Protected chambers

For your most sensitive cells

Cell culture

The proprietary Thermo Scientific™ Cell Locker™ System, consisting of individual segregated chambers within a CO_2 incubator, provides enhanced culture stability and protection. The Cell Locker System divides the CO_2 incubator into six chambers with individual glass doors, uniquely preserving critical conditions for sensitive cells by isolating cultures from door openings.

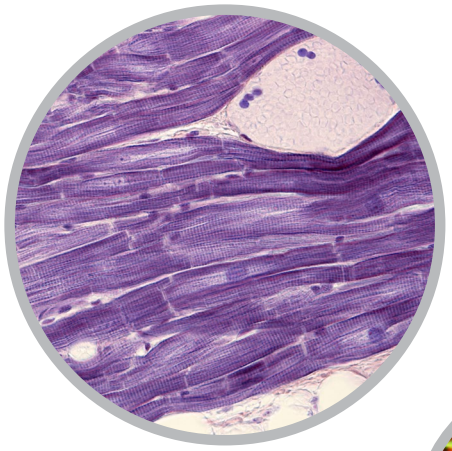
Designed into the following CO_2 incubators:

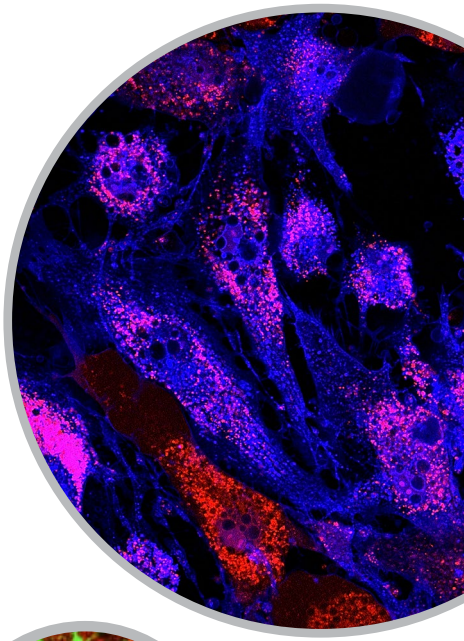
- Thermo Scientific™ Heracell™ VIOS™ 160i and CO_2 Incubators
- Thermo Scientific™ Heracell™ Vios™ 160i CR CO_2 Incubators CTS™ Series
- Thermo Scientific™ Forma™ Steri-Cycle™ i160 CO_2 Incubators
- Thermo Scientific™ Forma™ Steri-Cycle™ i160 CR CO_2 Incubators CTS™ Series

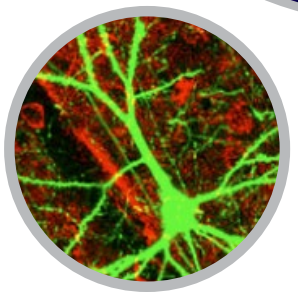
Sensitive cells like stem cells, primary cells, neural cells, and immune cells are less resilient

Changing culture conditions affect them comparatively more than immortalized cell lines. Unlike established cell lines that have been growing in culture for decades, slow-growing cell types or those that have only been passaged a few times have not had the opportunity to adapt (mutate) to artificial, two-dimensional in vitro culture conditions.

These fragile cell types generally require more exacting and labor-intensive effort to successfully culture [1]. Also, any microbial contamination is comparatively more costly if these cultures have to be discarded and the work repeated.







The Cell Locker System is well suited for sensitive cells including stem cells, primary cells, neural cells, lymphocytes, and more.

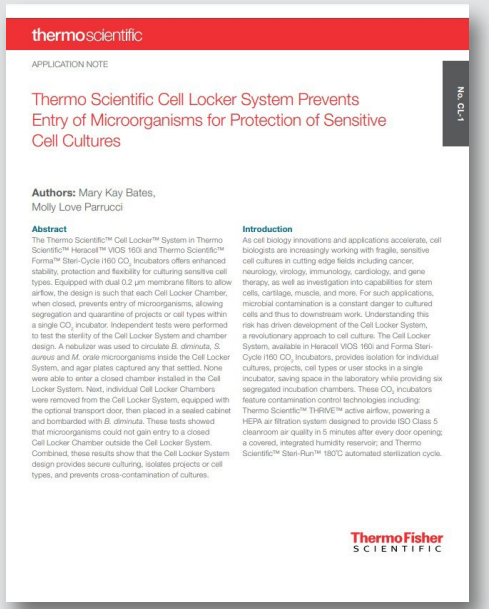
Breakthrough for maintaining cell health

In frequently opened or shared-use incubators

Recognizing increasing use of more fragile cell types in basic and applied research for regenerative medicine, neuroscience, immunotherapy, cell therapy, oncology, autoimmune diseases, and more, the Cell Locker System was designed to help:

- **Protect these cells**
- **Provide a more stable environment**
- **Prevent cross-contamination**
- **Conserve atmospheric gases**

Application note: "Thermo Scientific Cell Locker System prevents entry of microorganisms for protection of sensitive cell cultures":



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APPLICATION NOTE

No. CL-1

Thermo Scientific Cell Locker System Prevents Entry of Microorganisms for Protection of Sensitive Cell Cultures

Authors: Mary Kay Bates, Molly Love Parrucci

Abstract

The Thermo Scientific™ Cell Locker™ System in Thermo Scientific™ Heracell™ VIOS 160i and Thermo Scientific™ Forma™ Steri-Cycle i160 CO_2 incubators offers enhanced stability, protection and flexibility for culturing sensitive cell types. Equipped with dual 0.2 µm membrane filters to allow airflow, the design is such that each Cell Locker Chamber, when closed, prevents entry of microorganisms, allowing segregation and quarantine of projects or cell types within a single CO_2 incubator. Independent tests were performed to test the sterility of the Cell Locker System and chamber design. A nebulizer was used to circulate *B. diminuta*, *S. aureus* and *M. orale* microorganisms inside the Cell Locker System, and agar plates captured any that settled. None were able to enter a closed chamber installed in the Cell Locker System. Next, individual Cell Locker Chambers were removed from the Cell Locker System, equipped with the optional transport door, then placed in a sealed cabinet and bombarded with *B. diminuta*. These tests showed that microorganisms could not gain entry to a closed Cell Locker Chamber outside the Cell Locker System. Combined, these results show that the Cell Locker System design provides secure culturing, isolates projects or cell types, and prevents cross-contamination of cultures.

Introduction

As cell biology innovations and applications accelerate, cell biologists are increasingly working with fragile, sensitive cell cultures in cutting edge fields including cancer, neurology, virology, immunology, cardiology, and gene therapy, as well as investigation into capabilities for stem cells, cartilage, muscle, and more. For such applications, microbial contamination is a constant danger to cultured cells and thus to downstream work. Understanding this risk has driven development of the Cell Locker System, a revolutionary approach to cell culture. The Cell Locker System, available in Heracell VIOS 160i and Forma Steri-Cycle i160 CO_2 incubators, provides isolation for individual cultures, projects, cell types or user stocks in a single incubator, saving space in the laboratory while providing six segregated incubation chambers. These CO_2 incubators feature contamination control technologies including: Thermo Scientific™ THRIVE™ active airflow, powering a HEPA air filtration system designed to provide ISO Class 5 cleanroom air quality in 5 minutes after every door opening; a covered, integrated humidity reservoir; and Thermo Scientific™ Steri-Run™ 180°C automated sterilization cycle.

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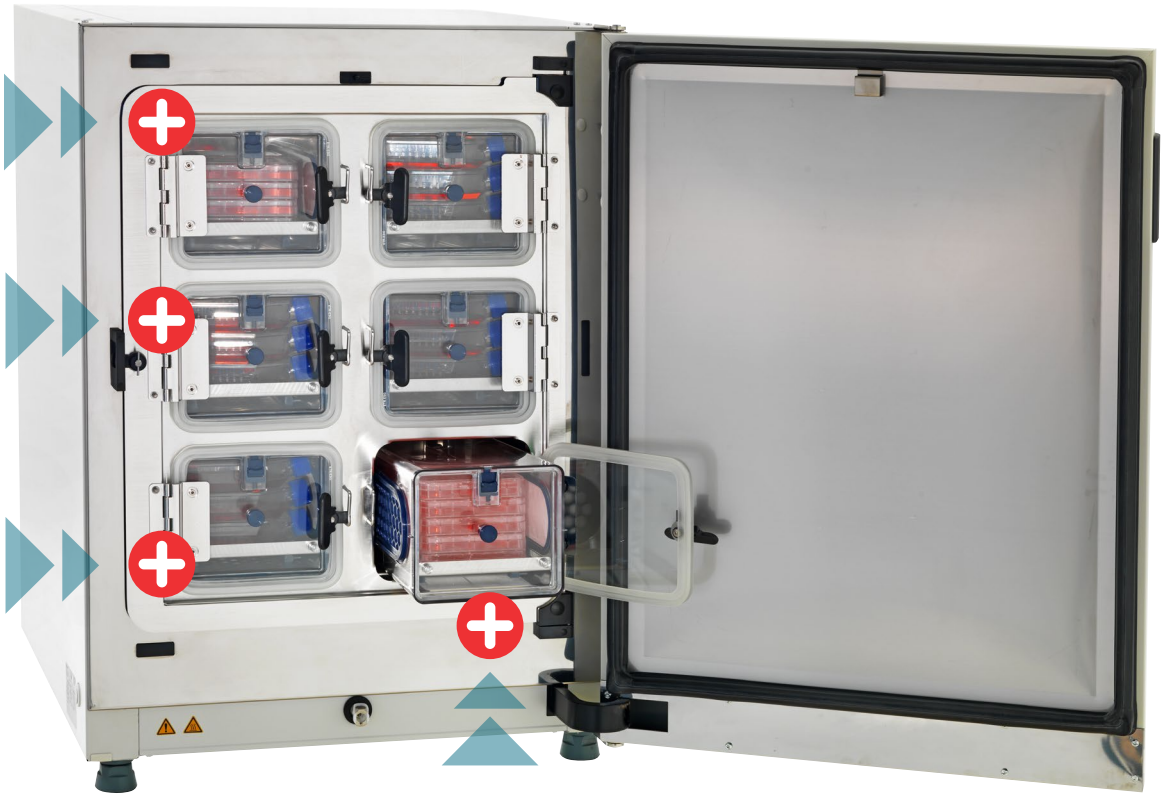
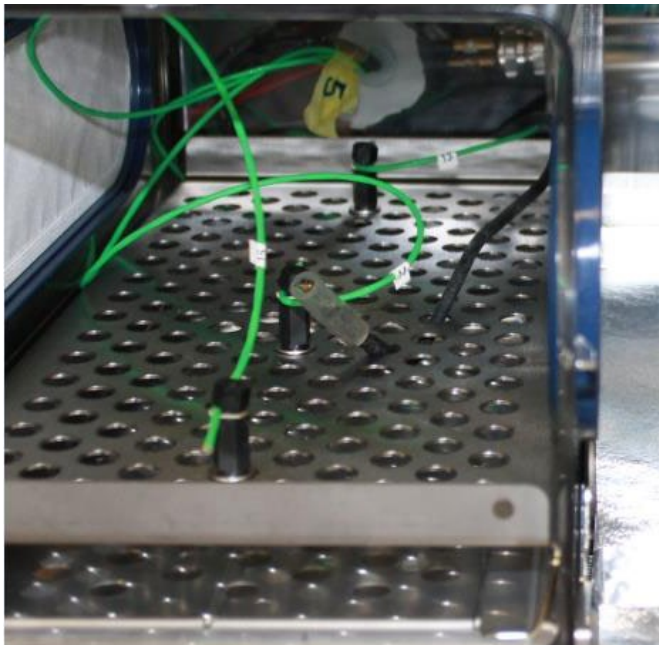
The Cell Locker System segregates cell types, projects, or user areas

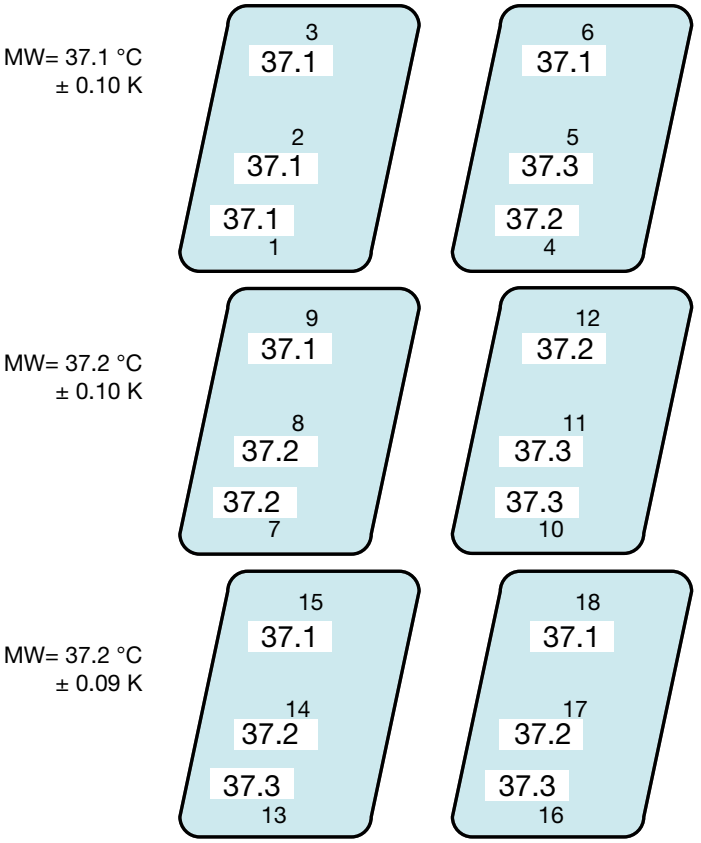


All Cell Locker chambers provide a uniform environment

Thermo Scientific™ CO_2 incubators adhere to strict temperature uniformity throughout the incubation chamber, measured in accordance with DIN 12880. Individual Cell Locker chambers in the system meet this uniformity standard.



Temperature probes positioned according to DIN 12880 except with a distance of 10% from the side walls.

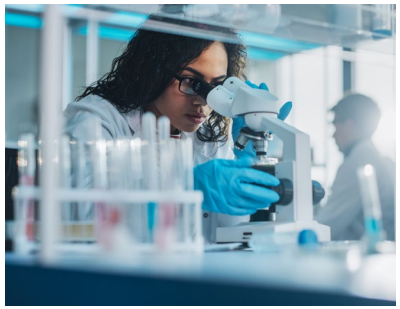


Throughout the Cell Locker System, the temperature is 37 ˚C ±0.3 ˚C.

The Cell Locker System enhances the stability of environmental conditions

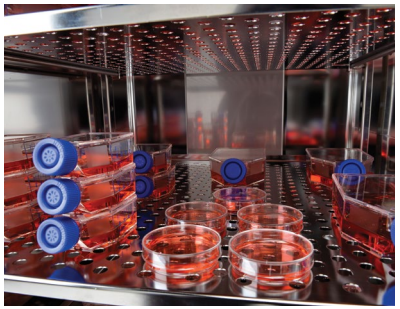
Closed Cell Locker chambers in the system do not experience the opening of a neighboring chamber.

This is very different than in a standard CO_2 incubator, where every door opening is experienced by all the cultured contents. When the door is opened, the incubator conditions rush to equilibrate with the ambient room conditions.



Typical laboratory

Conditions:
22 ˚C
0.04% CO_2
40–60% humidity



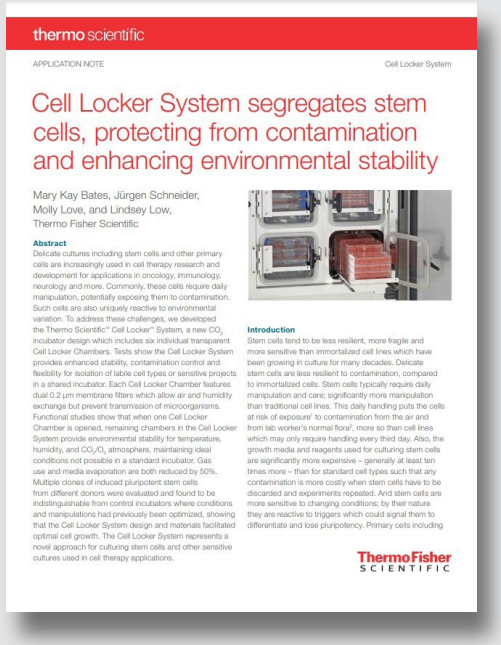
Standard Heracell VIOS 160i CO_2 incubator

Conditions during door opening:
Temperature below 30 ˚C
CO_2 below 1%
Humidity below 30%

Closed chambers in Cell Locker System when one chamber is opened

Maintains:
37 ˚C ±0.3 ˚C
5% CO2 ±0.2%
≥93% humidity ±3%

Application note: “Cell Locker System segregates stem cells, protecting from contamination and enhancing environmental stability”:



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APPLICATION NOTE — Cell Locker System

Cell Locker System segregates stem cells, protecting from contamination and enhancing environmental stability

Mary Kay Bates, Jürgen Schneider, Molly Love, and Lindsey Low, Thermo Fisher Scientific

Abstract

Introduction

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Temperature

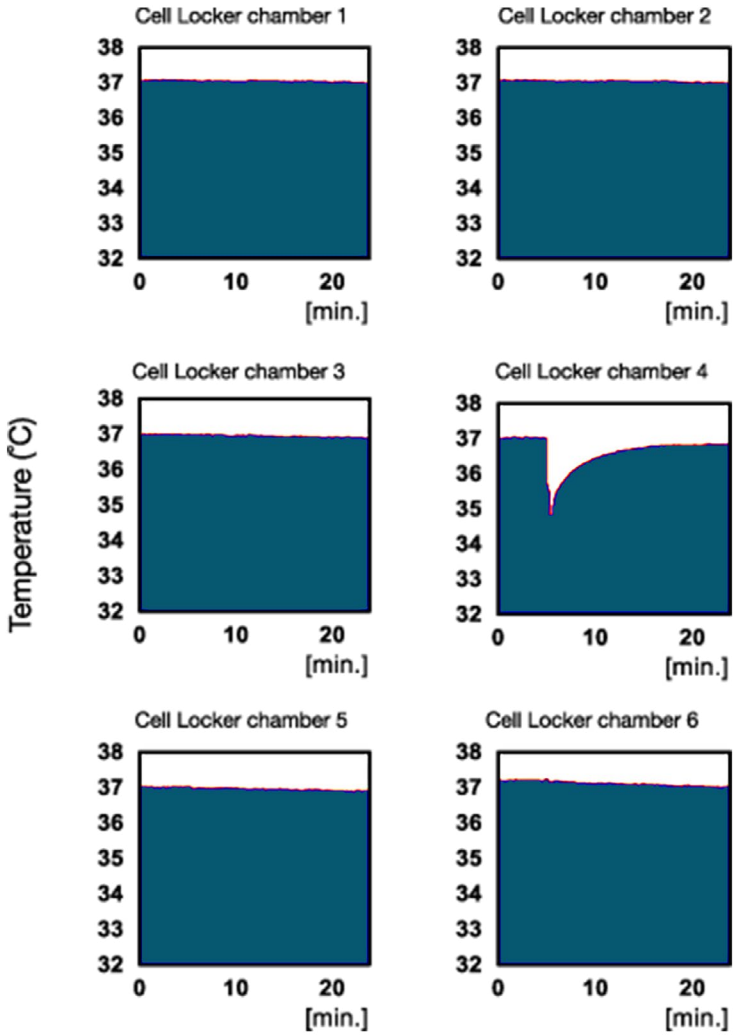
A stable temperature simulating body temperature native to cultured cells (in most cases 37 ˚C) is critical to all cultured cells, but especially for sensitive cell types.
A temperature of only 1 ˚C above 37 ˚C is detrimental and even immortalized cells will be degraded with temperatures of 2 ˚C above normal [2].

Temperature stability >

Temperature recovery >

Temperature in closed Cell Locker chambers remains stable when one chamber is opened.

When Cell Locker chamber 4 is opened for 30 seconds, the temperature drops from 37 ˚C to 35 ˚C. Following the door closing, the temperature rapidly recovers. Meanwhile, the temperature in Cell Locker chambers 1, 2, 3, 5, and 6 remains steady at 37 ˚C ±0.3 ˚C. Results are consistent for any opened Cell Locker chamber.

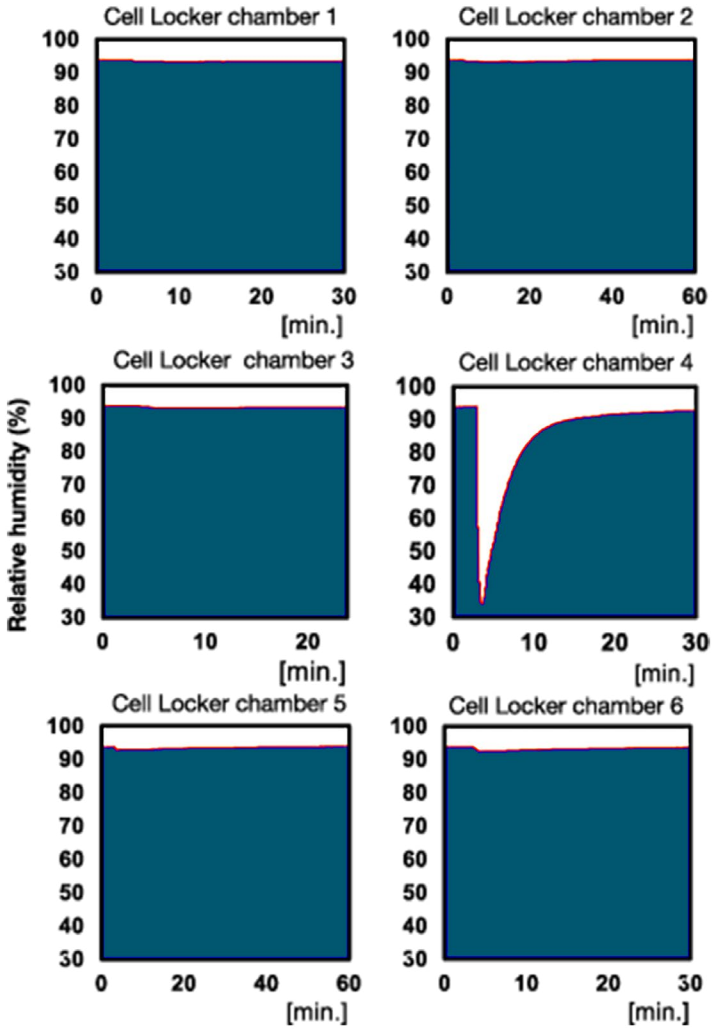


Humidity

High relative humidity (RH) is very important for sensitive cells because it prevents evaporation of water from growth media. Evaporation only involves removal of water, so the remaining salts, minerals, and other nutrients become more concentrated as a result, and can reach concentrations that are toxic for many cell types. But the Cell Locker System reduces evaporation and enables faster humidity recovery, providing improved maintenance of precisely balanced growth media.

Relative humidity in closed Cell Locker chambers remains constant when one chamber is opened.

When Cell Locker chamber 4 is opened for 30 seconds, the humidity level drops to ambient humidity—here, approximately 30%. But the remaining unopened chambers hold at the incubator-set humidity of 93.8% ±3%. Results are consistent for any opened Cell Locker chamber.



Carbon dioxide

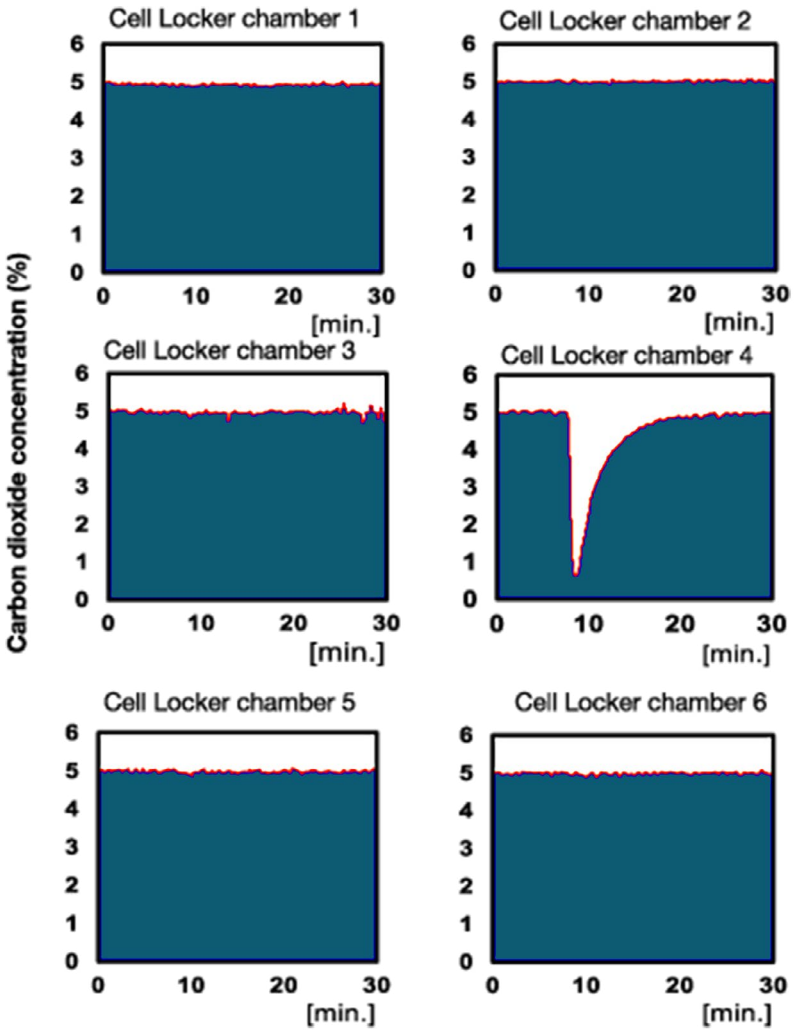
Carbon dioxide works with the buffer in culture growth media to maintain stable culture pH, mimicking what happens in the vertebrate bloodstream. All cells in the body produce CO_2 as a by-product of metabolism, and in the blood, bicarbonate ions are a native buffer. In the lungs, waste CO_2 is approximately 5%, similar to the concentration most often used in culture, in concert with 2 mg/mL sodium bicarbonate in growth media. When pH drifts too far from physiological 7.4, cells may develop morphological stress indicators such as granules in the cytoplasm, membrane detaching and other changes [2,3].

CO_2 stability >

CO_2 recovery >

Carbon dioxide concentration in closed Cell Locker chambers remains constant when one chamber is opened.

When Cell Locker chamber 4 is opened for 30 seconds, the CO_2 level drops rapidly from 5%; similar to any CO_2 incubator. The remaining 5 chambers remain at stable CO_2 of 5% ± 0.2%. Results are consistent for any opened Cell Locker chamber.

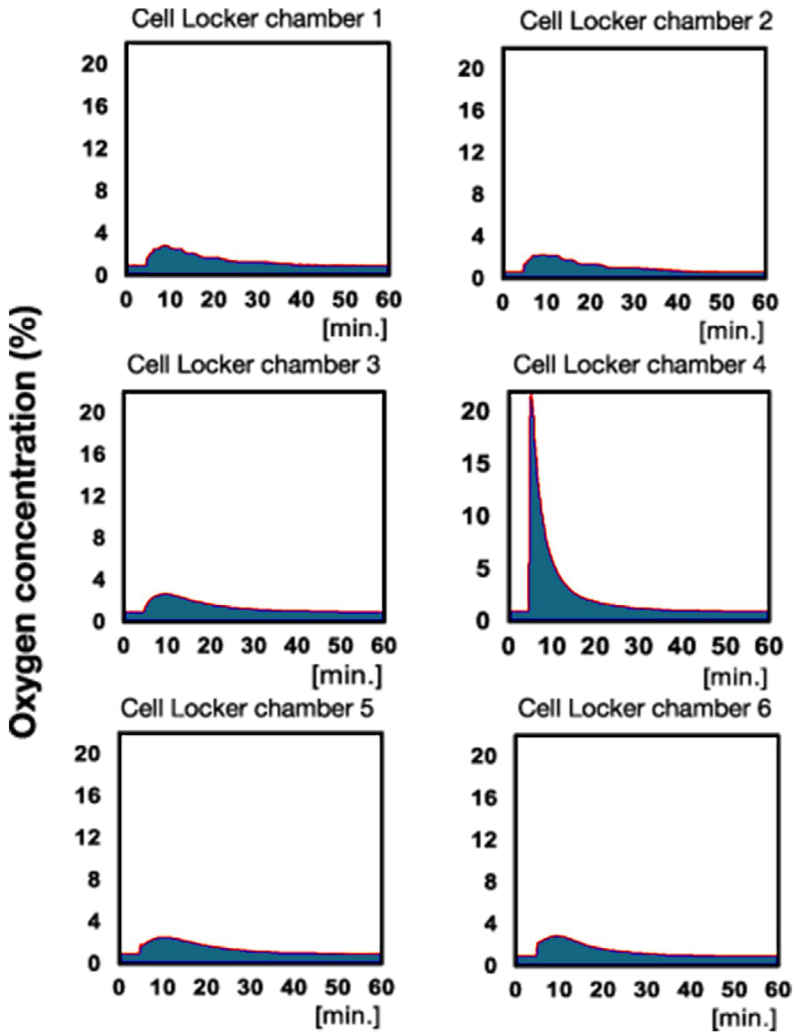


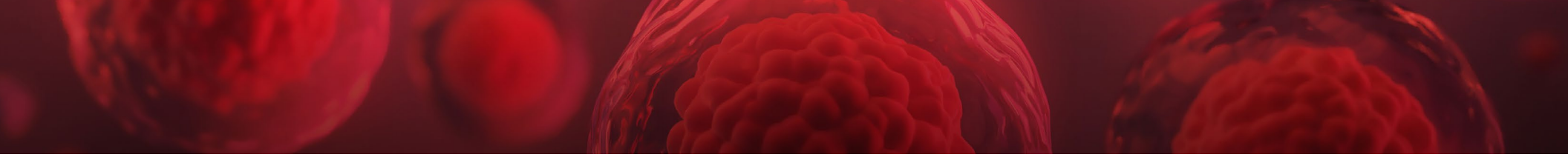
Oxygen

Several cell types grow faster with fewer stress indicators, less differentiation, and longer life when cultured under reduced O_2, mimicking hypoxic conditions *in vivo* [4]. In the body, O_2 concentration varies from 1–4% in the brain and bone marrow to 12–14% in the bloodstream and lungs. Because O_2 affects nearly every cellular process, differences in oxygen concentration can mean varied cell responses in experiments. When a standard hypoxic incubator door is opened for 30 seconds, the entire chamber rises to 15–16% O_2, approaching atmospheric oxygen of 21%. But in the Cell Locker System, when one chamber is opened, the neighboring five unopened chambers only see an increase of about 2%. So cells remain in nearly stable O_2 for more uniform results.

For cell culture under hypoxic conditions, the benefit of the Cell Locker System is very clear, maintaining nearly stable oxygen.

Under hypoxic conditions of 1% oxygen, when Cell Locker chamber 4 is opened, the other closed chambers remain stable, with an O_2 increase of approximately 2%, while chamber 4, like most hypoxic incubators, briefly returns to atmospheric O_2 of 21%. Results are consistent for any opened Cell Locker chamber.





Cell Locker System reduces CO_2 and N_2/O_2 gas consumption by over 50%

The effect is most impactful in a hypoxic system. The Cell Locker System greatly reduces both CO_2 and N_2 loss or usage during a door opening.

If the doors are never opened, the Cell Locker System will use slightly more N_2 gas over time, due to additional gaskets that slowly release gas. However, in a more realistic user scenario with 30-second door openings throughout the day, the Cell Locker System uses only about half as much gas.

This means that for a typical stem cell research lab, a bottle of N_2 gas will last twice as long.

The effect is most impactful in a hypoxic system. CO_2 gas is also reduced by a similar percentage (results not shown).

N_2 usage > | Total usage examples >

Cell Locker System N_2 gas consumption compared to an incubator with 3-door divided inner glass door

	N_2 gas consumption per day	
Activities per day	Standard CO_2 incubator	Cell Locker System
No door opening at 3% O_2	70 L	120 L
One x 30 sec. door opening **at 3% O_2**	236 L	80 L
Three x 30 sec. door opening **at 3% O_2**	778 L	360 L
Three x 30 sec. door opening **at 5% O_2**	548 L	224 L
Three x 30 sec. door opening **at 1% O_2**	1,325 L	840 L
Six x 30 sec. door opening **at 3% O_2**	1,486 L	600 L

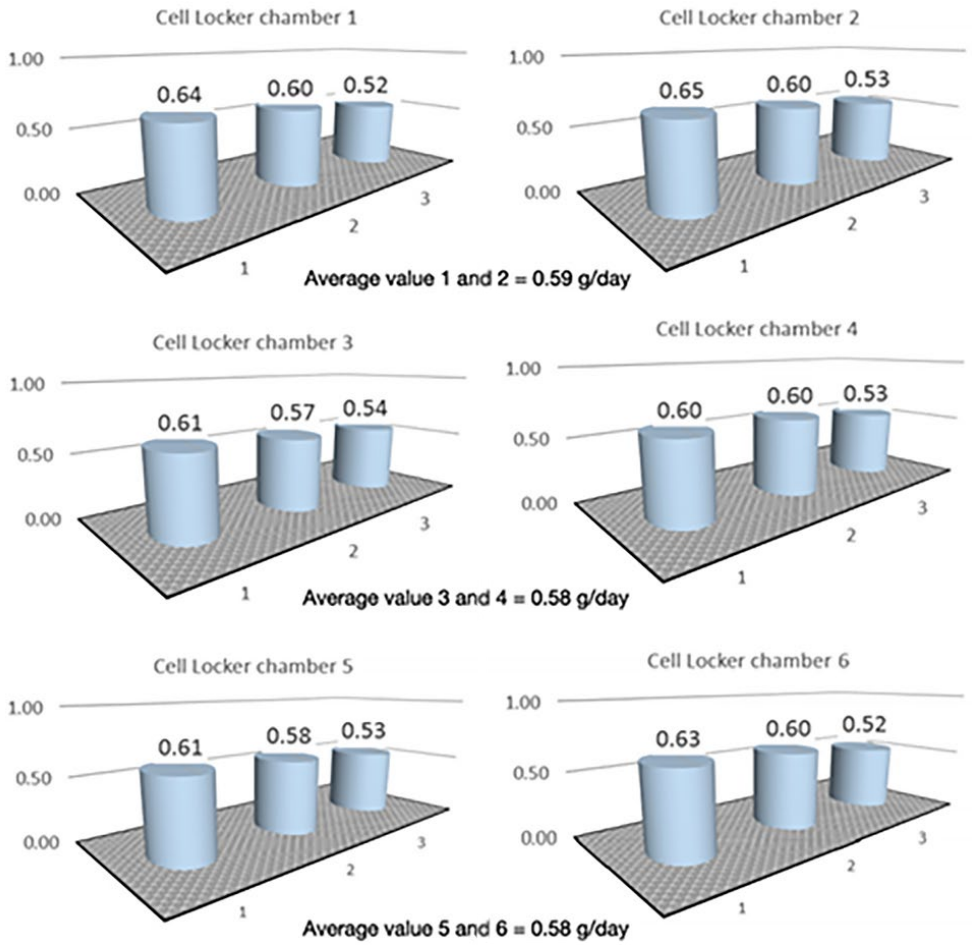
A canister of gas will last twice as long
For example, in the US, one canister of N_2 gas holds 8,500 L.

At 3% O_2 and 6 door openings/day with a 3-door gas-tight screen in the Heracell VIOS incubator, one canister will last 5.7 days. With the Cell Locker System, that canister will last 14.1 days.

Evaporation is reduced by 50% in the Cell Locker System

Limiting evaporation from cell culture media is increasingly important in precise applications and is especially critical in small-volume assays such as those in microwell plates, organ-on-a-chip cultures, and microfluidic systems. When water evaporates, salts, nutrients, and other additives in growth media can reach concentrations that are toxic to cultured cells.

Thermo Scientific™ THRIVE™ airflow technology is designed for very fast humidity recovery of <10 minutes following a 30-second door opening. But the Cell Locker System provides even more stable high humidity, reducing evaporation over a 24-hour period by 50%. The average evaporation rate for the Heracell VIOS incubator is 120 g/day, while the Cell Locker System's average evaporation rate is 0.58 g/day.



Evaporation in any Cell Locker System is an average of only 0.58 g/day. In unopened chambers inside a Heracell VIOS 160i incubator, evaporation rates were strikingly consistent, and more than 50% lower than the rate inside the incubator itself.

Materials and methods

Temperature >
Humidity >
Carbon dioxide >
Oxygen >
Gas consumption >
Evaporation rate >

Temperature was measured following DIN 12880 as much as physical limitations allowed. Validated PT100 temperature probes were placed in three locations in all 6 Cell Locker chambers in the System for a total of 18 locations tested.
Each probe was located 1.5 cm inside from the front or back edge of the Cell Locker chamber, and equidistant from the left and right sides, such that they were in a straight line down the middle of the incubator, and the middle probe was in the geometric center.
Each probe was positioned 1.5 cm above the culture tray, as shown in the Uniformity section. The humidity reservoir was filled to the maximum and the humidity was set to maximum. The incubator working under these conditions was left undisturbed for 12 hours before commencing the test measurement.
Each measurement had a 10-second duration and the test continued for 22 hours.
Uniformity equals the difference between the highest and lowest recorded temperatures. Four different units were tested with 5 tests total.

Summary

Protected chambers for your most sensitive cells

The Cell Locker System represents an advanced approach to providing improved culturing conditions for sensitive cell types such as primary cells, stem cells, and more. This patented design maintains desired conditions so that cells spend more time in an environment that mimics physiological conditions. Under such conditions, cultured cells will provide responses that better model those in the intact organism, for better predictions of human responses for drug and disease modeling; for studies in regenerative medicine, cell therapy, oncology, neuroscience, immunology, and more. Compared to our CO_2 incubator that itself has outstanding conditions, the Cell Locker System remains more stable, recovers faster, and uses less gas even under hypoxic conditions.

References:

1. Gibco Pluripotent stem cell guidebook (2017). Thermo Fisher Scientific COL31555 0417.
2. Freshney RI. Culture of Animal Cells (2016). 7th ed. John Wiley & Sons, Hoboken NJ.
3. Lo C-M, Keese CR, and Giaever I (1994) pH changes in pulsed CO2 incubators cause periodic changes in cell morphology. Exp Cell Res. 213:391-397.
4. Bates MK (2012) Culturing cells under hypoxic conditions for biologically relevant results. American Laboratory.

Learn more at **thermofisher.com/co2**

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