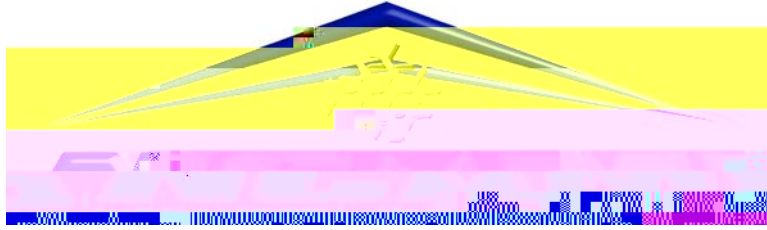


Report No: NCP-RP-2018-017 Rev N/C  
Report Date: December 19, 2019"



# Equivalency Statistical Analysis for Laminate Repair Prepreg Batch of Solvay (Formerly Cytec) 5320-1 T650 3K-PW fabric with 36% RC

NCAMP Project Number: NPN 031801

NCAMP Test Report Number: NCP-RP-2018-017 Rev N/C"

Report Date: December 19, 2019

## Elizabeth Clarkson, Ph.D.

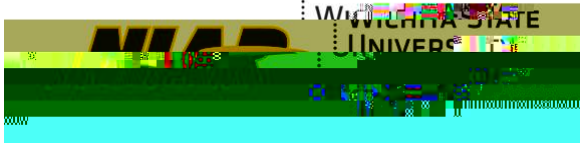
Pcvkqpcn"Egpgvt"hqt"Cfxcpgef"Ocvgtkcnu"Rgthqt o cpeg"\*PECOR+  
Pcvkqpcn"Kpukvwvg"hqt"Cxkcvkqp"Tgugcte.j"  
Yke.jkvc"Uvcvg"Wpkxgtukv{"  
Yke.jkvc."MU"89482/22;5"

## Testing Facility:

Pcvkqpcn"Kpukvwvg"hqt"Cxkcvkqp"Tgugcte.j"  
Yke.jkvc"Uvcvg"Wpkxgtukv{"  
3:67"P0"Hckt o qwpv"  
Yke.jkvc."MU"89482/22;5"  
"

## Test Panel Fabrication Facility:

Pcvkqpcn"Kpukvwvg"hqt"Cxkcvkqp"Tgugcte.j/PECV"  
Yke.jkvc"Uvcvg"Wpkxgtukv{"



**Report No: NCP-RP-2018-017 Rev N/C**  
**Report Date: December 19, 2019"**

**Prepared by:**

**Elizabeth Clarkson**

**Reviewed by:**

" **Jonathan Tisack**

**Approved by:**

" **Royal Lovingfoss** "







**December 19, 2019**

**NCP-RP-2018-017 Rev N/C"**

## **1. Introduction**

rgthqtokpi"rgtkqfke"gswxcngepe{lcf flvkqpcn"vguvki."rctvkekrcvki"kp"ocvgtkcn"ejcpig"opcigogpv"  
cevxkvkgu."eqpfwevki"uvckvkecn"rtqeguueqpvtn."cpf"eqpfwevki"tgiwnct"uwr rnkgt"cwfkvu0"

Vjg"crnkcedknkv{"cpf"ceewtce{"qh"PECOR"ocvgtkcn"rtqrgtv{"fcvc."ocvgtkcn"cnqycdngu."cpf"  
urgekhecvkqpu"owuv"dg"gxcnwcvgf"qp"ecug/d{/ecug"dcuku"d{"cktetchv"eq"rcpkgu"cpf"egtkh{kpi"  
cigpekgu0"PECOR"cuuwogu"pq"nkcdknkv{"yjcvuqgxtg."gzrtguugf"qt"ko rnkgtf."tncvvgf"vq"vjg"wg"qh"  
vjg"ocvgtkcn"rtqrgtv{"fcvc."ocvgtkcn"cnqycdngu"cpf"urgekhecvkqpu0"

Vjg"fcvc"kp"vjku"tgrqtv"ku"kpvgpfgf"hq"igpgtcn"fkuvtkdvwkqp"vq"vjg"rwdnke."gkvjgt"htgg{"qt"cv"c"rtkeg"  
vjcv"fqgu"pqv"gzeggf"vjg"equv"qh"tgrtqfwevki"gi0"rtkpvki+"cpf"fkuvtkdvwkqp"gi0"rquvcig+0"

**1.1 Symbols and Abbreviations**

Test Property	Abbreviation
Yctr"Eq ortguukqp"	YE"
Yctr"Vgpukqp"	YV"
Hknn"Eq ortguukqp"	HE"
Hknn"Vgpukqp"	HV"
Kp/Rncpg"Ujgct"	KRU"
Ujqtv"Dgc o "Uvtgpi vj"	UDU"
Qrgp"Jqng"Vgpukqp"	QJV"
Qrgp"Jqng"Eq ortguukqp"	QJE"
Eq ortguukqp"Chvgt"K o rcev"	ECK"
Ewtgfrn{"Vjkempguu"	ERV"
F{pc o ke"Ogejcpkecn"Cpcn{uku	FOC"

**Table 1-1 Test Property Abbreviations**

Environmental Condition	Temperature	Abbreviation
Eqnf"Vg o rgtcvwtg" Ft{ ""	87a"07•H"	EVF"
Tqq o "Vg o rgtcvwtg" Ft{ ""	"97a"032•H"	TVF"
Gngxcvgf"Vg o rgtcvwtg" Ygv"	"472a"07•H"	GVY4"

**Table 1-2 Environmental Conditions Abbreviations**

Vguvu"ykvj"cpw o dgt"ko o gfkcygn{"chvgt"vjg"cdtdgxkcvkqp"kp fkecvg"vjg"nc{/wr<"  
 " 3"tghgtu"vq"c"47172147"nc{wr0"Vjku"ku"cnuq"tghgttgf"vq"cu"0Swcuk/Kuqvtqrke0"  
 " 4"tghgtu"vq"c"321:2132"nc{wr0"Vjku"ku"cnuq"tghgttgf"vq"cu"0Uqhv0"  
 " 5"tghgtu"vq"c"62142162"nc{wr0"Vjku"ku"cnuq"tghgttgf"vq"cu"0Jctf0"  
 " GZ<"QJV3"ku"cp"qrgp"jqng"vgpukqp"vguv"ykvj"swcuk/kuqvtqrke"nc{wr0"

## 2. Background

Gswkxcngpeg"vguvu"ctg"rgthqt o gf"kp"ceeqtfcpeg"ykvj"ugevkqp":0603"qh"EO J/39/3 I"cpf"ugevkqp"803"  
 qh"FQVIHCCICT/2513;.δOcvgtkcn"Swcnkhkecvkqp"cpf"Gswkxcngpe{"hqt"Rqn{ o gt"Ocvtkz"  
 Eq o rqukvg"Ocvgtkcn"U{ uvg o uκ"W r fcvgf"Rtqegfwtgöö"  
 "

### 2.1 Results Codes

**Pass**"kpfkcevgu"vjcv"vjg"vguv"tguwnvu"ctg"gswwxcngpv"hqt"vjcv"gpvktqp o gpv"wpfgt"dqvj"eq o rwwcvkqpcn"  
 o gvjqfu0"  
 "

**Fail**"kpfkcevgu"vjcv"vjg"vguv"tguwnvu"ctg"PQV"gswwxcngpv"wpfgt"dqvj"eq o rwwcvkqpcn" o gvjqfu0"  
 "

**Pass with Mod CV** kpfkcevgu"vjg"vguv"tguwnvu"ctg"gswwxcngpv"wpfgt"vjg"cuuw o rvkqp"qh"vjg" o qfkhkgf"  
 EX" o gvjqf"vjcv"vjg"eqghkekgpv"qh"xctkcvkqp"ku"cv"ngcuv"8"dww"vjg"vguv"tguwnvu"hc kn"ykvjqwv"vjg"wg"qh"  
 vjg" o qfkhkgf"EX" o gvjqf0"  
 "

### 2.2 Equivalency Computations

Gswkxcngpe{"vguvu"ctg"rgthqt o gf"vq"fgvgt o kpg"kh"vjg"fkhhgtgpegu"dgy y ggp"vguv"tguwnvu"ecp"dg"  
 tgcupcdn{"gzrnckpgf"cu"fwg"vq"vjg"gzrgevfg"tcpfq o "xctkcvkqp"qh"vjg" o cvgtkcn"cpf"vguvkpi"  
 rtqeguugu0"Kh"uq." y g"ecp"eqpenwfg"vjg"v y q"ugvu"qh"vguvu"ctg"htq o "-:gswkxcngpvø" o cvgtkcnu0"  
 "

#### 2.2.1 Hypothesis Testing

Vjku"eq o rctkuqp"ku"rgthqt o gf"wukpi"vjg"uvcvkuvkecn" o gvjqfq nqi {"qh"j { rqvjguku" 6 Z go



2.2.2 Type I and Type II Errors

	<i>Materials are equal</i>	<i>Materials are not equal</i>
<i>Conclude materials are equal</i>	<i>Correct</i>	

2.2.4 Strength and Modulus Tests

Hqt"uvtgpi vj "vguv"xcnwgu." yg"ctg" rtk o ctkn{ "eqpegtpgf" qpn{ "kh"vjg"gswxncngpeg"uc o rng"ujqyu"nqygt"  
 uvtgpi vj "xcnwgu"vjcp"vjg"qtkikpcn"swcnkhkecvkqp" o cvgtkcnu0"Vjku"ku"tghgttgf"vq"cu"c"=:qpg/ukfgf0"  
 j { rqvjguku"vguv0" Jki jgt"xcnwgu"ctg"pqv"eqpukfgtgf"c"rtqdn go ."vjqwi j"vjg{ "oc{ "kpfkecvg"c"  
 fkhhtgpeg"dgvyggp"vjg"vyq" o cvgtkcnu0"Vjg"gswxncngpeg"uc o rng" o gcp"cpf"uc o rng" o kpk o w o "  
 xcnwgu"ctg"eq o rctgf"ci ckpuv"vjg" o kpk o w o "gzrgevfg"xcnwgu"hqt"vjqug"ucvkuvkeu." y jkej"ctg"  
 eq o rwwgf"htq o "vjg"swcnkhkecvkqp"vguv"tguwnv0"  
 "

Vjg"gzrgevfg"xcnwgu"ctg"eq o rwwgf" wukpi "vjg"xcnwgu"nkuvfg"kp"Vcdng"4/3"cpf"Vcdng"4/4"ceeqtfkpi "  
 vq"vjg"hqnnqykpi "hqt o wncu<"  
 "

$$Vjg" o gcp" o wuv"gzeggf" \bar{X} \quad k_n^{table 403} \quad S \quad y jgtg" \bar{X} \quad cpf"U"ctg."tgur gev kxgn\{."vjg" o gcp"cpf"vjg" \\
 uvcpfctf" fgxkcvkqp"qh"vjg"swcnkhkecvkqp"uc o rng0""$$

$$Vjg"uc o rng" o kpk o w o " o wuv"gzeggf" \bar{X} \quad k_n^{table 404} \quad S \quad y jgtg" \bar{X} \quad "cpf"U"ctg."tgur gev kxgn\{."vjg" \\
 o gcp"cpf"vjg"ucpfctf" fgxkcvkqp"qh"vjg"swcnkhkecvkqp"uc o rng0""$$

Kh"gvjgt"vjg" o gcp"qt"vjg" o kpk o w o "hcnu"dgnqy"vjg" \_

	<b>0.25</b>	<b>0.1</b>	<b>0.05</b>	<b>0.025</b>	<b>0.01</b>	<b>0.005</b>	<b>0.0025</b>	<b>0.001</b>	<b>0.0005</b>
<b>2</b>	0.6266	1.0539	1.3076	1.5266	1.7804	1.9528	2.1123	2.3076	2.4457
<b>3</b>	0.5421	0.8836	1.0868	1.2626	1.4666	1.6054	1.7341	1.8919	2.0035
<b>4</b>	0.4818	0.7744	0.9486	1.0995	1.2747	1.3941	1.5049	1.6408	1.7371
<b>5</b>	0.4382	0.6978	0.8525	0.9866	1.1425	1.2488	1.3475	1.4687	1.5546
<b>6</b>	0.4048	0.6403	0.7808	0.9026	1.0443	1.1411	1.2309	1.3413	1.4196
<b>7</b>	0.3782	0.5951	0.7246	0.8369	0.9678	1.0571	1.1401	1.2422	1.3145
<b>8</b>	0.3563	0.5583	0.6790	0.7838	0.9059	0.9893	1.0668	1.1622	1.2298
<b>9</b>	0.3379	0.5276	0.6411	0.7396	0.8545	0.9330	1.0061	1.0959	1.1596
<b>10</b>	0.3221	0.5016	0.6089	0.7022	0.8110	0.8854	0.9546	1.0397	1.1002
<b>11</b>	0.3084	0.4790	0.5811	0.6699	0.7735	0.8444	0.9103	0.9914	1.0490
<b>12</b>	0.2964	0.4593	0.5569	0.6417	0.7408	0.8086	0.8717	0.9493	1.0044
<b>13</b>	0.2856	0.4418	0.5354	0.6168	0.7119	0.7770	0.8376	0.9121	0.9651
<b>14</b>	0.2760	0.4262	0.5162	0.5946	0.6861	0.7488	0.8072	0.8790	0.9300
<b>15</b>	0.2673	0.4121	0.4990	0.5746	0.6630	0.7235	0.7798	0.8492	0.8985
<b>16</b>	0.2594	0.3994	0.4834	0.5565	0.6420	0.7006	0.7551	0.8223	0.8700
<b>17</b>	0.2522	0.3878	0.4692	0.5400	0.6230	0.6797	0.7326	0.7977	0.8440
<b>18</b>	0.2455	0.3771	0.4561	0.5250	0.6055	0.6606	0.7120	0.7753	0.8202
<b>19</b>	0.2394	0.3673	0.4441	0.5111	0.5894	0.6431	0.6930	0.7546	0.7984
<b>20</b>	0.2337	0.3582	0.4330	0.4982	0.5745	0.6268	0.6755	0.7355	0.7782
<b>21</b>	0.2284	0.3498	0.4227	0.4863	0.5607	0.6117	0.6593	0.7178	0.7594
<b>22</b>	0.2235	0.3419	0.4131	0.4752	0.5479	0.5977	0.6441	0.7013	0.7420
<b>23</b>	0.2188	0.3345	0.4041	0.4648	0.5359	0.5846	0.6300	0.6859	0.7257
<b>24</b>	0.2145	0.3276	0.3957	977	7				

	<b>0.25</b>	<b>0.1</b>	<b>0.05</b>	<b>0.025</b>	<b>0.01</b>	<b>0.005</b>	<b>0.0025</b>	<b>0.001</b>	<b>0.0005</b>
<b>2</b>	1.2887	1.8167	2.1385	2.4208	2.7526	2.9805	3.1930	3.4549	3.6412
<b>3</b>	1.5407	2.0249	2.3239	2.5888	2.9027	3.1198	3.3232	3.5751	3.7550
<b>4</b>	1.6972	2.1561	2.4420	2.6965	2.9997	3.2103	3.4082	3.6541	3.8301
<b>5</b>									

"  
 V jku"ku"eqpxgtvgf"vq"rgtegpv"d{" o wnvkrn{kpi"d{"322 ' 0"  
 " EX"ku"wugf"vq"eq o rrwg"c" o qfkhkgf"uvcpfctf"fgxkcvkqp"U"0"  
 "

$$S = CV \cdot \bar{X} \tag{Equation 2}$$

"  
 Vq"eq o rrwg"vjg"rqqngf"uvcpfctf"fgxkcvkqp"dcugf"qp"vjg" o qfkhkgf"EX"<  
 "

$$S_p = \sqrt{\frac{\sum_{i=1}^k n_i (CV_i - \bar{X}_i)^2}{k-1}} \tag{Equation 3}$$

"  
 V jg"C/dcuku"cpf"D/dcuku"xcnwgu"wpfgt"vjg"cuuw o rvkqp"qh"vjg" o qfkhkgf"EX" o gvjqf"ctg"eq o rrwg"  
 d{"tgrncekpi"U" ykvj"U"0"  
 "

Y jgp"vjg"dcuku"xcnwgu" jcxg"dggp"ugv"wukpi"vjg" o qfkhkgf"EX" o gvjqf." yg"ecp"wug"vjg" o qfkhkgf"  
 EX"vq"eq o rrwg"vjg"gswkxcngpe{"vguv"tguwnvu0"  
 "

### 3. Equivalency Test Results

Vjgtg"ygtg"cvqvcn"qh"5;"fkhhtgtpv"vguvu"qh"gswkxcngpeg"twp"ykvj"uwhhkekppv"fcvc"ceeqtfkpi"vq"vjg"  
 tgeqo"ogpfcvkqpu"qh"EOJ/39/3I0"Vjgtg"ygtg"cp"cfkfkqpcn"vyq"vguvu"rgthqto"gf"ykvj"  
 kpuwhhkekppv"fcvc0"C"eqo"rectkuqp"qh"vjg"cxgtci"g"ewtgf"rn{"vj" Kempguu"cpf"FOC"tguwnvu"ycu"cnuc"  
 ocfg0"Cnn"vguvu"ygtg"rgthqto"gf"ykvj"cp" "ngxgn"qh"7 ' 0"  
 "

Vjg"tguwnvu"qh"vjg"gswkxcngpe{"eqo"rectkuqp"ctg"nkuvgf"cu":Rcuuø."÷Hcknø."qt":Rcuu"ykvj"Oqf"EXø"  
 :Rcuu"ykvj"Oqf"EXø"tghgtu"vq"ecugu"y"jgtg"vjg"gswkxcngpe{"hcknu"wpnguu"vjg"oqfkhkgf"eqghhkekppv"  
 qh"xctkcvkqp"ogvjqf"ku"wugf0"C"okpkowo"qh"gkijv"ucoringu"htqo"vyq"ugrctcvg"rcpgnu"cpf"  
 rtqeguukpi"e{engu"ku"tgswtgf"hqt



"

Description	Modulus	Strength
Oknf"Hcknwtg"	' "hckn""Ö"6 ' "	' "hckn""Ö"7 ' "
Oknf"vq"Oqfgtcvg"Hcknwtg"	6 ' ">" ' "hckn""Ö": ' "	7 ' ">" ' "hckn""Ö"32 ' "
Oqfgtcvg"Hcknwtg"	: ' ">" ' "hckn""Ö"34 ' "	32 ' ">" ' "hckn""Ö"37 ' "
Oqfgtcvg"vq"Ugxgtg"Hcknwtg"	34 ' ">" ' "hckn""Ö"38 ' "	37 ' ">" ' "hckn""Ö"42 ' "
Ugxgtg"Hcknwtg"	38 ' ">" ' "hckn""Ö"42 ' "	42 ' ">" ' "hckn""Ö"47 ' "
Gzvtg o g"Hcknwtg"	42 ' ">" ' "hckn"	47 ' ">" ' "hckn"

**Table 3-2 "% Failed" Results Scale**



**December 19, 2019**

**NCP-RP-2018-017 Rev N/C"**

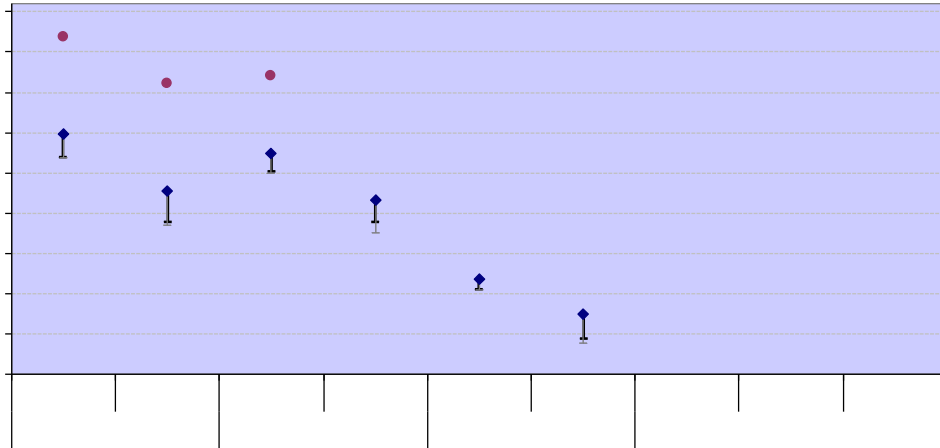
I tcr jkecn"rtgugpvcvkqpu"qh"cm"vg

### 3.1 Warp Compression (WC)

Vjg"YE"fcvc"ku"pqt ocnk |gf0"Dqvj"vjg"YE"uvtgpi vj"fcvc"cpf" o qfwnwu"fcvc"rcuugf"gswxengpe{"  
 vguvu"hqt"cn"vguvgf"eqpfkvkqpu0""Uvcvkuvkeu"cpf"cpn{uku"tguwnvu"ctg"ujqyp"hqt"vjg"uvtgpi vj"fcvc"kp"  
 Vcdng"5/5"cpf"hqt"vjg" o qfwnwu"fcvc"kp"Vcdng"5/60"

	Qual.	Equiv.	Qual.	Equiv.	Qual.	Equiv.
Fcvc"pqtocnk gf"ykvj"ERV"202299						
Ogcp"Uvtgpi vj"*muk+	32906:7	3530847	3240897	3440385	930633	990329
Uvepctf"fgxkcvkqp	:0253	7024:	80484	50:77	60:75	8058:

Hkiwtg"5/5"knwuvtcvgu"vjg"2à"Eqo rtguukqp"uvtgpi vj "ogcpu"cpf"okpkowo"xcnwgucpf"oqfwnwu"  
ogcpu"hqt"vjg"swcnkhkecvkqp"ucoring"cpf"vjg"gswxcngpe{"ucoring"Vjg"nko kvu"hqt"gswxcngpe{"  
ucoring"ctg"ujqyp"cu"gttqt"dctu"ykvj"vjg"swcnkhkecvkqp"fcvc0"Vjg"nqpi gt."nki jvgt"eqnqtgf"gttqt"dctu"  
ctg"hqt"vjg"oqfkhkgf"EX"eqorwvcvkqpu0"  
"



3.2 Warp Tension (WT)

Vjg"YV"fcvc"ku"pqt ocnk|gf0"Dqvj"vjg"YV"vgtgpi vj"fcvc"cpf"o qfwnwu"fcvc"rcuugf"gswxengpe{"  
 vguvu"hqt"cn"vguvgf"eqpfkvkqpu0"Uvcvkuvkeu"cpf"cpn{uku"tguwnvu"ctg"ujqyp"hqt"vjg"vgtgpi vj"fcvc"kp"  
 Vcdng"5/7"cpf"hqt"vjg"o qfwnwu"fcvc"kp"Vcdng"5/80"  
 "

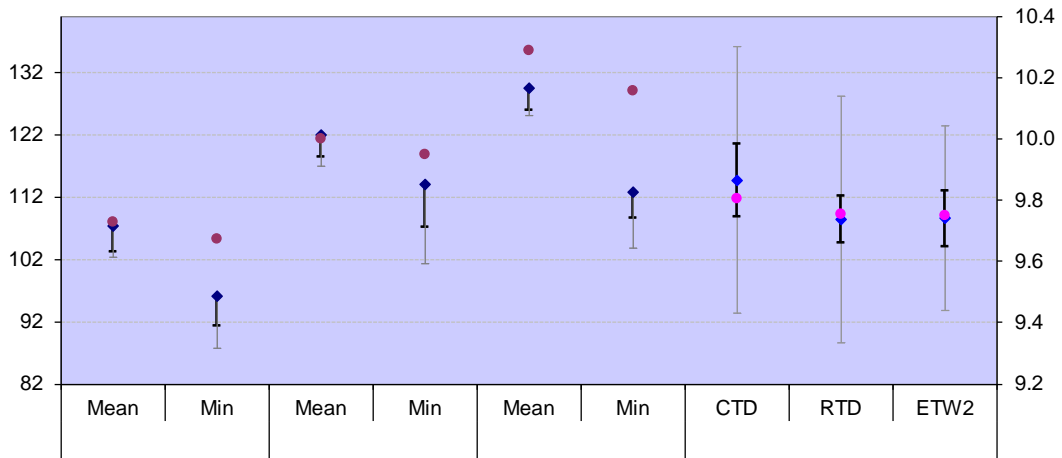
Warp Tension (WT) Strength	CTD		RTD		ETW2	
	Qual.	Equiv.	Qual.	Equiv.	Qual.	Equiv.
Fcvc"pqtocnk gf"ykvj"ERV"2/2299						
Ogcp"Uvgtgpi vj"*muk+	329/49;	32:0243	343/5:	343/538	34:0576	357/632
Uvcpfctf"fgxkcvkqp	70:;6	4/622	7/547	4/238	9/297	5/56;
Eqghhkekgpv"qh"Xctkcvkqp"	7/6;6	4/444	6/593	3/884	7/68;	4/695
Olpkwo	;70;5	327/395	335/;43	33:0:2:	334/;36	34;025:
Oczkwo	343/276	333/99;	353/827	346/88;	359/778	362/75:
Pwodgt"qh"Urgekogpu	43	:	44	:	44	38
<b>RESULTS</b>	<b>PASS</b>		<b>PASS</b>		<b>PASS</b>	
Olpkwo"Ceegrvcvng"Gswx0"Ucoring"Ogcp	325/499		33:0646		347/;56	
Olpkwo"Ceegrvcvng"Gswx0"Ucoring"Olp	;3/587		329/464		32:082;	
<b>MOD CV RESULTS</b>	<b>PASS with MOD CV</b>		<b>PASS with MOD CV</b>		<b>PASS with MOD CV</b>	
Oqfhhkgf"EX"	8/969		8/3:7		8/957	
Olpkwo"Ceegrvcvng"Gswx0"Ucoring"Ogcp	324/586		339/229		347/365	
Olpkwo"Ceegrvcvng"Gswx0"Ucoring"Olp	:9/958		323/3:3		325/;2;	

Table 3-5 Warp Tension Strength Results

"

	Qual.	Equiv.	Qual.	Equiv.	Qual.	Equiv.
Fcvc"pqtocnk gf"ykvj"ERV"2/2299						
Ogcp"Oqfwnwu"*Ouk+	;0:87	;0:28	;095:	;0977	;0963	;0973
Uvcpfctf"fgxkcvkqp	2/37:	2/284	2/326	2/289	2/35:	2/367
Eqghhkekgpv"qh"Xctkcvkqp"	3/828	2/859	3/287	2/8::	3/654	3/6:5
Olpkwo	;0773	;094:	;0769	;0885	;06;;	;06:9
Oczkwo	32/285	;0;2:	;0;88	;0;24	;0;:9;0	09
E 30		50 è	lk o	e		

Hk i wtg"5/6"knwuvtcvgu"vjg"2à"Vgpukqp"uvtgpi vj " o gcpu"cpf" o kpk o w o "xcnwgu"cpf" o qfwnwu" o gcpu"hqt"  
vjg"swcnkhkecvkqp"uc o rng"cpf"vjg"gswxengpe{"uc o rng"Vjg"nk o kvu"hqt"gswxengpe{"uc o rngu"ctg"  
ujqyp"cu"gttqt"dctu"ykvj"vjg"swcnkhkecvkqp"fcvc"Vjg"nqpi gt."nki jvgt"eqnqtgf"gttqt"dctu"ctg"hqt"vjg"  
o qfkhkgf"EX"eq o rwvcvkqpu0"  
"

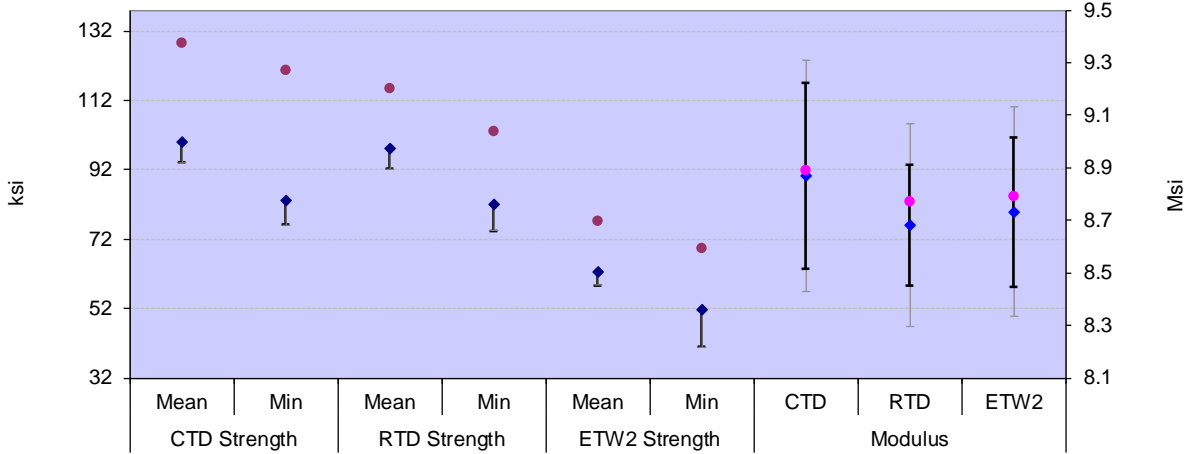


### 3.3 Fill Compression (FC)

Vjg"HE"fcvc"ku"pqt o cnk | gf0"Vjg"pqt o cnk | gf"HE"uvtgpi vj "fcvc"cpf" o qfwnwu"fcvc"rcuugf"  
gswkxcngpe{ "vguvu"hqt"cnm"vguvvf"eqpfkvpqu0""Oqfkhkgf"EX"tguwnvu"ygtg"pqv"rtqxkfgf"hqt"vjg"  
uvtgpi vj "fcvc"dgecwug"vjg"eqghhkekgpv"qh"xctkcvkqp"ycu"cdqyg": '

Hkiwtg"5/7"knwuvtcvgu"vjg";2Å"Eqo rrtguukqp"uvtgpi vj" ogcpu"cpf" o kpkow o "xcnwgucpf" o qfwnwu" o gcpu"hqt"vjg"swcnkhkecvkqp"uc o rng"cpf"vjg"gs wxcngpe {"uc o rng0"Vjg"nk o kvu"hqt"gs wxcngpe {" uc o rngu"ctg"ujqyp"cu"gttqt"dtu"ykvj"vjg"swcnkhkecvkqp"fcvc0"Vjg"nqpi gt."nki jvgt"eqnqtgf"gttqt"dtu" ctg"hqt"vjg" o qfkhkgf"EX"eq o r wvcvkqpu0"

Solvay (Formerly Cytec) 5320-1 T650 3k-PW fabric with 36% RC  
 Comparison of FAA Laminate Repair Stud A 6 ir dA 2



3.4 Fill Tension (FT)

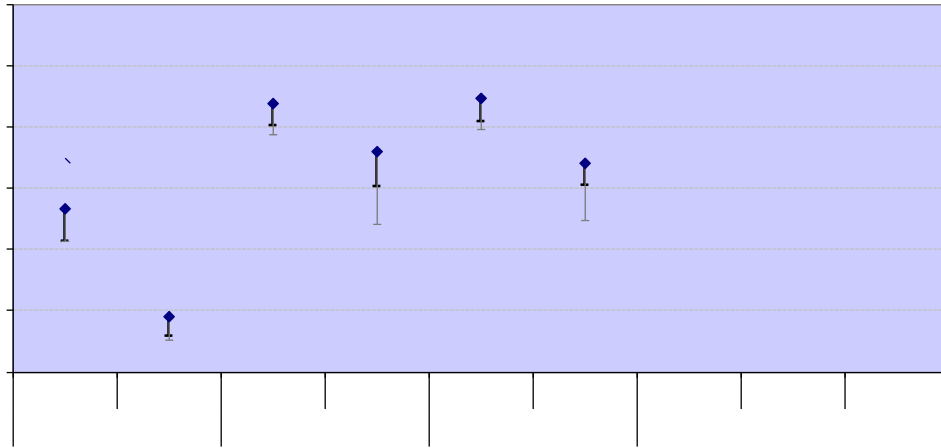
Vjg"HV"fcvc"ku"pqt o cnk |gf0"Vjg"pqt o cnk |gf"HV"uvtgpi vj "fcvc"cpf" o qfwnwu"fcvc"rcuugf"  
 gswkxcngpe{ "vguvu"hqt"cnm"vguvgf"eqpfkvkqpu0""

Uvcvkuvkeu"cpf"cpen{ uku"tguwnvu"ctg"ujqyp"hqt"vjg"uvtgpi vj "fcvc"kp"Vcdng"5/;"cpf"hqt"vjg" o qfwnwu"  
 fcvc"kp"Vcdng"5/320"

Fill Tension (FT) Strength	CTD		RTD		ETW2	
	Qual.	Equiv.	Qual.	Equiv.	Qual.	Equiv.
Fcvc"pqtocnk gf"ykvj"ERV"2/2299						
Ogcp"Uvtgpi vj"*muk	323/7:4	326/44:	33:089:	337/796	33:0748	34:07:4
Uvcpfctf"fgxkcvkqp	9/869	40:82	6/9;	5/9:8	7/385	6/755
Eqghhkekgp"qh"Xctkcvkqp"'	9/749	4/966	6/3:8	5/498	6/542	5/6:;
Olpkow o	:5/;78	322/333	332/;2	332/288	32:0;5;	347/334
Oczkow o	337/3:6	32:044;	349/553	343/77	348/858	358/722
Pwodgt"qh"Urgekogpu	43	:	43	:	43	:
<b>RESULTS</b>	<b>PASS</b>		<b>PASS</b>		<b>PASS</b>	
Olpkow o"Ceegrvcndng"Gswkx/0"Ucoring"Ogcp	:8/5; ;		337/4:9		338/242	
Olpkow o"Ceegrvcndng"Gswkx/0"Ucoring"Olp	:2/;66		327/456		327/7:8	
<b>MOD CV RESULTS</b>	<b>PASS with MOD CV</b>		<b>PASS with MOD CV</b>		<b>PASS with MOD CV</b>	
Oqfkhkgf"EX"'	9/986		8/2:;		8/382	
Olpkow o"Ceegrvcndng"Gswkx/0"Ucoring"Ogcp	:8/458		335/986		336/749	
Olpkow o"Ceegrvcndng"Gswkx/0"Ucoring"Olp	:2/4:8		:;035;		:;0869	



Hki wtg"5/8"knwuvtcvgu"vjg";2Å"Vgpukqp"uvtgpi vj" o gcpu"cpf" o kpk o w o "xcnwgu"cpf" o qfwnwu" o gcpu"  
hqt"vjg"swcnkhkecvkqp"uc o rng"cpf"vjg"gswxengpe{"uc o rng0"Vjg"nk o kvu"hqt"gswxengpe{"uc o rngu"ctg"  
ujqyp"cu"gttqt"dctu"ykvj"vjg"swcnkhkecvkqp"fcvc0"Vjg"nqpi gt."nki jvgt"eqnqtgf"gttqt"dctu"ctg"hqt"vjg"  
o fkhkgf"EX"eq o rwvcvkpu0"



### 3.5 Lamina Short Beam Strength (SBS)

Vjg"UDU"fcvc"ku"pqv"pqt o cnk | g f0"Vjg"UDU"fcvc"rcuugf"gs wxxcngpe {"vguvu"hqt"cn"vguvgf"eqp fkvkqpu0"

3.6 In-Plane Shear (IPS)

Vjg"KRU"fcvc"ku"pqv"pqt o cnk | gf0"Vjg"KRU"fcvc"rcuugf"cnm"gswxengpe{"vguvu"hqt"vjg"EVF"cpf"TVF"eqpfkvpqpu."cnvjqwij"vjg"vgtgpij"cv"7" "vutckp"fcvc"kp"vjg"EVF"eqpfkvpqptgswktgf"vjg"wug"qh"vjg"oqfkhkgf"EX"cr rtqcej"vq"rcuu"gswxengpe{0"Vjg"KRU"fcvc"kp"vjg"GVY4"eqpfkvpqpt"rcuugf"gswxengpe{"vguvu"qpn{"hqt"vgtgpij"cv"7" "vutckp."pqv"hqt"204" "qhhuvg"vgtgpij"qt"oqfwnwu"Vjg"vgtgpij"cv"7" "vutckp"fcvc"kp"vjg"EVF"eqpfkvpqptjcf"kpwhhkekgpv"fcvc"vgtgpij"tgwv"vq"dg"eqpukfgtgf"eqpenwukxg0"

Uvcvkukcu"cpf"cpn{uku"tgwvnu"ctg"ujqyp"vgtgpij"204" "qhhuvg"vgtgpij"fcvc"kp"Vcdng"5/34."vjg"vgtgpij"cv"7" "vutckp"fcvc"kp"Vcdng"5/35."cpf"vjg"oqfwnwu"fcvc"kp"Vcdng"5/360"

In-Plane Shear (IPS) 0.2% Offset Strength	CTD		RTD		ETW2	
	Qual.	Equiv.	Qual.	Equiv.	Qual.	Equiv.
Fvcv"cu"ogcuwtgf						
Ogcp"vgtgpij" B"204" "qhhuvg"mu-	330726	330758	:04;;	:0544	50982	50745
Uvcpfctf"fgxkcvkqp	2039;	203;8	20356	20274	2037;	20288
Eqghhkekgpv"qh"Xctkcvkqp"'	3077;	30925	30834	20852	6045;	30:92
Olpkow o	330233	33038;	:02;7	:0452	50767	50656
Oczkwo o	330:78	3309:;	:0836	:0637	6032:	50855
Pwodgt"qh"Urgekogpu	43	32	43	:	43	:
<b>RESULTS</b>	<b>PASS</b>		<b>PASS</b>		<b>FAIL</b>	
Olpkow o"Ceegrvcndng"Gswlx0"Uc orng"Ogcp	3305;7		:042;		50874	
Olpkow o"Ceegrvcndng"Gswlx0"Uc orng"Olp	330228		90;5;		50552	
<b>MOD CV RESULTS</b>	<b>PASS with MOD CV</b>		<b>PASS with MOD CV</b>		<b>FAIL</b>	
Oqfkhkgf"EX"'	80222		80222		8033;	
Olpkow o"Ceegrvcndng"Gswlx0"Uc orng"Ogcp	3302:6		90;83		50826	
Olpkow o"Ceegrvcndng"Gswlx0"Uc orng"Olp	:07:9		80;77		5035;	

Table 3-12 In-Plane Shear 0.2% Offset Strength Results

In-Pl x

	Qual.	Equiv.	Qual.	Equiv.	Qual.	Equiv.
Fvcv"cu"ogcuwtgf	<b>Insufficient Data</b>					
Ogcp"vgtgpij" B"7" "vutckp"mu-	3:0:4	3:052:	360872	360677	80;37	80934
Uvcpfctf"fgxkcvkqp	2085;	205;3	20673	20343	2054:	20368
Eqghhkekgpv"qh"Xctkcvkqp"'	505:4	40359	502:3	20:57	60959	403:4
Olpkow o	390;38	390:65	360293	3604:;	80649	8076;
Oczkwo o	3:0:4	3:0983	370799	360922	906:9	80:8;
Pwodgt"qh"Urgekogpu	39	7	43	:	3;	:
<b>RESULTS</b>	<b>FAIL</b>		<b>PASS</b>		<b>PASS</b>	
Olpkow o"Ceegrvcndng"Gswlx0"Uc orng"Ogcp	3:055:		360565		808;5	
Olpkow o"Ceegrvcndng"Gswlx0"Uc orng"Olp	39048:		350653		80253	
<b>MOD CV RESULTS</b>	<b>PASS with MOD CV</b>		<b>PASS with MOD CV</b>		<b>PASS with MOD CV</b>	
Oqfkhkgf"EX"'	80222		80222		8058;	
Olpkow o"Ceegrvcndng"Gswlx0"Uc orng"Ogcp	390;39		360275		80838	
Olpkow o"Ceegrvcndng"Gswlx0"Uc orng"Olp	38023:		340499		70948	

	Qual.	Equiv.	Qual.	Equiv.	Qual.	Equiv.
Fcvc"cu"ogcuwtgf						
Ogcp"Oqfwmwu"*Ouk	20:74	20:69	20957	20948	205:8	20587
Uvcpfctf"fgxlcvkqp	20242	20237	20234	20234	20239	20228
Eqghhkegpn"qh"Xctkcvkqp"'	405:9	30:4;	30886	30873	6057;	30848
Oipkow o	20:42	20:49	20933	20939	2057:	20579
Oczkow o	20::3	20:8:	2097;	20977	20644	20596
Pwodgt"qh"Urgekogpu	43	32	43	:	43	:
<b>RESULTS</b>		<b>PASS</b>		<b>PASS</b>		<b>FAIL</b>
Rcuulp i"Tcpig"hq t"Oqfwmwu"Ogcp	20:59"vq 20:89		20947"vq 20968		20596"vq 205;;	
Uvwfgpvju"v/uvckvke	206899		202092		202074:	
r/xcmwg"qh"Uvwfgpvju"v/uvckvke						
<b>MOD CV RESULTS</b>		<b>PASS with MOD CV</b>		<b>PASS with MOD CV</b>		<b>FAIL</b>
Oqfhhkf"EX'	20:3:"vq"20::8		20925"vq"2098:		2058:"vq"20626	
Rcuulp i"Tcpig"hq t"Oqfwmwu"Ogcp	/20562		/20782		/40737	
r/xcmwg"qh"Uvwfgpvju"v/uvckvke	20958		207:2		2023:	

Hkiwtg"5/: "knnwuvtcvgu"vjg"KRU"uvtgpi vj" o gcpu"cpf" o kpk o w o "xcnwgucpf"vjg" o qfwnwu" o gcpu"hqt"vjg" swcnkhkecvkqp"uc o rng"cpf"vjg"gs wxcngpe{ "uc o rng"Vjg"nk o kvu"hqt"gs wxcngpe{ "uc o rngu"ctg"ujqyp" cu"gttqt"dctu"ykvj"vjg"swcnkhkecvkqp"fcvc"Vjg"nqpi gt."nki jvgt"eqnqtgf"gttqt"dctu"ctg"hqt"vjg" o qfkhkgf"EX"eq o rwvcvkqpu"

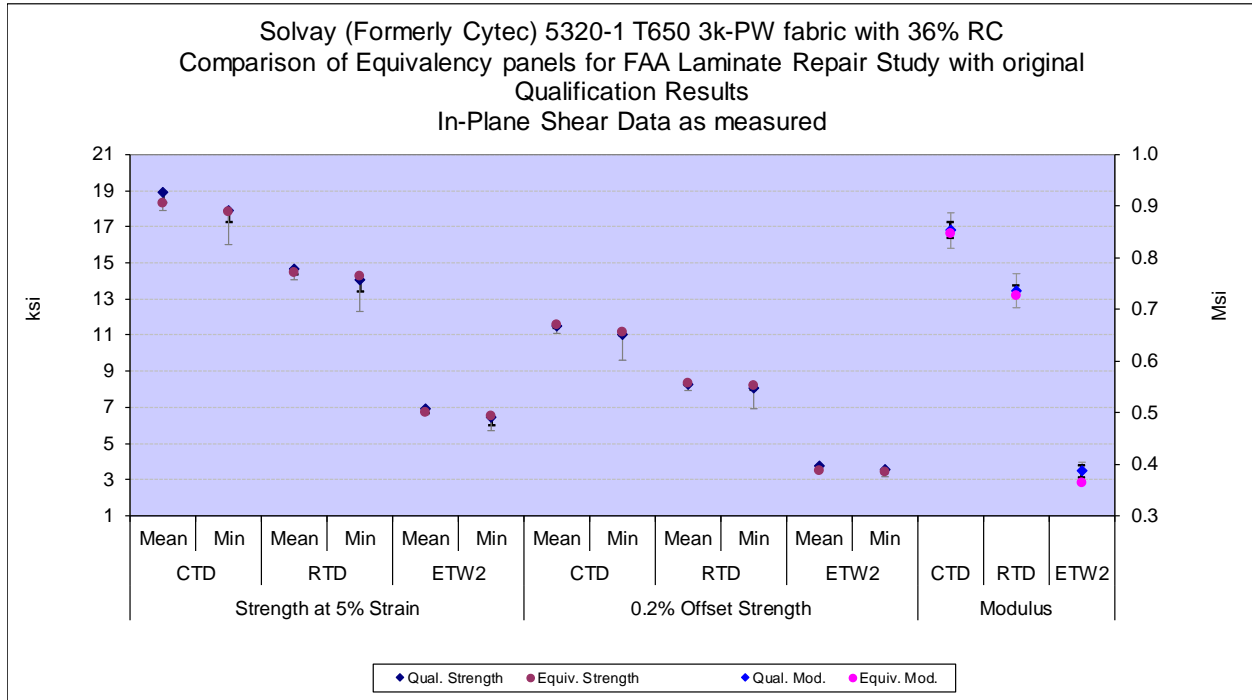


Figure 3-8 In-Plane Shear means, minimums and Equivalence limits

**3.7 “25/50/25” Open Hole Tension 1 (OHT1)**

Vjg"QJV3"fcvc"ku"pqt o cnk |gf0"Vjg"QJV3"uvtgpi vj"fcvc"rcuugf"gs wxcngpe{"vguvu"hqt"cn"vguvgf"  
 eqpfkvkqpu0""Uvcvkuvkeu"cpf"cpn{uku"tguwnvu"hqt"vjg"QJV3"uvtgpi vj"fcvc"ctg"ujqyp"kp"Vcdng"5/370"  
 "

	<b>Qual.</b>	<b>Equiv.</b>	<b>Qual.</b>	<b>Equiv.</b>
Fcvc"pqt ocnk gf"ykvj"ERV"202299				
Ogcp"Uvtgpi vj"*muk+	650867	650;73	6:0856	6:02:;
Uvcpfctf"Fgxkcvkqp	50564	30;65	3088;	3062:
Eqghhkekgpv"qh"Xctkcvkqp"'	90879	60642	50654	40;4;
Oqpkowo	590:99	620772	680257	680379
Oczkowo	6;08:9	6807;2	750438	6;0966
Pwodgt"qh"Urgekogpu	3;	:	3;	:

**RESULTS**

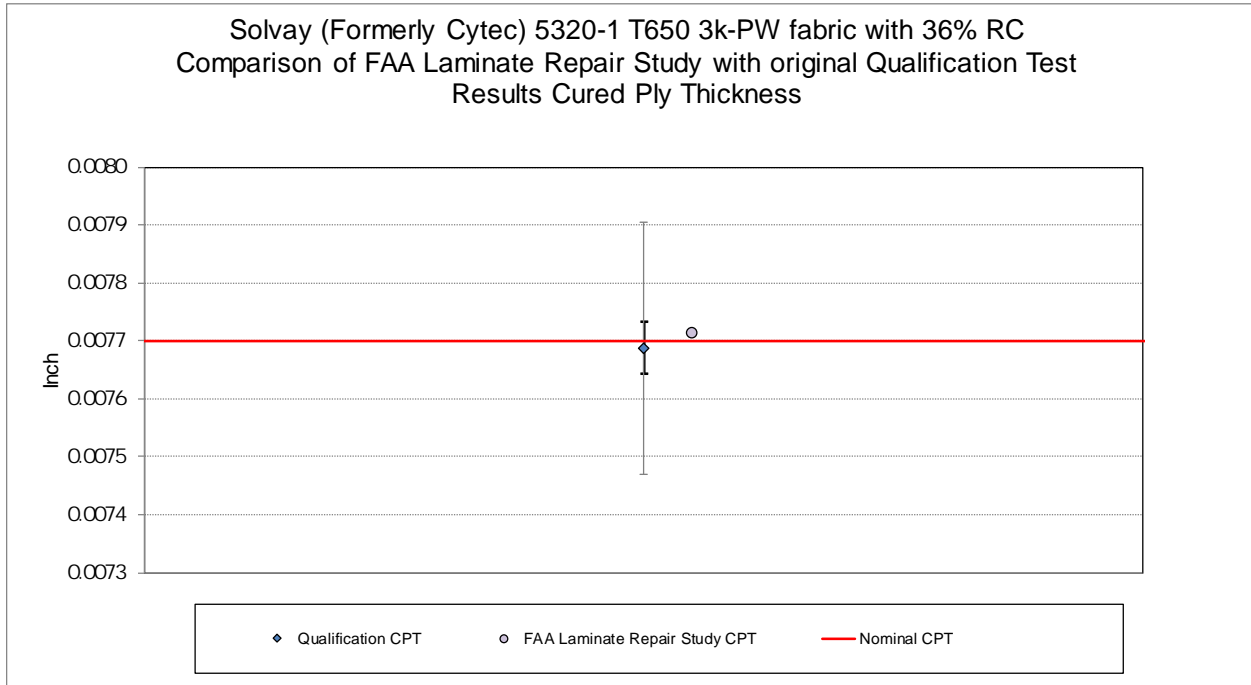


**3.9 “25/50/25” Compression After Impact 1 (CAI1)**

Vjg"ECK3"fcvc"ku"pqt o cnk | gf0"Vjg"ECK3"uvtgpi vj"fcvc"rcuugf"gs wxcngpe{"vguvu"hqt"vjg"TVF"  
eqpfkvkqp"dww"jcu"kpwwhhkekgy"fcvc"hqt"vjg"tguwnvu"vq"dg"eqpukfgtgf"eqpenwukxg0""Uvcvkuvkeu"cpf"  
cpcn{ r 2 O o O O ssgC O vg O O \_ O



### 3.10 Cured Ply Thickness (CPT)



**Figure 3-12 CPT means, 95% standard error bars and nominal value**

3.11 Dynamic Mechanical Analysis (DMA)

FOC"ku"eq o rctgf"hqt"v yq" o gcuwtg o gpvu."v jg"qpugv"qh"uvqtc i g" o qfwnwu"cpf"v jg"rgcm"qh"vcpi gpv"  
fgnvc"hqt"dqv j"ft{"cpf"y gv"eqpfkvkqpu0"V jgug"ctg"vguvvf"hqt"gswxengpe{"wukpi"c"rqqngf"v yq/  
uc o rng"fqwdng/ukfgf"v/vguv"cv"c";7 "'eqphkfgpeg"ngxgm0"V jg"o qfkhkgf"EX"o gvjqf"ku"pqv"cr rnkf"vq"  
FOC."dwy"cp"cf fkvkqpcn"cpnc{"uku"ku"cnuc"o cf g"y kvj"v jg"cnny cdng"tcp i g"hqt"FOC"dgkpi"ugv"vq"  
Õ3: ÅH0"V jku"gswxengpe{"etkvgtkqp"hqt"gxcnwcvkpi"i ncuu"vtcpukvqp"vg o rgtcvwtg"ku"pqv"c"uvcvkuvkecnn{/  
dcugf"etkvgtkqp"dwy"ku"i gpgtcnn{" o qtg"uvtkpi gpv"v jcp"v jcv"dcugf"qp" ?7 "'y kvj"o qfkhkgf"eqghhkegpv"  
qh"xctkcvkqp"dwy"nguu"uvtkpi gpv"v jcv"v jcv"dcugf"qp" ?7 "'y kvj"cu/o gcuwtgf"eqghhkegpv"qh"xctkcvkqp0"  
V jku"etkvgtkqp"ku"cf fgv"vq"v jg"vguv"qp"V i"vq"ckf"v jg"fgekukqp"o cmkpi"rtqegu"dgecwug"v jg"  
uvcvkuvkecnn{/dcugf"o gvjqfu"ctg"qhvqp"vqq"uvtkpi gpv"\*y jgp"cu/o gcuwtgf"eqghhkegpv"qh"xctkcvkqp"ku"  
wugf+"qt"vqq"ncz"\*y jgp"o qfkhkgf"eqghhkegpv"qh"xctkcvkqp"ku"wugf+0"

V jg"FOC"ft{"fcvc"ugvu"y gtg"unk i jvn{"cdqyg"v jg"wr rgt"ceegrvcpeg"nk o kvu"y jkng"v jg"FOC"y gv"fcvc"  
ugvu"y gtg"unk i jvn{"dgnqy"v jg"nq ygt"ceegrvcpeg"nk o kvu0""J qy gxtg."v jg"FOC"fcvc"rcuugf"  
gswxengpe{"vguvu"hqt"dqv j"v jg"ft{"Rgcm"qh"Vcpi gpv"fgnvc"cpf"v j

"

Vjg"Rgcm"qh"Vcpi gpv" Fgnvc"hqt" ygv" fcvc"hckngf"vjg"gswkxcngpe{"vguv"dgecwug"vjg"uc o rng" o gcp"  
xcnwg"\*5630722+"ku"dgnqy"vjg"nqygt"ceegrvcpeg"nk o kv"\*5640:48+0"Vjg"gswkxcngpe{"uc o rng" o gcp"ku"  
; ;083 ' "qh"vjg"nqygt"nk o kv"qh"ceegrvcng"xcnwg"Ykvj"vjg"cnqy cdng"tcpig"ugv"vq"Ô3: ÅH."vjg"Rgcm"  
qh"Vcpi gpv" Fgnvc"hqt"FOC" ygv"fcvc"rcuugf"vjg"gswkxcngpe{"vguv0"

Hkiwtg"5/35"knwuvtcvgu"vjg"cxgtcig"Vi"xcnwg"fgvgt okpgf"htqo"FOC"hqt"dqvj"vjg"swcnkhkecvkqp"  
uc o rng"cpf"vjg"gswkxcngpe{"uc o rng0"Vjg"nk o kvu"hqt"gswkxcngpe{"uc o rngu"ctg"ujqyp"cu"gttqt"dtu"  
ykvj"vjg"swcnkhkecvkqp"fcvc0"Vjg

#### 4. Summary of Results

Cm"vjg"gswxncngpe{"eq o rctkuqpu"ctg"eqpfwevgf"ykvj"V{ rg"K"gttqt"rtqdcdknv{"\* +"qh"7 ' "kp"  
ceeqtfcepeg"ykvj"HCCIFQVICT/2513;"tgrqtv"cpf"EO J /39/3 I"ugevkqp":06030"kv"ku"eq o o qp"vq"  
qdvckp"c"hg y"qt"gxgp"ugxgtcn"hcknwtgu"kp"c"v{ rkecn"gswxncngpe{"rtqi tc o"kpqxnxkpi" o wnwkrng"  
kpfgrgpfgp"rtqrgtv{"eq o rctkuqpu

4.2 Failures

Vjg"HCC"Nc o kpcvg"Tr rckt"Uvwf { " o cvgtkc n" j cu"uw h h k e k g p v"v g u v"t g u w n v u" h q t" e q o r c t k u q p" y k v j" v j g" q t k i k p c n" s w e n k h k e c v k q p" o c v g t k c n" v g u v" t g u w n v u" q p" c" v q v c n" q h" 5 ; " f k h h g t g p v" v g u v" v { r g u" c p f" e q p f k v k q p u. " p q v" k p e n w f k p i" v j g" e w t g f" r n { " v j k e m p g u u" q t" v j g" F O C" e q o r c t k u q p 0"

Wukpi"vjg" o q f k h k g f"EX" o g v j q f." v j g t g" y g t g" v y q" h c k n w t g u 0" D q v j" h c k n w t g u" y g t g" h q t" K R U" r t q r g t v k g u" \*204 ' " q h h u g v" u v t g p i v j" c p f" o q f w n w u + " k p" v j g" G V Y 4" e q p f k v k q p 0"

- 30 Kp/Rncpg"Ujgct"Oqfwnwu"hqt"vjg"GVY4"eqpfkvkqp"hcngf"d{"302: ' ' "
- 40 Kp/Rncpg"Ujgct"204 ' "Qhhugv"Uvtgp

#### 4.4 Probability of Failures

Kh"vjg"gswxncngpe{"uc o rng"ec o g"htq o "c" o cvgtken"ykvj"ejctcevgtkuvkeu"kfgpvkecn"vq"vjg"qtki kpcn" swcnkhkecvkqp" o cvgtken"cpf"cn"vguvu"ygtg"kpfgrgpfgpv"qh"cn"qvjgt"vguvu."vjg"ejcpeg"qh"jcxkpi"vyq" qt" o qtg"hcknwtgu"ku"7:093 ' 0"Hkiwtg"6/3"knwuvvcygu"vjg"rtqdcdknkv{"qh"igvvpki"qpg"qt" o qtg"hcknwtgu." vyq"qt" o qtg"hcknwtgu."gve0"htq" c"ugv"qh"5;"kpfgrgpfgpv"vguvu0"Kh"vjg"vyq" o cvgtken"ygtg"gswxncngpv." vjg"rtqdcdknkv{"qh"igvvpki"hxg"qt" o qtg"hcknwtgu"ku"nguu"vjcp"7 ' 0"Vjku" o gcpu"vjcv"vjg" o cvgtken"eqwnf" dg"eqpukfgtgf"cu"opqv"gswxncngpvö"ykvj" c";7 ' "ngxgn"qh"eqphkfgpeg"kh"vjgtg"ygtg"hxg"qt" o qtg" hcknwtgu"qvv"qh"5;"kpfgrgpfgpv"vguvu0"

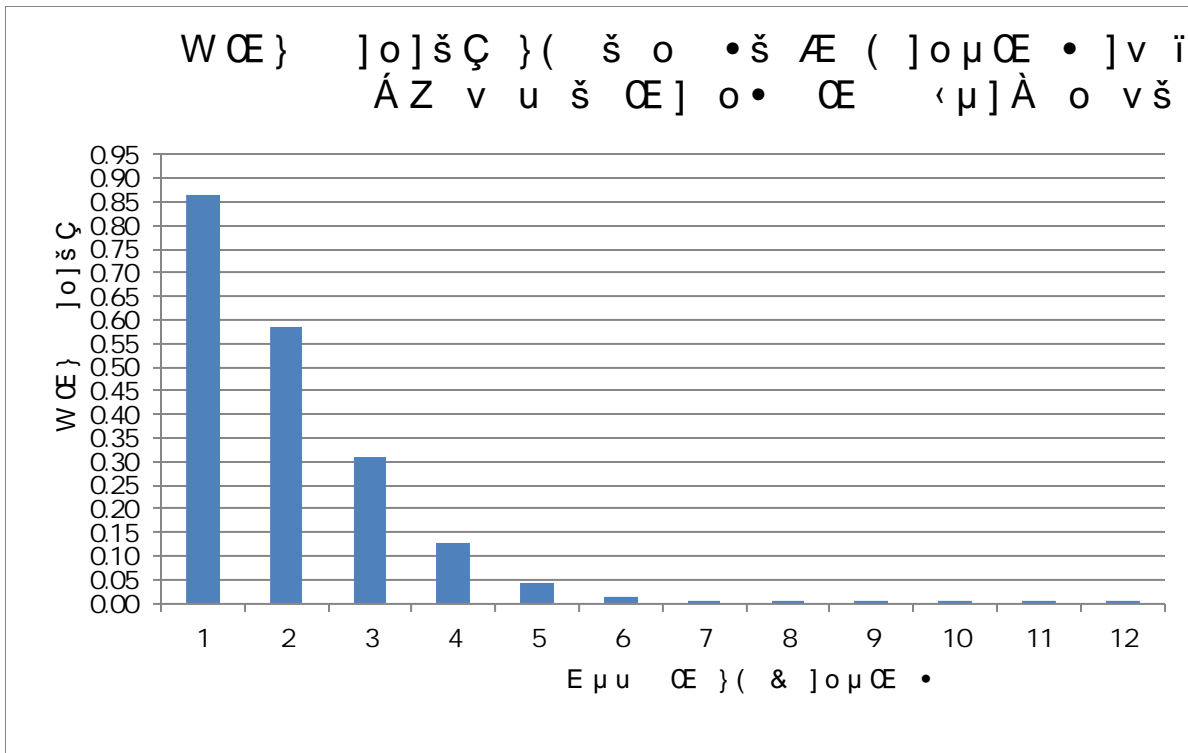


Figure 4-1 Probability of Number of Failures

#### 5. References

- 30 EO J/39"Txg" I."Xqnw o g"3."42340"UCG"Kpvgtpcvkqpcn."622"Eq o o qpy gcnvj" Ftkxg." Ycttgpfng."RC"372;8"
- 40 Lqjp"Vq o dnpk." [ gqy"E0"Pi."cpf"M0"Uwtguj"Tclw."öMaterial Qualification and Equivalency for polymer Matrix Composite Material Systems: Updated Procedureö." Pcvkqpcn"Vgejpkecn"Kphqt o cvkqp"Ugtxkeg"\*PVKU+."Urtkpi hkgnf."Xkti kpkc"44383"
- 50 Xcpi gn."Octm."\$Nqv"Ceegrvcepeg"cpf"Eq o rnkcepeg"Vguvkpi"Wukpi"vjg"Uc o rng"Ogcp"cpf" cp"Gzvtg o w o \$."Vgejppq o gvtkeu."Xqn"66."PQ0"5."Cwiwuv"4224."rr0"464/46;"