

ASTM F88/F88M-15 Seal Strength Testing

Seal Strength Testing of Flexible Barrier Materials

Seal strength is an important performance measure for flexible barrier packaging used in medical, pharmaceutical, food, and consumer applications. ASTM F88/F88M provides a tensile test framework for measuring the force required to separate a flexible seal and for documenting the associated failure behavior.

Using the CellScale UniVert S with a 2 N load cell

In this study, self-sealing sterilization pouches were evaluated using a CellScale UniVert S equipped with a 2 N load cell. Testing used an unsupported tail configuration based on Technique A of ASTM F88/F88M-15, with an application-specific specimen orientation selected to characterize peeling along the pouch seal.

ASTM F88/F88M-15 covers measurement of seal strength in flexible barrier materials and defines seal strength in terms of the force required to separate a sealed test strip.



Example sample



Seal Strength Testing Based on ASTM F88/F88M-15

ASTM F88/F88M-15 describes tensile testing of seals in flexible barrier materials. The method can be used to evaluate the force required to separate a seal, maximum seal force, average peel force, and specimen failure behavior.

Seal strength measurements are useful for evaluating opening force, package integrity, process validation, process control, and the ability of a packaging process to produce consistent seals.

Tail-Holding Techniques

ASTM F88/F88M-15 describes three tail-holding techniques:

Technique A: Unsupported

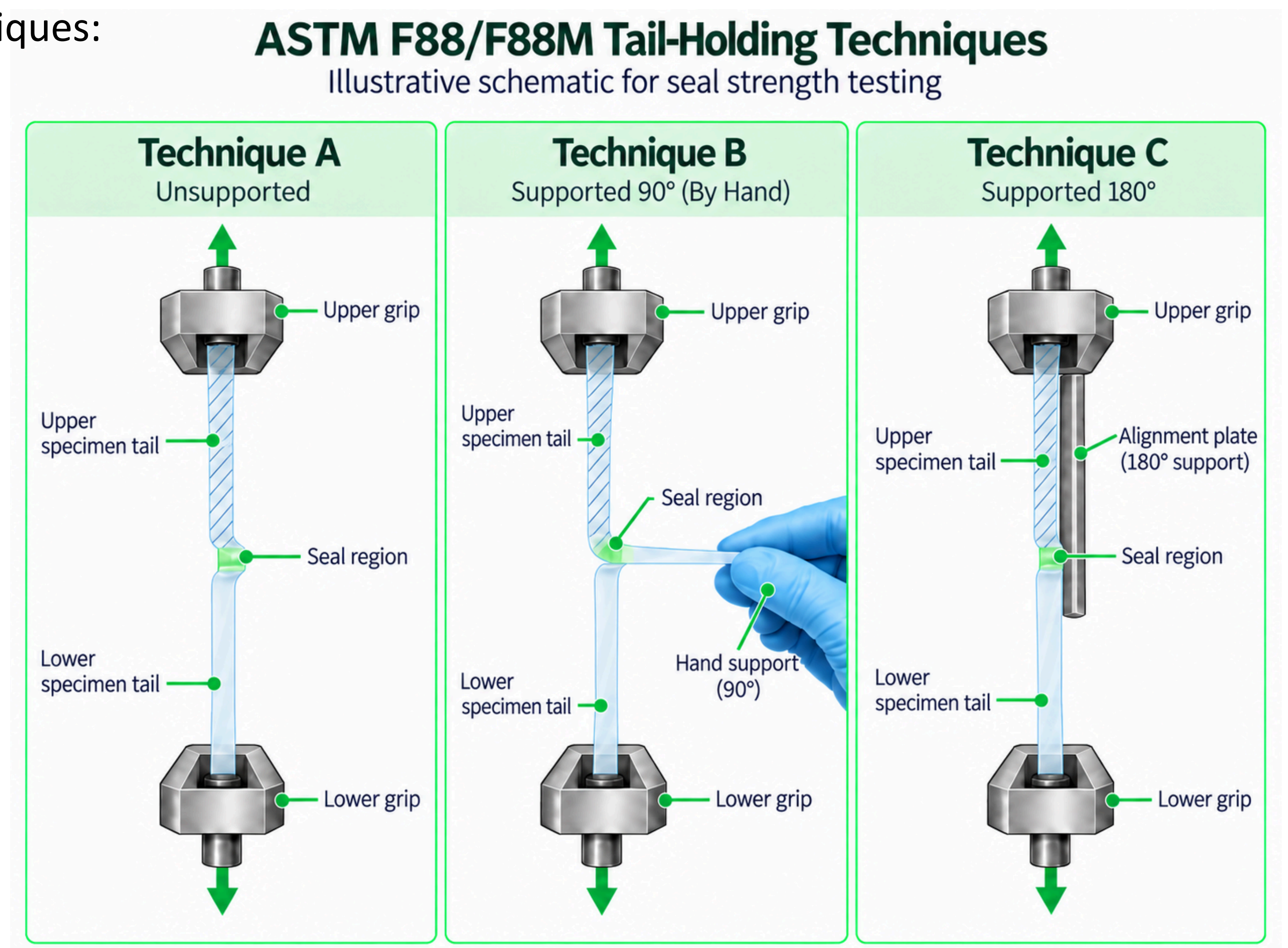
Both specimen tails are secured in opposing grips while the seal remains unsupported.

Technique B: Supported 90° (By Hand)

The seal is supported at approximately 90° to the specimen tails.

Technique C: Supported 180°

One specimen tail is supported against an alignment plate while the other is folded 180° over the seal.



Because the selected technique can affect the measured force, a consistent technique should be maintained throughout a test series.

Study Objective

The objective of this study was to evaluate whether the UniVert S could characterize the low-force peel response of a commercially available self-sealing sterilization pouch using test conditions based on ASTM F88/F88M-15.

The study evaluated:

- average peel force
- maximum force
- repeatability across 12 specimens
- suitability of a 2 N load cell for low-force seal testing
- force-displacement behavior during progressive seal separation

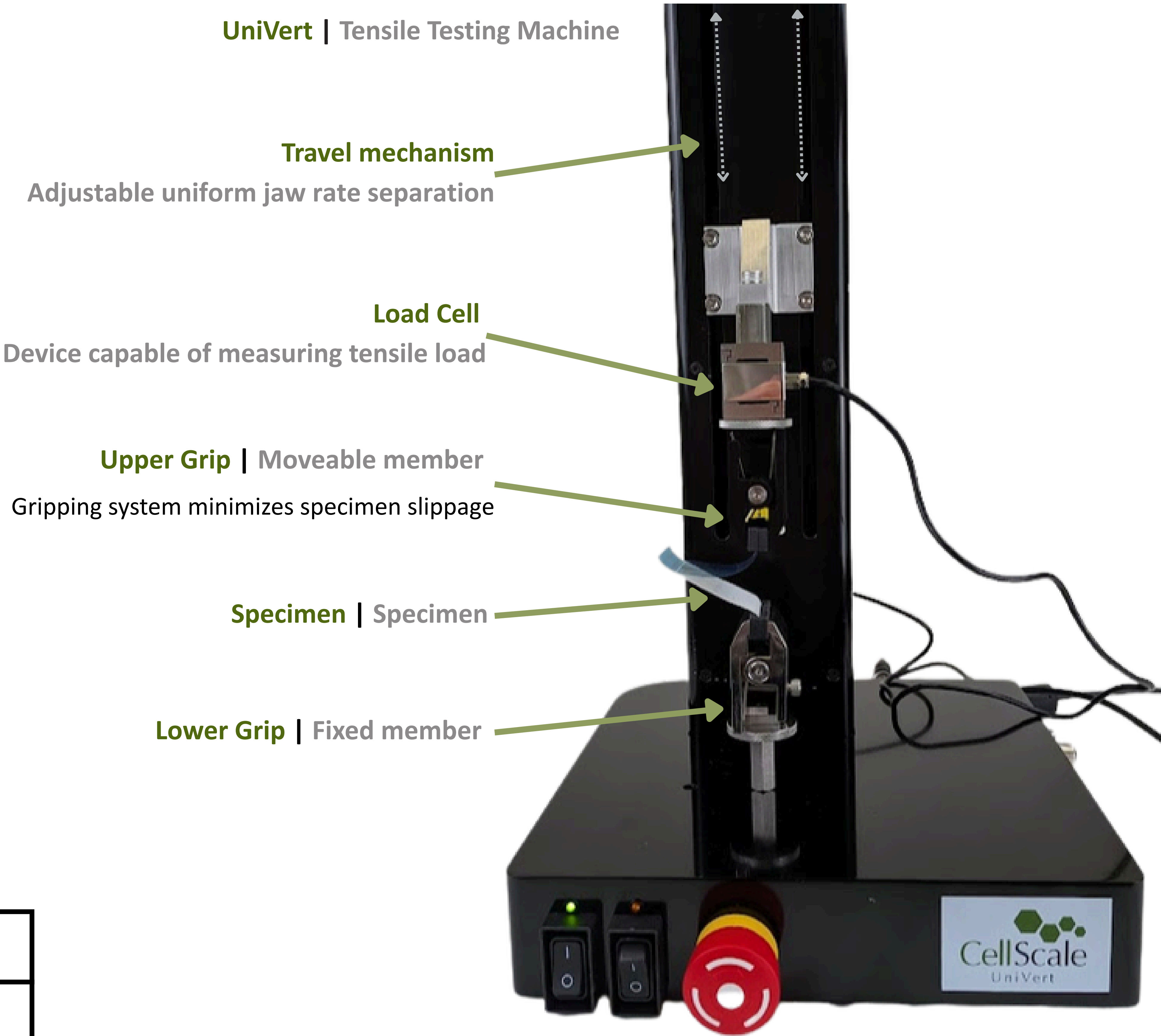
ASTM F88/F88M-15 requires a constant-rate-of-jaw-separation tensile testing system capable of recording tensile force and grip separation. The standard specifies a jaw separation rate adjustable between approximately 200 and 300 mm/min and requires a gripping system capable of minimizing specimen slippage and distributing stress evenly.

The UniVert S was configured for low-force tensile testing using a 2 N load cell and specimen grips.

Test Configuration

Cellscale UniVert system components are labeled in **green**, with the ASTM F88 equivalent in **grey**.

UniVert | Tensile Testing Machine



Parameter	Test Configuration
Mechanical test system	CellScale UniVert S
Test mode	Tension
Load cell	2 N
Load cell accuracy	±0.2% of rated capacity
Tail-holding technique	Technique A, unsupported
Grip separation rate	4.5 mm/s
Initial grip separation	25 mm
Motion accuracy	±0.05% of desired distance
Position accuracy	±0.02 mm
Data acquisition rate	50 Hz
Number of specimens	12

Measurement Accuracy

The 2 N load cell has an accuracy of ±0.2% of rated capacity, corresponding to ±0.004 N.

UniVert actuator motion accuracy is within ±0.05% of the desired distance, with a positional accuracy of ±0.02 mm.

ASTM F88/F88M-15 requires both the tensile-force and grip-separation measuring systems to be accurate within ±2%.

The UniVert also includes position-calibration procedures for establishing and verifying fixture separation.

Sterilization Pouch Specimens

Self-sealing sterilization pouches were selected as the flexible barrier material for this study.

Twelve specimens were prepared from the pouch material. Each specimen consisted of a plastic-film tail and a paper tail joined by the pouch seal.

Specimen and Conditioning Details

Parameter	Value
Material	Self-sealing sterilization pouch
Specimen width	15 mm
Specimen length	110 mm
Conditioning time	72 h
Temperature	Approximately 23°C
Relative humidity	45%
Material in upper grip	Plastic film
Material in lower grip	Waxed paper
Initial grip separation	25 mm

Test Procedure

Each specimen was mounted in the UniVert using an unsupported Technique A configuration.

The plastic tail was secured in the upper grip and the paper tail in the lower grip. The initial grip separation was set to 25 mm.

The moving grip separated the specimen at:

4.5 mm/s, equivalent to 270 mm/min

ASTM F88/F88M-15 specifies a grip separation rate between 200 and 300 mm/min.

Technique

A



Application-Specific Specimen Orientation

ASTM F88/F88M-15 specifies that the seal line should normally be perpendicular to the direction of pull.

For this study, specimens were intentionally tested **parallel to the seal**.

The sterilization pouch contained multiple sealed regions. When specimens were tested across the seal, these regions produced multiple separate force responses. Testing parallel to the seal produced a more continuous peel response and better represented the opening behavior being evaluated in this application.

Application-specific modification:

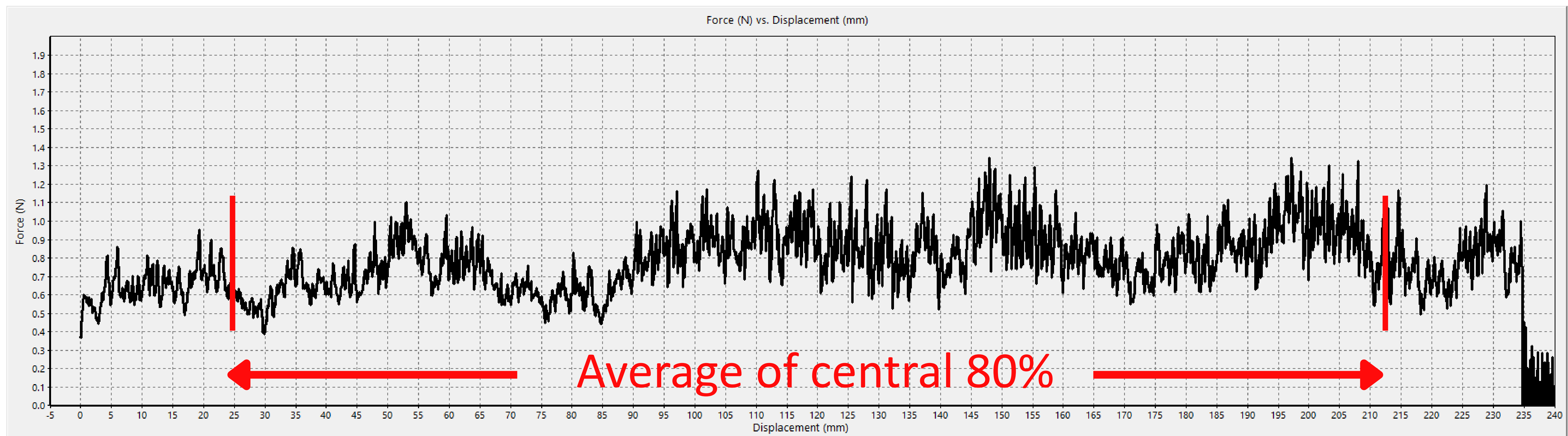
The specimen orientation differed from the conventional ASTM F88/F88M-15 orientation and is reported explicitly as a modification to the standard test configuration.



Measuring Average and Maximum Peel Force

Each test produced a force-displacement curve showing the force required to progressively separate the pouch seal.

Representative Force-Displacement Curve



Average Peel Force

Average peel force was calculated from the central 80% of the peel response.

The initial loading region and final portion of the curve were excluded because these regions do not represent the steady seal-separation response.

ASTM F88/F88M-15 explains that the initial ramp from zero force and the return toward zero after specimen failure should not be included in the average seal-strength calculation.

The standard also illustrates the use of the central 80% of the force curve as one method for determining average seal strength.

Maximum Force

The maximum force encountered during each test was also recorded.

Maximum force represents the highest tensile load measured during progressive separation of the specimen.

Data Acquisition

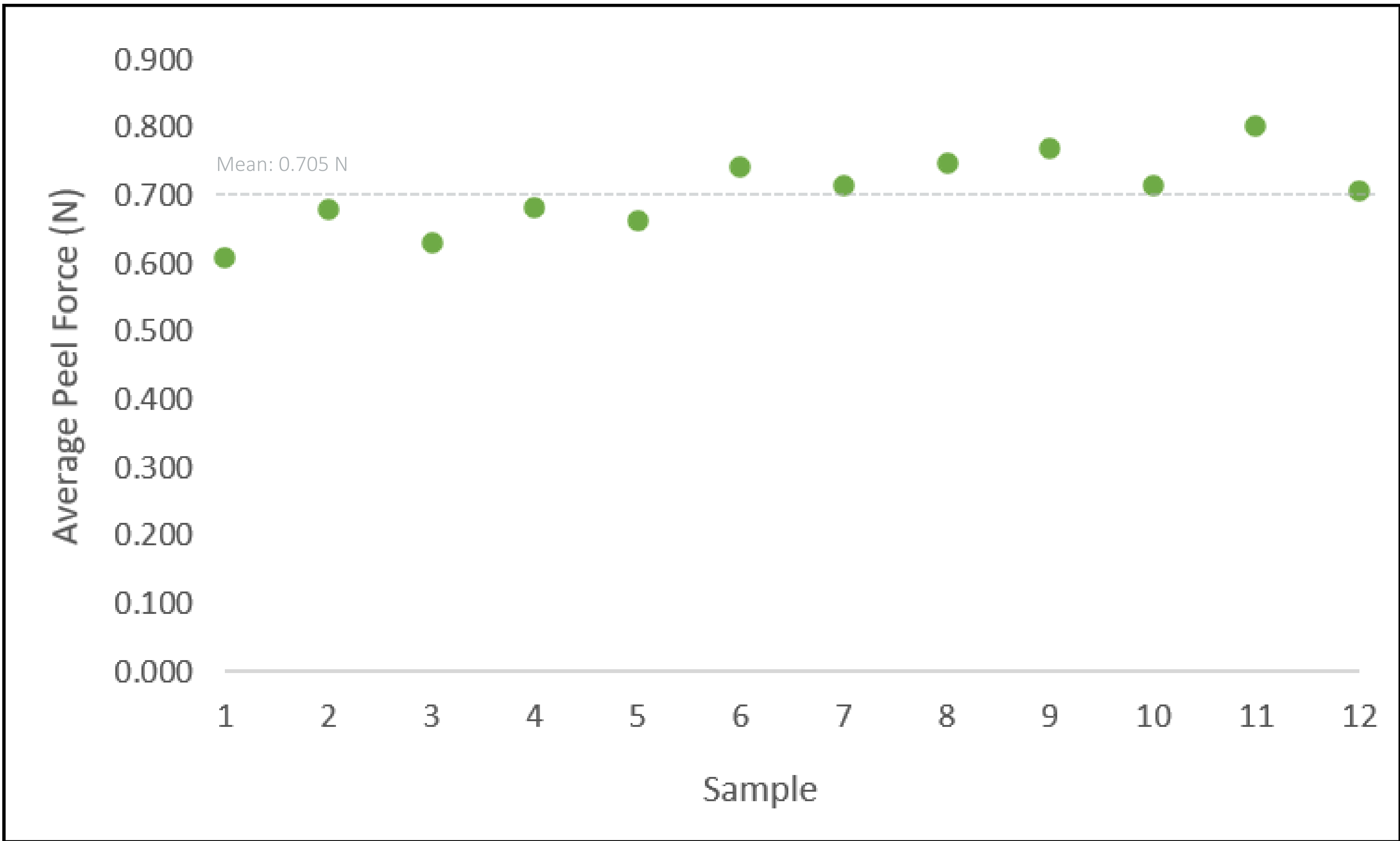
Force and displacement data were collected at 50 Hz, providing a detailed force-displacement profile throughout the peeling process.

Seal Strength Results



Twelve specimens were tested using the same UniVert configuration and test protocol.

Result	Average Peel Force	Maximum Force
Mean	0.705 N	1.186 N
Range	0.608 to 0.801 N	0.980 to 1.346 N
Standard deviation	0.0537 N	0.106 N



Repeatability

Across the 12 specimens, the average peel-force result had a coefficient of variation of approximately **7.6%**.

Maximum force had a coefficient of variation of approximately **8.9%**.

These results show a relatively narrow distribution across the test series while preserving measurable specimen-to-specimen variation.

Calculations:

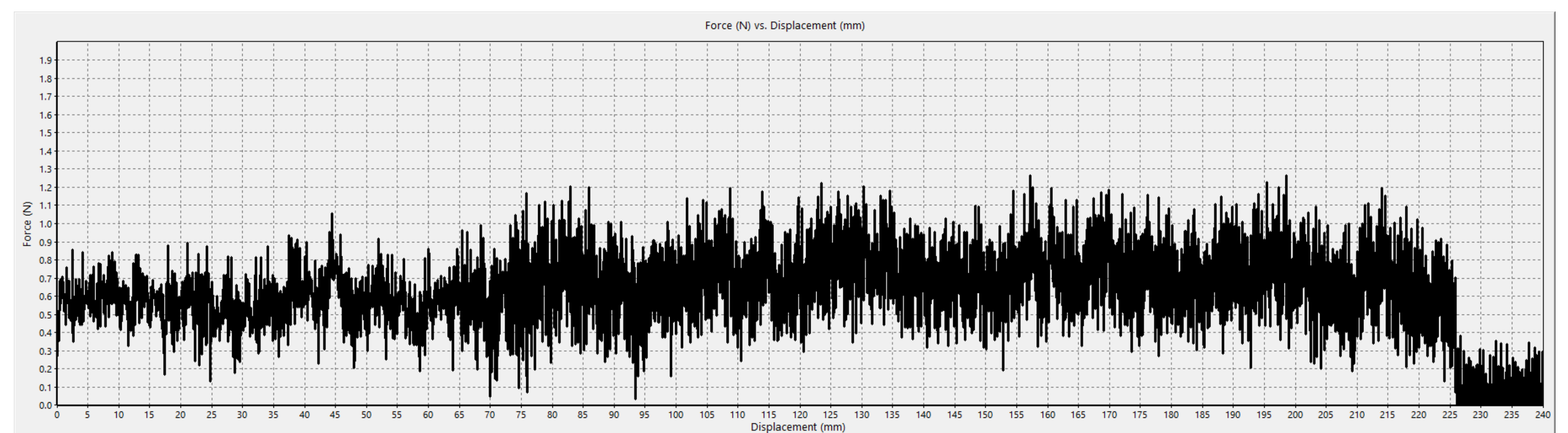
	Average Peel Force (N)	Maximum Force (N)	Maximum Force / Specimen Width (N/m)
Sample 1	0.608	0.982	65.4
Sample 2	0.679	1.141	76.1
Sample 3	0.632	0.98	65.4
Sample 4	0.682	1.19	79.4
Sample 5	0.664	1.232	82.1
Sample 6	0.741	1.274	84.9
Sample 7	0.714	1.258	83.9
Sample 8	0.747	1.195	79.7
Sample 9	0.77	1.238	82.5
Sample 10	0.714	1.154	77.0
Sample 11	0.801	1.346	89.7
Sample 12	0.706	1.247	83.1
Mean	0.705	1.186	79.1
Range	0.608 - 0.801	0.980 - 1.346	65.4 - 89.7
Std. Dev.	0.0537	0.106	7.04

Effect of Load Cell Selection

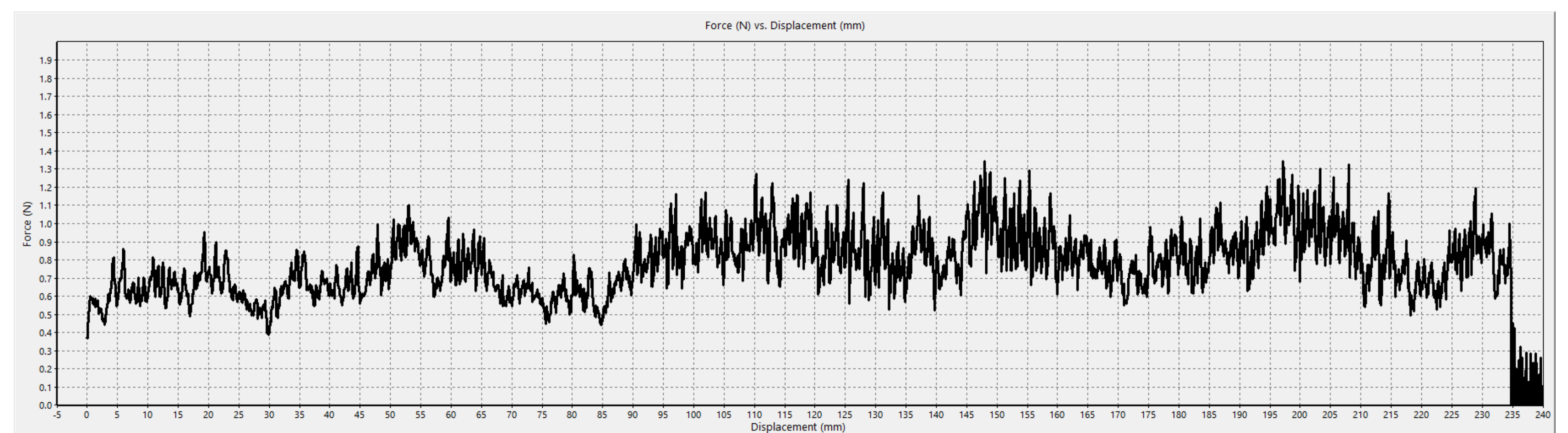
An appropriate force range is important when testing low-force seals. Initial trials using a higher-capacity 10 N load cell produced a visibly noisier force response at the loads generated by these specimens. Testing with the 2 N load cell produced a cleaner signal and more clearly resolved the seal-peeling response.

This demonstrates the importance of selecting a load cell with sufficient capacity for the expected maximum load while maintaining sensitivity in the measurement range of interest.

10 N load cell: higher
apparent signal noise



2 N load cell: lower
apparent signal noise

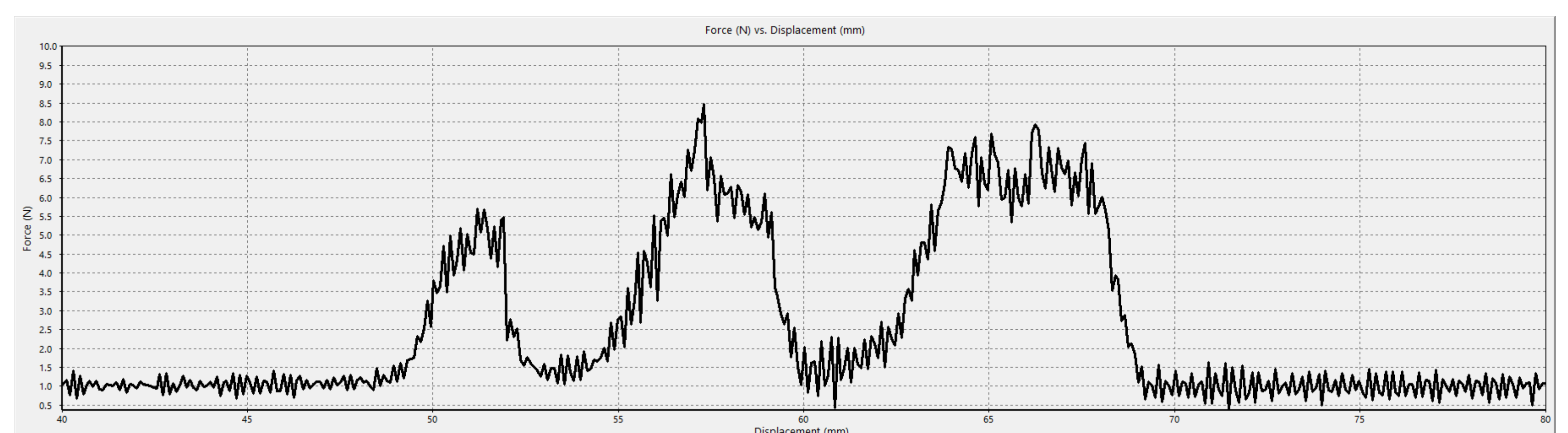


Effect of Specimen Orientation

The geometry of the sterilization pouch influenced the measured response. When specimens were pulled across the seal, the pouch's multiple sealed regions generated three distinct force responses.

For the purpose of this study, testing parallel to the seal produced a more continuous peel profile and better represented the opening behavior being evaluated. The specimen orientation therefore represents an application-specific modification from the conventional ASTM F88/F88M-15 configuration.

Peeling across the seal trial



Factors That Influence Seal Strength Measurements

ASTM F88/F88M-15 notes that measured seal strength can be influenced by specimen characteristics other than the seal itself, including material bending, material elongation, tearing, delamination, specimen geometry, and tail-holding technique. These factors should be considered when comparing test results between different materials or test configurations.

For comparative testing, specimen geometry, material orientation, grip configuration, separation rate, and analysis method should therefore remain consistent.

Conclusions

The CellScale UniVert S equipped with a 2 N load cell successfully characterized the low-force peel response of self-sealing sterilization pouch material using test conditions based on ASTM F88/F88M-15.

Across 12 specimens:
Mean average peel force: 0.705 N
Mean maximum force: 1.186 N

The 2 N load cell provided an appropriate measurement range for the low forces generated by the specimens.

The UniVert operated at a grip separation rate of 270 mm/min, within the 200 to 300 mm/min range specified by ASTM F88/F88M-15.

The 2 N load cell accuracy and verified actuator-position performance are both within the $\pm 2\%$ measurement criterion specified by ASTM F88/F88M-15.

Average peel force was determined using the central 80% of the recorded peel response.

The study also demonstrated that specimen geometry can influence the appropriate test configuration. For the multi-seal sterilization pouches evaluated here, an application-specific parallel-to-seal orientation produced a continuous peel response suitable for the study objective.

Parameter	Demonstrated Configuration
System	CellScale UniVert S
Load cell	2 N
Test mode	Tension
Tail holding	Technique A, unsupported
Initial grip separation	25 mm
Grip separation rate	270 mm/min
Data acquisition	50 Hz
Conditioning	72 h at approximately 23°C and 45% RH
Number of specimens	12
Analysis	Central 80% average peel force and maximum force

Standards Statement

This application note demonstrates seal strength testing using a UniVert configuration and test conditions based on ASTM F88/F88M-15. An application-specific specimen orientation was used. The study should therefore not be interpreted as a demonstration of full procedural conformance to ASTM F88/F88M-15.

Flexible Packaging and Low-Force Mechanical Testing

The UniVert supports interchangeable load cells, gripping configurations, and test protocols for mechanical testing of flexible packaging, films, adhesives, biomaterials, and other low-force specimens.

[Learn more about the CellScale UniVert](#)