DARVALL HEATED ZDS Qube

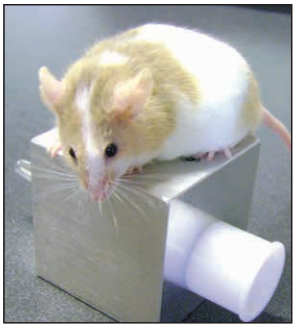
with Rodent Temperature Monitoring System

A Break-Through Solution
delivering better research outcomes
& improving welfare for all Rodents

Darvall presents the world's first rodent heated anesthesia breathing system with continuous animal temperature monitoring and closed-loop feedback for safer and effective hypothermia management.

Darvall Solving Hypothermia for Rodent Anesthesia

Darvall's Heated ZDS Qube rodent anesthesia breathing system &
Darvall's rodent continuous temperature monitoring system



Warm rodents
recover faster & better
from anesthesia

- Warms from Within: immediate & effective
- Protects animal's temperature: better welfare
- Protects researchers from WAG exposure: OSHA
- Protects homeostasis: robust research outcomes
- Protects experimental data: quality assurance
- Protects scientific investment: reduces wastage

DARVALL

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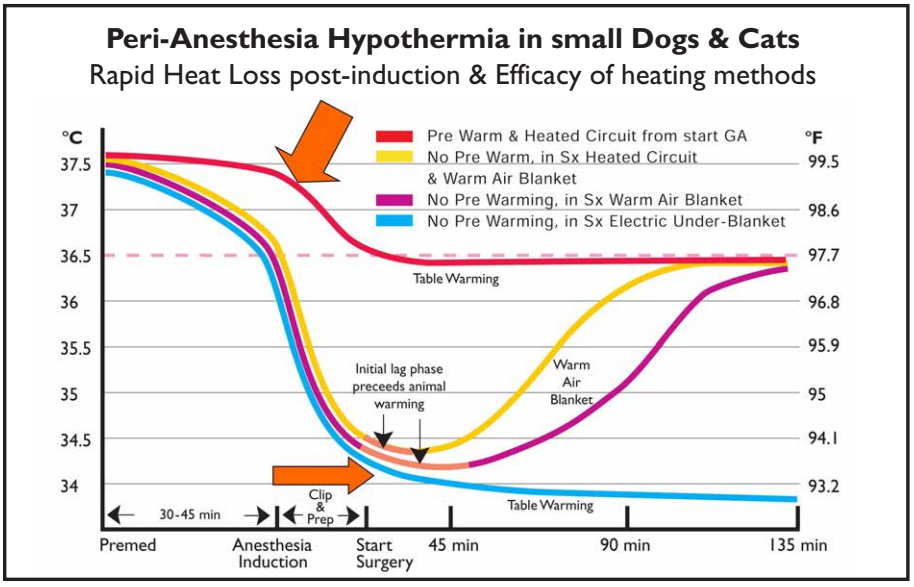
AAS ADVANCED ANESTHESIA SPECIALISTS

Peri-Anesthetic Hypothermia: an Animal Welfare Concern

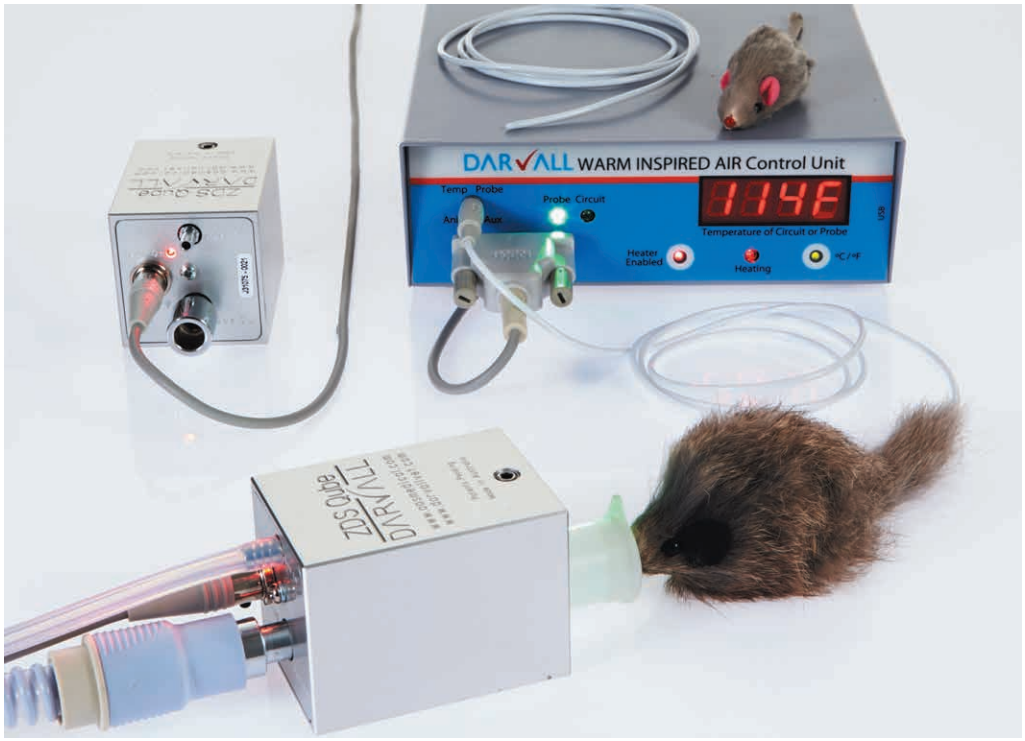
Hypothermia (body temperature < 97°F) occurs in up to 80% of anesthetized small animals including rats and mice. This can be due to their small body size relative to surface area, altered peripheral perfusion from sedative, analgesic or anesthetic drugs, inhaling cold gases and heat loss from skin surface or open body cavities. Hypothermia is associated with slow recovery from anesthesia and increased mortality risk. Prevention of peri-anesthesia hypothermia has focused on body surface heat conservation and surface warming using electric or warm water under-blankets but this has been proven to be ineffective and can burn animals (see graph: blue line).

Hypothermia occurs rapidly in the first 30 minutes of anesthesia. Continuous monitoring of body temperature shows that critical heat loss of 2 - 5°F occurs 15 to 30 minutes after induction during clip, prep & positioning . This is in part because moving the animal breaks thermal conduction from surface warming devices such as circulating warm-water blankets. Once animals are draped for surgery and remain in 1 position heat loss slows (see graph: blue line). Warming hypothermic animals is also exponential. There is typically a 30 to 45 minute lag from onset of surface warming until an increase in body temperature is observed (see graph: magenta line). During this lag period skin, subcutaneous tissue and blood warming occurs. Warming inspired air using Darvall's ZDS Heated Qube from the moment anesthesia commences will reduce onset of hypothermia and enhance the warming response to electric or warm water under-blankets (see graph: yellow line).



Hypothermia is observed in 85% of rodent anesthesia with the most rapid and critical heat loss occurring during clip, prep & positioning (blue line). Darvall's Heated ZDS Qube breathing system used from the moment anesthesia begins, warms inspired gas AND blood flow to the nose, reducing heat loss (red line & orange arrows). Surface warming devices such as electric or warm-water blankets may help during surgery but they can burn animals (magenta line). Response to surface warming is faster when combined with the Heated ZDS Qube (yellow line). Warm animals recover faster!

Adapted from Dunlop C. Heated Breathing Circuits (Abst.) WCVA Capetown S Africa Sept 23-27 2012.



Warming devices can burn animals. The margin of safety for causing significant thermal injury is surprisingly narrow. Skin can be burned from surface heating devices supplying as little as 114°F temperature for one hour. Containers of warm water, heated wheat bags or on-off electric heat pads have all caused severe burns to anesthetized animals which can't move away from excessive heat. Warming inspired anesthetic gas provides an innovative & safe solution to hypothermia managment.

Darvall's Heated ZDS Qube - A totally new solution to hypothermia. Warming inspired gas from the moment anesthesia begins slows the onset of hypothermia, especially during clip and prep time when the animal is being moved (see graph: red line & orange arrows). Darvall's innovative Heated ZDS Qube with low (200 ml/min) fresh gas flow enables the inspired gas to be effectively warmed immediately from the start of anesthesia. Inspired gas is usually cold, around room temperature (70 to 75°F). Darvall's Heated ZDS Qube is aluminum and contains heating elements and a sensor which monitors Qube temperature and a microprocessor controls heating. The Qube has a short gas path so is heated to 109 -113°F, resulting in an inspired temperature of 95 to 99°F.

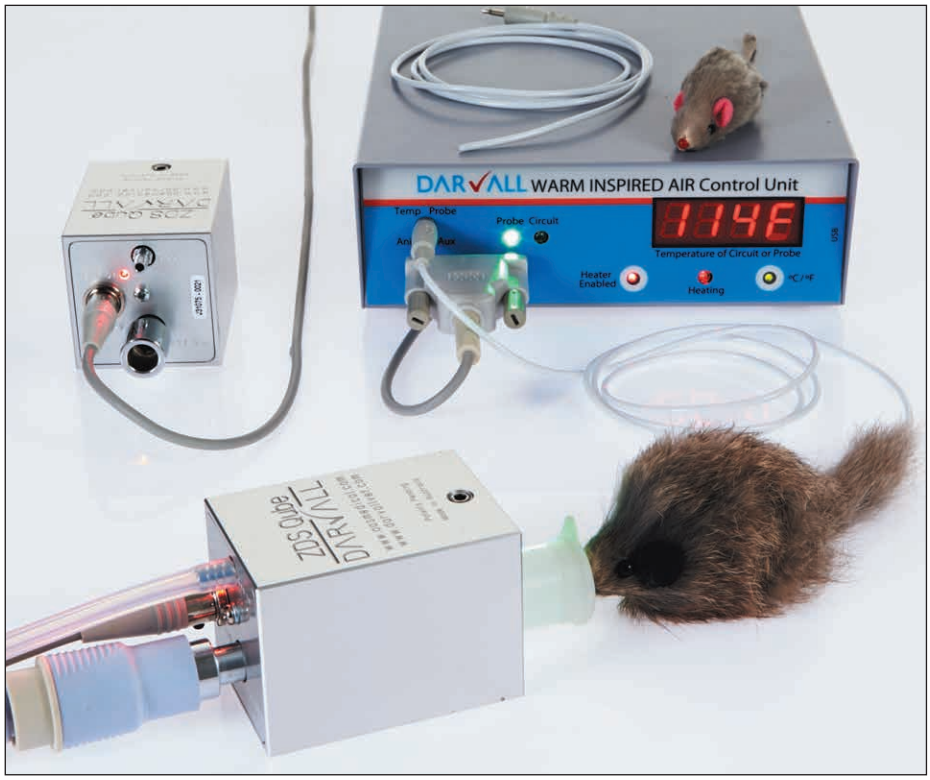
Darvall's Rodent Rectal Temperature Sensor for safer warming. Closed-loop animal feedback is provided from Darvall's new rodent rectal temperature probe which enables the heat control unit to monitor the animal's body temperature and turn off heating if > 99°F (settings adjustable by end-user). Both animal and Qube temperatures can be continuously recorded and displayed on computer via USB link using Darvall's proprietary software.

Darvall's Heated ZDS Qube Warms Inspired Gas & Blood Flow to the Nose

Warms from Within

Heated ZDS Qube* Anesthesia

Warm animals recover better: Our heated ZDS Qubes have microprocessor controlled temperature sensing delivering warm inspired air between 98°F & 103°F. Separate esophageal/rectal temperature probe provides safe warming with closed loop control



Darvall's Heated ZDS Qube: A World First Solution providing immediate, effective & continuous management for hypothermia

Revolutionary Heated ZDS Qube

- WARMS from start of anesthesia
- Controlled heating 98°F-103°F
- Animal temperature feedback
- USB port for data acquisition/display
- Sealed Masks - No WAG worries
- Low Gas Flows - save $$
- Less Enviromental pollution
- Stable, predictable anesthesia

* Patents applied for

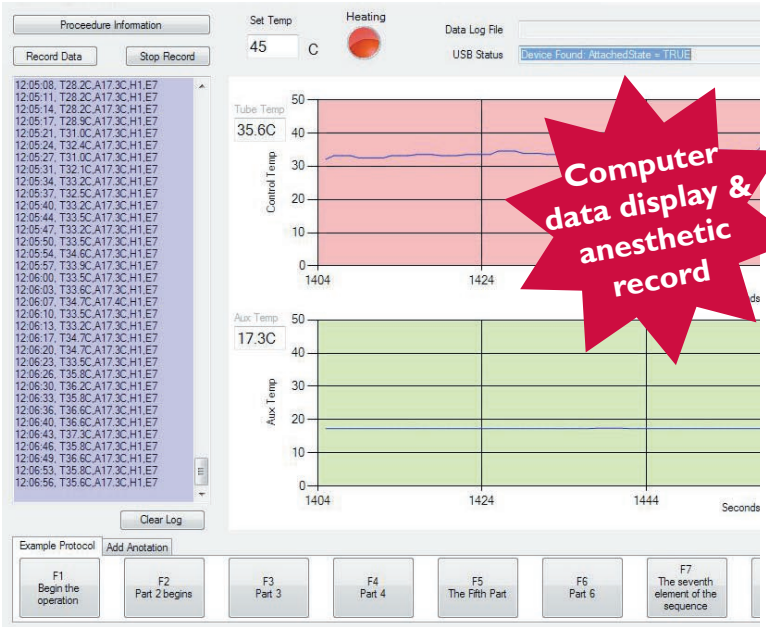
ZDS Qube exotics mask kit includes small rodent/reptile mask, larger bird/rabbit mask & ET tube connector

Real-time Anesthesia & Temperature Record

Darvall's Heated ZDS Qube & Rodent Temperature Monitoring software is included with every system to provide an integrated and continuous procedure record. The set-up is simple and intuitive with windows-based drop-down menus. A USB link from the Warm Inspired Air Control Unit to the computer provides continous data collection and display. The same USB link enables any microprocessor upgrades to occur via direct internet link to www.aasmedical.net.

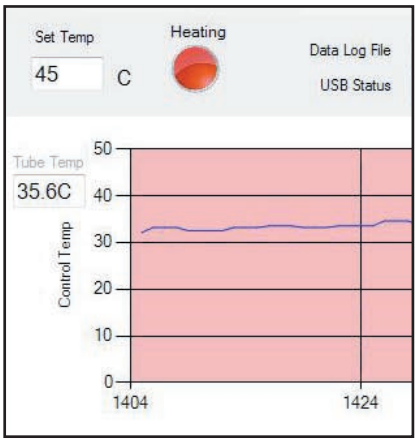
Software Features

- Animal & procedure data
- Anesthetic & analgesic drugs
- Heat Controller parameter set-up
- High & Low Temperature Settings
- Heating range tolerance
- "*F*" key protocol for single stroke data input during Procedure
- Animal and Qube temperatures
- Continous Procedure Record
- Quality Assured Research



DARVALL Temperature Monitoring Solutions

- Continuous temperature monitoring
- Unique 2.4 mm diameter sensor.
- Improves hypothermia recognition
- Real-time anesthesia record & display
- Quality assured continuous data
- Research without compromise
- Better animal welfare



Rodent body temperature can be continuously displayed and recorded via computer using Darvall's integrated software.

DARVALL Rodent Rectal Temperature Probe

Continuous body temperature monitoring in Anesthesia

Hypothermia affects over 85% of anesthetized rodents. Continuous body temperature monitoring and effective warming will provide better animal research outcomes without physiologic compromise. Darvall's new rodent 2.4 mm OD, rapid response, digital rectal/esophageal temperature probe permits continuous body temperature monitoring during rodent anesthesia. The temperature sensor is connected to Darvall's Warm Inspired Air Controll Unit with temperature displayed. The digital animal temperature data can also be streamed to a computer via USB link, providing continuous data display and acquisition for an anesthesia record. The animal's temperature is integrated with Darvall's Heated ZDS Qube warm inspired gas anesthesia breathing system, providing closed-loop control of animal warming. This sensor can also be used in modified Darvall ZDS face masks to continuously monitor inspired gas temperature.

Totally NEW Solutions for Rodent Anesthesia