Combining Tube-based Storage with New Acoustic Liquid Handling Technology to Dramatically Increase Sample Management Efficiency

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Abstract

Traditional sample management and high-throughput screening have relied heavily on high-density microplates for compound storage and tip-based liquid handling solutions for processing. Drawbacks of these technologies include increased microplate storage space requirements (empty wells cannot be excluded), sample integrity challenges (accessing sample subsets in a microplate requires thawing the entire plate) and compound loss during transfer (due to adhesion to or contamination from the tip plastic itself).

Adoption of individual tubes for storage and acoustic liquid handling technologies for transfer has addressed most but not all of these drawbacks. To date, sample tubes have not been compatible with acoustic liquid handling technology necessitating creation of working microplates using tip-based liquid handling systems.

We present an overview and performance details for a new acoustic liquid handling technology and compatible acoustic tubes that offers the full benefit of tube storage and acoustic liquid handling without the historical drawbacks. We will demonstrate the utility of the technology in maximizing compound storage both in terms of maximizing space and maintaining sample integrity. The combination of acoustic tubes and acoustic liquid handling offers a more efficient, streamlined approach to non-contact acoustic transfer of samples and reagents for sample management and high-throughput screening groups.

Streamlined Acoustic Sample Screening Workflow

- **Acoustic Tube Kit**
  - Sample plates
  - Acoustic ready plates
  - Microplate storage

- **Echo® 655T**
  - Acoustic transducer
  - Waveguide
  - Focus assembly
  - Acoustic fluid handler

Benefits of an Acoustic Workflow for Sample Management

- **MAXIMIZE Lab Budget**
  - Eliminate tip costs
  - Conserve sample and reagent
  - Minimize sample loss
  - Minimize sample exposure

- **INCREASE Sample Integrity**
  - Eliminate sample contamination
  - Eliminate carryover
  - No cross-contamination

- **IMPROVE Productivity**
  - Increase plate throughput
  - Reduce labor costs

- **ACCELERATE Turnaround**
  - Improve sample delivery time
  - Minimize sample transfer time

Impact of Acoustic Liquid Handling

- **Plate Bottom**
  - Fluid height to be established
- **Well Bottom**
  - Internal fluid interface
- **Fluid Surface**
  - Plate bottom, well bottom and fluid surface

Dynamic Fluid Analysis

- **All Echo® Liquid Handlers** are factory pre-calibrated for a wide variety of liquid classes and require no user calibration during use. To further adjust for variable fluid properties within the Labcyte defined fluid classes, Dynamic Fluid Analysis (DFA) is employed. Immediately prior to transfer, a series of increasing but low energy sound pulses are emitted and the effect of each pulse at the fluid surface is evaluated. This process takes millisecond to complete. Through this rapid, iterative process, parameters for accurate and repeatable droplet ejection are calculated tailoring the final acoustic energy ejection burst to the specific fluid properties in the well.

**Echo® 655T Liquid Handler Specifications & Performance**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Droplet size</td>
<td>2 µL</td>
</tr>
<tr>
<td>Volume transfer range</td>
<td>3.4 nL to 1.0 µL</td>
</tr>
<tr>
<td>Transfer accuracy</td>
<td>±1% deviation from target volume</td>
</tr>
<tr>
<td>DMSO hydration precision</td>
<td>±5% for all concentrations</td>
</tr>
<tr>
<td>Source Plate Compatibility</td>
<td>All Echo®-qualified plates, 384-well and 1536-well microplates</td>
</tr>
</tbody>
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**Echo® 655T New Features and Benefits**

- **Redesigned Transducer**
  - Accommodates tailored acoustic tube profile, and maintains more consistent transducer to microplate acoustic coupling. Eliminates the need for plate adapter inserts found in the previous generation Echo® 6xx Liquid Handlers thereby simplifying the swapping of plate types particularly when integrated into an automated workflow.

- **Isolated “plate-zones”**
  - Internal interface enable controlled air pressure base (either positive or negative) to the immediate vicinity of the source and destination plates can be maintained.

- **Redesigned Fluidics**
  - More consistent coupling fluid temperature, reduced instrument noise and less maintenance.

- **Redesigned Plate Dryer**
  - Increased airflow of the plate dryer addresses potential for greater coupling fluid retention on the bottoms of the acoustic tubes ensuring that, following sample transfer, tube rocks are functionally dry.

- **New Deionizer Bar**
  - More powerful deionizer bar increases plate load efficiency reducing total time for sample transfer.

**Echo® 655T Acoustic Workflow For Sample Management**

The full acoustic workflow solution for sample management offered by Labcyte encompasses sample management software from Titan Software Ltd, FluiD™ Acoustic™ Tubes and storage from Brooks Life Sciences Systems, the Labcyte Access™ 2.0 Automation System and the Echo® 655T Liquid Handler.

**Superior Sample Storage Solution**

Fluidic™ Acoustic™ Sample Tubes offer 70 µL working volume with a 15 µL dead zone volume when working with DMSO. The storage tubes have a unique cap design capable of withstanding over 100 cap/decap cycles and maintaining long term (years) sample integrity.

**Summary**

For small molecule compound management and high-throughout assay screening groups looking to maximize their assay hits while minimizing their cost per assay when screening medium to large compound libraries, the Echo® 655T Liquid Handler enables the fastest, most accurate and precise sample transfer from 384-well, microplate and 1536-well plates for highly accurate and precise liquid transfers, even at nanoliter scale volumes.

**FIGURE 1:** Details highlighting potential workflows utilizing acoustic sample tubes that reduce sample usage and streamline assay plate microplate storage space requirements (empty wells cannot be excluded), sample integrity challenges (accessing sample subsets in a microplate requires thawing the entire plate) and compound loss during transfer (due to adhesion to or contamination from the tip plastic itself).

**FIGURE 2:** Waveguide highlighting major steps in the acoustic workflow for sample management.

**FIGURE 3:** Schematic highlighting major steps in the acoustic workflow for sample management.