	Library #	Material	$\varepsilon_{1,tu}$	$\varepsilon_{2,tu}$	$\varepsilon_{1,cu}$	$\varepsilon_{2,cu}$	$\varepsilon_{6,su}$
Original Laminate	10	BMS 8-212, Type III, Class 2, 3K-70-PW, Solid Laminate	0.0064	0.0064	0.0059	0.0059	0.0117
Strain Allowables	12	BMS 8-212, Type III, Class1, Grade 95	0.0090	none	0.0072	none	0.0144
	1	none					
	1	none					
	1	none					
Repaired Laminate	10	BMS 8-212, Type III, Class 2, 3K-70-PW, Solid Laminate	0.0064	0.0064	0.0059	0.0059	0.0117
Strain Allowables	12	BMS 8-212, Type III, Class1, Grade 95	0.0090	none	0.0072	none	0.0144
	1	none					
	1	none					
	1	none					

Repair Design Strength

The ultimate strength of the original laminate is calculated in each fiber direction by determining the stress required achieve the allowable strain.

The unrotated normalized laminate compliance matrix was applied to σ_1 and σ_2 to calculate the strength in the 0 and 90 degree laminate direction.

A shear allowable is used only for laminates that do not have +/-45 degree plies to assume the shear loads. The same analysis is applied to the repaired laminate. All of the stresses were converted to shear flow using the laminate thickness and a margin of safety was calculated for each case.

Original Laminate Strain Allowables

$\varepsilon_{1,tensile\ ultimate}$ =	0.0064	in/in	$\varepsilon_{1,compression\ ultimate}$ =	0.0059	in/in
$\varepsilon_{2,tensile\ ultimate}$ =	0.0064	in/in	$\varepsilon_{2,compression\ ultimate}$ =	0.0059	in/in
$t_{original}$ =	0.0267	in.	$\varepsilon_{6,shear\ ultimate}$ =	0.0117	in/in

Repair Laminate Strain Allowables

$\varepsilon_{1,tensile\ ultimate}$ =	0.0064	in/in	$\varepsilon_{1,compression\ ultimate}$ =	0.0059	in/in
$\varepsilon_{2,tensile\ ultimate}$ =	0.0064	in/in	$\varepsilon_{2,compression\ ultimate}$ =	0.0059	in/in
t_{repair} =	0.0267	in.	$\varepsilon_{6,shear\ ultimate}$ =	0.0117	in/in

Original Laminate - Rotated 45 degrees - tension

0.0000		0.000146	-0.000038	-0.000026			0.00	ksi (σ_x)
0.0000	=	-0.000038	0.000146	-0.000026	1/ksi	x	0.00	ksi (σ_y)
0.0000		-0.000026	-0.000026	0.000432			0.00	ksi (σ_{xy})

$q_{tu,x} = \sigma_x * t =$ 0.00 lbs/in

0.0000		0.000146	-0.000038	-0.000026			0.00	ksi (σ_x)
0.0000	=	-0.000038	0.000146	-0.000026	1/ksi	x	0.00	ksi (σ_y)
0.0000		-0.000026	-0.000026	0.000432			0.00	ksi (σ_{xy})

$q_{tu,y} = \sigma_y * t =$ 0.00 lbs/in

Repair Laminate - Rotated 45 degrees - tension

0.0000		0.000146	-0.000038	-0.000026			0.00	ksi (σ_x)
0.0000	=	-0.000038	0.000146	-0.000026	1/ksi	x	0.00	ksi (σ_y)
0.0000		-0.000026	-0.000026	0.000432			0.00	ksi (σ_{xy})

$q_{tu,x} = \sigma_x * t =$ 0.00 lbs/in M.S. =

0.0000		0.000146	-0.000038	-0.000026			0.00	ksi (σ_x)
0.0000	=	-0.000038	0.000146	-0.000026	1/ksi	x	0.00	ksi (σ_y)
0.0000		-0.000026	-0.000026	0.000432			0.00	ksi (σ_{xy})

$q_{tu,y} = \sigma_y * t =$ 0.00 lbs/in M.S. =

Original Laminate - Rotated 45 degrees - compressions

0.0000		0.000146	-0.000038	-0.000026			0.00	ksi (σ_x)
0.0000	=	-0.000038	0.000146	-0.000026	1/ksi	x	0.00	ksi (σ_y)
0.0000		-0.000026	-0.000026	0.000432			0.00	ksi (σ_{xy})

$q_{cu,x} = \sigma_x * t =$ 0.00 lbs/in

0.0000		0.000146	-0.000038	-0.000026			0.00	ksi (σ_x)
0.0000	=	-0.000038	0.000146	-0.000026	1/ksi	x	0.00	ksi (σ_y)
0.0000		-0.000026	-0.000026	0.000432			0.00	ksi (σ_{xy})

$q_{cu,2} = \sigma_2 * t =$ 0.00 lbs/in

Repair Laminate - Rotated 45 degrees - compressions

0.0000		0.000146	-0.000038	-0.000026			0.00	ksi (σ_x)
0.0000	=	-0.000038	0.000146	-0.000026	1/ksi	x	0.00	ksi (σ_y)
0.0000		-0.000026	-0.000026	0.000432			0.00	ksi (σ_{xy})

$q_{cu,x} = \sigma_x * t =$ 0.00 lbs/in M.S. =

0.0000		0.000146	-0.000038	-0.000026			0.00	ksi (σ_x)
0.0000	=	-0.000038	0.000146	-0.000026	1/ksi	x	0.00	ksi (σ_y)
0.0000		-0.000026	-0.000026	0.000432			0.00	ksi (σ_{xy})

$q_{cu,2} = \sigma_2 * t =$ 0.00 lbs/in M.S. =

Original Laminate rotated 45 degrees - Shear

0.0000		0.000146	-0.000038	-0.000026			0.00	ksi (σ_x)
0.0000	=	-0.000038	0.000146	-0.000026	1/ksi	x	0.00	ksi (σ_y)
0.0000		-0.000026	-0.000026	0.000432			0.00	ksi (σ_{xy})

$q_{su} = \sigma_{xy} * t =$ 0.00 lbs/in

Repaired Laminate rotated 45 degrees - Shear

0.0000		0.000146	-0.000038	-0.000026			0.00	ksi (σ_x)
0.0000	=	-0.000038	0.000146	-0.000026	1/ksi	x	0.00	ksi (σ_y)
0.0000		-0.000026	-0.000026	0.000432			0.00	ksi (σ_{xy})

$q_{su} = \sigma_{xy} * t =$ 0.00 lbs/in M.S. =

[1] q_{tu} is calculated in inches per unit width

Allowable stress an a function of inplane stiffness and strain

$[\varepsilon]$ = [a*] $[\sigma]$

ε_1		a^*_{11}	a^*_{12}	a^*_{16}		σ_1
ε_2	=	a^*_{12}	a^*_{22}	a^*_{26}	x	σ_2
ε_6		a^*_{16}	a^*_{26}	a^*_{66}		σ_6