

# 24 Hour Shipping Simulation

## K-Lock Insulated Container and Gel Pack

### Introduction

This simulation was run using one frozen 24 ounce K-Lock™ gel pack, and one 24 ounce ice pack made purely of frozen water to act as the control. Each pack was placed in a K-Lock™ insulated foam cooler with interior dimensions 8"x6"x4.38", and temperature data was recorded over the course of a 24 hour summer shipping simulation using the following profile.

### Environmental Test Chamber – Summer Simulation Profile

**Soak** – Temperature stays the same for set period of time

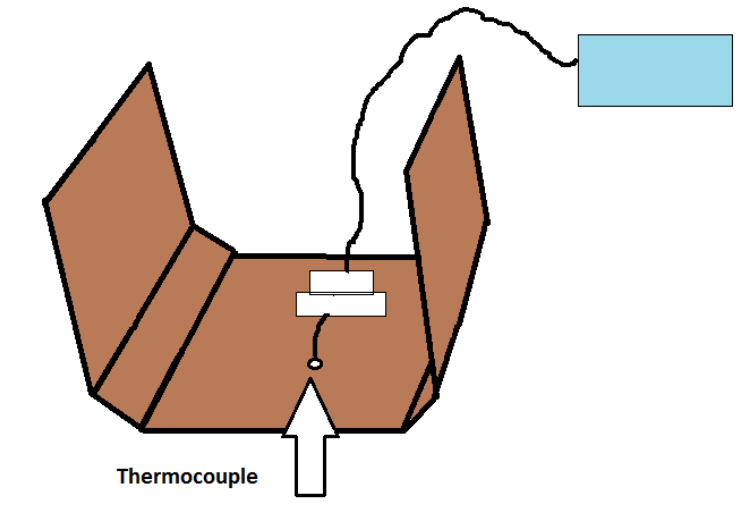
**Ramp Time** – Temperature changes from one point to another over set period of time

<b><u>Step</u></b>	<b><u>Time</u></b>	<b><u>Temperature (deg C)</u></b>
<b>Soak</b>	0 – 3 hours	22
<b>Ramp Time – 1 hour</b>	3 – 4 hours	Ramp to 35
<b>Soak</b>	4 – 5 hours	35
<b>Ramp Time – 1 hour</b>	5 – 6 hours	Ramp down to 30
<b>Soak</b>	6 –24 hours	30

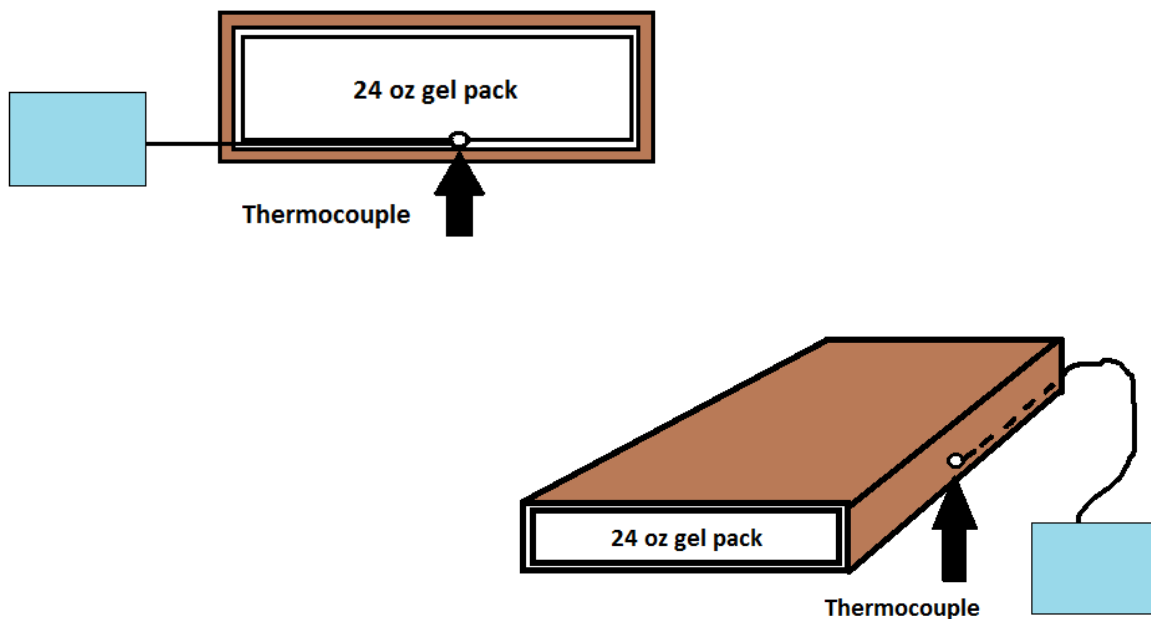
## Gathering Data

In order to retrieve accurate data, thermocouples were attached to the gel packs using a cardboard “sleeve” held in place by 3 inch packaging tape.

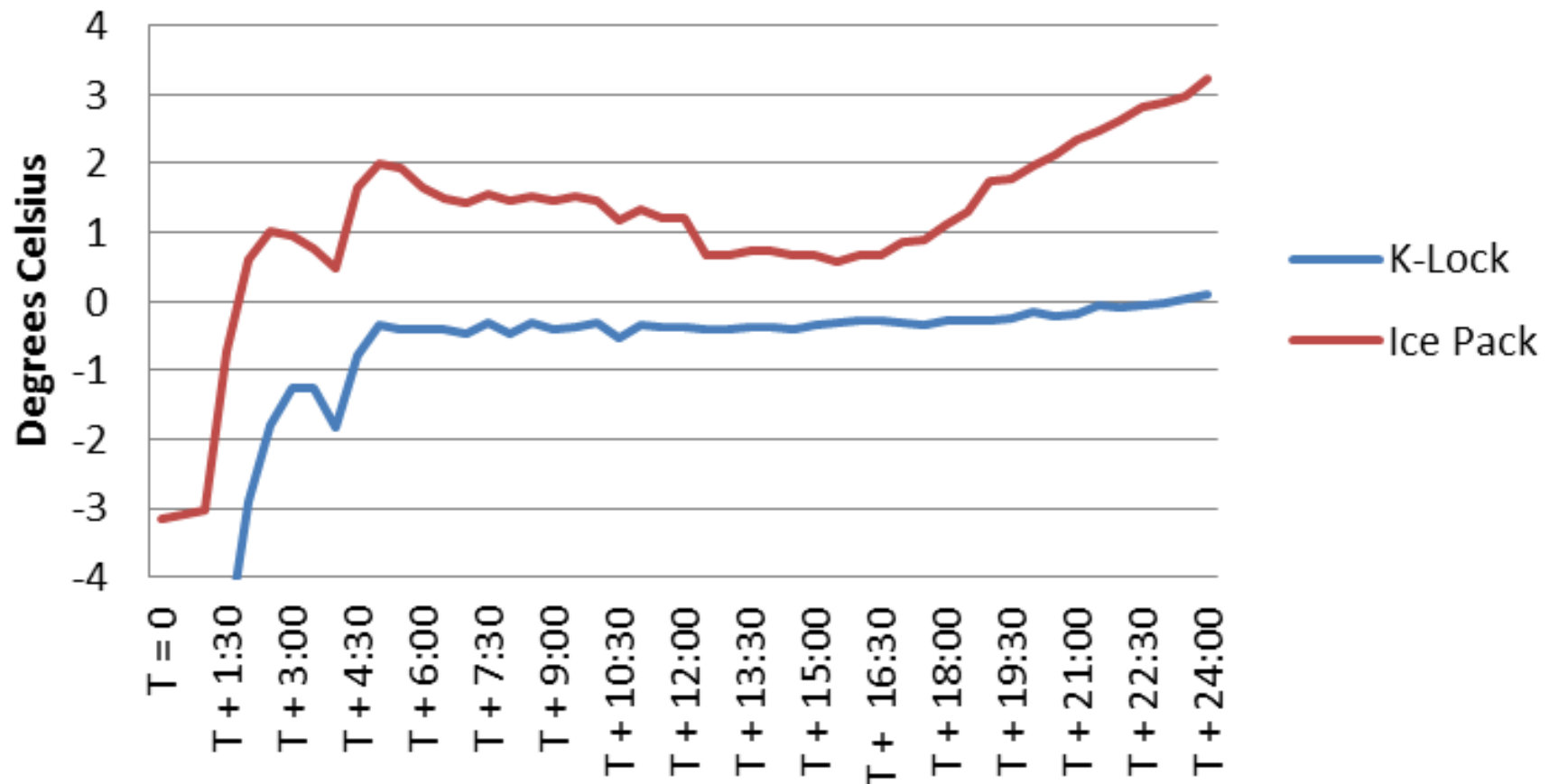
First, the thermocouple was taped to the bottom center of the cardboard sleeve.



The frozen gel pack was then placed directly on top of the thermocouple, and the sleeve was folded and secured around the gel pack. This ensures that the gel pack is directly on top of the thermocouple for the duration of the simulation.



# Gel Pack Temperature over Time



## Results and Data

All values are in degrees Celsius.

<b>Time</b>	<b>Ambient</b>	<b>K-Lock</b>	<b>Ice Pack (Water)</b>
T = 0	21.94	-11.48	-3.15
T + :30	22.01	-10.78	-3.08
T + 1:00	21.90	-7.57	-3.03
T + 1:30	21.81	-4.97	-0.73
T + 2:00	21.86	-2.91	0.60
T + 2:30	22.00	-1.80	1.01
T + 3:00	21.94	-1.25	0.97
T + 3:30	24.84	-1.26	0.77
T + 4:00	30.26	-1.84	0.47
T + 4:30	33.83	-0.78	1.64
T + 5:00	34.39	-0.34	2.01
T + 5:30	32.99	-0.42	1.95
T + 6:00	30.49	-0.40	1.66
T + 6:30	29.18	-0.41	1.49
T + 7:00	29.16	-0.46	1.43
T + 7:30	29.36	-0.31	1.54
T + 8:00	29.14	-0.47	1.46
T + 8:30	29.30	-0.30	1.53
T + 9:00	29.26	-0.39	1.47
T + 9:30	29.34	-0.38	1.53
T + 10:00	29.47	-0.32	1.46
T + 10:30	29.00	-0.54	1.19
T + 11:00	29.33	-0.33	1.34
T + 11:30	29.48	-0.36	1.22
T + 12:00	29.38	-0.36	1.20
T + 12:30	29.46	-0.42	0.68
T + 13:00	29.48	-0.42	0.68
T + 13:30	29.42	-0.37	0.72
T + 14:00	29.44	-0.37	0.74
T + 14:30	29.36	-0.39	0.68
T + 15:00	29.48	-0.33	0.67
T + 15:30	29.41	-0.31	0.57

T + 16:00	29.46	-0.29	0.68
T + 16:30	29.29	-0.28	0.68
T + 17:00	29.46	-0.31	0.87
T + 17:30	29.41	-0.33	0.90
T + 18:00	29.48	-0.29	1.11
T + 18:30	29.38	-0.29	1.30
T + 19:00	29.50	-0.28	1.75
T + 19:30	29.40	-0.26	1.79
T + 20:00	29.49	-0.16	1.98
T + 20:30	29.40	-0.21	2.14
T + 21:00	29.44	-0.19	2.34
T + 21:30	29.50	-0.06	2.46
T + 22:00	29.44	-0.08	2.62
T + 22:30	29.47	-0.06	2.82
T + 23:00	29.25	-0.02	2.88
T + 23:30	29.53	0.04	2.99
T + 24:00	29.41	0.11	3.24