ALLTEC

COMPOSITE MATERIALS

COMPANY

Established in 1995 and located in São José dos Campos, state of São Paulo, Alltec is a company specialized in manufacturing composite material parts, assembly structural bonding and thermoplastic components.

MARKETS

ALLTEC

Meet market needs for products based on composite materials.

Be an international reference in composite materials products and services.

Integrity, ethics and morality; Creativity; Customer needs first; Productivity; Spirit of Partnership; Flexibility; Focus on results; Exercise innovation.

Influence of cutting technique on composite specimens, going beyond standard tolerances.

1. Motivation
2. Mechanical properties evaluation - Main specimens tolerances
3. Cutting techniques
4. Prepreg system used
5. Results
6. Conclusions

Influence of cutting technique on composite specimens, going beyond standard tolerances.

1. Motivation

Your conclusions will be as good as the data you have.

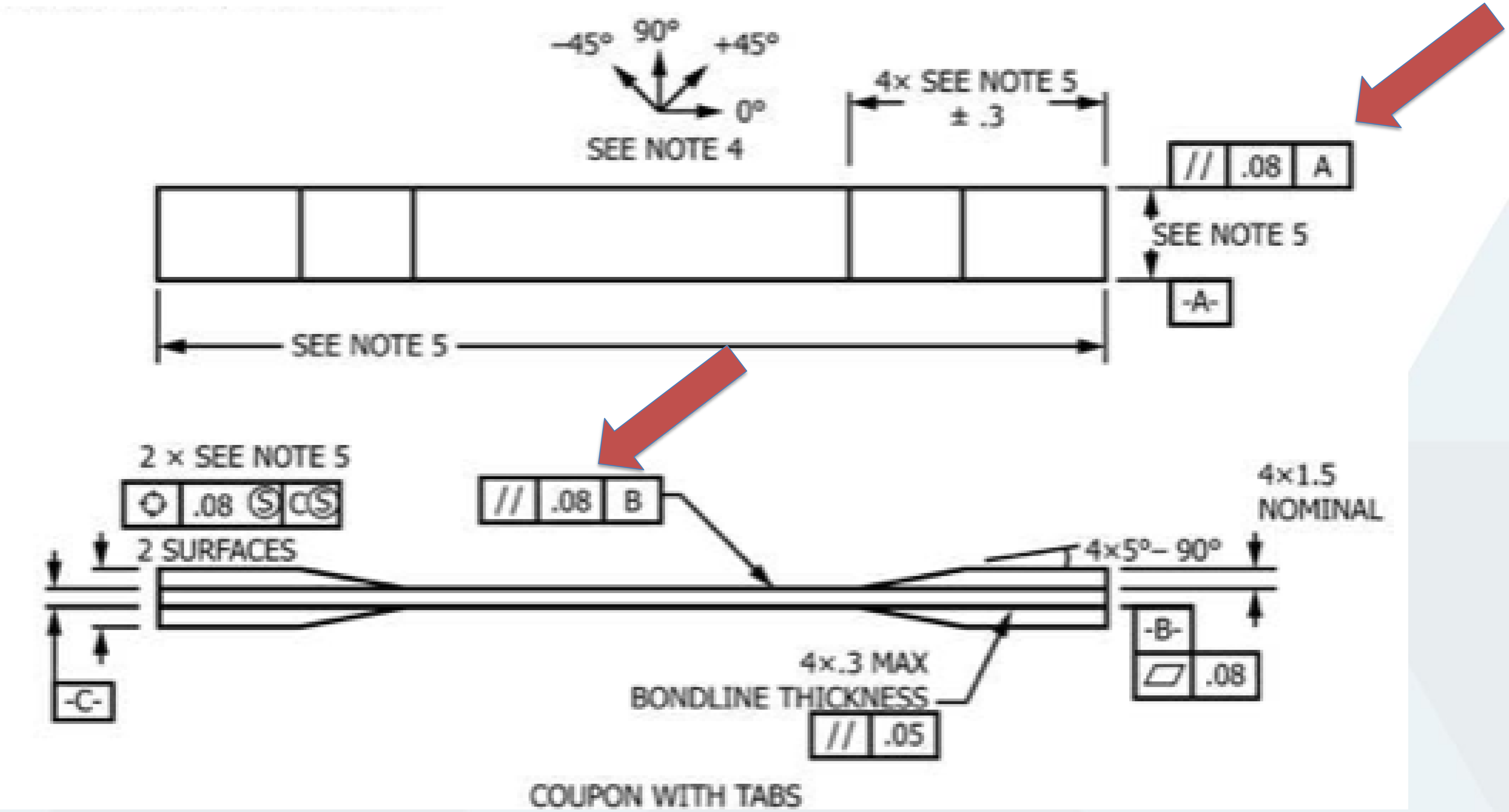
So, we need to have good data, to at least have good conclusions!

Influence of cutting technique on composite specimens, going beyond standard tolerances.

1. Motivation

Influence of cutting technique on composite specimens, going beyond standard tolerances.

2. Mechanical properties evaluation - Main specimens tolerances

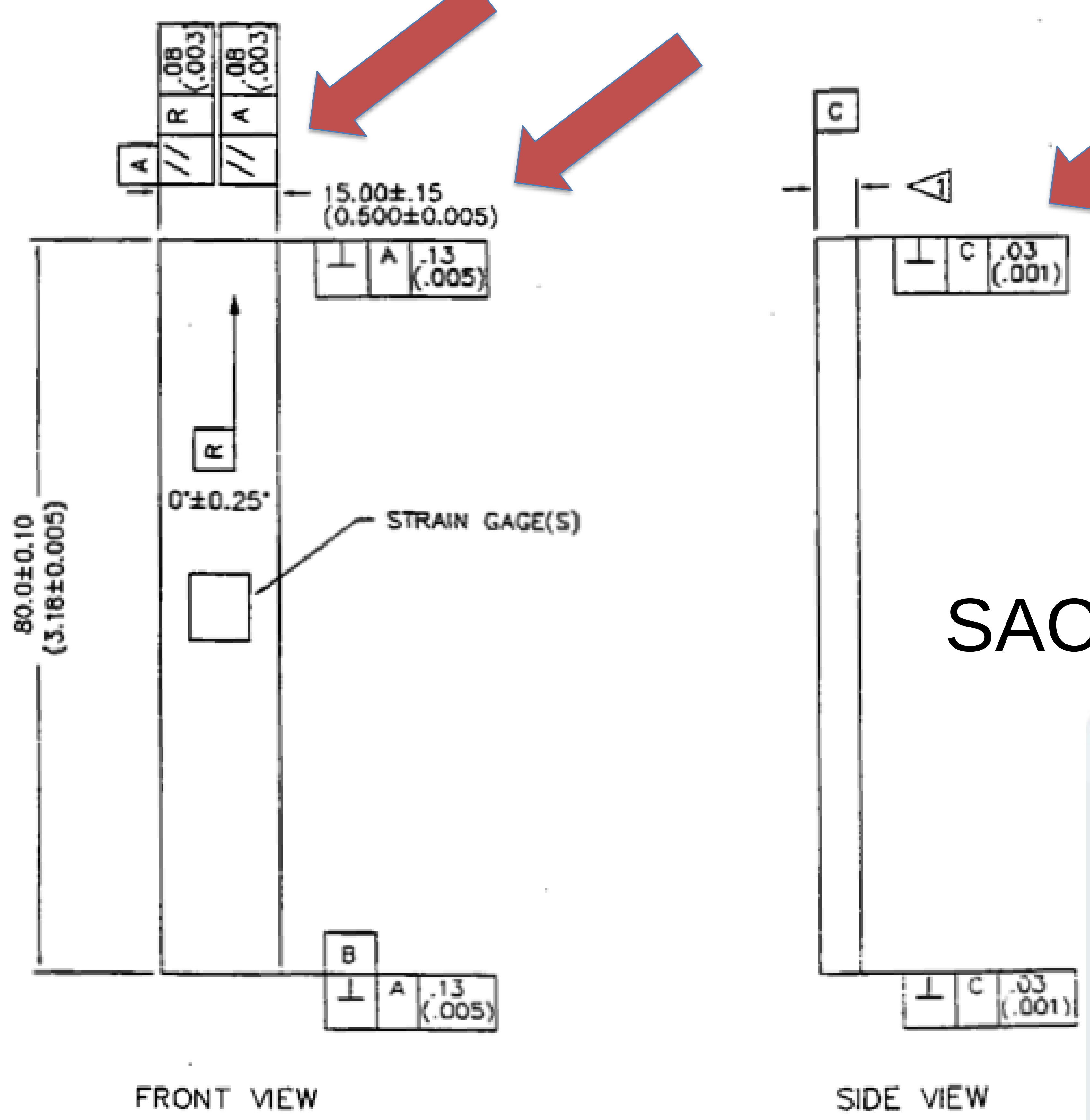


ASTM D3039

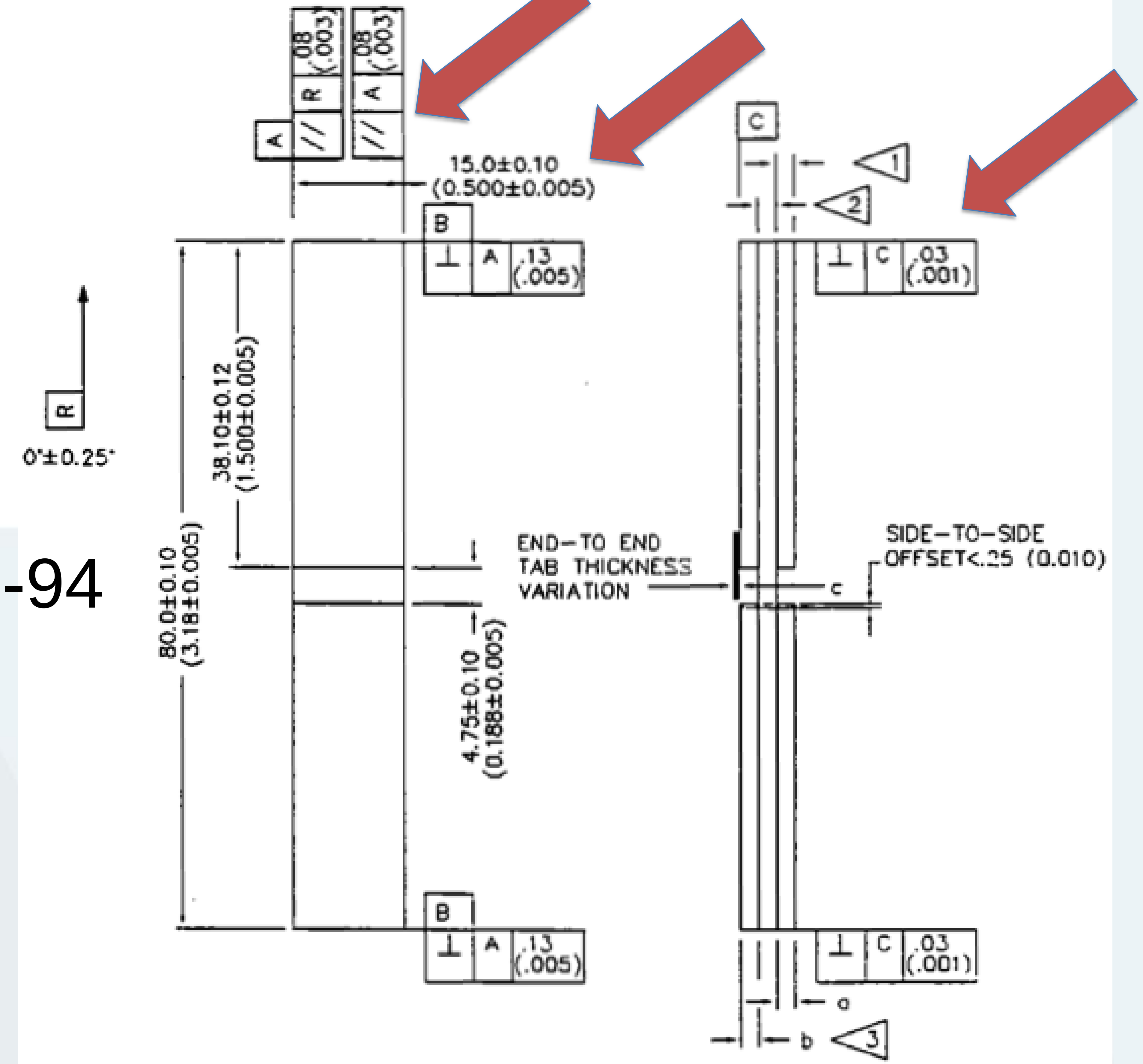
ASTM D3518

Influence of cutting technique on composite specimens, going beyond standard tolerances.

2. Mechanical properties evaluation - Main specimens tolerances



SACMA 1R-94



Influence of cutting technique on composite specimens, going beyond standard tolerances.

3. Cutting techniques

Machining:

- ✓ Milling cutter 6 mm
- ✓ Rotation – 1800 rpm
- ✓ Advance – 600 mm/min
- ✓ Thinning rate – 0,5 mm/step

Influence of cutting technique on composite specimens, going beyond standard tolerances.

3. Cutting techniques

Sawing:

- ✓ Circular saw
- ✓ Diamond disk 2 mm thick
- ✓ Abrasion cutting

Influence of cutting technique on composite specimens, going beyond standard tolerances.

4. Prepreg system used

NATIONAL CENTER for ADVANCED MATERIALS PERFORMANCE

Document No.: NMS 128/3, Revision B, May 8th, 2013

NCAMP Material Specification

This specification is generated and maintained in accordance with NCAMP Standard Operating Procedures, NSP 100

350ºF Autoclave Cure, Low Flow Toughened Epoxy Prepregs, Type 38, Class 2, Grade 193, Style 3K-70-PW
(Hexcel 8552S AS4 Plain Weave Fabric)

Influence of cutting technique on composite specimens, going beyond standard tolerances.

4. Prepreg system used

350ºF Autoclave Cure, Low Flow Toughened Epoxy Prepregs, Type 38, Class 2, Grade 193, Style 3K-70-PW
(Hexcel 8552S AS4 Plain Weave Fabric)

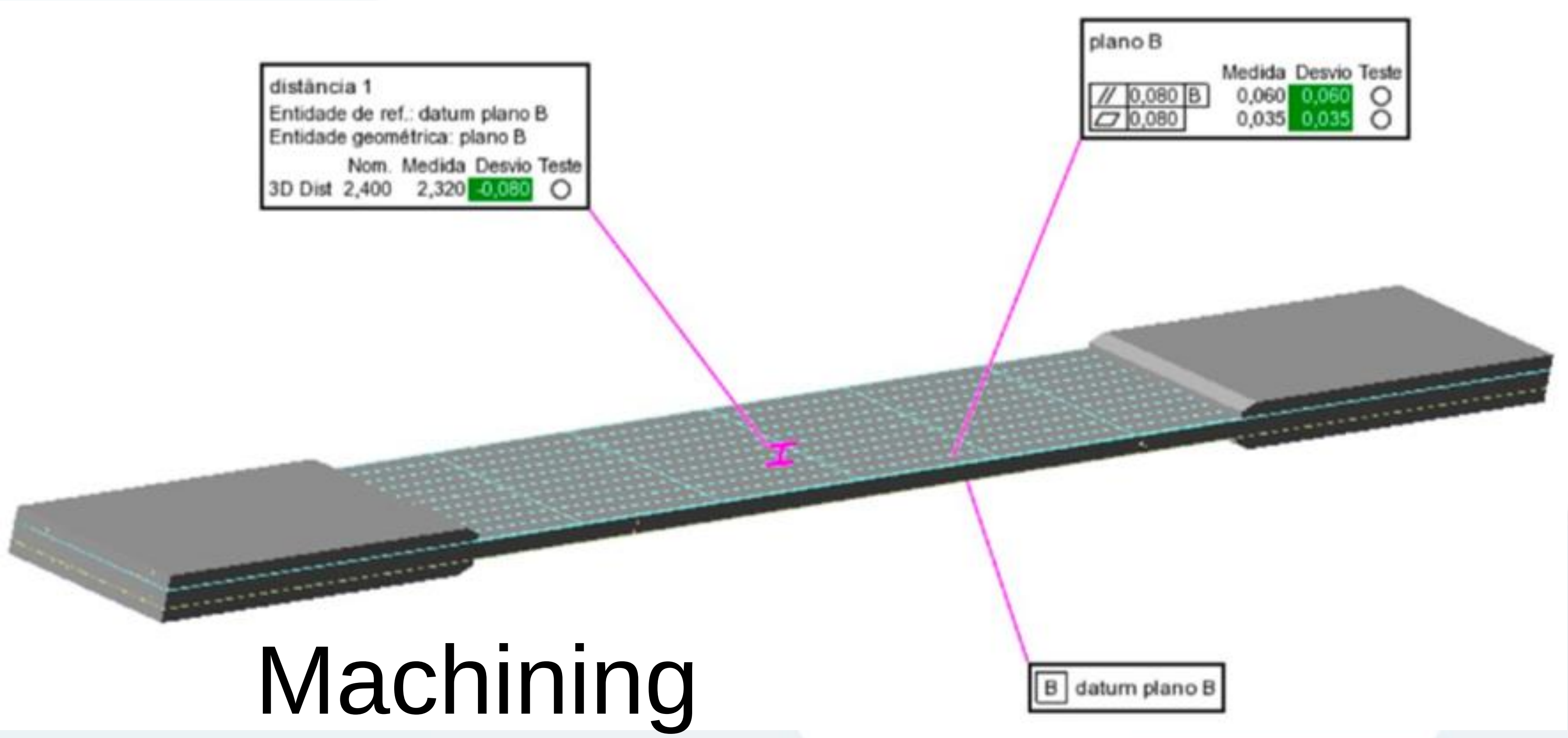
3.5.3 Cured Laminate Mechanical Properties:

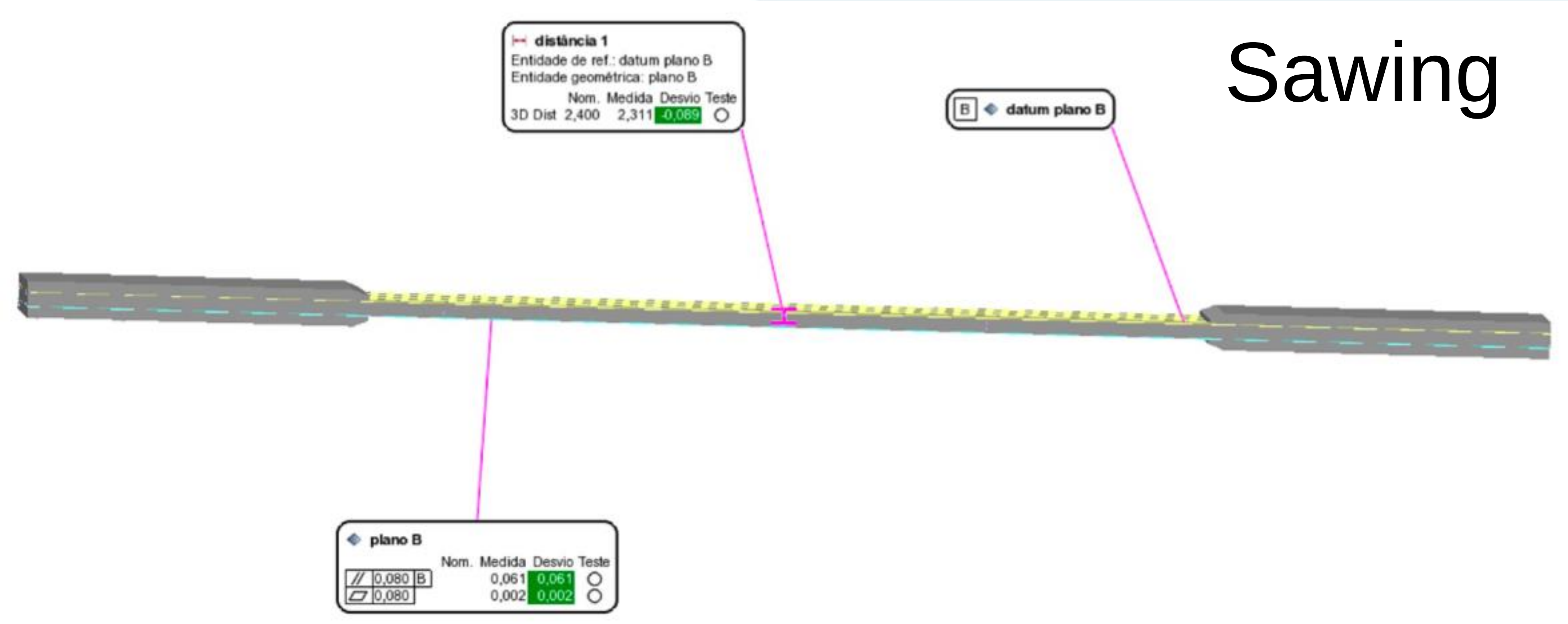
TABLE 5 - Required Cured Laminate Tests for Mechanical Properties (Class 2)

Property	Test Method[1]	Requirements[3]
0° (warp) Tension Strength and Modulus Layup: $[0]_{15}$	ASTM D3039	Strength[2]: Min. Ind. ≥ 89 ksi Strength[2]: Average ≥ 102 ksi Modulus[2]: Between 8.6 and 10.1 msi avg
90° (fill) Compression Strength and Modulus Layup: $[90]_{15}$	ASTM D6641	Strength[2]: Min. Ind. ≥ 78.0 ksi Strength[2]: Average ≥ 97.6 ksi Modulus[2,4]: Between 7.8 and 9.3 msi avg
0° (warp) Short Beam Strength Layup: $[0]_{32}$	ASTM D2344	Strength: Min. Ind. ≥ 9.9 ksi Strength: Average ≥ 12.1 ksi

5. Results

Dimensional inspection (ASTM D3039):



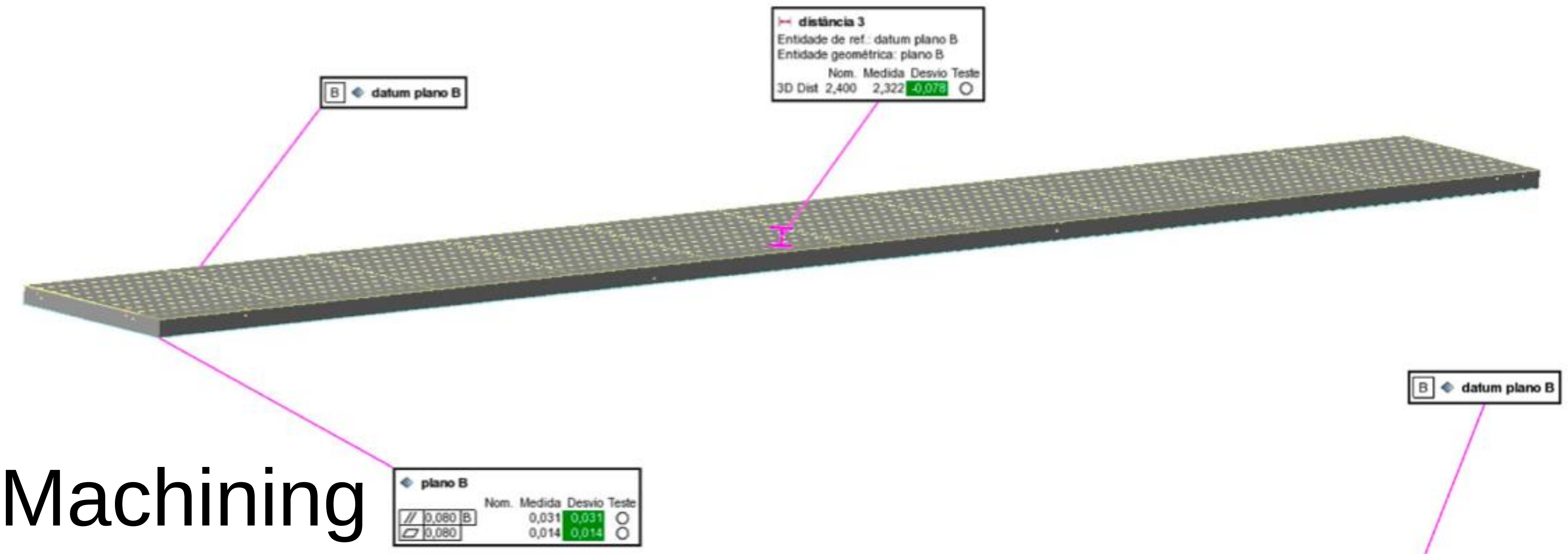


Influence of cutting technique on composite specimens, going beyond standard tolerances.

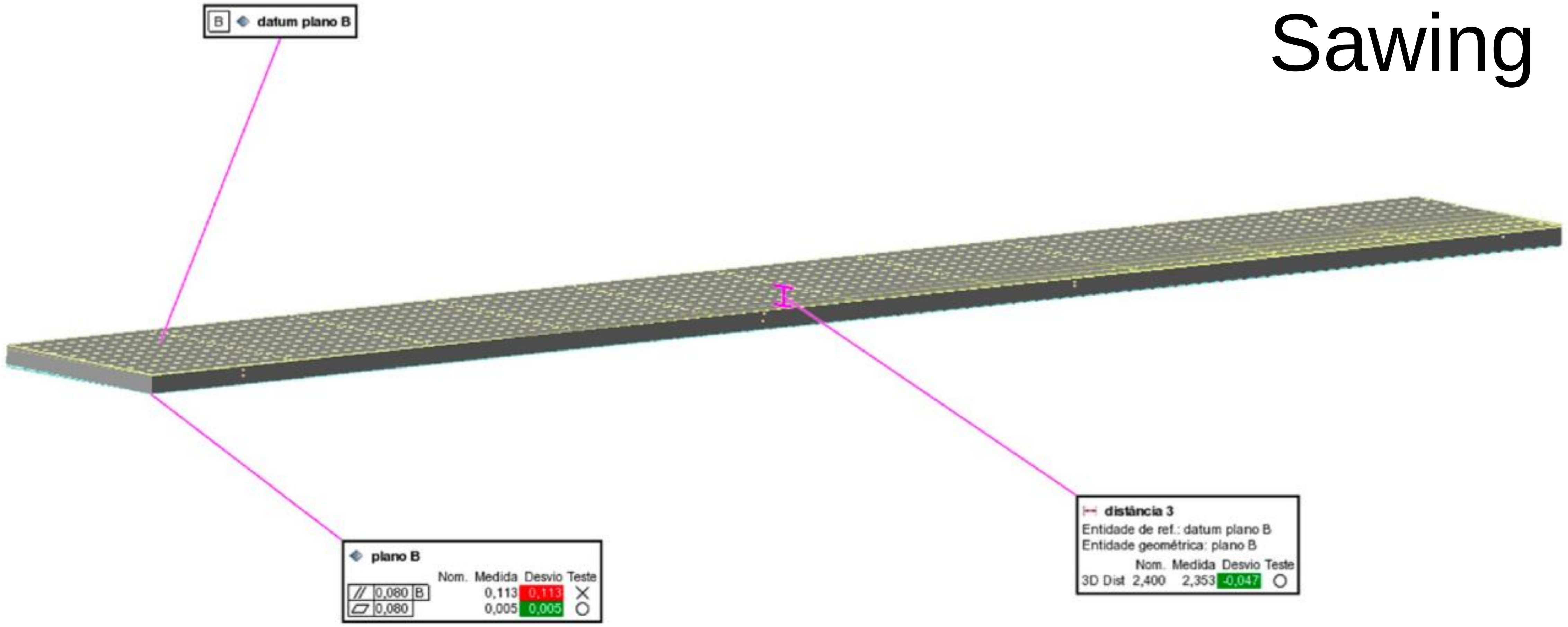
5. Results

Dimensional inspection (ASTM D3518):

Machining



Sawing

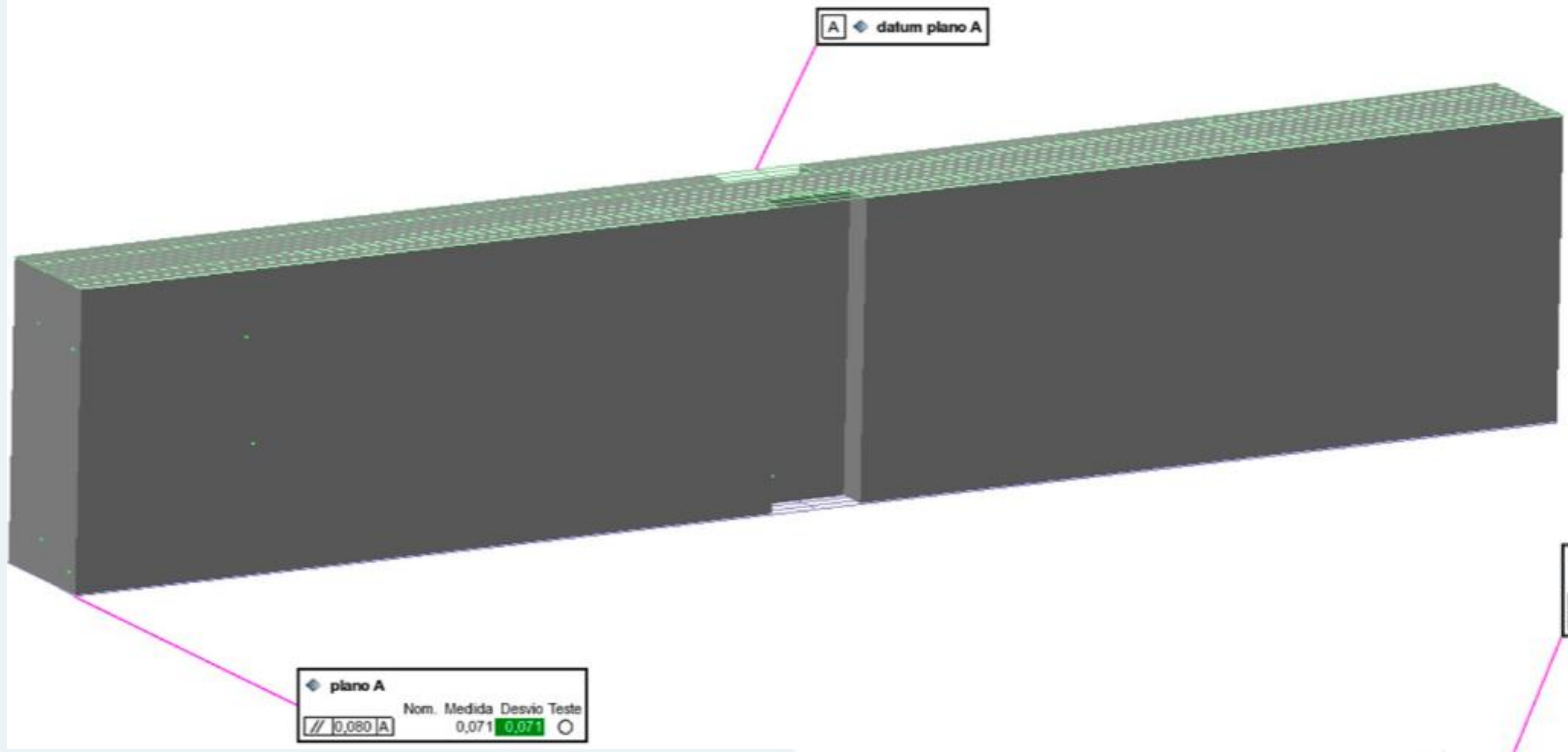


Influence of cutting technique on composite specimens, going beyond standard tolerances.

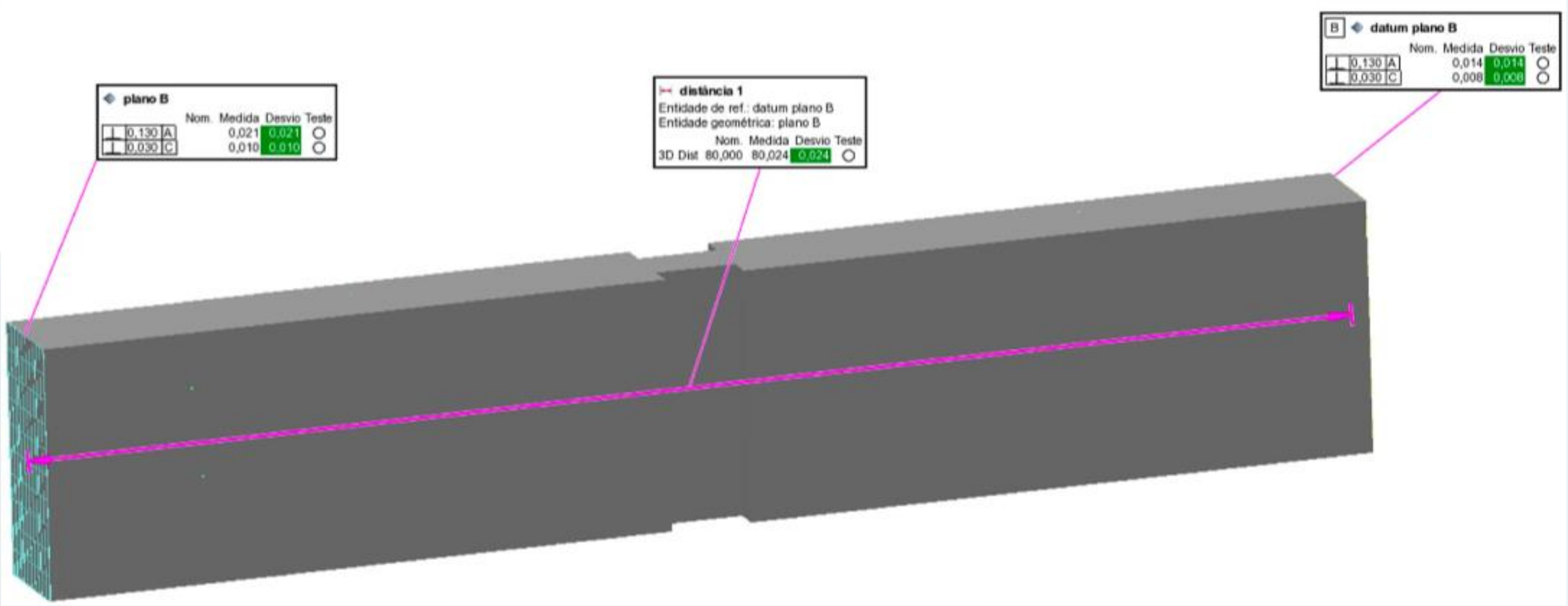
5. Results

Dimensional inspection (SACMA 1R-94):

Sawing



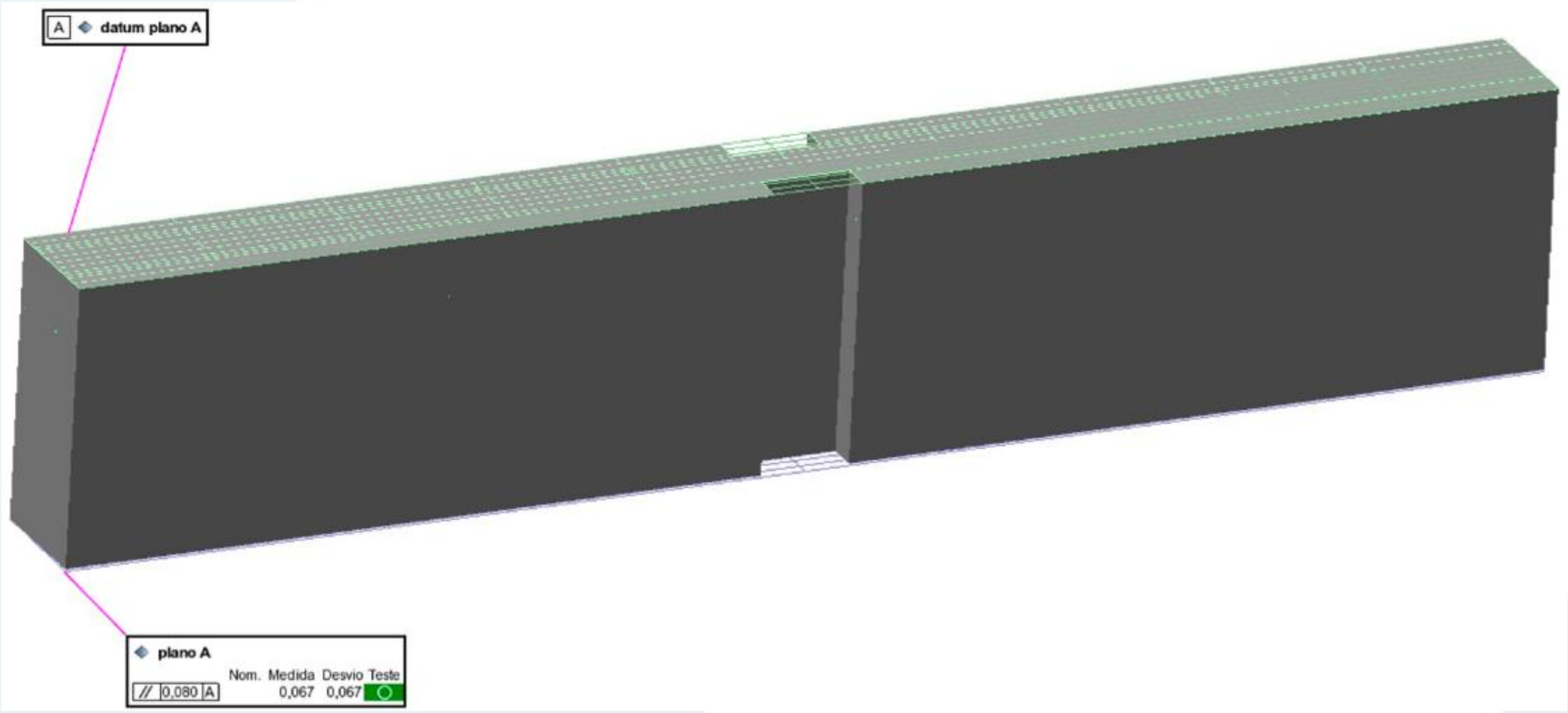
Machining



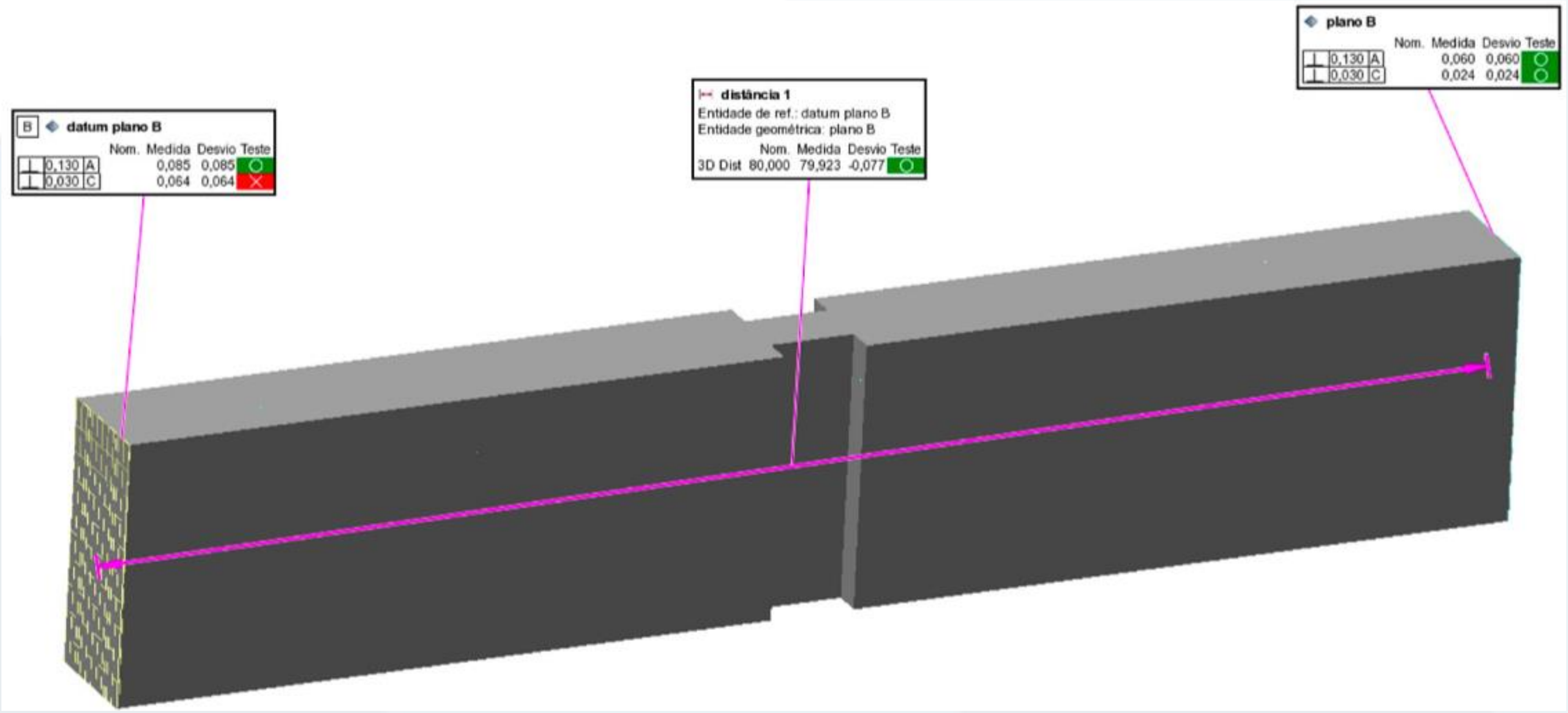
Influence of cutting technique on composite specimens, going beyond standard tolerances.

5. Results

Dimensional inspection (SACMA 1R-94):



Sawing



Influence of cutting technique on composite specimens, going beyond standard tolerances.

5. Results

Mechanical evaluation (Tendencies from average and standard deviation):

	Specimen's cutting technique							
	Machining				Sawing			
	Strength		Modulus		Strength		Modulus	
	X	Sx	X	Sx	X	Sx	X	Sx
ASTM D3039 [warp]	↘ (red)	↗ (red)	↘ (red)	↘ (green)	↗ (green)	↘ (green)	↗ (green)	↗ (red)
ASTM D3039 [fill]	↗ (green)	↘ (green)	↗ (green)	↘ (green)	↘ (red)	↗ (red)	↘ (red)	↗ (red)
ASTM D3518	↗ (green)	↘ (green)	↘ (red)	↘ (green)	↘ (red)	↗ (red)	↗ (green)	↗ (red)
SACMA 1R-94 [warp]	↘ (red)	↘ (green)	-	-	↗ (green)	↗ (red)	-	-
ASTM D2344 [warp]	↗ (green)	↘ (green)	-	-	↘ (red)	↗ (red)	-	-

X = average

Sx = standard deviation

6. Conclusions

i. It is possible to achieve standard geometric tolerances of specimens using both cutting methods: machining and sawing.

i. The probability of reaching the standard geometric tolerances is higher using machining than sawing.

i. For two populations of specimens cut from the same plate using machining and sawing, there is a tendency that the larger the dispersion the lower their mean values.

Final remarks:

The authors would like to thank **ALLTEC** for the permission to bring this work to the public and also to **FAPESP** for the support of this work, from the project - processes: 2015/50664-8 and 2016/50349-8.

ALLTEC

COMPOSITE MATERIALS

R. Moxotó, 456, Chácaras Reunidas
SJCampos, SP, Brazil
55 12 3876-0200.
alltec@allteccomposites.com.br
www.allteccomposites.com.br

José Maria Fernandes Marlet, Dr. Eng., PMP
New Developments
jmarlet@allteccomposites.com.br

Juliana Machado da Mota, MSc
Commercial Manager
juliana@allteccomposites.com.br

Liliana Burakowski, Dra.
Development Engineering
liliana@allteccomposites.com.br

Orestes Ferro, MSc
New Composite Technologies
orestes.ferro@allteccomposites.com.br