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Tech Note

Attention to Detail: Advanced Incubator Design of BioTek's PowerWave™ and ELx808 Microplate Instrumentation

Introduction

Temperature stability and uniformity are critical factors in many microplate-based assays. Even a small temperature variation during the course of an assay can often produce unacceptable results. The overall aims of microplate incubation are to efficiently warm up the microplate to a predefined temperature and to maintain the plate at that temperature. A well designed incubator should assure that temperature uniformity is provided throughout the microplate and that the plate's mean steady-state temperature is kept close to the set point temperature.

Convection vs. Forced-Air Incubation

In BioTek's PowerWave™ microplate spectrophotometer and EL_x808 reader, a natural convection approach is used in the incubator design. Although convection-based incubators are somewhat slower than forced air systems in warming the plate, they provide a number of important advantages. For example, evaporation and the accompanying well-to-well variability are minimized because there is no flow of air across the microplate. This results in a greatly enhanced temperature uniformity across the microplate. In addition, because there is no need for a fan inside the reading chamber, the size of the chamber can be kept small, resulting in an overall decrease in instrument size. The elimination of the fan also facilitates a dust-free environment in the reading chamber.

Incubator Design

The unique design of the PowerWave™ and EL_x808 incubators provides extremely uniform temperature distributions. The microplate incubation chamber in these instruments is constructed of anodized aluminum, which is an excellent heat conductor. The plate is completely surrounded by two aluminum channels (top and bottom). The top channel is split into two sections, with one section acting as an access to the reading chamber. The plate rests on a carrier that is 0.030" above the heated aluminum channel. The small distance between the carrier and the channel ensures a relatively rapid warm-up time.

There are four heating elements attached to the channel; these produce a highly uniform heat flux. The excellent heat conduction properties of the aluminum channel assures that the temperature is uniform across its surface. An important design feature is the fact that each heating element is controlled independently by a PID controller (PID stands for proportional, integral and derivative modes of control), and the set point temperature is therefore accurately controlled in all four zones. Heat is applied to the top of the channels as well as the bottom, which ensures that no condensation accumulates on the surface of the incubator's top channel.

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One heating element and one zone of control is dedicated to the access cover of the reading chamber. Thus, even if the reading chamber cover is left open, the temperature of the cover's aluminum extrusion remains at the set point, and after the microplate is positioned in the reading chamber and the cover is closed, the incubator's aluminum channels are immediately at the set point temperature. These channels run the full length of the reading chamber and the plate is therefore kept in the same thermal environment regardless of its position in the reading chamber. Attention to detail is critical in the maintenance of temperature uniformity, so BioTek's engineers have kept the optical access openings small enough that they create no adverse effects on the uniformity of the thermal field in the reading chamber.

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