



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**Work Study Utilizing Maynard Operation
Sequence Technique at Aerospace
Manufacturing Company: A Case Study at
A320 Spoiler Project**

Report submitted in accordance with the partial requirements of the
Universiti Teknikal Malaysia Melaka for the
Bachelor's Degree of Manufacturing Engineering
(Manufacturing Management) With Honours

By

Norhelmy Bin Rominor

Faculty of Manufacturing Engineering

May 2009



UNIVERSITI TEKNIKAL MALAYSIA MELAKA (UTeM)

BORANG PENGESAHAN STATUS TESIS*

JUDUL: WORK STUDY UTILIZING MAYNARD OPERATION SEQUENCE TECHNIQUE AT AEROSPACE MANUFACTURING COMPANY: A CASE STUDY AT A320 SPOILER PROJECT

SESI PENGAJIAN : 2008/2009

Saya NORHELMY BIN ROMINOR

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 Fakulti Kejuruteraan Pembuatan
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Tarikh: 12 MAY 2009

Tarikh: 12/5/2009

* Laporan dimaksudkan sebagai laporan bagi Ijazah Doktor Falsafah dan Sarjana secara penyelidikan, atau disertasi bagi pengajian secara kerja kursus dan penyelidikan, atau Laporan Projek Sarjana Muda (PSM).

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FAKULTI KEJURUTERAAN PEMBUATAN

Rujukan Kami (Our Ref) :
Rujukan Tuan (Your Ref):

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Pustakawan
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UTeM, Ayer Keroh
MELAKA.

Saudara,

**PENKELASAN LAPORAN SEBAGAI SULIT/TERHAD
- LAPORAN SARJANA MUDA KEJURUTERAAN PEMBUATAN (PENGURUSAN
PEMBUATAN): NORHELMY BIN ROMINOR
TAJUK: WORK STUDY UTILIZING MAYNARD OPERATION SEQUENCE
TECHNIQUE AT AEROSPACE MANUFACTURING COMPANY: A CASE
STUDY AT A320 SPOILER PROJECT**

Sukacita dimaklumkan bahawa laporan yang tersebut di atas bertajuk
*“Work Study Utilizing Maynard Operation Sequence Technique at
Aerospace Manufacturing Company: A Case Study at A320 Spoiler
Project”* mohon dikelaskan sebagai terhad untuk tempoh lima (5) tahun
dari tarikh surat ini memandangkan ia mempunyai nilai dan potensi untuk
dikomersialkan di masa hadapan.

Sekian dimaklumkan. Terima kasih.

“BERKHIDMAT UNTUK NEGARA KERANA ALLAH”

Yang benar,



ENCIK EFFENDI BIN MOHAMAD,
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Fakulti Kejuruteraan Pembuatan
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APPROVAL

This report submitted to the senate of UTeM and has been accepted as partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Manufacturing Management). The member of the supervisory committee is as follow:



Supervisor
Effendi Bin Mohamad
Faculty of Manufacturing Engineering
EFFENDI BIN MOHAMAD
Pensyarah
Fakulti Kejuruteraan Pembuatan
Universiti Teknikal Malaysia Melaka

DECLARATION

I hereby, declare this report entitled “Work Study Utilizing Maynard Operation Sequence Technique at Aerospace Manufacturing Company: A Case Study at A320 Spoiler Project” is the result of my own research except as cited in the references.

Signature	:	
Author's Name	:	Norhelmy Bin Rominor
Date	:	12 May 2009

APPENDIX A

Description:

LAY UP SKIN INNER 1

Date:

Mar-09

Analyst:

HELMY ROMINOR

Page:

01-01

Sketch of Layout

SUMMARY

Classification	O	NO	TIME
OPERATIONS	O		
TRANSPORT	T		
INSPECTION	I		
DELAYS	D		
STORAGE	S		
Total Time			

No	Activities	L R	Activities Sequence	Frequency		Classification Time (TMU)					0.036	Rating (100%) = 1.00	BT (sec)	ST (sec)	
				cf	rf	O	T	I	D	S					
1	Check paperwork		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	2		960						34.56	100%	34.56	39.74
2	Stack ply profiles in accordance with lay-up sequence		A1 B3 G3 A6 B3 P3 A1	26		5200						187.20	100%	187.20	215.28
3	Take lay-up board inner 1		A3 B3 G3 A3 B3 P3 A0			330						11.88	100%	11.88	13.66
4	Paperwork preparation		A1 B0 G1 A1 B0 P3 T6 A1 B0 P1 A0	10	4	3200						115.20	100%	115.20	132.48
5	Ensure lay-up is clean prior to use		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.280	19.87
6	Apply with Double Tape at the Fix point on Lay-up Board surface		A3 B3 G3 A3 B3 P3 A1	1		360						12.960	100%	12.96	14.90
7	Lay-up ply by ply.														
	Ply 1-2 @ 45°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 1-1 @ 45°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 2-1 @ 135°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 4 @ 0°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 7 @ 90°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 2-2 @ 135°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 6 @ 90°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 5 @ 0°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 3 @ 0°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 8 @ 90°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 9-2 @ 0°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 9-1 @ 0°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
8	Take B2000 (Go, Take and Back)		A1 B0 G1 A1 B0 P1 C10 A1 B0 P1 A0	1		160						5.76	100%	5.76	6.62
9	Debulk preparation		A1 B0 G1 A1 B0 P3 T6 A1 B0 P1 A0	10	4	3200						115.20	100%	115.20	132.48
10	Place under vacuum													300.00	300.00
11	Lay-up ply by ply.														
	Ply 10 @ 90°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 13 @ 45°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 16 @ 135°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 12 @ 45°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 15 @ 135°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 11 @ 45°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 14 @ 135°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 17 @ 90°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 18-2 @ 45°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 18-1 @ 45°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87

TIME STUDY SHEET

**A320 SPOILER
LAY-UP
INNER SPOILER 1**

**DATE: MARCH 2009
ANALYST: HELMY ROMINOR
PAGE: 1/1**

No.	Element Description	OBSERVATION (sec)		A.T (sec)	VA O	NON VALUE ADDED						Rating (%)	B.T (sec)	S.T (sec)	
		1	2			T	I	M	W	O	O				D
1.	Check paperwork	35.00	40.00	37.50								37.50	100%	37.50	43.13
2.	Stack ply profiles in accordance with lay-up sequence	270.36	300.63	285.50	285.50								100%	285.50	328.33
3.	Take lay-up board Inner 1	22.47	36.96	29.72		29.72							100%	29.72	34.18
4.	Paperwork preparation	300.00	300.00	300.00							300.00		100%	300.00	345.00
5.	Ensure lay-up is clean prior to use	16.74	20.63	37.37	37.37								100%	37.37	42.98
6.	Apply with Double Tape at the Fix point on Lay-up Board surface	79.37	80.42	79.90	79.90								100%	79.90	91.89
7.	Lay-up ply by ply.														
	Ply 1-2 @ 45°	28.60	29.06	28.83	28.83								100%	28.83	33.15
	Ply 1-1 @ 45°	5.54	5.73	5.64	5.64								100%	5.64	6.49
	Ply 2-1 @ 135°	40.15	40.62	40.39	40.39								100%	40.39	42.98
	Ply 4 @ 0°	9.19	10.62	9.91	9.91								100%	9.91	11.40
	Ply 7 @ 90°	7.54	8.43	7.99	7.99								100%	7.99	9.19
	Ply 2-2 @ 135°	16.34	15.05	15.70	15.70								100%	15.70	18.06
	Ply 6 @ 90°	13.31	17.05	15.18	15.18								100%	15.18	17.46
	Ply 5 @ 0°	7.53	10.84	9.19	9.19								100%	9.19	10.57
	Ply 3 @ 0°	6.00	8.54	7.27	7.27								100%	7.27	8.36
	Ply 8 @ 90°	21.27	24.06	22.67	22.67								100%	22.67	26.07
	Ply 9-2 @ 0°	18.85	20.65	21.46	21.46								100%	21.46	24.68
	Ply 9-1 @ 0°	13.93	14.95	14.44	14.44								100%	14.44	16.61
8.	Take B2000 (Go, Take and Back)	127.05	133.84	130.45		130.45							100%	130.45	150.02
9.	Debulk preparation	65.19	69.53	67.36	67.36								100%	67.36	77.46
10.	Place under vacuum	300.00	300.00	300.00	300.00								100%	300.00	300.00
11.	Lay-up ply by ply.														
	Ply 10 @ 90°	5.64	9.53	7.59	7.59								100%	7.59	8.73
	Ply 13 @ 45°	17.20	19.63	18.42	18.42								100%	18.42	21.18
	Ply 16 @ 135°	49.18	54.06	51.62	51.62								100%	51.62	59.36
	Ply 12 @ 45°	6.37	10.56	8.47	8.47								100%	8.47	9.74
	Ply 15 @ 135°	26.39	30.73	28.56	28.56								100%	28.56	32.84

	Ply 11 @ 45°	17.71	20.73	19.22	19.22								100%	19.22	22.10
	Ply 14 @ 135°	21.93	24.56	23.25	23.25								100%	23.25	26.74
	Ply 17 @ 90°	19.62	20.43	20.03	20.03								100%	20.03	23.03
	Ply 18-2 @ 45°	19.83	20.74	20.29	20.29								100%	20.29	23.33
	Ply 18-1 @ 45°	24.63	25.95	25.29	25.29								100%	25.29	29.08
12.	Debulk preparation	33.45	35.32	29.39	29.39								100%	29.39	33.80
13.	Place under vacuum	300.00	300.00	300.00	300.00								100%	300.00	300.00
14.	Paperwork updated	13.88	17.95	15.92	15.92								100%	15.92	18.31
15.	Test panel preparation	115.17	128.63	121.90	121.90								100%	121.90	140.19
16.	Removed B2000	23.39	29.62	26.51	26.51								100%	26.51	30.49
17.	Lay-up ply by ply.														
	Ply 19-1 @ 135°	3.20	4.96	4.08	4.08								100%	4.08	4.69
	Ply 22 @ 90°	4.70	6.96	5.83	5.83								100%	5.83	6.70
	Ply 25 @ 90°	25.35	26.65	25.99	25.99								100%	25.99	29.89
	Ply 19-2 @ 135°	10.05	10.74	10.40	10.40								100%	10.40	11.96
	Ply 23 @ 90°	7.02	11.96	9.49	9.49								100%	9.49	10.91
	Ply 26 @ 90°	7.69	10.59	9.14	9.14								100%	9.14	10.51
	Ply 20 @ 0°	12.83	14.71	13.77	13.77								100%	13.77	15.84
	Ply 21 @ 90°	17.32	19.63	18.48	18.48								100%	18.48	21.25
	Ply 24 @ 90°	15.47	20.48	17.98	17.98								100%	17.98	20.68
	Ply 27 @ 0°	17.02	23.73	20.38	20.38								100%	20.38	23.44
	Ply 28-1 @ 135°	14.82	20.73	17.78	17.78								100%	17.78	20.45
	Ply 28-2 @ 135°	49.34	53.77	51.56	51.56								100%	51.56	59.29
18.	Debulk preparation	34.28	37.84	36.06	36.06								100%	36.06	41.47
19.	Place under vacuum	300.00	300.00	300.00	300.00								100%	300.00	300.00
20.	Updated Paperwork	100.24	123.49	111.87	111.87								100%	111.87	128.65
21.	Removed B2000	28.51	30.95	29.73	29.73								100%	29.73	34.19
22.	Lay-up ply by ply.														
	Ply 29-2 @ 45°	7.80	10.64	9.22	9.22								100%	9.22	10.60
	Ply 33 @ 135°	8.22	12.65	10.44	10.44								100%	10.44	12.01
	Ply 36 @ 45°	13.64	15.09	14.37	14.37								100%	14.37	16.53
	Ply 29-1 @ 45°	7.45	12.63	10.04	10.04								100%	10.04	11.55
	Ply 32 @ 135°	6.58	9.95	8.27	8.27								100%	8.27	9.51
	Ply 35 @ 45°	48.32	50.63	49.48	49.48								100%	49.48	55.75
	Ply 30 @ 90°	31.10	30.34	30.72	30.72								100%	30.72	35.34
	Ply 31 @ 135°	17.76	18.54	18.15	18.15								100%	18.15	20.87

	Ply 34 @ 45°	30.54	35.01	32.78	32.78								100%	32.78	37.70
	Ply 37 @ 90°	19.77	23.96	21.87	21.87								100%	21.87	25.15
23.	Debulk preparation	42.75	45.85	44.30	44.30								100%	44.30	50.95
24.	Place under vacuum	300.00	300.00	300.00	300.00								100%	300.00	300.00
25.	Update Paperwork	99.32	100.64	99.98							99.98		100%		
26.	Removed B2000	30.83	35.74	33.29	33.29								100%	33.29	38.28
27.	Lay-up ply by ply.														
	Ply 38-2 @ 0°	33.79	35.96	34.88	34.88								100%	34.88	40.11
	Ply 38-1 @ 0°	13.14	15.85	14.50	14.50								100%	14.50	16.68
	Ply 41@ 90°	7.46	16.63	12.14	12.14								100%	12.14	13.96
	Ply 44 @ 0°	12.13	15.95	14.04	14.04								100%	14.04	16.15
	Ply 40 @ 90°	10.50	14.95	12.73	12.73								100%	12.73	14.64
	Ply 43 @ 0°	19.00	24.63	21.82	21.82								100%	21.82	25.09
	Ply 39 @ 0°	16.89	17.45	17.17	17.17								100%	17.17	19.75
	Ply 42 @ 0°	11.01	12.96	11.99	11.99								100%	11.99	13.79
	Ply 45-1 @ 135°	23.01	22.85	12.93	12.93								100%	12.93	14.87
	Ply 45-2 @ 135°	37.70	34.94	36.32	36.32								100%	36.32	41.77
	Ply 46-2 @ 45°	20.93	23.05	21.99	21.99								100%	21.99	25.29
	Ply 46-1 @ 45°	12.05	18.04	15.05	15.05								100%	15.05	17.31
28.	Debulk preparation	37.73	44.27	41.00	41.00								100%	41.00	47.15
29.	Place under vacuum	300.00	300.00	300.00	300.00								100%	300.00	300.00
	TOTAL TIME (second)	3949.34	4252.44	4100.89	3503.24	160.17	0	0	0	0	0	437.48		4100.89	4491.02
	TOTAL TIME (minute)	65.82	70.87	68.35	58.39	2.67	0	0	0	0	0	7.29		68.35	74.85
	TOTAL TIME (hour)	1.10	1.18	1.14	0.97	0.05	0	0	0	0	0	0.12		1.14	1.25

APPENDIX B

UTeM

BasicMOST

Description:
LAY UP SKIN OUTER 1

Date: **Mar-09**
Analyst: **HELMY ROMINOR**
Page: **01-01**

Sketch of Layout

SUMMARY

Classification	O	NO	TIME
OPERATIONS	O		
TRANSPORT	T		
INSPECTION	I		
DELAYS	D		
STORAGE	S		
Total Time			

No	Activities	L R	Activities Sequence	Frequency		Classification Time (TMU)					0.036	Rating (100%) = 1.00	BT (sec)	ST (sec)	
				cf	rf	O	T	I	D	S					
1	Check paperwork		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	2		960						34.56	100%	34.56	39.74
2	Stack ply profiles in accordance with layup sequence		A1 B3 G3 A6 B3 P3 A1	26		5200						187.20	100%	187.20	215.28
3	Take lay-up board Inner 2		A3 B3 G3 A3 B3 P3 A0			330						11.88	100%	11.88	13.66
4	Paperwork preparation		A1 B0 G1 A1 B0 P3 T6 A1 B0 P1 A0	10	4	3200						115.20	100%	115.20	132.48
5	Ensure lay-up is clean prior to use		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.280	19.87
6	Apply with Double Tape at the Fix Point on Layup Board Surface		A3 B3 G3 A3 B3 P3 A1	1		360						12.960	100%	12.96	14.90
7	Lay-up ply by ply.														
	Ply 1-1 @ 45°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 1-2 @ 45°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 2-1 @ 135°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 2-2 @ 135°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 5 @ 0°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 8 @ 0°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 4 @ 0°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 7 @ 90°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
8	Take B2000 (Go, Take and Back)		A1 B3 G1 A1 B3 P3 A0	1			120					4.32	100%	4.32	4.97
9	Debulk preparation		A1 B0 G1 A1 B0 P1 C10 A1 B0 P1 A0	1		160						5.76	100%	5.76	6.62
10	Place under vacuum												100%	300.00	300.00
11	Prepare for paperwork		A1 B0 G1 A1 B0 P3 T6 A1 B0 P1 A0	10	4	3200						115.20	100%	115.20	132.48
12	Lay-up ply by ply.														
	Ply 5 @ 90°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 8 @ 0°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 4 @ 90°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 7 @ 0°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 6 @ 90°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 3 @ 0°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 15 @ 135°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 9-2 @ 0°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 9-1 @ 0°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 10 @ 90°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Ply 12 @ 45°		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Hand consolidate		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87
	Paper work update		A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480						17.28	100%	17.28	19.87

	Ply 13 @ 45°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 16 @ 135°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 11 @ 45°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 14 @ 135°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 17-2 @ 45°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 17-1 @ 45°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 18-1 @ 135°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 18-1 @ 135°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
12	Debulk preparation	A1 B0 G1 A1 B0 P1 C10 A1 B0 P1 A0	1		160				5.76	100%	5.76	6.62
13	Place under vacuum									100%	300.00	300.00
14	Paperwork updated	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	2		960				34.56	100%	34.56	39.74
15	Test panel preparation	A1 B0 G1 A1 B0 P3 T6 A1 B0 P1 A0	10	4	3200				115.20	100%	115.20	132.48
16	Removed B2000	A3 B3 G1 A3 B3 P1 A0	1		140				5.04	100%	5.04	5.80
17	Lay-up ply by ply											
	Ply 23 @ 135°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 21 @ 45°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 24 @ 135°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 19 @ 45°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 22 @ 135°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 20 @ 45°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 25-1 @ 0°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 25-2 @ 0°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 26-1 @ 0°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 26-2 @ 0°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 27 @ 135°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 30 @ 45°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 28 @ 135°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 31 @ 45°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 29 @ 135°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 32 @ 45°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 33-1 @ 135°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 33-2 @ 135°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 34-2 @ 45°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 34-2 @ 45°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
18	Debulk preparation	A1 B0 G1 A1 B0 P1 C10 A1 B0 P1 A0	1		160				5.76	100%	5.76	6.62
19	Place under vacuum									100%	300.00	300.00
20	Update Paperwork	A1 B0 G1 A1 B0 P3 T6 A1 B0 P1 A0	10	4	3200				115.20	100%	115.20	132.48
21	Removed B2000	A3 B3 G1 A3 B3 P1 A0			140				5.04	100%	5.04	5.80
22	Lay-up ply by ply											
	Ply 35 @ 135°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 38 @ 45°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 36 @ 135°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 39 @ 45°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 37 @ 135°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 40 @ 45°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 41 @ 90°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 42-1 @ 0°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 42-2 @ 0°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
23	Debulk preparation	A1 B0 G1 A1 B0 P1 C10 A1 B0 P1 A0	1		160				5.76	100%	5.76	6.62
24	Place under vacuum									100%	300.00	300.00
25	Update Paperwork	A1 B0 G1 A1 B0 P3 T6 A1 B0 P1 A0	10	4	3200				115.20	100%	115.20	132.48
26	Remove B2000	A3 B3 G1 A3 B3 P1 A0			140				5.04	100%	5.04	5.80
27	Lay-up ply by ply.											
	Ply 45 @ 0°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 48 @ 90°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 43 @ 0°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 46 @ 90°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 44 @ 0°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 47 @ 90°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87
	Ply 49-1 @ 135°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1		480				17.28	100%	17.28	19.87

	Ply 49-2 @ 135°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1	480						17.28	100%	17.28	19.87
	Ply 50-1 @ 45°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1	480						17.28	100%	17.28	19.87
	Ply 50-2 @ 45°	A1 B0 G1 A1 B0 P1 S42 A1 B0 P1 A0	1	480						17.28	100%	17.28	19.87
28	Debulk preparation	A1 B0 G1 A1 B0 P1 C10 A1 B0 P1 A0	1	160						5.76	100%	5.76	6.62
29	Place under vacuum											300.00	300.00
												3597.72	
Total Time				58150	120					Total Time (unit/second)		3912.22	
										unit/min		65.20	
										unit/hour		1.09	

TIME STUDY SHEET

**A320 SPOILER
LAY-UP
OUTER SPOILER 1**

**DATE: MARCH 2009
ANALYST: HELMY ROMINOR
PAGE: 1/1**

No.	Element Description	OBSERVATION (sec)		A.T (sec)	VA O	NON VALUE ADDED						Rating (%)	B.T (sec)	S.T (sec)	
		1	2			T	I	M	W	O	O				D
1.	Check paperwork	300.00	300.00	300.00								300.00	100%	300.00	345.00
2.	Stack ply profiles in accordance with layup sequence	285.11	300.46	292.79	292.79								100%	292.79	336.71
3.	Take lay-up board Inner 2	33.78	13.22	23.50		23.50							100%	23.50	27.03
4.	Paperwork preparation	300.00	98.22	199.11							199.11		100%	199.11	228.98
5.	Ensure lay-up is clean prior to use	16.74	20.63	18.69	18.69								100%	18.69	21.47
6.	Apply with Double Tape at the Fix Point on Layup Board Surface	5.98	7.25	6.62	6.62								100%	6.62	7.61
7.	Lay-up ply by ply.														
	Ply 1-1 @ 45°	11.18	23.90	17.54	17.54								100%	17.54	20.17
	Ply 1-2 @ 45°	11.23	10.97	11.1	11.1								100%	11.10	12.77
	Ply 2-1 @ 135°	59.25	59.88	59.57	59.57								100%	59.57	68.51
	Ply 2-2 @ 135°	22.98	21.61	22.30	22.30								100%	22.30	25.65
	Ply 5 @ 0°	34.88	37.49	37.49	37.49								100%	37.49	43.11
	Ply 8 @ 0°	12.68	12.47	12.58	12.58								100%	12.58	14.47
	Ply 4 @ 0°	11.36	9.31	10.34	10.34								100%	10.34	11.89
	Ply 7 @ 90°	8.42	7.75	8.09	8.09								100%	8.09	9.30
8.	Take B2000 (Go, Take and Back)	127.05	133.84	130.45		130.45							100%	130.45	150.02
9.	Debulk preparation	65.19	69.53	67.36	67.36								100%	67.36	77.46
10.	Place under vacuum	300.00	300.00	300.00	300.00								100%	300.00	300.00
11.	Prepare for paperwork	60.00	60.00	60.00							60.00		100%	60.00	69.00
12.	Lay-up ply by ply.														
	Ply 5 @ 90°	3.92	4.98	4.45	4.45								100%	4.45	5.12
	Ply 8 @ 0°	8.47	10.53	9.5	9.5								100%	9.50	10.93
	Ply 4 @ 90°	7.40	6.34	6.87	6.87								100%	6.87	7.90
	Ply 7 @ 0°	4.45	5.32	4.89	4.89								100%	4.89	5.60
	Ply 6 @ 90°	11.20	12.35	11.78	11.78								100%	11.78	13.55
	Ply 3 @ 0°	9.52	10.35	9.94	9.94								100%	9.94	11.43
	Ply 15 @ 135°	18.47	19.03	18.75	18.75								100%	18.75	21.56
	Ply 9-2 @ 0°	3.48	4.56	4.02	4.02								100%	4.02	4.62
	Ply 9-1 @ 0°	35.85	38.28	37.07	37.07								100%	37.07	42.63
	Ply 10 @ 90°	3.00	5.04	4.02	4.02								100%	4.02	4.62
	Ply 12 @ 45°	5.65	6.11	5.88	5.88								100%	5.88	6.76
	Hand consolidate	25.68	26.12	14.4	14.4								100%	14.40	16.56

	Paper work update	99.32	100.64	99.98							99.98	100%	99.98	114.98
	Ply 13 @ 45°	21.03	22.09	43.12	43.12							100%	43.12	49.59
	Ply 16 @ 135°	10.44	11.52	10.99	10.99							100%	10.99	12.64
	Ply 11 @ 45°	8.14	10.25	9.20	9.20							100%	9.20	10.58
	Ply 14 @ 135°	25.62	23.81	24.72	24.72							100%	24.72	28.43
	Ply 17-2 @ 45°	11.44	12.83	12.14	12.14							100%	12.14	13.96
	Ply 17-1 @ 45°	21.17	22.39	21.78	21.78							100%	21.78	25.05
	Ply 18-1 @ 135°	2.45	3.11	2.78	2.78							100%	2.78	3.20
	Ply 18-1 @ 135°	6.66	6.10	6.38	6.38							100%	6.38	7.34
12.	Debulk preparation	65.19	69.53	67.36	67.36							100%	67.36	77.46
13.	Place under vacuum	300.00	300.00	300.00	300.00							100%	300.00	300.00
14.	Paperwork updated	60.00	60.00	60.00							60.00	100%	60.00	69.00
15.	Test panel preparation	300.00	300.00	300.00	300.00							100%	300.00	345.00
16.	Removed B2000	23.39	29.62	26.51	26.51							100%	26.51	30.49
17.	Lay-up ply by ply													
	Ply 23 @ 135°	13.28	14.72	14.00	14.00							100%	14.00	16.10
	Ply 21 @ 45°	10.89	11.68	11.29	11.29							100%	11.29	12.98
	Ply 24 @ 135°	9.02	10.05	9.54	9.54							100%	9.54	10.97
	Ply 19 @ 45°	12.38	12.74	12.56	12.56							100%	12.56	14.44
	Ply 22 @ 135°	7.31	8.23	7.77	7.77							100%	7.77	8.94
	Ply 20 @ 45°	23.56	23.98	23.77	23.77							100%	23.77	27.34
	Ply 25-1 @ 0°	42.15	44.19	43.17	43.17							100%	43.17	49.65
	Ply 25-2 @ 0°	21.79	23.07	22.43	22.43							100%	22.43	25.79
	Ply 26-1 @ 0°	39.21	40.72	39.97	39.97							100%	39.97	45.97
	Ply 26-2 @ 0°	21.64	22.73	22.19	22.19							100%	22.19	25.52
	Ply 27 @ 135°	15.56	16.34	15.95	15.95							100%	15.95	18.34
	Ply 30 @ 45°	6.93	10.65	8.79	8.79							100%	8.79	10.11
	Ply 28 @ 135°	13.80	14.93	14.37	14.37							100%	14.37	16.53
	Ply 31 @ 45°	6.85	7.37	7.11	7.11							100%	7.11	8.18
	Ply 29 @ 135°	4.13	5.28	4.71	4.71							100%	4.71	5.42
	Ply 32 @ 45°	7.72	7.65	7.69	7.69							100%	7.69	8.84
	Ply 33-1 @ 135°	57.99	58.63	58.31	58.31							100%	58.31	68.21
	Ply 33-2 @ 135°	56.17	57.73	56.95	56.95							100%	56.95	65.49
	Ply 34-2 @ 45°	28.45	30.26	29.34	29.34							100%	29.34	33.74
	Ply 34-2 @ 45°	14.26	15.93	15.10	15.10							100%	15.10	17.37
18.	Debulk preparation	26.90	27.93	27.42	27.42							100%	27.42	31.53
19.	Place under vacuum	300.00	300.00	300.00	300.00							100%	300.00	300.00
20.	Update Paperwork	37.00	37.00	37.00							37.00	100%	37.00	42.55
21.	Removed B2000	23.39	29.62	26.51	26.51							100%	26.51	30.49

22.	Lay-up ply by ply													
	Ply 35 @ 135°	36.36	37.83	37.10	37.10							100%	37.10	42.67
	Ply 38 @ 45°	11.44	12.93	12.19	12.19							100%	12.19	14.02
	Ply 36 @ 135°	9.25	10.34	9.80	9.80							100%	9.80	11.27
	Ply 39 @ 45°	6.74	7.32	7.03	7.03							100%	7.03	8.08
	Ply 37 @ 135°	12.40	13.48	12.94	12.94							100%	12.94	14.88
	Ply 40 @ 45°	14.67	15.93	15.3	15.3							100%	15.30	17.60
	Ply 41 @ 90°	56.34	57.43	56.89	56.89							100%	56.89	65.42
	Ply 42-1 @ 0°	53.26	54.92	54.09	54.09							100%	54.09	62.20
	Ply 42-2 @ 0°	27.89	28.74	28.32	28.32							100%	28.32	32.57
23.	Debulk preparation	28.46	30.34	29.4	29.4							100%	29.40	33.81
24.	Place under vacuum	300.00	300.00	300.00	300.00							100%	300.00	300.00
25.	Update Paperwork	37.00	37.00	37.00							37.00	100%	37.00	42.55
26.	Remove B2000	23.39	29.62	26.51	26.51							100%	26.51	30.49
27.	Lay-up ply by ply.													
	Ply 45 @ 0°	6.18	6.27	6.23	6.23							100%	6.23	7.16
	Ply 48 @ 90°	7.66	7.36	7.51	7.51							100%	7.51	8.64
	Ply 43 @ 0°	5.27	6.12	5.70	5.70							100%	5.70	6.56
	Ply 46 @ 90°	11.21	13.00	12.11	12.11							100%	12.11	13.93
	Ply 44 @ 0°	9.54	10.25	9.90	9.90							100%	9.90	11.39
	Ply 47 @ 90°	6.88	7.21	7.05	7.05							100%	7.05	8.11
	Ply 49-1 @ 135°	33.70	34.41	34.06	34.06							100%	34.06	39.17
	Ply 49-2 @ 135°	23.19	22.99	23.09	23.09							100%	23.09	26.55
	Ply 50-1 @ 45°	26.80	27.31	27.06	27.06							100%	27.06	31.12
	Ply 50-2 @ 45°	12.76	13.45	13.11	13.11							100%	13.11	15.08
28.	Debulk preparation	97.31	98.23	97.77	97.77							100%	97.77	112.44
29.	Place under vacuum	300.00	300.00	300.00	300.00							100%	300.00	300.00
	TOTAL TIME (second)	3949.34	4621.34	4285.34	3338.30	153.95	0	0	0	0	0	793.09	4285.34	4703.14
	TOTAL TIME (minute)	65.82	77.02	71.4	55.64	2.57	0	0	0	0	0	13.22	71.4	78.39
	TOTAL TIME (hour)	1.10	1.28	1.19	0.93	0.04	0	0	0	0	0	0.22	1.19	1.31

APPENDIX C

UTeM

BasicMOST

Description:

LAY UP SKIN INSERT 1

Date:

Mar-09

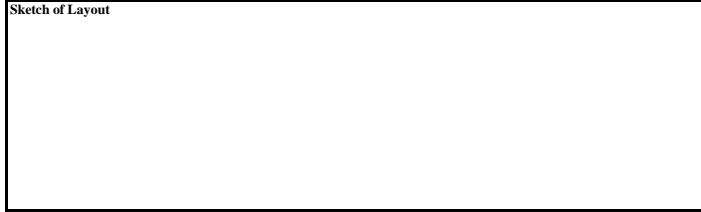
Analyst:

HELMY ROMINOR

Page:

01-01

Sketch of Layout



SUMMARY

Classification	O	NO	TIME
OPERATIONS	O		9640.00
TRANSPORT	T		0.00
INSPECTION	I		0.00
DELAYS	D		0.00
STORAGE	S		0.00
Total Time			

No	Activities	L R	Activities Sequence	Frequency		Classification Time (TMU)					0.036	Rating (100%) = 1.00	BT (sec)	ST (sec)	
				cf	rf	O	T	I	D	S					
1	Stack the profiles by following the sequence number		A1 B3 G3 A6 B3 P3 A1	26		5200						187.20	100%	187.20	215.28
2	Lay-up ply by ply.														
	Ply 1-6 @ 45°		A1 B0 G1 A1 B0 P1 S10 A1 B0 P1 A0	1		160						5.76	100%	5.76	6.62
	Ply 2-5 @ 135°		A1 B0 G1 A1 B0 P1 S10 A1 B0 P1 A0	1		160						5.76	100%	5.76	6.62
	Ply 3-4 @ 0°		A1 B0 G1 A1 B0 P1 S10 A1 B0 P1 A0	1		160						5.76	100%	5.76	6.62
	Ply 4-8 @ 90°		A1 B0 G1 A1 B0 P1 S10 A1 B0 P1 A0	1		160						5.76	100%	5.76	6.62
	Ply 3-6 @ 0°		A1 B0 G1 A1 B0 P1 S10 A1 B0 P1 A0	1		160						5.76	100%	5.76	6.62
	Ply 4-5 @ 90°		A1 B0 G1 A1 B0 P1 S10 A1 B0 P1 A0	1		160						5.76	100%	5.76	6.62
	Ply 1-2 @ 45°		A1 B0 G1 A1 B0 P1 S10 A1 B0 P1 A0	1		160						5.76	100%	5.76	6.62
	Ply 2-1 @ 135°		A1 B0 G1 A1 B0 P1 S10 A1 B0 P1 A0	1		160						5.76	100%	5.76	6.62
	Ply 4-6 @ 90°		A1 B0 G1 A1 B0 P1 S10 A1 B0 P1 A0	1		160						5.76	100%	5.76	6.62
	Ply 1-5 @ 90°		A1 B0 G1 A1 B0 P1 S10 A1 B0 P1 A0	1		160						5.76	100%	5.76	6.62
	Ply 2-4 @ 135°		A1 B0 G1 A1 B0 P1 S10 A1 B0 P1 A0	1		160						5.76	100%	5.76	6.62
	Ply 3-3 @ 0°		A1 B0 G1 A1 B0 P1 S10 A1 B0 P1 A0	1		160						5.76	100%	5.76	6.62
	Ply 4-4 @ 90°		A1 B0 G1 A1 B0 P1 S10 A1 B0 P1 A0	1		160						5.76	100%	5.76	6.62
	Ply 4-7 @ 90°		A1 B0 G1 A1 B0 P1 S10 A1 B0 P1 A0	1		160						5.76	100%	5.76	6.62
	Ply 3-1 @ 0°		A1 B0 G1 A1 B0 P1 S10 A1 B0 P1 A0	1		160						5.76	100%	5.76	6.62
	Ply 2-2 @ 135°		A1 B0 G1 A1 B0 P1 S10 A1 B0 P1 A0	1		160						5.76	100%	5.76	6.62
	Ply 1-1 @ 45°		A1 B0 G1 A1 B0 P1 S10 A1 B0 P1 A0	1		160						5.76	100%	5.76	6.62
	Ply 4-2 @ 90°		A1 B0 G1 A1 B0 P1 S10 A1 B0 P1 A0	1		160						5.76	100%	5.76	6.62
	Ply 2-3 @ 135°		A1 B0 G1 A1 B0 P1 S10 A1 B0 P1 A0	1		160						5.76	100%	5.76	6.62
	Ply 1-3 @ 45°		A1 B0 G1 A1 B0 P1 S10 A1 B0 P1 A0	1		160						5.76	100%	5.76	6.62
	Ply 4-3 @ 90°		A1 B0 G1 A1 B0 P1 S10 A1 B0 P1 A0	1		160						5.76	100%	5.76	6.62
	Ply 3-2 @ 0°		A1 B0 G1 A1 B0 P1 S10 A1 B0 P1 A0	1		160						5.76	100%	5.76	6.62
	Ply 4-1 @ 90°		A1 B0 G1 A1 B0 P1 S10 A1 B0 P1 A0	1		160						5.76	100%	5.76	6.62
	Ply 3-5 @ 0°		A1 B0 G1 A1 B0 P1 S10 A1 B0 P1 A0	1		160						5.76	100%	5.76	6.62
	Ply 2-6 @ 135°		A1 B0 G1 A1 B0 P1 S10 A1 B0 P1 A0	1		160						5.76	100%	5.76	6.62
	Ply 1-4 @ 45°		A1 B0 G1 A1 B0 P1 S10 A1 B0 P1 A0	1		160						5.76	100%	5.76	6.62
3	Manual consolidate and trim ply		A1 B0 G1 A1 B0 P1 C10 A1 B0 P1 A0	1		160						5.76	100%	5.76	6.62
4	Apply 1 layer of B2000 Release Film and Breather N10		A1 B3 G1 A1 B3 P3 A0	1		120						4.32	100%	4.32	4.97
5	Place under vacuum (5 minutes)			1									100%	300.00	300.00
Total Time															
											Total Time (unit/second)		698.99		
											unit/min		11.65		
											unit/hour		0.19		

TIME STUDY SHEET

**A320 SPOILER
LAY-UP
INSERT SPOILER 1**

**DATE: MARCH 2009
ANALYST: HELMY ROMINOR
PAGE: 1/1**

No.	Element Description	OBSERVATION (sec)		A.T (sec)	VA	NON VALUE ADDED							Rating (%)	B.T (sec)	S.T (sec)
		1	2			O	T	I	M	W	O	O			
1.	Stack the profiles by following the sequence number	57.71	55.54	56.63	56.63								100%	56.63	65.12
2.	Lay-up ply by ply.														
	Ply 1-6 @ 45°	3.48	10.91	7.20	7.20								100%	7.20	8.28
	Ply 2-5 @ 135°	9.14	10.35	9.75	9.75								100%	9.75	11.21
	Ply 3-4 @ 0°	6.83	5.58	6.21	6.21								100%	6.21	7.14
	Ply 4-8 @ 90°	7.05	7.86	7.46	7.46								100%	7.46	8.58
	Ply 3-6 @ 0°	9.92	8.04	8.98	8.98								100%	8.98	10.33
	Ply 4-5 @ 90°	9.18	8.79	8.99	8.99								100%	8.99	10.34
	Ply 1-2 @ 45°	6.41	8.88	7.65	7.65								100%	7.65	8.80
	Ply 2-1 @ 135°	12.27	12.55	12.41	12.41								100%	12.41	14.27
	Ply 4-6 @ 90°	10.21	9.99	10.1	10.1								100%	10.1	11.62
	Ply 1-5 @ 90°	6.14	6.35	6.25	6.25								100%	6.25	7.19
	Ply 2-4 @ 135°	9.08	8.38	8.73	8.73								100%	8.73	10.04
	Ply 3-3 @ 0°	7.53	7.70	7.62	7.62								100%	7.62	8.76
	Ply 4-4 @ 90°	8.40	8.12	8.26	8.26								100%	8.26	9.50
	Ply 4-7 @ 90°	6.61	7.00	6.81	6.81								100%	6.81	7.83
	Ply 3-1 @ 0°	7.51	7.17	7.34	7.34								100%	7.34	8.44
	Ply 2-2 @ 135°	10.30	10.31	10.31	10.31								100%	10.31	11.86
	Ply 1-1 @ 45°	6.98	7.35	7.17	7.17								100%	7.17	8.25
	Ply 4-2 @ 90°	20.26	19.96	20.11	20.11								100%	20.11	23.13
	Ply 2-3 @ 135°	10.04	9.83	9.94	9.94								100%	9.94	11.43
	Ply 1-3 @ 45°	6.36	6.83	6.60	6.60								100%	6.60	7.59
	Ply 4-3 @ 90°	6.92	6.76	6.84	6.84								100%	6.84	7.87
	Ply 3-2 @ 0°	6.92	7.20	7.06	7.06								100%	7.06	8.12
	Ply 4-1 @ 90°	7.75	7.64	7.70	7.70								100%	7.70	8.86
	Ply 3-5 @ 0°	8.48	8.07	8.28	8.28								100%	8.28	9.52
	Ply 2-6 @ 135°	9.28	9.50	9.39	9.39								100%	9.39	10.80
	Ply 1-4 @ 45°	8.27	8.01	8.14	8.14								100%	8.14	9.361

3.	Manual consolidate and trim ply	13.77	12.52	13.15	13.15								100%	13.15	15.12
4.	Apply 1 layer of B2000 Release Film and Breather N10	33.45	22.07	27.76	27.76								100%	27.76	31.92
5.	Place under vacuum	300.00	300.00	300.00								300.00	100%	300.00	300.00
	TOTAL TIME (second)	626.25	619.26	622.84	322.84	0	0	0	0	0	0	300.00		622.84	716.27
	TOTAL TIME (minute)	10.44	10.32	10.38	5.38	0	0	0	0	0	0	5.00		10.38	11.94
	TOTAL TIME (hour)	0.174	0.172	0.173	0.090	0	0	0	0	0	0	0.083		0.173	0.199