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Relatório de Testes e Ensaios	
Cliente:	Sn Portugal, Lda.
Contacto:	Alex Hell (alex@studioneves.com)
Proposta comercial:	PSO257/2026 - 2nd version
Relatório:	PSR257A/2026
Data de emissão do relatório:	09/06/2026
Data de receção das amostras:	19/05/2026

1. Objective

Determination of the multiaxial impact behaviour of two plate samples provided by the client, using the following references (Figure 1):

- *Melamina round plates*;
- *Melamina square plates*;

The results are compared with those obtained from the Studioneves bioplastic plates analysed in February 2025 (report PIEP PSR073/2025, issued on 26 February 2025).

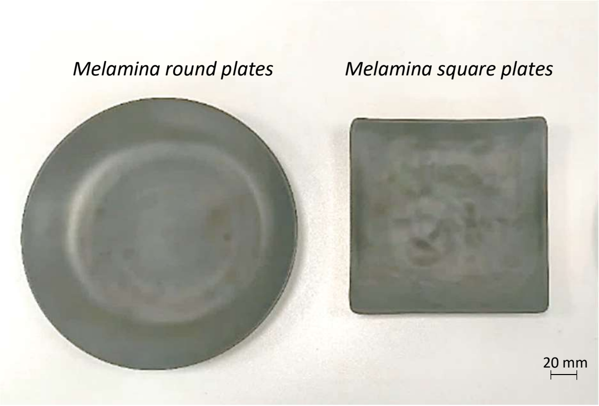

Figure 1 – Samples provided by the client for analysis

2. Experimental procedure

The multiaxial impact behaviour of two plate samples was evaluated according to ISO 6603- 2:2023 under the test conditions presented in Table 1. The initial conditions were identical to those used for the *StudioNeves* bioplastic plates.

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Table 1 – Experimental test conditions used to determine puncture impact resistance

Test method	ISO 6603-2:2023
Equipment	Ceast Fractovis Plus
Impactor	Hemispherical impactor with a diameter of 20 mm, non-lubricated
Impact velocity	2,8 m/s
Impact height	0,4 m
Mass applied	5,045 kg
Test temperature	(23±2) °C
Type of specimen used	Plates provided by the client (Figure 1)
Number of specimens tested	Ten plates per sample
Specimen conditioning	Before testing, the plates were conditioned at (23±2) °C and (50±10) % relative humidity
Date of the test	19–27 May 2026 – Conditioning of plates 27 May 2026 – Impact testing

3. Results

The force versus deflection curves recorded in the multiaxial impact tests carried out on the *Melamina* round and square plates are shown in Figures 2 to 3, respectevely. Figure 4 shows the curves obtained with the *StudioNeves* bioplastic plates under the same test conditions.

Tables 2 to 4 present the results for maximum force (F_M), deflection and energy at maximum force (l_M and E_M, respectively), puncture deflection (l_p) and puncture energy (E_p) determined from the aforementioned curves.

The failure mode observed in plate samples subjected to multiaxial impact tests are shown in Figure 5.

Figure 6 compares the average maximum impact force (F_M) obtained for the different plate samples, which indicates the material's ability to resist initial puncture. The *StudioNeves* bioplastic plates and the *Melamine* square plates showed very similar F_M, with average values of 533 N and 535 N, respectively. In contrast, the *Melamine* round plates exhibited the lowest F_M, with an average value of 248 N (less than half of the force sustained by the *StudioNeves* bioplastic plates), demonstrating a significantly lower resistance to impact loading.

The average energy at maximum force (E_M) obtained for the different plate samples is presented in Figure 7, reflecting the material's ability to absorb energy. The average value of E_M of the *StudioNeves bioplastic plates* (3,4 J) was approximately 2,4 times higher than that of the *Melamine square plates* (1,4 J) and more than eight times higher than that of the

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Melamine round plates (0,4 J). This result demonstrates the superior energy absorption capability of the *StudioNeves bioplastic plates* under impact loading.

Figure 8 illustrates the average puncture energy (E_p) obtained for the different plate samples tested, which reflects the material's ability to resist crack propagation. The *StudioNeves* bioplastic plates exhibited the highest E_p value among the samples that experienced puncture failure, with an average value of 3,5 J. This value was approximately 1,6 times higher than that obtained for the *Melamine* square plates (2,2 J) and five times higher than that of the *Melamine* round plates (0,7 J). These results indicate that the *StudioNeves* bioplastic plates were able to absorb substantially more impact energy before failure.

Table 2 – Puncture impact behaviour [ISO 6603-2:2023] of the *Melamina* round plates

Specimen	F_M (N)	l_M (mm)	E_M (J)	l_p (mm)	E_p (J)	Failure type
1	278	3,9	0,5	8,0	0,9	NY
2	233	49,0	0,4	7,3	0,7	NY
3	231	4,2	0,5	8,5	0,6	NY
4	229	40,7	0,3	7,6	0,7	NY
5	228	43,4	0,3	9,0	0,6	NY
6	260	3,2	0,4	8,7	0,6	NY
7	257	4,4	0,6	7,9	0,9	NY
8	245	3,0	0,3	7,7	0,7	NY
9	244	4,5	0,5	9,0	0,8	NY
10	280	3,9	0,5	8,1	0,8	NY
Average value	**248**	**16,0**	**0,4**	**8,2**	**0,7**	**NY**
Standard deviation	17	24,5	0,1	0,7	0,1	--

NY – No yielding

Table 3 – Puncture impact behaviour [ISO 6603-2:2023] of the *Melamina* square plates

Specimen	F_M (N)	l_M (mm)	E_M (J)	l_p (mm)	E_p (J)	Failure type
1	585	5,5	1,8	7,9	2,4	NY
2	504	3,6	1,1	7,1	1,8	NY
3	528	3,7	1,1	7,1	2,0	NY
4	559	3,6	1,1	8,4	2,0	NY
5	450	4,9	1,5	7,5	2,1	NY
6	532	4,4	1,4	8,8	2,8	NY
7	429	4,0	1,1	8,5	1,8	NY
8	508	3,7	1,1	7,8	1,6	NY
9	680	5,8	2,3	7,6	2,6	NY
10	575	3,6	1,3	8,8	2,3	NY
Average value	**535**	**4,3**	**1,4**	**7,9**	**2,2**	**NY**
Standard deviation	71	0,8	0,4	0,6	0,4	--

NY – No yielding

Table 4 – Puncture impact behaviour [ISO 6603-2:2023] of the *StudioNeves* bioplastic plates

Specimen	F_M (N)	l_M (mm)	E_M (J)	l_p (mm)	E_p (J)	Failure type
1	501	9,7	3,0	9,9	3,1	NY
2	535	11,4	3,5	11,7	3,7	NY
3	482	9,2	2,8	9,6	2,9	NY
4	512	9,6	3,1	10,0	3,3	NY
5	569	11,4	3,9	11,7	4,0	NY
6	590	11,2	3,8	11,3	3,9	NY
7	475	8,1	2,5	8,4	2,6	NY
8	557	11,5	3,8	11,8	4,0	NY
9	594	11,7	4,1	12,1	4,3	NY
10	519	10,7	3,4	10,9	3,5	NY
Average	**533**	**10,5**	**3,4**	**10,8**	**3,5**	**NY**
Standard deviation	43	1,2	0,5	1,2	0,5	--

NY – No yielding

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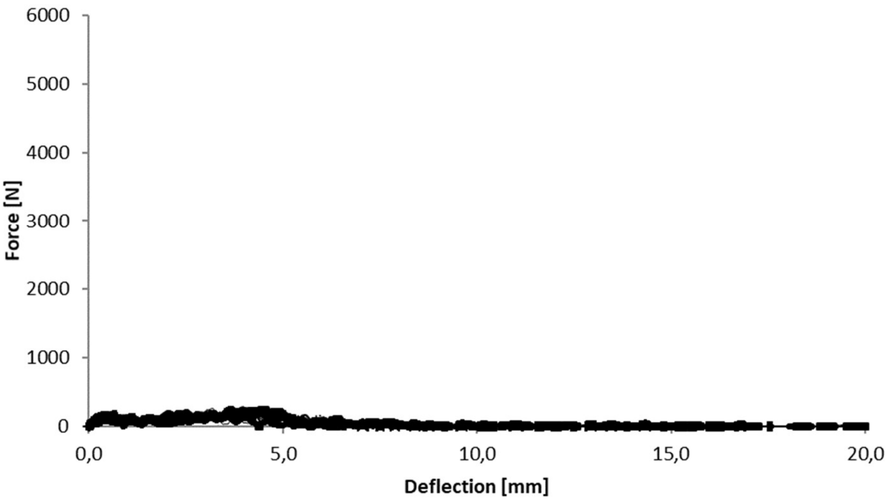
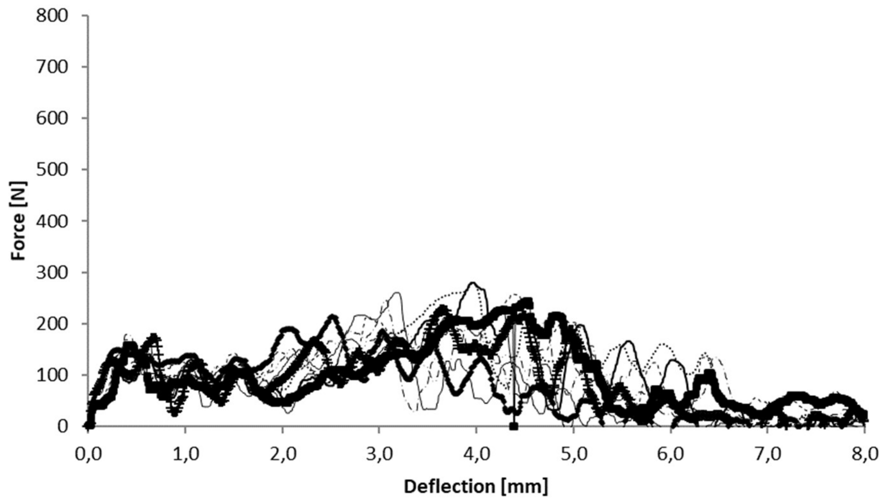


(a) Full-scale axis



(b) Magnification on the axis

Figure 2 - Curves of force versus deflection recorded in multiaxial impact tests carried out on *Melamina* round plates

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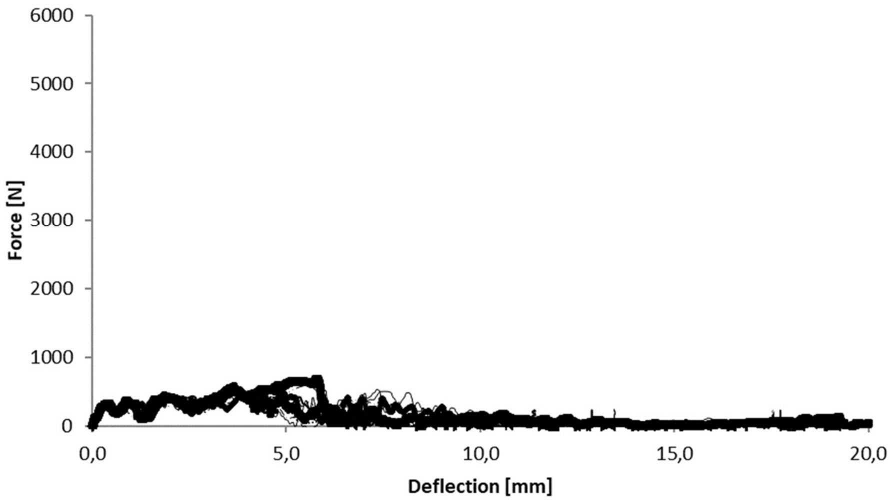
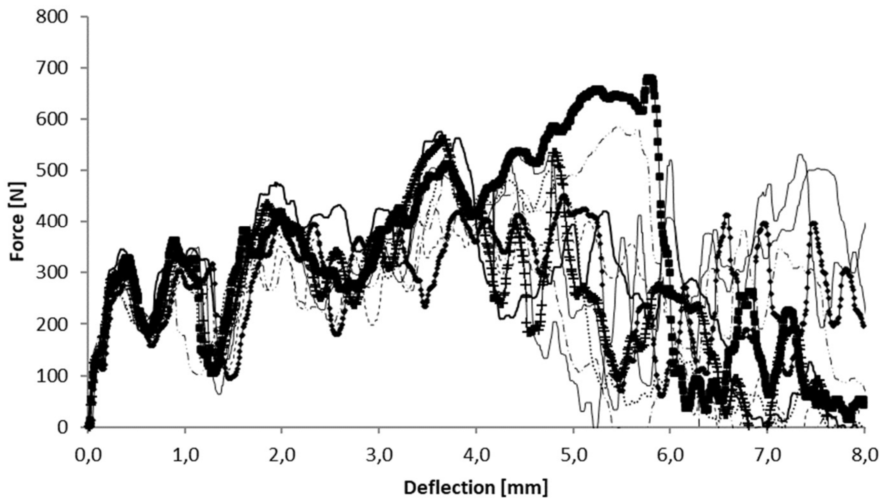


(a) Full-scale axis



(b) Magnification on the axis

Figure 3 - Curves of force versus deflection recorded in multiaxial impact tests carried out on *Melamina* square plates

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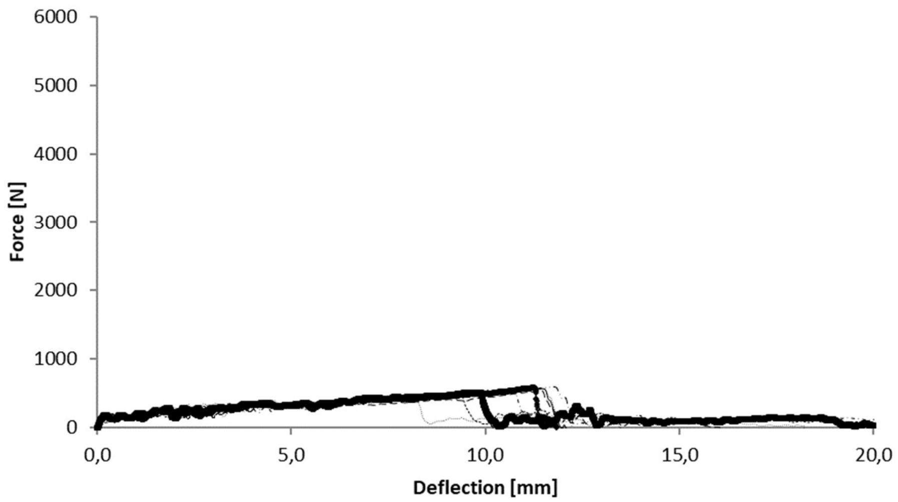
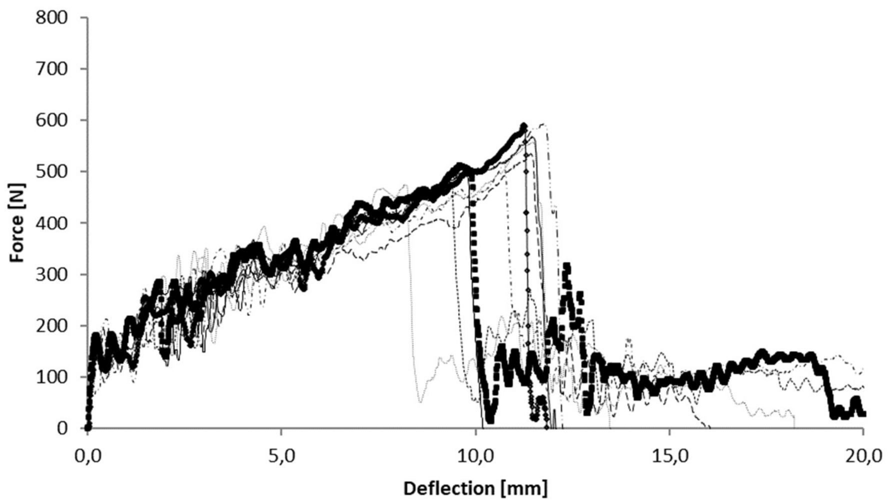


(a) Full-scale axis



(b) Magnification on the axis

Figure 4 - Curves of force versus deflection recorded in multiaxial impact tests carried out on *StudioNeves* bioplastic plates

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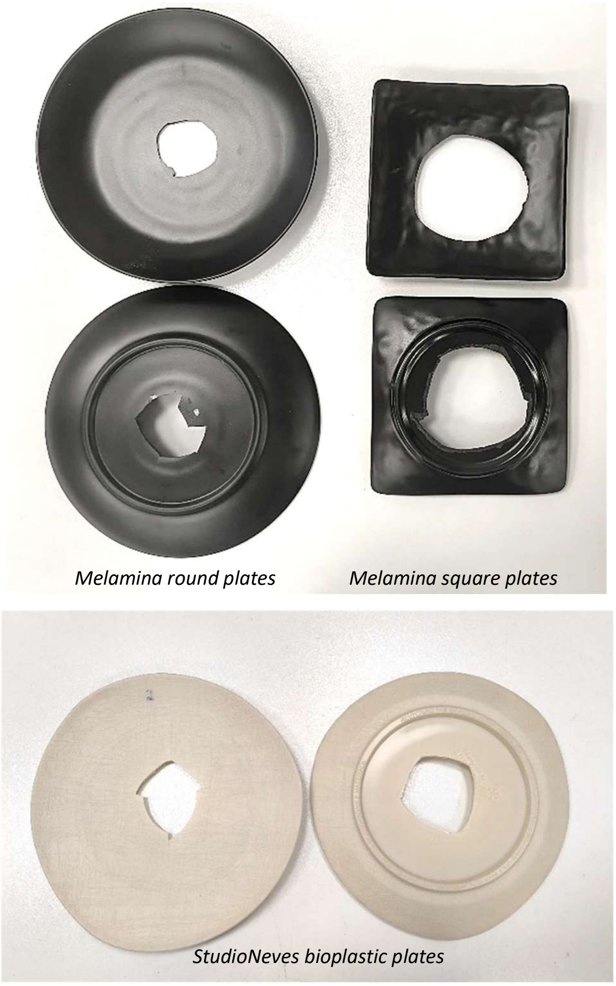

Figure 5 - Failure modes observed in the plate samples subjected to multiaxial impact tests

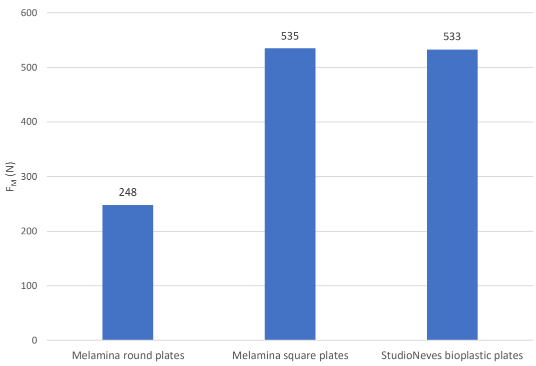

Figure 6 - Maximum impact force (F_M) obtained for the plate samples analysed

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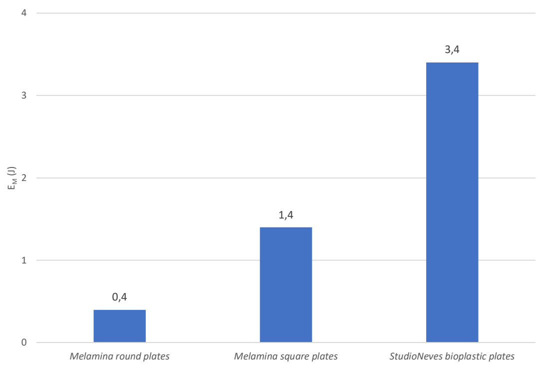

Figure 7 – Energy at maximum impact force (E_M) obtained for the plate samples analysed

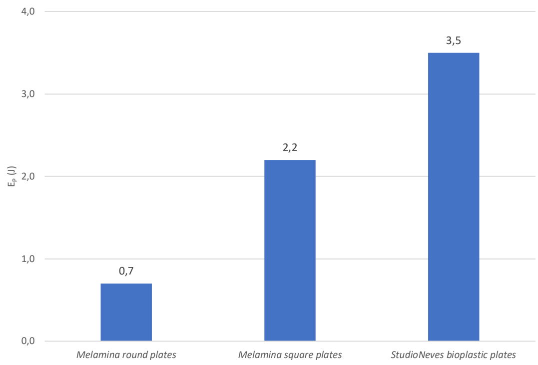

Figure 8 – Puncture energy (E_p) obtained for samples analysed

4. Conclusions

The multiaxial impact behaviour varied significantly across the tested materials. The *StudioNeves* bioplastic plates showed a remarkable energy absorption capability (E_M = 3,4 J and E_p = 3,5 J) substantially outperforming both *Melamine* variants. While the *Melamine* square plates maintained a peak force similar to the *StudioNeves* bioplastic plates, the *Melamine* round plates exhibited the lowest overall impact resistance, sustaining less than half of that force.

Report approved by:

Paula Peixoto

[Tests and Failure Analysis | Coordinator]