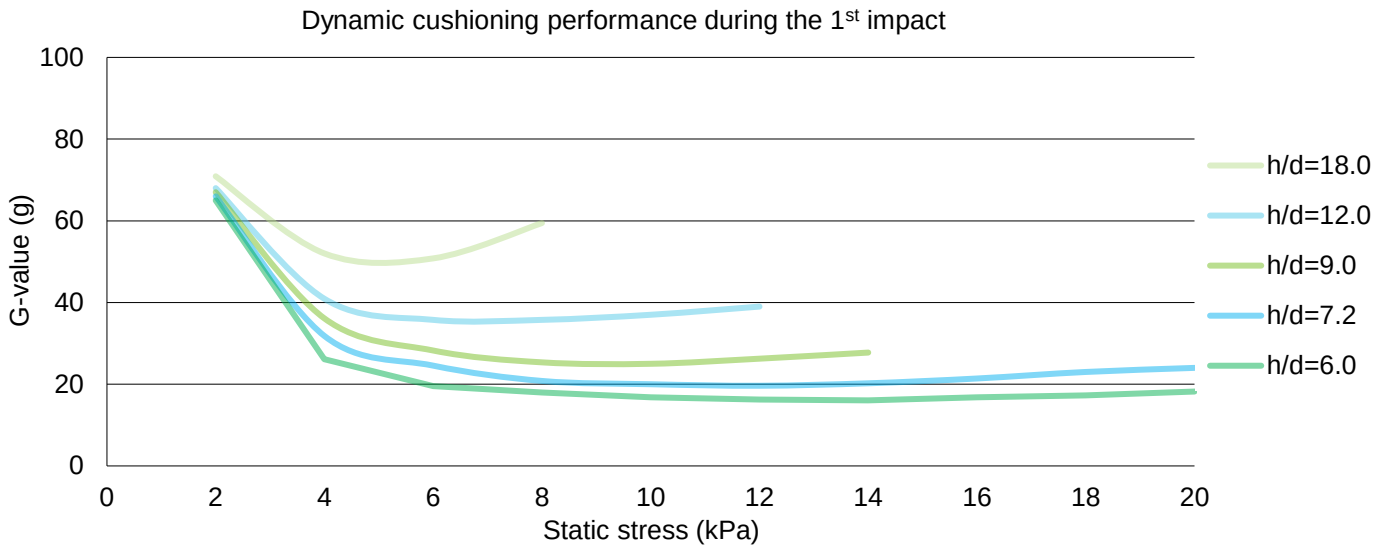
# Dynamic cushioning performance

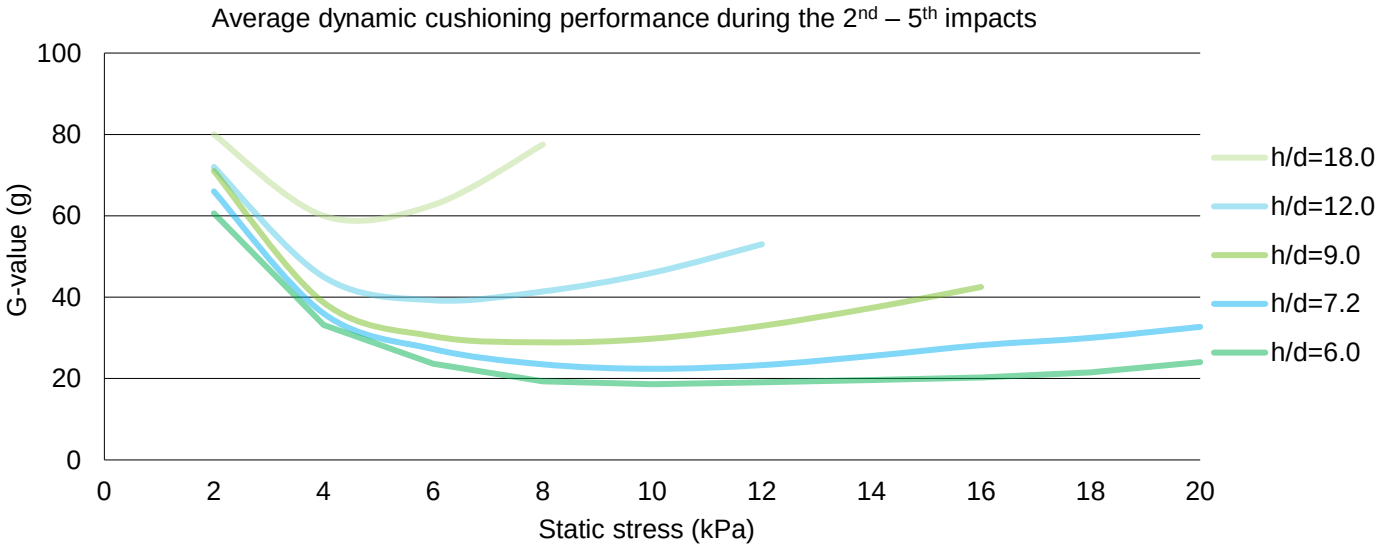
ARPRO is a remarkable energy absorbing material that withstands repeated impacts.

Where fragile items need to be protected from excessive shocks that are above their fragility rating (g-factor), it is necessary to ensure the correct packaging design. To do this one needs to determine the dynamic cushioning performance at different drop heights and static stress levels. To be effective, the design utilising ARPRO must have a G-value lower than the fragility level (g-factor) of the item(s) to be transported. The peak deceleration (G-value) is expressed in multiples of “g”, where “g” corresponds to the standard acceleration due to gravity (g = ~9.81m/s²).

**Test method:** A mass is dropped on a test piece of 150 x 150 x 50mm from a pre-determined height, five times in succession. The deceleration of the impactor, expressed as a G-value, is recorded during each drop. Deceleration values recorded during 2nd to 5th drops are averaged.

1. **Tested density: 20g/l (Where “h” is height and “d” is thickness)**

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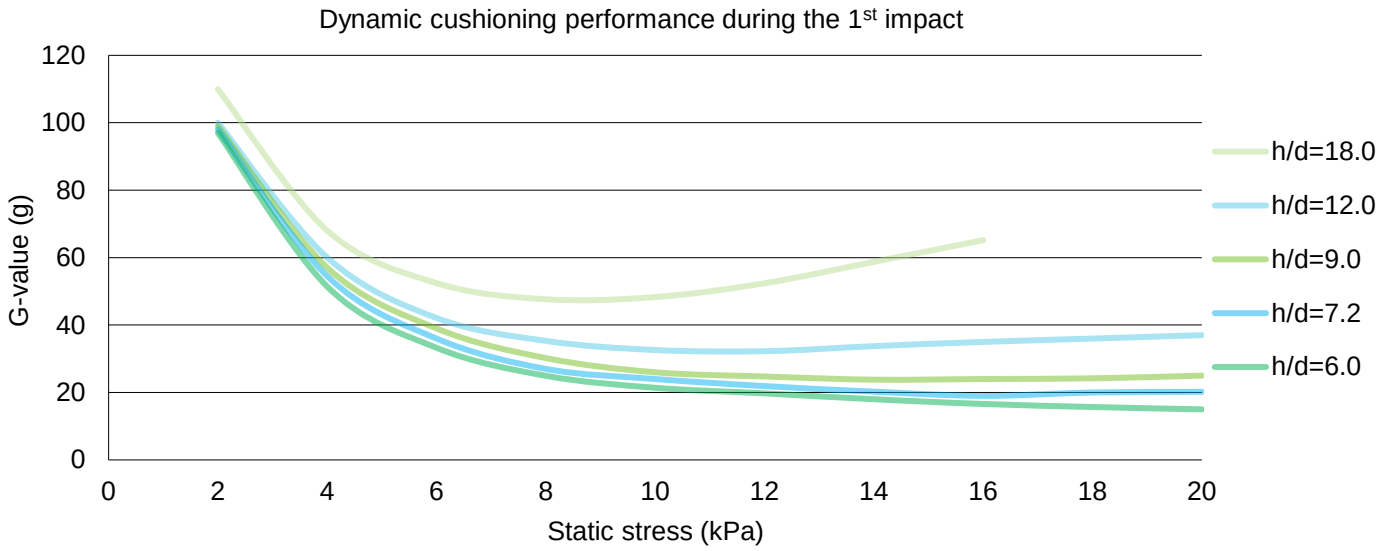
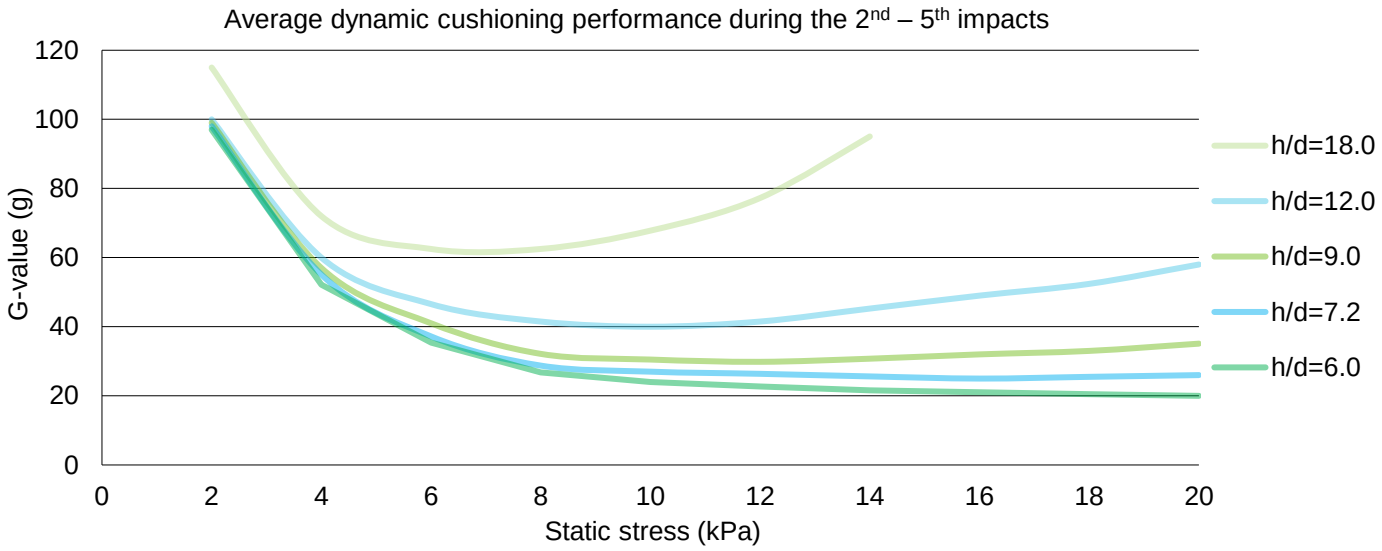
**2. Tested density: 28g/l (Where "h" is height and "d" is thickness)**




**Example 1:**

Dunnage thickness needed to ensure protection to an object from multiple drops of 1m.

- APRRO Black moulded at 20g/l
- G-factor of the object: 40g
- Height of drop: 1m
- Static stress induced by the drop: 6kPa

To provide effective protection, the dunnage has to have a lower G-value than the g-factor of the object. In this example, the G-value needs to be lower than 40g at 6kPa for ARPRO Black moulded at 20g/l. To meet the requirements, the h/d ratio has to be a maximum of 12 to avoid damaging the object. The minimum thickness needed to protect the object is therefore 8.33cm:

$$D = h/12 = 100cm/12 = 8.33cm$$

**Example 2:**
Safe height of drop to ensure protection to an object enclosed in dunnage moulded at 20g/l with a thickness of 10cm.

- APRRO Black moulded at 20g/l
- G-factor of the object: 40g
- Thickness of the dunnage: 10cm
- Static stress induced by the drop: 6kPa

In this example, the G-value needs to be lower than 40g at 6kPa for ARPRO Black moulded at 20g/l. To meet the requirements, the h/d ratio has to be a maximum of 12 to avoid damaging the object. The safe height of the drop is 120cm:

$$h/d = 12$$
$$h = 12*d = 12*10 = 120cm$$

Above 120cm, the dunnage will no longer be able to effectively protect the object.