

Animal Housing Options for the Culex® Automated Blood Sampler

The Culex Automated Blood Sampler (Culex ABS) was designed to be a multi-function workstation capable of performing simultaneous studies in each test subject. The product name is misleading since it is possible to obtain more than blood samples from each experiment. For example, urine, feces, bile, microdialysates and ultrafiltrates represent some of the other biofluids available for simultaneous collection during a blood sampling experiment. Electrocardiograms, animal activity, electroencephalograms, body temperature and blood pressure are examples of electrical or electrophysiological measurements that can be obtained. Culex cages impart flexibility in the system according to the needs of each user. This review provides guidelines on how to choose the appropriate cage.

Introduction

The Culex ABS system was designed to provide as much information as possible from a single experiment. This “parallel” approach reduces the number of animals needed for ADME research and refines the experiment by correlating urinary concentrations with blood concentrations in the same subject. The metabolic cage provided with the instrument collects both urine and feces. Other experiments may also be conducted at the same time, such as microdialysis studies or EEG. When an implant is mounted to the skull of a freely-moving animal, a different cage is needed. The implant impedes access to the food and water bins in a standard metabolic cage. When animals smaller than rats are used, another cage may be advantageous when collecting urine produced at reduced rates or volumes. Each Culex cage fits on the same interactive cage base (Return).

Culex Cage Types

TI lists the space available to an animal housed within each cage currently available for the Culex ABS, as well as the suitability of each model for additional experiments conducted simultaneously with blood sampling. All three cages exceed National Institutes of Health (USA) cage height requirements for small mammals (mice, rats, hamsters, guinea pigs) and include a removable lid to discourage escapes.

Standard Metabolic Cage

The standard cage shipped with a Culex ABS is a fully functional metabolic cage designed for rats (*F1*). The intent of a metabolic cage is to collect urine and separate it from feces. A stainless steel funnel under the cage directs the wastes to a stainless steel mesh basket underneath (“Feces Fetcher”). Fecal pellets roll to one side while urine drips into a glass funnel and out to a standard scintillation vial secured in a 1°C cold well (“I-cup”). Food and water dishes hang on the outside of the cage and can be covered with steel plates during fasting. Wet paste foods or very small pellets (1 - 2 mm) are preferred during metabolic collections in rats since these are least likely to contaminate the urine. A hinged and removable door was added to provide access to the animal during connection of automated blood sampling or automated drug infusion lines, or during dose administration. The existence of the door has made this the preferred cage for Culex operation because of access to the animal; even when metabolic wastes were not required for the experiment.

New Bowl Cage

Recently, a new cage was created for Culex. The bowl cage was originally designed for animals with implants on their skulls, including brain microdialysis probes and EEG electrodes. The intent of the bowl (*F2*), which featured a rounded bottom and

sloped walls, was to keep the animal from knocking implants on the skull against cage walls. This cage was intended for use with bedding materials, which were necessary to soak up urine and feces and also provided additional warmth and comfort for rodents. In the original cage, no access was available from the sides of the cage and a user had to reach down into the cage to make connections or collect the animal for dosing. In the new cage, an access panel was added. The panel lifts off completely and provides room for a user to place both hands into the cage as needed. As indicated in *TI*, the floor space of this cage changes according to the amount of bedding material added. When dense bedding is used, the animal walks on top of it and the floor space increases as more bedding is used. When fluffy bedding is used, the animal tends to burrow under it and the floor space is more difficult to estimate. The new bowl cage has a stainless steel spring mount for the standard Culex water bottle. The water bottle can either be mounted inside or outside the cage. Space limitations on the Culex cart make an inside mount preferable when four cages are installed on one system.

Mouse Metabolic Cage

The Mouse Metabolic Cage for Culex (*F3*) fits onto the same interactive cage platform as the rat metabolic cage. It was necessary to create a new cage for mice in order to collect urine samples.

The volume of urine produced by a mouse is considerably less than by a rat. The stainless steel collection funnel under the mouse cage is Teflon-coated to facilitate the flow of urine into the collecting cup. A mini “Feces Fetcher” collects the mouse fecal pellets while a small glass funnel routes the urine to a scintillation vial in the same cold well used in the rat metabolic cage. Wet paste foods are recommended for mouse urine collections since these materials are least likely to contaminate urine. Mice will pick up and fling small pellets out of the cage, and their aim is excellent.

Choosing a Cage

The standard metabolic cage has been used for automated blood collection in rats, hamsters, and guinea pigs. It was unsuitable for mice since the small volume of urine dried in the collection funnel before being collected. Mice also escaped via the large food and water ports and the spacing of the mesh floor was too large. The mouse cage addressed all of these issues. The new bowl cage with the access port is becoming an increasingly popular alternative with all rodent species, including mice. When urine/feces collection is not required, or when brain microdialysis is being performed, the bowl cage would be preferred. The use of bedding material increases animal comfort. The bowl cage should not be used without bedding material. Urine and feces would pool on the bottom of the cage, creating a wet, uncomfortable environment.

With all cage designs, an entire cage can be exchanged while the animal is still connected to the Culex. This procedure makes it possible to continue the study for longer periods while still maintaining good hygiene for the animal. The process is illustrated with step-by-step photographs on the Culex User’s Forum at www.culex.net.

T1. Culex ABS cage characteristics.

Culex Cage Model	Floor Space (sq.cm.)	Cage Height ¹ (cm)	Floor Type	Floor Mesh Hole (sq.cm)	Suitability for Other Collections		
					EEG or Brain microdialysis	Urine Collection	Behavioral Data
Standard Metabolic Cage (Shipped with Culex System)	481	30	Stainless Steel Round Rod Grid	1.44	NO	YES	YES
Mouse Metabolic Cage (optional)	168	29	Stainless Steel Flat Rod Grid	0.25	NO	YES	YES
Bowl Cage (optional) with 1.0 liter of bedding ²	506	32	Smooth, Acrylic Plastic	none	YES	NO	YES
Bowl Cage (optional) with 2.0 liter of bedding ³	615	29	Smooth, Acrylic Plastic	none	YES	NO	YES
Bowl Cage (optional) with 3.0 liters of bedding ⁴	730	28	Smooth, Acrylic Plastic	none	YES	NO	YES

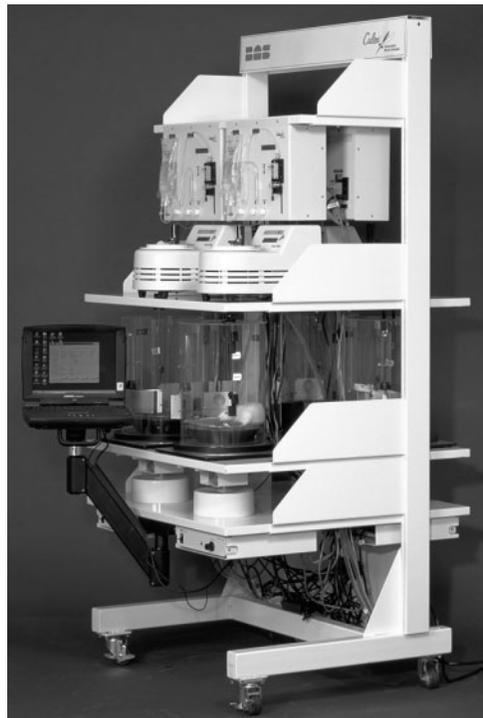
1 Space from the floor (top of bedding) to the underside of the cage lid.

2 Depth of bedding is approximately 3.8 cm.

3 Depth of bedding is approximately 6.3 cm, two liters of bedding material is ideal in this cage.

4 Depth of bedding is approximately 8.0 cm.

F1. Culex ABS with standard metabolic cages installed on a four station cart.



F2. New bowl cage with access panel. Top: removing panel. Bottom: preparing for PO dose.



F3. Mouse metabolic cage. The door of this cage is above the floor level so there is an obstruction to keep the mouse from darting out of the cage. Blood is being collected from a jugular catheter attached to the Culex ABS.

