2.6 BMS 8-168

2.6.1 BMS 8-168, Type II, Class 1, Grade 145 or 190

This specification applies to a 250°F cure epoxy resin impregnated BMS 9-8 Type I carbon fiber unidirectional tape.

Type II: Self Adhesive Resin System
Class 1: Unidirectional prepreg tape.

Reference: Coordination Sheet BY1HU-SHW-C92-007, "BMS 8-168 Analysis Methods and Design Values for 777 Program", 1/20/1992.

Contents:

Table 2.6.1-1 Ply Properties

TABLE 2.6.1-1		PLY PROPERTIES						
PREPREG MATERIAL SPECIFICATION: BMS 8-168, TYPE II, CLASS 1, GRADE 145 OR 190								
RESIN CONTENT: 40 (% WT)								
CURED PLY THICKNESS: .0062 (in) - Grade 145 .0082 (in) - Grade 190								
PROCESS SPECIFICATION: BAC 5317-5								
PROPERTY		UNIT	ENVIRONMENTAL CONDITION					
			-75° F		70° F		160° F	130° F
			DRY	WET	DRY	WET	DRY	WET
MODULUS ②	E_1 ①	msi	16.2					
	E_2	msi	1.1	(1.1)	1.1	(1.1)	1.0	1.0
	G_{12}	msi	0.68	(0.68)	0.68	(0.63)	0.53	0.53
	G_{13}	msi	0.68	(0.68)	0.68	(0.63)	0.53	0.53
	G_{23}	msi	0.68	(0.68)	0.68	(0.63)	0.53	0.53
POISSON'S RATIO	ν_{12}	----	.34					
COEFFICIENTS OF LINEAR THERMAL EXPANSION ③	α_1	in/in ° F	$.02 \times 10^{-6}$				$.02 \times 10^{-6}$	
	α_2	in/in ° F	15×10^{-6}				15×10^{-6}	
COEFFECIENTS OF LINEAR MOISTURE EXPANSION ④	β_1	in/in %M	0.0					
	β_2	in/in %M	2400×10^{-6}					
THERMAL CONDUCTIVITY	κ_1	BTU/(hr ft °F)						
	κ_2	BTU/(hr ft °F)						
	κ_3	BTU/(hr ft °F)						

① E_1 is the average of tension and compression moduli. For stability analysis use E_1, compression = 15.4 Msi.

② Modulus values are secant values at a strain level of 4000 μ in/in. For special analyses use modulus versus strain curves to determine secant values at the desired strain level.

③ CLTE values are for expansion between -75° F and 70° F, and 70° F and 180° F.

④ %M = Percent absorbed moisture by weight.

⑤ Values in ( ) are estimates.

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Guidelines for Usage of Moduli and Strength Design Values

Ply Properties - Table 2.6.1-1.

The room temperature (70°F) / dry condition values shown in this table are refered to as nominal moduli values. These values are to be used for almost all laminate analyses, including the calculation of strain design values from test data. The exceptions are:

1. buckling analyses, where compression moduli values at the appropriate environment are used,

2. test correlation analyses where it is desired to predict actual strain gage response.

The values for the other environments are used for the two cases listed above.

Unnotched Tension, Compression and Shear Strains - Table 2.6.1-2

These strain values are based on unnotched, undamaged coupon test results. The values may be used for test correlation analyses. The margin of safety analysis procedure in Section 5.6 should be used with the unnotched strain values.

For notched laminate strain values for use with bolted joint analyses or to account for impact damage, refer to Section 11.4.3. The notched strain values may be used with the margin of safety analysis procedures of section 5.6 for laminate checks away from bolted joint areas.

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Table 2.6.1-2 Design Values

Prepreg Material Specification:	BMS 8-168, TYPE II, CLASS 1, GRADE 145 OR 190
Resin Content:	42 (% WT)
Process Specification:	BAC 5317-5
70°F/DRY ENVIRONMENT, (0/±45/90) LAMINATES	

(Do not use Typical Values for Ultimate Strength analyses. They may be used for Damage Tolerance or test correlation analyses).

Typical Lamina (Ply) Strain

		Baseline Fiber Direction Strain		Tape Transverse Direction	Lamina Shear Strain
		RT/ambient		RT/amb	RT/amb
		Laminate t > 0.14 in.	Sandwich	All	All
BMS 8-168 Tape	Unnotched Tension	0.01000	0.00600	0.01000	------
	Unnotched Compression ***	0.01000	0.00500	0.01000	------
	Unnotched Shear	------	------	------	0.01500

Estimated B- Basis Lamina (Ply) Strain

		Baseline Fiber Direction Strain		Tape Transverse Direction	Lamina Shear Strain
		RT/ambient		RT/amb	RT/amb
		Laminate t > 0.14 in.	Sandwich	All	All
BMS 8-168 Tape	Unnotched Tension	0.00800	0.00480	0.01000	------
	Unnotched Compression ***	0.00800	0.00415	0.01000	------
	Unnotched Shear	------	------	------	0.01500

*** Minimum 10% 45 and -45 degree plies

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Table 2.4.1-3 Environment Adjustment Factors

Prepreg Material Specification:	BMS 8-168, TYPE II, CLASS 1, GRADE 145 OR 190
Resin Content:	42 (% WT)
Process Specification:	BAC 5317-5
70°F/DRY ENVIRONMENT, (0/±45/90) LAMINATES	

		Environment Correction Factors		
	Environment	Tension (Ct,env)	Comprs. (Cc,env)	Lamina Shear
BMS 8-168 Tape	-65F/ambient	0.90	1.00	1.00
	RT/ambient	1.00	1.00	1.00
	RT/wet	0.97	0.94	0.94
	130F/dry	0.93	0.88	0.88
	130F/wet	0.90	0.82	0.82
	160F/dry	0.90	0.82	0.82

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2.6.2 BMS 8-168, Type II, Class 2, Style 3K-70-PW

This specification applies to a 250°F cure epoxy resin impregnated BMS 9-8 Type I carbon fiber woven fabric.

Type II: Self Adhesive Resin System
Class 2: Woven Fabric Prepreg.

Reference: Coordination Sheet BY1HU-SHW-C92-007, "BMS 8-168 Analysis Methods and Design Values for 777 Program," 1/20/1992.

Contents:

Table 2.6.2-1 Ply Properties

TABLE 2.6.2-1		PLY PROPERTIES							
PREPREG MATERIAL SPECIFICATION: BMS 8-168, TYPE II, CLASS 2, STYLE 3K-70-PW									
RESIN CONTENT: 42 (% WT)									
CURED PLY THICKNESS: .0086 (In)									
PROCESS SPECIFICATION: BAC 5317-5									
PROPERTY		UNIT	ENVIRONMENTAL CONDITION						
			-75° F		70° F		160° F	130° F	
			DRY	WET	DRY	WET	DRY	WET	
MODULUS ②	E_1 ①	msi	←——— 7.8 ———						
	E_2	msi	←——— 7.8 ———						
	G_{12}	msi	0.56	(0.56)	0.56	(0.52	0.45	0.45	
	G_{13}	msi	0.56	(0.56)	0.56	(0.52)	0.45	0.45	
	G_{23}	msi	0.56	(0.56)	0.56	(0.52)	0.45	0.45	
POISSON'S RATIO	ν_{12}	----	←——— .06 ———						
COEFFICIENTS OF LINEAR THERMAL EXPANSION ③	α_1	in/in ° F	1.6×10^{-6}				1.6×10^{-6}		
	α_2	in/in ° F	1.6×10^{-6}				1.6×10^{-6}		
COEFFECIENTS OF LINEAR MOISTURE EXPANSION ④	β_1	in/in %M	220×10^{-6}						
	β_2	in/in %M	220×10^{-6}						
THERMAL CONDUCTIVITY	κ_1	BTU/(hr ft °F)							
	κ_2	BTU/(hr ft °F)							
	κ_3	BTU/(hr ft °F)							

① E_1 & E_2 are the average of tension and compression moduli. For stability analysis use E_1, compression = E_2, compression = 7.4 Msi.

② Modulus values are secant values at a strain level of 4000 μ in/in. For special analyses use modulus versus strain curves to determine secant values at the desired strain level.

③ CLTE values are for expansion between -75° F and 70° F, and 70° F and 180° F.

④ %M = Percent absorbed moisture by weight.

⑤ Values in ( ) are estimates.

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Guidelines for Usage of Moduli and Strength Design Values

Ply Properties - Table 2.6.2-1.

The room temperature (70°F) / dry condition values shown in this table are refered to as nominal moduli values. These values are to be used for almost all laminate analyses, including the calculation of strain design values from test data. The exceptions are:

1. buckling analyses, where compression moduli values at the appropriate environment are used,

2. test correlation analyses where it is desired to predict actual strain gage response.

The values for the other environments are used for the two cases listed above.

Unnotched Tension, Compression and Shear Strains - Table 2.6.2-2

These strain values are based on unnotched, undamaged coupon test results. The values may be used for test correlation analyses. The margin of safety analysis procedure in Section 5.6 should be used with the unnotched strain values.

For notched laminate strain values for use with bolted joint analyses or to account for impact damage, refer to Section 11.4.3. The notched strain values may be used with the margin of safety analysis procedures of section 5.6 for laminate checks away from bolted joint areas.

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Table 2.6.2-2 Design Values

Prepreg Material Specification:	BMS 8-168, TYPE II, CLASS 2, STYLE 3K-70-PW
Resin Content:	42 (% WT)
Process Specification:	BAC 5317-5
70°F/DRY ENVIRONMENT, (0/±45/90) LAMINATES	

(Do not use Typical Values for Ultimate Strength analyses. They may be used for Damage Tolerance or test correlation analyses).

Typical Lamina (Ply) Strain

		Baseline Fiber Direction Strain		Tape Transverse Direction	Lamina Shear Strain
		RT/ambient		RT/amb	RT/amb
		Laminate t > 0.14 in.	Sandwich	All	All
BMS 8-168 Fabric	Unnotched Tension	0.01000	0.00600	------	------
	Unnotched Compression ***	0.01000	0.00500	------	------
	Unnotched Shear	------	------	------	0.01500

Estimated B-Basis Lamina (Ply) Strain

		Baseline Fiber Direction Strain		Tape Transverse Direction	Lamina Shear Strain
		RT/ambient		RT/amb	RT/amb
		Laminate t > 0.14 in.	Sandwich	All	All
BMS 8-168 Fabric	Unnotched Tension	0.00800	0.00480	------	------
	Unnotched Compression ***	0.00800	0.00415	------	------
	Unnotched Shear	------	------	------	0.01500

*** Minimum 10% 45 and -45 degree plies

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Table 2.6.2-3 Environment Adjustment Factors

Prepreg Material Specification:	BMS 8-168, TYPE II, CLASS 2, STYLE 3K-70-PW
Resin Content:	42 (% WT)
Process Specification:	BAC 5317-5
70°F/DRY ENVIRONMENT, (0/±45/90) LAMINATES	

		Environment Correction Factors		
	Environment	Tension (Ct,env)	Comprs. (Cc,env)	Lamina Shear
BMS 8-168 Fabric	-65F/ambient	0.90	1.00	1.00
	RT/ambient	1.00	1.00	1.00
	RT/wet	0.97	0.94	0.94
	130F/dry	0.93	0.88	0.88
	130F/wet	0.90	0.82	0.82
	160F/dry	0.90	0.82	0.82

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