part of the inspection record.

ACCEM-0 INPUT CHECKLIST

CARD 1

ESTIMATOR NAME

¹ D.J. LEBLANC

ESTIMATE NUMBER

² PRELIM-12

PART NAME

⁴ LOWER LONGERON

PART NUMBER

⁶ SR001821-19

CARD 2

INPUT FORMS
ACCEM-1

LAYUP

QUANTITY USED

¹ 0.2

ACCEM-2

HONEYCOMB CORE PREPARATION

³ 0.1

ACCEM-3

PART CONSOLIDATION

⁵ 0.1

ACCEM-4

FINISHING OPERATIONS

⁷ 0.1

ACCEM-5

COST PROJECTION

⁹ 0.1

ACCEM-1 LAYUP

CARD 1	PART NAME	PART NUMBER	QTY
	ANGLE	-77	604
		TRIM ALLOWANCE	51
			IN.
	LAYOUT TOOL SAME AS CUTTING TOOL (CIRCLE ONE)	YES	61
		NO	62
	DEBULKING	NUMBER OF OCCURRENCES	64
	TYPE OF KAG (CIRCLE ONE)	DISPOSABLE	64
		REUSABLE	64

CARD 2 (BLANK)

CARD 3

COST (\$/LB)
DENSITY (LB/SQ. IN.)

KEYPUNCH CARD 4 AND CARD 5 ALTERNATELY

[illegible]

LAST ENTRY ON CARD 4 IS "9999"; LAST ENTRY ON CARD 5 IS "000"

LGGE:D

HANDLING METHOD: 1 - PREPLY, 2 - DIRECT-ON-TOOL.

LAYOUT METHOD: 1 - MANUAL, 2 - HAND-ASSIST, 4 - CONRAC AUTOMATIC (720 IPM), 5 - CONRAC AUTOMATIC (360 IPM)

DEPOSITION TECHNIQUE: 1 - PLV-ON-PLV, 2 - PLV-ON-MYLAR

TYPE OF BEND: 1 = STRAIGHT, SHARP, MALE; 2 = STRAIGHT, SHARP, FEMALE; 3 = STRAIGHT, RADIAL MALE;
4 = STRAIGHT, RADIAL, FEMALE; 5 = CURVED, STRETCH FLANGE (TAP); 6 = CURVED, SHRINK FLANGE (TAP);
7 = CURVED (NOON MATERIAL)

MATERIAL FORM: 1 - UNIDIRECTIONAL TAPE, 2 - KOVLY

MATERIAL TYPE: 1 • GRAPHITE/EPOXY, 2 • FIBERGLASS/EPOXY 56

ACCLM-1 LAYUP

CARD 1 PART NAME STRAP PART NUMBER 21-79 QTY 600

TRIM ALLOWANCE 0.1 IN.

LAYUP TOOL SAME AS CURING TOOL (CIRCLE ONE) YES 0 NO 1

DEBULFING NUMBER OF OCCURRENCES 0

TYPE OF BAG (CIRCLE ONE) DISPOSABLE 1 REUSABLE 2

CARD 2 (BLANK)

CARD 3

COST (\$/LB)
DENSITY (LB/SQ. IN.)

GRAPHITE TAPE MOVE 1 TAPE MOVE 1 FIBERGLASS TAPE MOVE 1

KEYPUNCH CARD 4 AND CARD 5 ALTERNATELY

CARD 4										CARD 5									
METHOD		BEND DESCRIPTION								PLY DESCRIPTION									
QUANTITY OF PREPLIES	TYPE OF BEND	BEND LENGTH (IN.)	RADIUS OF CURVATURE	FLANGE WIDTH (IN.)	ORIENTATION (DEG.)	COUNT	DIMENSIONS				MATERIAL	WIDTH							
							RECTANGULAR	NONRECTANGULAR											
							LENGTH (IN.)	WIDTH (IN.)	AREA (SQ. IN.)	DISTANCE (IN.)									
9999							0001	60											
							015005												
							090008												
							000												

LAST ENTRY ON CARD 4 IS "9999"; LAST ENTRY ON CARD 5 IS "000"

LEGEND

HANDLING METHOD: 1 = PREPLY, 2 = DIRECT-ON-TOOL

LAYUP METHOD: 1 = MANUAL, 2 = HAND-ASSIST, 4 = CONRAC AUTOMATIC (720 IPH), 5 = CONRAC AUTOMATIC (360 IPH)

DEPOSITION TECHNIQUE: 1 = PLY-ON-PLY, 2 = PLY ON ROLL

TYPE OF BEND: 1 = STRAIGHT, SHARP, MALE; 2 = STRAIGHT, SHARP, FEMALE; 3 = STRAIGHT, RADIAL MALE; 4 = STRAIGHT, RADIAL FEMALE; 5 = CURVED, SKETCH FLANGE (TAPE); 6 = CURVED, SHRINK FLANGE (TAPE); 7 = CURVED (Woven MATERIAL)

MATERIAL FORM: 1 = UNIDIRECTIONAL TAPE, 2 = WOVEN

MATERIAL TYPE: 1 = GRAPHITE/EPoxy, 2 = FIBERGLASS/EPoxy

ACCEM-3 PART CONSOLIDATION

CARD 1
 CYCLE NUMBER 1
 PART NAME LOWER LONGERON PART NUMBER SR001921-19 QUANTITY 20.2

COMPONENT DETAIL PARTS
 NUMBER OF LINES USED 0.3 (MINIMUM 10)

CARD 2	PART NAME	PART NUMBER	QUANTITY
	<u>ANGLE</u>	<u>-77</u>	<u>20.2</u>
	<u>STRAP</u>	<u>-79</u>	<u>20.1</u>

CARD 3
 CONSOLIDATION OF DETAILS
 ADHESIVE (CIRCLE ONE)

NO: 1 YES: 1
 APPLICATION AREA: _____ SQ. IN.

ADDITIONAL OPERATIONS
 (CIRCLE IF APPLICABLE)

BONDING: 1 SPLICING: 2

CURING PROCESS

VACUUM BAGGING

TYPE OF BAG: (CIRCLE ONE)

RESIN BLEED: (CIRCLE ONE)

DISPOSABLE: 1 REUSABLE: 1
 NO: 1 YES: 1

PLY-TO-BLEEDER RATIO: _____ -TO-1

BAGGING AREA:

SEALING/CLAMPING PERIMETER:

360 SQ. IN.
252 IN.

THERMAL EXPANSION MOLDING

EXTERNAL MOLD CAGE DIMENSIONS:

LENGTH: 41 IN.
 WIDTH: 61 IN.
 DEPTH: 61 IN.

CURING TOOL: (CIRCLE ONE)

AUTOCLAVE: 1
 OVEN: 2
 HEATING ELEMENT: 3

ACCEM-4 FINISHING OPERATIONS

CARD 1 PART NAME LOWER LONGERON PART NUMBER SR001921-19 QTY 100
 PART AREA 540.4 SQ. IN.

CARD 2 (OMIT IF LEFT BLANK)
 NET TRIM OPERATIONS

OPERATION	AVERAGE THICKNESS (IN.)	TRIM LENGTH (IN.)	TEMPLATE FIXTURE
1	49	126	10
2	49	126	10
3			
4			
5			
6			
7			
8			
9			
10			

CARD 3 0

CARD 4 (OMIT IF LEFT BLANK)
 HOLE OPERATIONS

OPERATION	QTY.	HOLE DIAMETER (IN.)	HOLE DEPTH (IN.)	TEMPLATE FIXTURE
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

CARD 5 0

LEGEND

OPERATION: 1 = HAND ROUTING
 2 = MACHINE ROUTING
 3 = HAND SAWING
 4 = MACHINE SAWING
 5 = HAND SANDING
 6 = PORTABLE TOOL SANDING
 7 = MACHINE SANDING
 FIXTURE: 0 = NO,
 1 = YES
 TEMPLATE: 0 = NO
 1 = YES

LEGEND

OPERATION: 1 = DRILLING
 2 = COUNTERSINKING
 3 = COUNTERBORING
 4 = REAMING
 5 = HOLE SAWING
 6 = HOLE PUNCHING
 FIXTURE: 0 = NO
 1 = EXTERNAL
 2 = INTERNAL
 TEMPLATE: 0 = NO
 1 = YES
 INSERTS: 0 = NO
 1 = YES

ACCEM-5 COST PROJECTION

CARD 1

UNIT NUMBER 01000
AVE. LOT SIZE 10

TYPE OF ESTIMATE

UNIT COST

COL. 21 NO 0

YES 1 (CIRCLE ONE)

CUMULATIVE AVERAGE COST

COL. 22 NO 0

YES 1 (CIRCLE ONE)

CUMULATIVE TOTAL COST

COL. 23 NO 0

YES 1 (CIRCLE ONE)

CARD 2

FACTORY LABOR PROJECTION FACTORS

LEARNING CURVE:

LOG-LINEAR UNIT 1

CUM. AVE. 1 (CIRCLE ONE)

DATA INPUT OPTIONS (CIRCLE ONE)

NONE
ITEM (a) - (d)
ITEM (e)

1
2

- (a) LAYUP
- (b) CORE PREPARATION
- (c) PART CONSOLIDATION
- (d) FINISHING OPERATIONS
- (e) TOTAL FACTORY LABOR

DATA INPUT OPTIONS (CIRCLE ONE)

NONE
ITEMS (a) - (f)

1
2

LABOR RATES

- (a) FACTORY LABOR
- (b) QUALITY CONTROL
- (c) TOOLING
- (d) MFG. ENG.
- (e) ENGINEERING
- (f) GRAPHIC SERVICES

DATA INPUT OPTIONS (CIRCLE ONE)

NONE
CARDS (a) - (b)
CARD (c)

1
2

SUPPORT FUNCTIONS

- QUALITY CONTROL
- TOOLING
- MFG. ENG.
- ENGINEERING
- GRAPHIC SERVICES
- SUPPORT MATERIAL

LEGEND

BASE: 1 = FACTORY FABRICATION, 2 = QUALITY CONTROL, 3 = TOOLING,
4 = MFG. ENG., 5 = ENGINEERING, 6 = GRAPHIC SERVICES, 7 = PRODUCTION MAT'L

BASE UNIT: 1 = HOURS, 2 = DOLLARS

DATA INPUT OPTIONS (CIRCLE ONE)

NONE
ITEMS (a) - (f), (2), (3)
ITEMS (1), (2), (3)

1
2

OVERHEAD RATES

- (a) FACTORY FABRICATION
- (b) QUALITY CONTROL
- (c) TOOLING
- (d) MFG. ENG.
- (e) ENGINEERING
- (f) GRAPHIC SERVICES
- (1) TOTAL LABOR
- (2) MATERIAL
- (3) ADMINISTRATIVE

CARD 3

T. VARIANCE

1 3 5
7 6 2
1 1 6 3
2 1 9 3

CARD 4

LEARNING CURVE SLOPE

1 7 9 4
2 5 1 6
3 0 1 2
4 6 1 8

CARD 5

1 0 1 \$/HR
2 1 2 5 \$/HR
3 1 4 \$/HR
4 5 1 \$/HR
5 1 7 5 \$/HR
6 9 \$/HR

CARD 6

BASE

1
1
1
1
1
1
1
1
1
1

CARD 7

BASE UNIT

1
1
1
1
1
1
1
1
1
1

CARD 8

FACTOR

1 1 2 0
2 1 1 2
3 1 1 4
4 1 1 0
5 1 0 5
6 1 2 5

CARD 9

LABOR HRS/MAT'L \$'S

1 1 2 0
2 1 1 2
3 1 1 4
4 1 1 0
5 1 0 5
6 1 2 5

CARD 10

1 1 2 0
2 1 1 2
3 1 1 4
4 1 1 0
5 1 0 5
6 1 2 5

CARD 11

1 1 2 0
2 1 1 2
3 1 1 4
4 1 1 0
5 1 0 5
6 1 2 5

ADVANCED COMPOSITE COST ESTIMATE

ESTIMATOR: D.J. LEBLANC DATE: 09/23/76
ESTIMATE NUMBER: PRELIM-12
PART NAME: LOWER LONGERON
PART NUMBER: SK001921-19

<u>INPUT FORMS</u>	<u>QUANTITY</u>
--------------------	-----------------

LAYUP	2
HONEYCOMB CORE OPERATION	6
PART CONSOLIDATION	1
FINISHING OPERATIONS	1
COST PROJECTIONS	1

PART NAME: ANGLE
 PART NUMBER: -77
 LAYUP TOOL NOT = CURING TOOL

LAYUP

QTY: 4
 TRIM ALLOWANCE: 1.00

MATERIAL DATA

DENSITY	COST
0.000400	20.00
0.000400	20.00
0.000800	93.00
0.000540	8.70
0.000540	8.70
0.001040	9.30

GRAPHITE--3" TAPE
 GRAPHITE--12" TAPE
 GRAPHITE--WOVEN
 FIBERGLASS--3" TAPE
 FIBERGLASS--12" TAPE
 FIBERGLASS--WOVEN

PLY DESCRIPTION

BEND DATA						RECT				NON-RECT		MATERIAL		
LD #	P	LH	DT	Tb	LENGTH	CR	FW	ORI	CT	LENGTH	WIDTH	AREA	DIST	F T WD
1	5	1	1	1	60.00	0.0	0.0	0	2	60.00	6.00	0.0	0.0	1 1 3.
0	0	0	0	0	0.0	0.0	0.0	45	1	60.00	6.00	0.0	0.0	1 1 3.
0	0	0	0	0	0.0	0.0	0.0	90	1	60.00	6.00	0.0	0.0	1 1 3.

FACTORY STANDARD HOURS	LAYUP -----	SET-UP -----	RUN -----	PERCENT SCRAP -----
CLEAN LAYUP TOOL	0.0	0.013		
POSITION MYLAR	0.0	0.279		
PLY DEPOSITION	0.050	5.939		
TRANS TO LAYUP TOOL	0.0	0.286		
CLEAN CURING TOOL	0.0	0.013		
APPLY RELEASE AGENT	0.0	0.020		
TRANS TO CURING TOOL	0.0	0.040		
SUBTOTAL	0.050	6.591		
TOTAL LAYUP	0.050 *****	6.591 *****		
BEND FACTOR HOURS		0.084		
MATERIAL -----	USAGE (SQ. IN.)	SCRAP (SQ. IN.)		PERCENT SCRAP -----
GRAPHITE--3" TAPE	42368.16	13508.17		46.90
GRAPHITE--3" TAPE	WEIGHT -----	COST -----		
	11.52	230.40		

PART NAME: STRAP
 PART NUMBER: -79
 LAYUP TOOL = CURING TOOL

QTY: 2
 TRIM ALLOWANCE: 1.00

LAYUP

MATERIAL DATA

DENSITY	COST
0.000400	20.00
0.000400	20.00
0.000880	93.00
0.000540	8.70
0.000540	8.70
0.001040	9.30

GRAPHITE--3" TAPE
 GRAPHITE--12" TAPE
 GRAPHITE--WOVEN
 FIBERGLASS--3" TAPE
 FIBERGLASS--12" TAPE
 FIBERGLASS--WOVEN

PLY DESCRIPTION

BEND DATA										RECT			NON-RECT		MAYL		
LD	#P	LM	DT	TB	LENGTH	CR	FW	ORI	CT	LENGTH	WIDTH	AREA	DIST	F	T	WD	
2	0	1	1	0	0.0	0.0	0.0	0	10	60.00	6.00	0.0	0.0	1	1	3.	
2	0	1	1	0	0.0	0.0	0.0	45	5	60.00	6.00	0.0	0.0	1	1	3.	
2	0	1	1	0	0.0	0.0	0.0	90	5	60.00	6.00	0.0	0.0	1	1	3.	

FACTORY STANDARD HOURS	LAYUP	SET-UP	RUN	
CLEAN LAYUP TOOL				
APPLY RELEASE AGENT	0.0		0.007	
PLY DEPOSITION	0.0		0.010	
SUBTOTAL	0.050		2.989	
	0.050		2.986	
TOTAL LAYUP	0.050		2.906	
	*****		*****	
BEND FACTOR HOURS			0.0	
MATERIAL	USAGE	SCRAP		PERCENT
	(SQ. IN.)	(SQ. IN.)		SCRAP
GRAPHITE---3" TAPE	21154.08	6754.08		46.90
	WEIGHT	COST		
GRAPHITE---3" TAPE	5.76	115.20		

PART CONSOLIDATION

CYCLE NO.: 1
PART NAME: LOWER LONGERON
PART NUMBER: SR001921-19

QTY: 2

COMPONENT DETAIL PARTS

<u>PART NAME</u>	<u>PART NO.</u>	<u>QTY</u>
ANGLE	-77	2
STRAP	-79	1

VACUUM BAGGING: REUSABLE
BAGGING AREA: 360.00

CURING TOOL: OVEN

SEALING/CLAMPING PERIMETER: 252.00

PART CONSOLIDATION

FACTORY STANDARD HOURS	SET-UP	RUN
SET UP	0.050	
BEFORE CURE		
PREFIT DETAILS		0.220
ASSEMBLE DETAILS		0.061
APPLY NONPURGUS FILM		0.006
APPLY VENT CLOTH		0.014
INSTALL THERMOPLS		0.032
APPLY REUSABLE BAG		0.011
CLAMP EDGES		0.116
CONNECT VACUUM LINES		0.012
SMOOTH BAG DOWN		0.004
CHECK SEALS		0.026
REMOVE VACUUM LINE		0.006
CHECK CHAMBER INT.		0.060
LOAD LAYUP IN OVEN		0.036
CONNECT VACUUM LINES		0.012
CONNECT T.C. LEADS		0.018
CHECK FOR LEAKS		0.158
CLOSE DOOR		0.038
DURING CURE		
SET RECORDERS		0.007
CYCLE CHECK		0.160
SHUT DOWN		0.002
REMOVE CHARTS		0.002
AFTER CURE		
OPEN DOOR		0.038
RELEASE T.C. LEADS		0.007
RELEASE VAC. LINES		0.005
REMOVE PART FR OVEN		0.036
RELEASE CLAMPS		0.035
REMOVE REUS. BAG		0.006
REMOVE THERMOCOUPLES		0.019
REMOVE PROCESS MATL		0.014
REMOVE LAYUP & ASIDE		0.004
CLEAN TOOL		0.004
TOTAL HOURS	0.050	1.232
	*****	*****

FINISHING

PART NAME: LOWEK LONGERON
 PART NUMBER: SRG01921-19
 PERIMETER: 252.00

CITY: 2
 PART AREA: 540.00

NET TRIM OPERATIONS

MATERIAL(IN.)				
CODE	AVE. THICK.	TRIM LENGTH	FLY. TEMP.	
2	0.49	126.00	1	0
5	0.49	126.00	0	0

FINISHING

FACTORY STANDARD HOURS	SET-UP	RUN
NET TRIM OPERATIONS		
MACHINE ROUTING	0.200	0.378
HANDLING		0.255
SUBTOTAL		0.633
HAND SANDING	0.020	0.126
HANDLING		0.020
SUBTOTAL		0.146
HOLE OPERATIONS		
TOTAL HOURS	0.220	0.779
	*****	*****

TOTAL FACTORY LABOR STANDARD HOURS.

<u>FACTORY STANDARD HOURS</u>	<u>SET-UP</u>	<u>RUN</u>
LAYUP	0.100	9.577
MONEYCOMB CORE PREP	0.0	0.0
PART CONSOLIDATION	0.050	1.232
FINISHING OPERATIONS	0.220	0.779
TOTAL HOURS	0.370	11.588
	*****	*****

COST PROJECTION

PRODUCTION COST ESTIMATE AT UNIT NO.: 1000
 AVERAGE LOT SIZE: 10.
 LINEAR UNIT CURVE

<u>PROJECTION FACTORS</u>	<u>T1.VAR</u>	<u>CURVE SLOPE</u>
LAYUP	13.35	79.40 %
MONEYCUMB CURE PREP	7.62	85.60 %
PART CONSOLIDATION	11.63	80.20 %
FINISHING OPERATIONS	21.93	76.20 %

<u>LABOR RATES</u>	<u>\$/HR</u>
FACTORY LABOR	10.00
QUALITY CONTROL	12.50
TOOLING	14.00
MFG ENGINEERING	15.00
ENGINEERING	11.75
GRAPHIC SERVICES	9.00

<u>SUPPORT FUNCTIONS</u>	<u>BASE</u>	<u>FACTORS</u>
QUALITY CONTROL	1 1	0.20
TOOLING	1 1	0.12
MFG ENGINEERING	1 1	0.14
ENGINEERING	1 1	0.10
GRAPHIC SERVICES	1 1	0.05
SUPPORT MATERIAL	7 2	0.25

<u>OVERHEAD RATES</u>	
FACTORY LABOR	1.900
QUALITY CONTROL	1.200
TOOLING	1.500
MFG ENGINEERING	1.100
ENGINEERING	1.750
GRAPHIC SERVICES	1.100
MATERIAL	0.200
ADMINISTRATIVE	0.250

COST PROJECTION

UNIT COST ESTIMATE AT T 1000

<u>COST ELEMENT</u>	<u>STD. HRS</u>	<u>T 1000 HRS</u>	<u>DOLLARS</u>
FACTORY LABOR			
LAYUP	9.59	12.85	128.47
HONEYCOMB CORE PREP	0.0	0.0	0.0
PART CONSOLIDATION	1.24	1.60	22.34
FINISHING OPERATIONS	0.80	1.17	17.56
TOTAL FACTORY LABOR	11.63	15.61	183.46
SUPPORT LABORS			
QUALITY CONTROL		3.12	39.03
TOOLING		1.87	26.23
MFG ENGINEERING		2.19	32.79
ENGINEERING		1.56	18.35
GRAPHIC SERVICES		0.78	7.03
TOTAL SUPPORT LABOR			123.42
LABOR OVERHEAD			
FACTORY LABOR			348.57
QUALITY CONTROL			46.84
TOOLING			39.35
MFG ENGINEERING			36.07
ENGINEERING			32.11
GRAPHIC SERVICES			7.73
TOTAL OVERHEAD			510.66
TOTAL LABOR			817.54
MATERIAL			
PRODUCTION MATERIAL			345.60
SUPPORT MATERIAL			66.40
MFG. ALLOWANCE			165.77
OVERHEAD			119.55
TOTAL MATERIAL			717.32
ADMINISTRATIVE OVERHEAD			383.72
TOTAL COST			1918.58

	<u>WEIGHT</u>
LAYUP	17.28
HONEYCOMB CORE PREP	0.0
TOTAL	17.28

COST PROJECTION

CUMULATIVE AVERAGE COST ESTIMATE AT T 1000

<u>COST ELEMENT</u>	<u>STD. HRS</u>	<u>T 1000 HRS</u>	<u>DOLLARS</u>
FACTORY LABOR			
LAYUP	9.59	19.14	191.36
HONEYCOMB CORE PREP	0.0	0.0	0.0
PART CONSOLIDATION	1.24	2.33	32.60
FINISHING OPERATIONS	0.80	1.91	28.60
TOTAL FACTORY LABOR	11.63	23.37	274.61
SUPPORT LABORS			
QUALITY CONTROL		4.67	58.43
TOOLING		2.80	39.26
MFG ENGINEERING		3.27	49.08
ENGINEERING		2.34	27.46
GRAPHIC SERVICES		1.17	10.52
TOTAL SUPPORT LABOR			184.75
LABOR OVERHEAD			
FACTORY LABOR			521.75
QUALITY CONTROL			70.11
TOOLING			58.89
MFG ENGINEERING			53.99
ENGINEERING			48.06
GRAPHIC SERVICES			11.57
TOTAL OVERHEAD			764.37
TOTAL LABOR			1223.72
MATERIAL			
PRODUCTION MATERIAL			345.60
SUPPORT MATERIAL			86.40
MFG. ALLOWANCE			167.59
OVERHEAD			119.92
TOTAL MATERIAL			719.51
ADMINISTRATIVE OVERHEAD			485.81
TOTAL COST			2429.03

	<u>WEIGHT</u>
LAYUP	17.28
HONEYCOMB CORE PREP	0.0
TOTAL	17.28

COST PROJECTION

CUMULATIVE COST ESTIMATE AT T 1000

<u>COST ELEMENT</u>	<u>STD. HRS</u>	<u>T 1000 HRS</u>	<u>DOLLARS</u>
FACTORY LABOR			
LAYUP	9.59	19135.95	191359.44
HONEYCOMB CORE PREP	0.0	0.0	0.0
PART CONSOLIDATION	1.24	2326.38	32597.27
FINISHING OPERATIONS	0.80	1906.44	28596.56
TOTAL FACTORY LABOR	11.63	23370.76	274606.37
SUPPORT LABORS			
QUALITY CONTROL		4674.15	58426.86
TOOLING		2804.49	39262.87
MFG ENGINEERING		3271.91	49078.58
ENGINEERING		2337.08	27460.64
GRAPHIC SERVICES		1168.54	10516.84
TOTAL SUPPORT LABOR			184745.69
LABOR OVERHEAD			
FACTORY LABOR			521752.00
QUALITY CONTROL			70112.19
TOOLING			58894.30
MFG ENGINEERING			53986.46
ENGINEERING			48056.12
GRAPHIC SERVICES			11568.53
TOTAL OVERHEAD			764369.50
TOTAL LABOR			1223721.00
MATERIAL			
PRODUCTION MATERIAL			345599.81
SUPPORT MATERIAL			86399.94
MFG. ALLOWANCE			5654.22
OVERHEAD			87530.75
TOTAL MATERIAL			525184.69
ADMINISTRATIVE OVERHEAD			437226.25
TOTAL COST			2186131.00

	<u>WEIGHT</u>
LAYUP	17279.98
HONEYCOMB CORE PREP	0.0
TOTAL	17279.98

LOWER FUSELAGE PANEL (SR-001921-15)

DESCRIPTION

The lower fuselage panel is a relatively simple structure composed of three ply (0° / 90° / $+45^\circ$) graphite-fiberglass/epoxy hybrid skins with localized fiberglass/epoxy buildup areas along the edges of the panel with a honeycomb core substructure. The tooling selected for the fabrication of this structure consists of a "brake formed" steel curing surface mechanically attached to a fiberglass/epoxy honeycomb sandwich base. This concept allowed one to obtain excellent heat-up and cool down rates while maintaining the weight and cost of the tool at a cost competitive base as compared to total metal or plastic tooling.

The hybrid skin assemblies for the lower fuselage panel were layed-up in the flat, with the outer skin being draped into the release coated (Fre-Kote 33) "female" tool. The fiberglass/epoxy localized buildups were then located and resin tacked in place. The localized fiberglass buildups were then located on the honeycomb core assembly and the inner skin assembly was draped and formed to the honeycomb core. No structural adhesive was required between the skin assemblies and honeycomb core as resin bonding was accomplished in these areas through the fiberglass/epoxy adhesive prepreg of the hybrid composite. The assembly was then vacuum bagged using a reusable rubber vacuum bag and cocured in one operation in an oven at vacuum pressure (15 psi) for two hours at 300°F with no resin bleeding being accomplished. After the cocuring cycle the lower panel exhibited an excellent aerodynamic surface on the outer mold-line skin, with the total assembly displaying good dimensional tolerances and configuration stability. The panel was then net trimmed and subjected to

quality assurance evaluations with no out-of-pattern readings being recorded. The panel was then set aside for subsequent joining to the lower longerons and equipment deck.

MANUFACTURING PLAN

1. The following list of detail parts makes up the lower panel assembly.
 - a. Composite skin - upper (-69)
 - b. Composite skin - lower (-67)
 - c. Honeycomb core - 3.1 lbs/ft³ (-65)
2. Materials
 - a. Thornel 300/SP288 graphite/epoxy - per NAI-1332
 - b. Narmco 3203 fiberglass/epoxy
 - c. Aluminum honeycomb core - per NAI-1171, Class I
3. Machining of (-65) Honeycomb Core
 - a. The honeycomb core shall conform to NAI-1171. Use 0.0007 foil, 0.125-inch cell, 3.1 lbs/ft³ density, 5056-H39 aluminum alloy (CR III coated) per specification QQ-A-250/8.
 - b. Machine honeycomb core per drawing SR-001921 (-15). Note ribbon direction.
 - c. Roll form core to shape of lower panel cocuring tool.
4. Layup and Cocure of Graphite-Fiberglass/Epoxy Hybrid Skin Assemblies
 - a. The No. 1 composite ply (0° - graphite) of the lower skin (-67) shall be draped and formed to the lower panel cocuring tool.

- b. The No. 2 composite ply (90° - graphite) of the lower skin shall be draped and formed over the No. 1 composite ply (ply-on-ply).
- c. The No. 3 composite ply (+45° fiberglass) of the lower skin shall be draped and formed over the No. 2 composite ply (ply-on-ply).
- d. The -6 honeycomb core which has been previously machined and roll formed shall be positioned on the lower skin. No structural adhesive is required between the honeycomb core and lower skin assembly as resin bonding is accomplished through the fiberglass/epoxy adhesive prepreg ply during the cocuring cycle.
- e. The No. 1 composite ply (+45° fiberglass) of the upper skin shall be draped and formed over the -65 honeycomb core. No structural adhesive is required between the honeycomb core and No. 1 composite ply of the upper skin as resin bonding is accomplished through the fiberglass/epoxy adhesive prepreg during the cocuring operation.
- f. The No. 2 composite ply (90° - graphite) of the upper skin shall be draped and formed over the No. 1 composite ply (ply-on-ply).
- g. The No. 3 composite (0° - graphite) of the upper skin shall be draped and formed over the No. 2 composite ply (ply-on-ply).
- h. Apply a layer of non-porous armalon over the entire assembly. Do not resin bleed composite skins.
- i. Position fairing blocks around periphery of assembly to prevent core crushing during cocuring operation.
- j. Position rubber tooling aids in core transition areas of assembly to prevent core migration.
- k. Apply two layers of Osnaburg breather cloth over the entire assembly.

1. The component shall be vacuum bagged using the reusable rubber vacuum bag, and cocured at vacuum bag pressure (15 psi) only, in an oven with a cure temperature of two hours at 300°F as monitored by thermocouples.

ACCEM-0 INPUT CHECKLIST

CARD 1

ESTIMATOR NAME

¹ TIMOTHY J. BETTNER

ESTIMATE NUMBER

²¹ 970

PART NAME

⁴¹ LOWER FUSELAGE PANEL

PART NUMBER

⁶¹ SR-001921(-15)

CARD 2 INPUT FORMS
ACCEM-1

LAYUP

QUANTITY USED
^{0.2}

ACCEM-2 HONEYCOMB CORE PREPARATION

³ 0.1

ACCEM-3 PART CONSOLIDATION

⁵ 0.1

ACCEM-4 FINISHING OPERATIONS

⁷ 0.1

ACCEM-5 COST PROJECTION

⁹ 0.1

ACCEM-1 LAYUP

CARD 1	PART NAME	PART NUMBER	QTY
	UPPER SKIN	2160	60
			51
		TRIM ALLOWANCE	IN.
	LAUP TOOL SAME AS CURING TOOL (CIRCLE ONE)	YES	NO
		61	0
	DEBULKING	NUMBER OF OCCURRENCES	
		62	
		63	
	TYPE OF BAG (CIRCLE ONE)	DISPOSABLE	REUSABLE
		1	2

CARD 2 (BLANK)

CARD 3

COST (\$/LB)
DENSITY (LB/SQ. IN.)

GRAPHITE FIBERGLASS

TAPE WUVEN TAPE WUVEN

93 11 21 20

KEYPUNCH CARD 4 AND CARD 5 ALTERNATELY

CARD 4

CARD 5

BEND DESCRIPTION					PLY DESCRIPTION									
METHOD	QUANTITY OF PLYS	BEND LENGTH (IN.)	RADIUS OF CURVATURE	FLANGE WIDTH (IN.)	ORIENTATION (DEG.)	DIMENSIONS				MATERIAL	TOLERANCE			
						RECTANGULAR		NONRECTANGULAR						
						LENGTH (IN.)	WIDTH (IN.)	AREA (SQ. IN.)	DISTANCE (IN.)					
2	114	25	16	3	045	001	35	25						
	1	50												
	2	50												
2	114	25	16		000	001	35	25			11	3		
	1	50												
	2	50												
2	114	25	16		090	001	35	25			11	3		
	1	50												
	2	50												
0000					000									

LAST ENTRY ON CARD 4 IS "9999"; LAST ENTRY ON CARD 5 IS "000"

LEGEND

HANDLING METHOD: 1 = PREPLY, 2 = DIRECT-ON-TOOL
LAYUP METHOD: 1 = MANUAL, 2 = HAND-ASSIST, 4 = CONFRAC AUTOMATIC (720 IPM), 5 = CONFRAC AUTOMATIC (360 IPM)
DEPOSITION TECHNIQUE: 1 = PLY-ON-PLY, 2 = PLY-ON-MYLAR
TYPE OF BEND: 1 = STRAIGHT, SHAL., MALE; 2 = STRAIGHT, SHARP, FEMALE; 3 = STRAIGHT, RADIAL, ALE;
4 = STRAIGHT, RADIAL, FEMALE; 5 = CURVED, SHRINK FLANGE (TAPE); 6 = CURVED, STRAIGHT FLANGE (TAPE);
7 = CURVED (WOVEN MATERIAL)
MATERIAL FORM: 1 = UNIDIRECTIONAL TYPE, 2 = WOVEN
MATERIAL TYPE: 1 = GRAPHITE/EPOXY, 2 = FIBERGLASS/EPOXY 79

ACCEN-1 LAYUP

CARD 1 PART NAME LOWER SKIN PART NUMBER 67 QTY 60.1

TRIM ALLOWANCE 1 IN.

LAYUP TOOL SAME AS CURING TOOL (CIRCLE ONE) YES 0 NO 0

DEBULKING NUMBER OF OCCURRENCES 1

TYPE OF BAG (CIRCLE ONE) DISPOSABLE 1 REUSABLE 2

CARD 2 (BLANK)

CARD 3

COST (\$/LB)
DENSITY (LB/SQ. IN.)

GRAPHITE FIBERGLASS

TAPE WOVEN TAPE WOVEN

03 11 21 20

KEYPUNCH CARD 4 AND CARD 5 ALTERNATELY

CARD 4						CARD 5									
METHOD		BEND DESCRIPTION				PLY DESCRIPTION									
QUANTITY OF PREPLIES	HANDLING METHOD	DEPOSITION TECHNIQUE	TYPE OF BEND	BEND LENGTH (IN.)	RADIUS OF CURVATURE	FLANGE WIDTH (IN.)	ORIENTATION (DEG.)	COUNT	DIMENSIONS				MATERIAL	WIDTH (IN.)	
									RECTANGULAR		NONRECTANGULAR				
									LENGTH (IN.)	WIDTH (IN.)	AREA (SQ. IN.)	DISTANCE (IN.)			
2	1	1	1	25	16				000001	23	25			11	3
2	1	1	1	25	16				000001	23	25			11	3
2	1	1	1	25	16				045001	23	25			11	3
9999									000						

LAST ENTRY ON CARD 4 IS "9999"; LAST ENTRY ON CARD 5 IS "000"

LEGEND

- HANDLING METHOD: 1 = PREPLY, 2 = DIRECT-ON-TOOL
- LAYUP METHOD: 1 = MANUAL, 2 = HAND-ASSIST, 4 = CONRAC AUTOMATIC (720 IPH), 5 = CONRAC AUTOMATIC (360 IPH)
- DEPOSITION TECHNIQUE: 1 = PLY-ON-PLY, 2 = PLY-ON-MYLAR
- TYPE OF BEND: 1 = STRAIGHT, SHARP, MALE; 2 = STRAIGHT, SHARP, FEMALE; 3 = STRAIGHT, RADIAL, MALE; 4 = STRAIGHT, RADIAL, FEMALE; 5 = CURVED, SHRINK FLANGE (TAPE); 6 = CURVED, STRAIGHT FLANGE (TAPE); 7 = CURVED (WOVEN MATERIAL)
- MATERIAL FORM: 1 = UNIDIRECTIONAL TAPE, 2 = WOVEN
- MATERIAL TYPE: 1 = GRAPHITE/EPOXY, 2 = FIBERGLASS/EPOXY

ACCEM-2 HONEYCOMB CORE PREPARATION

CARD 1 PART NAME PART NUMBER QTY.
HONEYCOMB CORE 60 0.01

CARD 2 MATERIAL DESCRIPTION

CELL SIZE: 1.25 IN.
DENSITY: 3 LB./CU. FT.
THICKNESS: 6.3 IN.
AREA: 7.50 SQ. IN.
COST: 3.50 \$/PART

CARD 3 OPERATIONS
SAWING
MACHINING
FLAT

LENGTH OF CUT: 51 IN.
LENGTH OF CUT: 1 IN.
MAXIMUM WIDTH: 1 IN.
LENGTH OF CUT: 2 IN.
MAXIMUM WIDTH: 3 IN.
LENGTH OF CUT: 4 IN.
WIDTH OF CUT: 5 IN.
LENGTH OF CUT: 6 IN.
WIDTH OF CUT: 7 IN.

CARD 4

BLEND
CUTOUTS

LENGTH OF CUT: 1 IN.
QUANTITY: 1

HANDFORMING (CIRCLE ONE)

YES: 1 NO: 0

BRAKEFORMING
(CIRCLE ONE)

RADIUS OF CURVATURE: 31 IN.
DIE LENGTH $\leq$ 5 FT: 4
NO. DIE CHANGES: 43
NO. DIE REPOSITIONS: 48

LIQUID POTTING

VOLUME FILLED: 51 CU. IN.

TAPE FOAMING

VOLUME FILLED: 61 CU. IN.

ACCEM-3 PART CONSOLIDATION

CARD 1
 CYCLE NUMBER 1
 PART NAME LOWER FUSELAGE PANEL PART NUMBER SR-001921(-15) QUANTITY 0.01

COMPONENT DETAIL PARTS
 NUMBER OF LINES USED 03 (MAXIMUM 10)

CARD 2	PART NAME	PART NUMBER	QUANTITY
	<u>LOWER SKIN</u>	<u>60</u>	<u>0.01</u>
	<u>UPPER SKIN</u>	<u>67</u>	<u>0.01</u>
	<u>HONEYCOMB CORE</u>	<u>65</u>	<u>0.01</u>

CARD 3
 CONSOLIDATION OF DETAILS
 ADHESIVE (CIRCLE ONE)

NO: 0 YES: 1
 APPLICATION AREA: _____ SQ. IN.

ADDITIONAL OPERATIONS
 (CIRCLE IF APPLICABLE)

BONDING: 1 SPLICING: 2

CURING PROCESS

VACUUM BAGGING

TYPE OF BAG: (CIRCLE ONE)
 RESIN BLEED: (CIRCLE ONE)

DISPOSABLE: 1 REUSABLE: 2
 NO: 0 YES: 1

PLY-TO-BLEEDER RATIO: _____ -TO-1
 BAGGING AREA: 8.25 SQ. IN.
 SEALING/CLAMPING PERIMETER: 1.16 IN.

THERMAL EXPANSION MOLDING

EXTERNAL MOLD CAGE DIMENSIONS:

LENGTH: 41 IN.
 WIDTH: 51 IN.
 DEPTH: 51 IN.

CURING TOOL: (CIRCLE ONE)

AUTOCLAVE: 1
 OVEN: 2
 HEATING ELEMENT: 3

ACCEM-4 FINISHING OPERATIONS

CARD 1 PART NAME LOWER FUSELAGE PANEL PART NUMBER 52-001921(15) QTY 100
 PART AREA 825 SQ. IN.

CARD 2 (OMIT IF LEFT BLANK)
 NET TRIM OPERATIONS

OPERATION	AVERAGE THICKNESS (IN.)	TRIM LENGTH (IN.)	TEMPLATE FIXTURE
1	0.05	1.16	10
2	0.05	1.16	10
3	0.05	1.16	10
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

CARD 3 0

CARD 4 (OMIT IF LEFT BLANK)
 HOLE OPERATIONS

OPERATION	QTY.	HOLE DIAMETER (IN.)	HOLE DEPTH (IN.)	TEMPLATE FIXTURE
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

CARD 5 0

LEGEND

OPERATION: 1 = HAND ROUTING
 2 = MACHINE ROUTING
 3 = HAND SAWING
 4 = MACHINE SAWING
 5 = HAND SANDING
 6 = PORTABLE TOOL SANDING
 7 = MACHINE SANDING
 FIXTURE: 0 = NO,
 1 = YES
 TEMPLATE: 0 = NO
 1 = YES

LEGEND

OPERATION: 1 = DRILLING
 2 = COUNTERBORING
 3 = REAMING
 4 = COUNTERSINKING
 5 = HOLE SAWING
 6 = HOLE PUNCHING
 FIXTURE: 0 = NO
 1 = EXTERNAL
 2 = INTERNAL
 TEMPLATE: 0 = NO
 1 = YES
 INSERTS: 0 = NO
 1 = YES

ACCEM-5 COST PROJECTION

CARD 1

UNIT NUMBER 01000
AVE. LOT SIZE 100

TYPE OF ESTIMATE

UNIT COST

COL. 21 NO 0

YES (1) (CIRCLE ONE)

CUMULATIVE AVERAGE COST

COL. 22 NO 0

YES (1) (CIRCLE ONE)

CUMULATIVE TOTAL COST

COL. 23 NO 0

YES (1) (CIRCLE ONE)

CARD 2

FACTORY LABOR PROJECTION FACTORS

LEARNING CURVE:

LOG-LINEAR UNIT (1)

CUM. AVE. (1) (CIRCLE ONE)

DATA INPUT OPTIONS (CIRCLE ONE)

NONE
ITEM (a) - (d) (1)
ITEM (e) (2)

- (a) LAYUP
- (b) CORE PREPARATION
- (c) PART CONSOLIDATION
- (d) FINISHING OPERATIONS

(1) TOTAL FACTORY LABOR

DATA INPUT OPTIONS (CIRCLE ONE)

NONE
ITEMS (a) - (f) (1)

LABOR RATES

- (a) FACTORY LABOR
- (b) QUALITY CONTROL
- (c) TOOLING
- (d) MFG. ENG.
- (e) ENGINEERING
- (f) GRAPHIC SERVICES

DATA INPUT OPTIONS (CIRCLE ONE)

NONE
CARDS (a) - (b) (1)
CARD (c) (2)

SUPPORT FUNCTIONS

- QUALITY CONTROL
- TOOLING
- MFG. ENG.
- ENGINEERING
- GRAPHIC SERVICES
- SUPPORT MATERIAL

LEGEND

BASE: 1 = FACTORY FABRICATION, 2 = QUALITY CONTROL, 3 = TOOLING,
4 = MFG. ENG., 5 = ENGINEERING, 6 = GRAPHIC SERVICES, 7 = PRODUCTION MAT'L
BASE UNIT: 1 = HOURS, 2 = DOLLARS

DATA INPUT OPTIONS (CIRCLE ONE)

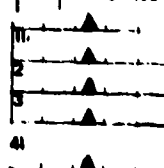
NONE
ITEMS (a) - (f), (2), (3) (1)
ITEMS (1), (2), (3) (2)

OVERHEAD RATES

- (a) FACTORY FABRICATION
- (b) QUALITY CONTROL
- (c) TOOLING
- (d) MFG. ENG.
- (e) ENGINEERING
- (f) GRAPHIC SERVICES
- (1) TOTAL LABOR
- (2) MATERIAL
- (3) ADMINISTRATIVE

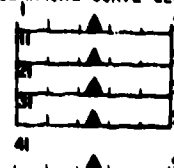
CARD 3

T₁ VARIANCE

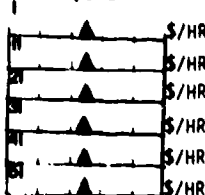


CARD 4

LEARNING CURVE SLOPE

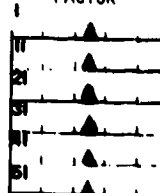


CARD 5



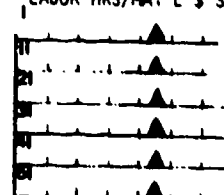
CARD 6

FACTOR

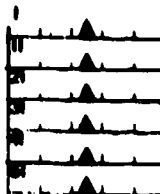


CARD 7

LABOR HRS/MAT'L \$'S



CARD 10



CARD 11



ADVANCED COMPOSITE COST ESTIMATE

ESTIMATOR: TIMOTHY J. BETTNER DATE: 09/23/76

ESTIMATE NUMBER: 970

PART NAME: LOWER FUSELAGE PANEL

PART NUMBER: SP-0019211-151

<u>INPUT FORMS</u>	<u>QUANTITY</u>
LAYUP	2
HONEYCOMB CORE OPERATION	1
PART CONSOLIDATION	1
FINISHING OPERATIONS	1
COST PROJECTIONS	1

PART NAME: UPPER SKIN
 PART NUMBER: 69
 LAYUP TOOL = CURING TOOL

QTY: 1
 TRIM ALLOWANCE: 1.00

LAYUP

MATERIAL DATA

DENSITY	COST
0.000490	93.00
0.000400	93.00
0.000880	93.00
0.000540	6.70
0.000540	6.70
0.001040	20.00

GRAPHITE---3" TAPE
 GRAPHITE---12" TAPE
 GRAPHITE---WOVEN
 FIBERGLASS---3" TAPE
 FIBERGLASS---12" TAPE
 FIBERGLASS---WOVEN

PLY DESCRIPTION

BEND DATA										RECT					NON-RECT					MATERIAL				
LD	#P	LH	LT	TB	LF	CTH	CR	FM		ORI	CT	LENGTH	WIDTH	AREA	DIST	F	T	MD						
2	0	1	1	4	25.00	16.00	0.0	0.0		45	1	33.00	25.00	0.0	0.0	2	2	36.						
0	0	0	0	1	50.00	0.0	0.0	0.0		0	0	0.0	0.0	0.0	0.0	0	0	0.						
0	0	0	0	2	50.00	0.0	0.0	0.0		0	0	0.0	0.0	0.0	0.0	0	0	0.						
2	0	1	1	4	25.00	16.00	0.0	0.0		0	1	33.00	25.00	0.0	0.0	1	1	3.						
0	0	0	0	1	50.00	0.0	0.0	0.0		0	0	0.0	0.0	0.0	0.0	0	0	0.						
0	0	0	0	2	50.00	0.0	0.0	0.0		0	0	0.0	0.0	0.0	0.0	0	0	0.						
2	0	1	1	4	25.00	16.00	0.0	0.0		90	1	33.00	25.00	0.0	0.0	1	1	3.						
0	0	0	0	1	50.00	0.0	0.0	0.0		0	0	0.0	0.0	0.0	0.0	0	0	0.						
0	0	0	0	2	50.00	0.0	0.0	0.0		0	0	0.0	0.0	0.0	0.0	0	0	0.						

FACTORY STANDARD HOURS	LAYUP -----	SET-UP -----	RUN -----	PERCENT SCRAP -----
CLEAN LAYUP TOOL		0.0	0.010	
APPLY RELEASE AGENT		0.0	0.015	
PLY DEPOSITION		0.100	0.346	
SUBTOTAL		0.100	0.371	
TOTAL LAYUP		0.100	0.371	
		*****	*****	
BEND FACTOR HOURS			0.735	
MATERIAL -----	USAGE (SQ. IN.)	SCRAP (SQ. IN.)		
GRAPHITE---3" TAPE	1917.00	267.00		16.18
FIBERGLASS---WOVEN	1660.81	855.61		103.73
	WEIGHT -----	COST -----		
GRAPHITE---3" TAPE	0.66	61.28		
FIBERGLASS---WOVEN	0.86	17.16		

PART NAME: LOWER SKIN
 PART NUMBER: 67
 LAYUP TOOL = CURING TOOL

QTY: 1
 TRIM ALLOWANCE: 1.00

LAYUP

MATERIAL DATA

DENSITY	COST
0.000400	93.00
0.000400	93.00
0.000880	93.00
0.000540	8.70
0.000540	8.70
0.001040	20.00

GRAPHITE--3" TAPE
 GRAPHITE--12" TAPE
 GRAPHITE--WOVEN
 FIBERGLASS--3" TAPE
 FIBERGLASS--12" TAPE
 FIBERGLASS--WOVEN

PLY DESCRIPTION

BEND DATA										RECT				NON-RECT		MATL		
LD	SP	LM	UT	TB	LENGTH	CR	FW	ORI	CT	LENGTH	WIDTH	AREA	DIST	F	T	WD		
2	0	1	1	4	25.00	16.00	0.0	0	1	33.00	25.00	0.0	0.0	1	1	3.		
2	0	1	1	4	25.00	16.00	0.0	90	1	33.00	25.00	0.0	0.0	1	1	3.		
2	0	1	1	4	25.00	16.00	0.0	45	1	33.00	25.00	0.0	0.0	1	1	3.		

FACTORY STANDARD HOURS	LAYUP -----	SET-UP	RUN	
CLEAN LAYUP TOOL		0.0	0.000	
APPLY RELEASE AGENT		0.0	0.000	
PLY DEPOSITION		0.050	0.365	
SUBTOTAL		0.050	0.380	
TOTAL LAYUP		0.050	0.380	
		*****	*****	
BEND FACTOR HOURS			0.001	
MATERIAL		USAGE	SCRAP	PERCENT
		(SQ. IN.)	(SQ. IN.)	SCRAP
GRAPHITE---3" TAPE		2912.22	437.22	17.67
		WEIGHT	COST	
GRAPHITE---3" TAPE		0.99	92.07	

ALUMINUM HONEYCOMB CORE PREPARATION

PART NAME: HONEYCOMB CORE
 PART NUMBER: 65
 CORE CELL SIZE: 0.12500
 CORE DEPTH: 0.63
 SCARF MACHINING--LENGTH(IN.): 50.00
 HANDFORMING
 QTY: 1
 COST/SQ.FT.: 35.04
 CORE DENSITY: 3.10
 CORE AREA: 750.00
 WIDTH(IN.): 1.00

FACTORY STANDARD HOURS	SET-UP	RUN
------------------------	--------	-----

POLYGLYCOL	0.020	0.153
SCARF CUT MACHINING	0.110	0.030
SCARF CUT HANDLING	0.0	0.075
HAND FORMING	0.050	0.024
CORE CLEANING	0.050	0.006
TOTAL HOURS	0.230	0.289
	*****	*****

WEIGHT	COST
--------	------

HONEYCOMB CORE	0.85	182.50
----------------	------	--------

PART CONSOLIDATION

CYCLE NO.: 1
 PART NAME: LOWER FUSELAGE PANEL
 PART NUMBER: SK-001921(-15) QTY: 1

COMPONENT DETAIL PARTS

PART NAME	PART NO.	QTY
LOWER SKIN	69	1
UPPER SKIN	67	1
HONEYCOMB CORE	65	1

VACUUM BAGGING: REUSABLE
 BAGGING AREA: 825.00

SEALING/CLAMPING PERIMETER: 116.00

CURING TOOL: OVEN

----- PART CONSULTATION -----

FACTORY STANDARD WORKS	SET-UP	RUN
SET UP	0.050	
BEFORE CURE		
PREFIT DETAILS		0.158
ASSEMBLE DETAILS		0.048
APPLY NONPOROUS FILM		0.007
APPLY VENT CLOTH		0.017
INSTALL THERMOPLS		0.032
APPLY REUSABLE BAG		0.012
CLAMP EDGES		0.027
CONNECT VACUUM LINES		0.006
SMOOTH BAG DOWN		0.005
CHECK SEALS		0.020
REMOVE VACUUM LINE		0.003
CHECK CHAMBER INT.		0.030
LOAD LAYUP IN OVEN		0.036
CONNECT VACUUM LINES		0.012
CONNECT T.C. LEADS		0.018
CHECK FOR LEAKS		0.054
CLOSE DOOR		0.019
DURING CURE		
SET RECORDERS		0.004
CYCLE CHECK		0.080
SHUT DOWN		0.001
REMOVE CHARTS		0.001
AFTER CURE		
OPEN DOOR		0.019
RELEASE T.C. LEADS		0.007
RELEASE VAC. LINES		0.006
REMOVE PART FR OVEN		0.026
RELEASE CLAMPS		0.008
REMOVE REUS. BAG		0.007
REMOVE THERMOCOUPLES		0.019
REMOVE PROCESS MATL		0.016
REMOVE LAYUP & ASIDE		0.005
CLEAN TOOL		0.005
TOTAL HOURS	0.650	0.719
	*****	*****

FINISHING

PART NAME: LOWER FUSELAGE PANEL
 PART NUMBER: SK-001921(-15)
 PERIMETER: 116.00
 CTV: 1
 PART AREA: 825.00

NET TRIM OPERATIONS

MATERIAL(IN.)				
CODE	AVE. THICK.	TRIM LENGTH	FIXT.	TEMP.
3	0.05	116.00	1	0
6	0.05	116.00	1	0
5	0.05	116.00	1	0

FINISHING

FACTORY STANDARD HOURS		SET-UP	RUN
NET TRIM OPERATIONS			
HAND SAWING		0.020	0.073
HANDLING			0.092
SUFTOTAL			0.165
HAND SANDING		0.020	0.058
HANDLING			0.092
SUFTOTAL			0.150
PORT. TCEL SANDING		0.020	0.007
HANDLING			0.092
SUFTOTAL			0.099
HOLE OPERATIONS			
TOTAL HOURS		0.060	0.414
		*****	*****

TOTAL FACTORY LABOUR STANDARD MLURS

<u>FACTORY STANDARD HOURS</u>	<u>SET-UP</u>	<u>RUN</u>
LAYUP	0.150	0.751
HONEYCOMB CORE PREP	0.230	0.289
PART CONSOLIDATION	0.050	0.719
FINISHING OPERATIONS	0.060	0.414
TOTAL HOURS	0.490	2.173
	*****	*****

COST PROJECTION

PRODUCTION COST ESTIMATE AT UNIT NO.: 1000
 AVERAGE LOT SIZE: 10.
 LINEAR UNIT CURVE

<u>PROJECTION FACTORS</u>	<u>T1.VAR</u>	<u>CURVE SLOPE</u>
LAYUP	23.24	76.63 %
HONEYCOMB CORE PREP	16.83	0.0 %
PART CONSOLIDATION	25.06	76.52 %
FINISHING OPERATIONS	13.44	76.77 %

<u>LABOR RATES</u>	<u>\$/HR</u>
FACTORY LABOR	10.00
QUALITY CONTROL	10.00
TOOLING	10.00
MFG ENGINEERING	10.00
ENGINEERING	10.00
GRAPHIC SERVICES	10.00

<u>SUPPORT FUNCTIONS</u>	<u>BASE</u>	<u>FACTORS</u>
QUALITY CONTROL	1 1	1.41
TOOLING	1 1	4.22
MFG ENGINEERING	1 1	2.55
ENGINEERING	1 1	1.64
GRAPHIC SERVICES	1 1	0.40
SUPPORT MATERIAL	7 2	0.30

<u>OVERHEAD RATES</u>	
FACTORY LABOR	1.500
QUALITY CONTROL	1.500
TOOLING	1.500
MFG ENGINEERING	1.500
ENGINEERING	1.700
GRAPHIC SERVICES	1.700
MATERIAL	0.200
ADMINISTRATIVE	0.150

COST PROJECTION

UNIT COST ESTIMATE AT T 1000

<u>COST ELEMENT</u>	<u>STD. HRS</u>	<u>T 1000 HRS</u>	<u>DOLLARS</u>
FACTORY LABOR			
LAYUP	0.77	1.26	12.55
HONEYCOMB CORE PREP	0.31	0.44	4.40
PART CONSOLIDATION	0.72	1.26	12.61
FINISHING OPERATIONS	0.42	0.72	7.19
TOTAL FACTORY LABOR	2.22	3.67	36.74
SUPPORT LABORS			
QUALITY CONTROL		0.27	2.68
TOOLING		0.13	1.28
MFG ENGINEERING		0.20	1.95
ENGINEERING		0.10	1.00
GRAPHIC SERVICES		0.04	0.45
TOTAL SUPPORT LABOR			7.36
LABOR OVERHEAD			
FACTORY LABOR			55.12
QUALITY CONTROL			4.03
TOOLING			1.92
MFG ENGINEERING			2.93
ENGINEERING			1.69
GRAPHIC SERVICES			0.76
TOTAL OVERHEAD			66.44
TOTAL LABOR			110.55
MATERIAL			
PRODUCTION MATERIAL			353.11
SUPPORT MATERIAL			105.93
MFG. ALLOWANCE			44.73
OVERHEAD			100.76
TOTAL MATERIAL			604.53
ADMINISTRATIVE OVERHEAD			107.26
TOTAL COST			822.34

	<u>WEIGHT</u>
LAYUP	2.51
HONEYCOMB CORE PREP	0.85
TOTAL	3.36

COST PROJECTION

CUMULATIVE AVERAGE COST ESTIMATE AT T 1000

<u>COST ELEMENT</u>	<u>STD. MRS</u>	<u>T 1000 MRS</u>	<u>DOLLARS</u>
FACTORY LABOR			
LAYUP	0.77	2.03	20.33
HONEYCOMB CORE PREP	0.31	0.47	4.71
PART CONSOLIDATION	0.72	2.05	20.48
FINISHING OPERATIONS	0.42	1.16	11.60
TOTAL FACTORY LABOR	2.22	5.71	57.13
SUPPORT LABORS			
QUALITY CONTROL		0.65	6.52
TOOLING		0.50	4.98
MFG ENGINEERING		0.77	7.75
ENGINEERING		0.34	3.40
GRAPHIC SERVICES		0.10	0.94
TOTAL SUPPORT LABOR			23.63
LABOR OVERHEAD			
FACTORY LABOR			85.69
QUALITY CONTROL			9.78
TOOLING			7.47
MFG ENGINEERING			11.62
ENGINEERING			5.78
GRAPHIC SERVICES			1.68
TOTAL OVERHEAD			122.02
TOTAL LABOR			202.76
MATERIAL			
PRODUCTION MATERIAL			353.11
SUPPORT MATERIAL			105.93
MFG. ALLOWANCE			45.14
OVERHEAD			100.84
TOTAL MATERIAL			605.02
ADMINISTRATIVE OVERHEAD			121.17
TOTAL COST			928.96

	<u>WEIGHT</u>
LAYUP	2.51
HONEYCOMB CORE PREP	0.85
TOTAL	3.36

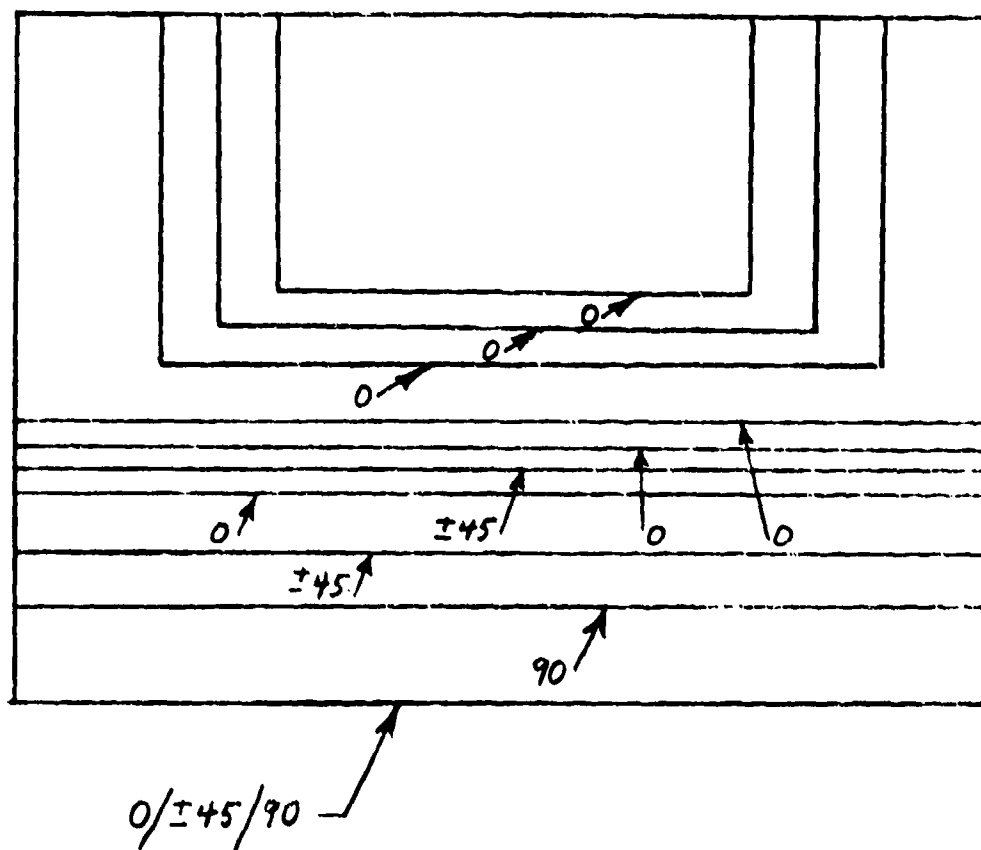
COST PROJECTION

CUMULATIVE COST ESTIMATE AT T 1000

<u>COST ELEMENT</u>	<u>STD. MRS .</u>	<u>T 1000 MRS</u>	<u>DOLLARS</u>
FACTORY LABOR			
LAYUP	0.77	2033.19	20331.87
HONEYCOMB CORE PREP	0.31	471.27	4712.72
PART CONSOLIDATION	0.72	2048.44	20484.93
FINISHING OPERATIONS	0.42	1159.82	11598.29
TOTAL FACTORY LABOR	2.22	5712.78	57127.77
SUPPORT LABORS			
QUALITY CONTROL		651.78	6517.77
TOOLING		498.06	4980.55
MFG ENGINEERING		774.82	7748.24
ENGINEERING		339.41	3399.14
GRAPHIC SERVICES		98.60	986.01
TOTAL SUPPORT LABOR			23631.71
INDIRECT OVERHEAD			
FACTORY LABOR			85691.62
QUALITY CONTROL			9776.65
TOOLING			7470.83
MFG ENGINEERING			11622.36
ENGINEERING			5778.53
GRAPHIC SERVICES			1676.22
TOTAL OVERHEAD			122016.06
TOTAL LABOR			202775.50
MATERIAL			
PRODUCTION MATERIAL			353109.81
SUPPORT MATERIAL			105432.94
MFG. ALLOWANCE			1186.55
OVERHEAD			92045.81
TOTAL MATERIAL			552275.06
ADMINISTRATIVE OVERHEAD			113257.56
TOTAL COST			868308.12

	<u>WEIGHT</u>
LAYUP	2508.00
HONEYCOMB CORE PREP	447.66
TOTAL	2955.66

UPPER AND LOWER SKINS - TRAILING EDGE FLAP



MANUFACTURING PLAN

1. The following list of details makes up the skins for the trailing edge flap.
 - a. Composite skin - upper
 - b. Composite skin - lower
2. Materials
 - a. AS/3501 - 5 prepreg 12" wide

3. Layup and Cure of Graphite/Epoxy Skin Assemblies

- a. The composite skin is composed of 15 tapered plies. Ply orientation and stacking sequences is established by using mylar tooling aids. After the mylars are stacked the sequence is inspected and checked against the engineering drawings.
- b. Mylars are then covered with 3501 prepreg to the proper orientation and again stacked prior to final layup.
- c. The mylars are keyed to two tooling holes along the main spar element line. The tool is prepared by first applying a coat of release agent (Fre-Kote 33) and covered with 1 mill thick Teflon separator film.
- d. After the tool is prepared the first ply is orientated to the two tooling holes, smoothed down, and the mylar removed. This procedure is then repeated until all 15 plies have been placed on the tool.
- e. An excess of approximately one inch is left on the prepreg for resin content, fiber volume and void content determinations.
- f. The layup is then covered perforated release film, 120 fiberglass bleeder cloth applied in a ratio of 1:3, and the layup closed out with a non-perforated release film and a disposable nylon vacuum bag. Leak tests are then performed to insure proper bag closeout.
- g. The skins are autoclaved cured using the following cure cycle listed below:
 1. Apply full vacuum
 2. Heat at 225 F; add 85 psi pressure
 3. Continue heating to 350 F
 4. Cure at 350 F for 30 minutes
 5. Cool below 150 F before releasing pressure.
- h. Upon removal of the component from the bag, it will be exposed and checked for conformity to previously determined dimensions and aerodynamic smoothness requirements; and discrepancy will be recorded.
- i. The component was not trimmed to final dimensions and fiber volume, resin content, voids and density determinations made.

ACCEM-0 INPUT CHECKLIST

CARD 1

ESTIMATOR NAME

1 J.A. LORENZANA

ESTIMATE NUMBER

21 NAD-3901-B

PART NAME

41 T.E. FLAP SKINS

PART NUMBER

81 390-15

CARD 2

INPUT FORMS
ACCEM-1

LAYUP

QUANTITY USED

0.1

ACCEM-2

HONEYCOMB CORE PREPARATION

3 0.0

ACCEM-3

PART CONSOLIDATION

0.1

ACCEM-4

FINISHING OPERATIONS

0.1

ACCEM-5

COST PROJECTION

0.2

CARD 1	PART NAME	PART NUMBER	QTY														
	TE. FLAP SKINS	550-15	600														
CARD 2	TRIM ALLOWANCE	IN															
	LAYOUT TOOL SAME AS CAVING TOOL (CIRCLE ONE)	YES ☒	NO ☐														
	DERULPING	NUMBER OF OCCURRENCES															
	TYPE OF BAG (CIRCLE ONE)	DISPOSABLE ☒	REUSABLE ☐														
CARD 3	<table border="1"> <thead> <tr> <th rowspan="2">COST (\$/LB)</th> <th colspan="2">GRAPHITE</th> <th colspan="2">FIBERGLASS</th> </tr> <tr> <th>TAPE</th> <th>WOVE</th> <th>TAPE</th> <th>WOVE</th> </tr> </thead> <tbody> <tr> <td>DENSITY (LBS/CU IN)</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>			COST (\$/LB)	GRAPHITE		FIBERGLASS		TAPE	WOVE	TAPE	WOVE	DENSITY (LBS/CU IN)				
	COST (\$/LB)	GRAPHITE			FIBERGLASS												
TAPE		WOVE	TAPE	WOVE													
DENSITY (LBS/CU IN)																	

KEYPUNCH CARD 4 AND CARD 5 ALTERNATELY

[illegible]

LAST ENTRY ON CARD 4 IS "9999"; LAST ENTRY ON CARD 5 IS "000"

1955:10

- MANUFG. METHOD: 1 = PREPLY, 2 = DIRECT-ON-TOOL
 LAYUP METHOD: 1 = MANUAL, 2 = HAND-ASSIST, 4 = CONRAC AUTOMATIC (720 IPM), 5 = CONRAC AUTOMATIC (360 IPM)
 DEPOSITION TECHNIQUE: 1 = PLY-ON-PLY, 2 = PLY-ON-MYLAR
 TYPE OF BOND: 1 = STRAIGHT, SHARP, MALE; 2 = STRAIGHT, SHARP, FEMALE; 3 = STRAIGHT, RABIAL MALE;
 4 = STRAIGHT, RABIAL, FEMALE; 5 = CURVED, NOTCH FLANGE (TAP); 6 = CURVED, SHRINK FLANGE (TAP);
 7 = CURVED (NOVEN MATERIAL)
 MATERIAL FORM: 1 = UNIDIRECTIONAL TAPE, 2 = NOVEN
 MATERIAL TYPE: 1 = GRAPHITE/EPXY, 2 = FIBERGLASS/EPXY
- 102

ACCEM-3 PART CONSOLIDATION

CARD 1
 CYCLE NUMBER 1
 PART NAME T.E. FLAP SKIN PART NUMBER 350-15 QUANTITY 0.02

COMPONENT DETAIL PARTS
 NUMBER OF LINES USED 1 (MAXIMUM 10)

CARD 2
 PART NAME T.E. FLAP SKIN PART NUMBER 350-15 QUANTITY 0.01

CARD 3
 CONSOLIDATION OF DETAILS
 ADHESIVE (CIRCLE ONE)

NO: 0 YES: 1
 APPLICATION AREA: SQ. IN.

ADDITIONAL OPERATIONS
 (CIRCLE IF APPLICABLE)

BONDING: 1 SPLICING: 2

CURING PROCESS

VACUUM BAGGING

TYPE OF BAG: (CIRCLE ONE)

DISPOSABLE: 0

REUSABLE: 2

RESIN BLEED: (CIRCLE ONE)

NO: 0

YES: 1

PLY-TO-BLEEDER RATIO: 3

-TO-1

BAGGING AREA:

2400 SQ. IN.

SEALING/CLAMPING PERIMETER:

2.54 IN.

THERMAL EXPANSION MOLDING

EXTERNAL MOLD CAGE DIMENSIONS:

LENGTH: 41 IN.

WIDTH: 31 IN.

DEPTH: 31 IN.

CURING TOOL: (CIRCLE ONE)

AUTOCLAVE: 0

OVEN: 2

HEATING ELEMENT: 3

ACCEM-4 FINISHING OPERATIONS

	PART NAME	PART NUMBER	QTY
CAND 1	T.B. FLAP SKINS	20 21 50-15	40 41 42 100
		PART AREA	SQ. IN.

CARD 2 (OMIT IF LEFT BLANK)
NET TRIM OPERATIONS

[illegible]

CARD 3

CARD 4 (OMIT IF LEFT BLANK)
HOLE OPERATIONS

OPERATION	QTY.	HOLE DIAMETER (IN.)	HOLE DEPTH (IN.)	INSTRUMENT EQUIPMENT
DRILLING	1	1/2"	1"	1"
	2	1/2"	1"	1"
	3	1/2"	1"	1"
	4	1/2"	1"	1"
	5	1/2"	1"	1"
	6	1/2"	1"	1"
	7	1/2"	1"	1"
	8	1/2"	1"	1"
	9	1/2"	1"	1"
	10	1/2"	1"	1"

CARD 5

LEGEND

```

OPERATION:  1 = HAND ROUTING
              2 = MACHINE ROUTING
              3 = HAND SAWING
              4 = MACHINE SAWING
              5 = HAND SANDING
              6 = PORTABLE TOOL SANDING
              7 = MACHINE SANDING

FIXTURE:    0 = NO,
              1 = YES

TEMPLATE:   0 = NO
              1 = YES

```

LEGEND

```

OPERATION:      1 = DRILLING
                  2 = COUNTERBORING
                  3 = REAMING
                  4 = COUNTERSINKING
                  5 = HOLE SAWING
                  6 = HOLE PUNCHING

FIXTURE:        0 = NO
                  1 = EXTERNAL
                  2 = INTERNAL

TEMPLATE:       0 = NO
                  1 = YES

INSERTS:        0 = NO
                  1 = YES

```

ACCEM-5 COST PROJECTION

CARD 1

UNIT NUMBER, 01000
AVE. LOT SIZE 20

TYPE OF ESTIMATE

UNIT COST
CUMULATIVE AVERAGE COST
CUMULATIVE TOTAL COST

COL. 21 NO 0 YES D (CIRCLE ONE)
COL. 22 NO 0 YES D (CIRCLE ONE)
COL. 23 NO 0 YES D (CIRCLE ONE)

CARD 2

FACTORY LABOR PROJECTION FACTORS

LEARNING CURVE: LOG-LINEAR UNIT 0 CUM. AVE. 1 (CIRCLE ONE)

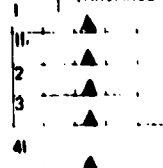
DATA INPUT OPTIONS (CIRCLE ONE) COL. 1

NONE 0
ITEM (a) - (d) 1
ITEM (e) 2

- (a) LAYUP
- (b) CORE PREPARATION
- (c) PART CONSOLIDATION
- (d) FINISHING OPERATIONS
- (e) TOTAL FACTORY LABOR

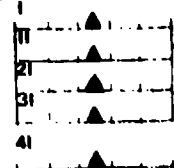
CARD 3

T VARIANCE



CARD 4

LEARNING CURVE SLOPE



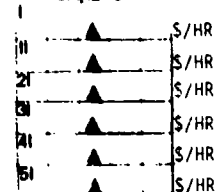
DATA INPUT OPTIONS (CIRCLE ONE) 2

NONE 0
ITEMS (a) - (f) 1

LABOR RATES

- (a) FACTORY LABOR
- (b) QUALITY CONTROL
- (c) TOOLING
- (d) MFG. ENG.
- (e) ENGINEERING
- (f) GRAPHIC SERVICES

CARD 5



DATA INPUT OPTIONS (CIRCLE ONE) 3

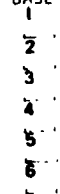
NONE 0
CARDS (6) - (8) 1
CARD (9) 2

SUPPORT FUNCTIONS

- QUALITY CONTROL
- TOOLING
- MFG. ENG.
- ENGINEERING
- GRAPHIC SERVICES
- SUPPORT MATERIAL

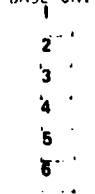
CARD 6

BASE



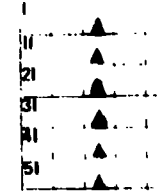
CARD 7

BASE UNIT



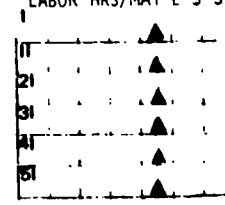
CARD 8

FACTOR



CARD 9

LABOR HRS/MAT'L S'S



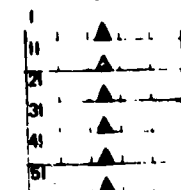
DATA INPUT OPTIONS (CIRCLE ONE) 4

NONE 0
ITEMS (a) - (f), (1), (2), (3) 1
ITEMS (1), (2), (3) 2

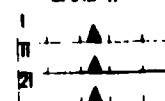
OVERHEAD RATES

- (a) FACTORY FABRICATION
- (b) QUALITY CONTROL
- (c) TOOLING
- (d) MFG. ENG.
- (e) ENGINEERING
- (f) GRAPHIC SERVICES
- (1) TOTAL LABOR
- (2) MATERIAL
- (3) ADMINISTRATIVE

CARD 10



CARD 11



ACCEM-5 COST PROJECTION

CARD 1

UNIT NUMBER 01000
AVE. LOT SIZE 20

TYPE OF ESTIMATE

UNIT COST	COL. 21	NO <u>0</u>	YES <u>1</u> (CIRCLE ONE)
CUMULATIVE AVERAGE COST	COL. 22	NO <u>0</u>	YES <u>1</u> (CIRCLE ONE)
CUMULATIVE TOTAL COST	COL. 23	NO <u>0</u>	YES <u>1</u> (CIRCLE ONE)

CARD 2

FACTORY LABOR PROJECTION FACTORS

LEARNING CURVE: LOG-LINEAR UNIT 0 CUM. AVE. 1 (CIRCLE ONE)

DATA INPUT OPTIONS (CIRCLE ONE)

NONE
ITEM (a) - (d)
ITEM (e)

1

- (a) LAYUP
- (b) CORE PREPARATION
- (c) PART CONSOLIDATION
- (d) FINISHING OPERATIONS
- (e) TOTAL FACTORY LABOR

DATA INPUT OPTIONS (CIRCLE ONE)

NONE
ITEMS (a) - (f)

1

LABOR RATES

- (a) FACTORY LABOR
- (b) QUALITY CONTROL
- (c) TOOLING
- (d) MFG. ENG.
- (e) ENGINEERING
- (f) GRAPHIC SERVICES

DATA INPUT OPTIONS (CIRCLE ONE)

NONE
CARDS (6) - (8)
CARD (9)

1

SUPPORT FUNCTIONS

- QUALITY CONTROL
- TOOLING
- MFG. ENG.
- ENGINEERING
- GRAPHIC SERVICES
- SUPPORT MATERIAL

CARD 6

BASE
1
2
3
4
5
6

CARD 7

BASE UNIT
1
2
3
4
5
6

CARD 8

FACTOR

1
2
3
4
5
6

CARD 9

LABOR HRS/MAT'L \$'S

15
12.5
1.25
5
27

LEGEND

BASE: 1 = FACTORY FABRICATION, 2 = QUALITY CONTROL, 3 = TOOLING,
4 = MFG. ENG. 5 = ENGINEERING, 6 = GRAPHIC SERVICES, 7 = PRODUCTION MAT'L

BASE UNIT: 1 = HOURS, 2 = DOLLARS

DATA INPUT OPTIONS (CIRCLE ONE)

NONE
ITEMS (a) - (f), (2), (3)
ITEMS (1), (2), (3)

1

OVERHEAD RATES

- (a) FACTORY FABRICATION
- (b) QUALITY CONTROL
- (c) TOOLING
- (d) MFG. ENG.
- (e) ENGINEERING
- (f) GRAPHIC SERVICES
- (1) TOTAL LABOR
- (2) MATERIAL
- (3) ADMINISTRATIVE

CARD 10

1
2
3
4
5
6

CARD 11

1.75
2.5
1.0

ADVANCED COMPOSITE COST ESTIMATE

ESTIMATOR: J.A. LORENZANA

DATE: 04/23/76

ESTIMATE NUMBER: NAD-3901-5

PART NAME: T.E. FLAP SKINS

PART NUMBER: 350-15

INPUT FORMS

QUANTITY

1 0 1 1 2

LAYUP
MCNEYCME COKE OPERATION
PART CONSOLIDATION
FINISHING OPERATIONS
COST PROJECTIONS

LAYUP

PART NAME: T.E. FLAP SKINS
 PART NUMBER: 35U-15
 LAYUP TOOL = CURING TOOL

QTY: 2

TRIM ALLOWANCE: 1.00

MATERIAL DATA

DENSITY	COST
0.000400	87.00
0.000400	87.00
0.000880	93.00
0.000540	8.70
0.000540	8.70
0.001040	9.30

GRAPHITE--3" TAPE
 GRAPHITE--12" TAPE
 GRAPHITE--WOVEN
 FIBERGLASS--3" TAPE
 FIBERGLASS--12" TAPE
 FIBERGLASS--WOVEN

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PLY DESCRIPTION

BEND DATA										RECT		NON-RECT		MATL		
LD	#P	LH	DT	TB	LENGTH	CR	FW	CRJ	CT	LENGTH	WIDTH	AREA	DIST	F	T	WD
2	0	1	2	0	0.0	0.0	0.0	45	2	68.00	49.00	0.0	0.0	1	1	12.
2	0	1	2	0	0.0	0.0	0.0	0	1	68.00	22.00	0.0	0.0	1	1	12.
2	0	1	2	0	0.0	0.0	0.0	90	1	68.00	43.00	0.0	0.0	1	1	12.
2	0	1	2	0	0.0	0.0	0.0	0	1	68.00	49.00	0.0	0.0	1	1	12.
2	0	1	2	0	0.0	0.0	0.0	0	1	49.00	28.00	0.0	0.0	1	1	12.
2	0	1	2	0	0.0	0.0	0.0	0	1	32.50	22.50	0.0	0.0	1	1	12.
2	0	1	2	0	0.0	0.0	0.0	45	2	68.00	33.00	0.0	0.0	1	1	12.
2	0	1	2	0	0.0	0.0	0.0	0	1	40.50	25.00	0.0	0.0	1	1	12.
2	0	1	2	0	0.0	0.0	0.0	0	1	68.00	35.00	0.0	0.0	1	1	12.
2	0	1	2	0	0.0	0.0	0.0	0	1	68.00	49.00	0.0	0.0	1	1	12.
2	0	1	2	0	0.0	0.0	0.0	90	1	68.00	30.00	0.0	0.0	1	1	12.
2	0	1	2	0	0.0	0.0	0.0	45	2	68.00	29.00	0.0	0.0	1	1	12.

FACTORY STANDARD HOURS	LAYUP -----	SET-UP -----	RUN -----	PERCENT SCRAP -----
CLEAN LAYUP TOOL	0.0	0.050		
APPLY RELEASE AGENT	0.0	0.076		
POSITION MYLAR	0.0	1.425		
PLY DEPOSITION	0.050	5.157		
TRANS TO LAYUP TOOL	0.0	0.879		
SUBTOTAL	0.050	7.587		
TOTAL LAYUP	0.050 *****	7.587 *****		
BEND FACTOR HOURS		0.0		
MATERIAL -----	USAGE (SQ.IN.)	SCRAP (SQ.IN.)		
GRAPHITE--12" TAPE	83503.12	16071.64		23.83
	WEIGHT -----	COST -----		
GRAPHITE--12" TAPE	26.97	2346.61		

PART CONSOLIDATION

CYCLE NO.: 1
PART NAME: T.E. FLAP SKINS
PART NUMBER: 350-15 QTY: 2

COMPONENT DETAIL PARTS

PART NAME	PART NO.	QTY
-----------	----------	-----

T.E. FLAP SKINS	350-15	1
-----------------	--------	---

VACUUM BAGGING: DISPOSABLE
RESIN BLEED PLYS-TO-BLEEDER RATIO: 3.0
BAGGING AREA: 3400.00

CURING TOOL: AUTOCLAVE

SEALING/CLAMPING PERIMETER: 234.00

PART CONSOLIDATION

<u>FACTORY STANDARD HOURS</u>	<u>SET-UP</u>	<u>RUN</u>
SET UP	0.070	
BEFORE CURE		
APPLY POROUS FILM		0.061
APPLY BLEEDER PLIES		1.113
APPLY NONPOROUS FILM		0.061
APPLY VENT CLOTH		0.136
INSTALL VACUUM FTGS		0.025
INSTALL THERMOPLS		0.065
APPLY SEAL STRIPS		0.075
APPLY DISPOSABLE BAG		0.041
SEAL EDGES		0.253
CONNECT VACUUM LINES		0.012
SMOOTH BAG DOWN		0.041
CHECK SEALS		0.080
REMOVE VACUUM LINE		0.006
CHECK CHAMBER INT.		0.060
LOAD LAYUP IN AUTO.		0.118
CONNECT VACUUM LINES		0.024
CONNECT T.C. LEADS		0.037
CHECK FOR LEAKS		0.202
CLOSE DOOR		0.038
DURING CURE		
SET RECORDERS		0.028
CYCLE CHECK		0.160
SHUT DOWN		0.007
REMOVE CHARTS		0.007
AFTER CURE		
OPEN DOOR		0.038
RELEASE T.C. LEADS		0.014
RELEASE VAC. LINES		0.012
REMOVE PART FR AUTO.		0.092
REMOVE DISP. BAG		0.020
REMOVE THERMOUPLS		0.038
REMOVE VACUUM FTGS		0.012
REMOVE PROCESS MATL		0.224
REMOVE LAYUP & ASIDE		0.041
CLEAN TOOL		0.041
TOTAL HOURS	0.070	3.183
	*****	*****

FINISHING

PART NAME: T.E. FLAP SKINS
 PART NUMBER: 350-15
 PERIMETER: 234.00

QTY: 2
 PART AREA: 3400.00

NET TRIM OPERATIONS

<u>MATERIAL(IN.)</u>				
<u>CODE</u>	<u>AVE. THICK.</u>	<u>TRIM LENGTH</u>	<u>FIXT.</u>	<u>TEMP.</u>
6	0.05	234.00	0	0
2	0.05	234.00	0	0

FINISHING

<u>FACTORY STANDARD HOURS</u>	<u>SET-UP</u>	<u>RUN</u>
NET TRIM OPERATIONS		
MACHINE ROUTING	0.200	0.702
HANDLING		0.068
SUBTOTAL		0.770
PORT. TOOL SANDING	0.020	0.028
HANDLING		0.068
SUBTOTAL		0.096
HOLE OPERATIONS		
TOTAL HOURS	0.220	0.866
	*****	*****

TOTAL FACTORY LABOR STANDARD HOURS

<u>FACTORY STANDARD HOURS</u>	<u>SET-UP</u>	<u>RUN</u>
LAYUP	0.050	7.587
HONEYCOMB CORE PREP	0.0	0.0
PART CONSOLIDATION	0.070	3.183
FINISHING OPERATIONS	0.220	0.866
TOTAL HOURS	0.340	11.636
	*****	*****

COST PROJECTION

PRODUCTION COST ESTIMATE AT UNIT NO.: 1000
 AVERAGE LOT SIZE: 20.
 LINEAR UNIT CURVE

PROJECTION FACTORS	T1.VAR	CURVE SLOPE
LAYUP	23.24	76.63 %
HONEYCOMB CORE PREP	16.63	0.0 %
PART CONSOLIDATION	25.06	76.52 %
FINISHING OPERATIONS	23.84	76.77 %

LABOR RATES	\$/HR
FACTORY LABOR	10.00
QUALITY CONTROL	10.00
TOOLING	10.00
MFG ENGINEERING	10.00
ENGINEERING	10.00
GRAPHIC SERVICES	10.00

SUPPORT FUNCTIONS	BASE	FACTORS
QUALITY CONTROL	1 1	1.41
TOOLING	1 1	4.22
MFG ENGINEERING	1 1	2.55
ENGINEERING	1 1	1.64
GRAPHIC SERVICES	1 1	0.40
SUPPORT MATERIAL	7 2	0.30

OVERHEAD RATES	
FACTORY LABOR	1.500
QUALITY CONTROL	1.500
TOOLING	1.500
MFG ENGINEERING	1.500
ENGINEERING	1.700
GRAPHIC SERVICES	1.700
MATERIAL	0.200
ADMINISTRATIVE	0.150

COST PROJECTION

UNIT COST ESTIMATE AT T 1000

<u>COST ELEMENT</u>	<u>STD. MRS</u>	<u>T 1000 MRS</u>	<u>DOLLARS</u>
FACTORY LABOR			
LAYUP	7.99	12.43	124.28
HONEYCOMB CORE PREP	0.0	0.0	0.0
PART CONSOLIDATION	3.19	5.99	59.46
FINISHING OPERATIONS	0.88	1.90	19.00
TOTAL FACTORY LABOR	11.65	19.47	194.74
SUPPORT LABORS			
QUALITY CONTROL		1.42	14.23
TOOLING		0.68	6.77
MFG ENGINEERING		1.04	10.36
ENGINEERING		0.53	5.28
GRAPHIC SERVICES		0.24	2.36
TOTAL SUPPORT LABOR			39.00
LABOR OVERHEAD			
FACTORY LABOR			292.11
QUALITY CONTROL			21.34
TOOLING			10.16
MFG ENGINEERING			15.54
ENGINEERING			8.98
GRAPHIC SERVICES			4.01
TOTAL OVERHEAD			352.14
TOTAL LABOR			545.88
MATERIAL			
PRODUCTION MATERIAL			2346.61
SUPPORT MATERIAL			703.98
MFG. ALLOWANCE			563.19
OVERHEAD			722.76
TOTAL MATERIAL			4336.54
ADMINISTRATIVE OVERHEAD			738.36
TOTAL COST			5460.78

	<u>WEIGHT</u>
LAYUP	26.97
HONEYCOMB CORE PREP	0.0
TOTAL	26.97

COST PROJECTION

CUMULATIVE AVERAGE COST ESTIMATE AT T 1000

<u>COST ELEMENT</u>	<u>STD. HRS</u>	<u>T 1000 HRS</u>	<u>DOLLARS</u>
FACTORY LABOR			201.33
LAYUP	7.59	20.13	0.0
HONEYCOMB CORE PREP	0.0	0.0	90.12
PART CONSOLIDATION	3.19	9.01	24.21
FINISHING OPERATIONS	0.88	2.42	315.66
TOTAL FACTORY LABOR	11.65	31.57	
SUPPORT LABORS		3.48	34.77
QUALITY CONTROL		2.66	26.63
TOOLING		4.14	41.42
MFG ENGINEERING		1.82	18.16
ENGINEERING		0.53	5.26
GRAPHIC SERVICES			126.24
TOTAL SUPPORT LABOR			
LABOR OVERHEAD			473.49
FACTORY LABOR			52.15
QUALITY CONTROL			39.94
TOOLING			62.13
MFG ENGINEERING			30.87
ENGINEERING			8.94
GRAPHIC SERVICES			667.53
TOTAL OVERHEAD			
			1109.43
TOTAL LABOR			
MATERIAL			2346.61
PRODUCTION MATERIAL			703.98
SUPPORT MATERIAL			565.61
MFG. ALLOWANCE			723.24
OVERHEAD			4339.44
TOTAL MATERIAL			
			817.33
ADMINISTRATIVE OVERHEAD			
			6266.20
TOTAL COST			*****

	<u>WGT</u>
LAYUP	26.97
HONEYCOMB CORE PREP	0.0
TOTAL	26.97

COST PROJECTION

CUMULATIVE COST ESTIMATE AT T 1000

COST ELEMENT	STD. HRS	T 1000 HRS	DOLLARS
FACTORY LABOR			
LAYUP	7.59	20133.43	201334.25
MONEYCOMB CORE PREP	0.0	0.0	0.0
PART CONSOLIDATION	3.14	9012.01	90120.06
FINISHING OPERATIONS	0.88	2420.93	24209.29
TOTAL FACTORY LABOR	11.65	31566.36	315663.56
SUPPORT LABORS			
QUALITY CONTROL		3476.96	34769.57
TOOLING		2662.67	26626.65
MFG ENGINEERING		4142.32	41423.16
ENGINEERING		1816.12	18161.23
GRAPHIC SERVICES		525.65	5256.50
TOTAL SUPPORT LABOR			126237.00
LABOR OVERHEAD			
FACTORY LABOR			473495.31
QUALITY CONTROL			52154.36
TOOLING			39939.98
MFG ENGINEERING			62134.75
ENGINEERING			30874.04
GRAPHIC SERVICES			8936.04
TOTAL OVERHEAD			667534.31
TOTAL LABOR			1109434.00
MATERIAL			
PRODUCTION MATERIAL			2346613.00
SUPPORT MATERIAL			703983.87
MFG. ALLOWANCE			6872.56
OVERHEAD			611493.56
TOTAL MATERIAL			3668961.00
ADMINISTRATIVE OVERHEAD			716759.12
TOTAL COST			5495154.00

	WEIGHT
LAYUP	26972.56
MONEYCOMB CORE PREP	0.0
TOTAL	26972.56

COST PROJECTION

PRODUCTION COST ESTIMATE AT UNIT NO.: 1000
 AVERAGE LOT SIZE: 20.
 LINEAR CUMULATIVE AVERAGE CURVE

<u>PROJECTION FACTORS</u>	<u>TL VAR</u>	<u>CURVE SLOPE</u>
TOTAL FACTORY LABOR	21.25	78.50 %

<u>LABOR RATES</u>	<u>\$/HR</u>
--------------------	--------------

FACTORY LABOR	12.00
QUALITY CONTROL	12.00
TOOLING	12.00
MFG ENGINEERING	12.00
ENGINEERING	12.00
GRAPHIC SERVICES	12.00

<u>SUPPORT FUNCTIONS</u>	<u>DOLLARS</u>
QUALITY CONTROL	15.00
TOOLING	12.50
MFG ENGINEERING	1.25
ENGINEERING	5.00
GRAPHIC SERVICES	0.05
SUPPORT MATERIAL	27.00

<u>OVERHEAD RATES</u>	
TOTAL LABOR	1.750
MATERIAL	0.250
ADMINISTRATIVE	0.100

COST PROJECTION

UNIT COST ESTIMATE AT T 1000

<u>COST ELEMENT</u>	<u>STD. MRS</u>	<u>T 1000 MRS</u>	<u>DOLLARS</u>
FACTORY LABOR			
TOTAL FACTORY LABOR	11.65	14.45	173.34
SUPPORT LABORS			
QUALITY CONTROL			180.00
TOOLING			150.00
MFG ENGINEERING			15.00
ENGINEERING			60.00
GRAPHIC SERVICES			0.60
TOTAL SUPPORT LABOR			405.60
LABOR OVERHEAD			
TOTAL OVERHEAD			1013.15
TOTAL LABOR			1592.09
MATERIAL			
PRODUCTION MATERIAL			2346.61
SUPPORT MATERIAL			27.00
MFG. ALLOWANCE			6872.56
OVERHEAD			2311.54
TOTAL MATERIAL			11557.71
ADMINISTRATIVE OVERHEAD			
TOTAL COST			1314.98
			14464.79

	<u>WEIGHT</u>
LAYUP	26.97
HONEYCOMB CORE PREP	0.0
TOTAL	26.97

COST PROJECTION

CUMULATIVE AVERAGE COST ESTIMATE AT T 1000

<u>COST ELEMENT</u>	<u>STD. MRS</u>	<u>T 1000 MRS</u>	<u>DOLLARS</u>
FACTORY LABOR			
TOTAL FACTORY LABOR	11.65	22.19	266.23
SUPPORT LABORS			
QUALITY CONTROL			180.00
TOOLING			150.00
MFG ENGINEERING			15.00
ENGINEERING			60.00
GRAPHIC SERVICES			0.60
TOTAL SUPPORT LABOR			405.60
LABOR OVERHEAD			
TOTAL OVERHEAD			1175.70
TOTAL LABOR			1847.53
MATERIAL			
PRODUCTION MATERIAL			2346.61
SUPPORT MATERIAL			27.00
MFG. ALLOWANCE			6872.56
OVERHEAD			2311.54
TOTAL MATERIAL			11557.71
ADMINISTRATIVE OVERHEAD			
TOTAL COST			1340.52
			14745.77

	<u>WEIGHT</u>
LAYUP	26.97
MONEYCOMB CURE PREP	0.0
TOTAL	26.97

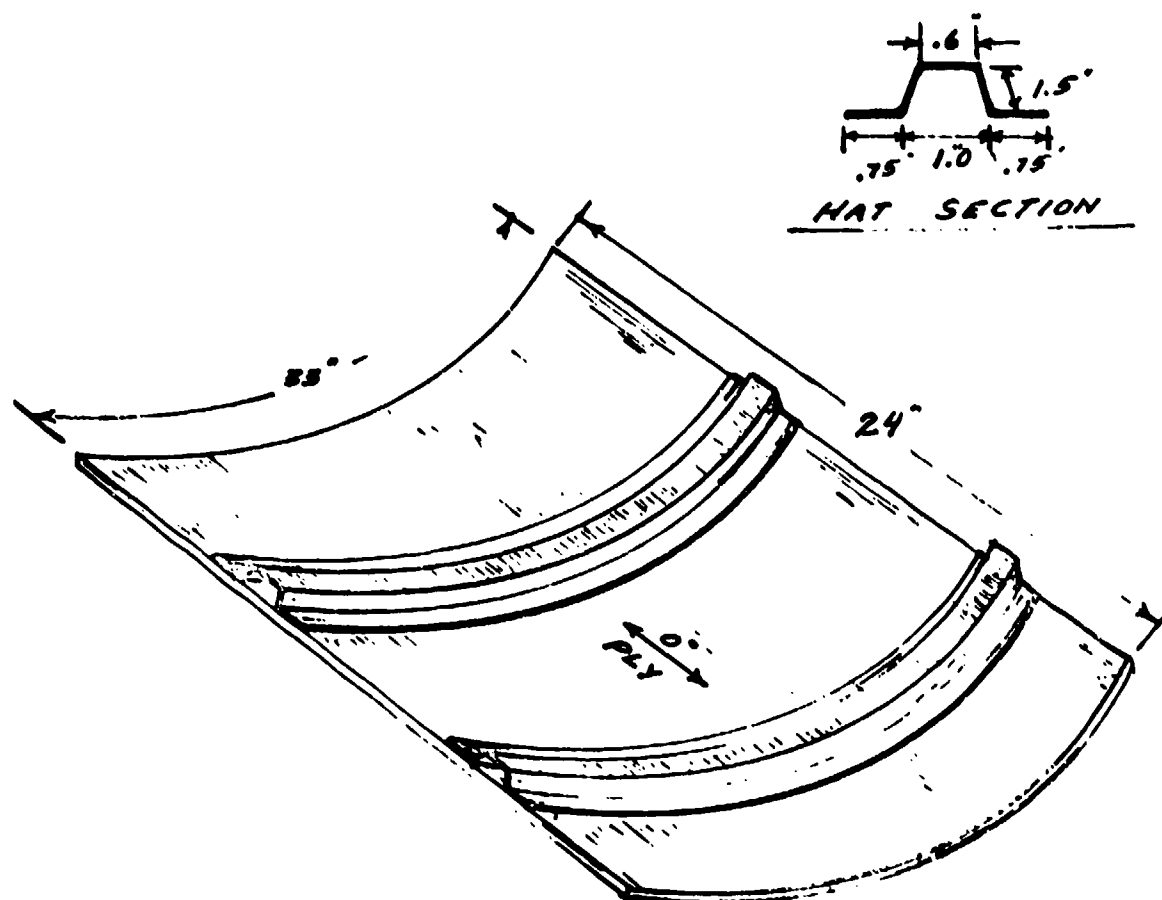
COST PROJECTION

CUMULATIVE COST ESTIMATE AT T 1000

<u>COST ELEMENT</u>	<u>STD. HRS</u>	<u>T 1000 HRS</u>	<u>DOLLARS</u>
FACTORY LABOR			
TOTAL FACTORY LABOR	11.65	22185.90	266230.81
SUPPORT LABORS			
QUALITY CONTROL			180.00
TOOLING			150.00
MFG ENGINEERING			15.00
ENGINEERING			60.00
GRAPHIC SERVICES			0.60
TOTAL SUPPORT LABOR			405.60
LABOR OVERHEAD			
TOTAL OVERHEAD			466613.62
TOTAL LABOR			733250.00
MATERIAL			
PRODUCTION MATERIAL			2346613.00
SUPPORT MATERIAL			27.00
MFG. ALLOW NCE			6872.56
OVERHEAD			588378.00
TOTAL M. LAL			2941890.00
ADMINISTRATIVE OVERHEAD			
TOTAL COST			367514.06
			4042654.00

	<u>WEIGHT</u>
LAYUP	26972.56
HONEYCOMB CORE PREP	0.0
TOTAL	26972.56

HAT STIFFENED PANEL ASSEMBLY



MANUFACTURING PLAN

1. The following list of details makes up the hat stiffened lower panel assembly.
 - a. Composite lower skin
 - b. Composite hat stiffener (2 required)
2. Materials
 - a. Thornel 300/SP28E graphite/epoxy per NA1-1332
 - b. Narmco 3203 fiberglass/epoxy

3. Layup and Cocure of Skin and Precured Hat Stiffeners

- a. The composite skin is composed of 6 ply (0 GR/90 GR/+45 GL)_S layed up in the flat with the outer skin being draped into the release coated (Fre - Kote 33) female lower panel cocuring tool.
- b. The No. 2 composite ply shall be draped and formed over the No. 1 composite ply (ply-on-ply), this sequence shall continue until the build-up of all plies is completed.
- c. The layed up composite skin shall be set aside for subsequent cocuring operations.
- d. The No. 1 fiberglass ply of ($\pm 45_{GL}$)_S is layed up on the rubber curing tool utilized in thermal expansion molds. This procedure continues until the build-up of all plies is completed. The layup is then transferred to the elastomeric mold cage.
- e. The encaged stiffener is subsequently placed in an oven for curing.
- f. Upon removal of the component from the mold it shall be checked for conformity to previously determined dimensions.
- g. The precured composite stiffener shall be positioned on the previously layed up skin assembly and resin tacked in place. No structural adhesive is required between the composite stiffeners and composite skin as resin bonding is accomplished during the cocuring operation.
- h. Apply a layer of non-porous armalon over the entire layup and drape to shape of component.
- i. Apply two layers of Osnaburg breather cloth over the layup and drape to shape of component.
- j. The component shall be vacuum bagged using a reusable rubber vacuum bag and cocured at vacuum bag pressure (15 psi) only, in a oven with a cure temperature of 300 F for two hours as monitored by thermocouple.

- h. Upon removal of the component from the bag, it will be exposed and check for conformity to previously determined dimensions and aerodynamic smoothness; any discrepancy will be recorded.
- l. The component shall be delivered to Quality Control for NDT. All detectable voids shall be mapped and retained as part of inspection record.
- m. The component shall be net trimmed to final dimensions and set aside for subsequent assembly operations.

ACCEM-0 INPUT CHECKLIST

CARD 1

ESTIMATOR NAME	¹ A.H. KOKAWA
ESTIMATE NUMBER	²¹ CA 1976-9
PART NAME	⁴¹ HAT STIFF. PANEL
PART NUMBER	⁶¹ 15-42937-61

CARD 2	INPUT FORMS		QUANTITY USED
	ACCEM-1	LAYUP	¹ 0.2
	ACCEM-2	HONEYCOMB CORE PREPARATION	³ 0.0
	ACCEM-3	PART CONSOLIDATION	⁵ 0.2
	ACCEM-4	FINISHING OPERATIONS	⁷ 0.1
	ACCEM-5	COST PROJECTION	⁹ 0.2

ACCEM-1 LAYUP

CARD 1 PART NAME STIFFENER PART NUMBER 2-65 QTY 002

TRIM ALLOWANCE 0.5 IN

LAYUP TOOL SAME AS CURING TOOL (CIRCLE ONE) YES 01 NO 02

DEBULKING NUMBER OF OCCURRENCES 04

TYPE OF BAG (CIRCLE ONE) DISPOSABLE 01 REUSABLE 02

CARD 2 (BLANK)

CARD 3 COST (\$/LB) DENSITY (LB/SQ. IN.)

GRAPHITE TAPE MOVEN

FIBERGLASS TAPE MOVEN

KEYPUNCH CARD 4 AND CARD 5 ALTERNATELY

CARD 4				CARD 5							
BEND DESCRIPTION				PLY DESCRIPTION							
METHOD	QUANTITY OF PLYS	BEND LENGTH (IN.)	RADIUS OF CURVATURE	FLANGE WIDTH (IN.)	ORIENTATION (DEG.)	DIMENSIONS				MATERIAL	
						RECTANGULAR		NONRECTANGULAR			
						LENGTH (IN.)	WIDTH (IN.)	AREA (SQ. IN.)	DISTANCE (IN.)		
1	1	140	1	2	0	140	6	840	1	1	
2	1	140	1	2	0	140	6	840	1	1	
3	1	140	1	2	0	140	6	840	1	1	
4	1	140	1	2	0	140	6	840	1	1	
5	1	140	1	2	0	140	6	840	1	1	
6	1	140	1	2	0	140	6	840	1	1	
7	1	140	1	2	0	140	6	840	1	1	
8	1	140	1	2	0	140	6	840	1	1	
9	1	140	1	2	0	140	6	840	1	1	
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0	1	140</									

PART NAME	PART NUMBER	QTY
SKIN	-67	60
TRIM ALLOWANCE		IN.
LAYOUT TOOL SAME AS CURING TOOL (CIRCLE ONE)		YES ☒ NO ☐
DEBULGING	NUMBER OF OCCURRENCES	62
TYPE OF BAG (CIRCLE ONE)		DISPOSABLE ☒ REUSABLE ☐

CARD 2 (BLANK)

CARD 3

COST (\$/LB)
DENSITY (LB/SQ. IN.)

[illegible]

KEYPUNCH CARD 4 AND CARD 5 ALTERNATELY

CARD 4

CARD 1

[illegible]

LAST ENTRY ON CARD 4 IS "9999"; LAST ENTRY ON CARD 5 IS "000"

LEGEND:

HANDLING METHOD:

1 = PREPLY, 2 = DIRECT-ON-TOOL

LAYUP METHOD:

1 - MANUAL, 2 - HAND-ASSIST, 4 - CONRAC AUTOMATIC (720 IPM), 5 - CONRAC AUTOMATIC (360 IPM)

DEPOSITION TECHNIQUE:

1 = PLY-ON-PLY, 2 = PLY-ON-MYLAR

TYPE OF BEND:

1 = STRAIGHT, SHARP, MALE; 2 = STRAIGHT, SHARP, FEMALE; 3 = STRAIGHT, RADIAL MALE;
4 = STRAIGHT, RADIAL, FEMALE; 5 = CURVED, SHRINK FLANGE (TAPE); 6 = CURVED, STRAIGHT FLANGE (TAPE);
7 = CURVED (WOVEN MATERIAL)

MATERIAL FORM:

1 - UNIDIRECTIONAL TAPE, 2 - WOVEN

MATERIAL TYPE:

1 - GRAPHITE/EPOXY, 2 - FIBERGLASS/EPOXY

ACCEN-3 PART CONSOLIDATION

CARD 1
 CYCLE NUMBER 1
 PART NAME PRECURSED STIFF PART NUMBER -65 QUANTITY 0.02

COMPONENT DETAIL PARTS
 NUMBER OF LINES 2.1 (MAXIMUM 10)

CARD 2	PART NAME	PART NUMBER	QUANTITY
	<u>STIFFNESS</u>	<u>-65</u>	<u>0.01</u>

CARD 3
 CONSOLIDATION OF DETAILS
 ADHESIVE (CIRCLE ONE)

NO: 1 YES: 1
 APPLICATION AREA: 1 SQ. IN.

ADDITIONAL OPERATIONS
 (CIRCLE IF APPLICABLE)

BONDING: 1 SPLICING: 2

CURING PROCESS

VACUUM BAGGING

TYPE OF BAG: (CIRCLE ONE)
 RESIN BLEED: (CIRCLE ONE)

DISPOSABLE: 1 REUSABLE: 2
 NO: 1 YES: 1
 PLY-TO-BLEEDER RATIO: 1 -TO-1
 BAGGING AREA: 1 SQ. IN.
 SEALING/CLAMPING PERIMETER: 1 IN.

THERMAL EXPANSION MOLDING

EXTERNAL MOLD CAGE DIMENSIONS:

LENGTH: 70 IN.
 WIDTH: 12 IN.
 DEPTH: 12 IN.

CURING TOOL: (CIRCLE ONE)

AUTOCLAVE: 1
 OVEN: 2
 HEATING ELEMENT: 1

ACCEM-3 PART CONSOLIDATION

CYCLE NUMBER 2

CARD 1 PART NAME HAT STIFF. PANEL PART NUMBER 15-42937-61 QUANTITY 00.1

COMPONENT DETAIL PARTS
NUMBER OF LINES USED 02 (MAXIMUM 10)

CARD 2	PART NAME	PART NUMBER	QUANTITY
	<u>PRECURED STIFF</u>	<u>-65</u>	<u>00.2</u>
	<u>SKIN</u>	<u>-67</u>	<u>00.1</u>

CONSOLIDATION OF DETAILS
CARD 3 ADHESIVE (CIRCLE ONE)

NO: 0 YES: 1
APPLICATION AREA: _____ SQ. IN.

ADDITIONAL OPERATIONS
(CIRCLE IF APPLICABLE)

BONDING: 1 SPLICING: 2

CURING PROCESS

VACUUM BAGGING

TYPE OF BAG: (CIRCLE ONE)

RESIN BLEED: (CIRCLE ONE)

DISPOSABLE: 1 REUSABLE: 12
NO: 0 YES: 1

PLY-TO-BLEEDER RATIO: _____ -TO-1

BAGGING AREA:

SEALING/CLAMPING PERIMETER.

1980 SQ. IN.
186 IN.

THERMAL EXPANSION HOLDING

EXTERNAL MOLD CAGE DIMENSIONS:

LENGTH: 41 IN.
WIDTH: 51 IN.
DEPTH: 61 IN.

CURING TOOL: (CIRCLE ONE)

AUTOCLAVE: 71
OVEN: 1
HEATING ELEMENT: 3

ACCEM-4 FINISHING OPERATIONS

CARD 1 PART NAME HOT STIFF PANEL PART NUMBER 15-42937-61 QTY 20
 PART AREA 1198.0 SQ. IN.

CARD 2 (OMIT IF LEFT BLANK)
NET TRIM OPERATIONS

OPERATION	AVERAGE THICKNESS (IN.)	TRIM LENGTH (IN.)	TEMPLATE
1	1.50	62	18
2	1.50	62	00
3			
4			
5			
6			
7			
8			
9			
0			

CARD 3

LEGEND

OPERATION: 1 = HAND ROUTING
 2 = MACHINE ROUTING
 3 = HAND SAWING
 4 = MACHINE SAWING
 5 = HAND SANDING
 6 = PORTABLE TOOL SANDING
 7 = MACHINE SANDING
 FIXTURE: 0 = NO,
 1 = YES
 TEMPLATE: 0 = NO
 1 = YES

CARD 4 (OMIT IF LEFT BLANK)
HOLE OPERATIONS

OPERATION	QTY.	HOLE DIAMETER (IN.)	HOLE DEPTH (IN.)	INSERTS
1	1			
2				
3				
4				
5				
6				
7				
8				
9				
0				

CARD 5

LEGEND

OPERATION: 1 = DRILLING
 2 = COUNTERSINKING
 3 = COUNTERBORING
 4 = REAMING
 5 = HOLE SAWING
 6 = HOLE PUNCHING
 FIXTURE: 0 = NO
 1 = EXTERNAL
 2 = INTERNAL
 TEMPLATE: 0 = NO
 1 = YES
 INSERTS: 0 = NO
 1 = YES

ACCEN-5 COST PROJECTION

CARD 1

UNIT NUMBER 00500
AVE. LOT SIZE 30

TYPE OF ESTIMATE

UNIT COST

COL. 21 NO 0

YES (CIRCLE ONE)

CUMULATIVE AVERAGE COST

COL. 22 NO 0

YES (CIRCLE ONE)

CUMULATIVE TOTAL COST

COL. 23 NO 0

YES (CIRCLE ONE)

CARD 2

FACTORY LABOR PROJECTION FACTORS

LEARNING CURVE:

LOG-1 LINEAR UNIT (CIRCLE ONE)

CUM. AVE. 1 (CIRCLE ONE)

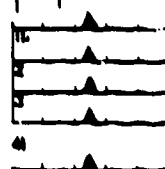
DATA INPUT OPTIONS (CIRCLE ONE)

ITEM (a) - (d)
ITEM (e)

- (a) LAYUP
- (b) CORE PREPARATION
- (c) PART CONSOLIDATION
- (d) FINISHING OPERATIONS
- (e) TOTAL FACTORY LABOR

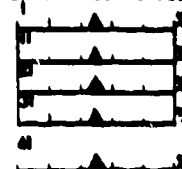
CARD 3

T₁ VARIANCE



CARD 4

LEARNING CURVE SLOPE



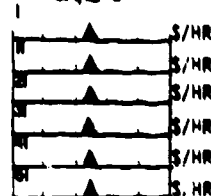
DATA INPUT OPTIONS (CIRCLE ONE)

ITEM (a) - (f)

LABOR RATES

- (a) FACTORY LABOR
- (b) QUALITY CONTROL
- (c) TOOLING
- (d) MFG. ENG.
- (e) ENGINEERING
- (f) GRAPHIC SERVICES

CARD 5



DATA INPUT OPTIONS (CIRCLE ONE)

ITEM (a) - (g)
CARD (g)

SUPPORT FUNCTIONS

CARD 6

CARD 7

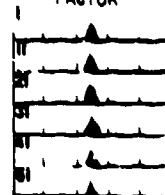
BASE

BASE UNIT

- QUALITY CONTROL
- TOOLING
- MFG. ENG.
- ENGINEERING
- GRAPHIC SERVICES
- SUPPORT MATERIAL

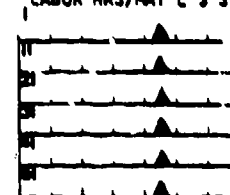
CARD 8

FACTOR



CARD 9

LABOR HRS/MAT'L S'S



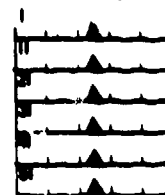
DATA INPUT OPTIONS (CIRCLE ONE)

ITEM (a) - (f), (2), (3)
ITEM (1), (2), (3)

OVERHEAD RATES

- (a) FACTORY FABRICATION
- (b) QUALITY CONTROL
- (c) TOOLING
- (d) MFG. ENG.
- (e) ENGINEERING
- (f) GRAPHIC SERVICES
- (1) TOTAL LABOR
- (2) MATERIAL
- (3) ADMINISTRATIVE

CARD 10



CARD 11



ACCEN-5 COST PROJECTION

CARD 1

UNIT NUMBER 00300
AVE. LOT SIZE 30

TYPE OF ESTIMATE

UNIT COST	COL. 21	NO <u>0</u>	YES <u>1</u> (CIRCLE ONE)
CUMULATIVE AVERAGE COST	COL. 22	NO <u>0</u>	YES <u>1</u> (CIRCLE ONE)
CUMULATIVE TOTAL COST	COL. 23	NO <u>0</u>	YES <u>1</u> (CIRCLE ONE)

CARD 2

FACTORY LABOR PROJECTION FACTORS

LEARNING CURVE: LOG-LINEAR UNIT 1 CUM. AVE. 1 (CIRCLE ONE)

DATA INPUT OPTIONS (CIRCLE ONE)

ITEM (a) - (d) 1
ITEM (e) 2

- (a) LAYUP
- (b) CORE PREPARATION
- (c) PART CONSOLIDATION
- (d) FINISHING OPERATIONS
- (e) TOTAL FACTORY LABOR

CARD 3

T VARIANCE
1 21 50
2 28 75
3 25
4 21
5

CARD 4

LEARNING CURVE SLOPE
1 78
2 85
3 80
4 78
5

DATA INPUT OPTIONS (CIRCLE ONE)

ITEM (a) - (f) 1

LABOR RATES

- (a) FACTORY LABOR
- (b) QUALITY CONTROL
- (c) TOOLING
- (d) MFG. ENG.
- (e) ENGINEERING
- (f) GRAPHIC SERVICES

CARD 5
1 7 50 \$/HR
2 6 00 \$/HR
3 6 00 \$/HR
4 6 00 \$/HR
5 12 00 \$/HR
6 9 00 \$/HR

DATA INPUT OPTIONS (CIRCLE ONE)

CARD (a) - (b) 1
CARD (c) 2

SUPPORT FUNCTIONS

- QUALITY CONTROL
- TOOLING
- MFG. ENG.
- ENGINEERING
- GRAPHIC SERVICES
- SUPPORT MATERIAL

CARD 6

BASE
1 1
2 1
3 3
4 1
5 1
6 1

CARD 7

BASE UNIT
1 1
2 1
3 1
4 1
5 1
6 1

CARD 8

FACTOR
1 1 5
2 1 5
3 5 0
4 2 0
5 1 0
6 3

CARD 9

LABOR HRS/MAT'L \$'S
1
2
3
4
5
6

LEGEND

BASE: 1 = FACTORY FABRICATION, 2 = QUALITY CONTROL, 3 = TOOLING, 4 = MFG. ENG., 5 = ENGINEERING, 6 = GRAPHIC SERVICES, 7 = PRODUCTION MAT'L

BASE UNIT: 1 = HOURS, 2 = DOLLARS

DATA INPUT OPTIONS (CIRCLE ONE)

ITEM (a) - (f), (2), (3) 1
ITEM (1), (2), (3) 2

OVERHEAD DATES

- (a) FACTORY FABRICATION
- (b) QUALITY CONTROL
- (c) TOOLING
- (d) MFG. ENG.
- (e) ENGINEERING
- (f) GRAPHIC SERVICES
- (1) TOTAL LABOR
- (2) MATERIAL
- (3) ADMINISTRATIVE

CARD 10
1 1 7
2 1 5
3 1 5
4 1 5
5 1 5
6 1 5
7 1 5

CARD 11

1
2 2 5
3 0 5

ADVANCED COMPOSITE COST ESTIMATE

ESTIMATOR: A.M. KOKANA DATE: 09/23/76

ESTIMATE NUMBER: CA1976-9

PART NAME: HAT STIFF. PANEL

PART NUMBER: 15-42937-61

INPUT FORMS

QUANTITY

LAYUP
HONEYCOMB CORE OPERATION
PART CONSOLIDATION
FINISHING OPERATIONS
COST PROJECTIONS

2
0
2
1
2

LAYUP

PART NAME: STIFFENER
 PART NUMBER: -65
 LAYUP TOOL = CURING TOOL

QTY: 2
 TRIM ALLOWANCE: 0.50

MATERIAL DATA

DENSITY	COST
0.000400	87.00
0.000400	87.00
0.000860	93.00
0.000540	8.70
0.000540	8.70
0.001040	9.30

GRAPHITE---3" TAPE
 GRAPHITE---12" TAPE
 GRAPHITE---WOVEN
 FIBERGLASS---3" TAPE
 FIBERGLASS---12" TAPE
 FIBERGLASS---WOVEN

PLY DESCRIPTION

RECT				NON-RECT		MATH		
CR1	CT	LENGTH	WIDTH	AREA	DIST	F	T	MD
45	4	60.00	6.00	0.0	0.0	1	2	3.

BEND DATA

LD #	P	LH	DT	TB	LENGTH	CR	FW
2	0	1	1	6	240.00	16.00	2.00

FACTORY STANDARD HOURS		LAYUP	SET-UP	RUN	
CLEAN LAYUP TOOL			0.0	0.005	
APPLY RELEASE AGENT			0.0	0.008	
PLY DEPOSITION			0.050	4.625	
SUBTOTAL			0.050	4.638	
TOTAL LAYUP			0.050	4.638	
			*****	*****	
BEND FACTOR HOURS				3.966	
MATERIAL		USAGE			PERCENT
		(SQ. IN.)		SCRAP	SCRAP
				(SQ. IN.)	
FIBERGLASS--3" TAPE		3346.13		466.13	16.19
		WEIGHT		COST	
FIBERGLASS--3" TAPE		1.56		13.53	

LAYUP

PART NAME: SKIN
 PART NUMBER: -67
 LAYUP TOOL = CURING TOOL

QTY: 1
 TRIM ALLOWANCE: 1.00

MATERIAL DATA

DENSITY	COST
0.000400	87.00
0.000400	87.00
0.000880	93.00
0.000540	8.70
0.000540	8.70
0.001040	9.30

GRAPHITE---3" TAPE
 GRAPHITE---12" TAPE
 GRAPHITE---WOVEN
 FIBERGLASS---3" TAPE
 FIBERGLASS---12" TAPE
 FIBERGLASS---WOVEN

PLY DESCRIPTION

BEND DATA										RECT			NON-RECT			MATH		
LD #	P	LH	DT	TB	LENGTH	CR	FW	ORI	CT	LENGTH	WIDTH	AREA	DIST	F	T	WD		
2	0	1	1	0	0.0	0.0	0.0	0	1	60.00	33.00	0.0	0.0	1	1	12.		
2	0	1	1	0	0.0	0.0	0.0	90	1	60.00	33.00	0.0	0.0	1	1	12.		
2	0	1	1	0	0.0	0.0	0.0	45	1	60.00	33.00	0.0	0.0	2	2	38.		

FACTORY STANDARD HOURS	LAYUP	SET-UP	RUN	
CLEAN LAYUP TOOL				
APPLY RELEASE AGENT	0.0		0.015	
PLY DEPOSITION	0.0		0.023	
SUBTOTAL	0.100		0.397	
			0.435	
TOTAL LAYUP	0.100		0.435	
	*****		*****	
BEND FACTOR HOURS			0.0	
MATERIAL	USAGE	SCRAP		PERCENT
	(SQ. IN.)	(SQ. IN.)		SCRAP
GRAPHITE--12" TAPE	4752.00	792.00		20.00
FIBERGLASS--WOVEN	2440.29	460.29		23.25
	WEIGHT	COST		
GRAPHITE--12" TAPE	1.58	127.81		
FIBERGLASS--WOVEN	2.06	19.15		

PART CONSOLIDATION

CYCLE NO.: 1
PART NAME: PRECURED STIFF
PART NUMBER: -65 QTY: 2

COMPONENT DETAIL PARTS

<u>PART NAME</u>	<u>PART NO.</u>	<u>QTY</u>
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STIFFENER	-65	1
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THERMAL EXPANSION MOLD CAGE DIMENSION:

LENGTH: 70.00
WIDTH: 12.00
DEPTH: 12.00

CURING TOOL: OVEN

PART CONSOLIDATION

<u>FACTORY STANDARD HOURS</u>	<u>SET-UP</u>	<u>RUN</u>
SET UP	0.100	
BEFORE CURE		
FIT LAYUPS INTO MOLD		0.010
CHECK OVEN INTERIOR		0.060
CLOSE DOOR		0.038
DURING CURE		
SET RECORDER		0.007
CYCLE CHECK		0.160
SHUT DOWN		0.017
REMOVE CHARTS		0.017
AFTER CURE		
OPEN DOOR		0.038
REMOVE PART FR CAGE		0.017
ASIDE PART		0.003
TOTAL HOURS	0.100	0.467
	*****	*****

 PART CONSOLIDATION

CYCLE NO.: 2
 PART NAME: HAT STIFF. PANEL
 PART NUMBER: 15-42937-61 QTY: 1

 COMPONENT DETAIL PARTS

----- PART NAME -----	----- PART NO. -----	----- QTY -----
PRECURED STIFF	-65	2
SKIN	-67	1

VACUUM BAGGING: REUSABLE
 BAGGING AREA: 1980.00

SEALING/CLAMPING PERIMETER: 186.00

CURING TOOL: OVEN

PART CONSOLIDATION

FACTORY STANDARD HOURS	SET-UP	RUN
SET UP	0.050	
BEFORE CURE		
PREFIT DETAILS		0.144
ASSEMBLE DETAILS		0.044
APPLY NONPOROUS FILM		0.018
APPLY VENT CLOTH		0.040
INSTALL THERMOCPLS		0.032
APPLY REUSABLE BAG		0.030
CLAMP EDGES		0.043
CONNECT VACUUM LINES		0.006
SMOOTH BAG DOWN		0.012
CHECK SEALS		0.032
REMOVE VACUUM LINE		0.003
CHECK CHAMBER INT.		0.030
LOAD LAYUP IN OVEN		0.077
CONNECT VACUUM LINES		0.012
CONNECT T.C. LEADS		0.018
CHECK FOR LEAKS		0.080
CLOSE DOOR		0.019
CURING CURE		
SET RECORDERS		0.004
CYCLE CHECK		0.080
SHUT DOWN		0.001
REMOVE CHARTS		0.001
AFTER CURE		
OPEN DOOR		0.019
RELEASE T.C. LEADS		0.007
RELEASE VAC. LINES		0.006
REMOVE PART FR OVEN		0.077
RELEASE CLAMPS		0.013
REMOVE REUS. BAG		0.016
REMOVE THERMOCOUPLES		0.019
REMOVE PROCESS MATL		0.036
REMOVE LAYUP & ASIDE		0.012
CLEAN TOOL		0.012
TOTAL HOURS	0.650	0.944

FINISHING

PART NAME: HAT STIFF. PANEL
 PART NUMBER: 15-42937-61
 PERIMETER: 186.00

QTY: 1
 PART AREA: 196C.CC

NET TRIM OPERATIONS

MATERIAL(IN.)				
CODE	AVE. THICK.	TRIM LENGTH	PICT.	TEMP.
2	0.50	62.00	1	0
5	0.50	62.00	0	0

FINISHING

FACTORY STANDARD HOURS	SET-UP	RUN
NET TRIM OPERATIONS		
MACHINE ROUTING	0.200	0.043
HANDLING		0.137
SUBTOTAL		0.230
HAND SANDING	0.020	0.031
HANDLING		0.024
SUBTOTAL		0.055
MOLE OPERATIONS		
TOTAL HOURS	0.220	0.285
	*****	*****

TOTAL FACTORY LABOR STANDARD HOURS

<u>FACTORY STANDARD HOURS</u>	<u>SET-UP</u>	<u>RUN</u>
LAYUP		
HONEYCOMB CORE PREP	6.150	5.073
PART CONSOLIDATION	0.0	0.0
FINISHING OPERATIONS	6.150	1.412
	0.220	0.285
TOTAL HOURS	0.520	6.769
	*****	*****

COST PROJECTION

PRODUCTION COST ESTIMATE AT UNIT NO.: 300
 AVERAGE LOT SIZE: 30.
 LINEAR UNIT CURVE

<u>PROJECTION FACTORS</u>	<u>11.5AK</u>	<u>CURVE SLOPE</u>
LAYUP	23.24	76.63 %
HONEYCOMB CORE PREP	16.83	0.0 %
PART CONSOLIDATION	25.06	76.92 %
FINISHING OPERATIONS	23.84	76.77 %

<u>LABOR RATES</u>	<u>\$/HR</u>
FACTORY LABOR	10.00
QUALITY CONTROL	10.00
TOOLING	10.00
MFG ENGINEERING	10.00
ENGINEERING	10.00
GRAPHIC SERVICES	10.00

<u>SUPPORT FUNCTIONS</u>	<u>BASE</u>	<u>FACTORS</u>
QUALITY CONTROL	1 1	1.14
TOOLING	1 1	3.09
MFG ENGINEERING	1 1	2.05
ENGINEERING	1 1	1.26
GRAPHIC SERVICES	1 1	0.31
SUPPORT MATERIAL	7 2	0.30

<u>OVERHEAD RATES</u>	
FACTORY LABOR	1.500
QUALITY CONTROL	1.500
TOOLING	1.500
MFG ENGINEERING	1.500
ENGINEERING	1.700
GRAPHIC SERVICES	1.700
MATERIAL	0.200
ADMINISTRATIVE	0.150

COST PROJECTION

UNIT COST ESTIMATE AT T 300

<u>COST ELEMENT</u>	<u>STD. HRS</u>	<u>T 300 HRS</u>	<u>DOLLARS</u>
FACTORY LABOR			
LAYUP	5.08	13.20	132.02
HONEYCOMB CORE PREP	0.0	0.0	0.0
PART CONSOLIDATION	1.42	3.93	39.25
FINISHING OPERATIONS	0.29	0.79	7.91
TOTAL FACTORY LABOR	6.79	17.92	179.18
SUPPORT LABORS			
QUALITY CONTROL			
TOOLING		1.72	17.24
MFG ENGINEERING		1.03	10.33
ENGINEERING		1.59	15.91
GRAPHIC SERVICES		0.76	7.60
TOTAL SUPPORT LABOR		0.27	2.71
			53.79
LABOR OVERHEAD			
FACTORY LABOR			
QUALITY CONTROL			268.77
TOOLING			25.86
MFG ENGINEERING			15.50
ENGINEERING			23.87
GRAPHIC SERVICES			12.91
TOTAL OVERHEAD			4.61
			351.52
TOTAL LABOR			584.49
MATERIAL			
PRODUCTION MATERIAL			
SUPPORT MATERIAL			170.49
MFG. ALLOWANCE			51.15
OVERHEAD			37.79
TOTAL MATERIAL			51.88
			311.31
ADMINISTRATIVE OVERHEAD			
			134.37
TOTAL COST			1030.16

	<u>WEIGHT</u>
LAYUP	
HONEYCOMB CORE PREP	5.20
	0.0
TOTAL	5.20

COST PROJECTION

CUMULATIVE AVERAGE COST ESTIMATE AT T 300

<u>COST ELEMENT</u>	<u>STD. HRS</u>	<u>T 300 HRS</u>	<u>DOLLARS</u>
FACTORY LABOR			
LAYUP	5.08	21.35	213.47
HONEYCOMB CORE PREP	0.0	0.0	0.0
PART CONSOLIDATION	1.42	6.37	63.65
FINISHING OPERATIONS	0.29	1.27	12.75
TOTAL FACTORY LABOR	6.79	28.99	289.87
SUPPORT LABORS			
QUALITY CONTROL		4.07	40.70
TOOLING		3.74	37.39
MFG ENGINEERING		5.85	58.46
ENGINEERING		2.44	24.44
GRAPHIC SERVICES		0.59	5.87
TOTAL SUPPORT LABOR			166.87
LABOR OVERHEAD			
FACTORY LABOR			434.80
QUALITY CONTROL			61.05
TOOLING			56.08
MFG ENGINEERING			87.69
ENGINEERING			41.54
GRAPHIC SERVICES			9.99
TOTAL OVERHEAD			691.16
TOTAL LABOR			1147.90
MATERIAL			
PRODUCTION MATERIAL			170.49
SUPPORT MATERIAL			51.15
MFG. ALLOWANCE			40.00
OVERHEAD			52.33
TOTAL MATERIAL			313.96
ADMINISTRATIVE OVERHEAD			219.28
TOTAL COST			1681.14

	<u>WEIGHT</u>
LAYUP	5.20
HONEYCOMB CORE PREP	0.0
TOTAL	5.20

COST PROJECTION

CUMULATIVE COST ESTIMATE AT T 300

<u>COST ELEMENT</u>	<u>STD. HRS</u>	<u>T 300 HRS</u>	<u>DOLLARS</u>
FACTORY LABOR			
LAYUP	5.08	6404.13	64041.29
HONEYCOMB CORE PREP	0.0	0.0	0.0
PART CONSOLIDATION	1.42	1909.51	19095.06
FINISHING OPERATIONS	0.29	382.46	3824.59
TOTAL FACTORY LABOR	6.79	8696.09	86960.87
SUPPORT LABORS			
QUALITY CONTROL			
TOOLING		1221.08	12210.79
MFG ENGINEERING		1121.64	11216.37
ENGINEERING		1753.89	17539.93
GRAPHIC SERVICES		733.14	7331.37
TOTAL SUPPORT LABOR		176.21	1762.10
			50059.55
LABOR OVERHEAD			
FACTORY LABOR			
QUALITY CONTROL			130441.31
TOOLING			18316.18
MFG ENGINEERING			16824.55
ENGINEERING			26308.39
GRAPHIC SERVICES			12463.32
TOTAL OVERHEAD			2995.57
			207349.19
TOTAL LABOR			344369.56
MATERIAL			
PRODUCTION MATERIAL			
SUPPORT MATERIAL			51146.62
MFG. ALLOWANCE			15343.98
OVERHEAD			1773.42
TOTAL MATERIAL			13652.79
			81916.69
ADMINISTRATIVE OVERHEAD			
			63942.93
TOTAL COST			490229.12

	<u>WEIGHT</u>
LAYUP	1559.52
HONEYCOMB CORE PREP	0.0
TOTAL	1559.52

COST PROJECTION

PRODUCTION COST ESTIMATE AT UNIT NO.: 300
 AVERAGE LOT SIZE: 30.
 LINEAR UNIT CURVE

<u>PROJECTION FACTORS</u>	<u>TI.VAR</u>	<u>CURVE SLOPE</u>
LAYUP	21.50	78.00 %
HONEYCOMB CORE PREP	23.75	85.00 %
PART CONSOLIDATION	25.00	80.00 %
FINISHING OPERATIONS	21.00	78.00 %

<u>LABOR RATES</u>	<u>\$/HR</u>
FACTORY LABOR	7.50
QUALITY CONTROL	6.00
TOOLING	6.00
MFG ENGINEERING	6.00
ENGINEERING	12.00
GRAPHIC SERVICES	9.00

<u>SUPPORT FUNCTIONS</u>	<u>BASE</u>	<u>FACTORS</u>
QUALITY CONTROL	1 1	0.15
TOOLING	1 1	0.15
MFG ENGINEERING	3 1	0.50
ENGINEERING	1 1	0.20
GRAPHIC SERVICES	5 1	0.10
SUPPORT MATERIAL	1 1	3.00

<u>OVERHEAD RATES</u>	
FACTORY LABOR	1.700
QUALITY CONTROL	1.500
TOOLING	1.500
MFG ENGINEERING	1.500
ENGINEERING	1.900
GRAPHIC SERVICES	1.900
MATERIAL	0.250
ADMINISTRATIVE	0.050

COST PROJECTION

UNIT COST ESTIMATE AT T 300

<u>COST ELEMENT</u>	<u>STD. HRS</u>	<u>T 300 HRS</u>	<u>DOLLARS</u>
FACTORY LABOR			
LAYUP	5.08	14.13	105.48
HONEYCOMB CORE PREP	0.0	0.0	0.0
PART CONSOLIDATION	1.42	5.65	33.68
FINISHING OPERATIONS	0.29	0.79	4.77
TOTAL FACTORY LABOR	6.79	20.57	246.86
SUPPORT LABORS			
QUALITY CONTROL		3.09	18.51
TOOLING		3.04	18.51
MFG ENGINEERING		1.54	9.26
ENGINEERING		4.11	49.37
GRAPHIC SERVICES		0.41	3.70
TOTAL SUPPORT LABOR			99.36
LABOR OVERHEAD			
FACTORY LABOR			419.65
QUALITY CONTROL			27.77
TOOLING			27.77
MFG ENGINEERING			13.89
ENGINEERING			93.81
GRAPHIC SERVICES			7.04
TOTAL OVERHEAD			589.92
TOTAL LABOR			936.14
MATERIAL			
PRODUCTION MATERIAL			170.49
SUPPORT MATERIAL			61.71
MFG. ALLOWANCE			39.14
OVERHEAD			67.84
TOTAL MATERIAL			339.18
ADMINISTRATIVE OVERHEAD			63.77
TOTAL COST			1339.06

	<u>WRIGHT</u>
LAYUP	5.20
HONEYCOMB CORE PREP	0.0
TOTAL	5.20

COST PROJECTION

CUMULATIVE AVERAGE COST ESTIMATE AT T 300

<u>COST ELEMENT</u>	<u>STD. HRS</u>	<u>T 300 HRS</u>	<u>DOLLARS</u>
FACTORY LABOR			
LAYUP	5.08	21.67	162.55
HONEYCOMB CORE PREP	0.0	0.0	0.0
PART CONSOLIDATION	1.42	8.22	44.35
FINISHING OPERATIONS	0.29	1.22	7.31
TOTAL FACTORY LABOR	6.79	31.12	373.40
SUPPORT LABORS			
QUALITY CONTROL		4.67	28.00
TOOLING		4.67	28.00
MFG ENGINEERING		2.33	14.00
ENGINEERING		6.22	74.68
GRAPHIC SERVICES		0.62	5.60
TOTAL SUPPORT LABOR			150.29
LABOR OVERHEAD			
FACTORY LABOR			634.77
QUALITY CONTROL			42.01
TOOLING			42.01
MFG ENGINEERING			21.00
ENGINEERING			141.89
GRAPHIC SERVICES			10.64
TOTAL OVERHEAD			892.32
TOTAL LABOR			1416.01
MATERIAL			
PRODUCTION MATERIAL			170.49
SUPPORT MATERIAL			93.35
MFG. ALLOWANCE			41.67
OVERHEAD			76.38
TOTAL MATERIAL			381.89
ADMINISTRATIVE OVERHEAD			89.89
TOTAL COST			1867.79
			*** *****

	<u>WEIGHT</u>
LAYUP	5.20
HONEYCOMB CORE PREP	0.0
TOTAL	5.20

COST PROJECTION

CUMULATIVE COST ESTIMATE AT T 300

<u>COST ELEMENT</u>	<u>STD. HRS</u>	<u>T 300 HRS</u>	<u>DOLLARS</u>
FACTORY LABOR			
LAYUP	5.08	6502.14	48766.02
HONEYCOMB CORE PREP	0.0	0.0	0.0
PART CONSOLIDATION	1.42	2467.27	14803.61
FINISHING OPERATIONS	0.29	365.53	2193.16
TOTAL FACTORY LABOR	6.79	9334.93	112019.06
SUPPORT LABOR			
QUALITY CONTROL			
TOOLING		1400.24	8401.43
MFG ENGINEERING		1400.24	8401.43
ENGINEERING		700.12	4200.71
GRAPHIC SERVICES		1866.98	22403.82
TOTAL SUPPORT LABOR		186.70	1660.29
			45087.68
LABOR OVERHEAD			
FACTORY LABOR			
QUALITY CONTROL			190432.37
TOOLING			12602.14
MFG ENGINEERING			12602.14
ENGINEERING			6301.07
GRAPHIC SERVICES			42567.24
TOTAL OVERHEAD			3192.54
			267697.37
TOTAL LABOR			424804.06
MATERIAL			
PRODUCTION MATERIAL			51146.62
SUPPORT MATERIAL			28004.78
MFG. ALLOWANCE			2274.58
OVERHEAD			20356.48
TOTAL MATERIAL			101712.37
ADMINISTRATIVE OVERHEAD			26329.32
TOTAL COST			552915.75

	<u>WEIGHT</u>
LAYUP	1559.52
HONEYCOMB CORE PREP	0.0
TOTAL	1559.52