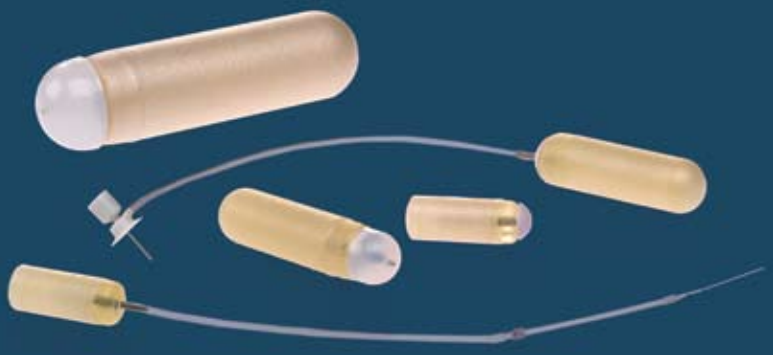
ALZET® Technical Information Manual

alzet®
OSMOTIC PUMPS

Contents:



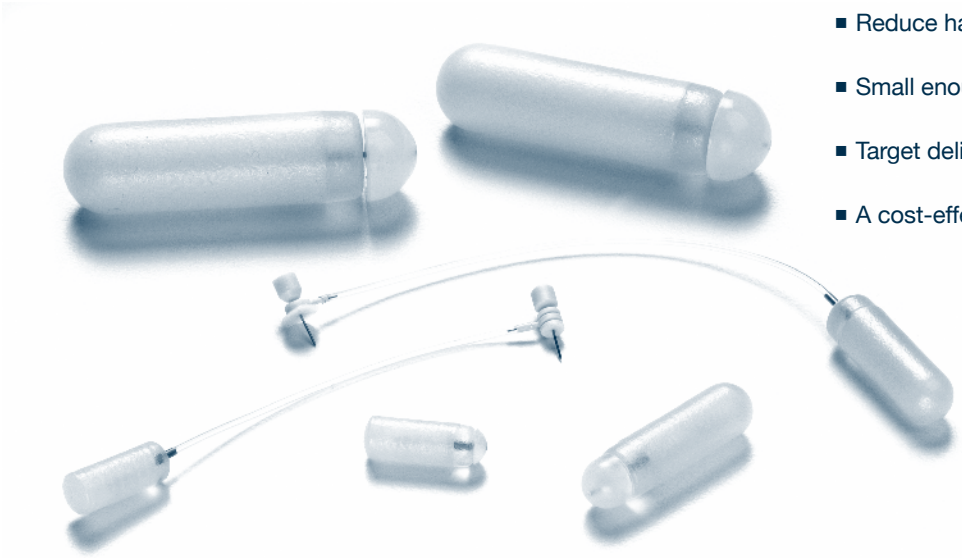
Overview

ALZET® osmotic pumps are miniature, implantable pumps used for research in mice, rats, and other laboratory animals. These infusion pumps continuously deliver drugs, hormones, and other test agents at controlled rates from one day to six weeks without the need for external connections or frequent handling. Their unattended operation eliminates the need for repeated nighttime or weekend dosing.

ALZET pumps can be used for systemic administration when implanted subcutaneously or intraperitoneally. They can be attached to a catheter for intravenous or intra-arterial delivery. Or, they can be used for targeted delivery, in which the effects of a drug or test agent are localized in a particular tissue or organ, by means of a catheter. The pumps have been used to target delivery to a wide variety of sites including the brain, spinal cord, spleen, liver, organ or tissue transplants, and wound healing sites.

ALZET pumps have been used in thousands of studies on the effects of controlled delivery of a wide range of experimental agents, including peptides, growth factors, cytokines, genetic materials, chemotherapeutics, addictive drugs, hormones, steroids, and antibodies. Due to the unique mechanism by which ALZET pumps operate, compounds of any molecular conformation can be delivered predictably at controlled rates, independent of their physical and chemical properties. A bibliography of pump work that has been documented in the scientific literature is available, as is information on the osmotic delivery mechanism of ALZET pumps.

ALZET pumps are intended for use in experimental animals only. They are not to be used in food animals or humans.



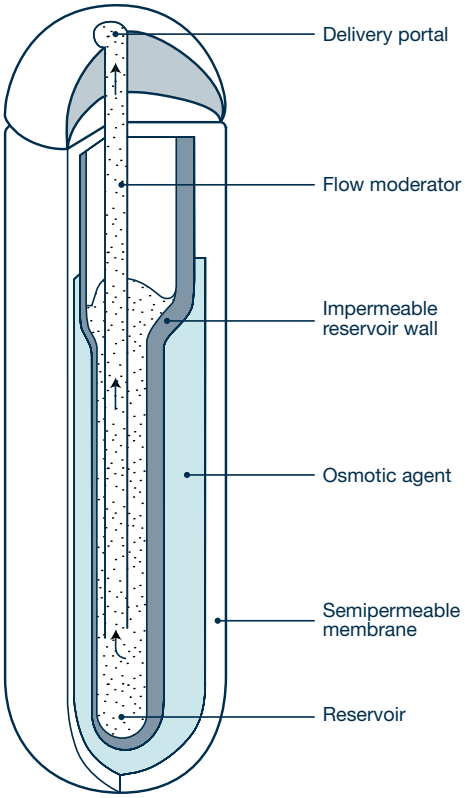
Pump Advantages

- Ensure around-the-clock exposure to test agents at predictable levels
- Permit continuous administration of short half-life proteins and peptides
- Provide a convenient method for the chronic dosing of laboratory animals – no need for nighttime or weekend dosing
- Minimize unwanted experimental variables and ensure reproducible, consistent results
- Eliminate the need for nighttime or weekend dosing
- Reduce handling and stress to laboratory animals
- Small enough for use in mice or very young rats
- Target delivery of agents to virtually any tissue
- A cost-effective research tool

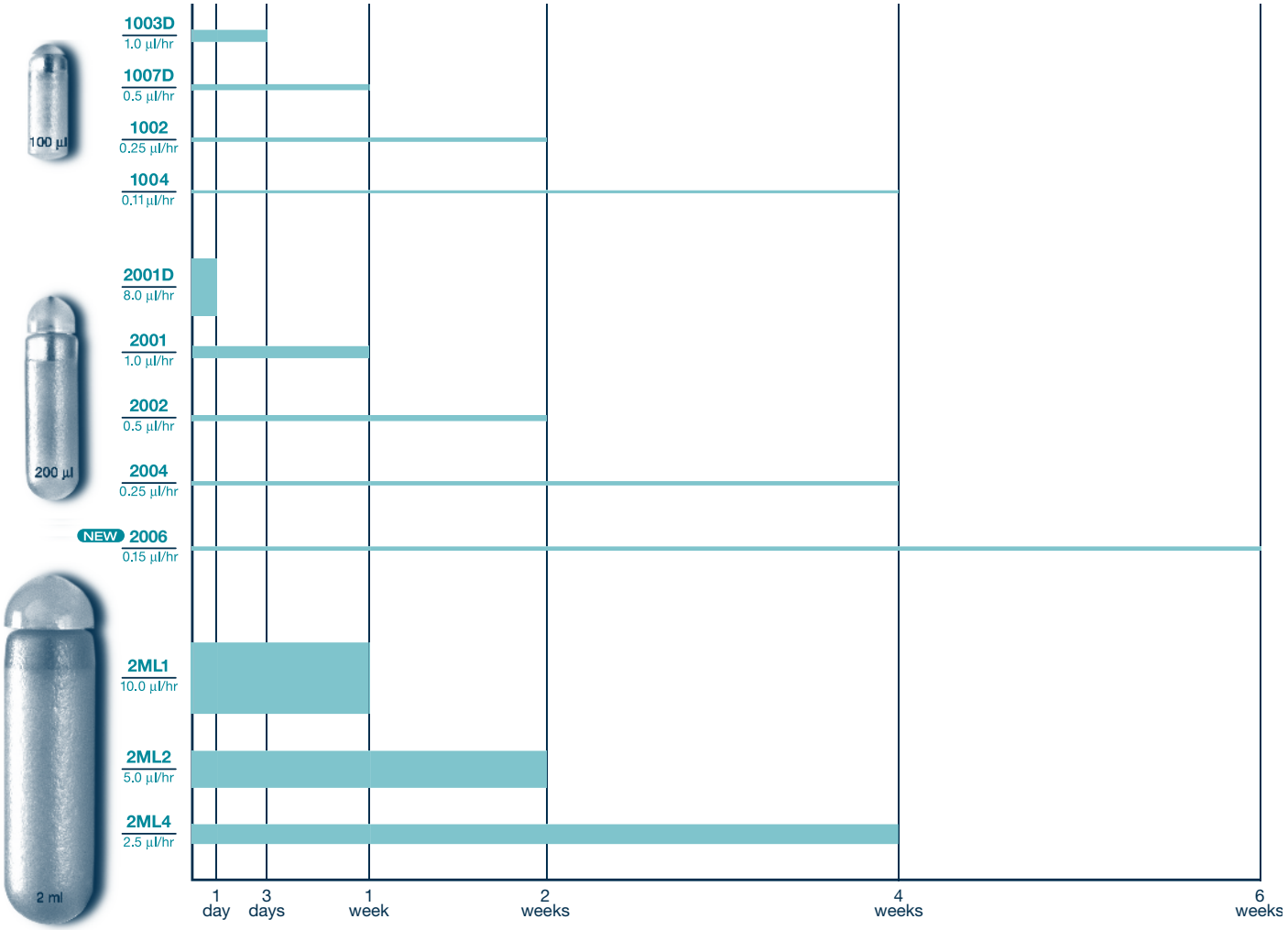
How does it work?

ALZET pumps operate because of an osmotic pressure difference between a compartment within the pump, called the salt sleeve, and the tissue environment in which the pump is implanted. The high osmolality of the salt sleeve causes water to flux into the pump through a semipermeable membrane which forms the outer surface of the pump. As the water enters the salt sleeve, it compresses the flexible reservoir, displacing the test solution from the pump at a controlled, predetermined rate. Because the compressed reservoir cannot be refilled, the pumps are for single use only.

The rate of delivery by an ALZET pump is controlled by the water permeability of the pump's outer membrane. Thus, the delivery profile of the pump is independent of the drug formulation dispensed. Drugs of various molecular configurations, including ionized drugs and macromolecules, can be dispensed continuously in a variety of compatible vehicles at controlled rates. The molecular weight of a compound, or its physical and chemical properties, has no bearing on its rate of delivery by ALZET pumps.

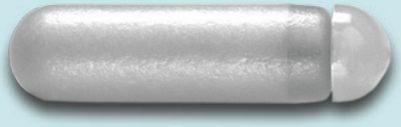


Rates and Durations



Specifications

Dimensions, Components, and Materials of ALZET Osmotic Pumps

ALZET Pump Model #	1003D 1007D 1002 1004	2001D 2001 2002 2004 NEW 2006	2ML1 2ML2 2ML4
Complete Osmotic Pump (pumps shown actual size)			
Length (cm)	1.5	3.0	5.1
Diameter (cm)	0.6	0.7	1.4
Weight (g)	0.4	1.1	5.1
Total Displaced Volume (ml)	0.5	1.0	6.5
Filling Tube			
Length (cm, tube only)	1.1	2.2	3.5
Gauge (tube)	27	27	25
O.D. (cm, tube)	0.04	0.04	0.05
I.D. (cm, tube)	0.02	0.02	0.03
Flow Moderator			
Length (cm)	1.3	2.4	4.6
Gauge (tube)	21	21	21
O.D. (cm, tube)	0.08	0.08	0.08
I.D. (cm, tube)	0.05	0.05	0.05
Weight (g)	0.05	0.2	0.9
Material (flange)	Styrene Acrylonitrile		
Material (cap)	n/a	Polyethylene	
Material (tube)	Stainless Steel 304		
Pump Body Materials			
Outer Membrane	Cellulose Ester Blend		
Drug Reservoir	Thermoplastic Hydrocarbon Elastomer		

NOTE: The nominal performance is the target for all pumps manufactured. Individual lots of pumps may vary from this target within limits. The actual mean pumping rate and fill volume of a particular lot are listed, together with statistical parameters, on the instruction sheet included with each box.

Nominal Performance of ALZET Osmotic Pumps

ALZET Pump Model #	1003D	1007D	1002	1004	2001D	2001	2002	2004	2006	2ML1	2ML2	2ML4
Nominal Pumping Rate (µl/hr)	1.0	0.5	0.25	0.11	8.0	1.0	0.5	0.25	0.15	10.0	5.0	2.5
Nominal Duration	3 days	7 days	14 days	4 weeks	1 day	1 week	2 weeks	4 weeks	6 weeks	1 week	2 weeks	4 weeks
Nominal Reservoir Volume	100 µl				200 µl					2 ML		

Performance

Each lot of ALZET pumps undergoes extensive testing in DURECT's Quality Assurance laboratories to determine the exact pumping rate and reservoir volume and to ensure accurate compound delivery. These data are summarized and provided on the instruction sheet found in each box of pumps. Typical of the series as a whole, Figures A and B are examples of the release rate profiles for ALZET osmotic pump Models 1003D and 2002. DURECT estimates the pumping rate of ALZET osmotic pumps by measuring their pumping rate *in vitro* in 0.9% saline at 37°C (+/- 0.5° C). This *in vitro* testing method gives a good measure of reproducibility over time, both within pumps and between pumps, and allows an estimation of the pumping rate to be expected in homeothermic animals for which 0.9% saline is isotonic.

For example, in rats and mice the mean pumping rates of subcutaneously or intraperitoneally implanted osmotic pumps are within 5% of the *in vitro* rate (see Figure C).

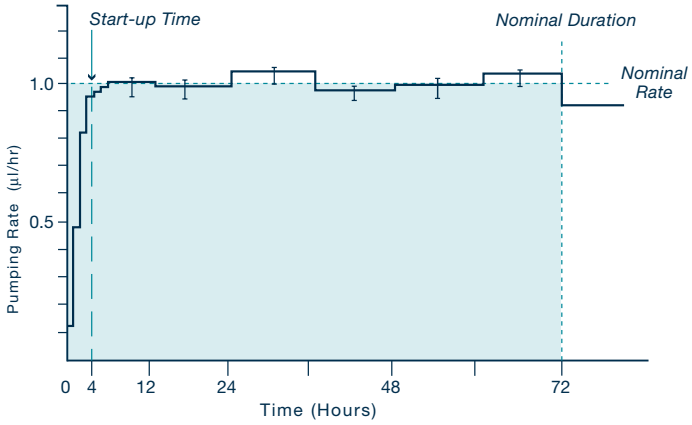


Figure A: The *in vitro* pumping rate of the Model 1003D ALZET osmotic pump over time (n=20).

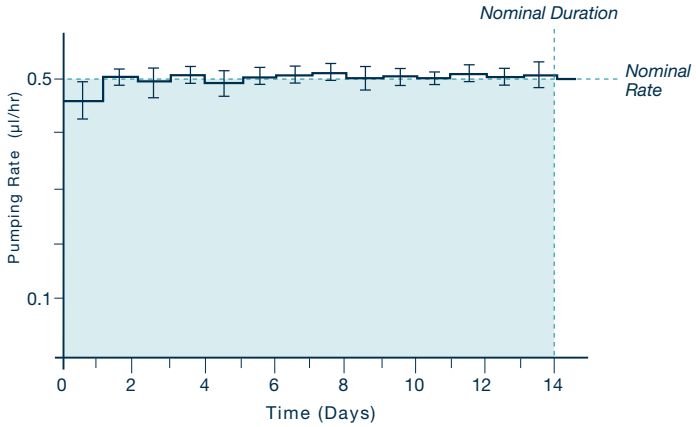


Figure B: The pumping rate of the Model 2002 ALZET osmotic pump over time (n=20).

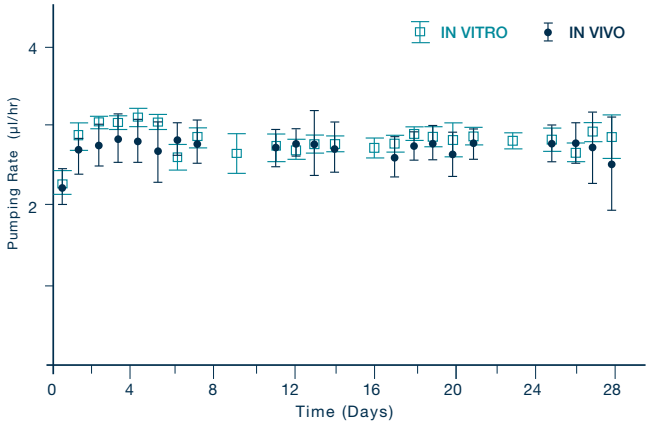


Figure C: The pumping rate of the Model 2ML4 ALZET osmotic pump over time *in vitro* and *in vivo* in Sprague Dawley rats after subcutaneous implantation (n=105).

Release Rate Profile

If an ALZET pump is loaded at room temperature (23° C) with a solution also at room temperature, and then placed in isotonic saline at 37° C, the pumping rate will not reach steady state for several hours. If your experiment requires immediate delivery, it is best to prime the filled pumps (see the 'Filling and Priming' section on pg. 9). After priming, each pump operates at a constant rate until about 95% of its volume has been delivered. The rate then falls rapidly to zero. From DURECT's experience, the coefficient of variation of each pump's infusion rate is less than 10%. The variation in the *in vitro* pumping rates among pumps on a given day and within a given pump across the duration of pumping appears on the instruction sheet included with each package of osmotic pumps.

Visit www.alzet.com for detailed technical information:

- Detailed "Guide To Use" for ALZET pumps
- Hundreds of new references available
- View our popular surgical videos in QuickTime format
- Download ALZET photos and images for your paper or presentation
- Links to other useful sites

Selecting a Pump Model

ALZET pumps are available in a variety of sizes, durations and flow rates to meet a wide range of research needs. While the pumping rate of each model is fixed at manufacture, the dose of agent delivered can be adjusted by varying the concentration of agent with which each pump is filled. Provided the animal is of sufficient size, multiple pumps may be implanted simultaneously to achieve higher delivery rates than are attainable with a single pump. For more prolonged delivery, pumps may be serially implanted successfully.

When choosing a pump model, consider the following:

- Animal size
- Route of compound administration for the desired target tissue and response
- Desired delivery rate
- Preferred duration of administration
- Compound characteristics* (solubility, cost)
- Dose
- Ambient temperature & osmolality (relevant to use in heterotherms or *in vitro* only)

*NOTE: The molecular weight of a compound is not relevant in the use or selection of ALZET pumps, since it has no impact on the release rate or function of the pump.

Animal Considerations

ALZET pumps can be implanted subcutaneously or intraperitoneally following the animal size guidelines below. We recommend use of the smallest size pump allowable for the solubility of the agent and experimental duration.

Estimated Minimum Animal Size For Implantation of ALZET Pumps

ALZET Pump Model #	Mice		Rats	
	Subcutaneous	Intraperitoneal	Subcutaneous	Intraperitoneal
1003D 1007D 1002 1004	10 g	20 g	10 g	20 g
2001D 2001 2002 2004 2006	20 g	n/a	20 g	150 g
2ML1 2ML2 2ML4	n/a	n/a	150 g	300 g

NOTE: The minimum animal size estimates are based on experience with male Sprague Dawley rats and Swiss Webster mice. When using the pumps with other types of rats and mice, or with animals other than rats and mice, these guidelines should be modified accordingly. (N/A = not applicable)

The pumps have been used in animals across the age spectrum, and in many different species. References are available on the use of ALZET pumps in the following animals:

Bird	Gerbil	Pig
Cat	Goat	Primate
Cattle	Guinea pig	Rabbit
Chinchilla	Hamster	Rat
Deer	Horse	Sheep
Dog	Iguana	Skunk
Ferret	Kangaroo	Squirrel
Fish	Mouse	Toad
Frog	Mink	Vole

Please contact us to inquire about animal models not listed above.

Route of Administration

ALZET pumps can be implanted either subcutaneously or in the peritoneal cavity, and these are the most common infusion sites. The choice between them is normally made based upon: prior work with the test compound, compound absorption and clearance, and animal size. Avoidance of the intraperitoneal route may be prudent for compounds rapidly metabolized by the liver, since uptake into the portal circulation can be substantial.

In addition, all pump models are easily attached to a catheter, such that a pump implanted either subcutaneously or intraperitoneally is used to infuse into a vessel, organ or tissue. Following are the major routes of administration via ALZET pump reported in the literature:

Subcutaneous	Local Tissue Microperfusion
Intraperitoneal	Arterial Wall
Intracavitary	Bone
Articular Cavity	Brain
Bladder	Ear
Cerebral Ventricles	Eye
Intestine	Muscle
Stomach	Nerves
Uterus	Ovary
Intravenous	Spinal Cord
Intra-Arterial	Spleen
Intraluminal	Testes
	Tumor

Duration of Administration

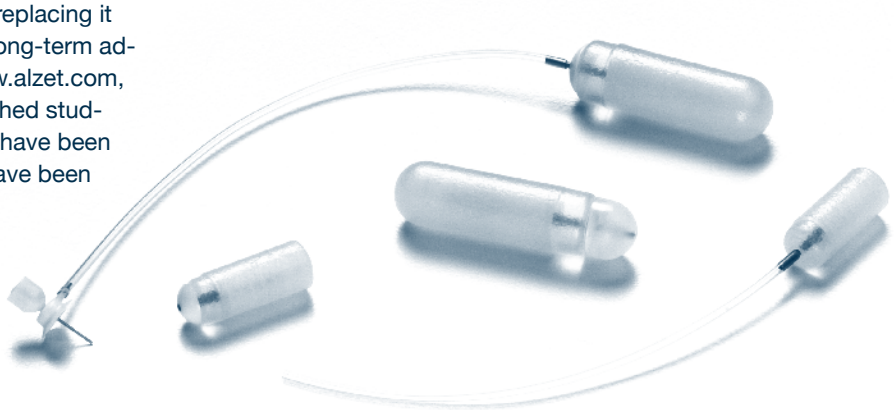
The nominal durations for ALZET pumps range from 1 day to 6 weeks depending upon the pump model. All pumps will deliver for longer than the nominal duration in order to ensure they last the full nominal duration. The actual duration of a particular lot can be estimated based on the mean pumping rate and fill volumes provided, together with statistical parameters, on the instruction sheet included in each box. Divide 95% of the average reservoir fill volume (µl) by the average pumping rate (µl/hr) to allow for a 5% residual which cannot be displaced from the pump. The mean pumping rate and mean fill volume are determined by *in vitro* testing performed by DURECT.

In fact, some pumps will deliver for longer periods (up to 25% longer than the nominal duration) depending upon the actual specifications of a given manufacturing lot. If your study calls for a particular duration not listed on our web site, please check with ALZET Technical Support for availability.

Longer durations can be achieved by serial implantation. For example, a 2-month infusion would be achieved by implanting a 4 week pump, removing it after one month, and replacing it with a fresh 4 week pump. A list of references on long-term administration with ALZET pumps is available at www.alzet.com, or upon request. This reference list includes published studies in which infusions of up to 18 months duration have been accomplished, and up to 36 serial implantations have been performed on a single animal.

Delivery Rate

Selecting a pump with the optimal flow rate is important for certain applications, such as when infusing into solid tissue. For example, lower flow rates (e.g., < 5 µl/hr) are typically preferred for administering compounds into brain parenchyma. The ALZET bibliography contains more than 8,000 references and is a useful source of information about the effects of delivery of a variety of agents via many different routes. Select references are available at www.alzet.com, and custom searches can be requested from ALZET Technical Support.



Compound Characteristics

Because of its mechanism of operation, the ALZET pump is well suited for administering a wide range of compounds regardless of their molecular weight. The molecular weight has no impact on the delivery or function of the pump. Successful delivery of an enormous range of compounds has been reported in the literature, and this list is available at www.alzet.com (Research Applications/Other Applications/Agents Administered) or upon request.

Solubility

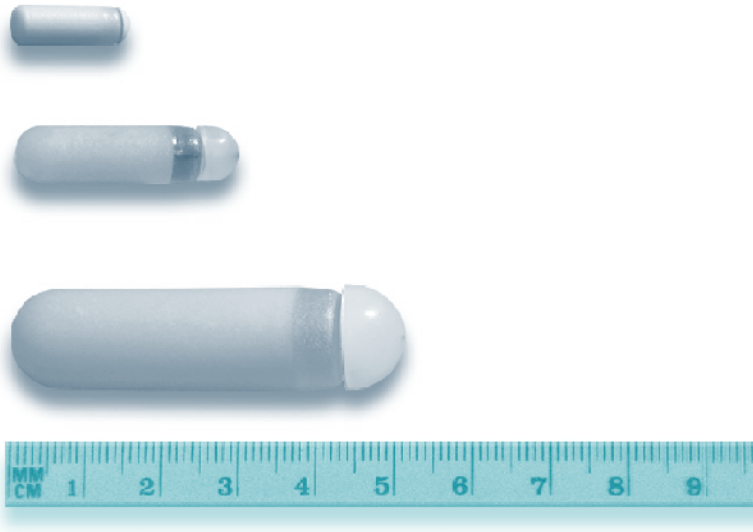
For poorly soluble compounds, a larger pump may be required to administer the required dose. Selecting the optimum vehicle is also critical. Solvent considerations include:

- Compatibility with the interior reservoir of the pump
- Compatibility with tissues or fluids at the site of administration
- Stability of the compound/vehicle solution for the duration of the experiment (if possible, vehicle control studies are recommended)
- Solubility of the agent to be delivered
- Sterility

Because the volume delivery rate of ALZET pumps is fixed, the maximum administration rate of a given compound from a given pump is limited by its solubility in the chosen vehicle. Alternate vehicles may be available which better solubilize the test compound, thereby increasing its maximum administration rate. Higher doses can be administered by choosing a pump with a higher flow rate, or dividing the dose among several simultaneously-implanted pumps (assuming that the experimental animal is of sufficient size). Please refer to Solvent Compatibility on page 8 for more solvent information.

Cost

For studies involving compounds that are expensive, or in limited supply, the driving factor in choice of pump may be small reservoir capacity. In addition, volumes smaller than the reservoir capacity of a single pump can be administered successfully using a simple coiled catheter technique called the Lynch Coil. A method is available at www.alzet.com (Products>Guide to Use>Catheter Use) or upon request.



Dose

Depending on the solubility of the compound, administering a larger dose quickly will require a pump with a relatively higher flow rate. Some studies have a daily dose as the goal. Use the following equation to determine the daily dose delivered by a particular pump. [Or, use our Drug Concentration Calculator available at www.alzet.com (Products>Guide to Use>Formulating the Solution)].

$$K = C \times Q$$

K = compound delivered per day, in µg
C = concentration of solution, in µg/µl
Q = release rate of pump, in µl/hr

Depending upon the size of the animal (e.g., adult rat or larger) multiple pumps may be implanted simultaneously to deliver a larger dose than would be possible with a single pump.

Ambient Temperature & Osmolality

Rates and durations listed for ALZET pumps are based on use *in vivo* in mammals unless otherwise specified. In alternate settings, such as in vitro or in other species, the pumping rate and duration may differ since both temperature and osmolality affect the rate at which water crosses the semi-permeable membrane and enters the osmotic sleeve.

Use the following equations to predict the pumping rate in heterothermic animals or in those whose body fluids are hypertonic relative to mammals. Or, use our interactive calculator located at www.alzet.com (Products>Guide to Use>In vitro Use).

Models:
2001, 2002, 2004, 2001D, 1003D, 1007D, 1002, 1004, and 2006

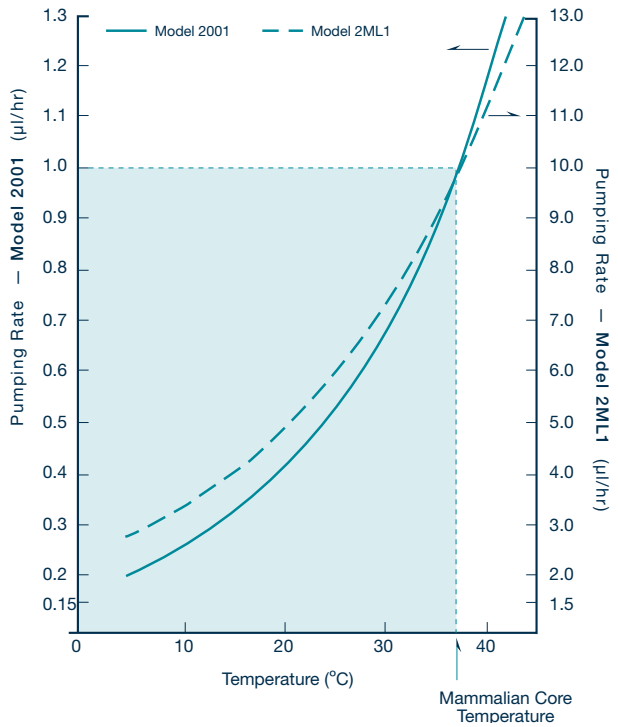
$$Q_T = Q_0 (0.135\, e^{(0.054T)} - (0.004\pi) + 0.03)$$

Models:
2ML1, 2ML2, and 2ML4

$$Q_T = Q_0 (0.141\, e^{(0.051T)} - (0.007\pi) + 0.12)$$

Q_T = the pumping rate at temperature T
Q_0 = the specified pumping rate at 37°C in µl/hr
T = temperature in degrees Celsius
π = osmolality of the solution outside the pump (atm)

These formulae are useful in the range of π = 0 to 25 atm and T = 4°C to 42°C. The equation is predictive within +/- 10%. At normal mammalian osmolality of 310 milliosmoles/l, the osmotic pressure is 7.5 atm. Environmental temperatures above 42°C have been found to cause fluctuating delivery rates and are not recommended.



The pumping rate of ALZET osmotic pumps varies in direct proportion to temperature. This graph shows the representative pumping rates for two pump models from 4°C to over 40°C in 0.9% saline.

Solvent Compatibility

The optimal solvent effectively dissolves the test agent, is sterile, and is compatible with both the ALZET pumps and the target biological environment. Please consider the following solvent guidelines:

- Standard parenteral fluids (e.g., non-lactated Ringer's solution) are recommended for subcutaneous, intraperitoneal or intravenous infusion of water-soluble agents to ensure sterility and non-pyrogenicity.
- Artificial cerebrospinal fluid (aCSF) is preferred for infusions into the brain (either via the cerebral ventricles or into solid tissue). A recipe for aCSF is available at www.alzet.com or upon request.
- Gas-generating solutions are not recommended for use in ALZET pumps, since this process can make the pumping rate highly unpredictable.
- Solutions with precipitated solute particles must be filtered before use.
- Solutions should be at room temperature when filling the pump.
- Viscous solutions can be delivered by ALZET pump, including PEG 300, PEG 400, propylene glycol, and glycerol.
- Suspensions may be delivered from the pump if they do not precipitate. To ensure uniform delivery, suspensions must remain homogenous throughout the duration of delivery.

The pumps are compatible with aqueous solutions, dilute acids and bases, dilute or low concentrations of DMSO, and ethanol. Suitable vehicles are listed below. In general, natural oils and most organic solvents are not compatible with ALZET pumps. Contact with these substances can result in pump malfunction.

If your preferred solvent does not appear at the top of the following page:

- Contact ALZET Technical Support to inquire about the compatibility of your solvent with the pumps
- Use a Lynch coil with the ALZET pumps. A method for fabricating this simple, inexpensive, alternate reservoir is available at www.alzet.com (Products>Guide to Use>Catheter Use) or upon request.
- Use an ALZAID® Chemical Compatibility Test Kit to test the solvent or solvent/drug mixtures. (Cannot be used for solvents containing ethanol.)

Commonly used solvents known to be compatible with ALZET pumps:

- Acids, with pH greater than 1.8
- Bases, with pH less than 14
- Cremophor EL, up to 25% in water
- Culture media (1% benzyl alcohol as bacteriostatic)
- β – Cyclodextrins
- Dextrose, up to 5%, in water or NaCl
- N,N-Dimethyl formamide (DMF), up to 25% in water
- DMSO, up to 50% in water or polyethylene glycol
- DMSO, up to 50% in ethanol (≤15%) and water
- Ethanol, up to 15% in water
- Glycerol
- 1-Methyl-2-Pyrrolidone, up to 12.5% in water
- Phosphate buffer
- Polyethylene glycol 300 or 400, neat or in water
- Propylene glycol, neat or in water
- Ringer's solution (with or without lactate)
- Saline, 0.9% (or other aqueous salt solution)
- Serum (rat, mouse, etc.)
- Solutol, up to 30% in water
- Triacetin, up to 5% in water
- Tween 80, up to 2%
- Water, distilled

Pump Filling & Priming

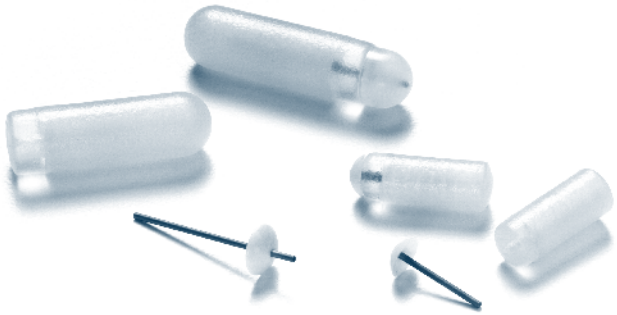
Detailed procedures for priming and filling are available at www.alzet.com (see Products>Guide to Use>Filling & Priming), and in the instruction sheet supplied in each box of pumps. The pumps are filled by syringe using a custom length, blunt needle provided in each box of pumps. Complete filling is essential for proper pump operation. To ensure complete filling, we recommend weighing each pump with its flow moderator, first empty, and then filled and with the flow moderator inserted.

Priming involves incubating the filled pump in saline at 37° C prior to implantation in order to allow the pump to equilibrate and reach its steady-state pumping rate. The priming duration is 6 hours (preferably overnight) for all except Models 1004 (48 hours), 2001D (3 hours), 2004 (40 hours), and 2006 (60 hours). Please refer to package insert for more detailed instructions. Priming is only mandatory when:

- Immediate pumping is required
- A catheter is used with the pump
- A viscous solution is being delivered
- The drug solution may have acute toxic effects

Delivery Verification

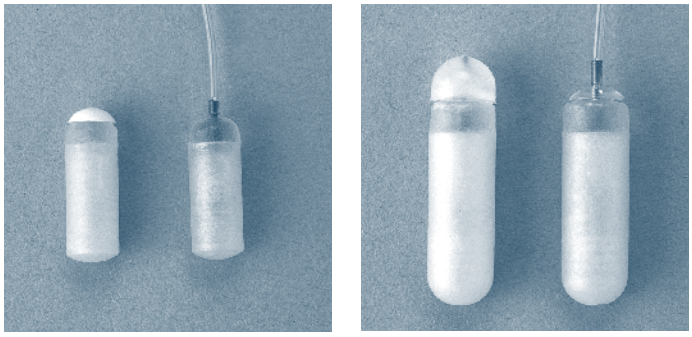
Some users may want to verify the operation of ALZET pumps in their experimental applications. One of the best methods for verifying correct operation of the pumps is to monitor blood or plasma levels of the drug administered at several points during the course of administration. This will allow one to detect when such levels reach steady state and whether variables unrelated to pump functionality (e.g., metabolic tolerance) influence experimental results. In addition, we recommend measuring the residual drug solution which remains in the pump reservoir at the time the pump is explanted. To do this, aspirate the solution from the reservoir using a syringe and a filling tube (provided with each box of pumps). To ensure complete recovery, flush the reservoir with additional vehicle. The active agent in the effluent solution can then be assayed using an appropriate technique. To calculate the average pumping rate, the difference between the amount of drug initially loaded and the residual amount in the reservoir is divided by the elapsed time.



Catheter Use

Via a catheter, ALZET pumps can deliver substances into the venous or arterial circulation, into the brain, or into any organ, lumen, or solid tissue. See page 6 for a list of select delivery routes. Attachment to a catheter does not alter the delivery rate of the pump. A variety of catheter materials have been used successfully with the pumps. See page 12 for information on catheters available from DURECT.

To use the pumps with a catheter, slide off the translucent cap from the flow moderator, and place the catheter tubing over the exposed metal tube. (For 100 µl pumps, break off and discard the plastic flange, and place the catheter tubing onto the metal tube about 3 mm.)



100 µl and 200 µl pumps before and after the attachment of catheters.

Surgical Implantation

Subcutaneous (SC) implantation is technically the easiest and least invasive procedure. The usual site for SC implantation of ALZET pumps in mice and rats is on the back, slightly posterior to the scapulae. Other regions may be used, provided that the pump does not impede vital organs or respiration. Once implanted, the contents of the pump will be delivered into the local subcutaneous space. Absorption of the compound by local capillaries results in systemic administration. With compounds absorbed slowly by the capillaries, a direct vascular connection from the pump may be required (see Catheter Use).

To implant a pump subcutaneously, anesthetize the animal and shave and surgically prep the back. Make a mid-scapular incision in the skin. Insert a hemostat, and gently open and close its jaws to create a pocket for the pump. The pocket should be large enough to allow some free movement of the pump (e.g., 1 cm longer and wider than the pump). Avoid creating so large a pocket that the pump can slip down on the flank of the animal. Insert the filled pump in the pocket, exit port first. It should not rest directly beneath the incision, as this could interfere with wound healing. Close the incision with wound clips or sutures.

Intraperitoneal implantation (IP) of ALZET pumps is appropriate in animals with sufficiently large peritoneal cavities (see Animal Size Guidelines on page 5). Depending on the size of the animal relative to the pump, intraperitoneal implantation can disrupt normal feeding and weight gain for a day or two thereafter. Allow 24 to 48 hours for the animal to recover after intraperitoneal implantation.

With any substance administered intraperitoneally, whether by injection or by infusion, a majority of the dose may be absorbed via the hepatic portal circulation rather than by the capillaries. For substances which are extensively metabolized by the liver (i.e., have a high “first pass effect”), the intraperitoneal route of administration may produce highly variable concentrations of agent in plasma and consequently highly variable effects. Therefore, the intraperitoneal route should probably be avoided with agents that have a significant first-pass effect.

For intraperitoneal implantation, once the animal is anesthetized, shave and prep the skin over the abdomen. Make a midline skin incision, slightly larger than the diameter of the pump, in the lower abdomen under the rib cage. Carefully tent up the musculoperitoneal layer to avoid damage to the bowel. Incise the peritoneal wall directly beneath the cutaneous incision. Insert a filled pump, delivery port first, into the peritoneal cavity. Close the musculoperitoneal layer with 4.0 absorbable sutures, taking care to avoid perforation of the underlying bowel. Close the skin incision with wound clips or interrupted sutures.

Detailed surgical procedures are available at www.alzet.com, or upon request. Please note that the pumps cannot remain implanted indefinitely, but should be removed by 1.5 times the actual duration of the pump in keeping with the following schedule:

Model	Explant Pumps By*
1003D	Day 5
1007D	Day 10
1002	Day 21
1004	Day 42
2001D	Day 1.5
2001	Day 10
2002	Day 21
2004	Day 42
2006	Day 63
2ML1	Day 10
2ML2	Day 21
2ML4	Day 42

*Data shown correspond to the nominal duration. Actual explant date should be calculated using the exact specifications for each lot of pumps.

Ancillary Products

Brain Infusion Kits:

Many agents do not cross the blood-brain barrier sufficiently to evaluate their effects on the brain without delivering them locally. Cerebral injection is one local delivery method, but it can be challenging to deliver an effective dose in a physiologically-compatible volume. In addition, the agent may not remain in the target location long enough to see an effect. For many compounds, local infusion directly into the brain is the only way to generate reliable data. ALZET pumps have been used in hundreds of published neuroscience studies to infuse agents, from growth factors to siRNA to psychoactive drugs and more, to the central nervous system.

The ALZET Brain Infusion Kits are designed specifically for use with ALZET pumps for targeted delivery to the central nervous system. They can be used in two ways:

- Infusion into the cerebral ventricles exposes a wide variety of brain regions to the infusate via the cerebrospinal fluid which bathes the brain.
- Direct microperfusion of discrete brain structures results in localized distribution of infusate in the target tissue.

Each ALZET Brain Infusion Kit includes materials for 10 brain infusions, including:

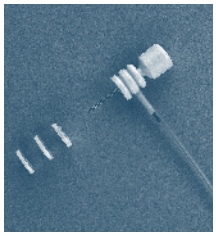
- 10 Brain Infusion Cannulae
- 10 Vinyl Catheter Tubes
- 40 Depth-Adjustment Spacers
- 1 Instruction Sheet

Features of Brain Kits:

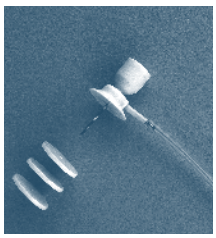
- Compatible with all ALZET pumps models. (Pumps and kits are sold separately.)
- Target lateral ventricles: Without modification, Brain Kits 1 & 2 will penetrate 5 mm below the surface of the skull. When affixed to the skull in the stereotaxically correct location, this will put the tip of the cannula in the region of the cerebral ventricles of a 250-300 g rat. Brain Kit 3 will penetrate 3 mm below the skull surface, which is appropriate for targeting the lateral ventricles in an adult mouse.
- Easily customized to target different brain regions or adjust for differences in animal size. Uniquely designed depth adjustment spacers allow the depth of the cannula tip within the brain to be adjusted in 0.5 mm increments. Note that the cannula can easily be shortened, using capillary cutters or a cutting wheel, to target more superficial structures.
- Design minimizes local trauma: Fine gauge stainless steel cannula minimizes trauma to the brain during cannula placement. (Brain Kits 1 & 2 are 28 gauge. Brain Kit 3 is 30 gauge.)
- All components provided sterile.
- Biocompatible: All materials in the Kits meet U.S. Pharmacopoeia (USP) Class VI standards for the biocompatibility of medical plastics.

Brain Infusion Cannula	Brain Kits 1 & 2	Brain Kit 3
Material (tube)	Stainless steel	
Gauge (tube)	28 gauge	30 gauge
Dimensions (steel tube)	ID = 0.18 mm OD = 0.36 mm	ID = 0.16 mm OD = 0.31 mm
Material (elbow stop, flange)	Polycarbonate	
Volume inside tube	0.32 µl	0.23 µl
Height Adjustment Spacer		
Material	Polycarbonate	
Catheter Tubing		
Material	Polyvinylchloride (medical grade)	
Length	15 cm (approx.)	
Inside diameter	0.69 mm (+/- 0.08)	
Outside diameter	1.14 mm (+/- 0.08)	
Volume per 15 cm	56 µ1 (3.7 µl/cm)	

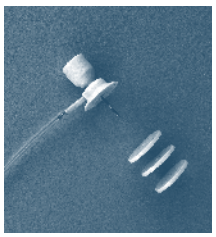
ALZET Brain Infusion Kit 1
- 28 gauge
- 3 - 5 mm
- original cannula design



ALZET Brain Infusion Kit 2
- 28 gauge
- 3 - 5 mm
- low profile cannula
- wide pedestal



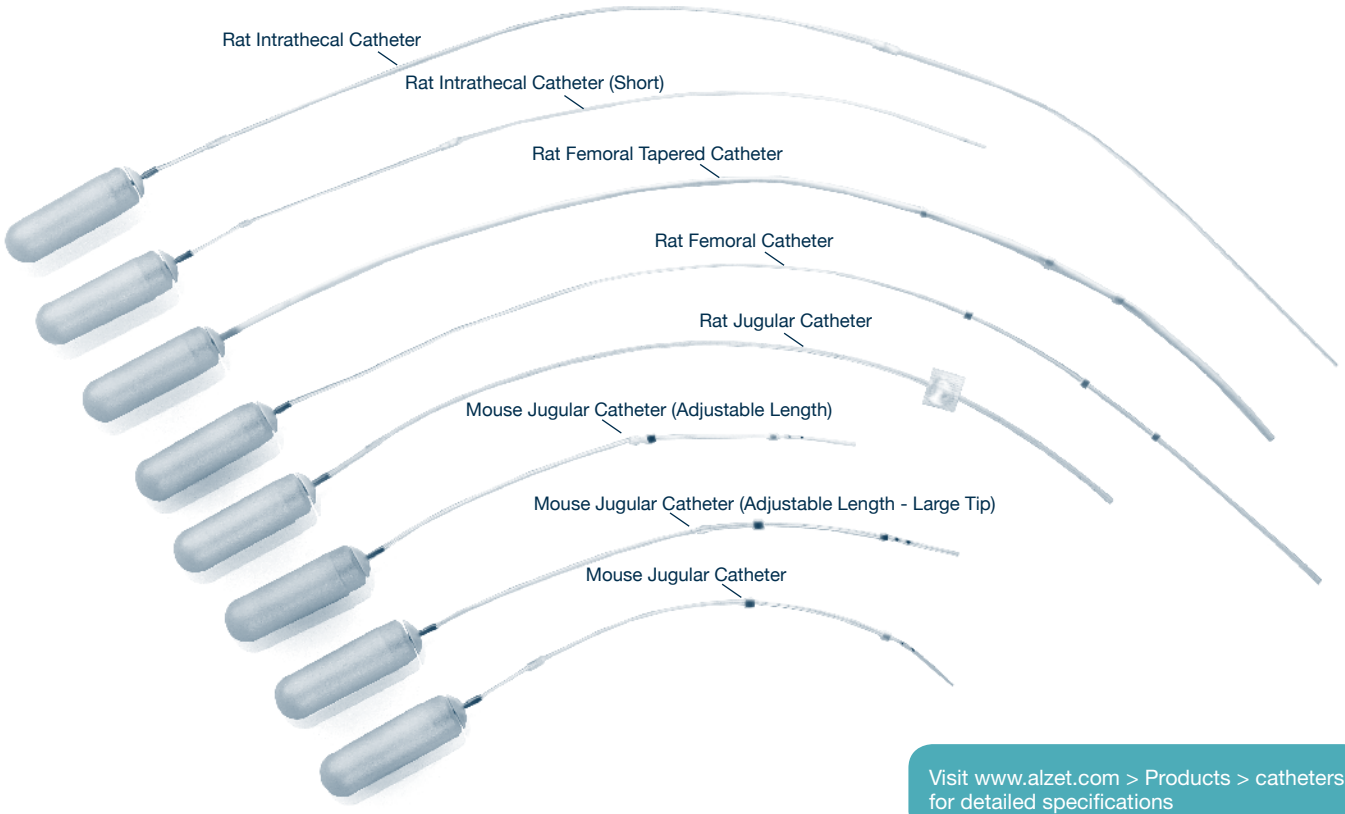
ALZET Brain Infusion Kit 3
- 30 gauge
- 1 - 3 mm
- low profile cannula
- wide pedestal



ALZET Specialized Catheters

ALZET specialized catheters are specifically designed for use with all ALZET pumps models to enable targeted delivery of test agents to a variety of sites. Each catheter is customized for a specific target and animal species. High quality polyurethane and silicone materials promote tissue biocompatibility. Retention beads or suture patches are incorporated into the catheters' design to facilitate placement and stabilization in a vessel or tissue. For added convenience, specialized catheters are available sterile and individually packaged. Pumps sold separately.

The following ALZET specialized catheters are currently available:



Visit www.alzet.com > Products > catheters for detailed specifications

PE and Vinyl Catheter Tubing

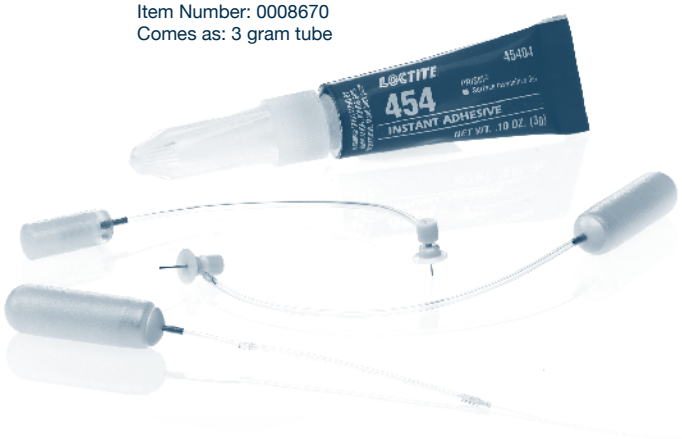
Appropriate for use with all ALZET pump models, our polyethylene and vinyl catheter tubing is sterile, medical grade, individually packaged and pre-cut to 15 cm.

Description	Item No.	Length	Outside Diameter	Inside Diameter	Volume
Vinyl Tubing (10 per bag)	0007760	15 cm (6 in)	1.14 mm (0.045 in)	0.69 mm (0.027 in)	3.74 µl/cm
Polyethylene Tubing (10 per bag)	0007750	15 cm (6 in)	1.22 mm (0.048 in)	0.72 mm (0.030 in)	4.566 µl/cm

Loctite Cyanoacrylate Adhesive

Loctite 454 is an instant adhesive gel for use with ALZET® Brain Infusion Kits and other brain infusion cannulae. It offers a convenient alternative to cranioplastic and dental cements. A very thin layer on the base of the pedestal adheres the cannula to the skull. Researchers have found it to be ideal for use in mice and other small animals when using short pedestal cannulae. One 3 gram tube is enough for 10 brain infusion cannulae implantations.

Item Number: 0008670
Comes as: 3 gram tube



ALZET Contact Information

Exclusive Distributor for Singapore
Chemtron Pte Ltd
T:62737252 E: info@chemtron.com.sg
Add:Blk 203A Henderson Road #02-03 Henderson Industrial Park, Singapore 159546

ALZET Osmotic Pumps
DURECT Corporation
PO Box 530, Cupertino, CA 95015-0530