

CO<sub>2</sub> incubators

QA

**How does the TC180 CO<sub>2</sub> sensor compare to the IR180Si CO<sub>2</sub> sensor in the Vios 165 L or 255 L CO<sub>2</sub> incubator?**

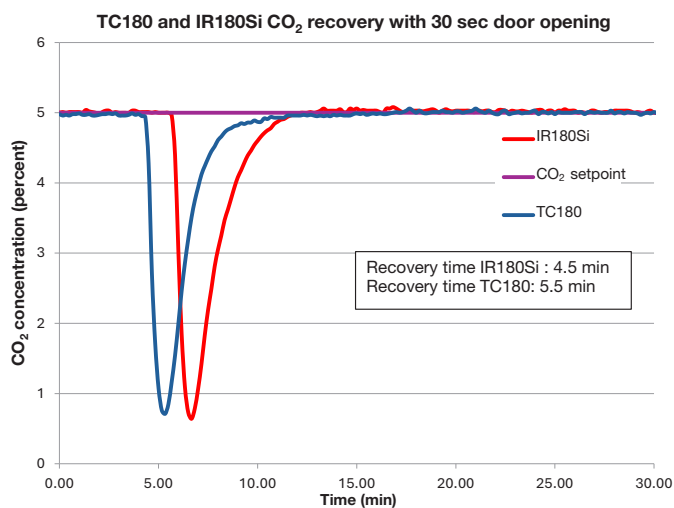
The TC180 sensor is likely to last the life of the incubator and is less expensive than an infrared sensor. A TC180 sensor recovers almost as fast from a door opening as an IR180Si sensor does, but for GMP data tracking and time course studies or multiple users in one incubator, we recommend the IR180Si sensor.

Vios iDx 165 CO<sub>2</sub> Incubator**What is a TC180 sensor?**

The Thermo Scientific TC180 CO<sub>2</sub> sensor is an innovative design that improves the traditional thermal conductivity (TC) sensor. A traditional TC sensor measures carbon dioxide (CO<sub>2</sub>) concentration as a function of temperature and humidity. Since high humidity is the most difficult parameter to recover following an incubator door opening, this dependence on temperature and humidity can slow CO<sub>2</sub> recovery for an incubator with a standard TC sensor. And if the humidity drops due to the water supply running out, the standard TC sensor may show drift in accuracy, requiring recalibration. Thus, a traditional TC sensor, because of its dependence on temperature and humidity recovery, works best in stable conditions with short door openings and when the water pan is regularly refilled to provide more consistent high humidity.

But the TC180 sensor has a unique, built-in humidity compensation function. Due to this innovation, the TC180 sensor recovers almost as fast as the Thermo Scientific IR180Si CO<sub>2</sub> sensor, as shown in Figure 1, and is much more stable, less prone to drift, than a standard TC sensor. For many users in general research, the TC180 CO<sub>2</sub> sensor is perfect for everyday culturing. A TC180 sensor is part of a CO<sub>2</sub> incubator design providing fast recovery of all parameters<sup>1,2</sup>, so this time-tested technology is available only on specific models. The TC180 sensor is available on Thermo Scientific™ Forma™ Steri-Cycle™

i160 and i250 direct heat CO<sub>2</sub> incubators, Forma Series 3 water jacketed CO<sub>2</sub> incubators, Thermo Scientific™ Heracell™ Vios™ 160i and 250i CO<sub>2</sub> incubators, and Thermo Scientific™ Vios™ iDx 165 and 255 CO<sub>2</sub> incubators.



**Figure 1. CO<sub>2</sub> gas recovery to 5% following a 30-second door opening with IR180Si sensor (red) or TC180 sensor (blue).**

Recovery is defined as return to 98% of set value following 30-second door opening. 98% of 5% is 4.9%. In practice the TC180 sensor recovery is nearly as good as IR180Si. The major difference is that for a situation with many door openings per hour or per day, the TC180 performance will not be as good as IR180Si performance.

## What is an IR180Si sensor?

A standard infrared (IR) sensor will show drift as the incandescent light bulb ages<sup>3</sup>, requiring replacement of the IR sensor once or twice over the life of the incubator. For many CO<sub>2</sub> incubators, this IR sensor replacement represents a hidden cost of what initially appears to be a low cost model CO<sub>2</sub> incubator. The Thermo Scientific IR180Si replaces the incandescent light with a silicon based micro-electrical mechanical systems (MEMS) emitter, providing precision over a long service life<sup>3</sup>. In fact, the IR180Si sensor may last the life of the incubator, but the precision and performance entail a higher cost than for the TC180 sensor.

## How do these different sensors compare?

Figure 1 compares the recovery to 5% CO<sub>2</sub> from a 30-second door opening in a Vios 165 CO<sub>2</sub> incubator. The graph shows that in practice, the TC180 sensor recovery is nearly as good as the IR180Si sensor for recovery performance. The major difference from a user perspective is that for a situation with many door openings per hour or per day, the TC180 performance will not be as good as IR180Si performance. The TC180 sensor does require some time between door openings to stabilize. For most users, this will not be a concern. Table 1 summarizes and compares performance and features of standard TC and IR sensors to the TC180 and IR180Si sensors. For best performance, we recommend to operate the “Auto-start” cycle four times per year, to re-zero the TC180 sensor.

**Table 1. Compare traditional standard TC and IR sensor features to TC180 and IR180Si sensors. Both TC180 and IR180Si sensors have long service life and fast recovery. A standard IR sensor has a very short service life and will show drift over time.**

Feature	Standard TC sensor	Standard IR sensor	TC180 sensor	IR180Si Sensor
Stable, independent measurement	No, affected by swings in temperature and humidity	No, will show drift over time	Yes	Yes
Long Service Life	Yes	No, limited by bulb life to 2-4 years	Yes	Yes
Robust, can withstand high temperatures	Up to 140 °C sterilization	No	Yes, including Thermo Scientific™ Steri-Run™ 180 °C sterilization cycle	Yes, including Thermo Scientific Steri-Run 180 °C sterilization cycle
Recovery from 30-second door opening	16-40 minutes	5-16 minutes	5.5 minutes	4.5 minutes

## Summary

A TC sensor for measuring CO<sub>2</sub> works well for a laboratory with few door openings and careful maintenance of the water level for humidity, and can last the life of the incubator. A standard IR sensor will drift as the incandescent bulb ages and must be replaced every 2-4 years, representing a hidden cost. In contrast, a TC180 sensor and an IR180Si sensor both have long service lives, low drift and similar recovery to set CO<sub>2</sub> concentration from a door opening. An IR180Si sensor is recommended for laboratories working under or considering GMP documentation or with many door openings per hour or per day.

## References:

1. Bates MK. (2014) Consider all CO<sub>2</sub> incubator parameters for best cell growth. LABO 56-59.
2. Thermo Fisher Scientific. (2022) Smart Note: Which incubation parameters are most important for proper cell growth and expression? EXT2369 0322.
3. Bates MK, Love Parrucci M, Wernerspach D. (2024) Evaluating infrared carbon dioxide sensors for 21st century cell culture: Thermo Scientific IR180Si infrared CO<sub>2</sub> sensor. Thermo Fisher Scientific APN-8754849 0924.

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