Performance Analysis of Wool Bedding

In partnership with

IWTO International Wool Textile Organisation

Prifysgol Bangor University

British Wool in partnership with the International Wool Textile Organisation (IWTO) and with funding from Welsh Government commissioned research into wool and the sleep environment. Research was undertaken by the BioComposites Centre at Bangor University.

The aim of the project was to show how Welsh wool performed in sleep products, specifically duvets, relative to other fibres. The results of the research highlight Welsh wool's superior performance relative to synthetic fillings and to feather & down in several key areas.

The inherent qualities of Welsh wool are similar to other British wools from similar breeds, and as such the results of the research have direct read across to other British wools.

As the benefits of wool's superior performance in sleep products becomes more widely understood British Wool believes that demand for wool from the sleep sector should grow thereby supporting returns for UK sheep farmers.

Scope

The aim of this work was to compare bedding filled with different materials.

All testing was conducted on full sized single duvets of similar tog ratings (10-10.5 Tog) from products readily available in the UK retail market with the following fillings:

Wool duvet

Synthetic duvet *(Polyester)*

85% Feather, 15% Down duvet *(Feather & Down)*

100% Down duvet *(Down)*

The testing consisted of thermal and moisture movement, two crucial areas when considering sleep.

Thermal Testing – Test One

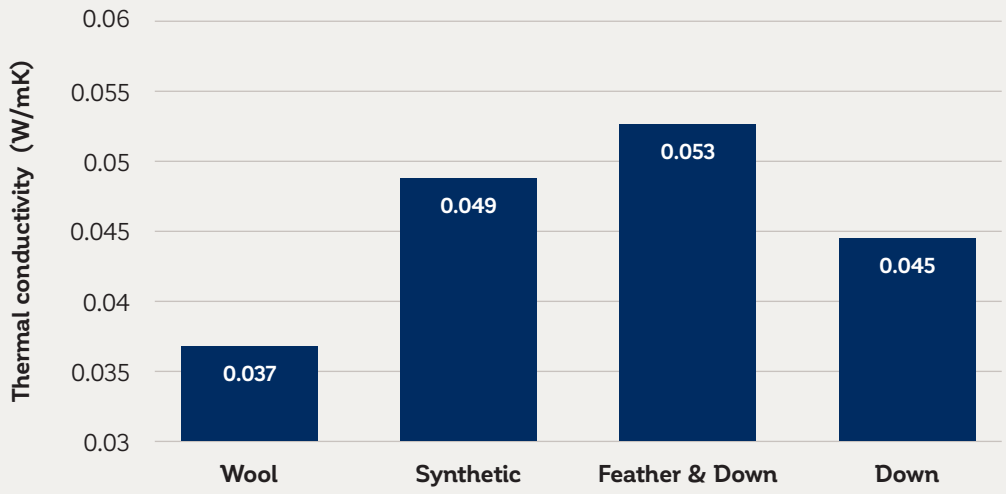
Methodology

Square samples measuring 30cm x 30cm were cut from each duvet, with the full thickness of the filling retained. Before testing, the samples were kept at a controlled room temperature (23°C) and humidity level (50% relative humidity) to ensure consistent conditions.

The samples were then tested using a FOX 300 thermal conductivity meter. In this device, the duvet sample is placed between two plates – one warm and one cool, to measure how easily heat passes through the material. The upper plate was set to 10°C and the lower plate to 30°C, creating a temperature gradient.

The amount of heat transferred through each sample was measured and used to compare how effectively the different duvet fillings provide insulation. The lower the thermal conductivity reading the more insulating the material.

Results



The value measured is called the thermal conductivity (or K-value). It describes how easily heat can pass through a material. For example, a K-value of 1W/mK means that for every 1 degree difference in temperature between two sides of a material, heat will flow through it at a rate of 1 watt.

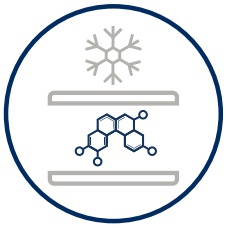
In simple terms, a higher K-value means heat moves through the material more easily, making it a poorer insulator. A lower K-value means the material slows heat transfer, making it a better insulator and more effective at keeping warmth in.

Wool duvets exhibited the lowest K-value of all the duvets tested, indicating superior thermal insulation performance. As a result, wool duvets provide greater warmth than the alternative materials evaluated, a key factor in supporting optimal sleep comfort.

Thermal Testing – Test One continued

Wool duvets are typically less lofty than the other duvets used in the test, appearing thinner and less voluminous, this can lead to a common consumer misconception that a wool duvet offers reduced warmth. The test results directly challenge this assumption, demonstrating that wool duvets deliver enhanced insulation performance even when accounting for their lower loft.

Wool duvets provide:



25% better insulation
than Synthetic duvets

30% better insulation
than Feather & Down duvets

17% better insulation
than Down duvets

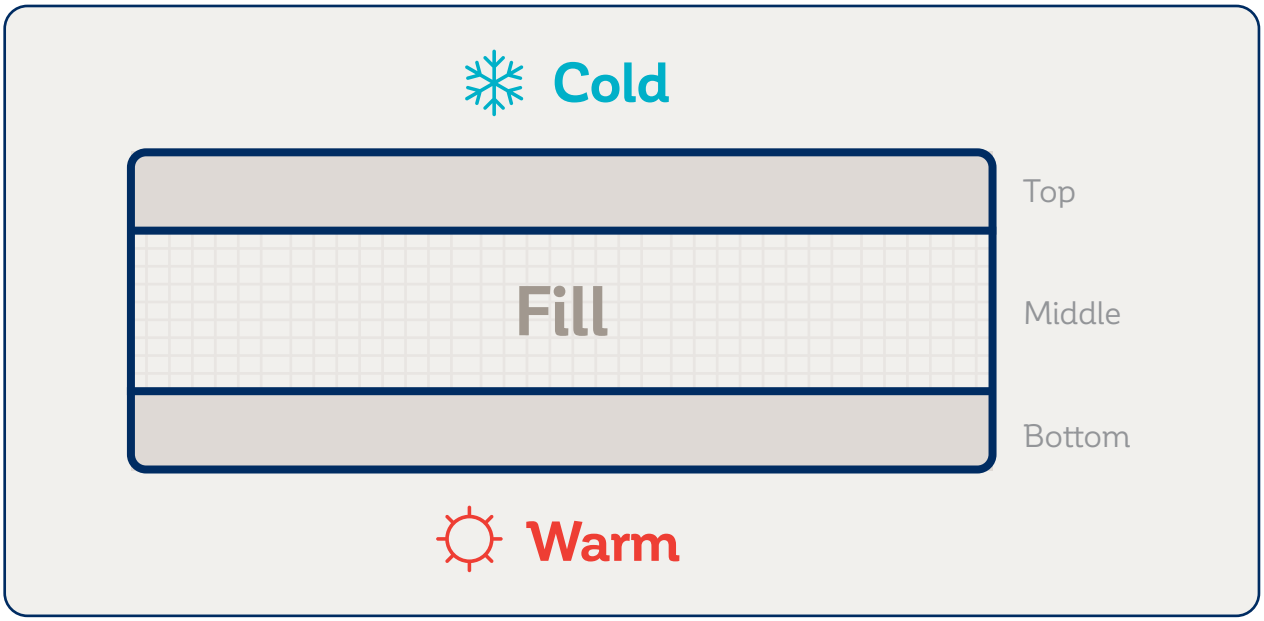
Thermal Testing – Test Two

Methodology

Thermal performance over time was assessed using temperature sensors placed within the duvet. One side of the test setup was kept warm (30°C) and the other cool (10°C) to create a temperature gradient.

Sensors were positioned just inside the outer fabric at both the top and bottom of the duvet, as well as in the centre of the filling, to track how heat moved through the material over an eight-hour period.

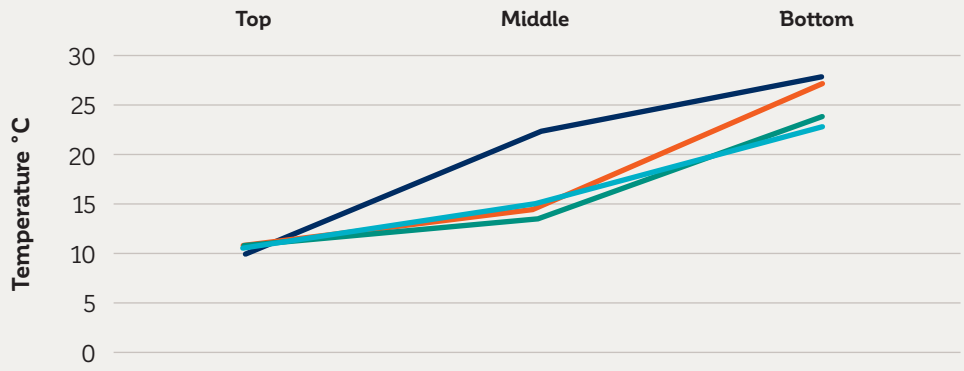
Temperatures were recorded every minute, and average values were calculated for each hour.
The test was repeated three times to ensure the results were consistent.



Thermal Testing – Test Two continued

Results

Thermal Testing at Different Positions



	Top	Middle	Bottom
Wool	9.92	22.11	27.71
Synthetic	10.80	14.40	27.03
Feather & Down	10.18	15.03	22.61
Down	10.69	13.53	23.55

The graphs show c.10°C temperature at the upper side of each duvet remains consistent in all cases as would be expected. At the bottom of the duvet both wool and synthetic had higher temperatures.

The temperature in the middle of the duvet is significantly higher on the wool duvet (22°C) than the other three duvets, (13-15°C) with only 20% heat loss from the bottom to the middle of the duvet as opposed to 34-47% heat loss on the other duvets. This shows that wool duvets retain more heat than the other duvets tested as the temperature loss from the bottom to the middle of the duvet is much lower. This reflects its low thermal conductivity and reinforces its position as the most effective insulating material.

Importantly, the findings confirm that despite its lower loft compared with alternative fillings, a wool duvet delivers superior warmth performance. This is consistent with the lower thermal conductivity/higher insulation of wool, holding onto the warmth and maintaining a more stable temperature than the other fillings.

Thermal Testing – Conclusions

Wool duvets have better insulation properties than the other filling types.

Wool duvets maintain a consistently warmer temperature in the duvet than other filling types.

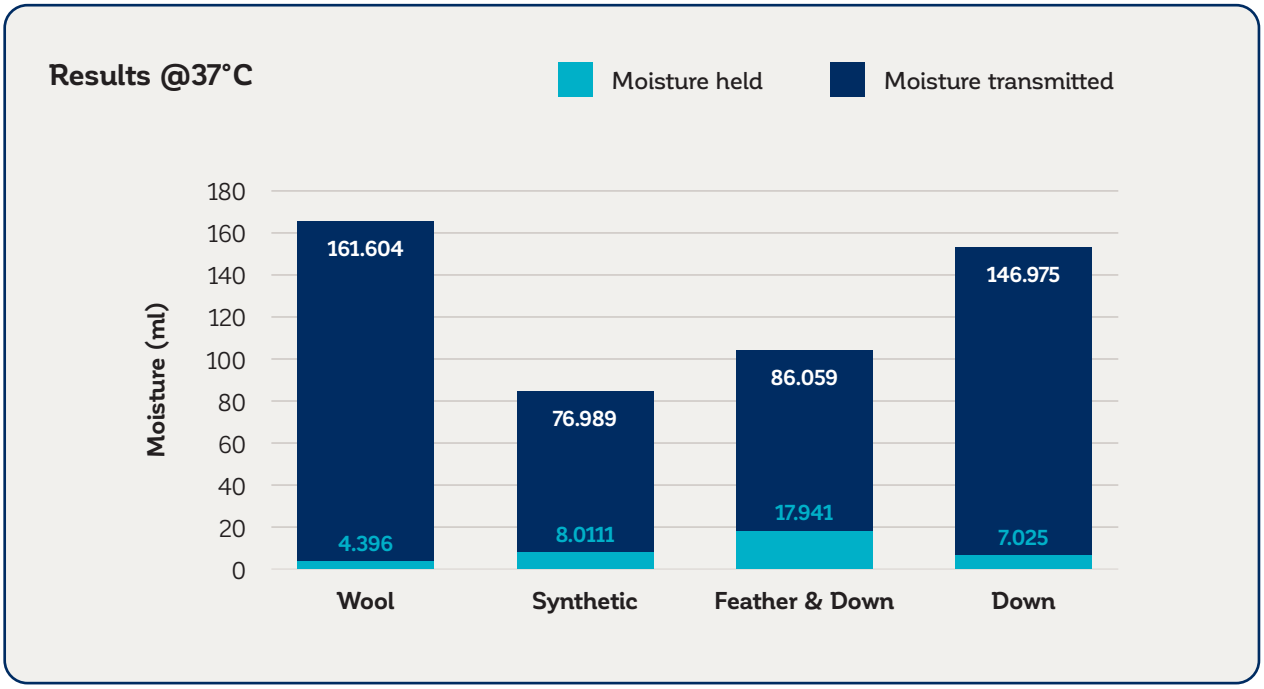
Humidity Buffering

Methodology

A sample of each duvet filling was placed over the top of a water bath, using a 35cm x 35cm piece sealed around the edges so that it did not touch the water. This setup allowed moisture to pass through the material without direct contact with the water below. The water was heated to 37°C, which represents normal body temperature and 50°C to see how the products performed when more moisture is introduced.

After approximately 24 hours, the sample was removed and weighed to see how much moisture it had absorbed. At the same time, the amount of water lost from the bath was measured to determine how much moisture had passed through the duvet material and escaped into the air. From this, the rate at which moisture moved through each material was calculated.

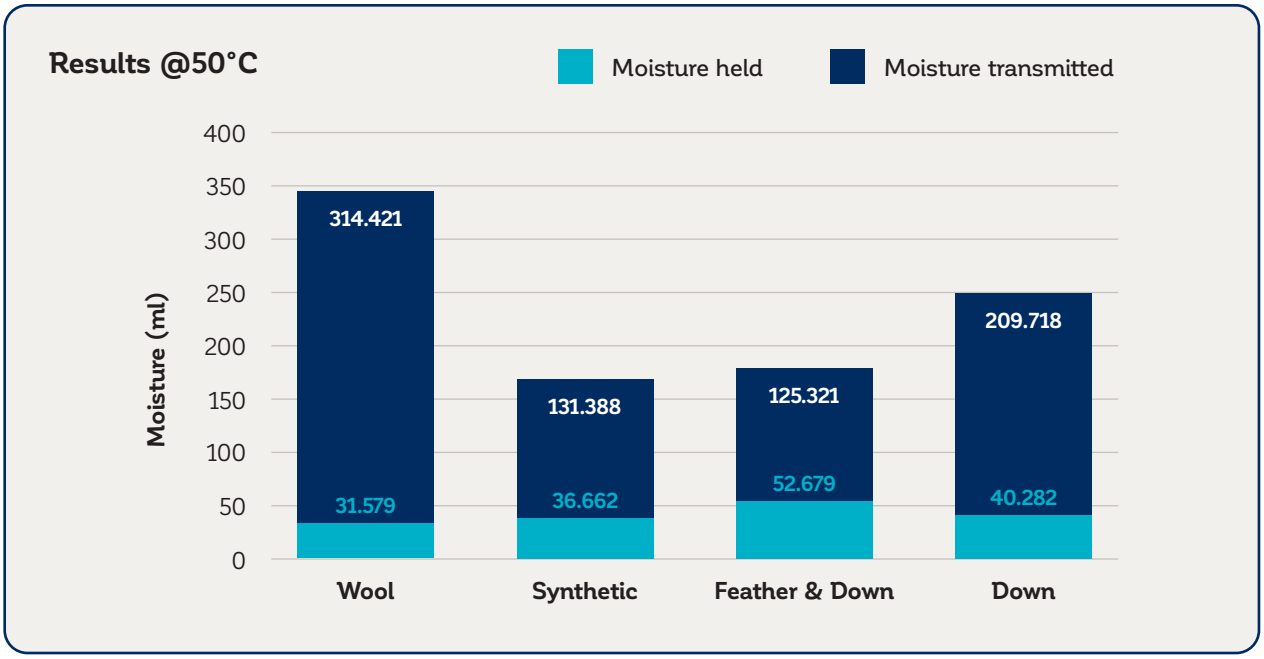
Measuring water loss from the bath shows how effectively each filling allows moisture to be transported away from the body.



Wool duvets significantly outperform the other duvets tested in both moisture retention and, critically, moisture transmission, indicating that moisture moves more efficiently through the wool filling.

At 37°C, which reflects normal human body temperature and simulates conditions of thermal comfort (neither excessively hot nor cold), wool demonstrates effective humidity regulation, contributing positively to overall in-bed comfort.

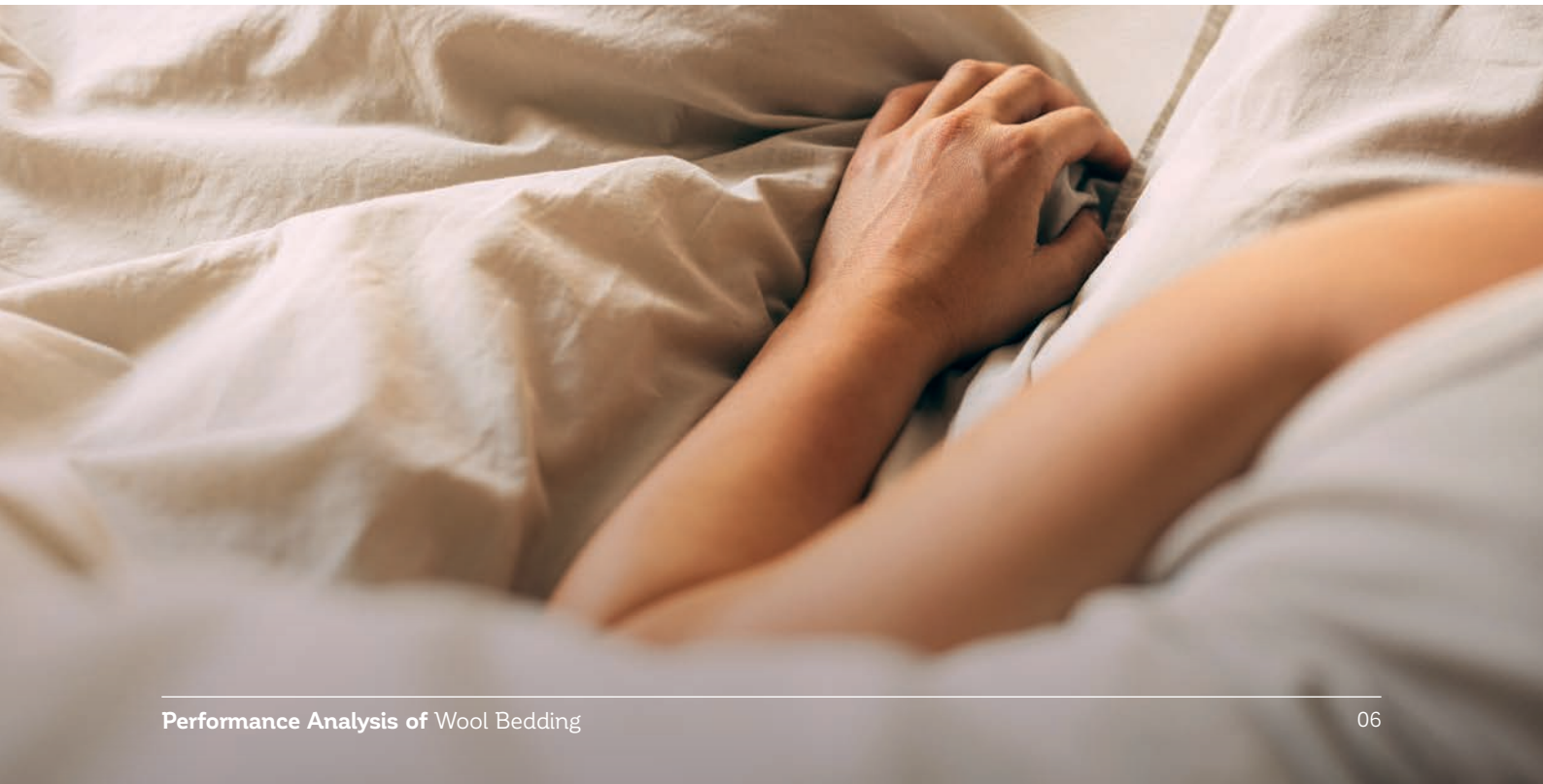
Humidity Buffering continued



At an elevated temperature of 50°C, the overall moisture load within the system increases substantially, resulting in higher levels of moisture buffering and transfer.

Under these conditions, wool duvets continue to outperform the other fillings tested, transmitting more moisture than down and significantly more than feather & down and synthetic alternatives. This enhanced moisture movement supports more effective evaporative cooling, enabling faster temperature regulation and a quicker return to thermal comfort.

Wool fibres are capable of absorbing up to approximately 30% of their own weight in moisture without feeling wet, the results indicate that this absorption capacity is being fully utilised in this test scenario, as moisture is transmitted through the wool duvet with high efficiency.



Humidity Buffering continued

Summary

As moisture/humidity levels increase, wool duvets respond dynamically, transporting nearly twice as much moisture at 50°C as it does at 37°C. While the other duvets also show increased moisture transmission at higher temperatures, this occurs from a lower baseline and at a significantly slower rate. Notably, at 50°C, condensation was observed within the synthetic duvet, with moisture collecting and dripping back into the test bath – an outcome that would likely result in a hot, clammy sleeping environment under real-world conditions.

When body temperature rises, thermoregulation occurs through sweating, with the evaporation of perspiration providing a cooling effect. The more rapidly moisture can be transported through the duvet and released to the surrounding air, the more effectively this natural cooling mechanism can function.

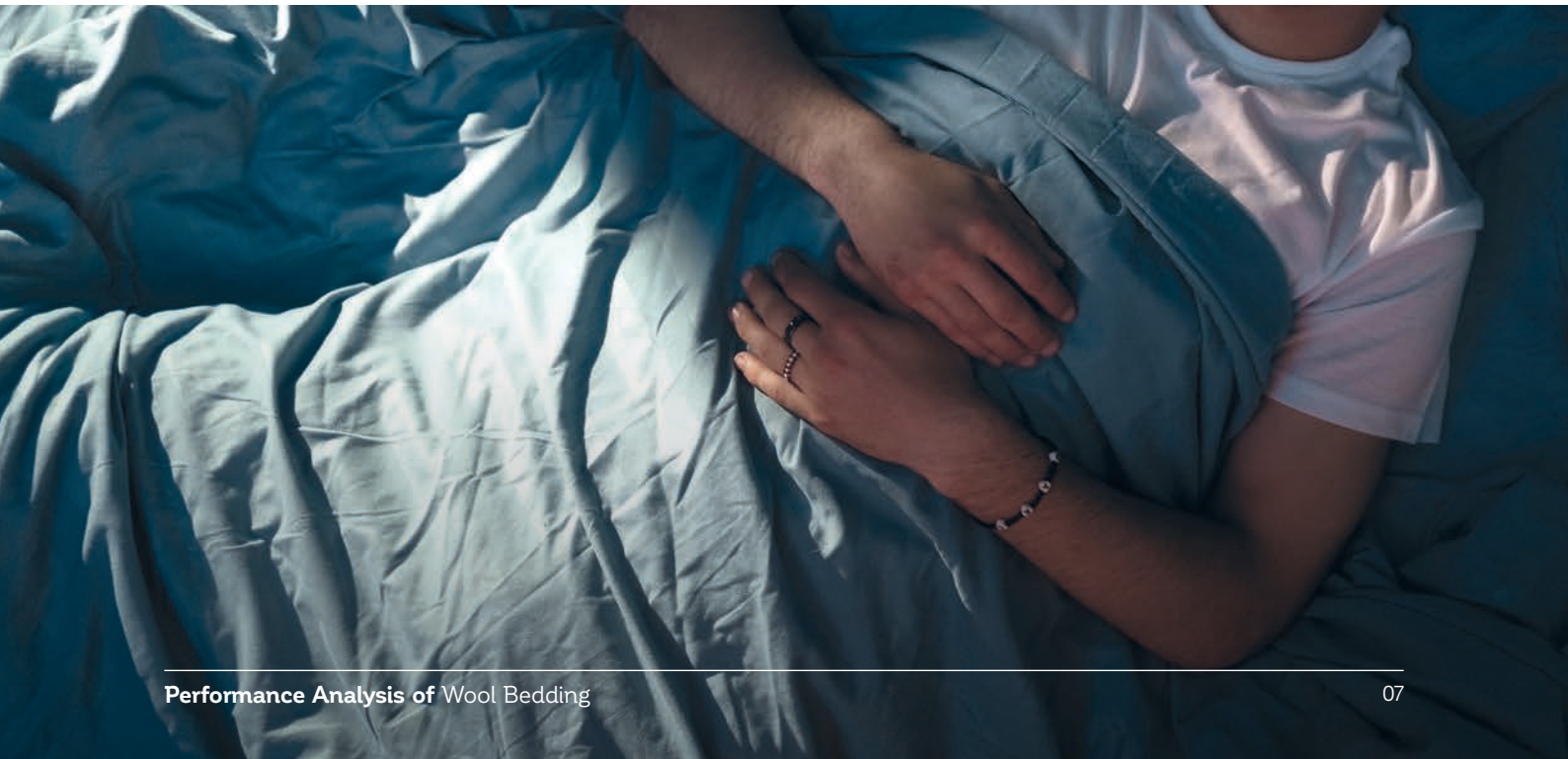
Conversely, slow moisture movement leads to elevated humidity within the bed microclimate, resulting in sensations of heat and clamminess. Enhanced moisture buffering and transmission therefore play a critical role in supporting thermal comfort by working in alignment with the body's natural cooling processes.

Based on testing at elevated temperatures, wool duvets transmit:

Up to 139%
more moisture
than Synthetic duvets

Up to 151%
more moisture
than Feather
& Down duvets

Up to 50%
more moisture
than Down duvets



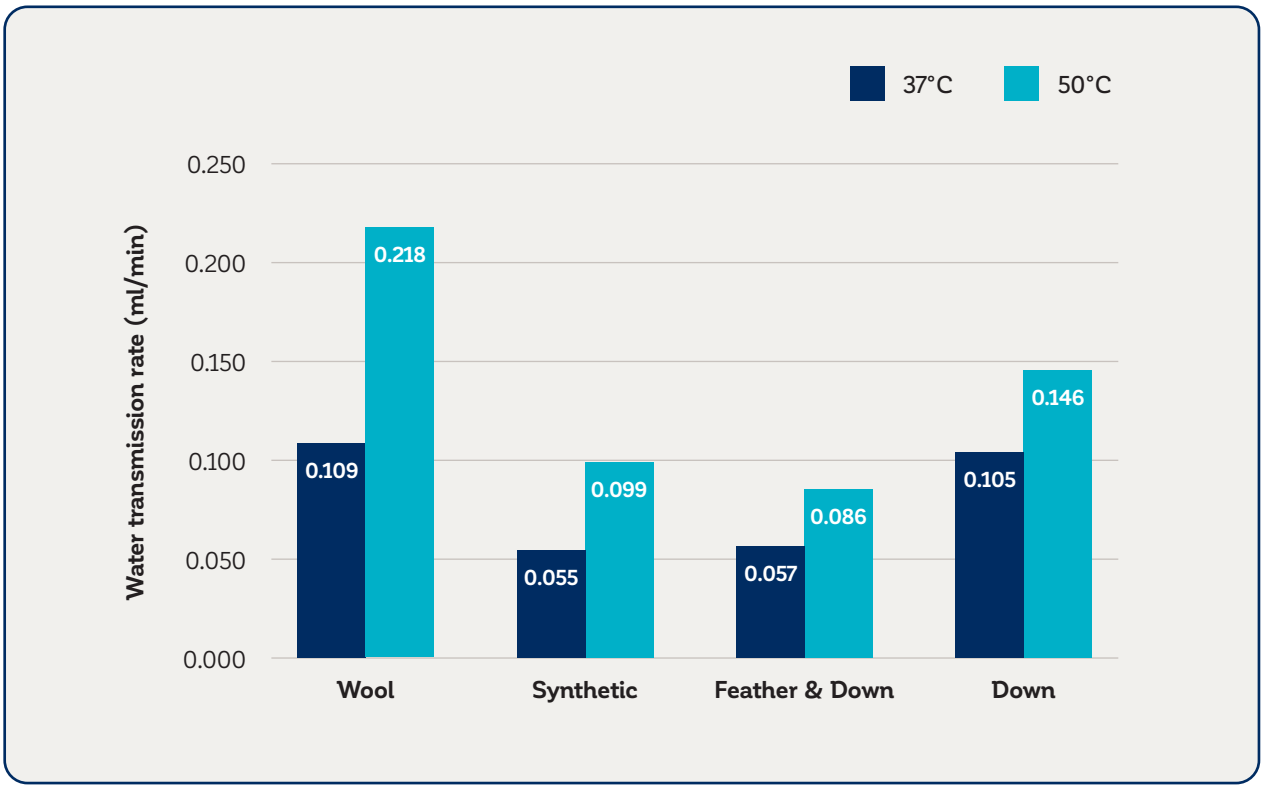
Moisture Transmission

Test

This metric reflects the rate at which moisture is transmitted through the duvet, with higher values indicating faster moisture movement. The results show that wool not only transports a greater volume of moisture, but does so at a significantly faster rate than the other materials tested.

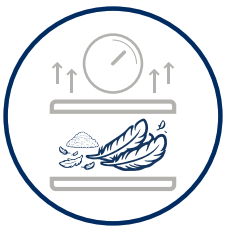
As temperature levels increase, wool duvets again respond dynamically, transporting the moisture twice as fast at 50°C as it does at 37°C. While the other duvets also show faster moisture transmission at higher temperatures, this occurs from a lower baseline and at a significantly slower rate.

Temperature data was recorded at one-minute intervals, with mean values calculated for each hour over an eight-hour exposure period.

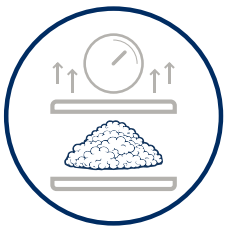


Based on testing at elevated temperatures, wool duvets move moisture:

Up to 120% faster
than Synthetic duvets



Up to 153% faster
than Feather & Down duvets



Up to 49% faster
than Down duvets

Humidity/Moisture Testing – Conclusions

Wool duvets transmit significantly more moisture than the alternative fillings tested, effectively simulating the transportation of perspiration away from the body. This performance advantage becomes increasingly pronounced at higher humidity levels

Wool duvets absorb less moisture than alternative fillings because moisture is transmitted more rapidly through the wool structure rather than being retained within the duvet.

Wool duvets transmit moisture significantly faster than alternative fillings, with the performance advantage becoming increasingly pronounced at higher humidity levels.

Conclusion

- Testing confirms wool has better performance for sleep products than other materials with respect to both thermal insulation and humidity/moisture buffering.
- These properties play a critical role in regulating body temperature and supporting sustained sleep comfort throughout the night.