



TO: GOODMORNING.COM

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DATE: March 19, 2024

RE: PHYSICAL MATTRESS TESTING

INTRODUCTION

GoodMorning.com has commissioned Techtree Engineering to provide independent 3rd party testing of multiple mattresses, based on an established testing schema prescribed by GoodMorning.com.

Techtree Engineering is an independent 3rd party engineering firm headquartered in Alberta, Canada, with a presence throughout the country.

The testing procedures are described briefly below, and in greater detail in document "TT-GM-01 – AppendixB".

Sincerely,

Techtree Engineering Ltd.

Brad Schroeder, P.Eng.



TESTING METHODOLOGY

a. **Reference Loads** – The equipment used to perform the tests below is as follows:

1. 105 lb Rescue Randy mannequin
2. 65 lb weighted vest
3. Accelerometer
4. 10 lb medicine ball
5. Mattress testing base
6. Levels, tape measure – not shown



Rescue Randy, weighted vest, accelerometer, and mattress testing base (levels/tape measure not shown)

b. **Test Conditions**

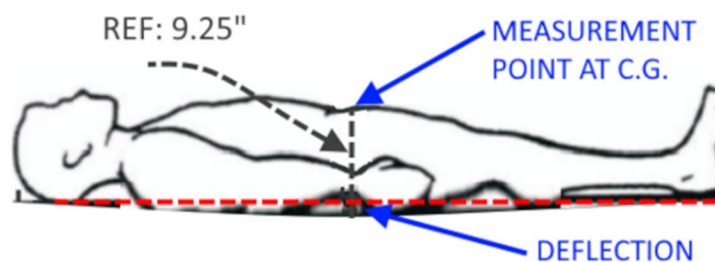
All tests were performed in offices equipped with thermostat-based temperature control, which maintains the environment within a specific range.



PART 1 - FIRMNESS TEST:

1. **Objective:** This test is conducted to assess the mattress's level of firmness, verifying that it adheres to the established criteria for comfort and support. This serves as a foundation for comparison, evaluation, and dialogue.
2. **Overview:** This test involves measuring the mattress's resistance to pressure by applying a human equivalent load and assessing its firmness level.
3. **Procedure:** A mannequin weighing 105 lb, outfitted with a weighted vest of 65 lb, was employed to assess the mattresses' deflection levels in comparison to a baseline measurement. These deflection readings help to ascertain the mattress's firmness, with greater deflection indicating a softer mattress.
4. **Formulas and calculations**

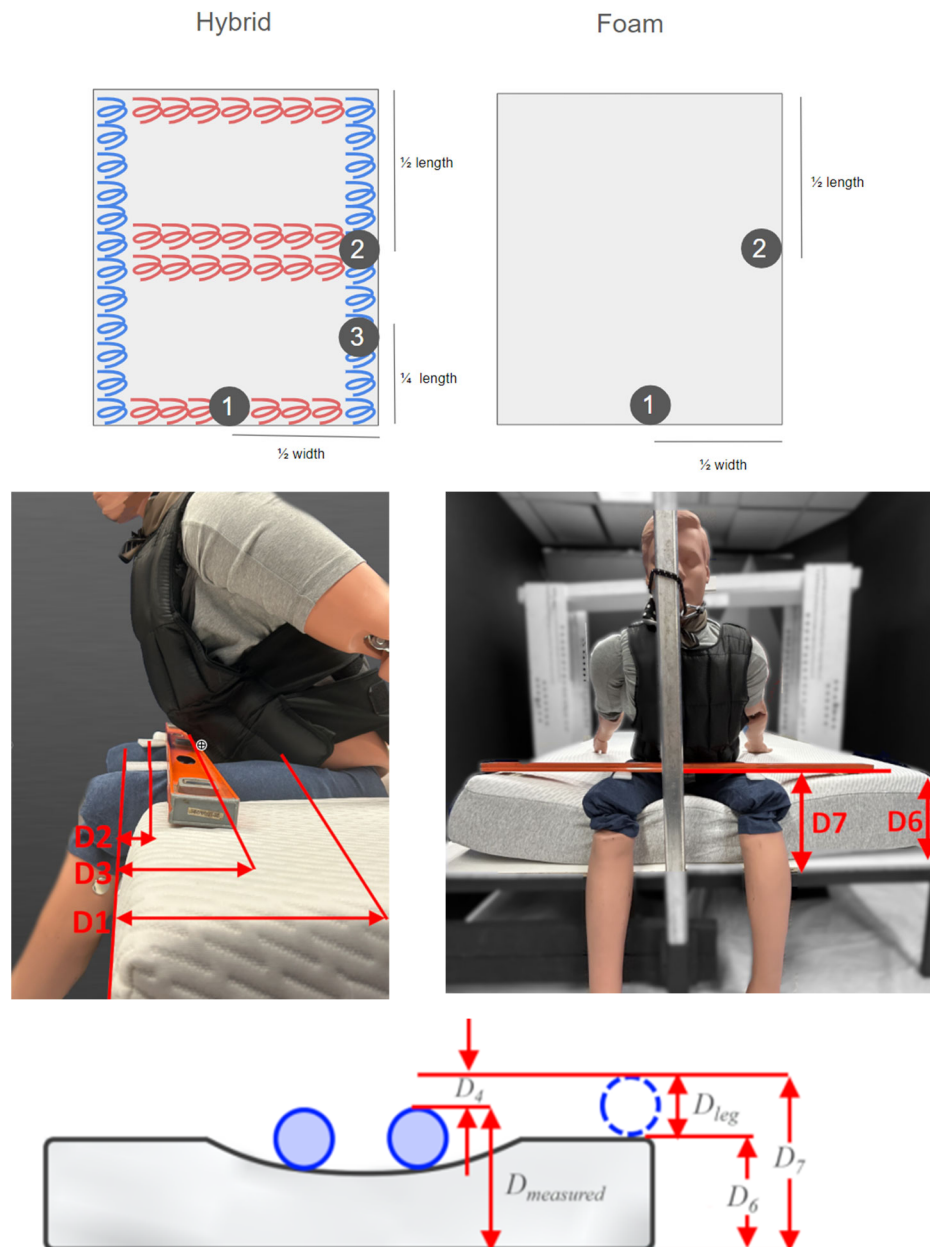
Deflection = Neutral measurement - (Deflected measurement + Mannequin thickness at the measurement point).





PART 2 EDGE SUPPORT TEST:

- 1. Objective:** This test aims to assess the edge of the mattress's capability to retain structural integrity and comfort when subjected to pressure. It serves as a foundation for comparison, evaluation, and discussion.
- 2. Overview:** This test involves measuring edge deflection by applying a human-equivalent load at various points along the mattress's perimeter, tailored to the specific type of mattress (hybrid or foam). Results are categorized and scored according to mattress type.
- 3. Procedure:** The edge support of mattresses is evaluated by situating a 105 lb mannequin at the mattress's edge, equipped with a 65 lb weighted vest, and conducting measurements from the thighs down to a predetermined reference point. Multiple measurements are systematically recorded for each mattress as outlined in the following illustrations:





4. Formulas and calculations – all measurements are in inches

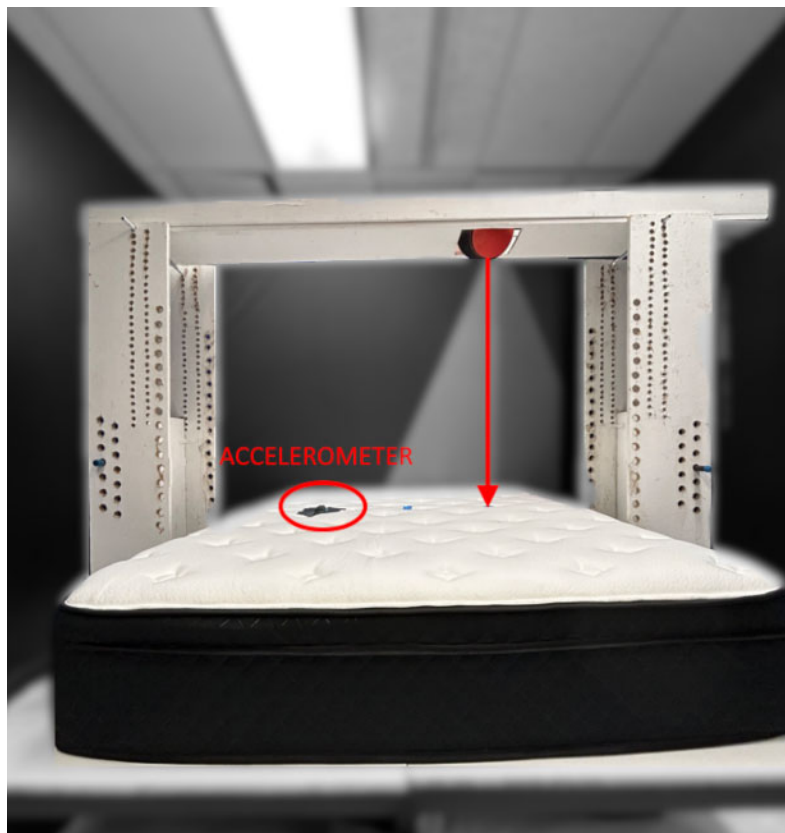
Constant values: D1=17 ; Leg thickness Dleg=5.375 at D2, Dleg=6.375 at D3

- Initial Setup and Measurements:
 - D1: Constant distance from the mattress edge to the center of mass of the mannequin.
 - D2: Horizontal reference point established by placing a level on the mannequin's knees.
 - D3: Alternate horizontal reference point, similar to D2.
 - D6: Mattress thickness.
 - D7: Distance from the top of the knees to the foundation base, indicating the height with no sinkage.
- Sinkage Measurement:
 - D measured: The distance from the top of the knees to the foundation base while the mannequin is seated, used to determine the sinkage.
- Deflection Calculations:
 - Deflection at the Knees $D4' = D7 - D$ measured.
 - Deflection at the Thigh $D4''$: Uses the same formula as $D4'$, calculated at a different point to capture the deflection at thigh level.
- Average Deflection:
 - D4: Average deflection value, obtained by averaging the two measurements ($D4'$ and $D4''$), provides a comprehensive assessment of the mattress edge support.
- Repeat Measurements and Final Calculations:
 - Measurements are repeated at various locations across the mattress according to the mattress type.
 - The average deflection value across all test points and for each mattress type: Hybrid and Foam, is determined, offering a metric for assessing overall edge support.



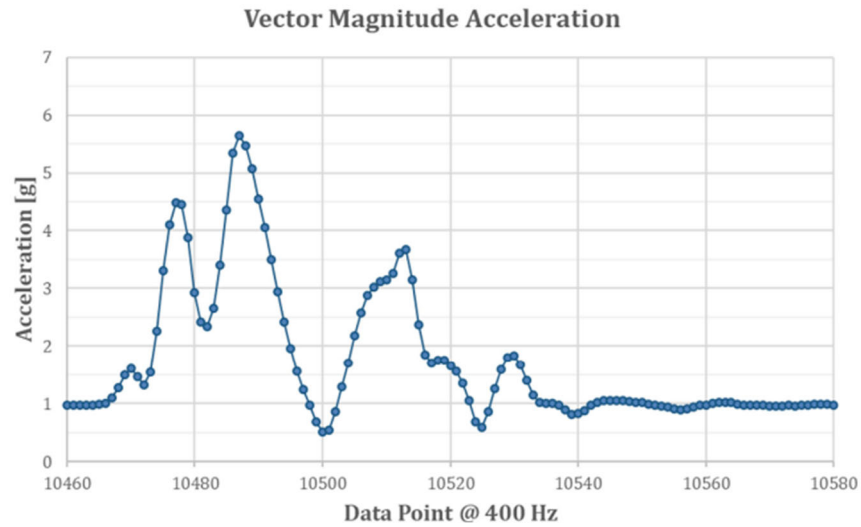
PART 3 – MOTION ISOLATION:

1. **Objective:** This test aims to assess how much motion transfer is experienced on one side of the mattress from movement on the other.
2. **Overview:** This test involves repeated drops of a medicine ball at a measured distance away from an accelerometer.
3. **Procedure:** The motion isolation of mattresses is evaluated by dropping a medicine ball on a mattress 20 times, and recording the accelerations experienced by an accelerometer. The acceleration is three-dimensional: up-down, left-right, head-toe. These three values are combined into a magnitude acceleration and averaged across the 20 test drops.





4. Formulas and calculations



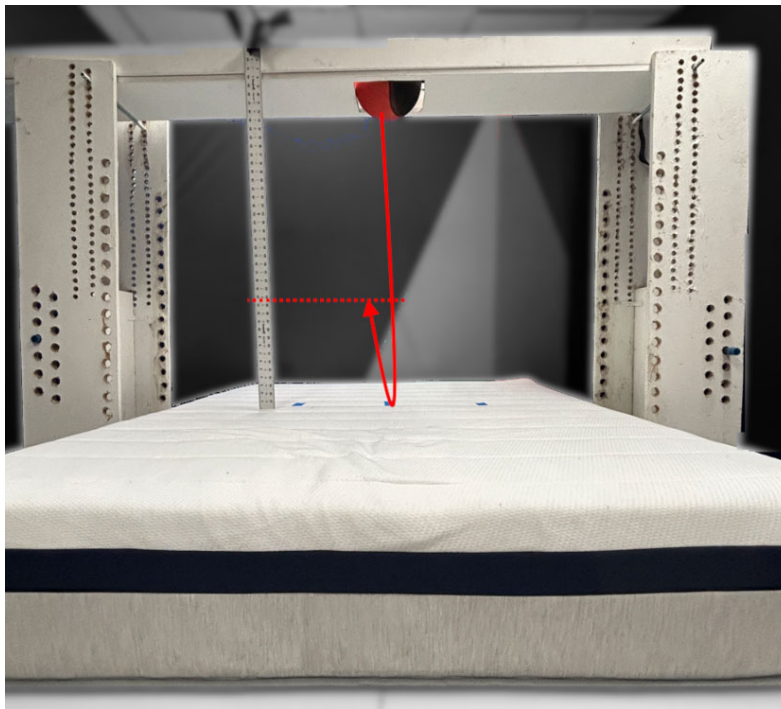
The vector magnitude of acceleration as shown above in is calculated using the expression shown below.

$$a = \sqrt{x^2 + y^2 + z^2}$$



PART 4 – BOUNCINESS:

1. **Objective:** This test aims to assess how much rebound a mattress exhibits to quantify its bounciness.
2. **Overview:** This test involves repeated drops of a medicine ball and recording the rebound height from the mattress surface.
3. **Procedure:** Drop a 10 lb sphere (9" diameter) from a fixed distance on to the top side of each subject mattress and measure the resultant peak rebound height on its first bounce. A high resultant peak rebound height shall indicate more bounciness, while a low resultant peak height shall indicate less bounciness.





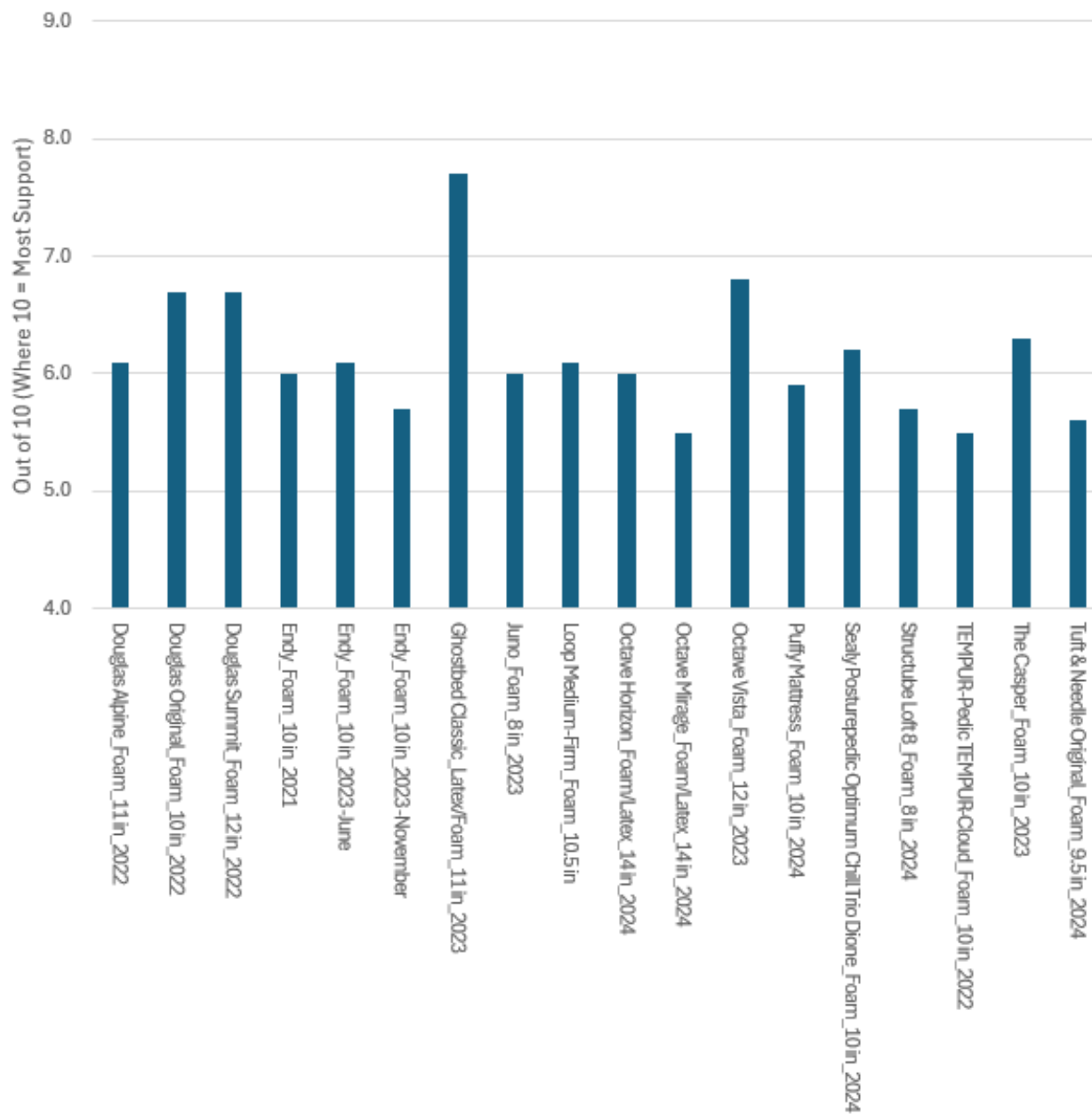
FIRMNESS TEST RESULTS

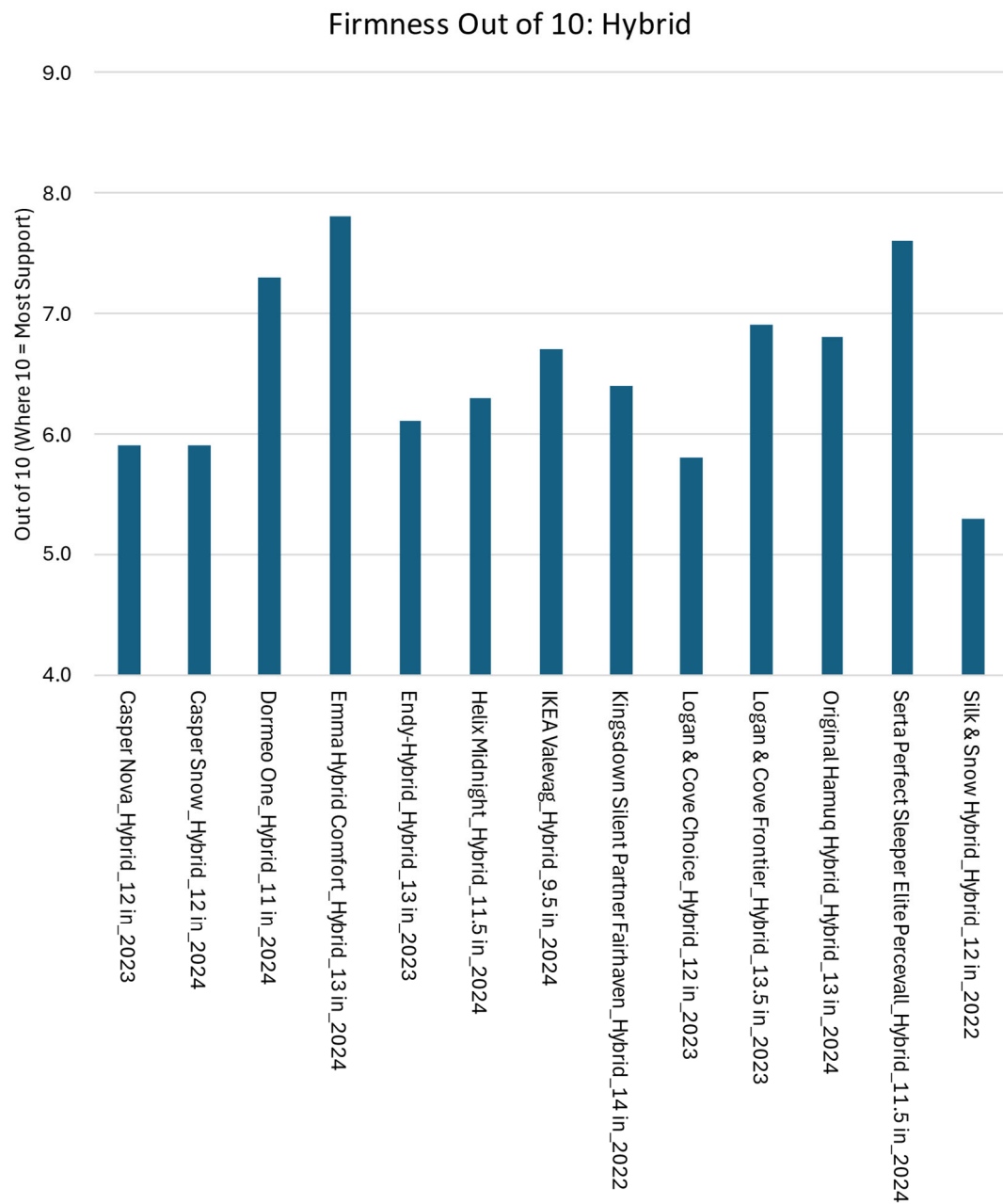
Mattress Firmness Measurements (in inches): Foam & Foam/Latex				
Mattress	Neutral Measurement (in)	Deflected Measurement (in)	Deflection (in)	Out of 10
Douglas Alpine_Foam_11 in_2022	32.5	23.4	2.6	6.1
Douglas Original_Foam_10 in_2022	33.8	24.0	2.0	6.7
Douglas Summit_Foam_12 in_2022	31.8	22.0	2.0	6.7
Endy_Foam_10 in_2021	33.8	24.8	2.8	6.0
Endy_Foam_10 in_2023 -June	33.5	24.4	2.7	6.1
Endy_Foam_10 in_2023 -November	33.5	24.8	3.0	5.7
Ghostbed Classic_Latex/Foam_11 in_2023	33.5	22.8	1.0	7.7
Juno_Foam_8 in_2023	35.0	26.0	2.8	6.0
Loop Medium-Firm_Foam_10.5 in	39.8	30.6	2.6	6.1
Octave Horizon_Foam/Latex_14 in_2024	30.8	21.8	2.8	6.0
Octave Mirage_Foam/Latex_14 in_2024	31.0	22.5	3.3	5.5
Octave Vista_Foam_12 in_2023	31.9	22.1	2.0	6.8
Puffy Mattress_Foam_10 in_2024	40.3	31.4	2.9	5.9
Sealy Posturepedic Optimum Chill Trio Dione_Foam_10 in_2024	40.3	31.0	2.5	6.2
Structube Loft 8_Foam_8 in_2024	44.3	35.5	3.0	5.7
TEMPUR-Pedic TEMPUR-Cloud_Foam_10 in_2022	33.7	25.3	3.3	5.5
The Casper_Foam_10 in_2023	33.3	23.9	2.4	6.3
Tuft & Needle Original_Foam_9.5 in_2024	40.5	31.9	3.1	5.6

Mattress Firmness Measurements (in inches): Hybrid				
Mattress	Neutral Measurement (in)	Deflected Measurement (in)	Deflection (in)	Out of 10
Casper Nova_Hybrid_12 in_2023	31.8	23.8	3.7	5.9
Casper Snow_Hybrid_12 in_2024	38.5	30.5	3.8	5.9
Dormeo One_Hybrid_11 in_2024	39.4	29.9	2.3	7.3
Emma Hybrid Comfort_Hybrid_13 in_2024	38.4	28.4	1.8	7.8
Endy-Hybrid_Hybrid_13 in_2023	30.8	22.5	3.5	6.1
Helix Midnight_Hybrid_11.5 in_2024	38.5	30.0	3.3	6.3
IKEA Valevag_Hybrid_9.5 in_2024	40.5	31.6	2.9	6.7
Kingsdown Silent Partner Fairhaven_Hybrid_14 in_2022	29.4	20.8	3.1	6.4
Logan & Cove Choice_Hybrid_12 in_2023	31.0	23.1	3.9	5.8
Logan & Cove Frontier_Hybrid_13.5 in_2023	30.4	21.3	2.6	6.9
Original Hamuq Hybrid_Hybrid_13 in_2024	41.0	32.0	2.8	6.8
Serta Perfect Sleeper Elite Percevall_Hybrid_11.5 in_2024	40.0	30.2	2.0	7.6
Silk & Snow Hybrid_Hybrid_12 in_2022	30.8	23.5	4.5	5.3



Firmness Out of 10: Foam & Foam/Latex





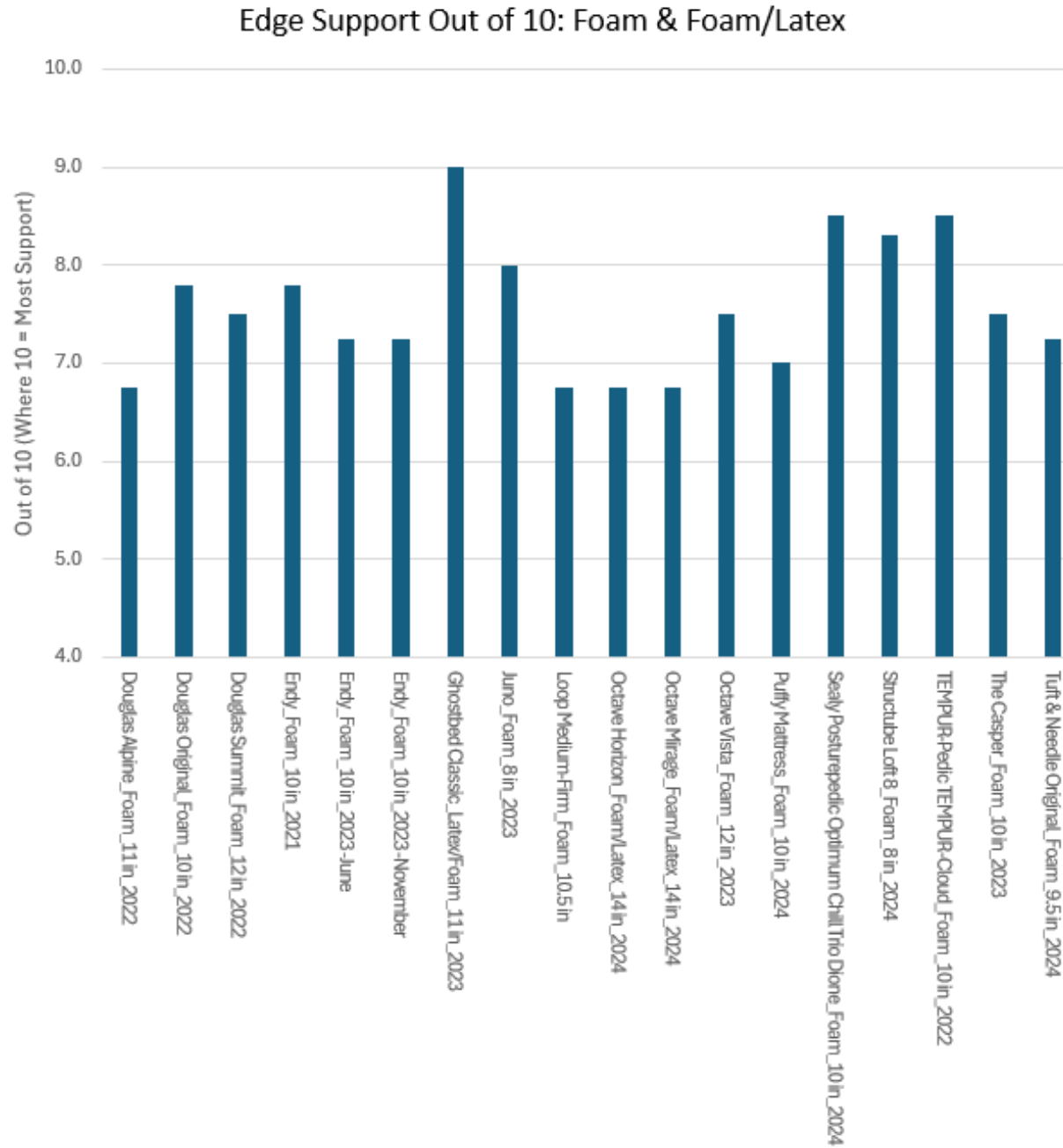


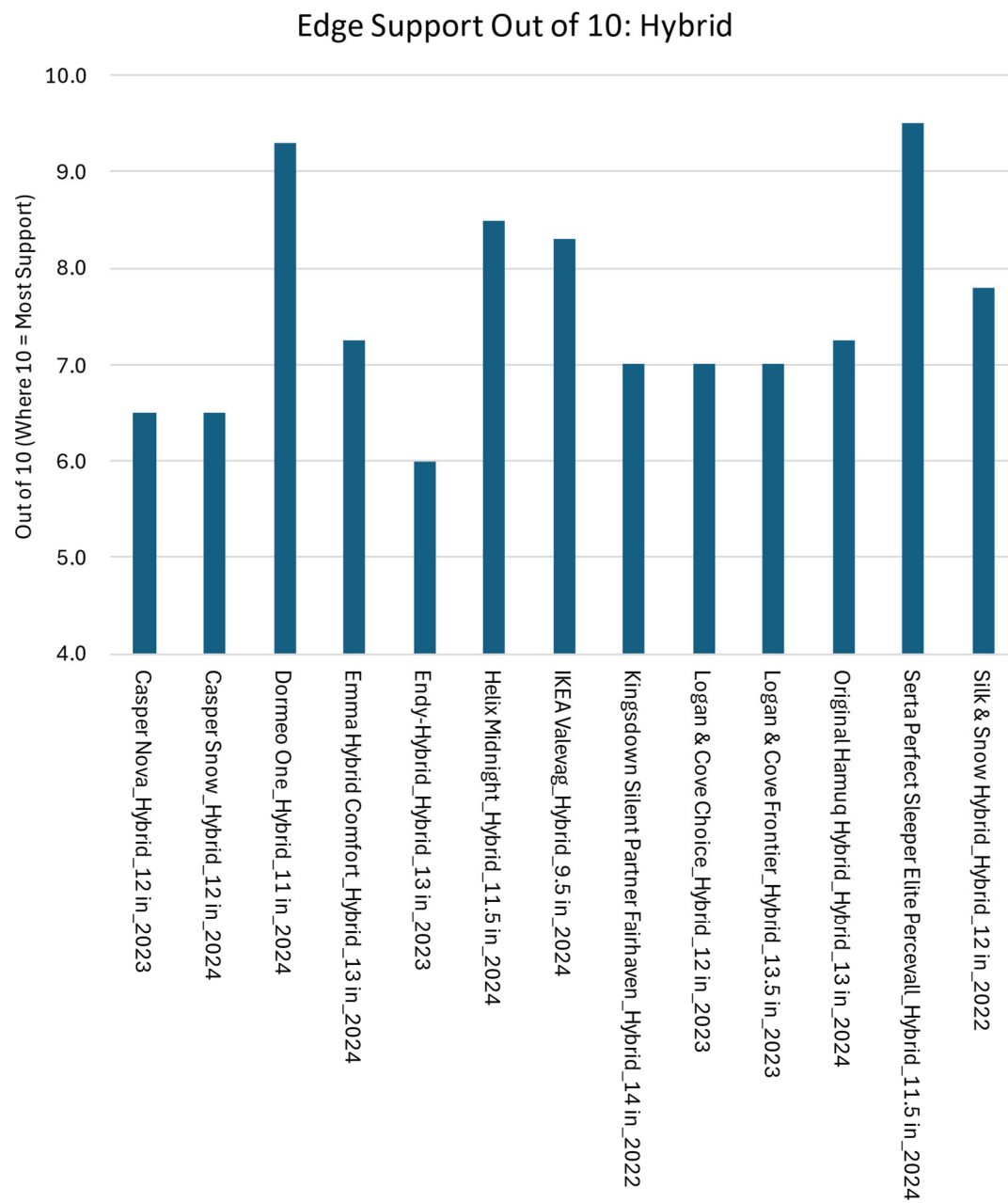
EDGE SUPPORT TEST RESULTS

Edge Support - Deflection Measurements (in inches): Foam & Foam/Latex						
Mattress Name	D4 - Sinkage Front [Location 1] @ D2	D4 - Sinkage Front [Location 1] @ D3	D4 - Sinkage Side [Location 2] @D2	D4 - Sinkage Side [Location 2] @D3	Average Deflection	Out of 10
Douglas Alpine_Foam_11 in_2022	4.0	4.8	6.2	6.3	5.3	6.8
Douglas Original_Foam_10 in_2022	4.4	4.6	4.1	4.1	4.3	7.8
Douglas Summit_Foam_12 in_2022	3.4	4.3	5.3	5.9	4.7	7.5
Endy_Foam_10 in_2021	4.1	4.6	4.4	4.9	4.5	7.8
Endy_Foam_10 in_2023 -June	4.3	4.9	4.4	5.4	4.8	7.3
Endy_Foam_10 in_2023 -November	4.7	5.5	4.3	5.0	4.9	7.3
Ghostbed Classic_Latex/Foam_11 in_2023	2.8	3.4	3.4	2.5	3.0	9.0
Juno_Foam_8 in_2023	3.4	4.1	4.4	4.9	4.2	8.0
Loop Medium-Firm_Foam_10.5 in	4.4	5.1	5.8	6.5	5.4	6.8
Octave Horizon_Foam/Latex_14 in_2024	5.0	5.8	5.1	5.7	5.4	6.8
Octave Mirage_Foam/Latex_14 in_2024	5.2	6.1	5.1	5.6	5.5	6.8
Octave Vista_Foam_12 in_2023	3.5	4.2	5.5	5.5	4.7	7.5
Puffy Mattress_Foam_10 in_2024	4.5	4.8	5.1	5.9	5.1	7.0
Sealy Posturepedic Optimum Chill Trio Dione_Foam_10 in_2024	3.6	4.3	3.0	3.8	3.7	8.5
Structube Loft 8_Foam_8 in_2024	3.5	4.2	3.4	4.0	3.8	8.3
TEMPUR-Pedic TEMPUR-Cloud_Foam_10 in_2022	2.5	3.1	4.2	4.9	3.7	8.5
The Casper_Foam_10 in_2023	4.5	4.8	4.2	4.6	4.6	7.5
Tuft & Needle Original_Foam_9.5 in_2024	4.7	5.5	4.6	5.3	5.0	7.3

**Edge Support - Deflection Measurements (in inches): Hybrid**

Mattress Name	D4 - Sinkage Front [Location 1] @ D2	D4 - Sinkage Front [Location 1] @ D3	D4 - Sinkage Side [Location 2] @D2	D4 - Sinkage Side [Location 2] @D3	D4 - Sinkage Side [Location 3] @D2	D4 - Sinkage Side [Location 3] @D3	Average Deflection	Out of 10
Casper Nova_Hybrid_12 in_2023	5.1	5.4	5.6	6.1	5.3	6.1	5.6	6.5
Casper Snow_Hybrid_12 in_2024	5.4	6.3	5.3	6.0	4.8	5.6	5.5	6.5
Dormeo One_Hybrid_11 in_2024	2.3	3.1	2.9	3.5	2.1	2.9	2.8	9.3
Emma Hybrid Comfort_Hybrid_13 in_2024	4.5	5.3	4.5	5.3	4.1	4.9	4.8	7.3
Endy-Hybrid_Hybrid_13 in_2023	5.4	5.8	6.0	6.6	6.3	6.3	6.1	6.0
Helix Midnight_Hybrid_11.5 in_2024	3.8	4.5	3.1	3.8	3.1	3.8	3.7	8.5
IKEA Valevag_Hybrid_9.5 in_2024	3.4	4.2	3.6	4.4	0.0	0.0	3.9	8.3
Kingsdown Silent Partner Fairhaven_Hybrid_14 in_2022	4.4	4.8	5.1	5.3	4.8	6.0	5.1	7.0
Logan & Cove Choice_Hybrid_12 in_2023	4.9	5.6	5.0	5.0	5.2	4.4	5.0	7.0
Logan & Cove Frontier_Hybrid_13.5 in_2023	4.4	4.6	4.8	5.1	4.9	6.4	5.0	7.0
Original Hamuq Hybrid_Hybrid_13 in_2024	4.3	5.0	4.5	5.1	4.8	6.0	4.9	7.3
Serta Perfect Sleeper Elite Percevall_Hybrid_11.5 in_2024	1.7	2.6	2.8	3.5	2.4	3.2	2.7	9.5
Silk & Snow Hybrid_Hybrid_12 in_2022	3.8	4.4	4.5	4.3	4.0	5.4	4.4	7.8







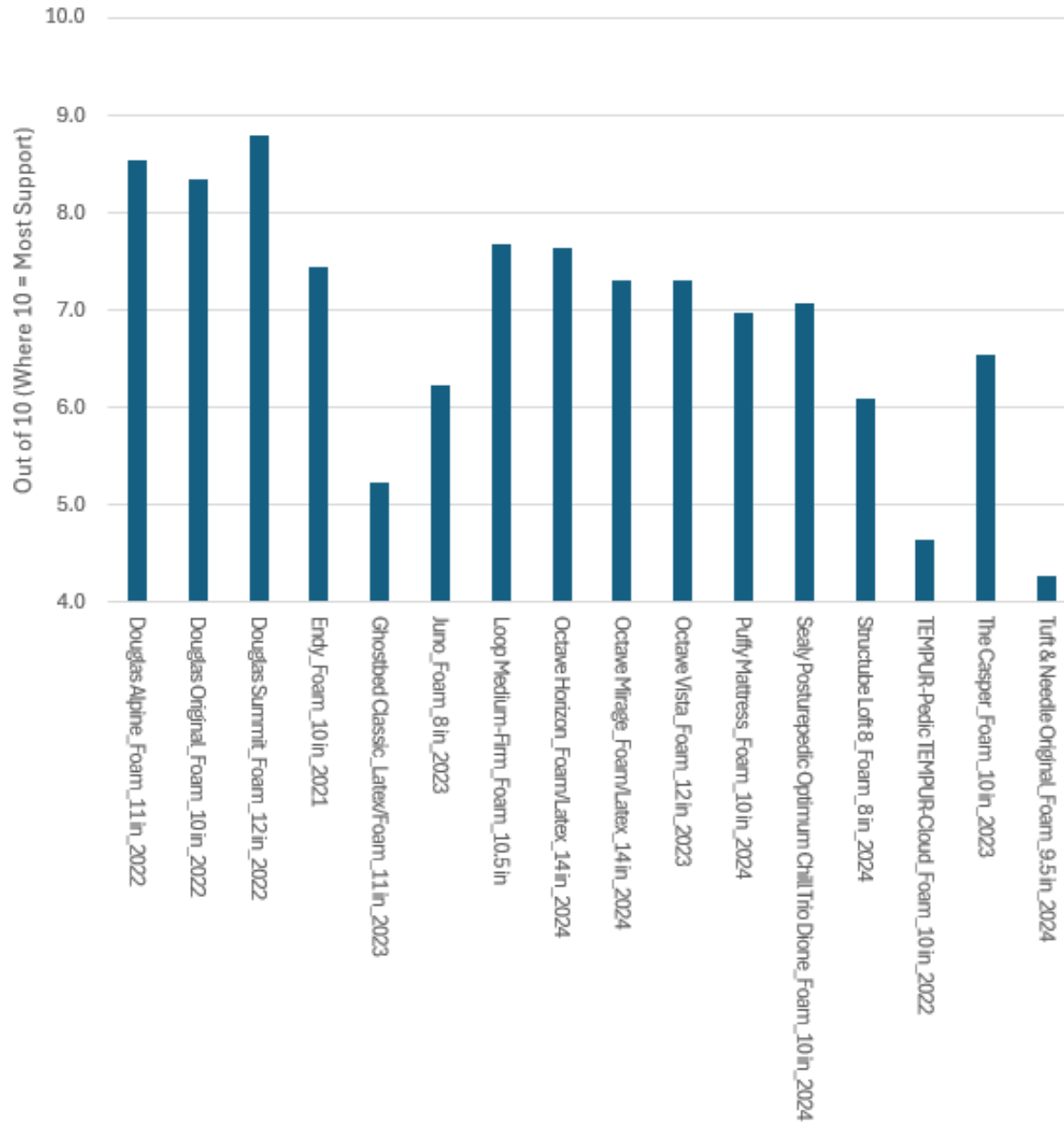
MOTION ISOLATION TEST RESULTS

Motion Isolation: Foam & Foam/Latex		
Mattress	Average Peak Acceleration [g]	Out of 10
Douglas Alpine_Foam_11 in_2022	2.4	8.5
Douglas Original_Foam_10 in_2022	2.8	8.3
Douglas Summit_Foam_12 in_2022	2.0	8.8
Endy_Foam_10 in_2021	4.3	7.4
Ghostbed Classic_Latex/Foam_11 in_2023	7.9	5.2
Juno_Foam_8 in_2023	6.3	6.2
Loop Medium-Firm_Foam_10.5 in	3.9	7.7
Octave Horizon_Foam/Latex_14 in_2024	3.9	7.6
Octave Mirage_Foam/Latex_14 in_2024	4.5	7.3
Octave Vista_Foam_12 in_2023	4.5	7.3
Puffy Mattress_Foam_10 in_2024	5.0	7.0
Sealy Posturepedic Optimum Chill Trio Dione_Foam_10 in_2024	4.9	7.1
Structube Loft 8_Foam_8 in_2024	6.5	6.1
TEMPUR-Pedic TEMPUR-Cloud_Foam_10 in_2022	8.9	4.6
The Casper_Foam_10 in_2023	5.7	6.6
Tuft & Needle Original_Foam_9.5 in_2024	9.5	4.3

Motion Isolation: Hybrid		
Mattress	Average Peak Acceleration [g]	Out of 10
Casper Snow_Hybrid_12 in_2024	3.6	7.9
Dormeo One_Hybrid_11 in_2024	4.7	7.2
Emma Hybrid Comfort_Hybrid_13 in_2024	5.5	6.7
Endy-Hybrid_Hybrid_13 in_2023	4.8	7.2
Helix Midnight_Hybrid_11.5 in_2024	3.5	7.9
IKEA Valevag_Hybrid_9.5 in_2024	4.4	7.4
Kingsdown Silent Partner Fairhaven_Hybrid_14 in_2022	7.8	5.3
Logan & Cove Choice_Hybrid_12 in_2023	6.1	6.4
Logan & Cove Frontier_Hybrid_13.5 in_2023	5.5	6.7
Original Hamuq Hybrid_Hybrid_13 in_2024	3.3	8.0
Serta Perfect Sleeper Elite Percevall_Hybrid_11.5 in_2024	6.1	6.3
Silk & Snow Hybrid_Hybrid_12 in_2022	3.3	8.0

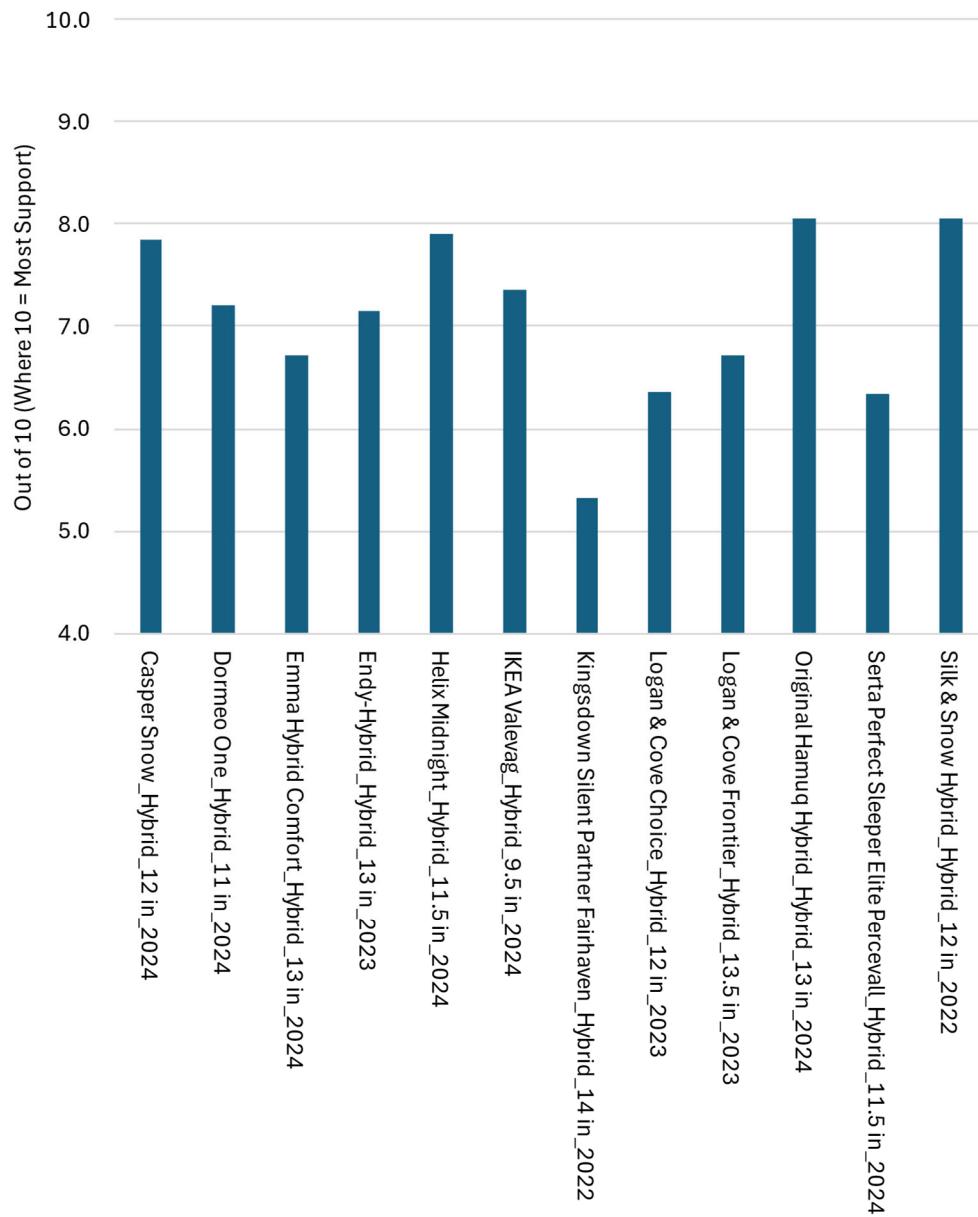


Motion Isolation Out of 10: Foam & Foam/Latex





Motion Isolation Out of 10: Hybrid





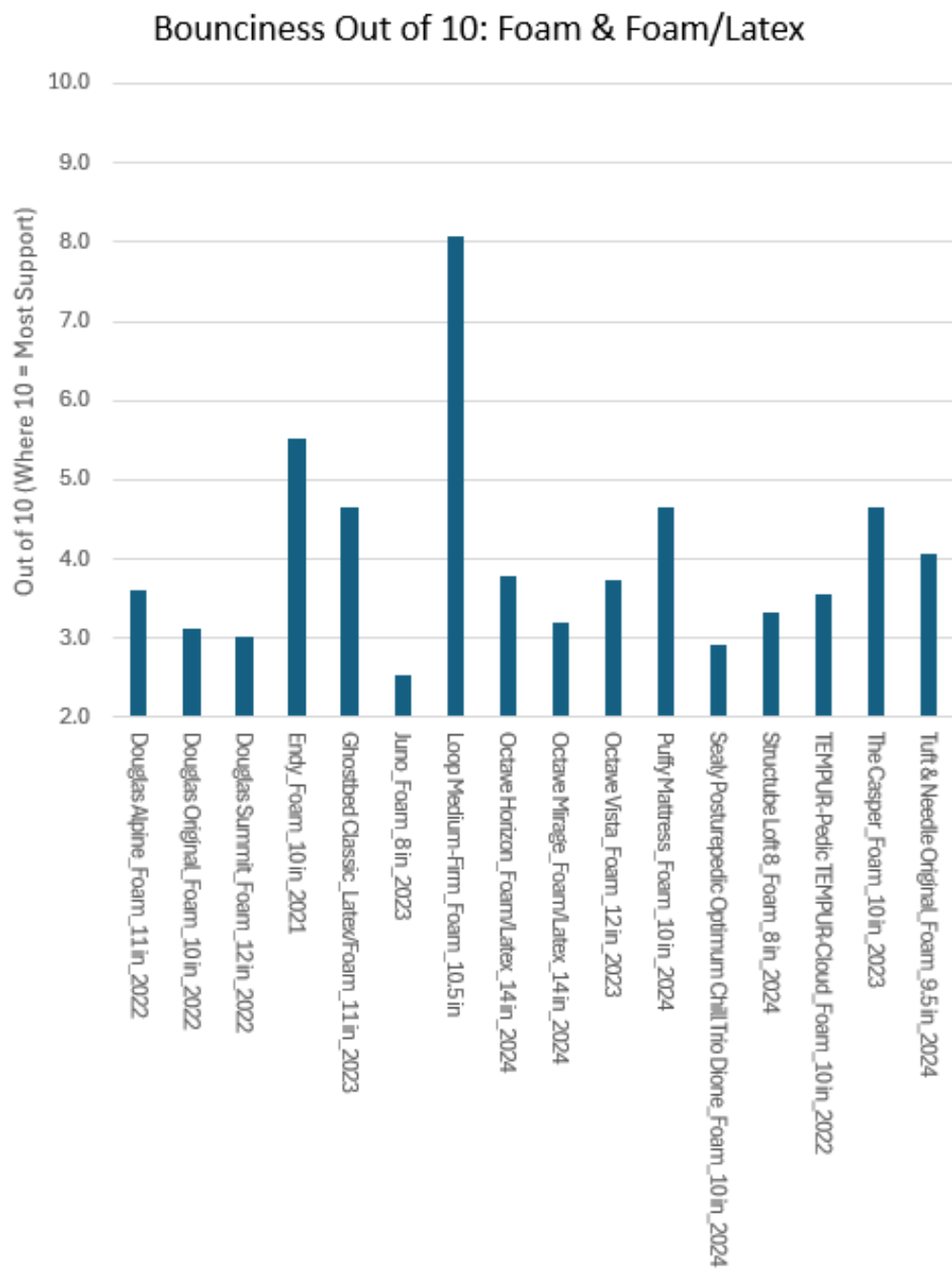
REBOUND HEIGHT TEST RESULTS

Bounciness: Foam & Foam/Latex					
Mattress	Rebound Height Run 1, [in]	Rebound Height Run 2, [in]	Rebound Height Run 3, [in]	Rebound Height Average, [in]	Out of 10
Douglas Alpine_Foam_11 in_2022	4.5	4.3	4.7	4.5	3.6
Douglas Original_Foam_10 in_2022	3.8	3.8	3.5	3.7	3.1
Douglas Summit_Foam_12 in_2022	3.5	3.3	3.7	3.5	3.0
Endy_Foam_10 in_2021	7.8	8.0	7.6	7.8	5.5
Ghostbed Classic_Latex/Foam_11 in_2023	6.3	6.5	6.1	6.3	4.6
Juno_Foam_8 in_2023	2.6	2.6	2.6	2.6	2.5
Loop Medium-Firm_Foam_10.5 in	12.2	12.5	11.9	12.2	8.1
Octave Horizon_Foam/Latex_14 in_2024	5.0	4.8	4.6	4.8	3.8
Octave Mirage_Foam/Latex_14 in_2024	3.8	3.6	4.0	3.8	3.2
Octave Vista_Foam_12 in_2023	4.7	4.5	4.9	4.7	3.7
Puffy Mattress_Foam_10 in_2024	6.3	6.0	6.6	6.3	4.7
Sealy Posturepedic Optimum Chill Trio Dione_Foam_10 in_2024	3.3	3.6	3.0	3.3	2.9
Structube Loft 8_Foam_8 in_2024	3.9	4.0	4.1	4.0	3.3
TEMPUR-Pedic TEMPUR-Cloud_Foam_10 in_2022	4.4	4.6	4.2	4.4	3.6
The Casper_Foam_10 in_2023	6.3	6.1	6.5	6.3	4.7
Tuft & Needle Original_Foam_9.5 in_2024	5.3	5.0	5.6	5.3	4.1

Bounciness: Hybrid					
Mattress	Rebound Height Run 1, [in]	Rebound Height Run 2, [in]	Rebound Height Run 3, [in]	Rebound Height Average, [in]	Out of 10
Casper Snow_Hybrid_12 in_2024	3.5	3.8	3.2	3.5	3.0
Dormeo One_Hybrid_11 in_2024	7.8	7.6	8.0	7.8	5.5
Emma Hybrid Comfort_Hybrid_13 in_2024	7.2	6.9	7.5	7.2	5.2
Endy-Hybrid_Hybrid_13 in_2023	7.5	7.3	7.7	7.5	5.4
Helix Midnight_Hybrid_11.5 in_2024	6.9	7.1	7.3	7.1	5.1
IKEA Valevag_Hybrid_9.5 in_2024	3.0	3.3	2.7	3.0	2.7
Kingsdown Silent Partner Fairhaven_Hybrid_14 in_2022	8.8	9.0	8.6	8.8	6.1
Logan & Cove Choice_Hybrid_12 in_2023	8.6	8.4	8.8	7.2	5.2
Logan & Cove Frontier_Hybrid_13.5 in_2023	8.2	8.4	8.0	8.2	5.8
Original Hamuq Hybrid_Hybrid_13 in_2024	9.4	9.6	9.2	9.4	6.5
Serta Perfect Sleeper Elite Percevall_Hybrid_11.5 in_2024	11.8	12.0	11.6	11.8	7.8
Silk & Snow Hybrid_Hybrid_12 in_2022	6.4	6.1	6.7	6.4	4.7



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Bounciness Out of 10: Hybrid

