Efficient and reliable plate sealing with the ALPS5000 Automated Plate Heat Sealer

Introduction

Sealing microplates with removable seals is a common practice in laboratory workflows for genomics, proteomics, molecular diagnostics, drugs of abuse testing, drug discovery, and biobanking. Even though plate sealing is routine in so many laboratories, it does not receive much attention, because of its simplicity and the minimal skill required to perform the process. However, improper sealing can lead to sample loss, inaccurate results, and other problems that are time-consuming and expensive to fix.

The **Thermo Scientific™ ALPS5000 Automated Plate Heat Sealer (Cat. No. AB-5000)** enables rapid sealing and process customization with saved protocols, and it can have immense value for your research. The user-friendly touchscreen makes it easy to adjust and optimize sealing temperature, force, distance, and time. Users can store up to 16 settings to seal plates ranging from 8 mm to 46 mm in height without adapters, making the plate sealing process fast and straightforward. The ALPS5000 Automated Plate Heat Sealer is easy to set up and maintain, and it has a compact footprint that can help you conserve valuable laboratory bench space. The ALPS5000 plate sealer does not require an external vacuum, air source, or peristaltic pump, making it quieter to operate than a pneumatically driven sealing system.

The ALPS5000 Automated Plate Heat Sealer is compatible with polystyrene, polypropylene, and polyethylene microplates, and it can be used to seal the same plate up to five times. The ALPS5000 plate sealer is also compatible with Thermo Scientific™ heat seals for various applications, including:

- **Diamond Clear Seal polymer roll** for fluorescence and colorimetric applications, qPCR, and ELISAs
- **ThermoSeal foil laminate** for sample transport and high-temperature applications like PCR
- **Easy Pierce foil** for compound management, high-throughput screening applications, and RT-qPCR
- **Easy-Peel foil laminate** for long-term storage at temperatures ranging from –120°C to +90°C

We conducted a series of experiments to optimize the sealing process and then evaluate the reliability of the ALPS5000 Automated Plate Sealer using Thermo Scientific™ KingFisher™ 96 Deep-Well Plates.

Materials and methods

Sealing optimization

The purpose of optimization is to identify the minimal force required to ensure successful sealing. We optimized sealing force by applying seals to KingFisher 96 Deep-Well Plates starting with 24 kg. Then, based on the sealing performance, we increased the force to 35 kg, and finally to 45 kg of force at 170°C (±2°C) for 3 sec. After each force adjustment, the sealed plates were placed upside down in a vacuum chamber under reduced pressure (15 in. Hg, 0.5 atm) for 30 s and inspected for leaks. Although seals applied with 24 kg of force passed the vacuum test, slight dimpling was observed near the top left corners of the seals (Table 1). To confirm the dimpling was the result of the sealing process and not the plate, the plate was rotated 180 degrees and resealed. When the dimpling occurred again in the same upper left corner, it confirmed the dimpling was the result of needing to further optimize the sealing parameter by increasing the force used. No wrinkles or dimples were observed after sealing with 45 kg of force, so we proceeded by sealing plates with 45 kg of force at 170°C for 3 s each.

Preparation of KingFisher 96 Deep-Well Plates for shipment

A total of 2,280 KingFisher 96 Deep-Well Plates from different lots that had been molded with 17 different injection molds were sealed using the ALPS5000 Automated Plate Heat Sealer for subsequent testing. Wells in alternating rows of the plates were filled with 1 mL each of an aqueous dye solution using the **Thermo Scientific™ Multidrop™ Combi Reagent Dispenser (Cat. No. 5840300)**. The plates were sealed with **Thermo Scientific™ Easy-Peel foil laminate (Cat. No. AB-3739)**, inverted on absorbent paper, and inspected for leaks (Figure 1). After passing the leak inspection, the sealed plates were stacked in two layers per box. The layers were separated with packaging material to prevent damage to the plates and seals during shipment. The boxes were then shipped via ground from Tempe, AZ to the Westpak package testing facility in San Diego, CA. As many as 120 plates per day were filled, sealed, and shipped to the Westpak facility for testing.

Table 1. Sealing force optimization.

No.	Force (kg)	Plate orientation*	Vacuum test	Observations
1	24	A1	Pass	A1 dimpling
2	24	H12	Pass	H12 dimpling
3	35	A1	Pass	A1 slight dimpling
4	35	H12	Pass	H12 slight dimpling
5	45	A1	Pass	No wrinkles or dimpling
6	45	H12	Pass	No wrinkles or dimpling

* Plate orientation is with respect to the well in the top right, furthest from the front of the instrument.

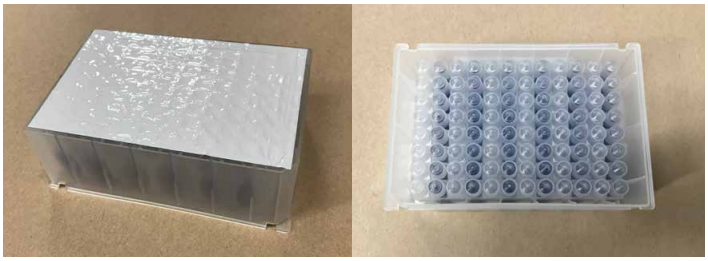

Figure 1. A sealed KingFisher 96 Deep-Well Plate. After filling wells in alternating rows of the plate with dyed liquid, the plate was sealed with Easy-Peel foil laminate using the ALPS5000 Automated Plate Heat Sealer and inspected for leaks.

Low-pressure testing

Westpak is an independent, ISO/IEC 17025–certified testing facility with International Safe Transit Association (ISTA) accreditation. After an initial inspection, Westpak conducted low-pressure hazard testing by subjecting the plates to simulated high-altitude shipping conditions according to ASTM D6653-13. The test was performed to determine whether the seals would remain intact throughout shipment under standard air freight conditions. Each of the 2,280 sealed plates was placed upside down in a vacuum chamber (Figure 2), then subjected to the conditions outlined in Table 2. The temperature of the chamber was not controlled during the test. After the test, the seals and plates were visually inspected for any signs of leakage between wells or external leakage.

Table 2. Conditions of low-pressure test conducted at the Westpak package testing facility.

Step	Equivalent altitude	Ramp (hr:min)	Dwell (hr:min)
1	Site elevation*	–	00:01
2–3	14,000 ft (4,267 m)	00:07	01:00
4	Site elevation	00:07	–

* The testing site was 469 feet above sea level.

Figure 2. KingFisher 96 Deep-Well Plate inverted on absorbent material for leak inspection prior to testing (left) and the vacuum chamber in which sealed plates were subjected to low-pressure testing (right).

Results

A visual inspection after testing found that seals on only six of the plates, or less than 0.3%, leaked. Three of the leaks were attributed to wrinkling observed on the seals prior to optimizing the sealing parameters. This was rectified by increasing the sealing force from 24 kg to 45 kg.

The other leaks were attributed to slight variations in plate wall thickness. Thinner walls may not have provided enough surface area to form tight seals, resulting in leakage. We encountered very few mechanical errors over the five-month period in which the 2,280 KingFisher plates were sealed using the ALPS5000 plate sealer. The issues were easily rectified and did not significantly delay the sealing process.

Conclusions

In this study, the ALPS5000 Automated Plate Heat Sealer consistently applied tight seals to KingFisher 96 Deep-Well Plates. Optimizing the sealing parameters is a critical and required initial step that enables consistent results, as evidenced by the sealed plates having less than a 0.3% chance of seal failure when subjected to the ISTA high-altitude testing conditions post-optimization. With the ALPS5000 Automated Plate Heat Sealer, a laboratory can:

- Minimize sample loss due to evaporation
- Prevent sample contamination
- Confidently store samples for long- or short-term use
- Safely ship liquid-filled plates
- Reduce variation between experimental replicates

The ALPS5000 Automated Plate Heat Sealer is compatible with a wide range of microplates, including Thermo Scientific™ Nunc™ DeepWell™ plates, Nunc™ MicroWell™ plates, KingFisher plates, Abgene™ deep-well plates, Abgene™ microplates, and many more, making it a must-have for routine laboratory protocols that require increased productivity and reliability.

Ordering information

Product	Cat. No.
ALPS5000 Automated Plate Heat Sealer	AB-5000

Heat seals and rolls for use with the ALPS5000 plate sealer

Product	qPCR	DMSO	Pierce	Peel	PCR	Storage temperatures	Compatible material(s)	Roll length	Cat. No.
ThermoSeal foil laminate		•		•	•	–80°C to +120°C	Polypropylene	370 m	AB-3559
Easy Pierce foil			•	•	•	–80°C to +120°C	Polypropylene Polyethylene	610 m	AB-3738
Easy Pierce foil, 20 µm			•	•	•	–80°C to +120°C	Polypropylene Polyethylene	610 m	AB-3720
Easy-Peel foil laminate		•		•	•	–120°C to +90°C	Polypropylene Polyethylene Cyclic olefin copolymer	610 m	AB-3739
Clear Seal thin polymer roll	•		•	•	•	–80°C to +120°C	Polypropylene Polyethylene Polystyrene	610 m	AB-3797
Diamond Clear Seal polymer roll	•	•			•	–80°C to +120°C	Polypropylene Polyethylene Polystyrene	370 m	AB-3799

Find out more at **thermofisher.com/alps5000**

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