

## Device Technology

### Patient-focused Dry Powder Inhalers



#### Dreamboat Technology

MannKind's approach to pulmonary delivery of APIs with a dry powder inhalation formula is based on adherence to several key principles:

- Simplicity through breath-powered delivery
- Consistency using high flow resistance
- Adaptability for a variety of powders and user groups
- Modularity of a platform-based delivery technology
- Portability with a discreet, small system
- Scale-ability in high- and low-volume applications
- Sensitivity to environmental exposure

Through extensive clinical experience and market research MannKind has developed

a new line of cost effective, innovative breath-powered devices. Our first embodiment, called Dreamboat™, is a reusable patient-friendly inhaler utilizing unit dose cartridges.

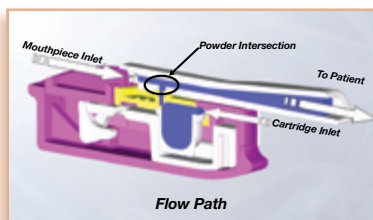
#### Dreamboat Overview



#### Dreamboat Development

The Dreamboat system was designed to be an efficient, simple, and low cost breath-powered inhaler technology platform that is adaptable to a broad range of products and therapies. High flow resistance coupled with a concept called "flow balance" enables convenient inhaler formats that are easy to use and function consistently with low patient inhalation efforts.

#### Dreamboat Inhaler Flow Path



Self-administration of pulmonary products is driven by patient compliance, so the inhalers



must be user-friendly and perform consistently. To this end, MannKind technology uses the patient's inhalation effort to deliver the dose in a single inhalation. This system efficiently and aggressively focuses the energy

supplied by the patient directly onto the dry powder resulting in high delivery performance.

When utilized with MannKind's Technosphere® formulations, greater than 90% of the powder is delivered to the patient with ~70% of that delivered in the respirable range. The Dreamboat Inhalation System shows



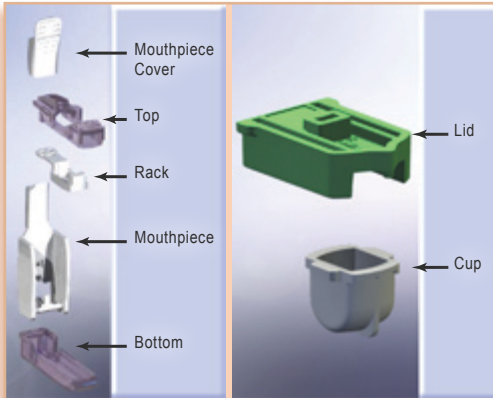
**Dreamboat Development (continued)**

very little change in performance over a wide range of relevant pressure drops (flow rates) and produces high bioavailability. In addition, a handling study has shown the device is compatible with pediatric use.

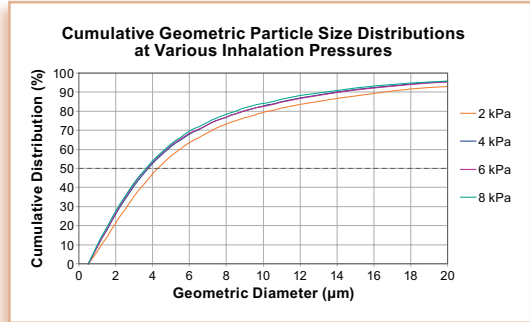
The manufacture of the Dreamboat Inhalation System is cost effective, featuring a 5-part inhaler and a 2-part cartridge that are:

- Highly amenable to automatic (top down) assembly
- Scaled to 16 cavity and 96 cavity component molding
- Manufactured from standard compliant resins: PBT, ABS, PP, and HDPE resins

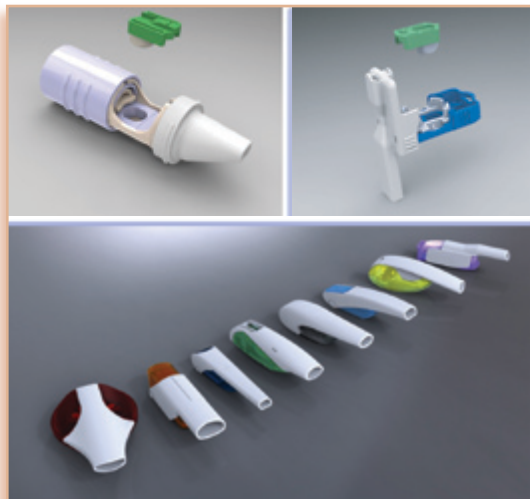
**Dreamboat Inhaler and Cartridge Assembly**



**Dreamboat Delivery Performance**



**Multi-use Dreamboat Family**



**MannKind's Vision**

The Dreamboat inhalation system is being expanded to a variety of other inhaler embodiments featuring the same user appeal and performance. Adjustments to meet the needs of specific API formulations and specific clinical indications can be easily implemented.

In addition, the Dreamboat principles have been used to develop the "Cricket" device family.

This novel pulmonary delivery device is designed for acute, time of need, and short duration treatments. It offers significant advantage in a single use, 2-part low cost format.

**Disposable Cricket Family**

