Thermocycler GEN2

Instruction Manual

Opentrons Labworks Inc.

December 2024

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Product and Manufacturer Description

PRODUCT DESCRIPTION

The Opentrons Thermocycler Module is a fully automated on-deck thermocycler, providing hands-free PCR in a 96-well plate format. Its heated lid works in combination with Opentrons single-use PCR lids or reusable rubber seals to help ensure efficient plate heating, protect samples against contamination, and reduce sample loss from evaporation.

MANUFACTURER DESCRIPTION

Opentrons Labworks Inc
45-18 Ct Square W
Long Island City, NY 11101

Safety Information and Regulatory Compliance

Opentrons recommends that you follow the safe use specifications listed in this section and throughout this manual.

SAFE USE SPECIFICATIONS

Input and Output Connections

The Thermocycler has the following power input requirements, which are met by the included power supply.

> **Warning:** Do not replace the power supply cable unless at the direction of Opentrons Support.

Power supply (AC):

- **Voltage:** 100–240 V
- **Frequency:** 50/60 Hz
- **Current:** 8.5–5 A
- **Overvoltage:** Category II

Environmental Conditions

The Thermocycler should only be used indoors on a sturdy, dry, flat horizontal surface. It must be installed in a low-vibration environment with stable ambient conditions. Keep the Thermocycler away from direct sunlight or HVAC systems that may cause significant temperature or humidity changes.

> **Note:** The Thermocycler should not be powered on or used in conditions outside of the acceptable operating conditions.

The following table lists and defines the environmental operating conditions for recommended use, acceptable use, and storage of your Thermocycler.

Environmental Conditions	Recommended	Acceptable	Storage and Transportation
Ambient Temperatures	+20 to +25 °C	+2 to +40 °C	–10 to +60 °C
Relative Humidity	30–80%, non-condensing	30–80%, non-condensing (below 30 °C)	10–85%, non-condensing (below 30 °C)
Altitude	Approximately 500 m above sea level	Up to 2000 m above sea level	Up to 2000 m above sea level

The following table lists and defines standards for recommended use, acceptable use, and storage.

Operating Conditions	Description
Recommended	Opentrons has validated the Thermocycler's performance in the conditions recommended for system operation. Operating the Thermocycler in these conditions helps provide optimal results.
Acceptable	The Thermocycler is safe to use in conditions acceptable for system operation, but results may vary.
Storage	Storage and transportation conditions only apply when the device is completely disconnected from power and other equipment.

Low Temperature Condensation

Setting the Thermocycler to hold a temperature below the ambient temperature for a long time can cause condensation to develop in and on the device.

> **Warning:** Do not set the plate temperature below the ambient temperature for over two hours, as the resulting condensation could affect performance or damage the module.

If you notice condensation on the Thermocycler's plate after use, remove any labware from the module. Use the Opentrons App to set a temperature of 40 °C until the condensation is no longer visible

Software requirements

The Thermocycler requires version 6.2.0 (or higher) of the Opentrons App and robot software. You can download the Opentrons App for Mac, Windows, or Linux at https://opentrons.com/ot-app.

Labware Compatibility

The Thermocycler is compatible with full-skirted, 96-well PCR plates. Performance specifications are based on use with Opentrons Tough PCR Plates, which you can purchase at https://shop.opentrons.com.

SAFETY WARNING LABELS

Warning symbols posted on the Opentrons Thermocycler and in this manual warn you about sources of potential injury or harm. The following table lists and defines each safety warning symbol.

Symbol	Description
	**CAUTION: Risk of danger!** This symbol identifies instrument components that pose a risk of personal injury or instrument damage if improperly handled. Wherever this symbol appears, please consult the manual for further information on safe handling before proceeding.
	**CAUTION: Risk of electrical shock!** This symbol identifies instrument components that pose a risk of electrical shock if handled improperly.
	**CAUTION: Hot surface!** This symbol identifies instrument components that pose a risk of burning or heat damage if handled improperly.
	**CAUTION: Pinch point!** This symbol identifies instrument components which can pose a risk of personal injury due to a closing mechanism. Please do not touch the lid while it is in operation.
	**CAUTION: Risk of explosion!** This symbol identifies instrument components that pose a risk of creating an explosion if handled improperly.

INSTRUMENT SAFETY WARNINGS

Warning symbols posted on the Opentrons Thermocycler refer directly to the safe use of the instrument. Refer to the previous table for symbol definitions.

Symbol	Description
	**CAUTION: Warning about risk of harm to body or equipment.** Operating the Opentrons Thermocycler before reading this manual poses a risk of personal injury or instrument damage. Only qualified laboratory personnel should operate this equipment.
	**CAUTION: Warning about risk of harm to body or equipment from electrical shock.** Do not attempt to repair or remove the outer case of the Opentrons Thermocycler or its power supply unless directed by Opentrons Support. Attempting to do so puts you at risk of electrical shock.
	**CAUTION: Warning about risk of burning.** The Opentrons Thermocycler generates enough heat to cause serious burns. Wear safety goggles or other eye protection at all times during operation. Always ensure the sample block returns to idle temperature before opening the lid and removing samples. Always allow maximum clearance to avoid accidental burns. The seal on the lid can also be hot when opened. Unplug the unit after use, if possible.
	**CAUTION: Warning about moving parts.** The lid on the Opentrons Thermocycler presents a pinch point hazard. Keep hands and fingers away from the module while the lid is opening or closing.
	**CAUTION: Warning about risk of explosion.** Do not operate the Opentrons Thermocycler in areas used for working with explosive substances. Do not process explosive or highly reactive materials in the module or use it with substances that could generate explosive gases.

STANDARDS COMPLIANCE

The Thermocycler has been tested and found to be in compliance with all applicable requirements of the following safety and electromagnetic standards.

Safety

- IEC/UL/CSA 61010-1 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use–Part 1: General Requirements
- IEC/UL/CSA 61010-2-010 Particular Requirements for Laboratory Equipment for the Heating of Materials

Electromagnetic Compatibility

- EN/BSI 61326-1 Electrical Equipment for Measurement, Control and Laboratory Use–EMC Requirements–Part 1: General Requirements
- EN 55011 Industrial, Scientific and Medical Equipment–Radio Frequency Disturbance Characteristics–Limits and Methods of Measurement
- FCC 47CFR Part 15 Subpart B Class A: Unintentional Radiators
- IC ICES–003 Spectrum Management and Telecommunications Interference Causing Equipment Standard–Information Technology Equipment (Including Digital Apparatus)

FCC Warnings and Notes

Warning: Changes or modifications to this unit not expressly approved by Opentrons could void the user's authority to operate the equipment. This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

This device may not cause harmful interference.

This device must accept any interference received, including interference that may cause undesired operation.

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide a reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at their own expense.

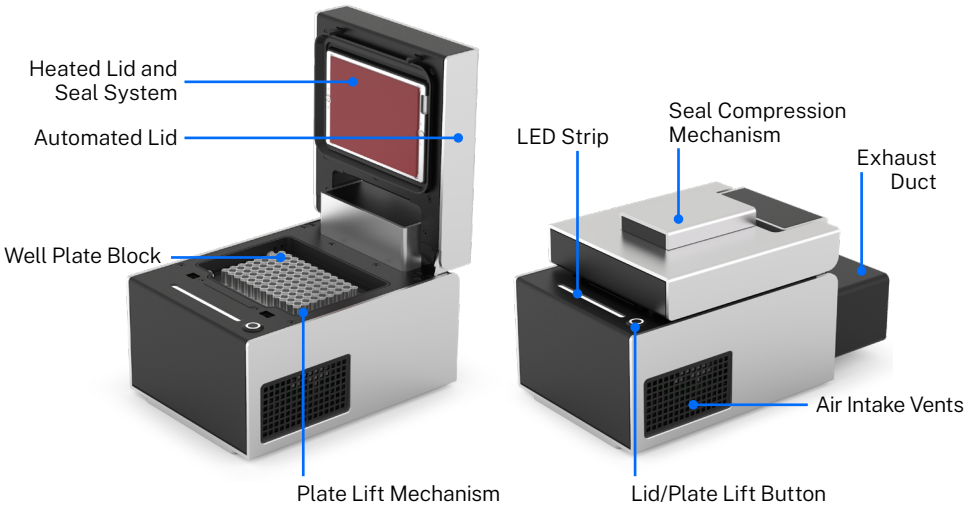
Canada ISED

Canada ICES–003(A) / NMB–003(A)
This product meets the applicable Innovation, Science and Economic Development Canada technical specifications.

CISPR 11 Class A

Caution: This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

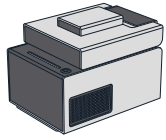
Product Specifications



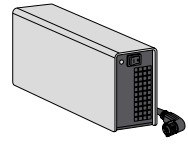
MODEL NUMBER

TCG2

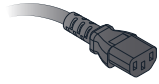
INCLUDED PARTS



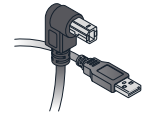
(1) Thermocycler



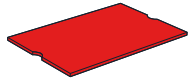
(1) Power Supply and Power Supply Connector



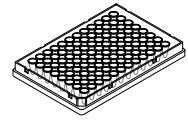
(1) Power Cable



(1) USB Cable



(5) Rubber Automation Seals



(10) Opentrons Tough PCR Plates

PHYSICAL SPECIFICATIONS

Dimensions with lid open	244.95 mm L x 172 mm W x 310.1 mm H
Dimensions with lid closed	244.95 mm L x 172 mm W x 170.25 mm H
Weight	8.4 kg (including rear duct)

TEMPERATURE PROFILE

Thermal Block	■ Range: 4–99 °C ■ Maximum heating ramp rate: 4.25 °C/s from ambient to 95 °C ■ Maximum cooling ramp rate: 2.0 °C/s from 95 °C to ambient
Lid	■ Range: 37–110 °C ■ Accuracy: ±1 °C

LED STATUS LIGHT

The Thermocycler has a strip of LEDs that can display four colors: white, orange, red, and blue. The possible module conditions indicated by the light are listed below.

LED Color and Behavior	Module Conditions
Solid white	Idle
Flashing orange	Error
Pulsing red	Changing to hot temperature (>23 °C)
Solid red	Holding at hot temperature (>23 °C)
Pulsing blue	Changing to cool temperature (<23 °C)
Solid blue	Holding at cool temperature (<23 °C)

Warning: The status LED displays solid white whenever the module is not actively heating or cooling, regardless of its current temperature. Handle with caution. The module may still be hot to the touch.

EMERGENCY LID OPENING

In case of a power outage, connectivity issue, or other electrical failure, the Thermocycler lid may not open. Follow these steps to manually open the lid:

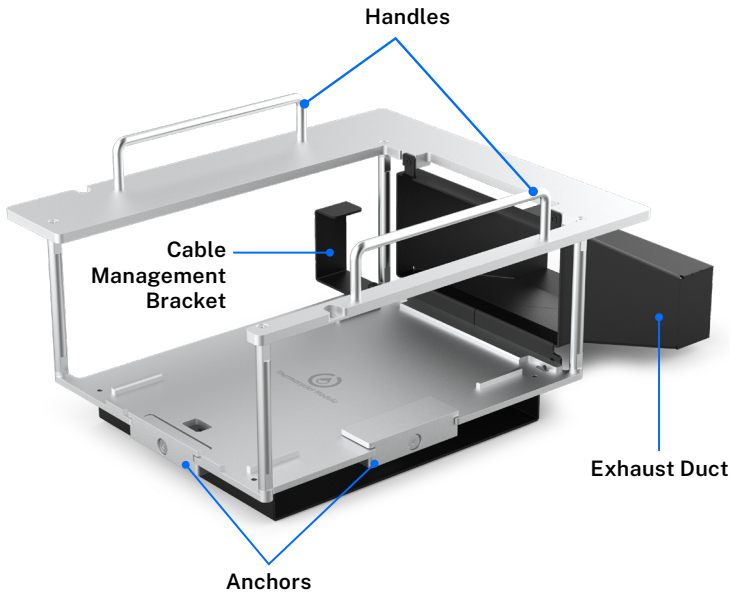
1. If possible, turn the unit off and unplug it.
2. Insert the included hex wrench into the circular slot on the left side of the module.
3. Push the wrench inward 25 mm / 1 inch.
4. Lift the lid manually.

Before You Begin

Review this section for important information about deck placement, alignment, and anchor adjustments for the Thermocycler.

FLEX CADDIES

When used with a Flex robot, the Thermocycler fits into a caddy that occupies space below the deck. The caddy places your labware closer to the deck surface and allows for below-deck cable routing. See the Modules chapter in the Flex Instruction Manual for more information.



The OT-2 does not use caddies. Modules clip directly to the deck. Also, the Thermocycler ships with a short exhaust duct, which is used by the OT-2 only. The module will not fit properly in its caddy with the OT-2 duct attached.

Module caddies are available for purchase at shop.opentrons.com.

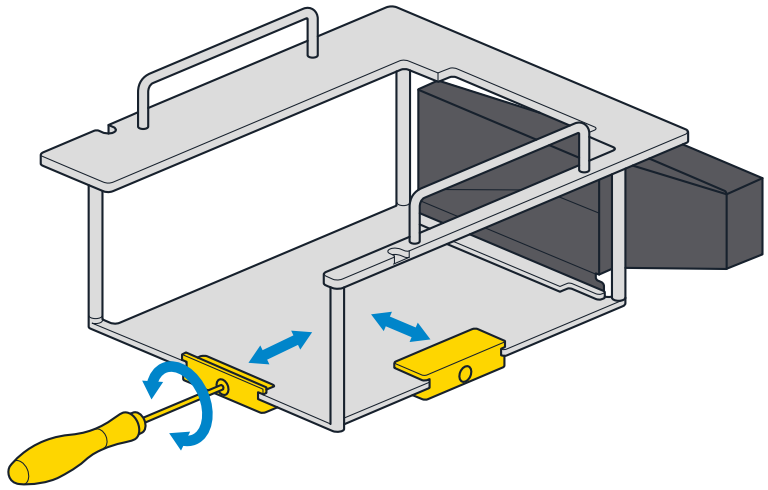
ANCHOR ADJUSTMENTS

Anchors are screw-adjustable panels on the Thermocycler caddy. They provide the clamping force that secures the module to its caddy. Use a 2.5 mm screwdriver to adjust the anchors.

- To loosen/extend the anchors, turn the screws counterclockwise.
- To tighten/retract the anchors, turn the screws clockwise.

Before installation:

- Check the anchors to make sure they're level or extend slightly past the sides of the caddy.
- If the anchors interfere with installing the module, adjust them until there's enough clearance to seat the module and then tighten them to hold it in place.



DECK PLACEMENT AND CABLE ALIGNMENT

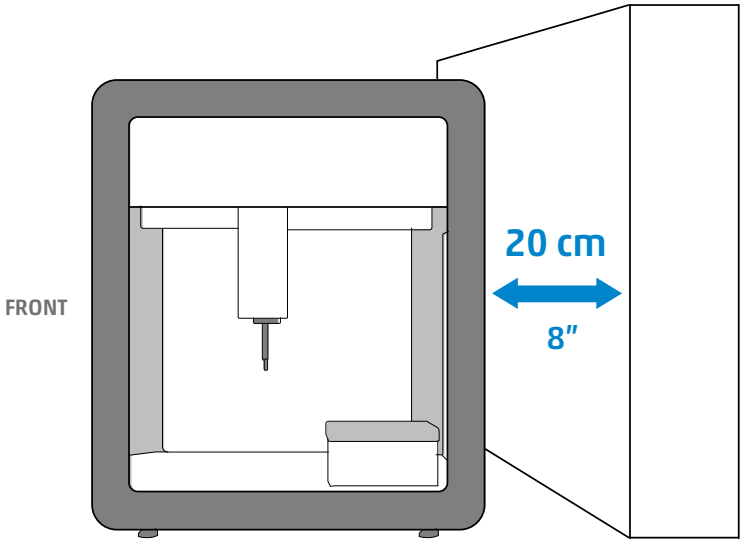
The supported deck slot positions for the Thermocycler depend on the robot you're using.

Robot Model	Deck Placement
Flex	Requires deck slots A1, B1, and the A1 expansion slot.
OT-2	Requires deck slots 7, 8, 10, and 11.

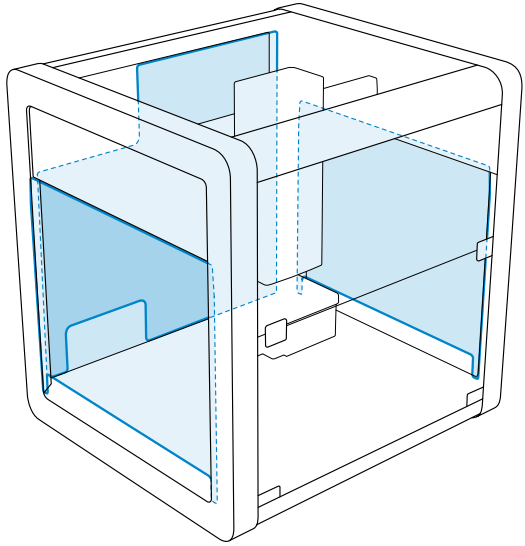
To properly align the module relative to the robot, make sure its exhaust port faces to the rear (away from the center of the deck). This keeps the exhaust port clear and aligns the power and USB ports to the left side of the robot for easy access.

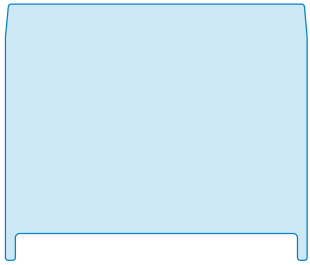
VENTILATION CLEARANCE

The Flex and OT-2 need at least 20 cm (8") of side and back clearance. This space helps dissipate exhaust from the Thermocycler.

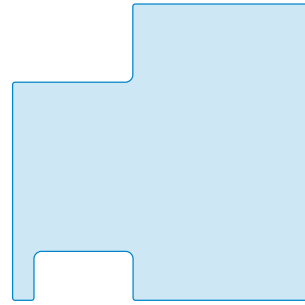


For OT-2 ventilation, Opentrons recommends using the side and rear window panels shown below. These panels are included with newer OT-2 models. If you have an older OT-2 and need these panels, contact us at support@opentrons.com.





2x Side Panels



1x Rear Panel

Flex Installation Steps

Setting up the Thermocycler on your robot includes attaching it to the deck and running a first-time calibration process. The instructions here and on the touchscreen will help you get started. The tools you need are included in the User Kit that came with your Flex.

ATTACHING THE THERMOCYCLER

1. Use a 2.5 mm hex screwdriver to remove the A1 expansion slot plate and the A1 and B1 deck slot plates.
2. Using both hands, lift the module carefully and insert it into its caddy. Make sure the module's exhaust port faces the exhaust duct on the caddy.
3. Use a 2.5 mm hex screwdriver to turn the anchor screws clockwise to tighten the anchors. The module is secure when it doesn't move while gently pulling on it and rocking it from side to side.
4. Connect the USB cable to the module and route the remaining cable through the cable management bracket.
5. Connect the power connector to the module by pressing it firmly into place. Route the remaining cable through the cable management bracket.
6. Insert the caddy, exhaust duct first, into the open deck slot. Route the USB and power cables through the removable side covers as you lower the caddy into position.
7. Connect the USB cable to a USB port on the Flex.
8. Connect the power cable from the module to the external power supply unit. Manually tighten the locking ring to secure it to the power supply.
9. Connect the power supply to a wall outlet and turn on the power supply.

If you see a white light on the Thermocycler, it is powered on. You can press the illuminated button to open and close the lid.

When successfully connected, the module appears in the Pipettes and Modules section on your robot's device detail page in the Opentrons App.

Next, you'll calibrate the module.

CALIBRATING THE THERMOCYCLER

You need to calibrate the Thermocycler after attaching it for the first time. To calibrate the Thermocycler, turn on the power supply. This starts the calibration workflow process on the touchscreen. Instructions on the touchscreen will take you through a guided workflow process, which is also outlined below.

> **Warning:** The gantry and pipette will move during calibration. Keep your hands clear of the working area before tapping an action button on the touchscreen.

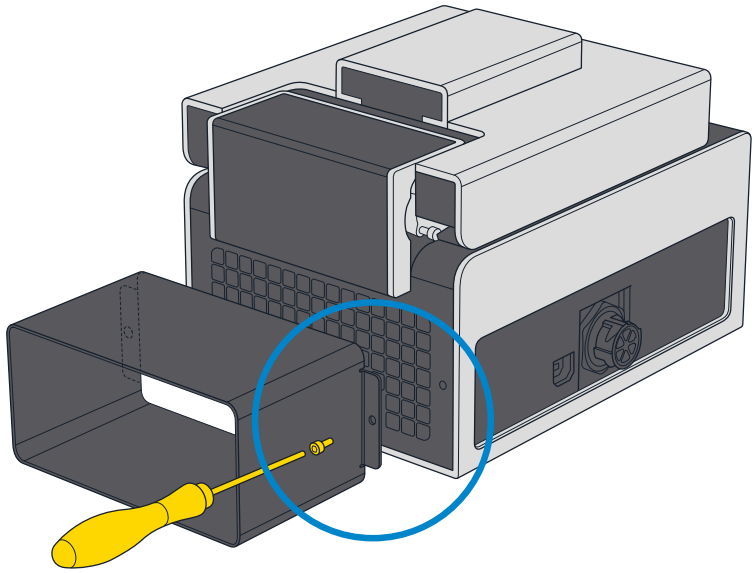
1. Tap **Start setup** on the touchscreen. The robot checks the module's firmware and updates it automatically, if required.
2. Attach the module's calibration adapter and tap **Confirm placement**.
3. Attach the calibration probe to the indicated pipette.
4. Tap **Begin calibration**.
5. After the calibration process is complete, remove the calibration block from the module and remove the calibration probe from the pipette.
6. Click **Exit**.

Your module is now calibrated. You will not have to recalibrate the same module if you remove and reattach it to the same Flex.

OT-2 Attachment Steps

To attach the Thermocycler to your OT-2:

1. Use a 2.5 mm hex screwdriver or L-key to attach the exhaust duct to the back of the module. Use the two included screws, one on either side of the duct.



2. Using both hands, lift the module carefully, set it in its supported deck location and press gently into place.
3. Connect the USB cable to the module. Route the remaining cable through the cable management bracket and connect the other end of the USB cable to a USB port on the OT-2.
4. Connect the power connector to the module by pressing it firmly into place. Route the remaining cable through the side window.
5. Connect the power cable to the power supply unit.
6. Connect the power supply to a wall outlet.
7. Turn on the Thermocycler power supply.

If you see a white light on the Thermocycler, it is powered on. You can press the illuminated button to open and close the lid.

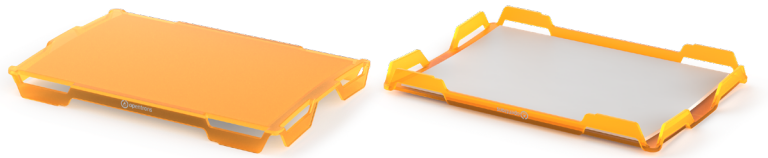
When successfully connected, the module appears in the Pipettes and Modules section on your robot's device detail page in the Opentrons App. The module is ready to use and does not require calibration on an OT-2.

Thermocycler Lid Seals

The Thermocycler GEN2 accepts two different plate seals to help protect PCR samples. These are the disposable Opentrons Tough PCR Auto-sealing Lid and the reusable rubber automation seal.

Disposable PCR lids

Opentrons Tough PCR Auto-sealing Lids are disposable, stackable well plate lids. They're ideal for protocols that require sterility, automated lid handling, single-use consumables, or that include two or more PCR steps in a single automated protocol.



Compatibility

The Opentrons auto-sealing lids work with the following Flex hardware and software.

Hardware	Compatibility
Modules	Lids are compatible with the Thermocycler GEN2. They offer an alternative to the adhesive-backed, reusable rubber seal that comes attached to the Thermocycler by default. **Warning:** *Do not* use the disposable lid while your Thermocycler has a rubber seal attached. Remove the rubber seal before using disposable lids in a protocol run.
Instruments	Lids are compatible with the Flex Gripper. The gripper can pick up lids directly off the deck or from a special deck riser, move them onto or off a PCR plate, and drop them in the trash. Note, however, the gripper cannot simultaneously pick up a well plate and an attached lid. The gripper must move labware and lids separately

Hardware	Compatibility
Labware	Lids are designed to cover the Opentrons Tough PCR plates. These sterile lids provide improved PCR plate sealing to help prevent sample contamination and reduce evaporation.
Deck fixtures	Lids are compatible with the trash bin, waste chute, the special deck riser, and other deck fixtures that can hold the Opentrons Tough PCR well plates.
API	Use the Python Protocol API to add and work with Opentrons Auto-sealing Lids in your PCR protocols.

Cleanliness standards

Auto-sealing lids are manufactured and packaged in cleanroom facilities that meet ISO 14644-1 Class 8 standards. Lids also have a “Sterile-R” designation, which means they’re irradiated to a sterility assurance level (SAL) of 10-6. Each box contains documentation that certifies the lids are free of ATP, pyrogens, DNA, DNase, RNase, and PCR inhibitors.

Packaging

Opentrons auto-sealing lids ship in blister packs of five lids each. There are four packs in a box, totaling 20 disposable lids per box. Each blister has its own lot, production, and serial number for tracking or other record-keeping purposes. You can store the lids until they’re needed, but we recommend using them within two years of their manufacture date.

Deck riser

You can stack up to 5 auto-sealing lids on a special deck riser. The riser keeps lids away from the unsterilized deck and provides better access for the gripper. Also, the deck riser is autoclave-safe. You can clean and reuse it between protocol runs without worrying too much about contaminating sterile lids.

Note: You can place lids directly on the deck, although you can only stack a maximum of 3 lids this way. Also, the gripper can pick up lids from the deck without needing the riser. However, use the deck riser if you need to stack more lids or require a sterile environment.

Reusable automation seals

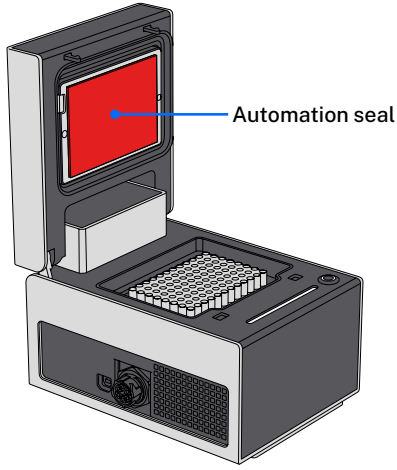
The Thermocycler also uses adhesive backed rubber automation seals to help reduce evaporation. The module ships with a seal i installed, along with replacement seals and well plates. Discard the pre-installed seal and well plate before using the Thermocycler. Then, put a new seal on the module lid and use a new well plate for your initial protocol run.

Attaching the Rubber Automation Seal

Your Thermocycler uses a rubber automation seal to help reduce evaporation. The module ships with a seal and Opentrons Tough well plate already installed, along with replacement seals and well plates. Discard the pre-installed seal and well plate before using the Thermocycler. Then, put a new seal on the module lid and use a new well plate for your initial protocol run.

Note:

- Attach a seal *after* installing the module.
- Apply the seal to the module lid, not to the plate.
- Seals must be cleaned before your first Thermocycler run.
- Do not put seals in an autoclave.



After applying the seal, wipe it with a 1:10 diluted bleach solution. Rinse the seal by wiping it with molecular biology grade water. Air dry when finished.

Each seal may be used for several runs. You should check the state of the seal after each run and replace it if needed. Worn or damaged seals may result in increased sample evaporation.

Maintenance

Users should not attempt to service or repair the Thermocycler themselves. If you have concerns about the module's performance or require maintenance, please contact Opentrons Support.

Cleaning

The following table lists the chemicals you can use to clean your Thermocycler. Diluted alcohol and distilled water are our recommended cleaning products, but you can refer to this list for other cleaning options.

Warning:

- *Do not* use acetone to clean the Thermocycler.
- *Do not* disassemble the Thermocycler for cleaning or attempt to clean its internal electronic components or mechanical parts.
- *Do not* put the Thermocycler in an autoclave.

Solution	Recommendations
Alcohol	Includes ethyl/ethanol, isopropyl, and methanol. Dilute to 70% for cleaning. Do not use 100% alcohol.
Bleach	Dilute to 10% (1:10 bleach/water ratio) for cleaning. Do not use 100% bleach.
Distilled Water	You can use distilled water to clean or rinse your Thermocycler.

Be sure to turn the Thermocycler's power off before cleaning it. You can clean the top surfaces of the module while it's installed in a deck slot. However, for better access, you may want to:

- Disconnect any USB or power cables before you begin.
- Remove the caddy (Flex only) and module from the deck slot.
- Remove the module from the caddy (Flex only).

Once you've prepared the module for cleaning:

1. Dampen a soft, clean cloth or paper towel with a cleaning solution.
2. Gently wipe off the module's surfaces.
3. Use a cloth dampened with distilled water as a rinse wipe-down.
4. Let the module air dry.

For information about cleaning the rubber seal, see the Attaching the Rubber Automation Seal section above.

Additional Product Information

WARRANTY

All hardware purchased from Opentrons is covered under a 1-year standard warranty. Opentrons warrants to the end-user of theproducts that they will be free of manufacturing defects due to part quality issues or poor workmanship and also warrants that the products will materially conform to Opentrons' published specifications.

SUPPORT

Opentrons Support can help you with questions about our products and services. If you discover a defect, or believe your product is not functioning to published specifications, contact us at support@opentrons.com.

Please have the Thermocycler's serial number available when contacting support. You can find the serial number on the bottom of the module or in the Opentrons App. To find the module serial number in the app, go to the Instruments and Modules section of your robot's device details page, click the three-dot menu (⋮) and then click **About**.

APP DOWNLOAD

Control your liquid handling robot and modules using the Opentrons App. Download the app for Mac, Windows, or Linux at https://opentrons.com/ot-app.

WEEE POLICY

Opentrons is dedicated to adhering to the EU Directive on Waste Electrical and Electronic Equipment (WEEE – 2012/19/EU). Our goal is to ensure that our products are properly disposed of or recycled once they reach the end of their useful life.

Opentrons products that fall under the WEEE directive are labeled with the  symbol, signifying that they should not be thrown away with regular household waste but must be collected and handled separately.

If you or your business have Opentrons products that are at end of life or need to be discarded for a separate purpose, contact Opentrons for proper disposal and recycling.

Post-sales service & contacting Opentrons

If you have any questions about the use of the system, abnormal phenomena, or special needs, please contact: support@opentrons.com. Also visit www.opentrons.com.