ion torrent

# Ion Chef™ Instrument

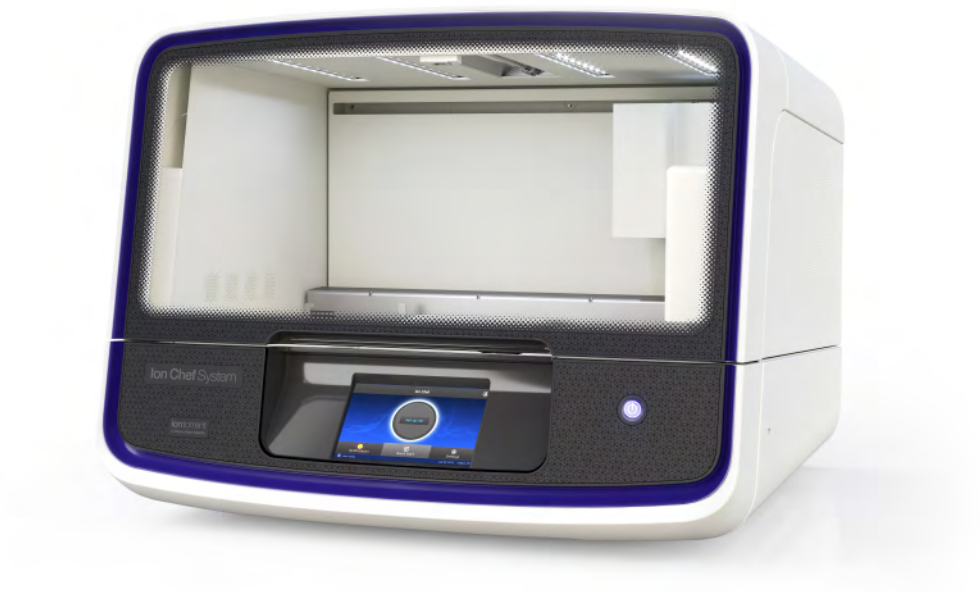
## USER GUIDE

### Maintenance, calibration, and troubleshooting

**Catalog Number** 4484177

**Publication Number** MAN0018668

**Revision** A.0




**For Research Use Only. Not for use in diagnostic procedures.**

ThermoFisher SCIENTIFIC

Life Technologies Holdings Pte Ltd | Block 33 | Marsiling Industrial Estate Road 3 | #07-06, Singapore 739256
For descriptions of symbols on product labels or product documents, go to **thermofisher.com/symbols-definition**.

The information in this guide is subject to change without notice.



**Revision history:** Pub. No. MAN0018668

| Revision | Date | Description |
|---|---|---|
| A.0 | 21 June 2019 | New user guide |

# Contents


About this guide ..... 5

**CHAPTER 1** Product information ..... 6

Product description ..... 6
Software compatibility ..... 6
Ion Chef™ reagent kits ..... 7
Compatible Ion Torrent™ sequencing chips ..... 8
Ion Chef™ Calibration Supplies Kit ..... 9
Ion Chef™ Instrument components ..... 10
Interior hardware and consumables ..... 11

**CHAPTER 2** Maintain and calibrate the Ion Chef™ Instrument ..... 12

About the Ion Chef™ System touchscreen interface ..... 13
Settings screen ..... 13
Change the instrument name ..... 16
Run the XYΘ calibration ..... 17
Required materials ..... 17
Set up the instrument ..... 18
Run the XYΘ calibration ..... 20
Run the Z calibration ..... 21
Required materials ..... 21
Set up the instrument ..... 22
Run the Z calibration ..... 24
Clean the Ion Chef™ System ..... 25
About the cleaning protocol ..... 25
Materials required ..... 25
Clean the Ion Chef™ Instrument ..... 25
Install a firmware update ..... 30
Replace the ultraviolet bulb ..... 31
Materials required ..... 31
Install a new UV bulb ..... 31

**APPENDIX A** Troubleshooting ..... 33

Ion Chef™ System setup and operation ..... 33
Expected throughput for Ion Torrent™ chips ..... 37
Loading images for normal runs ..... 38
Troubleshoot common loading failure types with chip image phenotypes ..... 39
Ion PGM™ Chef runs ..... 39
Ion Proton™, Ion S5™/Ion S5™ XL, and Ion GeneStudio™ S5 Chef runs ..... 41
Ion Chef™ Instrument user issues ..... 44

**APPENDIX B** Safety ..... 45

Symbols on this instrument ..... 45
Conformity symbols ..... 46
Location of safety labels on this instrument ..... 47
Safety information for instruments not manufactured by Thermo Fisher Scientific ..... 47
Instrument safety ..... 47
General ..... 47
Physical injury ..... 48
Electrical safety ..... 49
Cleaning and decontamination ..... 49
Ultraviolet (UV) Safety ..... 49
Safety and electromagnetic compatibility (EMC) standards ..... 50
Safety compliance ..... 50
EMC ..... 50
Environmental design ..... 51
Chemical safety ..... 51
Biological hazard safety ..... 52

Documentation and support ..... 53

Related documentation ..... 53
Customer and technical support ..... 54
Limited product warranty ..... 54

# About this guide

**CAUTION! ABBREVIATED SAFETY ALERTS.** Hazard symbols and hazard types specified in procedures may be abbreviated in this document. For the complete safety information, see the "Safety" appendix in this document.

**IMPORTANT!** Before using this product, read and understand the information in the "Safety" appendix in this document.

This guide is a reference for routine maintenance and calibration of the Ion Chef™ Instrument that is enabled for the user to perform. The guide is also a general reference for troubleshooting and ordering compatible reagent kits and sequencing chips, and provides instrument layout and safety information.

# 1 Product information

## Product description

The Ion Chef™ System (Cat. No. 4484177) provides automated, high-throughput template preparation and chip loading for use with an Ion PGM™ Sequencer, Ion Proton™ Sequencer, Ion S5™ Sequencer, Ion S5™ XL Sequencer, or Ion GeneStudio™ S5 Series Sequencer. The system includes a complete set of cartridge-based consumables and reagents that enable a user to load two chips in 13–18 hours, depending on the panel and sequencing chip, with less than 15 minutes of hands-on time. The Ion Chef™ System features network integration with Torrent Suite™ Software to enable sample and reagent traceability throughout the chip preparation workflow.

The Ion Chef™ System can also be used for automated Ion AmpliSeq™ library preparation from up to 8 DNA or RNA samples per run in approximately 7 hours, with 15 minutes of hands-on time.

### Software compatibility

To access the deck calibration routines described in this guide, you need to update your instrument firmware with updates in Torrent Suite™ Software 5.12 or later. For more information, see “Install a firmware update“ on page 30.

# Ion Chef™ reagent kits

The following table lists the reagent kits that are available from Thermo Fisher Scientific for use with the Ion Chef™ System. The template preparation kits include reagents and supplies for both template preparation and sequencing, excluding sequencing chips. For detailed information on use, see the kit user guides listed in "Related documentation" on page 53).

| Kit | Cat. No. |
|---|---|
| **Library preparation** | |
| Ion AmpliSeq™ Kit for Chef DL8 | A29024 |
| **Template preparation—Ion PGM™ System** | |
| Ion PGM™ Hi-Q™ View Chef Kit | A29902 |
| Ion PGM™ Hi-Q™ View Chef 400 Kit | A30798 |
| **Template preparation—Ion Proton™ System** | |
| Ion PI™ Hi-Q™ Chef Kit | A27198 |
| **Template preparation—Ion GeneStudio™ S5 Systems** | |
| Ion 510™ & Ion 520™ & Ion 530™ Kit – Chef | A34461/A34019 |
| Ion 520™ & Ion 530™ ExT Kit – Chef | A30670 |
| Ion 540™ Kit – Chef | A30011 |
| Ion 550™ Kit – Chef | A34541 |
| Ion 550™ Single Chip Supplemental Kit | A36953 |

# Compatible Ion Torrent™ sequencing chips

The following table lists the sequencing chip kits available from Thermo Fisher Scientific that are compatible with the Ion Chef™ System. Store all chips at 15°C–30°C.

| Sequencing platform | Kit | Quantity | Cat. No. |
|---|---|---|---|
| Ion PGM™ System | Ion 314™ Chip Kit v2 BC | 8 chips | 4488144 |
| | Ion 316™ Chip Kit v2 BC | 4 chips | 4488145 |
| | | 8 chips | 4488149 |
| | Ion 318™ Chip Kit v2 BC | 4 chips | 4488146 |
| | | 8 chips | 4488150 |
| Ion Proton™ System | Ion PI™ Chip Kit v3 | 8 chips | A26771 |
| Ion GeneStudio™ S5 Systems<br>Ion S5™/Ion S5™ XL Systems | Ion 510™ Chip Kit | 8 chips | A34292 |
| | Ion 520™ Chip Kit | 8 chips | A27762 |
| | Ion 530™ Chip Kit | 8 chips | A27764 |
| | Ion 540™ Chip Kit | 8 chips | A27766 |
| | Ion 550™ Chip Kit | 4 chips | A34537 |
| | | 8 chips | A34538 |

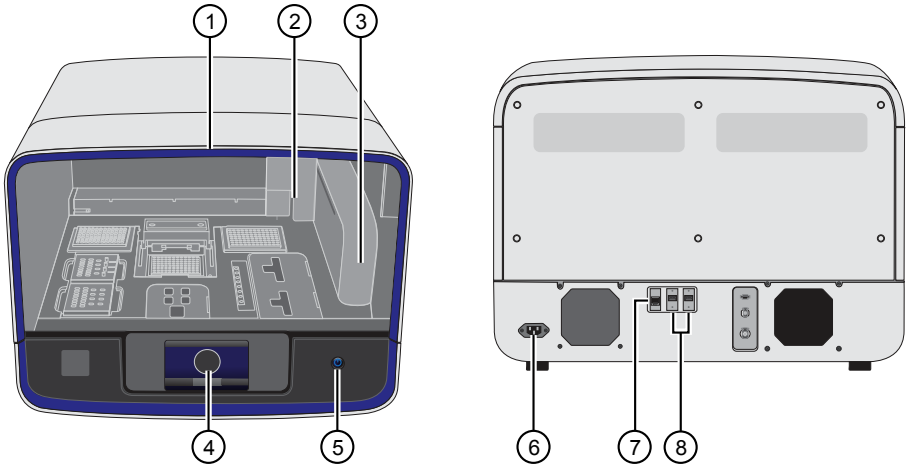
# Ion Chef™ Calibration Supplies Kit

The Ion Chef™ Calibration Supplies Kit (Cat. No. A34301) has enough components to perform ten XYΘ calibrations and ten Z calibrations (reuse of the Ion Chef™ Tip Cartridge required).


| Call out # | Description | Part No. | Quantity | Storage |
|---|---|---|---|---|
| 1 | Ion Chef™ PCR Plate | 4483352 | 10 | 15°C–30°C |
| 2 | Black tip, 1 mL | INS1011428 | 96 | |
| 3 | Ion Chef™ Recovery Tube | INS1011324 | 12 | |
| 4 | Pierce tool | INS1010975 | 10 | |
| 5 | Ion Chef™ Tip Cartridge and Tub | INS1011431<br>INS1008924 | 2 each | |

# Ion Chef™ Instrument components

The following figure illustrates the major external and internal features of the Ion Chef™ Instrument.




① **Door** – Provides access to the interior of the instrument. The door is locked in the closed position during operation.

② **Micropipettor** – A mechanical positive-displacement pipettor that performs all fluid transfers during sample and chip preparation.

③ **Robotic arm** – Enables fluid transfer by the Micropipettor. The arm also contains an optical sensor that reads the barcodes of instrument reagents and consumables.

④ **Touchscreen** – Provides access to all instrument functions for operation, maintenance, and troubleshooting.

⑤ **Power button** – Power switch for the Ion Chef™ Instrument, where the states are on (illuminated) and off.

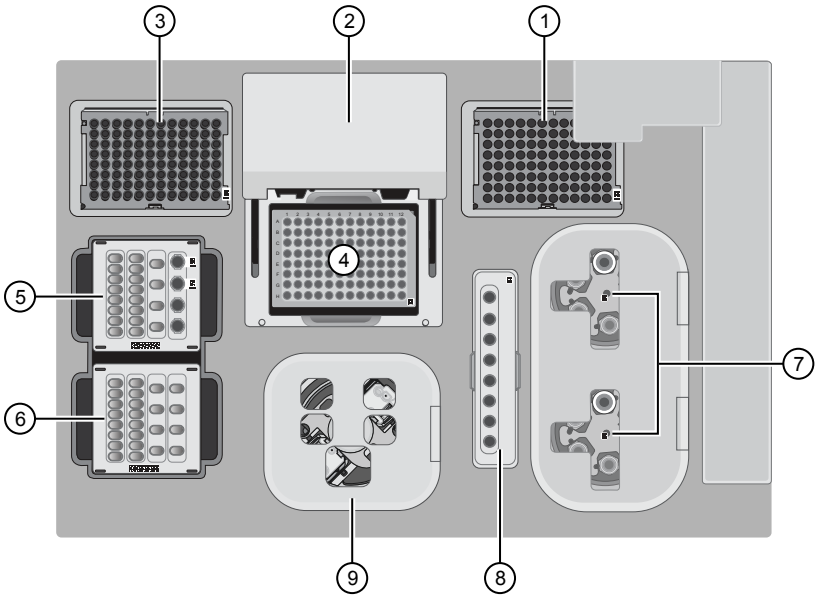
⑥ **Power port** – A 100–240 VAC port that provides power to the Ion Chef™ Instrument.

⑦ **Ethernet port** – An RJ45 port that provides Ethernet (100 Mbit) communication with the Ion Chef™ Instrument.

⑧ **USB port** – Provides USB communication with the Ion Chef™ Instrument. Used to update the instrument firmware and to transfer data during service or maintenance.

# Interior hardware and consumables

The following figure illustrates the interior of the Ion Chef™ Instrument and describes the stations involved in the preparation of sequencing chips.




① **Waste pipette tip rack** – The position of the rack containing waste (used) pipette tips.

② **Automated heated cover** – Transfers the plate cover to the PCR reaction plate within the sample block. During thermal cycling, the heated cover applies compression to seal the reaction plate and heats the cover to prevent condensation.

③ **New pipette tips** – The position of the rack containing unused pipette tips.

④ **Thermal cycler sample block** – Performs thermal cycling of the sequencing reactions on a 96-well PCR reaction plate.

⑤ **Reagents station** – The position on the instrument deck of the diluted libraries, NaOH, and the Ion Chef™ Reagents cartridge.

⑥ **Solutions station** – The position on the instrument deck of the Ion Chef™ Solutions cartridge, which is maintained at room temperature.

⑦ **Recovery centrifuges** – Twin stations that perform centrifugation of the Ion Sphere™ Particles (ISPs) during the recovery phase of template preparation.

⑧ **Enrichment station** – The position of the rack containing consumables for the enrichment of the template-positive ISPs.

⑨ **Chip-loading centrifuge** – Performs centrifugation of sequencing chips that have been mounted to chip-loading adapters and loaded with template-positive ISPs.

# 2 Maintain and calibrate the Ion Chef™ Instrument


- About the Ion Chef™ System touchscreen interface . . . . . 13
- Settings screen . . . . . 13
- Change the instrument name . . . . . 16
- Run the XYΘ calibration . . . . . 17
- Run the Z calibration . . . . . 21
- Clean the Ion Chef™ System . . . . . 25
- Install a firmware update . . . . . 30
- Replace the ultraviolet bulb . . . . . 31

# About the Ion Chef™ System touchscreen interface

The Ion Chef™ System features a simple interface for loading chips, cleaning the instrument, and performing system maintenance and configuration tasks.


① **Set up run** button – Set up the Ion Chef™ template preparation and chip-loading routine. Choose **Step by Step** to have the instrument lead you stepwise through installation of reagents and consumables, or choose **Quick Start** to proceed if you have already installed the consumables.

② **Open Door** button.

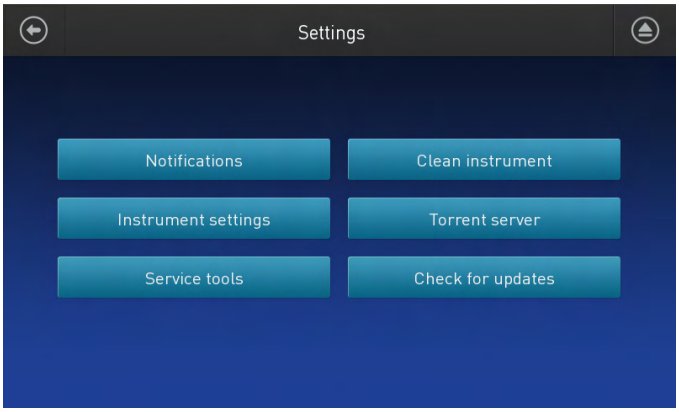
③ **Notifications** button – View notifications about instrument status during and between runs.

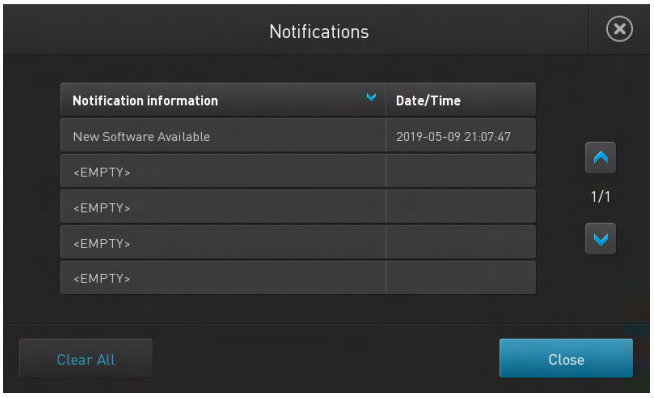
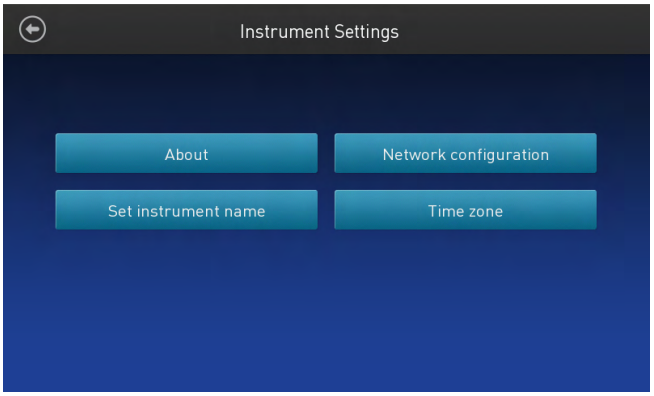
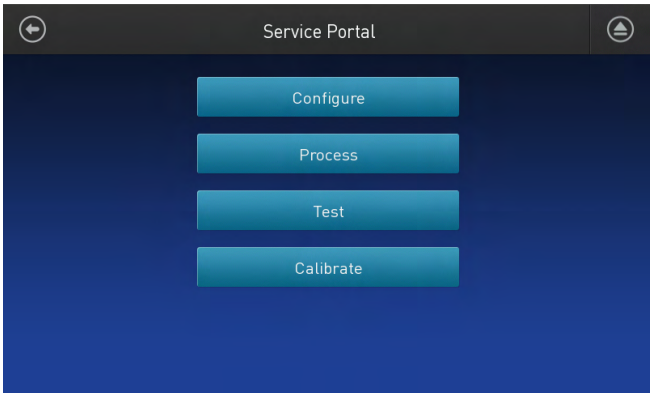
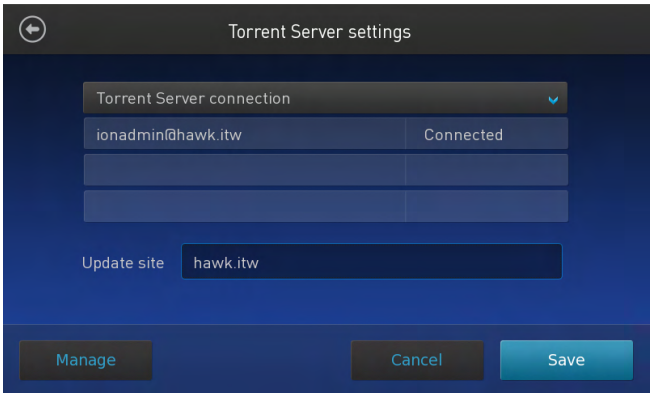
④ **Quick Start** button – Proceed directly to the Quick Start instrument setup mode. User verifies the loading of a new pipette tip cartridge and an empty pipette tip rack to hold waste tips generated during the run, before proceeding to Deck Scan.

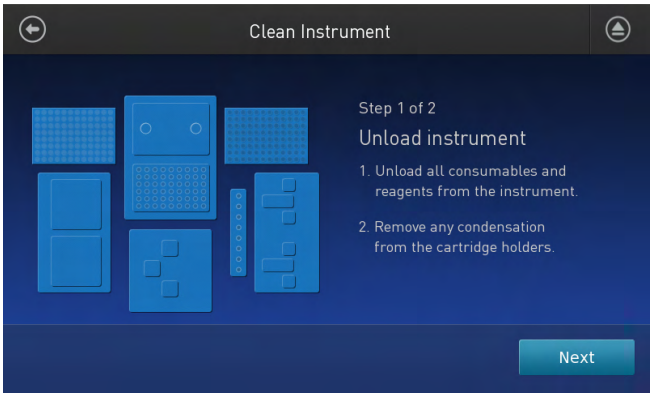
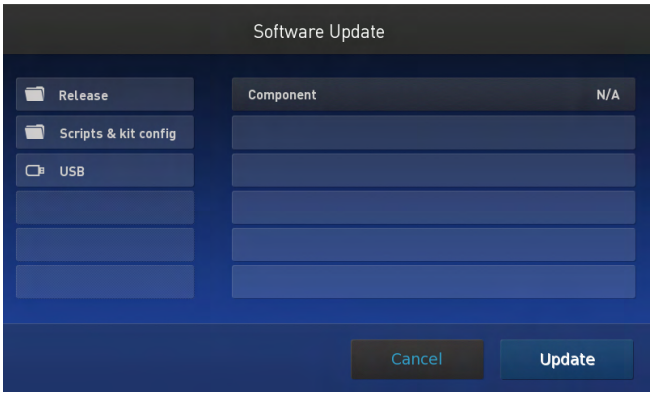
⑤ **Settings** button – Advance to the **Settings** screen with instrument configuration and maintenance options.

# Settings screen

From the Ion Chef™ **Settings** screen you can access instrument settings and configuration screens, and maintenance and calibration procedures.



| Item | Settings screen | When/How to use |
|---|---|---|
| **Notifications** |  | View notifications about instrument status during and between runs.<br>**Note:** The **Notifications** screen is the same screen that opens after clicking **Notifications** in the lower left corner of the home screen. |
| **Instrument settings** |  | View current settings and network configuration, set instrument name, adjust time zone. For more information on setting a new instrument name, see "Change the instrument name" on page 16.<br>For more information on configuring Ion Chef™ network connections, see the *Ion Chef™ Instrument Network Connection User Guide* (Pub. No. MAN0013444). |
| **Service tools** |  | Access screens for service-related maintenance and instrument diagnostics. Users can perform deck calibrations after updating instrument firmware in Torrent Suite™ Software 5.12.<br>For more information on performing XYΘ and Z calibrations, see "Run the XYΘ calibration" on page 17 and "Run the Z calibration" on page 21. |
| **Torrent server** |  | Add and manage Ion Torrent™ Server connections.<br>For more information on configuring Ion Chef™ and Ion Torrent™ Server connections, see the *Ion Chef™ Instrument Network Connection User Guide* (Pub. No. MAN0013444). |

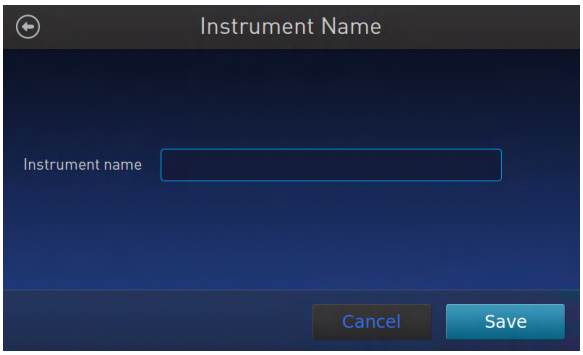
| Item | Settings screen | When/How to use |
|---|---|---|
| **Clean instrument** |  | Proceed directly to the instrument cleaning routine.<br>For more information on running the cleaning routine, see "Clean the Ion Chef™ System" on page 25. |
| **Check for updates** |  | Check availability of system software updates, and update system.<br>For more information on updating instrument firmware, see "Install a firmware update" on page 30. |

# Change the instrument name

The following procedure describes how to change the name that is used to identify the Ion Chef™ Instrument both on the network and in the data that it generates.

1. In the Ion Chef™ Instrument home screen, tap **Settings**.
2. In the **Settings** screen, tap **Instrument settings**.
3. In the **Instrument Settings** screen, tap **Set Instrument Name**. Tap in the **Instrument name** field, enter a new instrument name using the keypad that appears, then tap **Save**.

   **Note:** Use only alphanumeric characters. Do not use special characters or spaces in the name.




4. In the next screen, tap **Save** again. Power off and on the Ion Chef™ Instrument to effect the name change.

# Run the XYΘ calibration

The XYΘ calibration finds the precise location of the Z pump head (tip mandrel) relative to each consumable cartridge and a home position for the three centrifuges. To complete these tasks, the XYΘ calibration routine performs a series of X and Y position measurements, and it performs visual checks using the camera and the black dots.

Run XYΘ and Z calibrations if you see low chip loading or sample to sample variability problems that are not related to library input. We recommend running the XYΘ and Z calibrations after moving the instrument.

**Note:** Users can only perform this deck calibration after updating the Ion Chef™ firmware using Torrent Suite™ Software 5.12 or later.

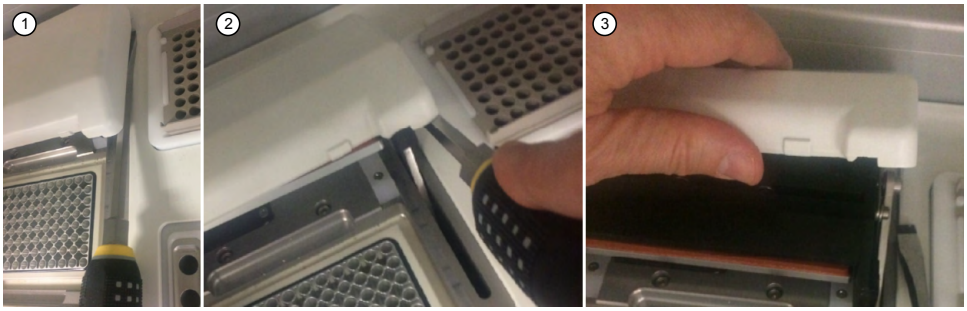
## Required materials

| Cat. No. | Description |
|---|---|
| A34301 | Ion Chef™ Calibration Supplies Kit (see page 9)<br>XYΘ calibration requires these components from the kit:<br>• Ion Chef™ PCR Plate<br>• Ion Chef™ Tip Cartridge (2)<br>• Pierce tool |


① Ion Chef™ PCR Plates
② 1-mL black tips
③ Ion Chef™ Recovery Tubes
④ Pierce tools
⑤ Ion Chef™ Tip Cartridge

## Set up the instrument

1. Power on the instrument, then wait for it to come to idle.
2. Open the instrument door.
3. Remove any consumables that may be loaded in the instrument.
4. Remove the PCR lid cover.



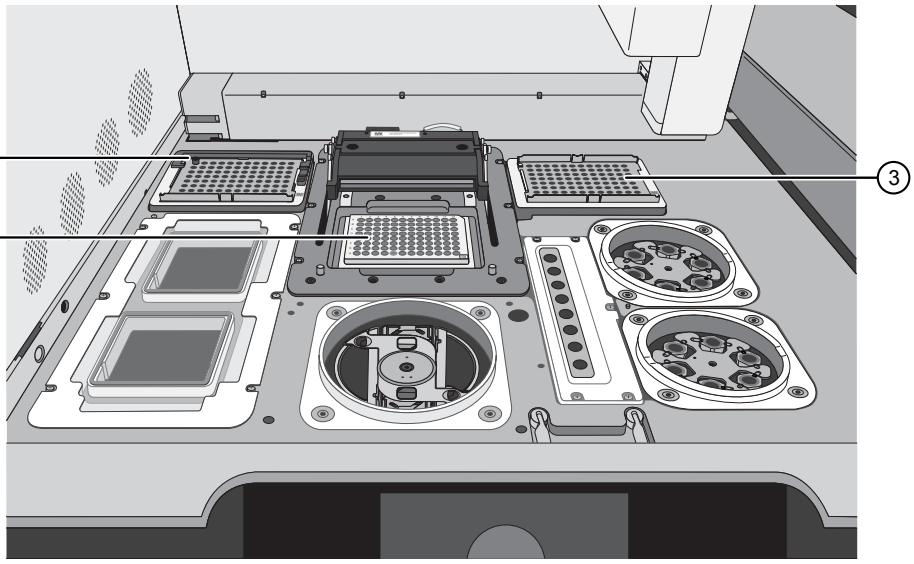

① Using a flat bladed screwdriver with a shaft that is at least 4 inches (100 mm) long, slide the blade under one side of the PCR plate cover.
② Lift up and pry off the PCR lid cover.
③ Remove the lid cover.

5. After removing the PCR lid cover, lift the deck plate at the front corners to detach the deck plate from deck magnets that hold it in place. Using two hands, carefully lift the deck plate above the deck and thermal cycler, then remove the deck plate from the instrument.

**IMPORTANT!** Be careful not to damage the PCR ribbon cable.

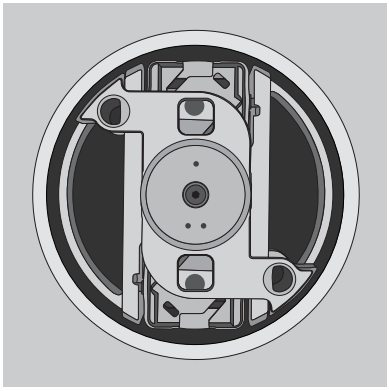
6. Install one new Pierce tool in the upper left position (A1) of an Ion Chef™ Tip Cartridge.
7. Load the deck.

| Call out # | Deck position | Item |
|---|---|---|
| 1 | New pipette tips (left rear) | Ion Chef™ Tip Cartridge with Pierce tool in position A1 |
| 2 | Thermal cycler sample block | Ion Chef™ PCR Plate |
| 3 | Waste pipette tip rack (right rear) | Empty Ion Chef™ Tip Cartridge |




① Ion Chef™ Tip Cartridge with Pierce tool in position A1
② Ion Chef™ PCR Plate
③ Empty Ion Chef™ Tip Cartridge

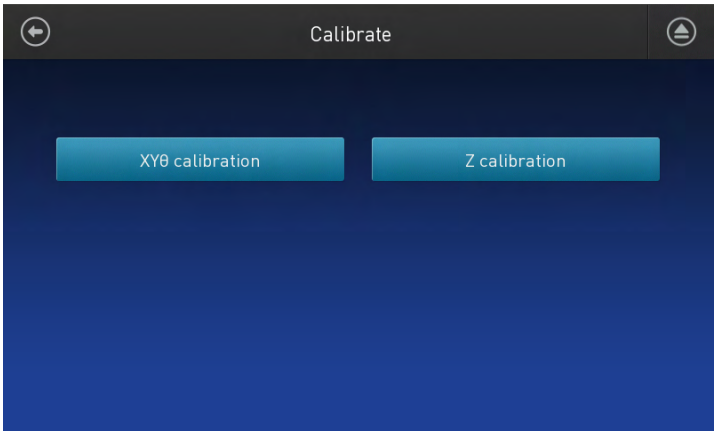
**IMPORTANT!** Ensure that the Chip-loading centrifuge is in the locked position with the bucket 2 position oriented toward the front of the deck.



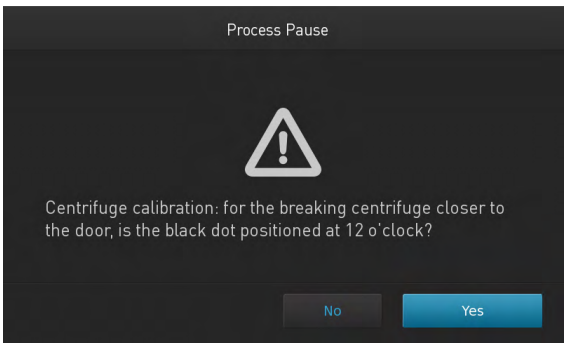
8. Close the instrument door.

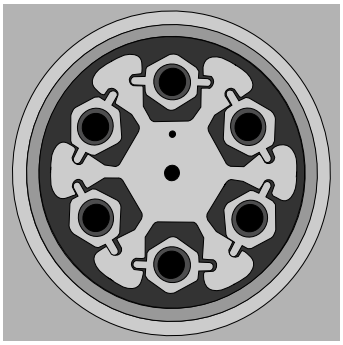
## Run the XYΘ calibration

1. In the main menu, tap **Settings** ▸ **Service tools** ▸ **Calibrate**.
2. Tap **XYΘ Calibration**, then tap **Start** to start the calibration.




3. Follow the screen instructions to complete the calibration. The calibration takes approximately 20–25 minutes to complete.
4. Toward the end of the calibration run, a **Process Pause** screen appears. You are prompted to confirm the rotor position of each Recovery centrifuge (also called a breaking centrifuge).
   - If the black dot on the rotor in question is positioned at 12 o'clock, tap **Yes**. The calibration continues to the next stage.
   - If the black dot is *not* positioned at 12 o'clock, tap **No**. The calibration fails. Repeat the calibration from the beginning.



Rotor position with the black dot at the 12 o'clock position.

5. After the XYΘ calibration completes, tap **Done** to return to the main menu.

6. Remove, then discard the Pierce tool.

   **Note:** Reuse the tip cartridges and PCR plate in the Z calibration.

7. Reinstall the deck plate and PCR lid cover.

- If the calibration fails, follow the error message instructions to correct the problem, then run the calibration again.
- If the calibration fails a second time, contact Technical Support.

Proceed to "Run the Z calibration". Always run a Z calibration following an XYΘ calibration.

# Run the Z calibration

The Z calibration routine uses eight 1-mL tips to conduct eight repeats on some calibration locations. Results are calculated based on these repeats.

**Note:** Run the Z calibration with the PCR lid cover and deck plate installed.

**IMPORTANT!** Always run a Z calibration after performing an XYΘ calibration.

## Required materials

| Cat. No. | Description |
|---|---|
| A34301 | Ion Chef™ Calibration Supplies Kit (see page 9)<br>Z calibration requires these components from the kit:<br>• Ion Chef™ PCR Plate<br>• Ion Chef™ Tip Cartridge (2)<br>• 1-mL black tips (8)<br>• Ion Chef™ Recovery Tubes (2) |


① Ion Chef™ PCR Plates
② 1-mL black tips
③ Ion Chef™ Recovery Tubes
④ Pierce tools
⑤ Ion Chef™ Tip Cartridge

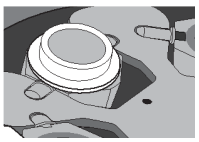
## Set up the instrument

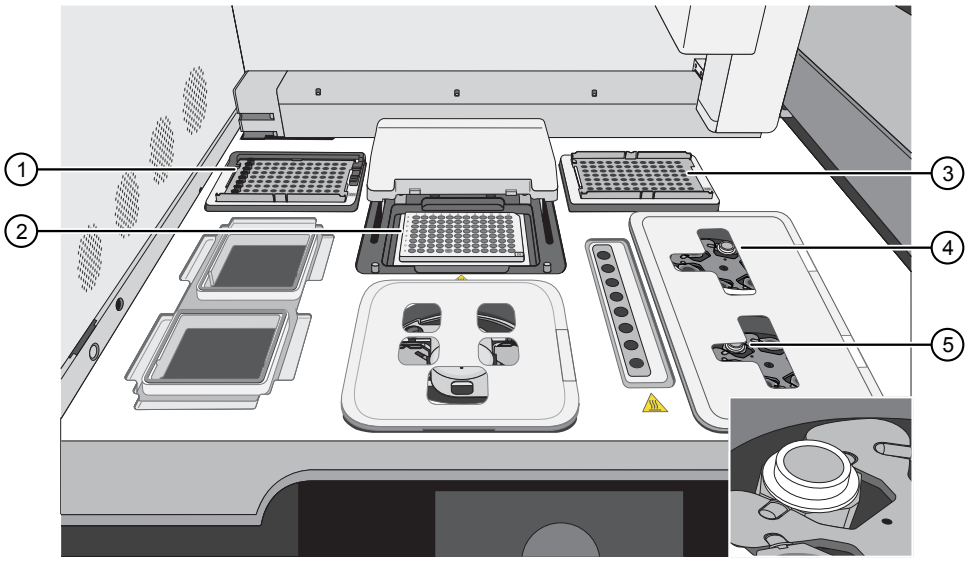
**IMPORTANT!** Before you run the Z calibration, note the following:

- Always use NEW, UNUSED 1-mL black tips.
- Ensure that no consumables are loaded in the instrument before setting up a Z calibration run. The Z calibration will fail and potentially cause major hardware damage if the calibration is performed with liquid in reagent strips.

1. Open the instrument door.
2. From the Ion Chef™ Calibration Supplies Kit, install at least 8 NEW 1-mL black tips in the left column (positions A1 to H1) of an Ion Chef™ Tip Cartridge.
3. Load the deck:

| Call out # | Deck position | Item |
|---|---|---|
| 1 | New pipette tips (left rear) | Ion Chef™ Tip Cartridge with 8 NEW UNUSED 1-mL black tips loaded in the left column (A1 to H1) |
| 2 | Thermal cycler sample block | Ion Chef™ PCR Plate |
| 3 | Waste pipette tip rack (right rear) | Empty Ion Chef™ Tip Cartridge |

| Call out # | Deck position | Item |
|---|---|---|
| 4 | Recovery centrifuge (rear) | One Ion Chef™ Recovery Tube in the bucket position nearest to the black dot on the rotor |
| 5 | Recovery centrifuge (front) |  |

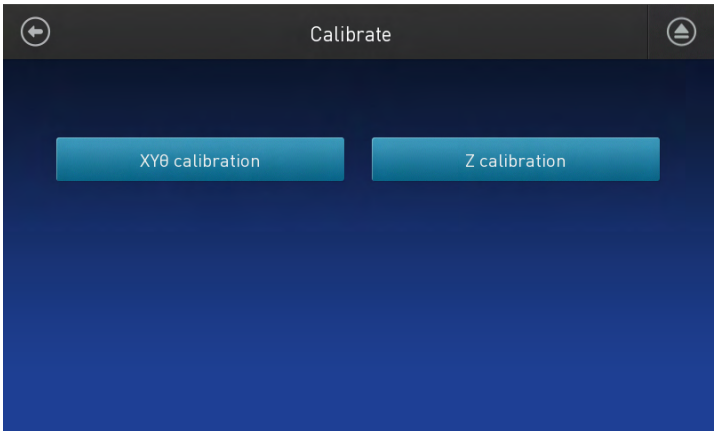



① Ion Chef™ Tip Cartridge with eight 1-mL black tips loaded in the left column (A1 to H1)
② Ion Chef™ PCR Plate
③ Empty Ion Chef™ Tip Cartridge
④ One Ion Chef™ Recovery Tube in the bucket position nearest to the black dot on the rotor (see figure inset)
⑤ One Ion Chef™ Recovery Tube in the bucket position nearest to the black dot on the rotor (see figure inset)

4. Close the instrument door.

## Run the Z calibration

1. In the main menu, tap **Settings** ▸ **Service Tools** ▸ **Calibrate**.
2. Tap **Z calibration**, then tap **Start** to start the calibration.




3. Follow the screen instructions to complete the calibration.
4. After the Z calibration completes, tap **Done** to return to the main menu.
5. Unload the following consumables from the deck.
   - Ion Chef™ Recovery Tubes
   - Ion Chef™ PCR Plate
   - Ion Chef™ Tip Cartridges and tips.

   Dispose of the used PCR plate and tips, but save the tip cartridges and recovery tubes for reuse.

- If the calibration fails, follow the error message instructions to correct the problem, then run the calibration again.

  **IMPORTANT!** Do not reuse the 1-mL black tips after a failed calibration. Use only new tips.

- If the calibration fails a second time, contact Technical Support.

# Clean the Ion Chef™ System

## About the cleaning protocol

The Ion Chef™ System has an automated cleaning function that must be performed after every run. The cleaning routine is started from the instrument touchscreen and is designed to minimize potential contamination. During the routine, the instrument irradiates the deck with ultraviolet light for one minute after all consumables have been removed from the instrument.

Cleaning can be started by tapping **Clean instrument** in the **Settings** screen at any time.

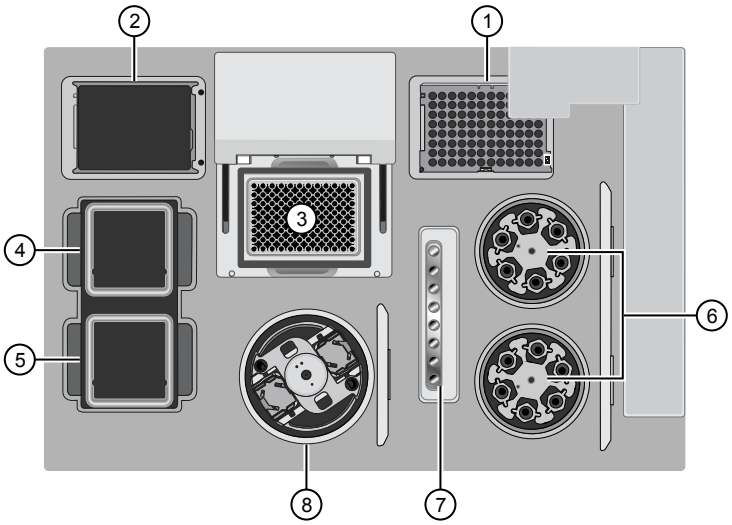
**IMPORTANT!** Although the cleaning routine provides some protection against contamination, it is not a substitute for good laboratory technique or precautions. When preparing DNA libraries or when preparing the Ion Chef™ Instrument, ensure that you always observe sterile laboratory procedures to ensure minimal contamination.

## Materials required

- Gloves, powder-free nitrile
- Isopropanol, 70% solution
- Wipes, lint-free

## Clean the Ion Chef™ Instrument

**IMPORTANT!** Clean the Ion Chef™ Instrument as described in the following pages after every run. To prevent contamination, do not operate the instrument unless it has been recently cleaned.




Ion Chef™ Instrument stations

1. Waste pipette tip position
2. Empty Tip Cartridge v2: move to waste pipette tip station
3. Thermal cycler sample block
4. Reagents station
5. Solutions station
6. Recovery centrifuges
7. Enrichment station
8. Chip-loading centrifuge

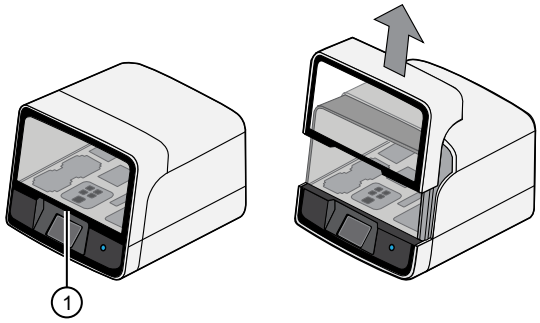
### Remove and dispose of used consumables

Follow these steps if used consumables are loaded on the instrument deck. If consumables from the previous run have already been removed, proceed to "Inspect and clean the Recovery centrifuges and buckets" on page 27.

**IMPORTANT!**

- Do not discard the empty Tip Cartridge v2.
- Make sure to transfer the QC samples before you remove and discard the Reagents cartridge.

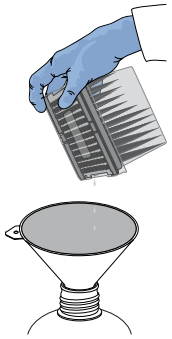
1. Tap ⏏ **(Open Door)** in the instrument touchscreen, then wait for the latch to open.
2. Lift the instrument door to the top of the travel until the latch mechanism engages.




① Hold here, then lift

3. Remove, then discard the PCR Plate from the thermal cycler sample block.
4. Remove, then discard the box of used pipette tips from the waste tip position.

**IMPORTANT!** Handle the disposable reservoir in the waste tip position with care. During the run, liquid waste collects in the reservoir. Dispose of the liquid waste by tipping the reservoir on one corner and pouring the waste into an appropriate waste container:



**IMPORTANT!** Do not reuse the waste pipette tip rack. Always move the empty Tip Cartridge v2 from the new tip position to the waste tip position.

5. Move the empty Tip Cartridge v2 to the waste tip position.

6. Remove, then discard the following cartridges.
   - Reagents cartridge
   - Solutions cartridge
   - Enrichment Cartridge v2

7. Remove, then discard the following consumables from the Recovery centrifuges.
   - Recovery Station Disposable Lid v2
   - Recovery Tubes v2

8. Close the Chip-loading centrifuge cover.

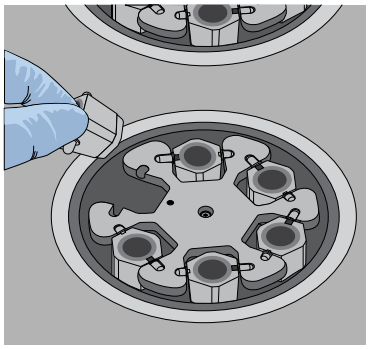
### Inspect and clean the Recovery centrifuges and buckets

1. Inspect the Recovery centrifuges, then clean the components if excess liquid is present.

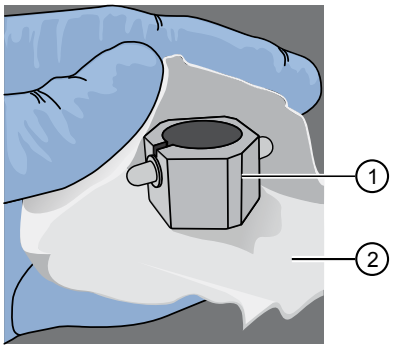
| Is liquid present? | Action |
|---|---|
| No | Proceed to "Start the cleaning" on page 28. |
| Yes | Clean the centrifuge bowl and buckets as described below.<br>**IMPORTANT!** Clean the Recovery centrifuges occasionally, only when excess liquid is noticeable in the bowl and/or buckets. You do *not* need to clean the centrifuges after every run. |

**IMPORTANT!** Wear powder-free, nitrile gloves when cleaning the Recovery centrifuge.

2. Remove the buckets from the Recovery centrifuges. Clean the inside and outside of each bucket using a lint-free wipe, then place the buckets on a clean, dry surface while you clean the centrifuge.

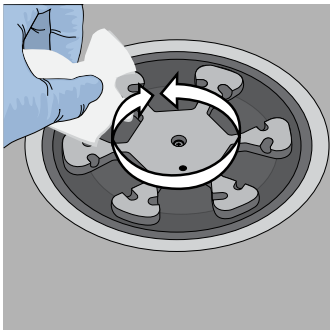


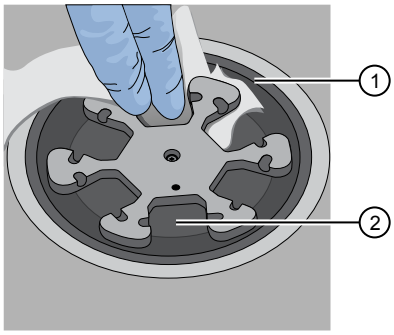
① Bucket




② Lint-free wipe

3. Use lint-free wipes to remove all fluid from inside the centrifuge bowl.





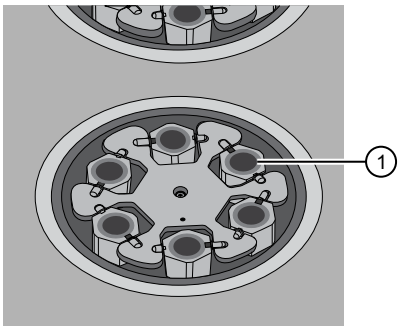

① Inside rim of the centrifuge

② Bottom of the centrifuge bowls

4. Use lint-free wipes treated with 70% isopropanol to clean the following parts.
   - Inside rim of the centrifuge.
   - Bottom of the centrifuge bowl.
   - Outside and inside of the centrifuge buckets.

5. Dry the centrifuge and buckets with lint-free wipes.

6. Install the centrifuge buckets, then close the Recovery centrifuge cover.



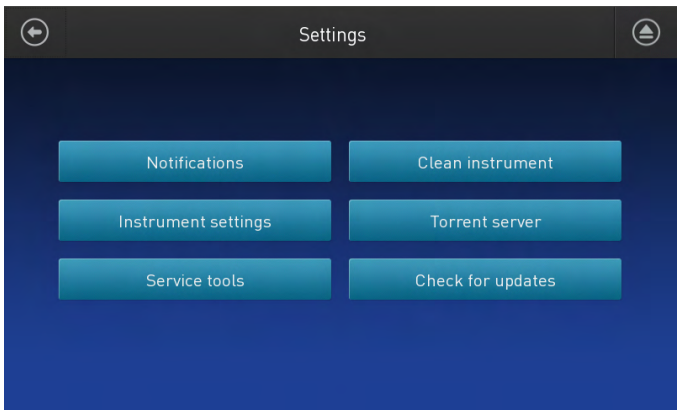

① Buckets (cleaned and installed)

### Start the cleaning

1. Close the instrument door by first lifting it up slightly to disengage the locking mechanism, then pushing down on the door until the locks engage.

   **IMPORTANT!** Before closing the door, ensure the covers of the Chip-loading and Recovery centrifuges are closed.

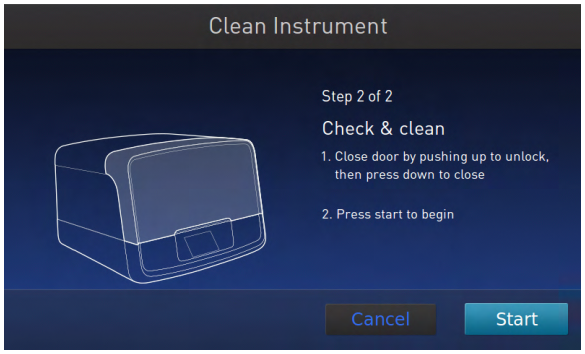
2. To start the cleaning, tap **Settings** ▸ **Clean instrument**.




**Note:** You can also clean the instrument after a run by tapping **Next** in the home touchscreen.

3. Confirm that you have removed all consumables from the Ion Chef™ Instrument, except the empty pipette tip rack in the waste tip position, then tap **Next**.


4. With the door closed, tap **Start**. The instrument performs a Deck Scan before starting the cleaning routine. The Ion Chef™ Instrument stops ventilation, then illuminates the ultraviolet (UV) light in the instrument for ~1 minute.

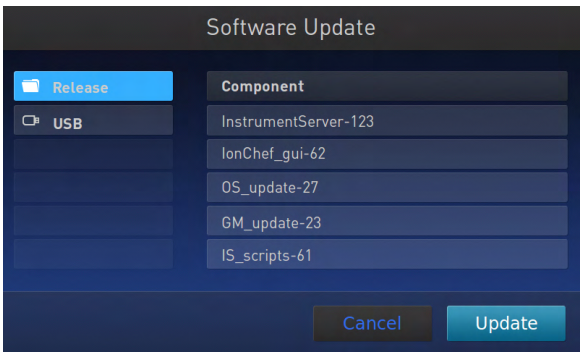



**CAUTION!** The Ion Chef™ Instrument emits UV light at 254 nm. Wear appropriate eye wear, protective clothing, and gloves when working near the instrument. Do not look directly at the UV light while it is illuminated during the cleaning routine.

# Install a firmware update

To ensure proper operation of the Ion Chef™ Instrument, we recommend periodically confirming that your instrument is running the most current firmware. We occasionally release updates to the instrument firmware, which can include important changes to the Ion Chef™ System operation. To ensure that your instrument is running the most current firmware, check the firmware version, then update if needed.

1. On the Ion Chef™ Instrument touchscreen, tap **Settings**.
2. On the **Settings** screen, tap **Check for updates**.
3. On the **Software Update** screen, tap **Release** to search the server for updates to the Ion Chef™ Instrument firmware.




**Note:** Users are also notified of the availability of firmware updates on the Notifications screen.

4. Select the available component update, tap **Update**, then wait for the instrument to complete the update.

   **Note:** If the Ion Chef™ Instrument is operating on an isolated network and cannot connect to our website, you must transfer the firmware update manually. To perform a manual update, transfer the firmware files to a USB drive and insert the drive into the USB port at the rear of the instrument. Tap **USB** on the Software Update screen, select from the list of available software components, then tap **Update**.

   When finished, the Ion Chef™ Instrument displays the update status.

5. Power off and on the Ion Chef™ Instrument to complete the update.

**IMPORTANT!** If you are updating the firmware manually, remove the USB drive before powering on the Ion Chef™ Instrument.

# Replace the ultraviolet bulb

Replace the ultraviolet (UV) bulb after approximately 500 hours of use.

## Materials required

| Item | Cat. No. |
|---|---|
| LAMP, 16W 2-PIN, G5T5 TUV | 4486547 |

**IMPORTANT!** The Ion Chef™ Instrument is designed to use UV bulbs ordered from Thermo Fisher Scientific only. Replace only with same type of UV bulb.

## Install a new UV bulb

**IMPORTANT!** Wear gloves when you handle the UV bulbs.

1. From the instrument touchscreen, tap ⏏, then open the instrument door.
2. Power off, then unplug the Ion Chef™ Instrument. Allow the instrument to cool for 15 minutes.

   **WARNING! PHYSICAL INJURY HAZARD.** The UV bulb in the Ion Chef™ Instrument can become hot when in use. Allow sufficient time for the bulb to cool and wear protective, powder-free gloves when handling it.

3. Firmly grasp the UV light (by the ends), twist the bulb 90 degrees, then carefully pull downward, removing from the slotted mount. Dispose of the used bulb appropriately.

   **Note:** The UV bulb fixture is positioned above the deck chamber at center.

① UV bulb

4. Remove the new UV bulb from its packaging. While holding the bulb nearest the ends, insert the bulb into the slotted mounts in the instrument, then rotate it until the bulb locks into place.

   **IMPORTANT!** Do not handle the replacement UV bulb without powder-free gloves. Oils from fingerprints can shorten lamp life.

5. Close the instrument door, then plug in and power on the Ion Chef™ Instrument.

6. When the instrument touchscreen displays the main menu, tap **Clean** to test the installation of the UV bulb by performing a cleaning routine.

   While the instrument performs the cleaning routine, confirm that the UV bulb illuminates the instrument interior, indicating a successful installation. If the UV bulb fails to illuminate, or if the instrument displays an error:

   a. Power off, then unplug the instrument.

   b. Reseat the UV bulb, then plug in and power on the instrument.

   c. Repeat the preceding test. If the UV bulb does not illuminate after reseating it several times, contact Technical Support.

A

# Troubleshooting

## Ion Chef™ System setup and operation

| Observation | Possible cause | Recommended action |
|---|---|---|
| Instrument does not display the home screen when powered on | Multiple causes are possible. | 1. Power off the instrument, wait 30 seconds, then power on the instrument.<br>2. If the instrument fails again, contact Technical Support. |
| The instrument door cannot be opened | An obstruction was present on or around the door mechanism. | Remove the obstruction blocking the door, then operate the instrument normally. |
| | A hardware or software error occurred. | Contact Technical Support to report the problem and for further assistance. |
| The instrument stops during a run | The instrument encountered an internal error. | 1. Record the error displayed on the instrument display, then tap **OK**.<br>2. Contact Technical Support to report the problem and for further assistance. |
| | A consumable was improperly loaded. | Ensure that all consumables are loaded according to the instructions provided. |
| Liquid droplets are present on the deck after a run | After normal instrument operation, a noticeable collection of liquid can be observed in the cartridge compartments, or on the deck. | Before the UV cleaning step, absorb any liquid residue with a dry lint-free laboratory wipe, then clean the area with a wipe moistened with 70% isopropanol. |
| Liquid residue is present in the Recovery centrifuge following a run | During normal instrument operation, a noticeable coating of liquid can collect on the bowl and buckets of the Recovery centrifuge following repeated runs. | Remove the residue as instructed in "Inspect and clean the Recovery centrifuges and buckets" on page 27. |

| Observation | Possible cause | Recommended action |
|---|---|---|
| Instrument will not begin a run | The instrument has encountered a Deck Scan error (one or more consumables are absent or loaded improperly). | 1. Confirm that the touchscreen does not display any Deck Scan warnings. If alarms are present, note the error(s) displayed, replace the missing consumable as directed, tap **No** when prompted then tap **Next** to cancel the run. After returning to the home screen, restart the run.<br>2. If the error persists, confirm that:<br>• All buckets are seated correctly in the rotors of the Recovery and Chip-Loading centrifuges.<br>• All cartridges are loaded correctly and are level on the instrument deck.<br>• The barcodes of the Ion Chef™ Library Sample Tubes are visible and positioned correctly.<br>• All tubes are both present *and* uncapped on the Reagents cartridge ( Library Sample Tubes, NaOH tube, and the empty tube).<br>3. If the error persists after you check the consumables on the instrument deck, do one of the following:<br>• If you are confident that the Ion Chef™ Instrument is set up correctly and you are comfortable disregarding the warnings, tap **YES** following Deck Scan to proceed with the run.<br>• If the instrument cannot begin the run, contact Technical Support for further assistance. |
| | The instrument has encountered an internal error. | 1. Record the error displayed on the instrument display, then touch **OK**.<br>2. Contact Technical Support to report the problem and for further assistance. |

| Observation | Possible cause | Recommended action |
|---|---|---|
| Instrument displays one or more alerts during a run | The instrument detected one or more problems during the run. | After the instrument completes the run, contact Technical Support. If possible, capture an image of the alert or error message to help troubleshoot.<br><br>**IMPORTANT!** The detected problem might impact the performance of the sequencing run. |
| | • Network connection to the server was interrupted.<br>• User name or password was incorrect. | 1. Tap the Instrument status button to view the alert(s).<br>2. In the Instrument status screen, confirm that the name of the Ion Torrent™ Server connection is red.<br>3. Contact your network administrator to confirm that:<br>  • The Ion Torrent™ Server can be accessed from the network port used by the Ion Chef™ Instrument. If not, troubleshoot the network connection.<br>  • The user name and password used by the Ion Chef™ Instrument are valid. If not, contact the server administrator to renew the credentials.<br>4. If the alert persists, capture an image of the alert or error message, if possible, to help troubleshoot, then contact Technical Support for further assistance. |

| Observation | Possible cause | Recommended action |
|---|---|---|
| Sequencing results are variable between samples in a run<br><br>**Note:** Users can sometimes see a significant difference in loading and sequencing metrics between identical samples that are prepared in the same Ion Chef™ run. A 10–20% difference in loading density using the same library is acceptable. The two samples in an Ion Chef™ run are handled independently, and due to normal variation intrinsic to the templating and chip-loading processes, these samples can exhibit different run results. Extensive testing has been done to evaluate the effect of sample position on sequencing metrics. These studies have shown no correlation between sample position and run quality. | The two libraries or barcoded library pools were not identical. | Confirm that the library type and input was the same for both samples. Different libraries can require different titration points and can behave differently on the Ion Chef™ Instrument. |
| | | Run a control library. Confirm that the control library shows the same disparity in performance as the sample. |
| | The library input was not optimal. | Confirm that the library input is correct. Use the Ion Sphere™ Assay on a Qubit™ Fluorometer to evaluate templating efficiency. We recommend a percentage of templated unenriched ISPs of 15–25%. |
| | | Increase the library input. If the library input is borderline too low, the differences in processing of the two samples can cause the recovery of one sample to be below the desired enriched ISP yield. Processing can vary with templating conditions, library types and lengths, and ISP types. |
| | The Ion Chef™ Instrument needs deck calibration. | If you see systematic variation that is unrelated to library input, perform the XYΘ and Z calibration routines (see "Run the XYΘ calibration" on page 17 and "Run the Z calibration" on page 21). |
| | | If the instrument continues to show systematic differences in throughput between the two sample and chip positions after a successful deck calibration, contact Technical Support to report the problem and for further assistance. |

# Expected throughput for Ion Torrent™ chips

The following table provides expected sequencing throughput specifications per chip type. For further information, see the specification sheets available at **thermofisher.com** at the web addresses listed after the table.

| Chip | Number of reads | Total throughput[1] | |
|---|---|---|---|
| | | 200-base read | 400-base read |
| Ion 314™ Chip v2 BC | 400–500 thousand | 30–50 Mb | 60–100 Mb |
| Ion 316™ Chip v2 BC | 2–3 million | 0.3–0.6 Gb | 0.6–1 Gb |
| Ion 318™ Chip v2 BC | 4–5.5 million | 0.6–1 Gb | 1.2–2 Gb |
| Ion 510™ Chip | 2–3 million | 0.3–0.5 Gb | 0.6–1 Gb |
| Ion 520™ Chip | 3–5 million | 0.6–1 Gb | 1.2–2 Gb |
| Ion 530™ Chip | 15–20 million | 3–4 Gb | 6–8 Gb |
| Ion 540™ Chip | 60–80 million | 8–10 Gb | — |
| Ion PI™ Chip v3 | 60–80 million | 8–10 Gb | — |
| Ion 550™ Chip | 100–130 million | 20–25 Gb | — |

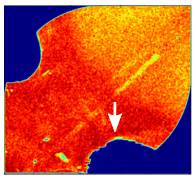
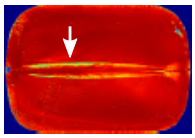
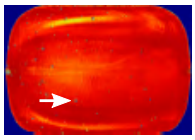
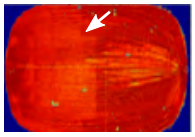
[1] Expected output with >99% aligned/measured accuracy. Output depends on read length and application.

System specification sheets

| | |
|---|---|
| Ion PGM™ System | **https://tools.thermofisher.com/content/sfs/brochures/PGM-Specification-Sheet.pdf** |
| Ion Proton™ System | **http://tools.thermofisher.com/content/sfs/brochures/CO06326_Proton_Spec_Sheet_FHR.pdf** |
| Ion S5™ System/Ion S5™ XL System | **http://tools.thermofisher.com/content/sfs/brochures/Ion-S5-S5XL-SpecSheet.pdf** |
| Ion GeneStudio™ S5 Series System | **https://www.thermofisher.com/document-connect/document-connect.ion-genestudio-s5-seriesflyer.pdf** |

# Loading images for normal runs

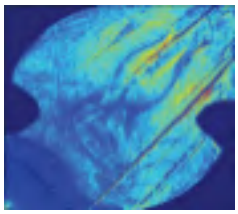
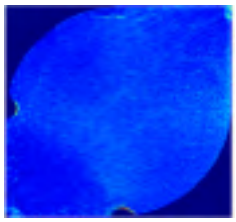
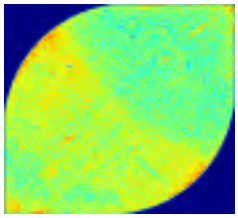
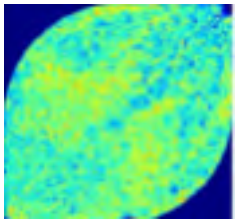
The following table shows loading images that depict typical loading phenotypes for normal runs. For each image type, causes and best practices are listed.

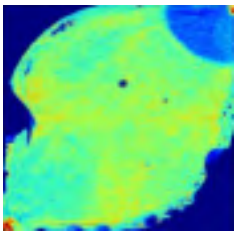
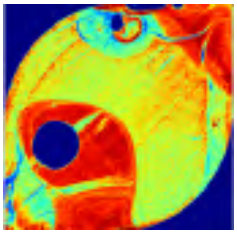
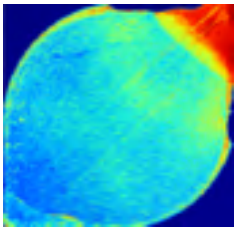
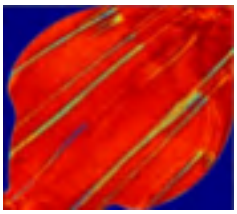
| Description | Run details | Chip image | Causes and best practices |
|---|---|---|---|
| Areas of blue at the side of chip | Ion 314™ Chips; all kits |  | • Bubbles or debris that obstructs part of the chip is normal. This will cause a reduction in reads and useable wells.<br>• This impact is lessened on larger chips like Ion 316™ and Ion 318™ Chips.<br>• Ensure that you are centrifuging Ion 314™ Chips upside down for 5 seconds to empty the flowcell after the Ion Chef™ run is complete. |
| Low loading streaks through middle of the chip | Ion PI™/Ion 5xx series chips; all kits |  | • Known cosmetic issue<br>• Bubbles introduced in loading can cause streaking throughout the chip.<br>• Does not impact performance. |
| Low loading speckling throughout the chip | Ion PI™/Ion 5xx series chips |  | • Known cosmetic issue<br>• Bead clumping or artifacts can cause speckles.<br>• Does not impact performance. |
| Visualized blocks in loading heatmap | Ion 530™ Chips |  | • Known cosmetic issue<br>• Does not impact performance. |
| | Ion 520™ Chips |  | |

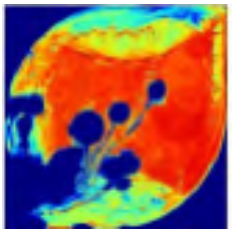
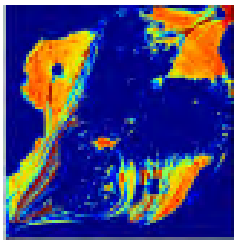
# Troubleshoot common loading failure types with chip image phenotypes

The following tables show loading images for commonly seen failure types. For each type, a description and possible causes and recommended actions are listed. This information is intended to help focus troubleshooting efforts based on the loading image from the sequencing run report.

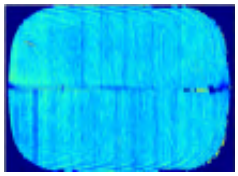
## Ion PGM™ Chef runs

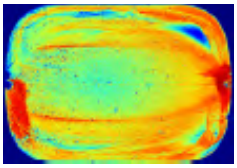
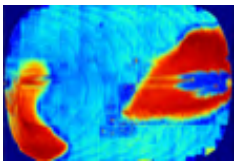
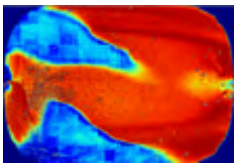
| Observation | Possible cause | Recommended action |
|---|---|---|
| Poor or no loading<br>  <br>  <br>  | Yield of template-positive Ion Sphere™ Particles (ISPs) was low, caused by<br>• Low library input<br>• Improper chip handling<br>• Enrichment failure, caused, for example, by failure to remove cap of NaOH tube in Reagents cartridge before start of run | 1. Review Test Fragment (TF) metrics.<br>• If TFs are missing, or count or signal is low:<br>– There was a problem with recovery.<br>– Chips were handled improperly.<br>• If TFs are present and have expected key signal and quality:<br>– Check percentage of unenriched template-positive ISPs using the Ion Sphere™ Assay with a Qubit™ Fluorometer: <10% unenriched template-positive ISPs indicates library input was too low.<br>– Requantify library concentration and repeat library preparation, if needed.<br>2. Repeat the Ion Chef™ templating run after verifying library quality, and/or remaking library, to rule out user error or a consumable problem.<br>3. If low library input and user error are ruled out, perform XYΘ and Z calibrations on the Ion Chef™ Instrument.<br>4. If the problem continues, contact Technical Support to report the problem and for further assistance. |
| Punctate yellow or blue dots, or uniform teal loading<br>  | No or insufficient polymerase or primer was added to the sample. | 1. Repeat the Ion Chef™ templating run to rule out user error, or a consumable or sequencer problem.<br>2. If failure repeats, run a control library to rule out a library preparation problem.<br>3. If the problem continues, contact Technical Support to report the problem and for further assistance. |

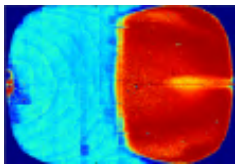
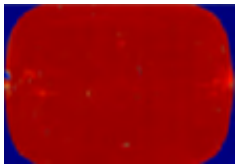
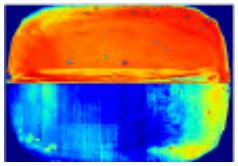
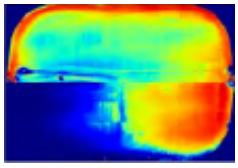
| Observation | Possible cause | Recommended action |
|---|---|---|
| Low loading area upper right corner of chip<br>  | Chip was installed in the Ion Chef™ Instrument in the incorrect orientation. | • See the kit user guide for proper chip installation instructions.<br>• Place the adapter/chip assemblies into centrifuge buckets so that the chip barcode aligns above the white outline that is imprinted on the floor of the bucket. |
| Variable, low, or uneven loading<br>  <br>  | Liquid was left in chip. | • See the kit user guide for proper chip handling after the run completes. Remove the chip and adapter from the Chip-loading centrifuge promptly.<br>• If there is visible liquid in the Chip Adapter ports, it can be withdrawn with a pipette before removing the adapter from the chip.<br>• To remove an adapter, hold the chip with the tab facing downward, then remove Chip Adapter the starting with the top hinge first.<br>• If using Ion 314™ Chips, centrifuge upside down for 5 seconds after removing the adapter. |
| High loading or high polyclonality<br>  | Too many ISPs were loaded. | 1. Requantify library concentration and perform a QC check for percentage of template-positive ISPs in unenriched ISP samples using the Ion Sphere™ Assay with a Qubit™ Fluorometer: >30% template-positive ISPs indicates that library input is too high.<br>2. Repeat the Ion Chef™ templating run after verifying library concentration, and reduce library input. |

| Observation | Possible cause | Recommended action |
|---|---|---|
| Bubbles<br>  <br>  | • The Wash 2 Bottle had a leaky seal.<br>• The sequencer waste line was clogged.<br>• There was an internal line leak in the sequencer. | Contact Technical Support for service on the Ion PGM™ Sequencer. |

## Ion Proton™, Ion S5™/Ion S5™ XL, and Ion GeneStudio™ S5 Chef runs

| Observation | Possible cause | Recommended action |
|---|---|---|
| No loading (blue chip)<br>  | Yield of template-positive Ion Sphere™ Particles (ISPs) was low, caused by<br>• Low library input<br>• Enrichment failure, caused, for example, by failure to remove cap of NaOH tube in Reagents cartridge before start of run | 1. Review Test Fragment (TF) metrics.<br>  • If TFs are missing, or count or signal is low, there may be a problem with consumables, ISP enrichment, or recovery on the Ion Chef™ Instrument or with the sequencer.<br>  • If TFs are present and have expected key signal and quality:<br>  – Check percentage of unenriched template-positive ISPs using the Ion Sphere™ Assay with a Qubit™ Fluorometer: <10% unenriched template-positive ISPs indicates that library input was too low.<br>  – Requantify library concentration and repeat library preparation, if needed.<br>2. Repeat the Ion Chef™ templating run after verifying library quality, and/or remaking library, to rule out user error or a consumable problem.<br>3. If the problem continues, contact Technical Support. |

| Observation | Possible cause | Recommended action |
|---|---|---|
| Low loading<br>  | • The Chip Adapter was improperly installed.<br>• The Chip Adapter was defective.<br>• The yield of template-positive ISPs was low due to low library input. | 1. Review Test Fragment (TF) metrics.<br>  • If TFs are missing, or count or signal is low, there may be a problem with consumables, ISP enrichment, or recovery on the Ion Chef™ Instrument or with the sequencer.<br>  • If TFs are present and have expected key signal and quality:<br>  – Check percentage of unenriched template-positive ISPs using the Ion Sphere™ Assay with a Qubit™ Fluorometer: <10% unenriched template-positive ISPs indicates that library input was too low.<br>  – Requantify library concentration and repeat library preparation, if needed.<br>2. Carefully inspect Chip Adapters for defective gaskets and presence of foreign material before use.<br>3. Repeat the Ion Chef™ templating run after verifying library quality, and/or remaking library, to rule out user error or a consumable problem.<br>4. If low library input and user error are ruled out, perform XYΘ and Z calibrations on the Ion Chef™ Instrument.<br>5. If the problem continues, contact Technical Support to report the problem and for further assistance. |
| Uneven loading—Ion S5™ chips<br>  <br>  | Loading was uneven due to a defective Ion S5™ Chip Adapter. | Carefully inspect Chip Adapters for defective gaskets and presence of foreign material before use. |

| Observation | Possible cause | Recommended action |
|---|---|---|
| Poor loading on the left side of the chip<br>  | The sample volume that was loaded in the chip was low. | Contact Technical Support to report the problem and for further assistance. |
| High loading or high polyclonality<br>  | Too many ISPs were loaded. | 1. Requantify library concentration and perform a QC check for percentage of template-positive ISPs in unenriched ISP samples using the Ion Sphere™ Assay with a Qubit™ Fluorometer: >25% template-positive ISPs indicates that library input is too high.<br>2. Repeat the Ion Chef™ templating run after verifying library concentration, and reduce library input. |
| Missing chip blocks, blocky heat map<br>  <br>  | • There was a chip problem.<br>• The sequencer has a pogo pin or chip clamp problem. | • Save the chip for possible diagnosis by support team.<br>• Contact Technical Support to report the problem and for further assistance. |

# Ion Chef™ Instrument user issues

The following is a list of common errors that are made by Ion Chef™ users.

- Tip Cartridge locking bracket is not closed securely before the start of a run.
  - The Tip Cartridge can be dislodged during a run if it is not closed securely.
  - The lever of the locking bracket can interfere with pipette arm and cause run to abort or complete with chips with no ISP loading.
- Cap of NaOH tube in Position C of Reagents cartridge has not been not removed before the start of a run.

  Deck scan should detect a capped tube and report it to the user. If this is does not happen, the following failure modes are possible:
  - Ion Chef™ run aborts—no samples created
  - Ion Chef™ run completes but chips do not have any ISPs (Melt off solution for enrichment is not created; can have bent 1000-uL pipette tip in waste location or on deck).
- Recovery tubes have not been fully seated in buckets.
  - During a run, pipette can dislodge bucket causing centrifuge fault, and causing a run to abort.
- Recovery centrifuge lids have not been snapped into place firmly.
  - Pipette can lift centrifuge lid, causing the lid to interfere with downstream pipette movement and causing a run to abort.
- The Ion Chef™ Instrument is power-cycled before a firmware update is complete.
  - Files can become corrupted and Ion Chef™ Instrument may not run, or may run an incorrect program.
- User does not recognize that the door spring is damaged.
  - Door cannot open during QC pause or at end of timed run, causing a run to abort.
- The door is incompletely latched.
  - Ion Chef™ Instrument will not proceed. The stall sometimes occurs at the QC pause.

B

# Safety

**WARNING! GENERAL SAFETY.** Using this product in a manner not specified in the user documentation may result in personal injury or damage to the instrument or device. Ensure that anyone using this product has received instructions in general safety practices for laboratories and the safety information provided in this document.

- Before using an instrument or device, read and understand the safety information provided in the user documentation provided by the manufacturer of the instrument or device.
- Before handling chemicals, read and understand all applicable Safety Data Sheets (SDSs) and use appropriate personal protective equipment (gloves, gowns, eye protection, and so on). To obtain SDSs, see the "Documentation and Support" section in this document.

## Symbols on this instrument

Symbols may be found on the instrument to warn against potential hazards or convey important safety information. In this document, the hazard symbol is used along with one of the following user attention words:

- **CAUTION!** – Indicates a potentially hazardous situation that, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.
- **WARNING!** – Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.
- **DANGER!** – Indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury.

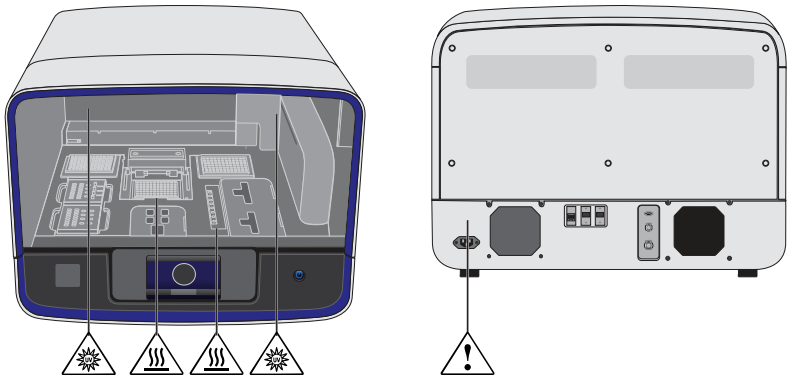
| Symbol | English | Français |
|---|---|---|
|  | Caution, risk of danger<br>Consult the manual for further safety information. | Attention, risque de danger<br>Consulter le manuel pour d'autres renseignements de sécurité. |
|  | Moving parts | Parties mobiles |
|  | Caution, hot surface | Attention, surface chaude |

| Symbol | English | Français |
|---|---|---|
|  | Ultraviolet light | Rayonnement ultraviolet |
|  | Protective conductor terminal (main ground) | Borne de conducteur de protection (mise à la terre principale) |
|  | Do not dispose of this product in unsorted municipal waste<br><br>**CAUTION!** To minimize negative environmental impact from disposal of electronic waste, do not dispose of electronic waste in unsorted municipal waste. Follow local municipal waste ordinances for proper disposal provision and contact customer service for information about responsible disposal options. | Ne pas éliminer ce produit avec les déchets usuels non soumis au tri sélectif.<br><br>**MISE EN GARDE !** Pour minimiser les conséquences négatives sur l'environnement à la suite de l'élimination de déchets électroniques, ne pas éliminer ce déchet électronique avec les déchets usuels non soumis au tri sélectif. Se conformer aux ordonnances locales sur les déchets municipaux pour les dispositions d'élimination et communiquer avec le service à la clientèle pour des renseignements sur les options d'élimination responsable. |

## Conformity symbols

| Conformity mark | Description |
|---|---|
|  | Indicates conformity with safety requirements for Canada and U.S.A. |
|  | Indicates conformity with European Union Low Voltage Directive 2006/95/EC, EMC Directive 2014/30/EU, and R&TTE Directive 1999/5/EC. |
|  | Indicates conformity with Australian standards for electromagnetic compatibility. |

# Location of safety labels on this instrument



# Safety information for instruments not manufactured by Thermo Fisher Scientific

Some of the accessories provided as part of the instrument system are not designed or built by Thermo Fisher Scientific. Consult the manufacturer's documentation for the information needed for the safe use of these products.

# Instrument safety

## General

**CAUTION! Do not remove instrument protective covers.** If you remove the protective instrument panels or disable interlock devices, you may be exposed to serious hazards including, but not limited to, severe electrical shock, laser exposure, crushing, or chemical exposure.

**CAUTION! Solvents and Pressurized fluids.** Wear eye protection when working with any pressurized fluids. Use caution when working with any polymeric tubing that is under pressure:

- Extinguish any nearby flames if you use flammable solvents.
- Do not use polymeric tubing that has been severely stressed or kinked.
- Do not use polymeric tubing with tetrahydrofuran or nitric and sulfuric acids.
- Be aware that methylene chloride and dimethyl sulfoxide cause polymeric tubing to swell and greatly reduce the rupture pressure of the tubing.
- Be aware that high solvent flow rates (~40mL/min) may cause a static charge to build up on the surface of the tubing and electrical sparks may result.

## Physical injury

**CAUTION! Moving and Lifting Injury.** The instrument is to be moved and positioned only by the personnel or vendor specified in the applicable site preparation guide. Improper lifting can cause painful and permanent back injury.

Things to consider before lifting or moving the instrument or accessories:

- Depending on the weight, moving or lifting may require two or more persons.
- If you decide to lift or move the instrument after it has been installed, do not attempt to do so without the assistance of others, the use of appropriate moving equipment, and proper lifting techniques.
- Ensure you have a secure, comfortable grip on the instrument or accessory.
- Make sure that the path from where the object is to where it is being moved is clear of obstructions.
- Do not lift an object and twist your torso at the same time. Keep your spine in a good neutral position while lifting with your legs.
- Participants should coordinate lift and move intentions with each other before lifting and carrying.
- For smaller packages, rather than lifting the object from the packing box, carefully tilt the box on its side and hold it stationary while someone else slides the contents out of the box.

**CAUTION! Moving Parts.** Moving parts can crush, pinch and cut. Keep hands clear of moving parts while operating the instrument. Disconnect power before servicing.

## Electrical safety

**WARNING! Fuse Installation.** Before installing the instrument, verify that the fuses are properly installed and the fuse voltage matches the supply voltage. Replace fuses only with the type and rating specified for the unit. Improper fuses can damage the instrument wiring system and cause a fire.

**WARNING! Voltage Selector Switch.** Before installing the instrument, verify that the voltage selector switch is set for the supply voltage. This will prevent damage to the instrument, reduce risk of fire, and enable proper operation.

**WARNING! Ensure appropriate electrical supply.** For safe operation of the instrument:

- Plug the system into a properly grounded receptacle with adequate current capacity.
- Ensure the electrical supply is of suitable voltage.
- Never operate the instrument with the ground disconnected. Grounding continuity is required for safe operation of the instrument.

**WARNING! Power Supply Line Cords.** Use properly configured and approved line cords for the power supply in your facility.

**WARNING! Disconnecting Power.** To fully disconnect power either detach or unplug the power cord, positioning the instrument such that the power cord is accessible.

## Cleaning and decontamination

**CAUTION! Cleaning and Decontamination.** Use only the cleaning and decontamination methods that are specified in the manufacturer user documentation. It is the responsibility of the operator (or other responsible person) to ensure that the following requirements are met:

- No decontamination or cleaning agents are used that can react with parts of the equipment or with material that is contained in the equipment. Use of such agents could cause a HAZARD condition.
- The instrument is properly decontaminated a) if hazardous material is spilled onto or into the equipment, and/or b) before the instrument is serviced at your facility or is sent for repair, maintenance, trade-in, disposal, or termination of a loan. Request decontamination forms from customer service.
- Before using any cleaning or decontamination methods (except methods that are recommended by the manufacturer), confirm with the manufacturer that the proposed method will not damage the equipment.

## Ultraviolet (UV) Safety

The Ion Chef™ System uses a UV lamp which emits light at 254 nm. Under normal operating conditions, the UV lamp is powered on when performing the cleaning protocol. Safety interlocks are used to ensure that the UV lamp is not powered when the door is open.

# Safety and electromagnetic compatibility (EMC) standards

The instrument design and manufacture complies with the following standards and requirements for safety and electromagnetic compatibility.

## Safety compliance

| Reference | Description |
|---|---|
| EU Directive 2006/95/EC | European Union "Low Voltage Directive" |
| IEC 61010-1<br>EN 61010-1<br>UL 61010-1<br>CSA C22.2 No. 61010-1 | *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements* |
| IEC 61010-2-010<br>EN 61010-2-010 | *Safety requirements for electrical equipment for measurement, control and laboratory use – Part 2-010: Particular requirements for laboratory equipment for the heating of materials* |
| IEC/EN 61010-2-020 | *Safety requirements for electrical equipment for measurement, control and laboratory use – Part 2-020: Particular requirements for laboratory centrifuges* |
| IEC 61010-2-081<br>EN 61010-2-081 | *Safety requirements for electrical equipment for measurement, control and laboratory use – Part 2-081: Particular requirements for automatic and semi-automatic laboratory equipment for analysis and other purposes* |

## EMC

| Reference | Description |
|---|---|
| Directive 2014/30/EU | *European Union "EMC Directive"* |
| FCC Part 15 | *U.S. Standard "Industrial, Scientific, and Medical Equipment"* |
| AS/NZS 2064 | *Limits and Methods of Measurement of Electromagnetic Disturbance Characteristics of Industrial, Scientific, and Medical (ISM) Radiofrequency Equipment* |
| ICES-001, Issue 3 | *Industrial, Scientific and Medical (ISM) Radio Frequency Generators* |
| US FCC CFR Title 47 Part 15.225, Subpart C | *Operation within the band 13.110–14.010 MHz.* |
| Industry Canada RSS 210, Issue 8, Annex 2 EN 302 291-1/2 V1.1.1 | *Licence-Exempt Radio Apparatus: Category I Equipment* |

## Environmental design

| Reference | Description |
|---|---|
| Directive 2012/19/EU | European Union "WEEE Directive" – Waste electrical and electronic equipment |
| Directive 2011/65/EU | European Union "RoHS Directive" – Restriction of hazardous substances in electrical and electronic equipment |

# Chemical safety

**WARNING! GENERAL CHEMICAL HANDLING.** To minimize hazards, ensure laboratory personnel read and practice the general safety guidelines for chemical usage, storage, and waste provided below. Consult the relevant SDS for specific precautions and instructions:

- Read and understand the Safety Data Sheets (SDSs) provided by the chemical manufacturer before you store, handle, or work with any chemicals or hazardous materials. To obtain SDSs, see the "Documentation and Support" section in this document.
- Minimize contact with chemicals. Wear appropriate personal protective equipment when handling chemicals (for example, safety glasses, gloves, or protective clothing).
- Minimize the inhalation of chemicals. Do not leave chemical containers open. Use only with sufficient ventilation (for example, fume hood).
- Check regularly for chemical leaks or spills. If a leak or spill occurs, follow the manufacturer cleanup procedures as recommended in the SDS.
- Handle chemical wastes in a fume hood.
- Ensure use of primary and secondary waste containers. (A primary waste container holds the immediate waste. A secondary container contains spills or leaks from the primary container. Both containers must be compatible with the waste material and meet federal, state, and local requirements for container storage.)
- After emptying a waste container, seal it with the cap provided.
- Characterize (by analysis if needed) the waste generated by the particular applications, reagents, and substrates used in your laboratory.
- Ensure that the waste is stored, transferred, transported, and disposed of according to all local, state/provincial, and/or national regulations.
- **IMPORTANT!** Radioactive or biohazardous materials may require special handling, and disposal limitations may apply.

**WARNING! HAZARDOUS WASTE (from instruments).** Waste produced by the instrument is potentially hazardous. Follow the guidelines noted in the preceding General Chemical Handling warning.

**WARNING! 4L Reagent and Waste Bottle Safety.** Four-liter reagent and waste bottles can crack and leak. Each 4-liter bottle should be secured in a low-density polyethylene safety container with the cover fastened and the handles locked in the upright position.

# Biological hazard safety

**WARNING! Potential Biohazard.** Depending on the samples used on this instrument, the surface may be considered a biohazard. Use appropriate decontamination methods when working with biohazards.

**WARNING! BIOHAZARD.** Biological samples such as tissues, body fluids, infectious agents, and blood of humans and other animals have the potential to transmit infectious diseases. Conduct all work in properly equipped facilities with the appropriate safety equipment (for example, physical containment devices). Safety equipment can also include items for personal protection, such as gloves, coats, gowns, shoe covers, boots, respirators, face shields, safety glasses, or goggles. Individuals should be trained according to applicable regulatory and company/ institution requirements before working with potentially biohazardous materials. Follow all applicable local, state/provincial, and/or national regulations. The following references provide general guidelines when handling biological samples in laboratory environment.

- U.S. Department of Health and Human Services, *Biosafety in Microbiological and Biomedical Laboratories (BMBL)*, 5th Edition, HHS Publication No. (CDC) 21-1112, Revised December 2009; found at:
  **https://www.cdc.gov/labs/pdf/CDC-BiosafetymicrobiologicalBiomedicalLaboratories-2009-P.pdf**
- World Health Organization, *Laboratory Biosafety Manual*, 3rd Edition, WHO/CDS/CSR/LYO/2004.11; found at:
  **www.who.int/csr/resources/publications/biosafety/Biosafety7.pdf**

# Documentation and support

## Related documentation

The following Ion Chef™ reagent kit user guides and quick references, and related guides are available for download on the instrument and kit product pages at **thermofisher.com**.

| Document | Publication number |
|---|---|
| *Ion AmpliSeq™ Library Preparation on the Ion Chef™ System User Guide* | MAN0013432 |
| *Ion AmpliSeq™ Library Preparation on the Ion Chef™ System Quick Reference* | MAN0013433 |
| *Ion PGM™ Hi-Q™ View Chef Kits User Guide* | MAN0014571 |
| *Ion PGM™ Hi-Q™ View Chef Kits Quick Reference* | MAN0014572 |
| *Ion PI™ Hi-Q™ Chef Kit User Guide* | MAN0010967 |
| *Ion PI™ Hi-Q™ Chef Kit Quick Reference* | MAN0010968 |
| *Ion 510™ & Ion 520™ & Ion 530™ Kit – Chef User Guide* | MAN0016854 |
| *Ion 510™ & Ion 520™ & Ion 530™ Kit – Chef Quick Reference* | MAN0016855 |
| *Ion 520™ & Ion 530™ ExT Kit – Chef User Guide* | MAN0015805 |
| *Ion 520™ & Ion 530™ ExT Kit – Chef Quick Reference* | MAN0015806 |
| *Ion 540™ Kit – Chef User Guide* | MAN0010851 |
| *Ion 540™ Kit – Chef Quick Reference* | MAN0014119 |
| *Ion 550™ Kit – Chef User Guide* | MAN0017275 |
| *Ion 550™ Kit – Chef Quick Reference* | MAN0017276 |
| *Ion Chef™ System Site Preparation Guide* | MAN0007956 |
| *Ion Chef™ Instrument Network Connection User Guide* | MAN0013444 |
| *Ion Sphere™ Quality Control Kit User Guide* | MAN0017531 |

# Customer and technical support

Visit **thermofisher.com/support** for the latest service and support information.

- Worldwide contact telephone numbers
- Product support information
  - Product FAQs
  - Software, patches, and updates
  - Training for many applications and instruments
- Order and web support
- Product documentation
  - User guides, manuals, and protocols
  - Certificates of Analysis
  - Safety Data Sheets (SDSs; also known as MSDSs)

    **Note:** For SDSs for reagents and chemicals from other manufacturers, contact the manufacturer.

# Limited product warranty

Life Technologies Corporation and/or its affiliate(s) warrant their products as set forth in the Life Technologies' General Terms and Conditions of Sale at **www.thermofisher.com/us/en/home/global/terms-and-conditions.html**. If you have any questions, please contact Life Technologies at **www.thermofisher.com/support**.