

Application News

AG-Series Universal Testing Machines

Determination of Short Beam Strength of Polymer Matrix Composite in Accordance with ASTM D 2344

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User Benefits

- ◆ Conformity of the machine, fixtures and method with the ASTM D 2344
- ◆ Easy to use software to get the short-beam strength and maximum load observed for PMCs

Introduction

Polymer matrix composites (PMCs) are composed of a matrix from thermoset or thermoplastic and embedded glass, carbon, steel or fibers. PMCs as high-performance special engineering materials are the research interest of scientists around the world¹.

According to the literature, several tests have been performed to study the effect of the specimen parameter on the short-beam strength. For instance, a systematic study has been undertaken to investigate the effect of specimen size on the interlaminar shear strength of unidirectional carbon fiber-epoxy using the three-point short-beam shear test².

Application of this test method is limited to continuous or discontinuous-fiber-reinforced polymer matrix composites, for which the elastic properties are balanced and symmetric with respect to the longitudinal axis of the beam.

In this regard, ASTM D 2344 provides a method to measure the short-beam strength from the maximum load observed during the test and the measured specimen width and thickness. Therefore, in this data sheet, five laminated PMCs materials have been investigated to determine the short-beam strength parameter.

Measurement Conditions and Samples

Table 1 shows the composition of the test system. A Shimadzu AGX-V, desk-top type, autograph series universal testing machine, with a capacity of 50 kN has been used for the measurements in combination with TH103-ASTM D 2344 + ISO14130 jig (PN 980-28437). The set-up of the sample measurement is shown in Figure 1.

The specimen geometry and the conditions for this test can be found respectively in table 2 and 3.

Table 1 Test system composition

Testing machine	: AGX-V 20 kN/50 kND + 250 mm
JIGS	: TH103-ASTM 2344 + ISO14130
Software	: TrapeziumX-V Single, 3-Point Bending
Loadcell	: 50 kN

Table 2 Specimen Information

Thickness (h)	: ca. 5,5 mm
Width (b)	: ca. 12 mm
Distance between supports	: 12 mm
Punch diameter	: 10 mm instead of 6 mm

Table 3 Test Conditions

Test speed	: 1 mm/min during the whole test up to break
Pre-load	: 1 N

Based on ASTM D2344, the short-beam strength is calculated using the following equation:

$$F^{sbs} = 0.75 \times \frac{P_m}{b \times h}$$

F^{sbs} : Short-beam strength (MPa)

P_m : Maximum load observed during the test (N)

b : measured specimen width (mm)

h : measured specimen thickness (mm)

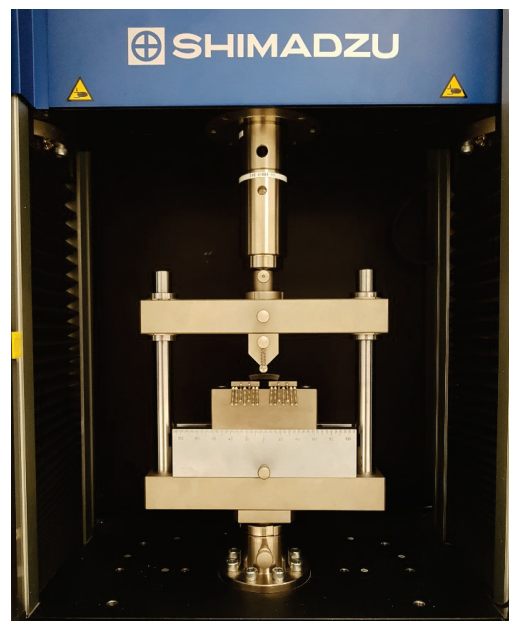


Figure 1 Set-up of the sample measurement

Test Result

The specimen before and after the break is illustrated in Figure 2. The Force-Stroke curves for five laminated PMCs specimens can be found in Figure 3. The output data is reported in Table 4 and shows short-beam strength and maximum load. Pre-force or start of displacement measuring should be set to a higher level to provide starting at the same level.

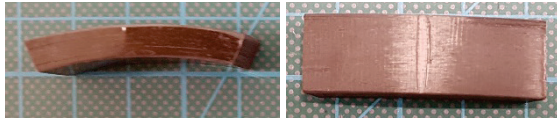


Figure 2 Specimen before (left) and after (right) the break

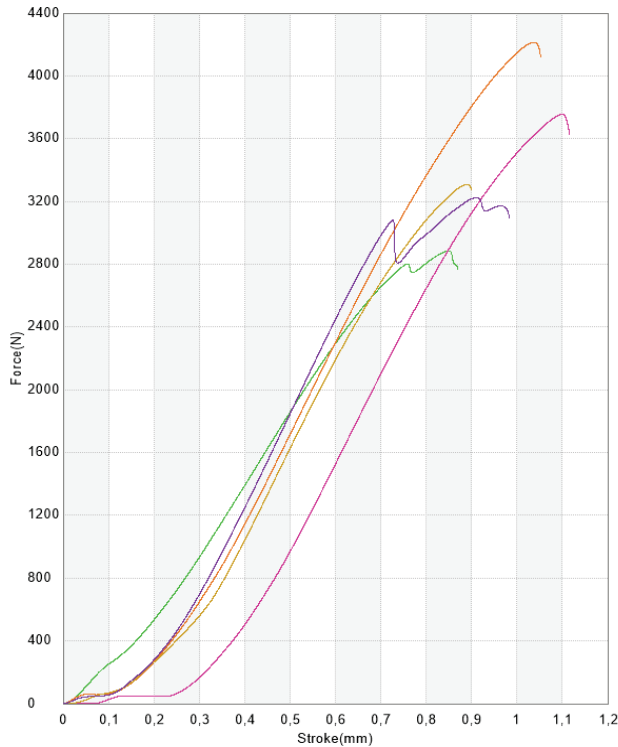


Figure 3 Force - Stroke Curves

Table 4 Details of the tested samples

Name	F_{sbs}	P_m
Unit	MPa	N
1-1	31,3033	2884,25
1-2	47,2337	4212,06
1-3	40,2245	3755,67
1-4	37,3134	3307,83
1-5	34,9083	3223,53
Average	38,1966	3476,67
SD	6,01856	515,312
CV(%)	0,15757	0,14822

■ Conclusion

The short-beam strength according to ASTM D 2344 can easily be determined by using a Shimadzu universal testing machine in combination with special jig according to the standard. In this data sheet, a punch diameter of 10 mm instead of 6mm has been used which has a slight influence on the measurements. Overall, the results are in an acceptable and reproduceable range.

■ The Package

The recommended hardware and software configuration is listed below.

- ❑ *Main Unit*
AGS-X/AGX-V 50 kN Universal Testing machine
- ❑ *Accessories*
TH103-ASTM 2344 + ISO14130
Loadcell for 20/50 kN
- ❑ *Software and Libraries*
TrapeziumX-V Single

■ References

1. Polymer Matrix Composites Materials for Water and Wastewater Treatment Applications; Maryam Ahmadzadeh Tofighy, Toraj Mohammadi; in Encyclopedia of Materials: Composites, 2021.
2. Effect of specimen size on interlaminar shear strength of unidirectional carbon fibre-epoxy; Weicheng Cui, Michael R. Wisnom and Mike Jones; Composites Engineering, Volume 4, Issue 3, 1994.