iontorrent
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Oncomine™ Dx Target Test Part I: Sample Preparation and Quantification

USER GUIDE

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IVD

For In Vitro Diagnostic Use.

Life Technologies Holdings Pte Ltd | Block 33 | Marsiling Industrial Estate Road 3 | #07-06, Singapore 739256

Products manufactured in Singapore:

Ion PGM™ Dx Instrument System
Ion PGM™ Dx Sequencer
Ion OneTouch™ Dx Instrument
Ion OneTouch™ ES Dx Instrument
Ion PGM™ Dx Chip Minifuge (120V)
Ion PGM™ Wireless Scanner
Ion Torrent™ Server
Veriti™ Dx Thermal Cycler

Life Technologies Corporation | 7335 Executive Way | Frederick, MD 21704 | USA

Products manufactured in Frederick:

Oncomine™ Dx Target Test Kit
Ion Torrent Dx FFPE Sample Preparation Kit
Ion PGM™ Dx Library Kit
Ion OneTouch™ Dx Template Kit
Ion PGM™ Dx Sequencing Kit
Ion 318™ Dx Chip
Ion OneTouch™ Rack Kit
DynaMag™ Dx 96-Well Plate Magnet
DynaMag™ Dx 16 2-mL Magnet

The customer is responsible for validation of assays and compliance with regulatory requirements that pertain to their procedures and uses of the instrument.

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

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A.0	30 September 2016	FDA submission

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About this guide

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

Purpose of this guide

This user guide provides instructions for using the Ion Torrent Dx FFPE Sample Preparation Kit to isolate and quantify DNA and RNA from formalin-fixed, paraffin-embedded (FFPE) tissue samples that are mounted on slides. Instructions are also provided for preparing cDNA from the isolated RNA.

Oncomine™ Dx Target Test Kit user guides

This user guide is part of a five-guide set.

Note: The procedures in these guides supersede the instructions in the *Ion PGM™ Dx System User Guide* when using the Ion PGM™ Dx System with the Oncomine™ Dx Target Test.

- *Oncomine™ Dx Target Test Part I: Sample Preparation and Quantification User Guide*
- *Oncomine™ Dx Target Test Part II: Library Preparation User Guide*
- *Oncomine™ Dx Target Test Part III: Template Preparation User Guide*
- *Oncomine™ Dx Target Test Part IV: Sequencing User Guide*
- *Oncomine™ Dx Target Test Part V: Analysis and Test Reports User Guide*

All five guides are required to complete the entire Oncomine™ Dx Target Test workflow.

1 Product information

Product description

Oncomine™ Dx Target Test

The Oncomine™ Dx Target Test is an *in vitro* diagnostic next-generation sequencing test to detect somatic alterations in human DNA and RNA isolated from non-small cell lung cancer (NSCLC) tumor specimens in formalin-fixed, paraffin-embedded (FFPE) tissue samples. Detection of these variants is performed using the Ion PGM™ Dx System.

The Oncomine™ Dx Target Test Kit (Cat. No. A32451) provides a set of primers in two panels that target key regions of 23 cancer-related genes.

Sample preparation components

The Ion Torrent Dx FFPE Sample Preparation Kit, included as part of the Oncomine™ Dx Target Test Kit, provides the following components for isolating and quantifying DNA and RNA from FFPE tissue samples that are mounted on slides:

- Ion Torrent Dx Total Nucleic Acid Isolation Kit, for extracting and isolating DNA and RNA from FFPE tissue samples
- Ion Torrent Dx DNA Quantification Kit, for quantifying DNA using a fluorometer/fluorescence reader
- Ion Torrent Dx RNA Quantification Kit, for quantifying RNA using a fluorometer/fluorescence reader

The Ion Torrent Dx cDNA Synthesis Kit and the Oncomine™ Dx Target Test and Controls are used to reverse transcribe the quantified RNA into cDNA.

Intended use

The Oncomine™ Dx Target Test is a qualitative *in vitro* diagnostic test that uses targeted high-throughput, parallel-sequencing technology to detect single-nucleotide variants (SNVs) and deletions in 23 genes from DNA and fusions in ROS1 from RNA isolated from formalin-fixed, paraffin-embedded (FFPE) tumor tissue samples from patients with non-small cell lung cancer (NSCLC) using the Ion PGM™ Dx System.

The test is indicated to aid in selecting NSCLC patients for treatment with the targeted therapies listed in Table 1 in accordance with the approved therapeutic product labeling.

Table 1 List of variants for therapeutic use

Gene	Variant	Targeted therapy
BRAF	BRAF V600E	TAFINLAR® (dabrafenib) in combination with MEKINIST® (trametinib)
ROS1	ROS1 fusions	XALKORI® (crizotinib)
EGFR	L858R, Exon 19 deletions	IRESSA® (gefitinib)

Safe and effective use has not been established for selecting therapies using this device for the variants in Table 1 in tissue types other than NSCLC.

Results other than those listed in Table 1 are indicated for use only in patients who have already been considered for all appropriate therapies (including those listed in Table 1).

Analytical performance using NSCLC specimens has been established for the variants listed in Table 2.

Table 2 List of variants with established analytical performance only

Gene	Variant ID/type	Nucleotide change
KRAS	COSM512	c.34_35delGGinsTT
KRAS	COSM516	c.34G>T
MET	COSM707	c.3029C>T
PIK3CA	COSM754	c.1035T>A

The test is not indicated to be used for standalone diagnostic purposes, screening, monitoring, risk assessment, or prognosis.

Theory of operation

Overview

DNA and RNA are isolated from NSCLC tissue samples prepared as FFPE sections on slides. The amounts of DNA and RNA in a sample are quantified, and if they meet the minimum required amounts for the test, cDNA is prepared from the RNA. The DNA and cDNA are made into amplicon libraries using the Ion PGM™ Dx Library Kit and the Oncomine™ Dx Target Test DNA and RNA Panel, which target the variants and gene fusions of interest for the test. No-template libraries and control libraries specific to the test are also prepared.

Employing emulsion PCR, each amplicon library is templated onto Ion PGM™ Dx Ion Sphere™ Particles (ISPs) using the Ion OneTouch™ Dx Template Kit on the Ion OneTouch™ Dx Instrument. Templated ISPs are enriched from non-templated ISPs on the Ion OneTouch™ ES Dx Instrument and loaded onto an Ion 318™ Dx Chip with the Ion PGM™ Dx Chip Minifuge. The sequencing reaction is performed using the Ion PGM™ Dx Sequencing Kit on the Ion PGM™ Dx Sequencer, which measures hydrogen ions that are generated during the incorporation of nucleotides into the nascent strand complementary to the template sequence.

The signal generated by the sequencing reaction on the Ion 318™ Dx Chip is translated into base calls and then reads. The reads are mapped to a reference sequence, and reports are generated for the specific variants and gene fusions targeted by the test. This process is executed using the Torrent Suite™ Dx Software, which runs on the Ion Torrent™ Server. A final test report is generated with a summary of the samples, test results, and any recommended therapies associated with the detected variants and gene fusions.

Using parameters in the Oncomine™ Dx Target Test Assay Definition File, Torrent Suite™ Dx Software manages the complete end-to-end workflow from sample preparation to test results. The Ion OneTouch™ Dx Instrument and Ion PGM™ Dx Sequencer are controlled by instrument control software (ICS). The end result of this workflow is a set of variant calls that correspond to the original tissue sample and that result in a recommendation for a particular patient therapy or therapies.

Sample and library preparation

The system has been validated with DNA and RNA isolated from FFPE NSCLC tissue samples using the Ion Torrent Dx FFPE Sample Preparation Kit. For resection or surgical biopsies, the recommended tissue input is 2 × 5-micron sections. For core-needle biopsies, the recommended tissue input is 9 × 5-micron sections. If the tumor content is less than 20% and the tumor content in the region of interest is greater than or equal to 10%, the tissue samples should be macrodissected and enriched for tumor content. After DNA and RNA isolation and quantification, the following minimum values are required for library preparation:

Table 3 Required sample concentrations and R^2 values from the linear regression of the standards

Sample type	Required concentration	Required R^2 value
DNA	≥0.83 ng/µL	≥0.99
RNA	≥1.43 ng/µL	≥0.98

The RNA is transcribed into cDNA using the Ion Torrent Dx cDNA Synthesis Kit, and sample and control amplicon libraries are prepared from the cDNA and DNA using primers and reagents in the Oncomine™ Dx Target Test and Controls and Ion PGM™

Dx Library Kit. Libraries created using these kits have a distinguishing nucleic acid sequence barcode incorporated into each amplicon. Information about each sample and its resulting libraries are entered into Torrent Suite™ Dx Software, which tracks the progress of the sample from library preparation through analysis. The Oncomine™ Dx Target Test Assay Definition File defines the sample and library information required and tracked by the software.

Template preparation and sequencing

Using the Ion OneTouch™ Dx Instrument and the process of emulsion PCR, the pooled library molecules are bound to Ion PGM™ Dx ISPs and each nucleic acid sequence is clonally amplified over the ISP surface. The templated beads are enriched and collected using the Ion OneTouch™ ES Dx Instrument. Sequencing primer is annealed to the single-stranded template, sequencing enzyme is added, and the beads are loaded onto the Ion 318™ Dx Chip. Chip loading occurs through use of the Ion PGM™ Dx Chip Minifuge. The chip is then placed onto the Ion PGM™ Dx Sequencer, where the DNA sequencing reaction occurs.

As the Ion PGM™ Dx Sequencer flows nucleotides over the chip surface, bases are incorporated into the strands on the bead in each well, resulting in the release of protons and a concomitant pH change in the well. The change in pH is detected by sensors at the base of each well on the chip. This initial electrical trace is processed for each well and transmitted to the Ion PGM™ Torrent Server associated with the system.

Throughout this procedure, as the sample is prepared and processed by each instrument, sample and reagent information are recorded and tracked by Torrent Suite™ Dx Software.

Data analysis

On the Ion PGM™ Torrent Server, the initial traces are processed and bases are called. These calls are assembled into files representing the reads, which are strings of nucleotide bases in the order found in the original library molecules. The reads are then mapped to the reference files provided with the test. Finally, Torrent Suite™ Dx Software assesses the mapped reads at specific nucleotide locations and looks for variation from the sequence information in the human reference sequence.

Results

Using the parameters in the Oncomine™ Dx Target Test Assay Definition File, Torrent Suite™ Dx Software generates electronic reports for each sequenced sample and its associated controls. The Results Report contains QC and reference information, detailed sequencing analytics, and all variant and gene fusion calls. The Test Report is a clinical report that lists the variants and gene fusions detected in the sample that are screened by the Oncomine™ Dx Target Test, and any recommended therapies. The Lab Report is a clinical report that includes the information in the Test Report as well as a list of all the variants and gene fusions screened by the test, associated information, and the result for each.

These reports are subject to approval by a lab manager or administrator via electronic signature.

Assay warnings and limitations

- Use of this product must be limited to personnel trained in the techniques of PCR, NGS, and the use of the Oncomine™ Dx Target Test and the Ion PGM™ Dx System.
- The Oncomine™ Dx Target Test has only been validated for use with NSCLC FFPE tumor slide specimens.
- The Oncomine™ Dx Target Test has been validated to detect the following somatic mutations: single-nucleotide variations (SNVs), multi-nucleotide variations (MNVs), and deletions of 3, 6, 9, 12, 15, and 18 base pairs (bps).
- The Oncomine™ Dx Target Test is only validated for use with the Ion PGM™ Dx System and the Veriti™ Dx 96-Well Thermal Cycler.
- The Oncomine™ Dx Target Test is only validated for use with 10 ng each of DNA and RNA per sample. Input amounts lower or higher than 10 ng are not recommended.
- Both the DNA and RNA from a single sample extraction must meet the concentration requirements specified in the procedure. Do not use DNA from one extraction with RNA from a different extraction.
- The effects of potential variations in FFPE specimen fixation have not been evaluated.
- Extraction from FFPE sample curls has not been evaluated.
- A potential source of contamination in the procedure is nucleic acid from previous sample processing steps. Follow good laboratory practices and all precautions and guidelines in these user guides to avoid cross-contamination between samples.
- The Oncomine™ Dx Target Test is a qualitative test. The test is not for quantitative measurements of percent mutation.
- The Ion OneTouch™ Rack Kit has only been designed to work with GeneMate SnapStrip™ 8-Strip 0.2 mL PCR Tubes. Tubes from other manufacturers may not fit properly in the rack, resulting in a higher risk of user error.

Software compatibility and requirements

The procedures in this guide are designed for use with Torrent Suite™ Dx Software version 5.6 or later. To view the current software version, log in to the software as an Administrator, click on the **Settings (⚙)** tab, then select **Configuration** and click on the **Software Updates** tab. Version-specific information is provided in the software release notes for your version of the software.

Torrent Suite™ Dx Software is supported on Chrome™ browser version 39, and is best viewed with 1024 × 768 screen resolution. It has not been tested with other browsers.

The Ion Torrent™ Server operating system is Ubuntu™ 14.04 LTS.

Materials provided

Oncomine™ Dx Target Test Kit

The Oncomine™ Dx Target Test Kit (Cat. No. A32451) includes the following subkits.

IMPORTANT! Refer to the product label for the storage conditions and expiration dates of individual modules and components.

✓	Subkit	Part no.
	Oncomine™ Dx Target Test and Controls	A32447
	Ion Torrent Dx FFPE Sample Preparation Kit	A32445
	Ion PGM™ Dx Library Kit	A18975
	Ion OneTouch™ Dx Template Kit	A18976
	Ion PGM™ Dx Sequencing Kit	A18977
	Ion 318™ Dx Chip Kit	A18937
	Oncomine™ Dx Target Test User Guides and Assay Definition File	A32461

Subkits used in this guide

The procedures in this user guide use the following subkits from the Oncomine™ Dx Target Test Kit.

Ion Torrent Dx FFPE Sample Preparation Kit

The Ion Torrent Dx FFPE Sample Preparation Kit (Cat. no. A32445) provides reagents for nucleic acid isolation, quantification, and cDNA synthesis from FFPE samples.

✓	Component	Amount	Storage
Ion Torrent Dx Total Nucleic Acid Isolation Kit box 1 of 2 (36 reactions; Part no. A32434)			
	10X DNase Buffer (white cap)	6 × 46 µL	–30°C to –10°C
	Protease (blue cap)	6 × 34 µL	
	DNase (purple cap)	6 × 34 µL	
Ion Torrent Dx Total Nucleic Acid Isolation Kit box 2 of 2 (36 reactions; Part no. A32435)			
	Elution Solution (red cap)	6 × 900 µL	15°C to 30°C
	Isolation Additive (brown cap)	6 × 1 mL	
	Wash 1 Concentrate (amber cap)	6 × 5.9 mL	
	Wash 2 Concentrate (clear cap)	6 × 3.4 mL	
	Digestion Buffer (green cap)	6 × 200 µL	
	Dilution Solution (black cap)	6 × 1.5 mL	
	Collection Tubes	6 × 6 tubes	

✓	Component	Amount	Storage
	Filter Cartridges[1]	6 × 12 cartridges	15°C to 30°C
	Low-bind Elution Tubes	6 × 14 tubes	
Ion Torrent Dx DNA Quantification Kit (72 reactions; Part no. A32437)			
	DNA Dye Reagent (blue cap)	6 × 70 µL	2°C to 8°C
	DNA Buffer (white cap)	6 × 14.3 mL	
	DNA Std - 0 ng/µL(white cap)	6 × 150 µL	
	DNA Std - 0.5 ng/µL (green cap)	6 × 150 µL	
	DNA Std - 4 ng/µL (red cap)	6 × 150 µL	
	DNA Std - 10 ng/µL (yellow cap)	6 × 150 µL	
Ion Torrent Dx RNA Quantification Kit (72 reactions; Part no. A32438)			
	RNA Dye Reagent (green cap)	6 × 70 µL	2°C to 8°C
	RNA Buffer (blue cap)	6 × 14.3 mL	
	RNA Std - 0 ng/µL (teal cap)	6 × 150 µL	
	RNA Std - 0.5 ng/µL (tan cap)	6 × 150 µL	
	RNA Std - 4 ng/µL (purple cap)	6 × 150 µL	
	RNA Std - 10 ng/µL (orange cap)	6 × 150 µL	
Ion Torrent Dx cDNA Synthesis Kit (48 reactions; Part no. A32436)			
	10X Enzyme Mix (green cap)	6 × 13 µL	–30°C to –10°C
	5X Reaction Mix (red cap)	6 × 22 µL	
Ion Torrent Dx Sample Dilution Kit (Part no. A32439)			
	Dilution Solution (black cap)	8 × 1.5 mL	15°C to 30°C

[1] Includes a filter column pre-inserted in a Collection Tube.

Oncomine™ Dx Target Test and Controls

The Oncomine™ Dx Target Test and Controls Kit (Part no. A32447) provides the following panels and controls.

✓	Component	Amount	Storage
Oncomine™ Dx Target Test DNA and RNA Panel (Part no. A32441)			
	Oncomine™ Dx Target Test—DNA panel (blue cap)	6 × 32 µL	–30°C to –10°C
	Oncomine™ Dx Target Test—RNA panel (yellow cap)	6 × 32 µL	

✓	Component	Amount	Storage
Oncomine™ Dx Target DNA Control (Part no. A32442)			
	Oncomine™ Dx Target DNA Control (brown cap)	8 × 7 µL (single-use tubes)	–30°C to –10°C
Oncomine™ Dx Target RNA Control (Part no. A32443)			
	Oncomine™ Dx Target RNA Control (white cap)	8 × 7 µL (single-use tubes)	–90°C to –60°C
Ion Torrent Dx No Template Control Kit (Part no. A32444)			
	No Template Control (purple cap)	8 × 30 µL	15°C to 30°C

Materials and equipment required but not provided

Unless otherwise indicated, all materials are available through **thermofisher.com**. MLS: Fisher Scientific (**fisherscientific.com**) or other major laboratory supplier.

Description	Source
Veriti™ Dx 96-Well Thermal Cycler	4452300
Laminar flow hood	MLS
Dry-bath heaters and aluminum heat blocks (quantity = 3), for use with 1.5-mL tubes	MLS
1.5-mL snap-cap low-retention polypropylene microcentrifuge tubes	MLS
Aluminum cold blocks for use with 1.5-mL tubes and 96-well plates	MLS
Microcentrifuge (must accommodate standard 1.5- and 0.2-mL microcentrifuge tubes, and generate 20,000 rcf)	MLS
0.2-mL tube adapters	MLS
Mini centrifuge	MLS
96-well plate centrifuge	MLS
Benchtop cold box	MLS
Fluorometer/fluorescence reader (see additional specifications following)	MLS
Tubes or plates for the fluorometer/fluorescence reader	MLS
Slide rack, able to hold standard 3″ × 1″ (75 × 25 mm) slides	MLS
Staining dish or jar, able to hold sufficient liquid to fully submerge the slide rack	MLS
Disposable scalpel	MLS

Description	Source
RNase decontamination solution	MLS
Absolute ethanol (ACS grade)	MLS
Xylene (ACS grade, ≥98.5%)	MLS
Single- and multi-channel pipettes (2-, 20-, 200-, 1000-µL)	MLS
Aerosol-barrier pipette tips (2-, 20-, 200-, 1000-µL)	MLS
MicroAmp™ Optical 96-well Reaction Plates	4481191 4481192 (with barcode)
Adhesive PCR Plate Seals	AB-0558
Vortex mixer with a rubber platform	MLS

Fluorometer/ fluorescence reader specifications

For the DNA and RNA quantification procedure, you can use any qualified fluorometer/fluorescence reader that can accommodate the use of a 2–4-point standard curve and is able to operate at the excitation and emission wavelengths listed below:

Dye reagent	Excitation (nm)	Emission (nm)
RNA Dye Reagent	620/15	680/30
DNA Dye Reagent	485/20	528/20

2 Before you begin

Tissue input requirements for FFPE sample extraction

The starting material for the extraction procedure is an FFPE tissue sample that is unstained and mounted on a slide. Confirm the tumor content of each sample based on the area of a hematoxylin and eosin (H&E) stained section.

The recommended number of slide-mounted 5-micron FFPE sections used in extraction varies depending on the sample collection method:

Sample collection method	Recommended number of sections
Resection or surgical biopsies	2 × 5-micron sections
Core needle biopsies	9 × 5-micron sections

Note: Extraction from FFPE sample curls has not been evaluated.

Guidelines for macrodissection:

- If the tumor content is less than 20% and the tumor content in the region of interest is greater than or equal to 10%, macrodissect and enrich the sample for tumor content. Following tumor enrichment, proceed with the extraction protocol.
- Necrotic samples: 10–20% necrotic tissue in the region of interest does not seem to interfere with the assay. However, we recommend that you macrodissect highly necrotic areas or select alternate samples if possible.

Sample storage and stability

Store FFPE blocks and slides at room temperature (15–30°C). Slides (paraffin-dipped or undipped) are stable for 8 months when stored at 15–30°C.

Extracted DNA can be stored at –30°C to –10°C for up to 9 months, including 3 freeze-thaw cycles. Extracted RNA can be stored at –90°C to –60°C for up to 9 months, including 3 freeze-thaw cycles.

Reagent management

Follow the guidelines below for proper reagent storage and use.

Storage

Reagents must be stored under appropriate conditions. Refer to the Product Information section in each user guide for the storage conditions of the kit components used in the procedures in that guide. The Oncomine™ Dx Target Test Kit System includes kits with multiple component boxes that require different storage conditions. For example, the Oncomine™ Dx Target Test and Controls Kit is composed of four boxes: Oncomine™ Dx Target Test and Oncomine™ Dx Target DNA Control are stored at −30°C to −10°C, whereas the Oncomine™ Dx Target RNA Control and Ion Torrent Dx No Template Control Kit require storage at −90°C to −60°C and 15–30°C, respectively. To use the Oncomine™ Dx Target Test and Controls, retrieve all boxes from their different storage areas and confirm that they are from the same master lot.

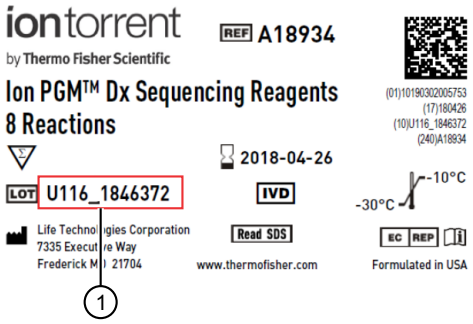
Kit and component matching

Each component box of the Oncomine™ Dx Target Test Kit lists the lot numbers of compatible component boxes on the inside of the box lid. Before use, confirm that the lot numbers of all boxes used in a sequencing run are compatible.

ATTENTION: This kit can only be used with the following lots:

REF		LOT
A18928	Ion PGM™ Dx Library Reagents	N117_1849183
A18929	Ion PGM™ Dx Library Equalizer	N117_1849184
A18930	Ion OneTouch™ Dx Template Reagents	N117_1849185
A18931	Ion OneTouch™ Dx Template ES Beads	N117_1849186
A18932	Ion OneTouch™ Dx Template Solutions	N117_1849187
A18933	Ion OneTouch™ Dx Template Supplies	N117_1849188
A18934	Ion PGM™ Dx Sequencing Reagents	N117_1849189
A18935	Ion PGM™ Dx Sequencing Solutions	N117_1849190
A18936	Ion PGM™ Dx Sequencing Supplies	N117_1849191
A32441	Oncomine™ Dx Target Test	1705001
A32442	Oncomine™ Dx Target DNA Control	R117_1867106
A32443	Oncomine™ Dx Target RNA Control	R117_1867107
A32444	Ion Torrent™ Dx No Template Control	R117_1867103

An example box label with lot information is shown below:



① Lot number

Sample preparation workflow

The following workflow summarizes the steps for isolating DNA and RNA from FFPE tumor samples, and preparing cDNA.

Chapter 3, "Sample setup in Torrent Suite™ Dx Software" on page 21

▼

"Deparaffinize and digest samples" on page 27

▼

"Separate RNA from DNA" on page 31

▼

"Recover the RNA from the flow-through" on page 33

▼

"Recover the DNA from the Filter Cartridge" on page 37

▼

Chapter 5, "DNA and RNA quantification" on page 40

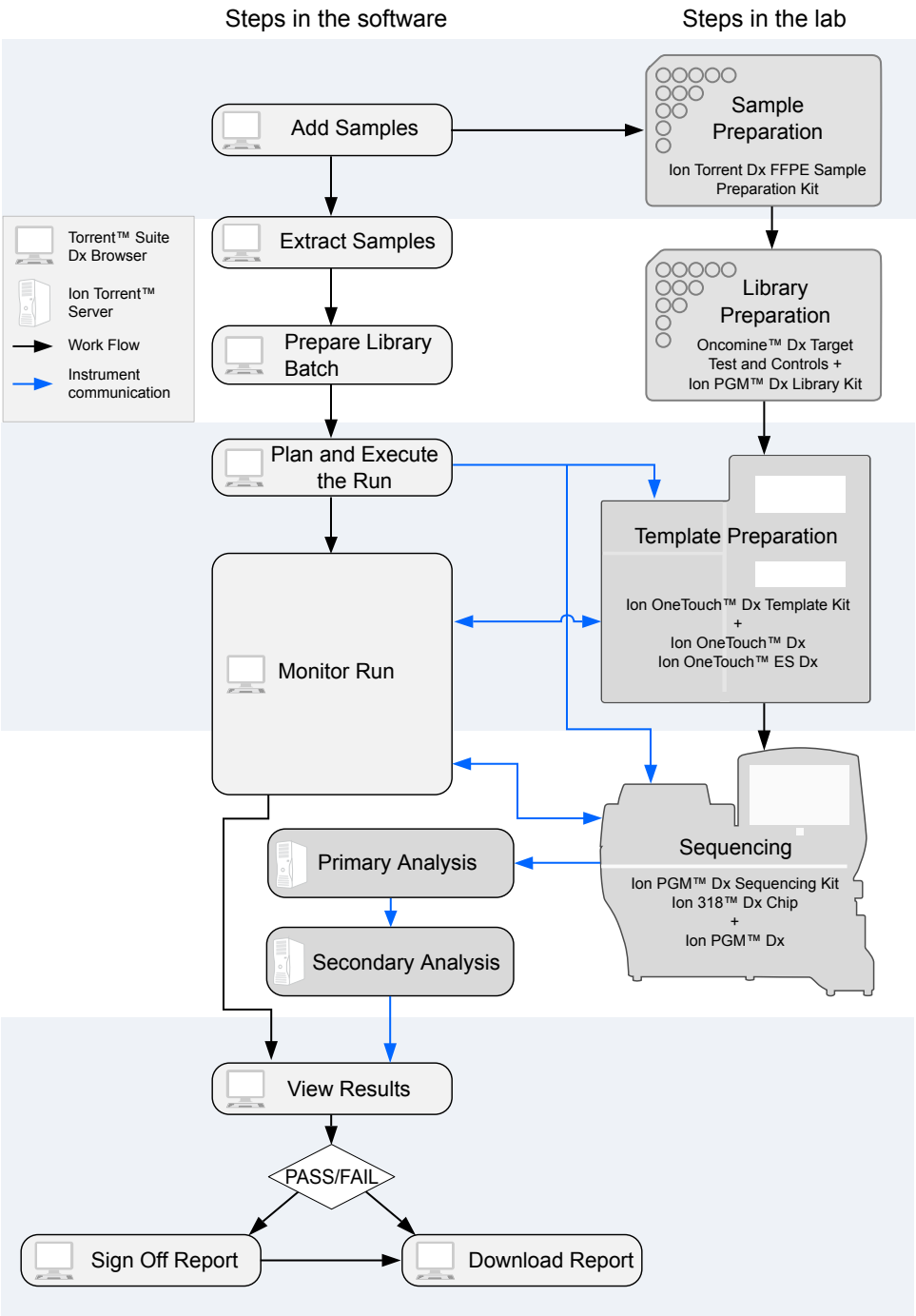
▼

Chapter 6, "Prepare the cDNA" on page 48

▼

Proceed to *Oncomine™ Dx Target Test Part II: Library Preparation User Guide* (Pub. No. MAN0016168)

Oncomine™ Dx Target Test system diagram



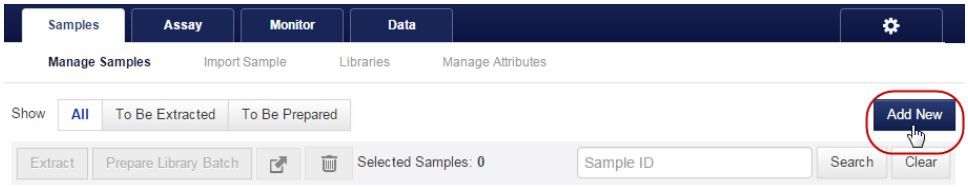
3 Sample setup in Torrent Suite™ Dx Software

Add a new sample

Note: Managers and Administrators can import sample information from a formatted Microsoft™ Excel™ spreadsheet. Refer to the *Oncomine™ Dx Target Test Part V: Analysis and Test Reports User Guide* for more information.

1. Sign in to the Torrent Suite™ Dx Software.

2. Under the **Samples** tab, in the **Manage Samples** screen, click on the **Add New** button.



3. In the **Add New Sample** dialog, fill out the fields as follows:

   Note: Fields identified with a red asterisk (*) in the dialog are required. If no information is available, substitute dummy data to complete required fields.

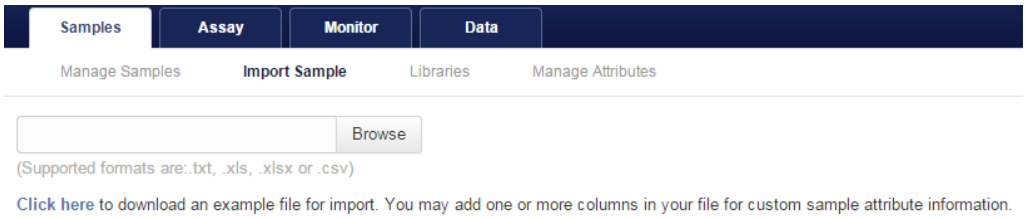
Field	Description
Sample ID*	A unique identifier representing the sample, containing only alphanumeric characters (0–9 and A to Z), full stops/periods (.), underscores (_), or hyphens (-). The Sample ID cannot contain spaces and is limited to a maximum of 20 characters. **Note:** After a Sample ID is entered into the system, it cannot be edited. It can be deleted unless it has already been used in a library. The software checks all Sample IDs entered or imported to prevent duplication and will return an error message if a non-unique Sample ID is detected.
Patient ID*	An identifier representing the patient. This field accepts all characters including spaces.
Date of Birth*	The patient's date of birth. Click the button to select the date in the correct format.
Ordering Physician*	The name of the ordering physician. This field accepts all characters including spaces.
Collection Date*	The date the sample was collected from the patient. Click the button to select the date in the correct format.

Field	Description
Sample Source **Sample Condition*** **Sample Type***	These are open-entry fields that accept all characters, including spaces.
Gender*	The biological gender of the sample. This must be Male, Female, or Unknown.
Cancer Type*	The type of cancer to be tested in the sample.
%Cellularity	The percentage of tumor cellularity in the sample.
%Necrosis	The percentage of cellular necrosis in the sample.
Reference Interval	A normal range of measure for the sample.
Notes	An open-entry field.

4. Click **Save**. The sample will be listed in the **Manage Samples** screen.

Import samples

Under the **Samples** tab in the **Import Sample** screen, you can import sample data in the form of a .txt, .xls, .xlsx or .csv file. Ensure that the same sample attributes that are entered in the **Add new sample** dialog are included in the import file.



1. In the **Import Sample** screen, below the **Browse** field, click **Click here** to download a Microsoft™ Excel™ template file.

   Note: The template file contains default sample attributes as columns. If additional custom sample attributes have been configured in the software, these attributes need to be added as columns to the template file.

   a. In the template file, fill in data for each sample, one sample per row. Required attributes are flagged with an asterisk (*).

   - Sample ID*
   - Patient ID*
   - Sample Source
   - Ordering Physician*
   - Sample Condition*
   - Collection Date*
   - Gender*
   - Cancer type*
   - Notes
   - Reference Interval
   - Date Of Birth*
   - Sample Type*
   - %Cellularity
   - %Necrosis

   *Indicates a field required to be filled in during sample creation.

b. Click **Save** or **Save As** to save the file.

2. Click **Browse**, then navigate to the saved file and click **Open**.

3. Click **Import**.

   A progress bar followed by an import report will display. If the import process fails, an error message will indicate the reason for failure (e.g., an invalid character was used). For additional troubleshooting, see "Batch sample import fails" on page 52.

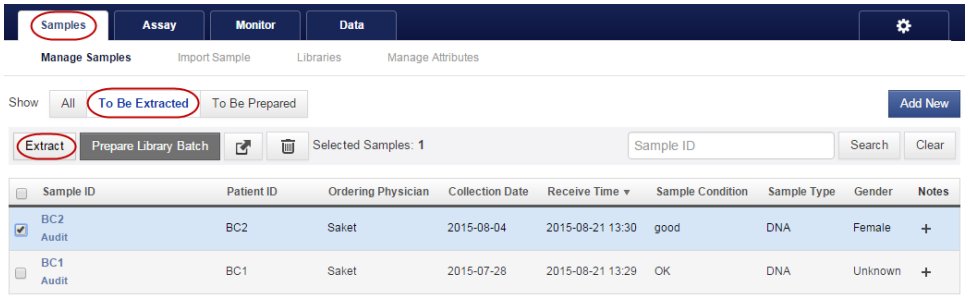
4. Click **Manage Samples** to return to the sample list. Successfully imported samples will be listed.

Enter the Ion Torrent Dx Total Nucleic Acid Isolation Kit barcode

Under the **Samples** tab, in the **Manage Samples** screen, scan the barcode of the Ion Torrent Dx Total Nucleic Acid Isolation Kit used in the extraction process for a particular sample. This barcode is saved with the sample and can be viewed by clicking the Sample ID.

1. Above the samples list, click **To Be Extracted** to display only those samples that do not have a kit barcode associated with them.

2. Select the checkbox of the sample to be extracted. Select multiple samples if you are using the same kit to process them.



3. Click **Extract**. In the dialog box, scan the barcode printed on the Ion Torrent Dx Total Nucleic Acid Isolation Kit (box 1 of 2, Part No. A32434).

   IMPORTANT! Check the expiration date on the box. If the kit is expired, select another kit.

4. Click **Save**.

   The sample is no longer listed in the **To Be Extracted** list.

4 Isolate RNA and DNA from FFPE samples

Procedural guidelines

Definitions

Throughout this guide:

- Room temperature is defined as the temperature range 15–30°C.
- A pulse centrifugation consists of a 3–5 second centrifugation at maximum speed in a mini centrifuge.

Guidelines for mixing reagents

Immediately before each use:

- Mix enzyme solutions (e.g., Protease and DNase) by flicking the tubes 4 times, followed by a pulse centrifugation.
- Vortex non-enzyme-containing reagents for ~5 seconds, followed by a pulse centrifugation.
- Mix reagent bottles by inverting them 5 times.

Guidelines for RNA

- Wear clean gloves and a clean lab coat.
- Change gloves whenever they may be contaminated.
- Open and close all sample tubes carefully. Avoid splashing or spraying samples.
- Clean lab benches and equipment (including gloves, tube racks, pipettes, centrifuges, and vortexers) with an RNase decontamination solution before and after use.
- Work in a designated RNase-free pre-PCR area.
- Keep RNA on ice or in a –30°C to –10°C chilled benchtop cold box during use.
- Never vortex RNA. Flick 4 times to mix, then pulse centrifuge to collect.

Guidelines for pipetting

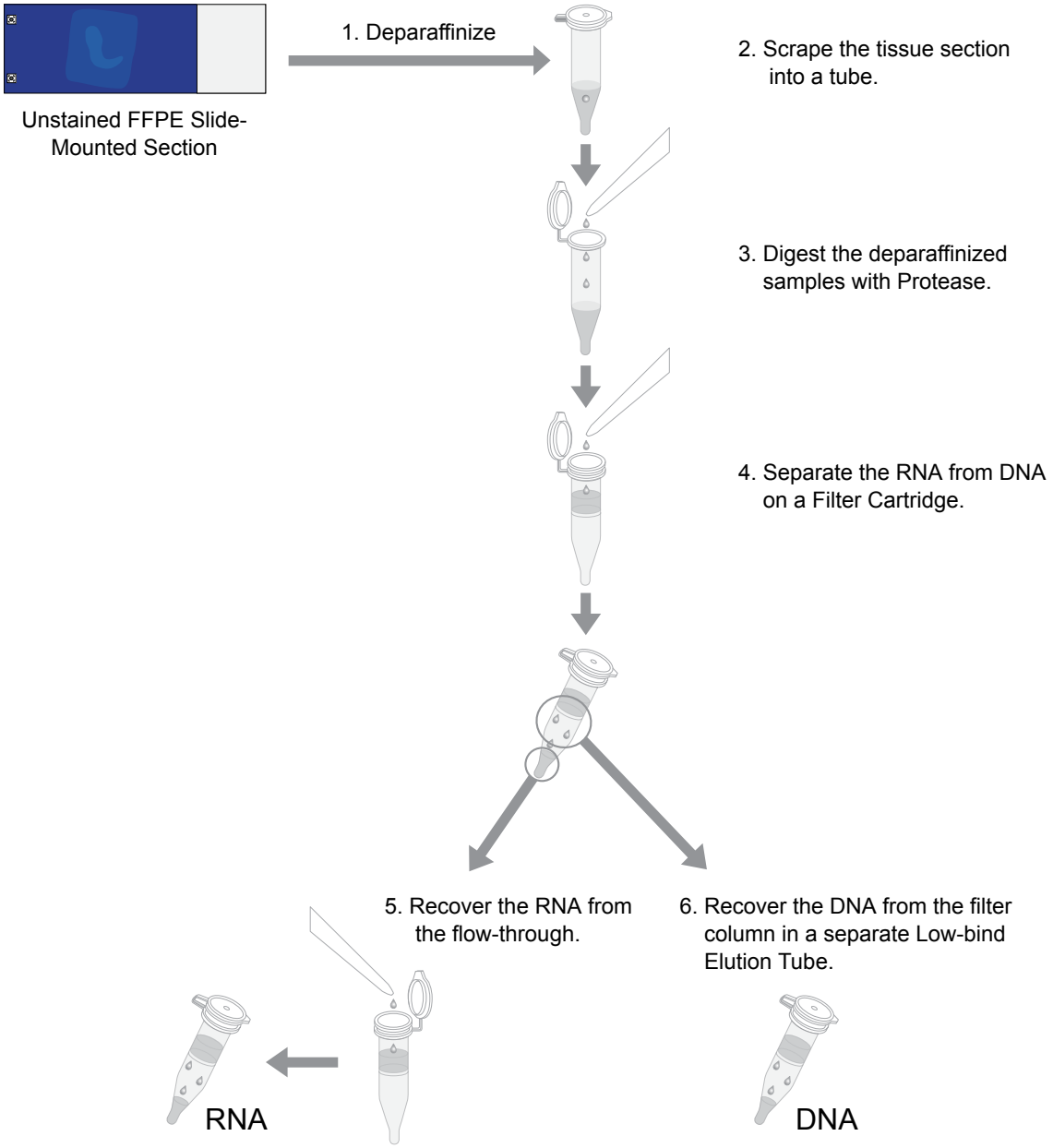
- Use aerosol-barrier pipette tips. Change pipette tips between samples.
- Avoid introducing air bubbles when pipetting by keeping the pipette tip at the bottom of the solution in the wells.
- Set the pipette to the recommended volume for mixing, and insert tip into the solution with the pipette plunger depressed to avoid introducing air bubbles.
- Visually inspect multi-channel pipette tips to ensure volumes are equivalent during pipeting.
- Touch tip to the side of well and slowly pipet reagent on the side of the well to form a droplet. This enables small volumes to be pipetted accurately and to ensure that the reagent has been added to the well.
- Inspect the pipette tips to verify that the reagent has been adequately dispensed.

Guidelines for freezing and thawing samples

There are stopping points throughout this procedure where you can freeze samples overnight or longer and then thaw the samples before proceeding. If you cannot perform the complete procedure in a day, proceed to a designated stopping point and freeze the samples overnight.

IMPORTANT! Freeze-thaw samples no more than 3 times.

Sample extraction workflow



Equilibrate the equipment and reagents

Before starting the following procedure:

- Equilibrate a benchtop cold box in a –30°C to –10°C freezer for at least 24 hours before use.

  Note: The cold box holds temperature for up to 1 hour on the bench.

- Equilibrate aluminum cold blocks for 1.5-mL tubes and 96-well plates at 2–8°C before use.

- Power on three dry-bath heaters with aluminum heat blocks 45 minutes before starting the procedure. Set the heaters to 55°C, 90°C, and 95°C.

  CAUTION! Use care when working near the heat block to avoid being burned.

  Note: Ensure that the heaters are calibrated.

- Remove the Protease and DNase from the freezer, then place them in an equilibrated 2–8°C aluminum block or refrigerator.

- Thaw the 10X DNase Buffer at room temperature (15°C to 30°C) and hold at room temperature until use.

- If you plan to quantify the DNA and RNA immediately after the extraction, equilibrate the quantification kit reagents (except the standards) to room temperature for at least 30 minutes before performing the assays.

Prepare wash buffers

Prepare the following buffers before using the Ion Torrent Dx FFPE Sample Preparation Kit. These buffers only need to be prepared once for each kit.

1. To prepare Wash 1 Buffer, add 14 mL of ACS grade 100% ethanol (EtOH) to the bottle labeled "Wash 1 Concentrate". Cap the bottle tightly and mix well by inverting the bottle 5 times.

2. To prepare Wash 2 Buffer, add 14 mL of ACS grade 100% ethanol to the bottle labeled "Wash 2 Concentrate". Cap the bottle tightly and mix well by inverting the bottle 5 times.

3. Mark the bottle labels to indicate that ethanol has been added ("+EtOH," initials, and date). Store the reconstituted Wash 1 and 2 Buffers at room temperature.

Deparaffinize and digest samples

Kit components used in this procedure

Kit component	Box
Digestion Buffer (green cap) Dilution Solution (black cap)	Ion Torrent Dx Total Nucleic Acid Isolation Kit box 2 of 2 (Part No. A32435, stored at 15°C to 30°C)
Protease (blue cap)	Ion Torrent Dx Total Nucleic Acid Isolation Kit box 1 of 2 (Part No. A32434, stored at –30°C to –10°C)

Prepare 1X Digestion Buffer

1. Label a nuclease-free 1.5-mL low-retention microcentrifuge tube for each FFPE tissue sample. Label each tube (cap and side) with its Sample ID using a marker that is resistant to xylene and ethanol.
2. Vortex the Digestion Buffer (green cap) and Dilution Solution (black cap) supplied in the kit for ~5 seconds each, then pulse centrifuge to collect the contents.
3. In a separate 1.5-mL low-retention microcentrifuge tube, prepare a master mix of the 1X Digestion Buffer as follows, where "n" is the number of tissue samples:

Component	Volume per reaction	
	For ≤6 samples	For ≥7 samples
Digestion Buffer (green cap)	(n+1) × 25 µL	(n+2) × 25 µL
Dilution Solution (black cap)	(n+1) × 75 µL	(n+2) × 75 µL
Total 1X Digestion Buffer	**(n+1) × 100 µL**	**(n+2) × 100 µL**

4. Vortex the 1X Digestion Buffer for ~5 seconds to mix, then pulse centrifuge to collect.
5. Add 100 µL of 1X Digestion Buffer to each labeled tube from step 1.

Deparaffinize dipped FFPE slides

WARNING! Xylene is a toxic substance. Read the safety data sheet provided by the manufacturer. Handle it only in a well-ventilated area using personal protection equipment, and discard the waste according to regulations.

IMPORTANT! These instructions are only for paraffin-dipped FFPE slides. For slides that have not been dipped in paraffin, see “Deparaffinize the FFPE slide-mounted sections“ on page 29.

Note:

- Use fresh xylene and fresh ACS-grade 100% ethanol after two rounds of deparaffinization with dipped slides. Each jar should have ~400 mL of either xylene or ethanol and be clearly marked with the date and initials after replacing the solutions.
- Perform the following steps carefully to avoid tissue loss.

1. Scrape any excess paraffin from each slide.
   a. Grasp the slide at the slide label, and firmly hold the slide in an upright vertical position with the bottom oriented on the lab-bench paper.

   b. Using a sterile disposable scalpel, scrape the layer of paraffin from the back of the slide. Use even pressure to scrape the back from top to bottom. Repeat if necessary to remove all the paraffin.

   IMPORTANT! Use light pressure to prevent cracking the slide.

   c. If the tissue section cannot be visualized, do not perform this step. Turn the slide so the label and tissue face the operator. Carefully scrape around the tissue section to remove the paraffin.

   Note: Scrape away from the tissue section to avoid accidentally removing the section itself.

   d. Repeat steps a–c for each slide, using a new scalpel for each unique sample.

   Note: Properly discard used scalpels.

2. Fill a staining dish or jar with ~400 mL of xylene.

3. Place the slides in a slide rack, then completely submerge the rack in the xylene for 5 minutes at room temperature.

4. Incubate the slides for 30 minutes at room temperature. At ~10-minute intervals, lift the rack up and down 3 times to mix.

5. Remove the rack, then drain any excess xylene solution by tilting the rack.

6. Fill a staining dish or jar with ~400 mL of fresh xylene, then completely submerge the slide rack.

7. Incubate the slides for 15 minutes at room temperature. After ~7.5 minutes, lift the rack up and down 3 times to mix.

8. Remove the slides, then drain any excess xylene solution by tilting the slide holder.

9. Inspect the slides. If any paraffin remains, repeat steps 6–8 one more time.

10. Fill a staining dish or jar with ~400 mL of 100% ethanol.

11. Completely submerge the slides in the rack in the 100% ethanol for 5 minutes at room temperature.

12. Remove the rack, then drain any excess ethanol by tilting the rack.

13. Touch the edge of each slide with a clean laboratory wipe to wick any remaining ethanol from the surface, then lay the slide (section-side up) on a clean laboratory wipe.

14. Air dry each slide for at least 15 minutes.

    Note: The drying time can vary depending on the section size. Ensure that there are no droplets on the tissue section before scraping.

15. Proceed to "Collect the tissue" on page 30.

Deparaffinize the FFPE slide-mounted sections

WARNING! Xylene is a toxic substance. Read the safety data sheet provided by the manufacturer. Handle it only in a well-ventilated area using personal protection equipment, and discard the waste according to regulations.

Note:
- Use fresh xylene and fresh ACS-grade 100% ethanol after two rounds of deparaffinization with dipped slides. Each jar should have ~400 mL of either xylene or ethanol and be clearly marked with the date and initials after replacing the solutions.
- Perform the following steps carefully to avoid tissue loss.

1. Fill a staining dish or jar with ~400 mL of xylene.

2. Place the slides with the unstained FFPE tissue sections in a slide rack, then completely submerge the rack in the xylene for 5 minutes at room temperature.

3. Remove the rack, then drain any excess xylene solution by tilting the rack.

4. Inspect the slides. If any paraffin remains, repeat steps 1–2 one more time.

5. Fill a staining dish or jar with ~400 mL of 100% ethanol.

6. Completely submerge the slides in the rack in the 100% ethanol for 5 minutes at room temperature.

7. Remove the rack, then drain any excess ethanol by tilting the rack.

8. Touch the edge of each slide to a clean laboratory wipe to wick any remaining ethanol from the surface, then lay the slide (section-side up) on a clean laboratory wipe.

9. Air dry each slide for at least 15 minutes.

   Note: The drying time can vary depending on the section size. Ensure that there are no droplets on the tissue section before scraping.

10. Proceed to "Collect the tissue".

Collect the tissue

IMPORTANT! Before proceeding, review "Tissue input requirements for FFPE sample extraction" on page 17.

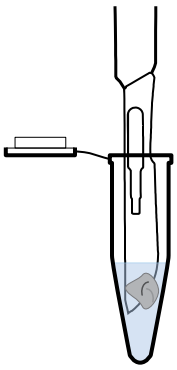
In this procedure, scrape each tissue section into the appropriate labeled 1.5-mL low-retention microcentrifuge tube containing 1X Digestion Buffer (prepared in "Prepare 1X Digestion Buffer" on page 27).

1. Pipet 4 µL of 1X Digestion Buffer from the labeled tube evenly across the fixed tissue section on the slide to pre-wet the tissue section.

   Note: Larger sections may need an additional 4 µL of Digestion Buffer.

2. Using a sterile disposable scalpel, scrape the tissue in a single direction, and collect the tissue into a cohesive mass on the tip of the scalpel blade.

3. Carefully insert the scalpel blade with the tissue mass into the 1X Digestion Buffer in the 1.5-mL low-retention microcentrifuge tube. Rinse the tissue from the blade into the buffer, and ensure that the entire mass is in solution.



4. Remove the blade and inspect it to ensure that no tissue remains on the blade.

5. Inspect the slide to ensure that all the tissue has been removed (the slide should be translucent). Discard the scalpel in a waste container for sharp objects.

Digest the deparaffinized samples

1. Flick-mix the Protease (blue cap) 4 times with your finger, then pulse centrifuge to collect the contents.

2. Add 4 µL of Protease to each tissue sample tube.

3. Flick-mix each sample tube 4 times, then pulse centrifuge.

4. Incubate the samples at 55°C in a calibrated heat block for 1 hour.

   Note: During incubation, proceed to "Label the Filter Cartridges and Collection Tubes" and "Preheat the Elution Solution" to save time.

5. Pulse centrifuge to collect any condensation droplets.

6. Incubate the samples at 90°C in a calibrated heat block for 1 hour.

7. Pulse centrifuge to collect any condensation droplets, then proceed immediately to "Separate RNA from DNA on a Filter Cartridge" on page 32.

Separate RNA from DNA

Kit components used in this procedure

Kit component	Box
Filter Cartridges[1] Collection Tubes Low-bind Elution Tubes Elution Solution (red cap) Isolation Additive (brown cap)	Ion Torrent Dx Total Nucleic Acid Isolation Kit box 2 of 2 (Part No. A32435; stored at 15°C to 30°C)

[1] Includes a filter column pre-inserted in a Collection Tube.

Label the Filter Cartridges and Collection Tubes

Note: To save time, label sets of Filter Cartridges (filter column + Collection Tube) and Collection Tubes (tube only) in advance. Use ethanol-resistant markers for labeling. Do not write on the side of the filter column, because the ink may bleed into the sample.

For each FFPE tissue sample, label the following cartridges and tubes as indicated for use in the subsequent DNA and RNA extraction steps:

- Filter Cartridges (2)
- Collection Tubes (1)
- Low-bind Elution Tubes (2)

Component	Label		Material collected	
	Filter column cap	Tube	Filter	Tube
Filter Cartridge (A)	Sample ID and "DNA"	Sample ID and "RNA"	Bound DNA	Flow-through RNA
Collection Tube (B)	—	Sample ID and "DNA Wash"	—	DNA wash
Filter Cartridge (C)	Sample ID and "RNA"	Sample ID and "RNA Wash"	Bound RNA	RNA wash
Low-bind Elution Tube (D)	—	Sample ID, "RNA," date, and operator initials	—	Eluted RNA
Low-bind Elution Tube (E)	—	Sample ID, "DNA," date, and operator initials	—	Eluted DNA

Preheat the Elution Solution

1. For each sample, pipet 125 µL of Elution Solution (red cap) into a 1.5-mL low-retention microcentrifuge tube.
2. Place the tube(s) of Elution Solution in the 95°C heat block for at least 5 minutes. Keep the Elution Solution in the heat block throughout the following procedure.

CAUTION! Use care when working near the heat block to avoid being burned.

Note: A tube rack may be placed on top of the tubes to prevent the tubes from popping open.

Separate RNA from DNA on a Filter Cartridge

Use the following previously labeled Filter Cartridges and Collection Tubes for the following procedure:

Component	Label		Material collected	
	Filter column cap	Tube	Filter	Tube
Filter Cartridge (A)	Sample ID and "DNA"	Sample ID and "RNA"	Bound DNA	Flow-through RNA
Collection Tube (B)	—	Sample ID and "DNA Wash"	—	DNA wash

1. Place the labeled Filter Cartridge (A) in a tube rack.
2. Add 120 µL of the Isolation Additive (brown cap) to the digested sample, then mix by pipetting up and down 5 times. The sample appears slightly cloudy.
3. Transfer the digested sample and Isolation Additive mix (~224 µL) to the Filter Cartridge, then close the lid.
4. Centrifuge the Filter Cartridge at 10,000 rcf for 30 seconds in a microcentrifuge.

IMPORTANT! Do not discard the flow-through in the Collection Tube (labeled with Sample ID and "RNA"). The flow-through contains the RNA.

5. Place the filter column with the bound DNA in a new Collection Tube (B), then store it at 2–8°C for later DNA purification in “Recover the DNA from the Filter Cartridge“ on page 37.
6. Proceed to “Recover the RNA from the flow-through“ on page 33.

Recover the RNA from the flow-through

Kit components used in this procedure

Kit component	Source/Box
Filter Cartridges Collection Tubes Low-bind Elution Tubes	Previously labeled
Wash 1 Buffer Wash 2 Buffer	Previously prepared from concentrate
Dilution Solution (black cap)	Ion Torrent Dx Total Nucleic Acid Isolation Kit box 2 of 2 (Part no. A32435; stored at 15°C to 30°C)
10X DNase Buffer (white cap) DNase (purple cap)	Ion Torrent Dx Total Nucleic Acid Isolation Kit box 1 of 2 (Part no. A32434; stored at –30°C to –10°C)

Bind the RNA to the Filter Cartridge

Use the following previously labeled Filter Cartridge for the following procedure:

Component	Label		Material collected	
	Filter column cap	Tube	Filter	Tube
Filter Cartridge (C)	Sample ID and "RNA"	Sample ID and "RNA Wash"	Bound RNA	RNA wash

1. Place the new Filter Cartridge (C) in a tube rack.
2. Add 275 µL of ACS-grade 100% ethanol to the flow-through containing RNA (the tube labeled with the Sample ID and "RNA") from “Separate RNA from DNA on a Filter Cartridge“ on page 32.
3. Mix well by pipetting up and down 5 times, then transfer the sample (~450 µL) to the new Filter Cartridge (C).
4. Centrifuge the Filter Cartridge at 10,000 rcf for 30 seconds in a microcentrifuge.
5. Discard the flow-through in the Collection Tube, then reinsert the filter column into the same Collection Tube.
6. Add 600 µL of Wash 1 Buffer (prepared in “Prepare wash buffers“ on page 26) to the Filter Cartridge.
7. Centrifuge the Filter Cartridge at 10,000 rcf for 30 seconds.
8. Discard the flow-through, then reinsert the filter column in the same Collection Tube.
9. Centrifuge the Filter Cartridge at 10,000 rcf for 30 seconds to remove any remaining fluid.

Treat the RNA bound to the Filter Cartridge with DNase

1. In a 1.5-mL low-retention microcentrifuge tube, prepare a master mix of 1X DNase Solution as follows, where "n" is the number of samples you are preparing.

Component	Volume per reaction	
	For ≤6 samples	For ≥7 samples
Dilution Solution (black cap)	(n+1) × 50 µL	(n+2) × 50 µL
10X DNase Buffer (white cap)	(n+1) × 6 µL	(n+2) × 6 µL
DNase (purple cap)	(n+1) × 4 µL	(n+2) × 4 µL
Total Volume	**(n+1) × 60 µL**	**(n+2) × 60 µL**

2. Flick the 1X DNase Solution tube 4 times to mix, then pulse centrifuge to collect.
3. Pipet 60 µL of the 1X DNase Solution into the center of each filter column (previously labeled with Sample ID and "RNA").

   IMPORTANT! To avoid puncturing, do **NOT** touch the pipette tip to the filter.

4. Hold the Filter Cartridge at room temperature for 30 minutes.

Wash the RNA bound to the Filter Cartridge

Use the following previously labeled Filter Cartridges and Low-bind Elution Tubes for the following procedure.

Component	Label		Material collected	
	Filter column cap	Tube	Filter	Tube
Filter Cartridge (C)	Sample ID and "RNA"	Sample ID and "RNA Wash"	Bound RNA	RNA wash
Low-bind Elution Tube (D)	—	Sample ID, "RNA," date, and operator initials	—	Eluted RNA

1. Add 600 µL of Wash 1 Buffer to the Filter Cartridge (C).
2. Hold the Filter Cartridge for 30 seconds at room temperature, then centrifuge the Filter Cartridge at 10,000 rcf for 30 seconds.
3. Discard the flow-through, then reinsert the filter column in the same Collection Tube.
4. Add 500 µL of Wash 2 Buffer (prepared in "Prepare wash buffers" on page 26) to the Filter Cartridge, then centrifuge the Filter Cartridge at 10,000 rcf for 30 seconds.
5. Discard the flow-through, then reinsert the filter column into the same Collection Tube.
6. Repeat steps 4 and 5 for a second wash.

7. Centrifuge the Filter Cartridge at 20,000–21,000 rcf for 2 minutes to remove any remaining fluid.

8. Remove the filter column from the tube, then touch the bottom of the column with a clean laboratory wipe to wick off any remaining wash buffer.

9. Transfer the filter column to the pre-labeled Low-bind Elution Tube (D).

Elute the RNA

Use the following components for this procedure.

Component	Label		Material collected	
	Filter column cap	Tube	Filter	Tube
Filter column with bound RNA from Filter Cartridge (C)	Sample ID and "RNA"	—	Bound RNA	—
Low-bind Elution Tube (D)	—	Sample ID, "RNA," date, and operator initials	—	Eluted RNA

IMPORTANT!
- Keep the 1.5-mL low-retention microcentrifuge tube containing preheated Elution Solution in the heat block throughout the procedure to maintain a 95°C temperature.
- Change pipette tips between samples when pipetting Elution Solution across multiple samples.

1. Remove the Elution Solution from the heat block, and pulse centrifuge the tube to collect the contents. Return the tube to the heat block.

   CAUTION! The heat block and Elution Solution are hot. Use care when handling tubes and tube contents to avoid being burned.

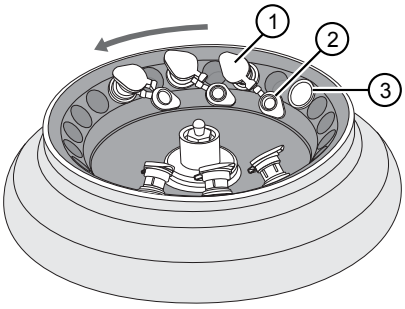
2. Wet the pipette tip by slowly pipetting up and down 3 times in the pre-heated Elution Solution.

3. Slowly pipet up 30 µL of Elution Solution, then confirm that there are no large air gaps in the tip (a small air gap at the bottom of the tip is acceptable). Pipet the solution into the center of the filter column in the Low-bind Elution Tube (D) (from step 9 in "Wash the RNA bound to the Filter Cartridge").

   IMPORTANT! To avoid puncturing the filter, do not touch it with the pipette tip.

4. Close the cap on the filter column, then hold the filter column/Low-bind Elution Tube assembly at room temperature for 1 minute. Close the cap on the Elution Solution tube in the heat block.

5. Insert the filter column/Low-bind Elution Tube assembly in the microcentrifuge in the orientation shown below. To prevent the Low-bind Elution Tube caps from breaking, place a 0.2-mL tube adapter in the position shown.



① Filter column cap (closed)
② Low-bind Elution Tube cap (open)
③ 0.2-mL tube adapter

6. Centrifuge at 20,000–21,000 rcf for 1 minute.

   Note: The eluted RNA is in the Low-bind Elution Tube. If the tube cap breaks in the centrifuge, transfer the sample to a new labeled Low-bind Elution Tube.

7. Discard the filter column.

8. Temporarily store the sample at 2–8°C if quantifying on the same day.

STOPPING POINT If you are not quantifying on the same day, store the recovered RNA aliquots at −90°C to −60°C for up to 9 months.

Recover the DNA from the Filter Cartridge

Wash the DNA bound to the Filter Cartridge

Use the following pre-labeled Filter Cartridges and tubes for the following protocol:

Component	Label		Material collected	
	Filter column cap	Tube	Filter	Tube
Filter Cartridge (A)	Sample ID and "DNA"	Sample ID and "RNA"	Bound DNA	Flow-through RNA
Collection Tube (B)	—	Sample ID and "DNA Wash"	—	DNA wash
Low-bind Elution Tube (E)	—	Sample ID, "DNA," date, and operator initials	—	Eluted DNA

1. Retrieve the Filter Cartridge (A) with bound DNA and Collection Tube (B) from 2–8°C storage (previously stored in "Separate RNA from DNA on a Filter Cartridge" on page 32).
2. Add 600 µL of Wash 1 Buffer to the filter column.
3. Hold the Filter Cartridge for 30 seconds at room temperature, then centrifuge at 10,000 rcf for 30 seconds.
4. Discard the flow-through, then reinsert the filter column into the same Collection Tube (B).
5. Add 500 µL of Wash 2 Buffer to the filter column, then centrifuge at 10,000 rcf for 30 seconds.
6. Discard the flow-through, then reinsert the filter column into the same Collection Tube (B).
7. Repeat steps 5 and 6 for a second wash.
8. Centrifuge the Filter Cartridge at 20,000–21,000 rcf for 2 minutes to remove any remaining fluid.
9. Remove the filter column from the tube, then touch the bottom of the column with a clean laboratory wipe to wick off any remaining wash buffer.
10. Transfer the filter column to the pre-labeled Low-bind Elution Tube (E).

Elute the DNA

Use the following components for this procedure.

Component	Label		Material collected	
	Filter column cap	Tube	Filter	Tube
Filter column with bound DNA from Filter Cartridge (A)	Sample ID and "DNA"	—	Bound DNA	—
Low-bind Elution Tube (E)	—	Sample ID, "DNA," date, and operator initials	—	Eluted DNA

IMPORTANT!
- Keep the 1.5-mL low-retention microcentrifuge tube containing preheated Elution Solution in the heat block throughout the procedure to maintain a 95°C temperature.
- Change pipette tips between samples when pipetting Elution Solution across multiple samples.

1. Remove the Elution Solution from the heat block, and pulse centrifuge the tube to collect the contents. Return the tube to the heat block.

   CAUTION! The heat block and Elution Solution are hot. Use care when handling tubes and tube contents to avoid being burned.

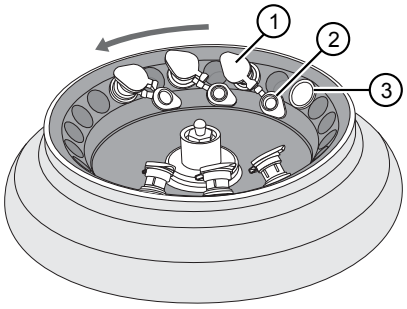
2. Wet the pipette tip by slowly pipetting up and down 3 times in the pre-heated Elution Solution.

3. Slowly pipet up 30 µL of Elution Solution, then confirm that there are no large air gaps in the tip (a small air gap at the bottom of the tip is acceptable). Pipet the solution into the center of the filter column in the Low-bind Elution Tube (E) (from step 10 in “Wash the DNA bound to the Filter Cartridge“).

   IMPORTANT! To avoid puncturing the filter, do not touch it with the pipette tip.

4. Close the cap on the filter column, then hold the filter column/Low-bind Elution Tube assembly at room temperature for 1 minute. Close the cap on the Elution Solution tube in the heat block.

5. Insert the filter column/Low-bind Elution Tube assembly in the microcentrifuge in the orientation shown below. To prevent the Low-bind Elution Tube caps from breaking, place a 0.2-mL tube adapter in the position shown.



① Filter column cap (closed)
② Low-bind Elution Tube cap (open)
③ 0.2-mL tube adapter

6. Centrifuge at 20,000–21,000 rcf for 1 minute.

   Note: The eluted DNA is in the Low-bind Elution Tube. If the tube cap breaks in the centrifuge, transfer the sample to a new labeled Low-bind Elution Tube.

7. Discard the filter column.

8. Temporarily store the sample at 2–8°C if quantifying on the same day.

STOPPING POINT If you are not quantifying on the same day, store the recovered DNA aliquots at –30°C to –10°C for up to 9 months.

5 DNA and RNA quantification

Procedural guidelines

Definitions

Throughout this guide:

- Room temperature is defined as the temperature range 15–30°C.
- A pulse centrifugation consists of a 3–5 second centrifugation at maximum speed in a mini centrifuge.

Guidelines for RNA

- Wear clean gloves and a clean lab coat.
- Change gloves whenever they may be contaminated.
- Open and close all sample tubes carefully. Avoid splashing or spraying samples.
- Clean lab benches and equipment (including gloves, tube racks, pipettes, centrifuges, and vortexers) with an RNase decontamination solution before and after use.
- Work in a designated RNase-free pre-PCR area.
- Keep RNA on ice or in a –30°C to –10°C chilled benchtop cold box during use.
- Never vortex RNA. Flick 4 times to mix, then pulse centrifuge to collect.

Guidelines for freezing and thawing samples

There are stopping points throughout this procedure where you can freeze samples overnight or longer and then thaw the samples before proceeding. If you cannot perform the complete procedure in a day, proceed to a designated stopping point and freeze the samples overnight.

IMPORTANT! Freeze-thaw samples no more than 3 times.

Prepare the reagents and equipment

- If the DNA and RNA samples were frozen for storage, thaw them at room temperature until no ice crystals are present, then transfer them to 2–8°C storage until use.
- Equilibrate a benchtop cold box at −30°C to −10°C for at least 24 hours before use.

  Note: The cold box holds temperature for up to 1 hour on the bench.
- Equilibrate the DNA Dye Reagent, RNA Dye Reagent, DNA Buffer , and RNA Buffer to room temperature for at least 30 minutes before use.
- Keep the DNA Std and RNA Std at 2–8°C.

- If necessary, set up the fluorometer/fluorescence reader to read the appropriate excitation and emission wavelengths:

Dye reagent	Excitation (nm)	Emission (nm)
RNA Dye Reagent	620/15	680/30
DNA Dye Reagent	485/20	528/20

Set up the DNA quantification assay

Kit components used in this procedure

Kit component	Box
DNA Dye Reagent (blue cap) DNA Buffer (white cap) DNA Std - 0 ng/µL(white cap) DNA Std - 0.5 ng/µL (green cap) DNA Std - 4 ng/µL (red cap) DNA Std - 10 ng/µL (yellow cap)	Ion Torrent Dx DNA Quantification Kit (Part No. A32437, stored at 2°C to 8°C)

Prepare the DNA Working Solution

1. Determine the number of DNA standards to use with your quantification system.

   IMPORTANT! We recommend using 4 standards. If your quantification system does not allow the use of 4 standards, use the maximum allowed by the system. At a minimum, you must use the 0 ng/µL and 10 ng/µL DNA standards. Note that R^2 values should only be evaluated when 3 or more standards are used.

2. Calculate the number of reactions using the following formula:

   S (# of standards) + N (# of samples) +1 = # of reactions

3. Calculate the total volume of DNA Dye Reagent and DNA Buffer required for the number of reactions:

   # reactions × 1 µL (DNA Dye Reagent) = total volume of DNA Dye Reagent
   # reactions × 199 µL (DNA Buffer) = total volume of DNA Buffer

4. Mix the DNA Buffer and DNA Dye Reagent bottles by inverting 5 times.

5. Prepare the DNA Working Solution: Pipet the calculated volume of DNA Buffer into a pre-labeled tube, then add the calculated volume of DNA Dye Reagent into the same tube.

6. Vortex the tube for ~5 seconds, then proceed to the next steps.

   IMPORTANT! If you are not immediately proceeding to the next steps, protect the DNA Working Solution from light. The DNA Working Solution must be used within 3 hours.

Prepare the DNA standards

1. Add 190 µL of DNA Working Solution to each well or tube that will contain a DNA standard.
2. Vortex each DNA standard for ~5 seconds, then pulse centrifuge. Refer to the following table of DNA standards and concentrations.

   Note: If you are using fewer than four standards, at a minimum you must use the 0 ng/µL and 10 ng/µL DNA standards.

Standard	Concentration
DNA STD 1 (white cap)	0 ng/µL
DNA STD 2 (green cap)	0.5 ng/µL
DNA STD 3 (red cap)	4.0 ng/µL
DNA STD 4 (yellow cap)	10 ng/µL

3. Pipet 10 µL of each DNA standard into its designated well or tube.

Prepare the DNA samples

1. Add 196 µL of DNA Working Solution to each well or tube that will contain a DNA sample.
2. Vortex each DNA sample for ~5 seconds, then pulse centrifuge.
3. Pipet 4 µL of each DNA sample into its designated well or tube, then proceed to set up the RNA quantification assay.

Set up the RNA quantification assay

IMPORTANT! Wipe down your work surface and pipettes with an RNase decontamination solution. Change gloves before starting and as needed to maintain RNase-free conditions.

Kit components used in this procedure

Kit component	Box
RNA Dye Reagent (green cap) RNA Buffer (blue cap) RNA Std - 0 ng/µL (teal cap) RNA Std - 0.5 ng/µL (tan cap) RNA Std - 4 ng/µL (purple cap) RNA Std - 10 ng/µL (orange cap)	Ion Torrent Dx RNA Quantification Kit (Part No. A32438, stored at 2°C to 8°C)

Prepare the RNA working solution

1. Determine the number of RNA standards to use with your quantification system.

   IMPORTANT! We recommend using 4 standards. If your quantification system does not allow the use of 4 standards, use the maximum allowed by the system. At a minimum, you must use the 0 ng/µL and 10 ng/µL RNA standards. Note that R^2 values should only be evaluated when 3 or more standards are used.

2. Calculate the number of reactions using the following formula:
   S (# of standards) + N (# of samples) +1 = # of reactions

3. Calculate the total volume of RNA Dye Reagent and RNA Buffer required for the number of reactions:
   # reactions × 1 µL (RNA Dye Reagent) = total volume of RNA Dye Reagent
   # reactions × 199 µL (RNA Buffer) = total volume of RNA Buffer

4. Mix the RNA Buffer and RNA Dye Reagent bottles by inverting five times.

5. Prepare the RNA Working Solution: Pipet the total volume of RNA Buffer into a pre-labeled tube, then add the total volume of RNA Dye Reagent into the same tube.

6. Vortex the tube for ~5 seconds, then proceed to the next steps.

IMPORTANT! If you are not immediately proceeding to the next steps, protect the RNA Working Solution from light. The RNA Working Solution must be used within 3 hours.

Prepare the RNA standards

1. Add 190 µL of RNA Working Solution to each well or tube that will contain an RNA standard.

2. Flick mix each RNA Standard 4 times, then pulse centrifuge. Refer to the following table of RNA Standards and concentrations.

   Note: If you are using fewer than four standards, at a minimum you must use RNA STD 1 (0 ng/µL) and RNA STD 4 (10 ng/µL).

Standard	Concentration
RNA STD 1 (teal cap)	0 ng/µL
RNA STD 2 (tan cap)	0.5 ng/µL
RNA STD 3 (purple cap)	4.0 ng/µL
RNA STD 4 (orange cap)	10 ng/µL

3. Pipet 10 µL of each RNA Standard into its designated well or tube.

Prepare the RNA samples

1. Add 196 µL of RNA Working Solution to each well or tube that will contain an RNA sample.

2. Flick mix each RNA sample 4 times, then pulse centrifuge.

3. Pipet 4 µL of each RNA sample into its designated well or tube, then proceed to quantification.

Run the quantification assays

1. Incubate the prepared DNA and RNA standards and samples for at least 2 minutes at room temperature before reading.

2. Determine the concentration of the DNA and RNA samples in ng/µL using a fluorometer/fluorescence reader and linear regression of the standards for DNA and RNA respectively.

   The required minimum values for the Oncomine™ Dx Target Test are shown in the following table:

   Table 4 Required sample concentrations and R^2 values

Sample type	Required concentration	Required R^2 value[1]
DNA	≥0.83 ng/µL	≥0.99
RNA	≥1.43 ng/µL	≥0.98

[1] R^2 values should be evaluated only if the standard curve includes 3 or more points.

IMPORTANT! To proceed with library preparation, both the DNA and RNA from a single sample extraction must meet the minimum requirements. Do not use DNA from one extraction with RNA from a different extraction.

3. If the samples do not meet the minimum concentration requirements, repeat the extraction with increased tissue input (i.e., more sections) if possible.

STOPPING POINT If you do not dilute the sample on the same day, store the quantified DNA sample at −30°C to −10°C and the quantified RNA sample at −90°C to −60°C (for up to 9 months).

Dilute the samples

Kit components used in this procedure

Kit component	Box
Dilution Solution (black cap)	Ion Torrent Dx Sample Dilution Kit (Part No. A32439, stored at 15°C to 30°C)

Procedural guidelines

- In the following procedure, do not pipet volumes less than 2.0 µL. If necessary, dilute each sample to an intermediate dilution (e.g., 5 ng/µL), then dilute the sample to a final concentration of 0.83 ng/µL for DNA and 1.43 ng/µL for RNA.
- Unless the study design dictates that multiple libraries must be made from a single sample (e.g., replicate libraries), dilute only sufficient sample to prepare a single library plus 10% overage to accommodate pipetting errors.

Thaw frozen samples

If DNA and RNA samples were frozen for storage, thaw them at room temperature until no ice crystals are present, then dilute them as described in "Dilute the samples" on page 44 before proceeding. Transfer diluted samples to 2–8°C storage until use.

Note: Freeze-thaw samples no more than 3 times.

Dilute the samples

Dilute DNA samples to a final concentration of 0.83 ng/µL and RNA samples to a final concentration of 1.43 ng/µL, as follows.

IMPORTANT! Do not perform the following dilution procedure until you are ready to proceed directly to reverse transcription and library preparation.

---

1. Label two new 1.5-mL low-retention microcentrifuge tubes, one for the DNA sample and the other for the RNA sample. Place the tubes in a pre-chilled benchtop cold box until needed.

2. Use the DNA and RNA sample concentrations (ng/µL) determined in the quantification assays to calculate the volume (X) of each RNA and DNA sample required for 10 ng of sample plus 10% overage. Use the following formula:

   1.1 × (10 ng/DNA or RNA sample concentration in ng/µL) = X µL of DNA or RNA

   Note: See "Example dilution calculations" on page 46.

3. Calculate the volume (Y) of Dilution Solution required to yield a correctly diluted sample using the following formulas:

   DNA samples: (11 ng/0.83 ng/µL) – X µL of DNA = Y µL of Dilution Solution
   RNA samples: (11 ng/1.43 ng/µL) – X µL of RNA = Y µL of Dilution Solution

   ---

   IMPORTANT!
   - If the sample volume (X) from step 2 is <2.0 µL, use 2.0 µL of the sample and adjust the volume of Dilution Solution accordingly.
   - If volume of Dilution Solution (Y) from step 3 is <2.0 µL, increase the amount of the DNA and/or RNA sample volume until the required volume of Dilution Solution is ≥2 µL. See "Example dilution calculations" on page 46.

   ---

4. For each DNA or RNA sample, pipet the calculated Y µL of Dilution Solution into the appropriate labeled 1.5-mL low-retention microcentrifuge tube from step 1.

5. Add the calculated X µL of DNA or RNA sample into the appropriate labeled tube.

6. Pipet up and down 5 times to mix, then pulse centrifuge.

7. Place the diluted DNA and RNA samples back in the chilled benchtop cold box or in a 2–8°C refrigerator, then proceed immediately to "Reverse transcribe the RNA" on page 48.

IMPORTANT! Proceed directly to reverse transcription and then library preparation. Do not store the diluted DNA and RNA samples for longer than necessary.

STOPPING POINT Store the remaining undiluted DNA sample at –30°C to –10°C and the remaining undiluted RNA sample at –90°C to –60°C for up to 9 months.

Example dilution calculations

Table 5 Example calculation if the sample volume is ≥2 µL

		DNA concentration = 3 ng/µL	RNA concentration = 4 ng/µL
1	Sample volume calculation	1.1 × [10 ng/(3 ng/µL)] = **3.67 µL DNA sample volume**	1.1 × [10 ng/(4 ng/µL)] = **2.75 µL RNA sample volume**
2	Dilution Solution calculation	(11 ng/0.83 ng/µL) – 3.67 µL DNA sample = **9.58 µL of Dilution Solution**	(11 ng/1.43 ng/µL) – 2.75 µL RNA sample = **4.90 µL of Dilution Solution**
3	Final concentration check	(3.67 µL × 3 ng/µL) / (3.67 µL + 9.58 µL) = **0.83 ng/µL**	(2.75 µL × 4 ng/µL) / (2.75 µL + 4.94 µL) = **1.43 ng/µL**

Table 6 Example calculation if the sample volume is <2 µL

		DNA concentration = 15 ng/µL	RNA concentration = 14 ng/µL
1	Sample volume calculation	1.1 × [10 ng/(15 ng/µL)] = **0.73 µL DNA sample volume**	1.1 × [10 ng/(14 ng/µL)] = **0.79 µL RNA sample volume**
2	Sample volume adjustment (× 3)	0.73 µL of sample × 3 = **2.19 µL DNA sample volume**	0.79 µL of sample × 3 = **2.37 µL RNA sample volume**
3	Dilution Solution calculation with adjustment	[(11 ng/0.83 ng/µL) × 3] – 2.19 µL DNA sample = **37.6 µL of Dilution Solution**	[(11 ng/1.43 ng/µL) × 3] – 2.37 µL RNA sample = **20.7 µL of Dilution Solution**
4	Final concentration check	(2.19 µL × 15 ng/µL) / (2.19 µL + 37.6 µL) = **0.83 ng/µL**	(2.37 µL × 14 ng/µL) / (2.37 µL + 20.7 µL) = **1.43 ng/µL**

Table 7 Example calculation if the Dilution Solution volume is <2 µL

		DNA concentration = 0.9 ng/µL	**RNA concentration = 1.8 ng/µL**
1	Sample volume calculation	1.1 × [10 ng/(0.9 ng/µL)] = **12.22 µL DNA sample volume**	1.1 × [10 ng/(1.8 ng/µL)] = **6.11 µL RNA sample volume**
2	Dilution Solution calculation	(11 ng/0.83 ng/µL) – 12.22 µL DNA sample = **1.03 µL of Dilution Solution**	(11 ng/1.43 ng/µL) – 6.11 µL RNA sample = **1.58 µL of Dilution Solution**
3	Dilution Solution adjustment (× 2)	1.03 µL of Dilution Solution × 2 = **2.06 µL of Dilution Solution**	1.58 µL of Dilution Solution × 2 = **3.16 µL of Dilution Solution**
4	Sample volume adjustment (× 2)	12.22 µL of sample × 2 = **24.44 µL DNA sample volume**	6.11 µL of sample × 2 = **12.22 µL RNA sample volume**
5	Dilution Solution calculation with adjustment	[(11 ng/0.83 ng/µL) × 2] – 24.44 µL DNA sample = **2.06 µL of Dilution Solution**	[(11 ng/1.43 ng/µL) × 2] – 12.22 µL RNA sample = **3.16 µL of Dilution Solution**
6	Final concentration check	(24.44 µL × 0.9 ng/µL) / (24.44 µL + 2.06 µL) = **0.83 ng/µL**	(12.22 µL × 1.8 ng/µL) / (12.22 µL + 3.16 µL) = **1.43 ng/µL**

6 Prepare the cDNA

Kit components used in this procedure

Kit component	Box
5X Reaction Mix (red cap) 10X Enzyme Mix (green cap)	Ion Torrent Dx cDNA Synthesis Kit (Part No. A32436, stored at –30°C to –10°C)
Oncomine™ Dx Target RNA Control (white cap; single-use tubes)	Oncomine™ Dx Target RNA Control box 3 of 3 (Part No. A32443, stored at –90°C to –60°C)
No Template Control (purple cap)	Ion Torrent Dx No Template Control Kit (Part No. A32444, stored at 15°C to 30°C)

Thaw frozen samples

If DNA and RNA samples were frozen for storage, thaw them at room temperature until no ice crystals are present, then dilute them as described in "Dilute the samples" on page 44 before proceeding. Transfer diluted samples to 2–8°C storage until use.

Note: Freeze-thaw samples no more than 3 times.

Reverse transcribe the RNA

Perform the following steps in a laminar flow hood.

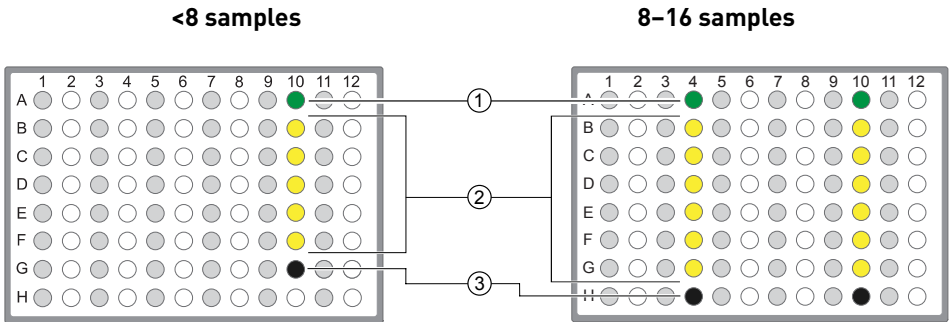
Prepare a master mix for cDNA synthesis reactions for up to 16 samples (for example, 12 clinical samples plus 4 controls).

1. Vortex the No Template Control (purple cap) and Dilution Solution (black cap) for ~5 seconds each, then pulse centrifuge.
2. Flick the prediluted RNA sample (1.43 ng/µL), the single-use Oncomine™ Dx Target RNA Control tube (white cap), and the 10X Enzyme Mix (green cap) 4 times each to mix, then pulse centrifuge.

   IMPORTANT! Do not vortex the prediluted RNA sample.

3. Label a MicroAmp™ Optical 96-well Reaction Plate with "RNA/cDNA".

4. Place the labeled 96-well plate on a 2–8°C aluminum cold block, and set up the reactions in the designated wells of the plate. Configure the plate for <8 samples or 8–16 samples as shown in the figure.



① Oncomine™ Dx Target RNA Control
② Prediluted RNA samples
③ No Template Control

Note: If you are preparing >8 samples, skip columns to prevent cross-contamination. Include one No Template Control and one Oncomine™ Dx Target RNA Control well for each column of samples, as illustrated.

5. To each No Template Control well, add 7 µL of No Template Control.

6. To each Oncomine™ Dx Target RNA Control well, add the following components in the order indicated:

Order	Component	Volume per reaction
1	Oncomine™ Dx Target RNA Control (white cap)	3 µL
2	Dilution Solution (black cap)	4 µL

7. For each RNA sample reaction, add 7 µL of prediluted RNA sample into the designated well.

   Note: Do not exceed 7 µL of prediluted RNA, which is equivalent to 10 ng.

8. Prepare a master mix for n+1 reactions. Add the following components to a 1.5-mL low-retention microcentrifuge tube:

Component	Volume per reaction
5X Reaction Mix (red cap)	(n+1) × 2 µL
10X Enzyme Mix (green cap)	(n+1) × 1 µL
Total	**(n+1) × 3 µL**

9. Flick the master mix tube 4 times to mix, then pulse centrifuge to collect.

10. Pipet 3 µL of the master mix into each RNA sample, No Template Control, and Oncomine™ Dx Target RNA Control well in the 96-well plate.

11. Set a pipette to 8 µL, then pipet the contents of each reaction well up and down 5 times to mix.

12. Seal the plate with an Adhesive PCR Plate Seal, then centrifuge the plate at 100 rcf for 30 seconds.

13. Load the plate in the Veriti™ Dx Thermal Cycler, then select the **1 ODxTT cDNA Synthesis** program. Select **View** and confirm that the steps in the program match those in the table below.

Temperature	Time
42°C	30 minutes
85°C	5 minutes
10°C	Hold (up to 1 hour)

14. When you have confirmed the steps, run the program.

STOPPING POINT The cDNA can be held on the thermal cycler up to 1 hour. Store at −30°C to −10°C for up to 7 days.

A Troubleshooting—Sample preparation

Observation	Possible cause	Recommended action
Slide cracked during scraping	Too much pressure was used during scraping.	Repeat the extraction using a fresh slide if possible. Processing a cracked or broken slide can pose a safety hazard to the operator.
Low-bind Elution tube cap breaks off	Low-bind Elution tubes were not properly aligned in the microcentrifuge prior to centrifugation.	Transfer eluted samples to new, prelabeled Low-bind Elution tubes. Extra Low-bind Elution tubes are provided, however 1.5-mL snap-cap low-retention microcentrifuge tubes may also be used.
DNA/RNA quantification values are not returned	The signal for the sample was oversaturated.	Dilute the DNA and RNA samples with Dilution Solution. Prepare new standards and repeat the quantification assay.
	The signal from the sample was too low.	Prepare new standards and repeat the quantification assay. If the low signal persists, repeat the extraction with increased tissue input (i.e., more sections) if possible.
DNA/RNA samples do not meet the minimum concentration requirement	Quantification assays performed incorrectly.	Prepare new standards and repeat the quantification assay.
	Insufficient tissue was used in the extraction.	Repeat the extraction with increased tissue input (i.e., more sections) if possible. If the tissue was collected via macrodissection of a resection/surgical biopsy sample, repeat the macrodissection and DNA/RNA extraction with more than two 5-micron sections if available. If only two 5-micron sections remain from the sample, repeat the DNA/RNA extraction with the remaining sections without macrodissection. **Note:** To proceed with library preparation, both the DNA and RNA from a single sample extraction must meet the minimum concentration requirement. Do not use DNA from one extraction with RNA from a different extraction.
	Elution Solution cooled below 95°C.	Keep the Elution Solution in a 95°C heat block throughout the procedure, including when pipetting.
R^2 values do not meet minimum requirement	Standards were not prepared correctly.	Prepare new standards and repeat the quantification assay.

Observation	Possible cause	Recommended action
"Fatal Error" message displayed by Veriti™ Dx Thermal Cycler	Various	For assistance, contact Technical Support (see "Customer and technical support" on page 57). Refer to the *Veriti™ Dx Thermal Cycler User Guide* (Pub. no. 4453697) for general troubleshooting information for this instrument.
Batch sample import fails	One or more entries in the sample-import spreadsheet contains special characters, lines breaks, unexpected spaces, incorrect entry length, incorrect date formatting, or other formatting errors.	Check each entry for correct formatting, correct any errors, and repeat the import.
	Blank rows were copied into the sample-import template file from a different source.	Rows that appear empty may contain hidden formatting that conflicts with the import function. Start with a clean sample-import template file, and be careful to copy only those rows that contain actual data.
	The sample import spreadsheet contains a nonunique Sample ID.	Every Sample ID in the software must be unique. Make sure the spreadsheet does not contain any duplicate IDs, and repeat the import. Note that the system check is not case-sensitive, so a Sample ID of ABC1 conflicts with abc1.
	The headings in the sample import spreadsheet do not match the sample attributes in the software.	The headings must match the sample attributes in the software exactly. Check the headings for spelling or other errors.

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, etc). To obtain SDSs, see the "Documentation and Support" section in this document.

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:
  www.cdc.gov/biosafety/publications/bmbl5/BMBL.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

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 adequate ventilation (for example, fume hood).
- Check regularly for chemical leaks or spills. If a leak or spill occurs, follow the manufacturer's 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 necessary) 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.

Precaution—strong magnet

Note: Do not substitute non-IVD labeled magnets for the DynaMag™ Dx 96-Well Plate Magnet and DynaMag™ Dx 16 2-mL Magnet, provided with Ion PGM™ Dx System.

The DynaMag™ Dx 96-Well Plate Magnet and DynaMag™ Dx 16 2-mL Magnet contain very strong permanent magnets. People wearing a pacemaker or any other medical magnetized implant should not use this product unless advised by a health professional; the implant could be affected or damaged by exposure to a strong magnetic field. Keep tools and objects that could be damaged by the magnetic field out of the working area. This includes, but is not restricted to, credit cards and other products containing magnetic recording devices. Keep away from delicate instruments, watches, electronic equipment, displays and monitors. The magnet may attract steel or other magnetic material with high mechanical forces. Take care during handling. Avoid contact between two magnets. Do not pull the magnets apart if contact has been made; twist off to prevent damage to the unit or fingers. The Health and Safety Officer should take all necessary steps and full responsibility to ensure that the precautions and statements are followed and adhered to.

Medical device symbols

The following table describes symbols that may be displayed on instruments, consumables, or reagents. The symbols used on labels conform to standard BS EN ISO 15223-1:2012 and FDA guidance "Use of Symbols on Labels and in Labeling of In Vitro Diagnostic Devices Intended for Professional Use".

Symbol	Description	Symbol	Description
	MANUFACTURER		CONTAINS SUFFICIENT FOR <n> TESTS
	DATE OF MANUFACTURE		USE BY
LOT	BATCH CODE	REF	CATALOG NUMBER
SN	SERIAL NUMBER		FRAGILE, HANDLE WITH CARE
	LOWER LIMIT OF TEMPERATURE		PROTECT FROM LIGHT
	UPPER AND LOWER LIMITS OF TEMPERATURE		UPPER LIMIT OF TEMPERATURE
	DO NOT REUSE		BIOLOGICAL RISKS
	CAUTION, CONSULT ACCOMPANYING DOCUMENTS		CONSULT INSTRUCTIONS FOR USE
	UPPER AND LOWER LIMITS OF HUMIDITY		OBSERVE PRECAUTIONS FOR HANDLING ELECTROSTATIC SENSITIVE DEVICES
IVD	IN VITRO DIAGNOSTIC MEDICAL DEVICE		

C Performance characteristics

For performance characteristics of the Oncomine™ Dx Target Test Kit, see the *Oncomine™ Dx Target Test Part V: Analysis and Test Reports User Guide* (Pub. No. MAN0016171).

For performance characteristics of the Ion PGM™ Dx System, see Appendix B of the *Ion PGM™ Dx System User Guide* (Pub. No. MAN0016694) and the *Ion PGM™ Dx System Performance Characteristics User Guide* (Pub. No. MAN0016697).

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- Product support
- Order and web support
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Additional product documentation, including user guides and Certificates of Analysis, are available by contacting Customer Support.

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The Certificate of Analysis provides detailed quality control and product qualification information for each product. Certificates of Analysis are printed and shipped with the product.

Obtaining Certificates of Conformance

The Certificate of Conformance provides information on conformance testing of each instrument provided with the system. Certificates of Conformance are shipped with the instrument, and are also available by contacting Customer Support at **thermofisher.com/support**.

iontorrent
by Thermo Fisher Scientific

Oncomine™ Dx Target Test Part II: Library Preparation

USER GUIDE

Publication Number MAN0016168

Revision B.0

IVD

For In Vitro Diagnostic Use.

Life Technologies Holdings Pte Ltd |
Block 33 |
Marsiling Industrial Estate Road 3 |
#07-06, Singapore 739256

Products manufactured in Singapore:

Ion PGM™ Dx Instrument System
Ion PGM™ Dx Sequencer
Ion OneTouch™ Dx Instrument
Ion OneTouch™ ES Dx Instrument
Ion PGM™ Dx Chip Minifuge (120V)
Ion PGM™ Wireless Scanner
Ion Torrent™ Server
Veriti™ Dx Thermal Cycler

Life Technologies Corporation |
7335 Executive Way |
Frederick, MD 21704 | USA

Products manufactured in Frederick:

Oncomine™ Dx Target Test Kit
Ion Torrent Dx FFPE Sample Preparation Kit
Ion PGM™ Dx Library Kit
Ion OneTouch™ Dx Template Kit
Ion PGM™ Dx Sequencing Kit
Ion 318™ Dx Chip
Ion OneTouch™ Rack Kit
DynaMag™ Dx 96-Well Plate Magnet
DynaMag™ Dx 16 2-mL Magnet

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

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Revision history: Pub. No. MAN0016168

Revision	Date	Description
B.0	25 May 2017	Final for commercial release
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About this guide

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

Purpose of this guide

This user guide provides instructions for preparing barcoded sample libraries from DNA and cDNA using the Oncomine™ Dx Target Test DNA and RNA panels. The resulting libraries are ready for template preparation and sequencing using the Ion PGM™ Dx System.

Oncomine™ Dx Target Test Kit user guides

This user guide is part of a five-guide set.

Note: The procedures in these guides supersede the instructions in the *Ion PGM™ Dx System User Guide* when using the Ion PGM™ Dx System with the Oncomine™ Dx Target Test.

- *Oncomine™ Dx Target Test Part I: Sample Preparation and Quantification User Guide*
- *Oncomine™ Dx Target Test Part II: Library Preparation User Guide*
- *Oncomine™ Dx Target Test Part III: Template Preparation User Guide*
- *Oncomine™ Dx Target Test Part IV: Sequencing User Guide*
- *Oncomine™ Dx Target Test Part V: Analysis and Test Reports User Guide*

All five guides are required to complete the entire Oncomine™ Dx Target Test workflow.

1 Product information

Product description

Oncomine™ Dx Target Test

The Oncomine™ Dx Target Test is an *in vitro* diagnostic next-generation sequencing test to detect somatic alterations in human DNA and RNA isolated from non-small cell lung cancer (NSCLC) tumor specimens in formalin-fixed, paraffin-embedded (FFPE) tissue samples. Detection of these variants is performed using the Ion PGM™ Dx System.

The Oncomine™ Dx Target Test Kit (Cat. No. A32451) provides a set of primers in two panels that target key regions of 23 cancer-related genes.

Library preparation components

The Oncomine™ Dx Target Test Kit includes the following components for preparing barcoded libraries from DNA and cDNA for sequencing on the Ion PGM™ Dx System:

- Oncomine™ Dx Target Test and Controls, which includes primer panels for amplifying DNA- and RNA-specific target regions as well as controls
- Ion PGM™ Dx Library Kit, which includes 16 unique barcode adapters (BC 1–BC 16) as well as enzymes and other reagents for library preparation
- Ion PGM™ Dx Library Equalizer™ Reagents, to normalize the concentration of the resulting libraries to ~100 pM without the need for quantification

The library preparation procedure requires 10 ng of DNA and cDNA, prepared as described in the *Oncomine™ Dx Target Test Part I: Sample Preparation and Quantification User Guide* (Pub. no. MAN0016167).

Intended use

For the Intended Use statement for the Oncomine™ Dx Target Test, see the *Oncomine™ Dx Target Test Part I: Sample Preparation and Quantification User Guide* (Pub. No. MAN0016167).

Theory of operation

For a complete description of the Theory of Operation of the system, see the *Oncomine™ Dx Target Test Part I: Sample Preparation and Quantification User Guide* (Pub. No. MAN0016167).

Software compatibility and requirements

The procedures in this guide are designed for use with Torrent Suite™ Dx Software version 5.6 or later. To view the current software version, log in to the software as an Administrator, click on the **Settings (⚙)** tab, then select **Configuration** and click on the **Software Updates** tab. Version-specific information is provided in the software release notes for your version of the software.

Torrent Suite™ Dx Software is supported on Chrome™ browser version 39, and is best viewed with 1024 × 768 screen resolution. It has not been tested with other browsers.

The Ion Torrent™ Server operating system is Ubuntu™ 14.04 LTS.

Materials provided

Oncomine™ Dx Target Test Kit

The Oncomine™ Dx Target Test Kit (Cat. No. A32451) includes the following subkits.

IMPORTANT! Refer to the product label for the storage conditions and expiration dates of individual modules and components.

✓	Subkit	Part no.
	Oncomine™ Dx Target Test and Controls	A32447
	Ion Torrent Dx FFPE Sample Preparation Kit	A32445
	Ion PGM™ Dx Library Kit	A18975
	Ion OneTouch™ Dx Template Kit	A18976
	Ion PGM™ Dx Sequencing Kit	A18977
	Ion 318™ Dx Chip Kit	A18937
	Oncomine™ Dx Target Test User Guides and Assay Definition File	A32461

Subkits used in this guide

The procedures in this user guide use the following subkits from the Oncomine™ Dx Target Test Kit.

Oncomine™ Dx Target Test and Controls

The Oncomine™ Dx Target Test and Controls Kit (Part no. A32447) provides the following panels and controls.

✓	Component	Amount	Storage
Oncomine™ Dx Target Test DNA and RNA Panel (Part no. A32441)			
	Oncomine™ Dx Target Test—DNA panel (blue cap)	6 × 32 µL	–30°C to –10°C
	Oncomine™ Dx Target Test—RNA panel (yellow cap)	6 × 32 µL	

✓	Component	Amount	Storage
Oncomine™ Dx Target DNA Control (Part no. A32442)			
	Oncomine™ Dx Target DNA Control (brown cap)	8 × 7 µL (single-use tubes)	–30°C to –10°C
Oncomine™ Dx Target RNA Control (Part no. A32443)			
	Oncomine™ Dx Target RNA Control (white cap)	8 × 7 µL (single-use tubes)	–90°C to –60°C
Ion Torrent Dx No Template Control Kit (Part no. A32444)			
	No Template Control (purple cap)	8 × 30 µL	15°C to 30°C

Ion PGM™ Dx Library Kit

The Ion PGM™ Dx Library Kit (Cat. No. A18975) provides reagents for preparing up to 96 sample libraries.

IMPORTANT! Do not mix components from other library kits.

✓	Component	Amount	Storage
Ion PGM™ Dx Library Reagents (Part No. A18928)			
	LIB HiFi Mix (red cap)	6 × 252 µL	–30°C to –10°C
	LIB FuPa (green cap)	6 × 32 µL	
	LIB Switch Soln (orange cap)	6 × 64 µL	
	LIB DNA Ligase (clear cap)	6 × 32 µL	
	BC 1 through BC 16 (16 unique barcode adapters, numbered 1–16, white cap)	16 × 12 µL	
Ion PGM™ Dx Library Equalizer™ Reagents (Part No. A18929)			
	LIB AMPure™ Reagent (clear cap)	4.4 mL	2°C to 8°C
	LIB Beads (yellow cap)	6 × 48 µL	
	LIB Primers (blue cap)	6 × 36 µL	
	LIB Capture (violet cap)	6 × 160 µL	
	LIB Wash Soln (clear cap)	30 mL	
	LIB Elution Soln (clear cap)	9.6 mL	

Materials and equipment required but not provided

Unless otherwise indicated, all materials are available through **thermofisher.com**. MLS: Fisher Scientific (**fisherscientific.com**) or other major laboratory supplier.

Description	Source
Veriti™ Dx 96-Well Thermal Cycler, 0.2 mL	4452300
Laminar flow hood	MLS
MicroAmp™ Optical 96-well Reaction Plates	4481191 4481192 (with barcode)
Adhesive PCR Plate Seals	AB-0558
96-well aluminum cold block	MLS
96-well plate centrifuge	MLS
Mini centrifuge	MLS
Benchtop cold box	MLS
DynaMag™ Dx 96-Well Plate Magnet magnet	A31347
DynaMag™ Dx 16 2-mL Magnet	A31346
Nuclease-free water	MLS
Absolute ethanol	MLS
Single- and multi-channel pipettors (2-, 20-, 200-, 1000- µL)	MLS
Aerosol-barrier pipette tips (2-, 10-, 20-, 200-, 1000- µL)	MLS
1.5-mL snap-cap low-retention polypropylene microcentrifuge tubes	MLS
1.5-mL tube rack	MLS
Vortex mixer with a rubber platform	MLS

DynaMag™ Dx 96-Well Plate Magnet and DynaMag™ Dx 16 2-mL Magnet

Note: Do not substitute non-IVD labeled magnets for the DynaMag™ Dx 96-Well Plate Magnet and DynaMag™ Dx 16 2-mL Magnet.

The DynaMag™ Dx 96-Well Plate Magnet and DynaMag™ Dx 16 2-mL Magnet, provided with Ion PGM™ Dx System, contain high-energy neodymium magnets and are used as part of the procedure for purifying sample libraries bound to LIB AMPure™ Reagent and LIB Beads . The DynaMag™ Dx 16 2-mL Magnet is also used to prepare TMPL ES Beads as part of template preparation.

The DynaMag™ Dx 96-Well Plate Magnet has 7 bar magnets with a hard plastic top to fit 96-well PCR plates. When you insert a plate, the magnets collect bead-bound biomolecules in suspension at the sides of the plate wells, allowing removal of fluid without disturbing the bead pellets. An extra column in the magnet enables sample mixing by shifting the plate back and forth in the magnet.

The DynaMag™ Dx 16 2-mL Magnet holds 16 standard 1.5-mL or 2-mL microcentrifuge tubes, and collects bead-bound biomolecules in suspension at the sides of the tubes, allowing removal of fluid without disturbing the bead pellets.

Do not use the magnets above 50°C (122°F) and store in a cool, dry environment.

2 Before you begin

Procedural guidelines

Definitions

Throughout this guide:

- Room temperature is defined as the temperature range 15–30°C.
- A pulse centrifugation consists of a 3–5 second centrifugation at maximum speed in a mini centrifuge.

Guidelines for library preparation

- Up to 16 barcode adapters may be used in a single sequencing run.
- Freeze-thaw barcode adapters no more than 6 times.
- Verify that the correct program is selected before starting the Veriti™ Dx program.
- To avoid cross-contamination between samples, skip wells or columns when setting up reactions in a 96-well plate. Circle wells that are used with ethanol-resistant marker to help indicate where the samples are located.
- Because cDNA and DNA amplification reactions require a different number of cycles, they must be set up and run on separate 96-well plates.

Guidelines to prevent cross-contamination

- ⚠ **CAUTION!** A primary source of contamination is nucleic acid from previous sample processing steps. Do not introduce amplified DNA into the target amplification preparation area.
- When designing the laboratory layout, dedicate separate areas for pre- and post-amplification activities. Dedicate laboratory supplies and/or equipment to the appropriate area.
- Use a laminar flow hood in the dedicated pre-amplification area for target amplification reaction setup.
- Before and after use, clean all surfaces and equipment in the laminar flow hood with 10% bleach followed by two water rinses.
- Turn on the UV light in the hood for 10 minutes before and after use.
- Use fresh gloves before entering the hood.
- Change tips between pipetting steps.
- Prepare a waste container containing 10% bleach solution for disposing of used tips after pipetting libraries.

Guidelines for pipetting

- Use aerosol-barrier pipette tips.
- Change pipette tips between samples.
- Pipet viscous solutions slowly and ensure complete mixing.
- When pipetting, avoid introducing air bubbles by keeping the pipette tip at the bottom of the solution in the wells.
- Set the pipettor to the recommended volume for up-and-down mixing, and insert the tip into the solution with the pipette plunger depressed to avoid introducing air bubbles.
- If you are using a multi-channel pipettor, visually check pipette tips to ensure that volumes are equivalent.
- When dispensing liquid into a well, touch the tip to the inside of the well and slowly dispense the liquid down the side to form a droplet. This enables you to both pipet small volumes accurately and see that you added solution to the well.
- When dispensing, inspect the pipette tip to verify that the solution has been adequately dispensed.

Reagent contamination

Before use, verify that any nuclease-free water used in the procedure is not cloudy, a potential indication of contamination. If the water is cloudy, use a different vial.

Equilibrate materials

- Equilibrate two 96-well aluminum cold blocks to 2–8°C in a refrigerator.
- Equilibrate a benchtop cold box to −30°C to −10°C in a freezer.
- Equilibrate a separate benchtop cold box to 2–8°C in a refrigerator, or use ice to keep reaction tubes chilled on the bench.

Reagent management

Follow the guidelines below for proper reagent storage and use.

Storage

Reagents must be stored under appropriate conditions. Refer to the Product Information section in each user guide for the storage conditions of the kit components used in the procedures in that guide. The Oncomine™ Dx Target Test Kit System includes kits with multiple component boxes that require different storage conditions. For example, the Oncomine™ Dx Target Test and Controls Kit is composed of four boxes: Oncomine™ Dx Target Test and Oncomine™ Dx Target DNA Control are stored at −30°C to −10°C, whereas the Oncomine™ Dx Target RNA Control and Ion Torrent Dx No Template Control Kit require storage at −90°C to −60°C and 15–30°C, respectively. To use the Oncomine™ Dx Target Test and Controls, retrieve all boxes from their different storage areas and confirm that they are from the same master lot.

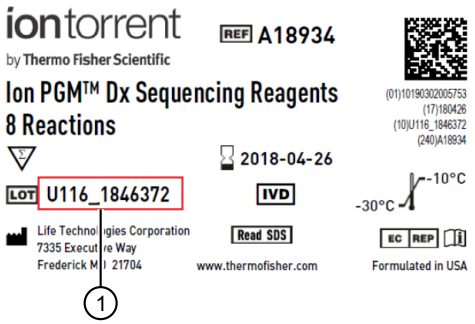
Kit and component matching

Each component box of the Oncomine™ Dx Target Test Kit lists the lot numbers of compatible component boxes on the inside of the box lid. Before use, confirm that the lot numbers of all boxes used in a sequencing run are compatible.

ATTENTION: This kit can only be used with the following lots:

REF		LOT
A18928	Ion PGM™ Dx Library Reagents	N117_1849183
A18929	Ion PGM™ Dx Library Equalizer	N117_1849184
A18930	Ion OneTouch™ Dx Template Reagents	N117_1849185
A18931	Ion OneTouch™ Dx Template ES Beads	N117_1849186
A18932	Ion OneTouch™ Dx Template Solutions	N117_1849187
A18933	Ion OneTouch™ Dx Template Supplies	N117_1849188
A18934	Ion PGM™ Dx Sequencing Reagents	N117_1849189
A18935	Ion PGM™ Dx Sequencing Solutions	N117_1849190
A18936	Ion PGM™ Dx Sequencing Supplies	N117_1849191
A32441	Oncomine™ Dx Target Test	1705001
A32442	Oncomine™ Dx Target DNA Control	R117_1867106
A32443	Oncomine™ Dx Target RNA Control	R117_1867107
A32444	Ion Torrent™ Dx No Template Control	R117_1867103

An example box label with lot information is shown below:



① Lot number

Library preparation workflow

Previous guide: *Oncomine™ Dx Target Test Part I: Sample Preparation and Quantification User Guide* (Pub. No. MAN0016167)

"Prepare a library batch in Torrent Suite™ Dx Software" on page 17

▼

"Prepare reagents and equipment" on page 19

▼

"Amplify the cDNA" on page 20

▼

"Amplify the DNA" on page 22

▼

"Transfer the cDNA amplicons" on page 26

▼

"Partially digest amplicons" on page 26

▼

"Ligate barcode adapters" on page 28

▼

"Prepare the LIB HiFi Mix plus LIB Primers mix" on page 29

▼

"Purify the barcode-adapted library" on page 30

▼

"Amplify the barcode-adapted library" on page 31

▼

"Prepare the LIB Beads" on page 32

▼

"Add LIB Capture to the amplified sample library" on page 32

▼

"Add the LIB Beads and wash" on page 33

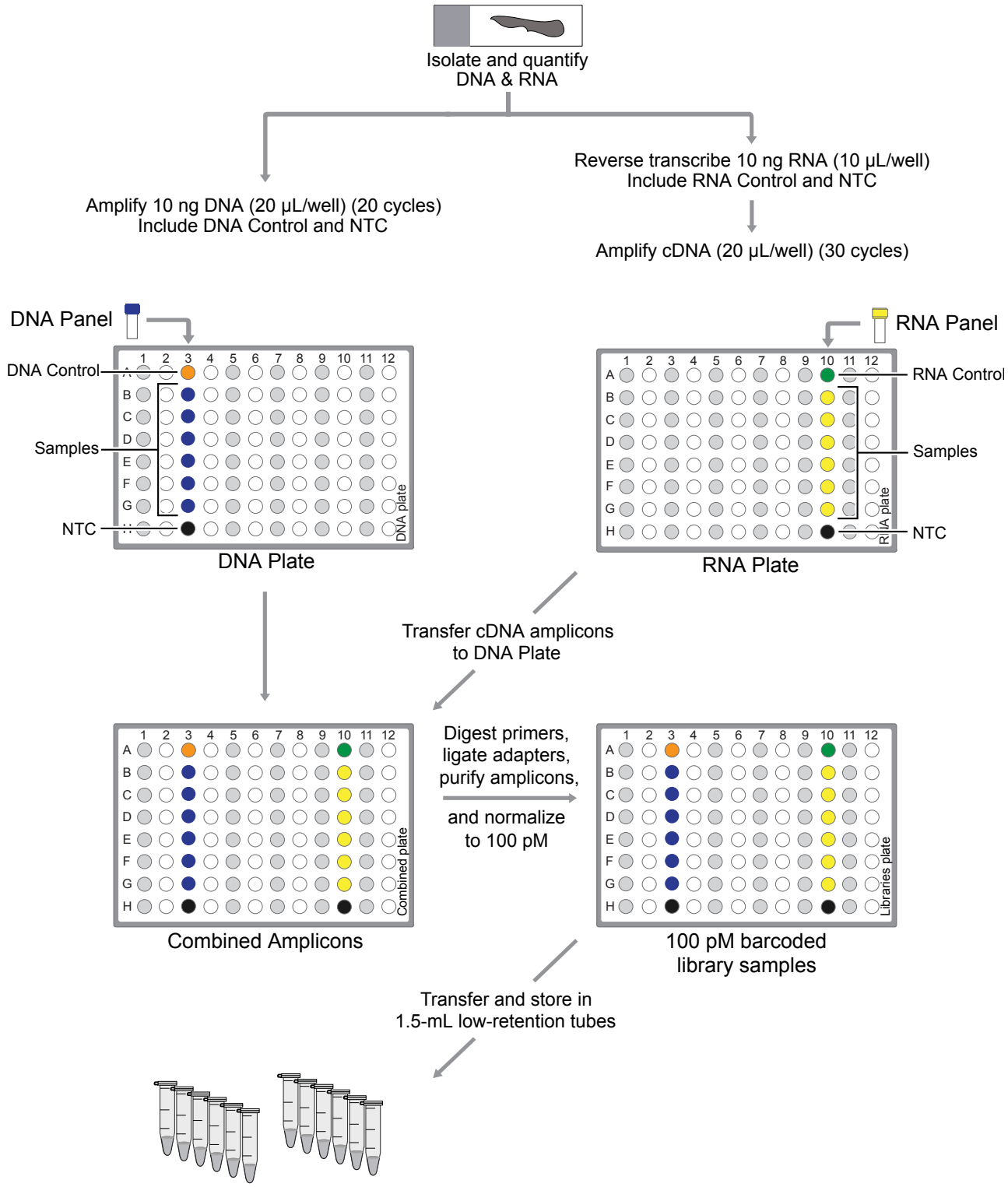
▼

"Elute the library" on page 33

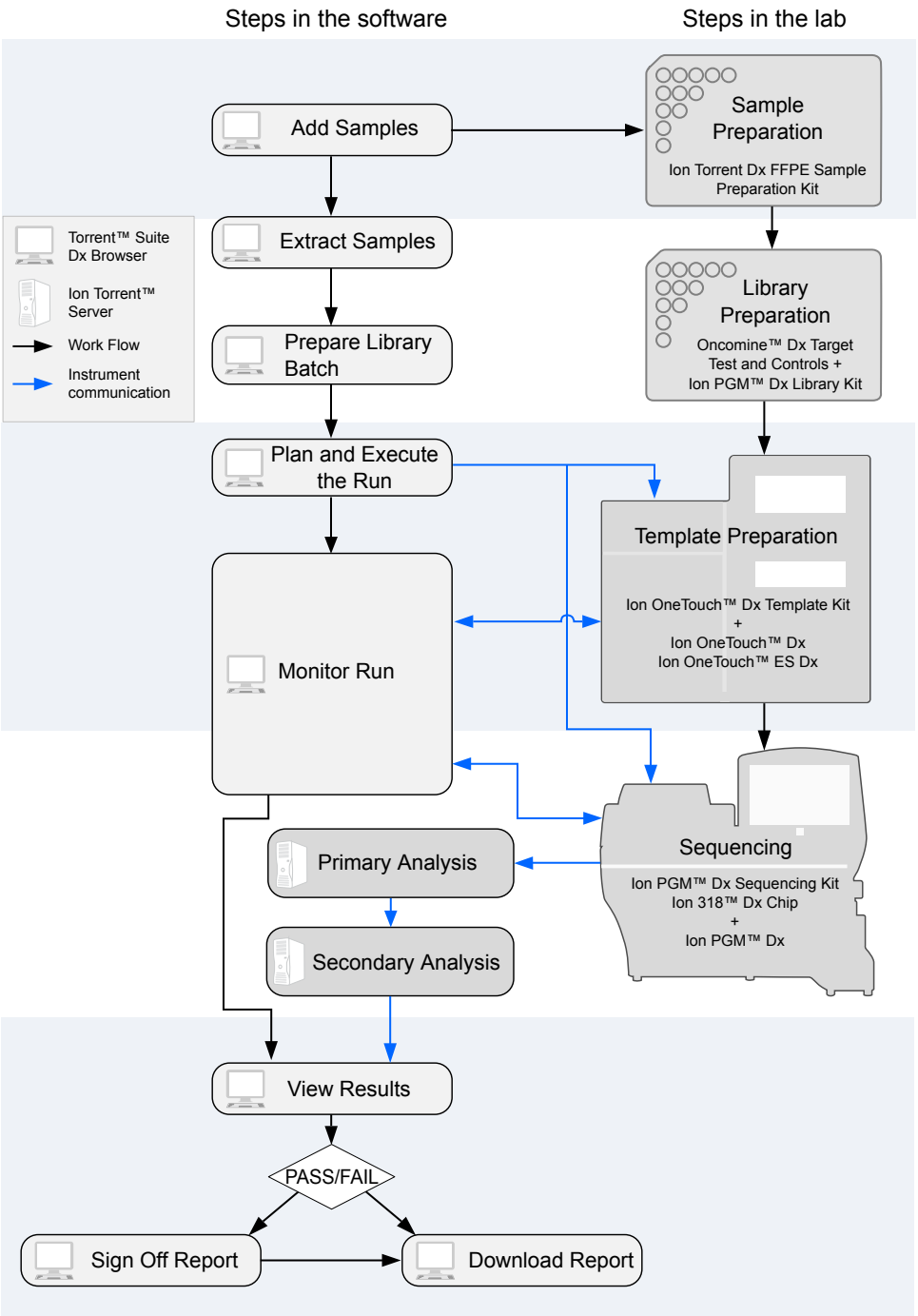
▼

Proceed to *Oncomine™ Dx Target Test Part III: Template Preparation User Guide* (Pub. No. MAN0016169)

Library preparation workflow diagram



Oncomine™ Dx Target Test system diagram



3 Prepare libraries

Prepare a library batch in Torrent Suite™ Dx Software

In Torrent Suite™ Dx Software, samples entered into the software are placed in library batches for processing and tracking. A library batch consists of a group of libraries that are prepared at the same time.

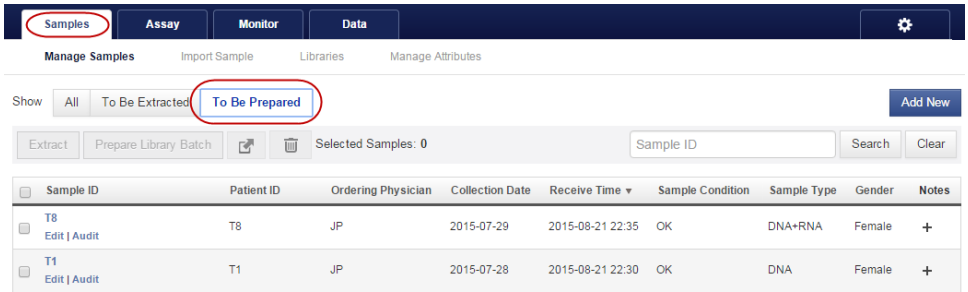
Note:

- Each library within a library batch must have a unique library name. When combining libraries in the same run, each must also have a unique barcode.
- Control libraries must be included in the same library batch as the sample library they control for.
- Fields identified with a red asterisk (*) are required.

1. Sign in to the Torrent Suite™ Dx Software.

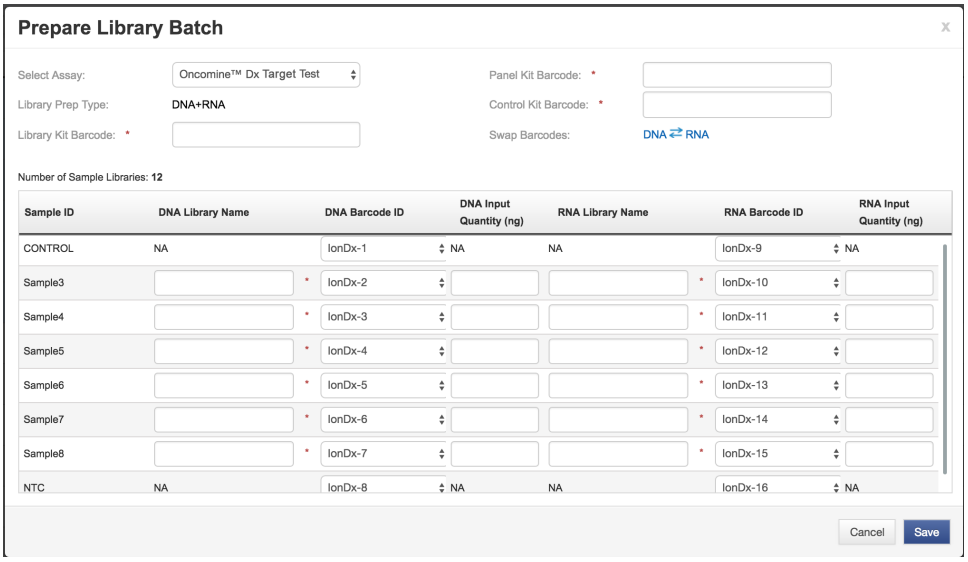
2. Under the **Samples** tab, in the **Manage Samples** screen, click **To Be Prepared** to display only those samples that have not been placed in a library batch.

   IMPORTANT! Samples that have not been queued for extraction in the software will also appear on this tab. Ensure that the samples have been queued for extraction prior to queueing them for library batch preparation.



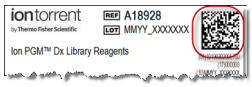
3. Select up to 6 samples in the list, then click **Prepare Library Batch**.
   The **Prepare Library Batch** dialog will open. Required fields are indicated with a red asterisk(*).

4. In the **Select Assay** dropdown list, select **Oncomine™ Dx Target Test**. The assay determines certain parameters of the run, including required controls and post-run data analysis settings.



5. Scan the barcodes from their respective kit boxes into the appropriate fields. Each library batch is associated with a kit lot by scanning the 2D barcode on the appropriate kit box.

IMPORTANT! Check the expiration date on each box. If the kit is expired, select another kit.

Barcode field	Kit	Kit box	Storage	Label scanned
Library Kit Barcode	Ion PGM™ Dx Library Kit	Ion PGM™ Dx Library Reagents	–30°C to –10°C	
Panel Kit Barcode	Oncomine™ Dx Target Test Panel	Oncomine™ Dx Target Test DNA and RNA Panel (box 1 of 3)	–30°C to –10°C	
Control Kit Barcode	Oncomine™ Dx Target Test and Controls	Oncomine™ Dx Target DNA Control (box 2 of 3)	–30°C to –10°C	

6. Type a unique library name for each library in the batch. Library names may only contain alphanumeric characters (0–9 and A to Z), full stop/period (.), underscore (_), and hyphen (-).

Note: The Oncomine™ Dx Target Test Kit requires specific controls, which are automatically listed in the dialog box shown in step 4.

7. Select the Barcode ID of the adapter used to prepare each library. Swap the default barcodes in the dialog between DNA and RNA using the DNA ⇄ RNA button.

   Note: Each library in a library batch must have a different Barcode ID. When preparing the physical libraries, we recommend swapping barcodes between DNA and RNA libraries in consecutive sequencing runs to prevent carryover contamination. See "Alternating barcodes" on page 27.

   IMPORTANT! Be careful to confirm that the actual barcodes used to create the libraries match the barcodes entered in the **Prepare Library Batch** dialog.

8. In the **Input Quantity** field, enter 10 ng for each library.

9. Click **Save** to save your selections and close the dialog.
   The **Libraries screen** will open, listing the libraries that you created. Libraries prepared in the same batch will have the same **Library Batch ID**.

Prepare reagents and equipment

- See "Procedural guidelines" on page 11 before setting up the reactions.
- Equilibrate the reagents listed below at room temperature for at least 30 minutes.
  - LIB AMPure™ Reagent
  - LIB Beads
  - LIB Primers
  - LIB Capture
  - LIB Wash Soln
  - LIB Elution Soln
- Place kit components that contain enzymes (LIB HiFi Mix, LIB FuPa, and LIB DNA Ligase) on ice or in a −30°C to −10°C chilled benchtop cold box throughout the procedure until needed. Before use, flick each tube 4 times to mix, then pulse centrifuge.
- Thaw the remaining kit components (except enzymes) at room temperature until no ice is present in the tubes. Vortex for ~5 seconds, then pulse centrifuge before use.
- If there is visible precipitate in the LIB Switch Soln after thawing, vortex for ~5 seconds at room temperature, and pulse centrifuge to collect. Repeat if needed until the solution is clear.

Amplify the cDNA

Kit components used in this procedure

Kit component	Box
Oncomine™ Dx Target Test—RNA panel (yellow cap)	Oncomine™ Dx Target Test box 1 of 3 (Cat. No. A32441, stored at –30°C to –10°C)
LIB HiFi Mix (red cap)	Ion PGM™ Dx Library Reagents (Part No. A27388, stored at –30°C to –10°C)

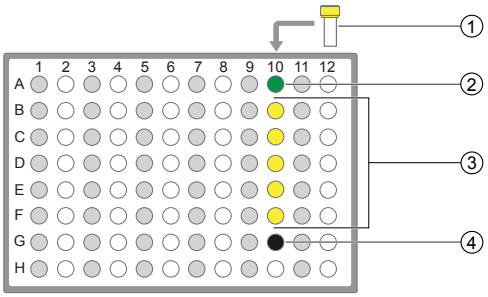
Set up the cDNA amplification reaction (<8 samples)

If you are preparing <8 samples, see below. If you are preparing 8–16 samples, see "Set up the cDNA amplification reaction (8–16 samples)" on page 21. The number of samples depends on the configuration of your "RNA/cDNA" plate (prepared as described in the *Oncomine™ Dx Target Test Part I: Sample Preparation and Quantification User Guide*).

1. Remove the "RNA/cDNA" plate from the thermal cycler, then centrifuge the plate at 100 rcf for 30 seconds.

2. Transfer the plate to a chilled (2–8°C) 96-well aluminum block.

3. Vortex the Oncomine™ Dx Target Test—RNA panel for ~5 seconds, then pulse centrifuge. Flick the tube of LIB HiFi Mix 4 times to mix, then pulse centrifuge.



① Oncomine™ Dx Target Test—RNA panel
② Oncomine™ Dx Target RNA Control
③ cDNA samples
④ No Template Control

4. Remove the seal from the plate, then add the following components to each well.

Component	Volume
Nuclease-free Water	2 µL
Oncomine™ Dx Target Test—RNA panel (yellow cap)	4 µL
LIB HiFi Mix (red cap)	4 µL
Total volume per well (includes 10 µL from cDNA synthesis)	**20 µL**

5. With the pipettor set to 15 µL, pipet up and down 5 times to mix the contents of each reaction well.

6. Proceed to "Amplify the cDNA targets" on page 22.

Set up the cDNA amplification reaction (8–16 samples)

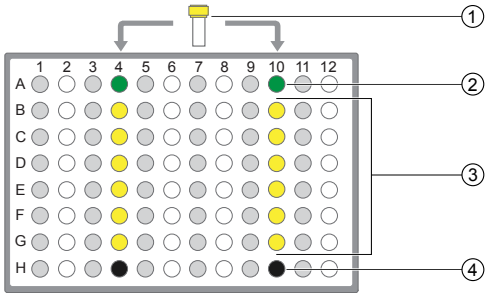
If you are preparing 8–16 samples, see below. If you are preparing <8 samples, see "Set up the cDNA amplification reaction (<8 samples)" on page 20. The number of samples depends on the configuration of your "RNA/cDNA" plate (prepared as described in the *Oncomine™ Dx Target Test Part I: Sample Preparation and Quantification User Guide*).

For 8–16 amplification reactions (including controls), make a master mix for n+1 reactions, where "n" is the number of reactions you are preparing.

1. Remove the "RNA/cDNA" plate from the thermal cycler, then centrifuge the plate at 100 rcf for 30 seconds.

2. Transfer the plate to a chilled (2–8°C) 96-well aluminum block.

3. Vortex the Oncomine™ Dx Target Test—RNA panel for ~5 seconds, then pulse centrifuge. Flick the tube of LIB HiFi Mix 4 times to mix, then pulse centrifuge.



① Oncomine™ Dx Target Test—RNA panel
② Oncomine™ Dx Target RNA Control
③ cDNA samples
④ No Template Control

4. Calculate the amounts of the following components needed for n+1 reactions, then add the components to a single 1.5-mL low-retention microcentrifuge tube.

Component	Volume per reaction
Nuclease-Free Water	(n+1) × 2 µL
Oncomine™ Dx Target Test—RNA panel (yellow cap)	(n+1) × 4 µL
LIB HiFi Mix (red cap)	(n+1) × 4 µL
Total	**(n+1) × 10 µL**

5. Vortex the tube for ~5 seconds, then pulse centrifuge to collect.

   Note: Keep the master mix on ice or chilled in a 2–8°C benchtop cold box until ready for use.

6. Pipet 10 µL of the master mix into each sample or control well in the 96-well plate.

7. Set the pipettor to 15 µL, then pipet the contents of each well up and down 5 times to mix.

8. Proceed to "Amplify the cDNA targets".

Amplify the cDNA targets

Note: The Veriti™ Dx 96-Well Thermal Cycler has been validated with this procedure.

1. Seal the 96-well plate with a new adhesive film, then centrifuge the plate at 100 rcf for 30 seconds.

2. Load the 96-well plate in the Veriti™ Dx 96-Well Thermal Cycler, then select the **2 ODxTT cDNA Target Amp** program. Select **View**, then confirm that the program steps match those listed in the following table:

Stage	Step	Temperature	Time
Hold	Activate the enzyme	99°C	2 minutes
Cycle (30 cycles)	Denature	99°C	15 seconds
	Anneal and extend	60°C	4 minutes
Hold	—	10°C	Hold (up to 24 hours)

3. After you have confirmed the steps, run the program.

STOPPING POINT Amplicons can be held in the thermal cycler for up to 24 hours or stored at 2–8°C for up to 1 week. If stored longer than 1 week, prepare new amplicons.

Amplify the DNA

Kit components used in this procedure

Kit component	Box
No Template Control (purple cap)	Ion Torrent Dx No Template Control Kit (Part No. A32444, stored at 15°C to 30°C)
Oncomine™ Dx Target Test—DNA panel (blue cap)	Oncomine™ Dx Target Test box 1 of 3 (Part No. A32441, stored at –30°C to –10°C)
LIB HiFi Mix (red cap)	Ion PGM™ Dx Library Reagents (Part No. A27388, stored at –30°C to –10°C)
Dilution Solution (black cap)	Ion Torrent Dx Sample Dilution Kit (Part No. A32439, stored at 15°C to 30°C)
Oncomine™ Dx Target DNA Control (brown cap)	Oncomine™ Dx Target DNA Control box 2 of 3 (Part No. A32442, stored at –30°C to –10°C)

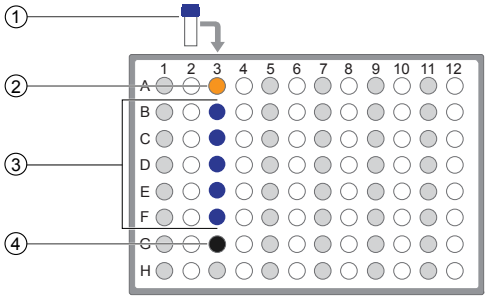
Set up the DNA amplification reaction (<8 samples)

If you are preparing <8 samples, see below. If you are preparing 8–16 samples, see page 24.

For <8 samples, set up individual reactions, including a No Template Control (purple cap), an Oncomine™ Dx Target DNA Control (brown cap), and up to 5 clinical samples.

1. Label a 96-well plate "DNA".

2. Place the labeled 96-well plate on a 2–8°C chilled 96-well aluminum block, then set up individual reactions in an odd-numbered column. For every run, include the No Template Control and the Oncomine™ Dx Target DNA Control.



① Oncomine™ Dx Target Test—DNA panel
② Oncomine™ Dx Target DNA Control
③ Prediluted FFPE DNA sample
④ No Template Control

3. Vortex the Oncomine™ Dx Target Test—DNA panel for ~5 seconds, then pulse centrifuge. Flick the tube of LIB HiFi Mix 4 times to mix, then pulse centrifuge.

4. To the No Template Control well, add the following components in the order indicated:

Order	Component	Volume
1	No Template Control (purple cap)	12 µL
2	Oncomine™ Dx Target Test—DNA panel (blue cap)	4 µL
3	LIB HiFi Mix (red cap)	4 µL
—	**Total**	**20 µL**

5. To the Oncomine™ Dx Target DNA Control well, add the following components in the order indicated:

Order	Component	Volume
1	Dilution Solution (black cap)	9 µL
2	Oncomine™ Dx Target DNA Control (brown cap)	3 µL
3	Oncomine™ Dx Target Test—DNA panel (blue cap)	4 µL
4	LIB HiFi Mix (red cap)	4 µL
—	**Total**	**20 µL**

6. Vortex the prediluted FFPE DNA sample (0.83 ng/µL) for ~5 seconds, then pulse centrifuge to collect.

7. To each sample well, add the following components in the order indicated.

IMPORTANT! If preparing multiple sample libraries, ensure that the appropriate FFPE DNA sample is added to the correct well to avoid patient sample mix-up.

Note: Do not exceed 12 µL of prediluted FFPE DNA, which is equivalent to 10 ng.

Order	Component	Volume
1	Prediluted sample FFPE DNA (0.83 ng/µL)	12 µL
2	Oncomine™ Dx Target Test—DNA panel (blue cap)	4 µL
3	LIB HiFi Mix (red cap)	4 µL
—	**Total**	**20 µL**

8. Set a 20-µL pipettor to 15 µL, and pipet the contents of each well up and down 5 times to mix.

9. Proceed to "Amplify the DNA targets" on page 25.

Set up the DNA amplification reaction (8–16 samples)

If you are preparing 8–16 samples, see below. If you are preparing <8 samples, see page 23.

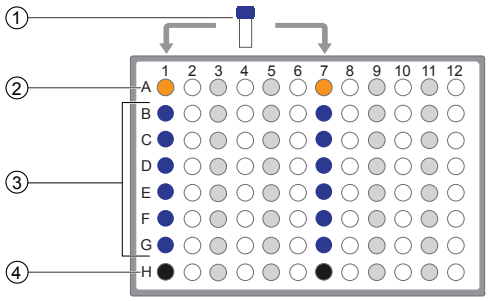
For 8–16 sample libraries (for example, 12 clinical samples plus 4 controls), make a master mix containing every component except prediluted FFPE DNA as follows, where "n" is the number of reactions you are preparing. Include one No Template Control (purple cap) and one Oncomine™ Dx Target DNA Control (brown cap) for each column of samples as illustrated.

1. Label a 96-well plate "DNA".

2. Place the labeled 96-well plate on a 2–8°C chilled aluminum block, then set up reactions in individual wells in odd-numbered columns of the plate. Skip columns to prevent cross-contamination.

3. To each No Template Control well, add 12 µL of No Template Control (purple cap).

4. To each Oncomine™ Dx Target DNA Control well, add the following components in the order indicated:



① Oncomine™ Dx Target Test—DNA panel
② Oncomine™ Dx Target DNA Control
③ Prediluted FFPE DNA samples
④ No Template Control

Order	Component	Volume per reaction
1	Dilution Solution (black cap)	9 µL
2	Oncomine™ Dx Target DNA Control (brown cap)	3 µL

5. Vortex the prediluted FFPE DNA samples (0.83 ng/µL) for ~5 seconds, then pulse centrifuge to collect.

6. To each DNA sample well, add 12 µL prediluted FFPE DNA.

   Note: Do not exceed 12 µL of prediluted FFPE DNA, which is equivalent to 10 ng.

7. Vortex the Oncomine™ Dx Target Test—DNA panel for ~5 seconds, then pulse centrifuge. Flick the tube of LIB HiFi Mix 4 times to mix, then pulse centrifuge.

8. Calculate the volume of each component below needed for n+1 reactions, then add that volume to a pre-labeled 1.5-mL low-retention microcentrifuge tube in the order stated:

Order	Component	Volume
1	Oncomine™ Dx Target Test—DNA panel (blue cap)	(n+1) × 4 µL
2	LIB HiFi Mix (red cap)	(n+1) × 4 µL
—	**Total**	**(n+1) × 8 µL**

9. Vortex for ~5 seconds, then pulse centrifuge.

   Note: Keep the master mix at 2–8°C on ice until ready for use.

10. Pipet 8 µL of master mix into each DNA sample, No Template Control, and Oncomine™ Dx Target DNA Control well in the labeled 96-well plate.

11. Set a pipettor to 15 µL, then pipet the contents of each well up and down 5 times to mix.

12. Proceed to "Amplify the DNA targets".

Amplify the DNA targets

Note: The Veriti™ Dx 96-Well Thermal Cycler has been validated with this procedure.

1. Seal the 96-well plate with a new adhesive film, then centrifuge the plate at 100 rcf for 30 seconds.

2. Load the 96-well plate in the Veriti™ Dx 96-Well Thermal Cycler, then select the **3 ODxTT DNA Target Amp** program. Select **View**, and confirm that the program steps match those in the following table:

Stage	Step	Temperature	Time
Hold	Activate the enzyme	99°C	2 minutes
Cycle (20 cycles)	Denature	99°C	15 seconds
	Anneal and extend	60°C	4 minutes
Hold	—	10°C	Hold (up to 24 hours)

3. After you have confirmed the steps, run the program.

STOPPING POINT Amplicons can be held in the thermal cycler for up to 24 hours or stored at 2–8°C for up to 1 week. If stored longer than 1 week, prepare new amplicons.

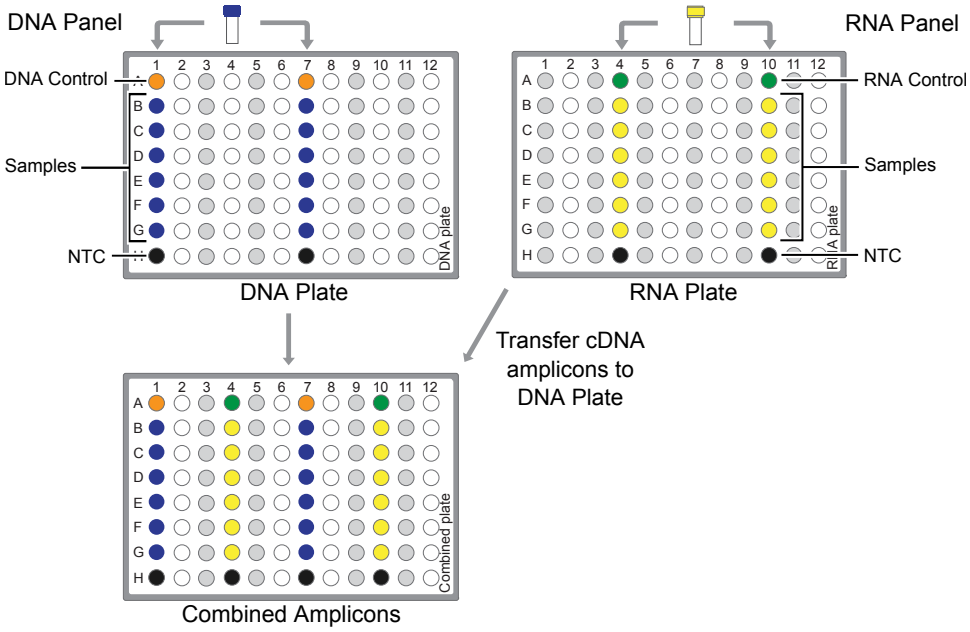
Transfer the cDNA amplicons

1. After themal cycling, centrifuge the plates containing amplified cDNA and DNA at 100 rcf for 30 seconds.

2. Carefully remove the adhesive film from the plates.

   IMPORTANT! Be careful when removing the adhesive film from the plate to minimize cross-contamination.

3. Transfer the cDNA amplicons from the cDNA plate to the corresponding empty wells in even-numbered columns of the DNA plate. Skip columns to prevent cross-contamination, as shown in the example below.



Proceed to "Partially digest amplicons" on page 26.

Partially digest amplicons

1. Place the plate with the amplicons on a 2–8°C cold block.

2. Flick the LIB FuPa tube (green cap) 4 times to mix, then pulse centrifuge to collect.

3. Add 2 µL of LIB FuPa to each reaction well. The total volume is 22 µL per well.

   IMPORTANT! LIB FuPa is highly viscous. To avoid carrying over excess enzyme, do not submerge the whole tip in the LIB FuPa solution. Aspirate the solution from just below the surface. The volume is critical and must be accurate. Ensure that no excess solution is added to the sample.

4. Set the pipettor to 15 µL, then slowly pipet the mixture up and down 5 times to mix.

5. Seal the plate with a new adhesive film, then centrifuge at 100 rcf for 30 seconds.

6. Load the plate in the Veriti™ Dx 96-Well Thermal Cycler, then select the **4 ODxTT Amplicon Digestion** program. Select **View**, and confirm that the program steps match those listed in the table below:

Temperature	Time
50°C	10 minutes
55°C	10 minutes
60°C	20 minutes
10°C	Hold (for up to 1 hour)

7. After you have confirmed the steps, run the program.

IMPORTANT! Do not leave samples in the thermal cycler for more than 1 hour after cycling.

Alternating barcodes

When preparing libraries, we recommend swapping barcodes between DNA and RNA libraries in consecutive sequencing runs to prevent carryover contamination. The following table provides an example of swapping barcodes between runs.

IMPORTANT! Be careful to confirm that the barcodes used to create the libraries match the barcodes entered in the **Prepare Library Batch** dialog.

Library type	System Run 1 barcode usage		System Run 2 barcode usage	
	DNA	RNA	DNA	RNA
Positive control	1	9	9	1
Sample	2	10	10	2
Sample	3	11	11	3
Sample	4	12	12	4
Sample	5	13	13	5
Sample	6	14	14	6
Sample	7	15	15	7
No-template control (NTC)	8	16	16	8

Ligate barcode adapters

IMPORTANT! Libraries prepared from DNA and RNA from the same sample must have different barcodes, because the libraries are combined before the amplification reaction on the Ion OneTouch™ Dx Instrument.

1. After thermal cycling, centrifuge the 96-well plate at 100 rcf for 30 seconds, then place the plate back on the 2–8°C chilled aluminum block.

2. Vortex the LIB Switch Soln (orange cap) for ~5 seconds, then pulse centrifuge to collect.

   IMPORTANT! LIB Switch Soln is highly viscous and must be thoroughly mixed before use. There should be no visible precipitate after vortexing. Inspect the tube and cap carefully for precipitate. If precipitate is visible, secure the cap, invert the tube, then vortex upside down for ~5 seconds or until no visible precipitate is present. Use caution to ensure that the correct volume is delivered while pipetting.

3. Flick the tube of LIB DNA Ligase (clear cap) 4 times to mix, then pulse centrifuge to collect.

4. Ensure that the barcode adapters (BC 1–16) are thawed such that no visible ice is present. Vortex for ~5 seconds, then pulse centrifuge to collect.

5. Carefully remove the adhesive film from the plate, then add the following components to each well containing digested sample in the order shown:

   IMPORTANT! When preparing barcoded samples, prevent cross-contamination by opening only one tube of barcode adapter at a time during each addition. We recommend that this step be monitored by a co-technician to prevent sample mix-up and/or cross-contamination.

	Order	Component	Volume
☐	1	LIB Switch Soln (orange cap)	4 µL
☐	2	Barcode adapter (white cap)[1]	2 µL
☐	3	LIB DNA Ligase (clear cap)	2 µL
☐	—	**Total volume per well** (includes 22 µL of sample)	**30 µL**

[1] Select from BC 1 through BC 16, based on the sample and your barcode scheme.

6. Set a pipettor to 20 µL, then pipet the volume in each well up and down 5 times.

7. Seal the plate with a new adhesive plate seal, then centrifuge the plate at 100 rcf for 30 seconds.

8. Load the plate in the Veriti™ Dx Thermal Cycler, then select the **5 ODxTT Adapter Ligation** program. Select **View**, and confirm that the program steps match those listed in the table below.

Temperature	Time
22°C	30 minutes
72°C	10 minutes
10°C	Hold (for up to 1 hour)

9. After you have confirmed the steps, run the program.

IMPORTANT! Do not leave samples in the thermal cycler for more than 1 hour after cycling.

Prepare the LIB HiFi Mix plus LIB Primers mix

1. Flick the LIB HiFi Mix 4 times to mix, then pulse centrifuge. Keep the LIB HiFi Mix in a –30°C to –10°C chilled benchtop cold box.

2. Vortex the LIB Primers for ~5 seconds, then pulse centrifuge.

3. Prepare the LIB HiFi Mix plus LIB Primers master mix:

   - <8 libraries—For each library, add components to individual 1.5-mL low-retention microcentrifuge tubes on ice or in a 2–8°C chilled benchtop cold box in the following order:

	Order	Component	Volume
☐	1	Nuclease-free Water	40 µL
☐	2	LIB HiFi Mix (red cap)	10 µL
☐	3	LIB Primers (blue cap)	2 µL
☐	—	**Total**	**52 µL**

   - 8–16 libraries—Calculate the amount of every component needed for n+1 libraries, where "n" is the number of libraries being prepared, then add the components to a single 1.5-mL low-retention microcentrifuge tube on ice or in a 2-8°C chilled benchtop cold box in the following order:

	Order	Component	Volume
☐	1	Nuclease-free Water	(n+1) × 40 µL
☐	2	LIB HiFi Mix (red cap)	(n+1) × 10 µL
☐	3	LIB Primers (blue cap)	(n+1) × 2 µL
☐	—	**Total**	**(n+1) × 52 µL**

4. Flick the LIB HiFi Mix/LIB Primers master mix 4 times to mix, then pulse centrifuge. Keep at 2–8°C.

   Note: You must use the master mix on the same day it was prepared.

Purify the barcode-adapted library

1. Prepare fresh 70% ethanol: combine 230 µL of ethanol with 100 µL of Nuclease-free Water per library, then vortex for 10 seconds to mix.
2. When thermal cycling is complete, centrifuge the 96-well plate at 100 rcf for 30 seconds.
3. Before use, invert the LIB AMPure™ Reagent 10 times, then vortex for 10 seconds until the beads are thoroughly suspended.
4. Carefully remove the adhesive film from the plate, then add 45 µL of LIB AMPure™ Reagent to each well.

   IMPORTANT! Ensure that an accurate amount of LIB AMPure™ Reagent is dispensed to each sample, and prevent excess carryover from droplets adhering to the tip.

5. With the pipettor set to 45 µL, pipet up and down 5 times to thoroughly mix the beads in each well. The total volume is 75 µL.
6. Hold the mixture for 5 minutes at room temperature.
7. Place the plate in a DynaMag™ Dx 96-Well Plate Magnet for 3 minutes. The solution in each well must be clear, with beads pelleted to one side.
8. Using a 200-µL pipettor, remove and discard ~73 µL of the supernatant without disturbing the pellet. Use a 20-µL pipettor to remove any remaining supernatant.
9. If you see beads in the pipette tip when removing the supernatant, pipet the supernatant and beads back into their respective wells to re-pellet the beads, then remove and discard the supernatant.
10. Add 150 µL of freshly prepared 70% ethanol to each well.
11. Move the plate from left-to-right on the DynaMag™ Dx 96-Well Plate Magnet, then hold for ~5 seconds to wash and re-pellet the beads.
12. Move the plate from right-to-left on the magnet, then hold for ~5 seconds to wash and re-pellet the beads.
13. Repeat steps 11 and 12 two more times. Keep the plate in the final position on the magnet for 3 minutes or until the solution in each well is clear, with the beads in a pellet to one side.
14. Using a 200-µL pipette, remove and discard ~150 µL of the supernatant without disturbing the pellet. Use a 20-µL pipette to remove any remaining supernatant.
15. Repeat steps 10–14 one more time.
16. Ensure that all the ethanol droplets are removed from the wells. Keeping the plate in the magnet, air-dry the beads at room temperature for 5 minutes.

Amplify the barcode-adapted library

1. Flick the LIB HiFi Mix/LIB Primers master mix (prepared in "Prepare the LIB HiFi Mix plus LIB Primers mix" on page 29) 4 times to mix, then pulse centrifuge.

2. Remove the 96-well plate from the DynaMag™ Dx 96-Well Plate Magnet, then add 52 µL of LIB HiFi Mix/LIB Primers master mix to each well.

3. Set the pipettor to 40 µL, then pipet up and down 10 times to mix until the beads are resuspended.

   Note: Visually inspect the sides of the wells to ensure complete resuspension of the beads.

4. Seal the 96-well plate with a new adhesive film. Centrifuge the plate at 100 rcf for 30 seconds.

5. Load the plate in the Veriti™ Dx 96-Well Thermal Cycler, then select the **6 ODxTT Library Amplification** program. Select **View**, and confirm that the program steps match those in the table below.

Stage	Temperature	Time
Hold	98°C	2 minutes
7 cycles	98°C	15 seconds
	60°C	1 minutes
Hold	10°C	Hold (for up to 30 minutes)

6. After you have confirmed the steps, run the program.

   Note: During thermal cycling, you may start to prepare the LIB Beads as described in the next procedure.

Prepare the LIB Beads

Note: LIB Beads must be freshly prepared before every use.

1. Equilibrate the LIB Beads (yellow cap) to room temperature, vortex for 10 seconds or until resuspended, then pulse centrifuge to collect.
2. For each library, combine 3 µL of LIB Beads and 6 µL of LIB Wash Soln (clear cap) in a 1.5-mL low-retention microcentrifuge tube, as follows:
   - For 1–3 libraries, prepare a separate tube of beads and wash solution per library.
   - For ≥4 libraries, prepare a master mix as shown below.

Number of libraries	Number of reactions to prepare in master mix	Volume of LIB Beads to add	Volume of LIB Wash Soln to add
4–7	n + 0.5	(n + 0.5) × 3 µL	(n + 0.5) × 6 µL
8	9	27 µL	54 µL
9–16	n + 2	(n +2) × 3 µL	(n +2) × 6 µL

3. Vortex each tube for ~5 seconds to mix, then pulse centrifuge to collect any beads present on the lid of the tube.
4. Place the tube in a DynaMag™ Dx 96-Well Plate Magnet for 1 minute.
5. Carefully remove and discard the supernatant without disturbing the pellet.
6. Remove the tube from the DynaMag™ Dx 96-Well Plate Magnet, then add the same volume of LIB Wash Soln as added in step 2.
7. Resuspend by pipetting up and down 5 times.
8. Keep the prepared beads at room temperature and use them on the same day.

Add LIB Capture to the amplified sample library

1. Equilibrate the LIB Capture (violet cap) to room temperature, vortex for ~5 seconds, then pulse centrifuge to collect.
2. When thermal cycling is complete, centrifuge the 96-well plate at 100 rcf for 30 seconds.
3. Carefully remove the adhesive film from the plate, then add 10 µL of LIB Capture (violet cap) to each well.

   IMPORTANT! Accurate volume transfer in this step is critical. Ensure that no excess LIB Capture is carried on the pipette tip by aspirating the solution from just below the surface.

4. Set the pipettor to 40 µL, then pipet the mixture up and down 5 times to mix.
5. Hold at room temperature for 5 minutes.

Add the LIB Beads and wash

1. Mix the prepared LIB Beads by pipetting up and down 5 times, or until the beads are resuspended.
2. Add 6 µL of washed LIB Beads to each well.
3. Set the pipettor to 40 µL, then pipet the mixture up and down 5 times to mix.
4. Hold at room temperature for 5 minutes.
5. Place the 96-well plate in the DynaMag™ Dx 96-Well Plate Magnet for 3 minutes. The solution should be clear.
6. Using a 200-µL pipette, remove, then discard ~78 µL of the supernatant without disturbing the pellet. Use a 20-µL pipette to remove any remaining supernatant.
7. Add 150 µL of LIB Wash Soln to each well.
8. Move the 96-well plate from left-to-right on the DynaMag™ Dx 96-Well Plate Magnet, then hold for 5 seconds to wash and re-pellet the beads.
9. Move the 96-well plate from right-to-left on the magnet, then hold for 5 seconds to wash and re-pellet the beads.
10. Repeat steps 8 and 9 two more times.
11. With the 96-well plate still in the magnet, use a 200-µL pipette to remove and discard ~150 µL of the supernatant without disturbing the pellet.
12. Repeat the bead wash as described in steps 7–11.
13. Use a 20-µL pipette to remove any remaining LIB Wash Soln by pipetting without disturbing the pellet.

Elute the library

1. Remove the plate from the DynaMag™ Dx 96-Well Plate Magnet, then add 100 µL of LIB Elution Soln to each pellet. Set the pipettor to 100 µL and pipet up and down at least 10 times until the beads are resuspended.
2. Seal the plate with a new adhesive film, then centrifuge at 100 rcf for 30 seconds.

3. If beads pellet at the bottom of the wells:
   a. Carefully remove the adhesive film, and gently resuspend the pellet by pipetting up and down until resuspended.

      IMPORTANT! Ensure that the sample remains at the bottom of the well. Avoid introducing bubbles while pipetting.

   b. Seal the plate with a new adhesive film.

4. Load the plate in the Veriti™ Dx 96-Well Thermal Cycler, then select the **7 ODxTT Library Elution** program. Select **View**, and confirm that the program steps match those listed in the following table.

Temperature	Time
35°C	5 minutes

5. After you have confirmed the steps, run the program.

6. During cycling, label a 1.5-mL low-retention microcentrifuge tube for each library. Alternatively, if you are proceeding directly to pooling libraries, label a tube for each library pool.

7. Remove the plate from the Veriti™ Dx 96-Well Thermal Cycler, then centrifuge the plate at 100 rcf for 30 seconds.

   ⚠ **CAUTION!** The sample block and plate are hot. Use care when handling the plate to avoid being burned.

8. Place the plate in the DynaMag™ Dx 96-Well Plate Magnet, then hold at room temperature for 3 minutes. Confirm that the solution is clear.

9. Carefully remove the adhesive film, then transfer the supernatant containing the equalized library (~100-µL total volume) to a labeled 1.5-mL low-retention microcentrifuge tube. The final concentration of each library is ~100 pM.

   STOPPING POINT The eluted libraries can be stored at –30°C to –10°C for up to 30 days. If stored for longer than 30 days, prepare new libraries.

A Troubleshooting

Warnings and alarms—Veriti™ Dx Thermal Cycler

Observation	Possible cause	Recommended action
"Fatal Error" message displayed by Veriti™ Dx Thermal Cycler	Various	For assistance, contact Technical Support (see "Customer and technical support" on page 40). Refer to the *Veriti™ Dx Thermal Cycler User Guide* (Pub. no. 4453697) for general troubleshooting information for this instrument.

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, etc). To obtain SDSs, see the "Documentation and Support" section in this document.

Biological hazard safety

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:
  www.cdc.gov/biosafety/publications/bmbl5/BMBL.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

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 adequate ventilation (for example, fume hood).
- Check regularly for chemical leaks or spills. If a leak or spill occurs, follow the manufacturer's 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 necessary) 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.

Precaution—strong magnet

Note: Do not substitute non-IVD labeled magnets for the DynaMag™ Dx 96-Well Plate Magnet and DynaMag™ Dx 16 2-mL Magnet, provided with Ion PGM™ Dx System.

The DynaMag™ Dx 96-Well Plate Magnet and DynaMag™ Dx 16 2-mL Magnet contain very strong permanent magnets. People wearing a pacemaker or any other medical magnetized implant should not use this product unless advised by a health professional; the implant could be affected or damaged by exposure to a strong magnetic field. Keep tools and objects that could be damaged by the magnetic field out of the working area. This includes, but is not restricted to, credit cards and other products containing magnetic recording devices. Keep away from delicate instruments, watches, electronic equipment, displays and monitors. The magnet may attract steel or other magnetic material with high mechanical forces. Take care during handling. Avoid contact between two magnets. Do not pull the magnets apart if contact has been made; twist off to prevent damage to the unit or fingers. The Health and Safety Officer should take all necessary steps and full responsibility to ensure that the precautions and statements are followed and adhered to.

Medical device symbols

The following table describes symbols that may be displayed on instruments, consumables, or reagents. The symbols used on labels conform to standard BS EN ISO 15223-1:2012 and FDA guidance "Use of Symbols on Labels and in Labeling of In Vitro Diagnostic Devices Intended for Professional Use".

Symbol	Description	Symbol	Description
	MANUFACTURER		CONTAINS SUFFICIENT FOR <n> TESTS
	DATE OF MANUFACTURE		USE BY
LOT	BATCH CODE	REF	CATALOG NUMBER
SN	SERIAL NUMBER		FRAGILE, HANDLE WITH CARE
	LOWER LIMIT OF TEMPERATURE		PROTECT FROM LIGHT
	UPPER AND LOWER LIMITS OF TEMPERATURE		UPPER LIMIT OF TEMPERATURE
	DO NOT REUSE		BIOLOGICAL RISKS
	CAUTION, CONSULT ACCOMPANYING DOCUMENTS		CONSULT INSTRUCTIONS FOR USE
	UPPER AND LOWER LIMITS OF HUMIDITY		OBSERVE PRECAUTIONS FOR HANDLING ELECTROSTATIC SENSITIVE DEVICES
IVD	IN VITRO DIAGNOSTIC MEDICAL DEVICE		

C Performance characteristics

For performance characteristics of the Oncomine™ Dx Target Test Kit, see the *Oncomine™ Dx Target Test Part V: Analysis and Test Reports User Guide* (Pub. No. MAN0016171).

For performance characteristics of the Ion PGM™ Dx System, see Appendix B of the *Ion PGM™ Dx System User Guide* (Pub. No. MAN0016694) and the *Ion PGM™ Dx System Performance Characteristics User Guide* (Pub. No. MAN0016697).

Customer and technical support

Visit **thermofisher.com/support** for the latest in services and support, including:

- Worldwide contact telephone numbers
- Product support
- Order and web support
- Safety Data Sheets (SDSs; also known as MSDSs)

Additional product documentation, including user guides and Certificates of Analysis, are available by contacting Customer Support.

Obtaining Certificates of Analysis

The Certificate of Analysis provides detailed quality control and product qualification information for each product. Certificates of Analysis are printed and shipped with the product.

Obtaining Certificates of Conformance

The Certificate of Conformance provides information on conformance testing of each instrument provided with the system. Certificates of Conformance are shipped with the instrument, and are also available by contacting Customer Support at **thermofisher.com/support**.

iontorrent
by Thermo Fisher Scientific

Oncomine™ Dx Target Test Part III: Template Preparation

USER GUIDE

Publication Number MAN0016169

Revision B.0

IVD

For In Vitro Diagnostic Use.

Life Technologies Holdings Pte Ltd |
Block 33 |
Marsiling Industrial Estate Road 3 |
#07-06, Singapore 739256

Products manufactured in Singapore:

Ion PGM™ Dx Instrument System
Ion PGM™ Dx Sequencer
Ion OneTouch™ Dx Instrument
Ion OneTouch™ ES Dx Instrument
Ion PGM™ Dx Chip Minifuge (120V)
Ion PGM™ Wireless Scanner
Ion Torrent™ Server
Veriti™ Dx Thermal Cycler

Life Technologies Corporation |
7335 Executive Way |
Frederick, MD 21704 | USA

Products manufactured in Frederick:

Oncomine™ Dx Target Test Kit
Ion Torrent Dx FFPE Sample Preparation Kit
Ion PGM™ Dx Library Kit
Ion OneTouch™ Dx Template Kit
Ion PGM™ Dx Sequencing Kit
Ion 318™ Dx Chip
Ion OneTouch™ Rack Kit
DynaMag™ Dx 96-Well Plate Magnet
DynaMag™ Dx 16 2-mL Magnet

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

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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.

Purpose of this guide

This user guide provides instructions for using the Ion OneTouch™ Dx System to prepare enriched, template-positive Ion PGM™ Dx Ion Sphere™ Particles (ISPs) from sample and control libraries prepared using the Oncomine™ Dx Target Test Kit. The Ion OneTouch™ Dx System includes the Ion OneTouch™ Dx Instrument and the Ion OneTouch™ ES Dx Instrument.

This user guide is organized as follows:

- Prepare template-positive ISPs from Oncomine™ Dx Target Test libraries using the Ion OneTouch™ Dx Template Kit with the Ion OneTouch™ Dx Instrument.
- Enrich the template-positive ISPs with the Ion OneTouch™ ES Dx Instrument.

Oncomine™ Dx Target Test Kit user guides

This user guide is part of a five-guide set.

Note: The procedures in these guides supersede the instructions in the *Ion PGM™ Dx System User Guide* when using the Ion PGM™ Dx System with the Oncomine™ Dx Target Test.

- *Oncomine™ Dx Target Test Part I: Sample Preparation and Quantification User Guide*
- *Oncomine™ Dx Target Test Part II: Library Preparation User Guide*
- *Oncomine™ Dx Target Test Part III: Template Preparation User Guide*
- *Oncomine™ Dx Target Test Part IV: Sequencing User Guide*
- *Oncomine™ Dx Target Test Part V: Analysis and Test Reports User Guide*

All five guides are required to complete the entire Oncomine™ Dx Target Test workflow.

1 Product information

Product description

Oncomine™ Dx Target Test

The Oncomine™ Dx Target Test is an *in vitro* diagnostic next-generation sequencing test to detect somatic alterations in human DNA and RNA isolated from non-small cell lung cancer (NSCLC) tumor specimens in formalin-fixed, paraffin-embedded (FFPE) tissue samples. Detection of these variants is performed using the Ion PGM™ Dx System.

The Oncomine™ Dx Target Test Kit (Cat. No. A32451) provides a set of primers in two panels that target key regions of 23 cancer-related genes.

Template preparation components

The Ion OneTouch™ Dx Template Kit, included as part of the Oncomine™ Dx Target Test Kit, is used in conjunction with the Ion OneTouch™ Dx System to prepare template-positive Ion PGM™ Dx ISPs for sequencing on the Ion PGM™ Dx Sequencer.

The Ion OneTouch™ Dx System includes the following components:

- Ion OneTouch™ Dx Instrument and accessories
- Ion OneTouch™ ES Dx Instrument and accessories
- Ion OneTouch™ Solutions Rack
- Ion OneTouch™ Assembly Rack
- Ion OneTouch™ Sample Rack

Intended use

For the Intended Use statement for the Oncomine™ Dx Target Test, see the *Oncomine™ Dx Target Test Part I: Sample Preparation and Quantification User Guide* (Pub. No. MAN0016167).

Theory of operation

For a complete description of the Theory of Operation of the system, see the *Oncomine™ Dx Target Test Part I: Sample Preparation and Quantification User Guide* (Pub. No. MAN0016167).

Software compatibility and requirements

The procedures in this guide are designed for use with Torrent Suite™ Dx Software version 5.6 or later. To view the current software version, log in to the software as an Administrator, click on the **Settings (⚙)** tab, then select **Configuration** and click on the **Software Updates** tab. Version-specific information is provided in the software release notes for your version of the software.

Torrent Suite™ Dx Software is supported on Chrome™ browser version 39, and is best viewed with 1024 × 768 screen resolution. It has not been tested with other browsers.

The Ion Torrent™ Server operating system is Ubuntu™ 14.04 LTS.

Materials provided

Oncomine™ Dx Target Test Kit

The Oncomine™ Dx Target Test Kit (Cat. No. A32451) includes the following subkits.

IMPORTANT! Refer to the product label for the storage conditions and expiration dates of individual modules and components.

✓	Subkit	Part no.
	Oncomine™ Dx Target Test and Controls	A32447
	Ion Torrent Dx FFPE Sample Preparation Kit	A32445
	Ion PGM™ Dx Library Kit	A18975
	Ion OneTouch™ Dx Template Kit	A18976
	Ion PGM™ Dx Sequencing Kit	A18977
	Ion 318™ Dx Chip Kit	A18937
	Oncomine™ Dx Target Test User Guides and Assay Definition File	A32461

Subkits used in this guide

The procedures in this user guide use the following subkits from the Oncomine™ Dx Target Test Kit.

Ion OneTouch™ Dx Template Kit

The Ion OneTouch™ Dx Template Kit (Cat. No. A18976) includes the following modules and components.

IMPORTANT! Refer to the product label for the expiration date of the kit.

✓	Component	Amount	Storage
Ion OneTouch™ Dx Template Supplies (Part No. A18933)			
	TMPL Amplification Plate	8	15°C to 30°C
	TMPL Recovery Router	8	
	TMPL Recovery Tube	16	
	TMPL Sipper	2	
	TMPL Reagent Tube	2	
	TMPL ES Tip	8	
	TMPL ES Strip Tube	1 pack of 12	
	TMPL Cleaning Adapter	8	
	TMPL Emulsion Cartridge	8	
	TMPL Reagent Tube Labels	1 set	
Ion OneTouch™ Dx Template Solutions (Part No. A18932)			
	TMPL Oil (white cap)	450 mL	15°C to 30°C
	TMPL Reaction Oil (white cap)	22 mL	
	TMPL Water (yellow cap)	320 µL	
	TMPL Recovery Solution (brown cap)	280 mL	
	TMPL Wash Solution (white cap)	15.2 mL	
	TMPL Rgnt B (blue cap)	2 × 1.2 mL	
	TMPL ES Rsp Soln (orange cap)	1.04 mL	
	TMPL Neutral Soln (red cap)	80 µL	
	TMPL Tween™ Solution (white cap)	2.24 mL	

✓	Component	Amount	Storage
Ion OneTouch™ Dx Template Reagents (Part No. A18930)			
	TMPL Enzyme Mix (brown cap)	400 µL	–30°C to –10°C
	TMPL Rgnt Mix (violet cap)	8 × 500 µL (single-use tubes)	
	TMPL ISP (black cap)	800 µL	
	TMPL CF-1 (clear cap)	40 µL	
Ion OneTouch™ Dx Template ES Beads (Part No. A18931)			
	TMPL ES Beads (green cap)	104 µL	2°C to 8°C

Ion PGM™ Dx Instrument System

The Ion PGM™ Dx Instrument System (Cat. No. A25511) includes the following components, which are also sold separately.

✓	Component	Catalog no.
	Ion OneTouch™ Dx Instrument and accessories	A25483
	Ion OneTouch™ ES Dx Instrument and accessories	A25484
	Ion PGM™ Dx Sequencer and accessories	A25485
	Ion PGM™ Wireless Scanner	A25486
	Ion Torrent™ Server (software installed separately)	A28552
	Ion OneTouch™ Rack Kit • Ion OneTouch™ Solutions Rack • Ion OneTouch™ Assembly Rack • Ion OneTouch™ Sample Rack	A24694
	Ion PGM™ Dx Chip Minifuge: • 120 VAC • 230 VAC	 A25058 A25482
	DynaMag™ Dx Kit—Tube & Plate • DynaMag™ Dx 96-Well Plate Magnet • DynaMag™ Dx 16 2-mL Magnet	A31755 A31347 A31346

Materials and equipment required but not provided

Unless otherwise indicated, all materials are available through **thermofisher.com**. MLS: Fisher Scientific (**fisherscientific.com**) or other major laboratory supplier.

✓	Description	Source
	Laminar flow hood	MLS
	1.5-mL snap-cap low-retention polypropylene microcentrifuge tubes	MLS
	Mini centrifuge	MLS
	Pipettes (2-, 20-, 200-, 1000-µL)	MLS
	Aerosol-barrier pipette tips (10-, 20-, 200-, 1000-µL)	MLS
	Vortex mixer with a rubber platform	MLS
	50-mL conical tubes	MLS
	Holder for 50-mL conical tube	MLS
	DynaMag™ Dx 16 2-mL Magnet	A31346
	GeneMate SnapStrip™ 8-Strip 0.2 mL PCR Tubes[1]	BioExpress T-3035-1
	NaOH, ACS grade (10 M)	MLS
	Nuclease-free Water	MLS
	Benchtop cold box	MLS

[1] The Ion OneTouch™ Rack Kit has only been designed to work with GeneMate SnapStrip™ 8-Strip 0.2 mL PCR Tubes. Tubes from other manufacturers may not fit properly in the rack, resulting in a higher risk of user error.

DynaMag™ Dx 96-Well Plate Magnet and DynaMag™ Dx 16 2-mL Magnet

Note: Do not substitute non-IVD labeled magnets for the DynaMag™ Dx 96-Well Plate Magnet and DynaMag™ Dx 16 2-mL Magnet.

The DynaMag™ Dx 96-Well Plate Magnet and DynaMag™ Dx 16 2-mL Magnet, provided with Ion PGM™ Dx System, contain high-energy neodymium magnets and are used as part of the procedure for purifying sample libraries bound to LIB AMPure™ Reagent and LIB Beads . The DynaMag™ Dx 16 2-mL Magnet is also used to prepare TMPL ES Beads as part of template preparation.

The DynaMag™ Dx 96-Well Plate Magnet has 7 bar magnets with a hard plastic top to fit 96-well PCR plates. When you insert a plate, the magnets collect bead-bound biomolecules in suspension at the sides of the plate wells, allowing removal of fluid without disturbing the bead pellets. An extra column in the magnet enables sample mixing by shifting the plate back and forth in the magnet.

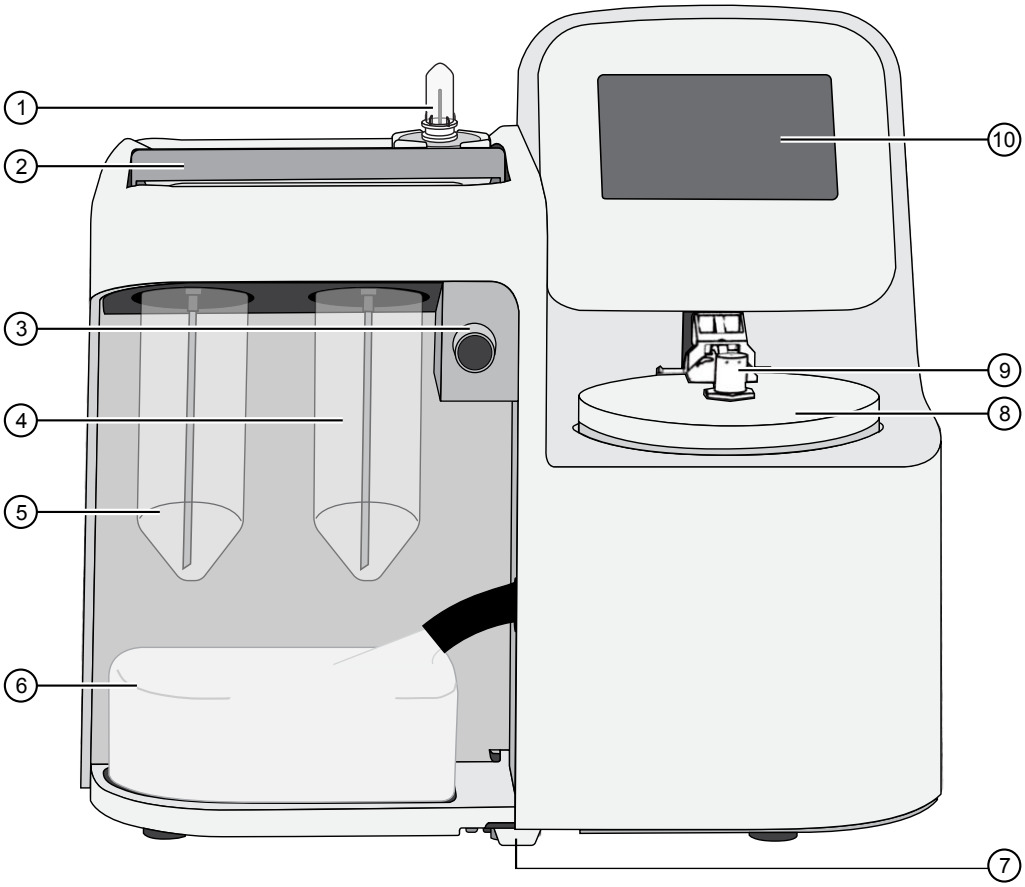
The DynaMag™ Dx 16 2-mL Magnet holds 16 standard 1.5-mL or 2-mL microcentrifuge tubes, and collects bead-bound biomolecules in suspension at the sides of the tubes, allowing removal of fluid without disturbing the bead pellets.

Do not use the magnets above 50°C (122°F) and store in a cool, dry environment.

Recommended materials and equipment

Description	Source
Benchtop absorbent paper or mat	MLS

Ion OneTouch™ Dx Instrument



1. Reaction Filter
2. Clamp handle to access the TMPL Amplification Plate in the heat block
3. Pinch valve to hold disposable tubing
4. TMPL Reagent Tube containing TMPL Recovery Solution
5. TMPL Reagent Tube containing TMPL Oil
6. Waste Container
7. Oil waste tray
8. Centrifuge and TMPL Recovery Router
9. Injector hub
10. Touchscreen

Electrical and environmental conditions

IMPORTANT! Protection provided by the equipment may be impaired if the instrument is operated outside the environment and use specifications, the user provides inadequate maintenance, or the equipment is used in a manner not specified by the manufacturer.

IMPORTANT! Observe current Good Clinical Laboratory Practices (GCLP) when using this instrument.

See the *Ion PGM™ Dx System Site Preparation Guide* (Pub. No. MAN0016696) for information about instrument location and setup. Instruments should be shielded from excess exposure to dust, vibration, strong magnetic fields, drafts, excessive moisture, or large temperature fluctuations. Surge protectors or line conditioners should be used if the voltage source is not stable. Sudden voltage spikes can cause damage to the electronics inside the instruments.

Ensure that the room where the instruments have been installed is maintained under correct environmental conditions. Avoid placing the instruments adjacent to heaters, cooling ducts, or in direct sunlight. Place the instruments at least a meter away from major sources of electronic noise, such as refrigerators or microwaves.

Electrical requirements

CAUTION! Do not unpack or plug in any components until a field service representative has configured them for the proper operating voltage.

WARNING! For safety, the power outlet used for powering the instrument must be accessible at all times. In case of emergency, you must be able to immediately disconnect the main power supply to all the equipment. Allow adequate space between the wall and the equipment so that the power cords can be disconnected in case of emergency.

- Electric receptacle required: 2-prong with ground pin
- Main AC line voltage tolerances must be at most ±10% percent of nominal voltage.
- Power cords are provided with the instruments. If not suitable for installation in your region, ensure any power cord you do use is:
  - Maximum 10 feet (3 meters) in length
  - Grounding type
  - Compatible with the power supply receptacles used to connect to main power
  - Suitable for the rating of the instrument and main power supply
  - Compliant with local safety requirements (for example, UL Listed for North America, JIS approved for Japan, HAR or agency certified for Europe)

- (Ion OneTouch™ Dx Instrument only) Fuse Rating: 6 A, 250 VAC, Type M. Replace only with the same fuse type and rating.

WARNING! FIRE HAZARD. For continued protection against the risk of fire, replace fuses only with fuses of the type and rating specified for the instrument.

Device	Rated voltage [1,2]	Rated frequency	Rated current [3]
Ion PGM™ Dx Sequencer	110/120VAC 220/240VAC	50/60 Hz	9 A
Ion Torrent™ Server [4]	110/120VAC 220/240VAC	50/60 Hz	11 A
Ion OneTouch™ Dx Instrument with power supply	110/120VAC 220/240VAC	50/60 Hz	5.5 A
Ion OneTouch™ ES Dx Instrument	110/120VAC 220/240VAC	50/60 Hz	375 mA 160 mA
Ion PGM™ Dx Chip Minifuge	120 VAC 220–240 VAC	50/60 Hz	130 mA 65 mA

[1] In Japan, rated voltages of 100 VAC and 200 VAC are acceptable.
[2] If the supplied power fluctuates beyond the rated voltage, a power line regulator may be required. High or low voltages can adversely affect the electronic components of the instrument.
[3] Based on rated current at minimum input voltage.
[4] Minimum Efficiency: 65% (Energy Star Qualified); 85% Efficient Power Supply.

Environmental requirements

Ensure that the room where the instruments have been installed is maintained under the correct environmental conditions. Avoid placing the instruments next to heaters, cooling ducts, or in direct sunlight. Place the sequencer at least a meter away from major sources of electronic noise, such as refrigerators or microwaves.

CAUTION! Use of the instruments in an unspecified manner may result in the protection provided by the instruments to be impaired.

Component	Acceptable range
Altitude	Between sea level and 2,000 meters (6,500 feet) above sea level
Humidity: operating	10–90% relative humidity
Humidity: transportation and storage	20–80% relative humidity
Temperature: operating	15–30°C (59–86°F) At or above 1,800 meters (5,906 feet), the system must not be used if the temperature is above 29.5°C.

Component	Acceptable range
Temperature: transportation and storage	–30°C to 60°C (–22°F to 140°F)
Vibration	Ensure that benches where instruments are to be installed are free of vibration and have no contact with equipment that causes vibration (freezers, pumps, and similar equipment). Vibration can reduce the quality of sequencing measurements.
Pollution	The system has a Pollution Degree rating of II (2). The system may only be installed in an environment that has nonconductive pollutants, such as dust particles or wood chips. Typical environments with a Pollution Degree II (2) rating are laboratories, sales, and commercial areas.
Overvoltage category	The instruments have an installation (overvoltage) category of II (2).
Other conditions	For indoor use only. Keep away from any vents that could expel particulate material on the system components.

2 Before you begin

Procedural guidelines

Definitions

Throughout this guide:

- Room temperature is defined as the temperature range 15–30°C.
- A pulse centrifugation consists of a 3–5 second centrifugation at maximum speed in a mini centrifuge.

Guidelines for pipetting

Pipet viscous solutions slowly and ensure complete mixing.

Guidelines to prevent cross-contamination

- Use good laboratory practices to minimize cross-contamination of products and reagents.
- When designing the laboratory layout, dedicate separate areas for pre- and post-amplification activities. Dedicate laboratory supplies and/or equipment to the appropriate area.
- Before and after use, clean all working surfaces with fresh 10% bleach followed by two water rinses.
- Use a laminar flow hood in the dedicated pre-amplification area when combining libraries and preparing the amplification solution.
- Before and after use, clean all surfaces and equipment in the laminar flow hood with fresh 10% bleach followed by two water rinses.
- Turn on the UV light in the hood for 10 minutes before and after use.
- Use fresh gloves before entering the hood.
- Change tips between pipetting steps.
- Prepare a waste container containing fresh 10% bleach solution for disposing of used tips after pipetting libraries.
- To collect the contents before opening, pulse centrifuge tubes containing libraries and library pools.
- When simultaneously preparing more than one amplification solution, only open one library-pool tube at a time.
- Use fresh reagents if a contamination event occurs or is suspected.
- Use fresh gloves when installing new consumables.
- To avoid contamination of TMPL Reagent Tubes (which may be reused), discard waste from the tubes in a separate container from other Ion OneTouch™ Dx Instrument waste and 50-mL conical-tube waste.

- Always change gloves after handling Ion OneTouch™ Dx Instrument waste oil, used amplification plates, and used cleaning adapters.
- To prevent cross-contamination, we do not recommend running the same barcode for the same type of library sample (DNA or RNA) in a consecutive system run.

Guidelines for Ion OneTouch™ Dx Instrument operation

- To prevent debris from entering the system, keep the TMPL Reagent Tubes installed on the Ion OneTouch™ Dx Instrument when not in use.
- After a Planned Run is executed on the Ion Torrent™ Server, the run must be initiated immediately on the Ion OneTouch™ Dx Instrument.
- A run on the Ion OneTouch™ Dx Instrument can be performed overnight. Enrichment on the Ion OneTouch™ ES Dx Instrument must start within 24 hours after completion of the Ion OneTouch™ Dx Instrument run.
- If a run is aborted for any reason, you must restart the Ion OneTouch™ Dx Instrument by power cycling.
- **CAUTION!** Spilled oil from the Ion OneTouch™ Dx Instrument may present a slip hazard. Be sure to clean up any spills immediately. Place a nonslip floor mat in front of the instrument to prevent slips.

Reagent management

Follow the guidelines below for proper reagent storage and use.

Storage

Reagents must be stored under appropriate conditions. Refer to the Product Information section in each user guide for the storage conditions of the kit components used in the procedures in that guide. The Oncomine™ Dx Target Test Kit System includes kits with multiple component boxes that require different storage conditions. For example, the Oncomine™ Dx Target Test and Controls Kit is composed of four boxes: Oncomine™ Dx Target Test and Oncomine™ Dx Target DNA Control are stored at −30°C to −10°C, whereas the Oncomine™ Dx Target RNA Control and Ion Torrent Dx No Template Control Kit require storage at −90°C to −60°C and 15–30°C, respectively. To use the Oncomine™ Dx Target Test and Controls, retrieve all boxes from their different storage areas and confirm that they are from the same master lot.

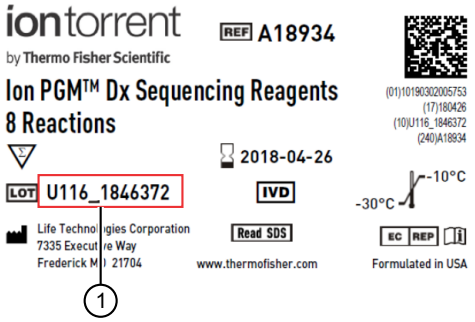
Kit and component matching

Each component box of the Oncomine™ Dx Target Test Kit lists the lot numbers of compatible component boxes on the inside of the box lid. Before use, confirm that the lot numbers of all boxes used in a sequencing run are compatible.

ATTENTION: This kit can only be used with the following lots:

REF		LOT
A18928	Ion PGM™ Dx Library Reagents	N117_1849183
A18929	Ion PGM™ Dx Library Equalizer	N117_1849184
A18930	Ion OneTouch™ Dx Template Reagents	N117_1849185
A18931	Ion OneTouch™ Dx Template ES Beads	N117_1849186
A18932	Ion OneTouch™ Dx Template Solutions	N117_1849187
A18933	Ion OneTouch™ Dx Template Supplies	N117_1849188
A18934	Ion PGM™ Dx Sequencing Reagents	N117_1849189
A18935	Ion PGM™ Dx Sequencing Solutions	N117_1849190
A18936	Ion PGM™ Dx Sequencing Supplies	N117_1849191
A32441	Oncomine™ Dx Target Test	1705001
A32442	Oncomine™ Dx Target DNA Control	R117_1867106
A32443	Oncomine™ Dx Target RNA Control	R117_1867107
A32444	Ion Torrent™ Dx No Template Control	R117_1867103

An example box label with lot information is shown below:



① Lot number

Precautions before using the Ion OneTouch™ Dx instruments

For additional safety information, see Appendix C, "Safety".

Instrument installation by trained personnel only

IMPORTANT! The Ion PGM™ Dx System is installed by trained service personnel and must not be relocated without assistance from trained service personnel. See Appendix F, "Customer and technical support".

Nucleic acid contamination

IMPORTANT! A primary source of contamination is DNA fragments from previously processed samples. See the notes about avoiding contamination in the procedural guidelines.

Reagent contamination

Before use, verify that the TMPL Water and TMPL Tween™ Solution are not cloudy, a potential indication of contamination. If these reagents are cloudy, use a different vial.

Service and maintenance

You will be alerted by the Ion PGM™ Dx System when annual maintenance service is required. A notification will appear on the instrument touchscreen and in the Torrent Suite™ Dx Software.

Library preparation

Libraries must be prepared as described in the *Oncomine™ Dx Target Test Part II: Library Preparation User Guide* (Pub. No. MAN0016168).

Template preparation workflow

The total workflow time is 7 hours, including 1 hour of hands-on time.

Previous guide: *Oncomine™ Dx Target Test Part II: Library Preparation User Guide* (Pub. No. MAN0016168)

▼

Chapter 3, "Plan and execute a run on the Torrent Suite™ Dx Software" on page 22

▼

Chapter 4, "Pool sample and control libraries" on page 26

▼

"Clean the Ion OneTouch™ Dx Instrument before a run" on page 29

▼

"Run the Ion OneTouch™ Dx Instrument" on page 42

▼

"Prepare the Ion OneTouch™ ES Dx Instrument and perform the run" on page 48

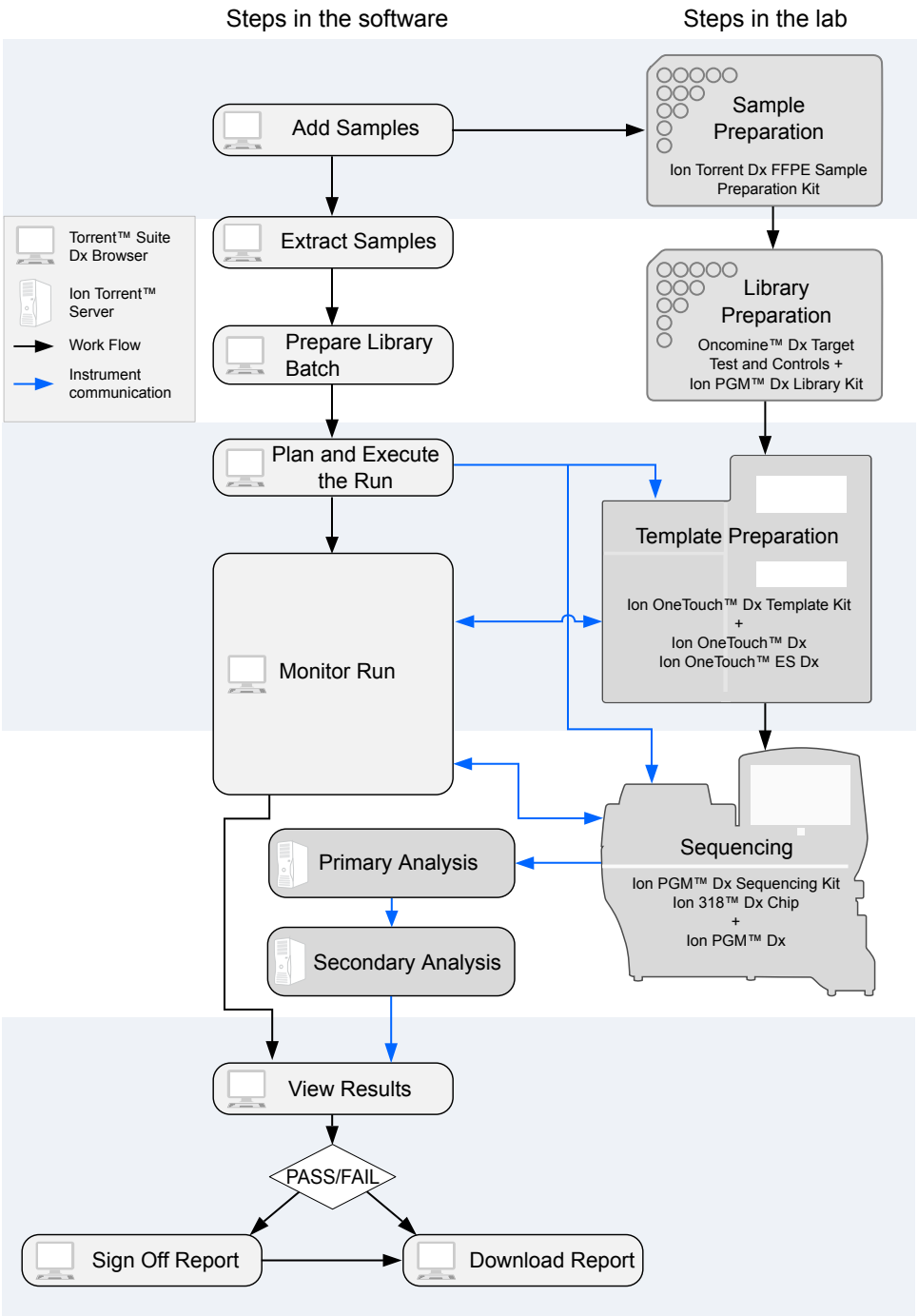
▼

"Clean the Ion OneTouch™ Dx Instrument after the run" on page 50

▼

Proceed to: *Oncomine™ Dx Target Test Part IV: Sequencing User Guide* (Pub. No. MAN0016170)

Oncomine™ Dx Target Test system diagram



3 Plan and execute a run on the Torrent Suite™ Dx Software

Components such as libraries, kits, and chips used in a diagnostic assay must be uniquely identified, and the identification must be stored so that the record can be audited. Torrent Suite™ Dx Software records these components in the Planned Run, which is prepared in the Torrent Suite™ Dx Software and then transferred to the system instruments for tracking and verification at each stage of the run.

The software also uses the Planned Run to verify that only unexpired kits and chips are used and the correct assay is performed on the correct sample.

For more information, see the *Oncomine™ Dx Target Test Part V: Analysis and Test Reports User Guide* (Pub. No. MAN0016171).

Create a Planned Run

Libraries that are ready to be entered into a Planned Run are listed under the **Samples** tab in the **Libraries** screen.

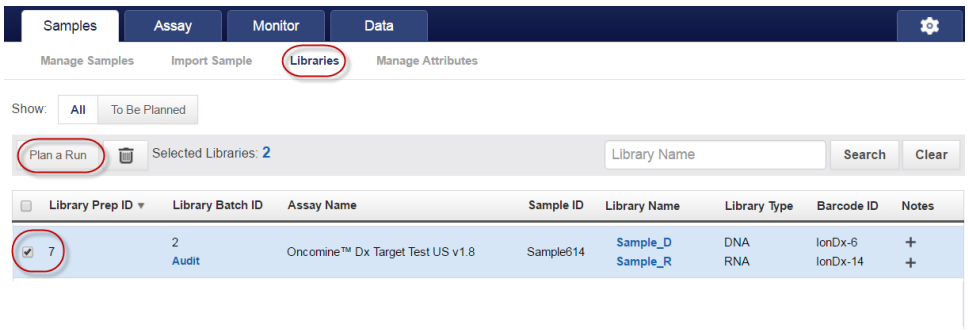
Note: You can also plan a run from the **Assay** tab in the **Planned Runs** screen (using the **Add New** button).

1. Sign in to the Torrent Suite™ Dx Software.

2. In the **Libraries** screen, select the library or libraries to be run by selecting checkboxes in the list. To view only those libraries that have not yet been added to a Planned Run, click **To Be Planned** above the list.

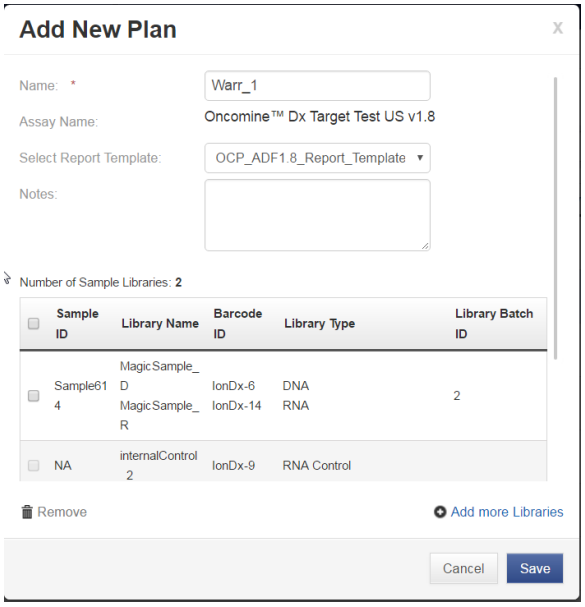
   Note:
   - Libraries prepared with the same assay in the same library batch can be combined and run together, as long as they have unique library names and Barcode IDs.
   - To plan a run with the Oncomine™ Dx Target Test assay, a report template must be created and associated with the assay by an Administrator or Manager. See the *Oncomine™ Dx Target Test Part V: Analysis and Test Reports User Guide* (Pub. No. MAN0016171).
   - Up to 16 libraries (including controls) can be sequenced in a single run.
   - If libraries need to be rerun due to a run failure, they can be added to a new Planned Run.

3. Click **Plan a Run**.



4. In the **Add New Plan** dialog, enter a name for the run, then select the appropriate report template.

   The selected library or libraries will be listed in the dialog, and the control libraries will be automatically listed.



5. To remove libraries from the run, select the appropriate checkbox(es), then click **Remove**. To add libraries, click **Add more libraries** and select them from the **Add Libraries** dialog.

   Note: Any added libraries must be from the same library batch and have unique library names and Barcode IDs.

6. Click **Save**.

   The new Planned Run is automatically assigned a Run Short Code and is displayed at the top of the list under the **Assay** tab in the **Planned Runs** screen.

Execute a Planned Run

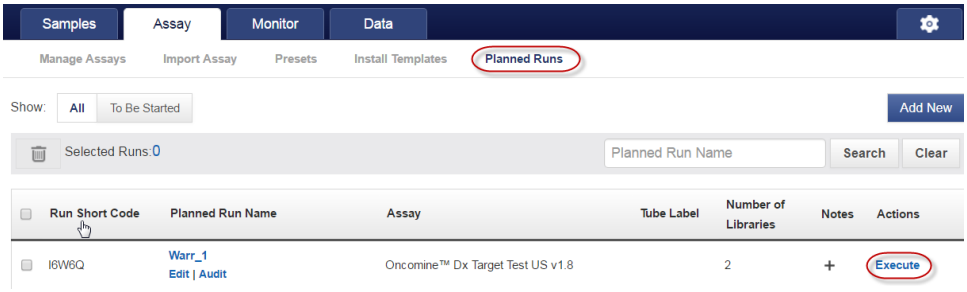
Planned Runs are listed under the **Assay** tab in the **Planned Runs** screen. Runs that are ready to be performed have the **Execute** command available in the **Actions** column.

Executing a Planned Run in the software cues the run for initiation on the Ion OneTouch™ Dx Instrument. Once a Planned Run has been cued for execution, the operator should immediately begin template preparation.

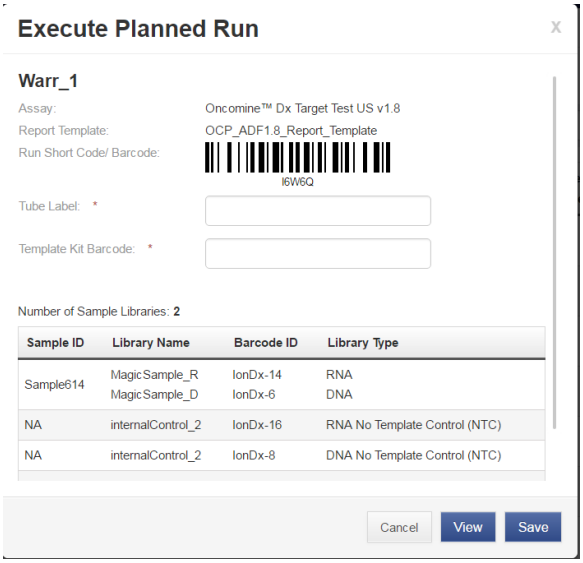
In the **Planned Runs** screen:

1. Click **To Be Started** to limit the list of Planned Runs to only those runs yet to be started.

2. Locate the Planned Run in the list, then under the **Actions** header, click **Execute**.



The **Execute Planned Run** dialog will open.



3. In the **Tube Label** field, enter the text that will be used to label the tubes that contain the final combined libraries. The tube-label text can be any combination of letters and numbers. This text is tracked by the system throughout the run, so be careful to label each tube legibly at the points noted in the procedure. The software will not allow use of the same Tube Label text within 7 days.

4. Click inside the **Template Prep Kit barcode** field, then scan the barcode from the Ion OneTouch™ Dx Template Reagents box.

   IMPORTANT! Be sure to scan the barcode from the actual Ion OneTouch™ Dx Template Reagents box that will be used in the run.

5. Click **Save** to save your changes.
   The **Review Planned Run** dialog will open.

6. Write down the **Run Short Code** and/or click the **Print** button to print the scannable barcode. The code must be entered into the Ion OneTouch™ Dx Instrument and Ion PGM™ Dx Sequencer for tracking and verification before the start of the instrument run.

7. Click **Close** to close the dialog and send the run to the instrument.

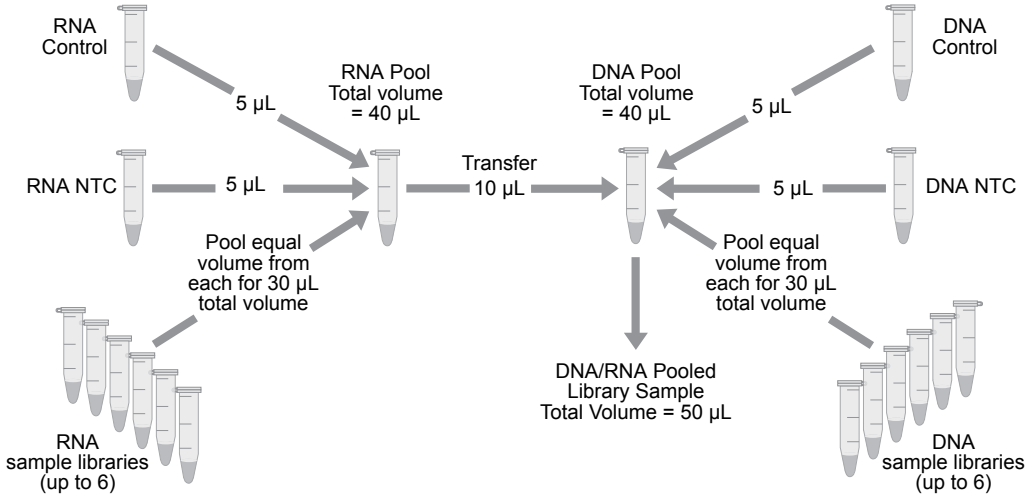
Note: The last 5 executed Planned Runs are listed under the **Monitor** tab in the software.

4 Pool sample and control libraries

Strategy for combining libraries

You can multiplex up to six RNA sample libraries and six DNA sample libraries into a single Ion PGM™ Dx System run. You must also include separate DNA Control, RNA Control, and No Template Control libraries with each run.

A strategy for combining multiple libraries and controls is diagrammed below.



Create an RNA combined library

Perform the following steps in a laminar flow hood in a designated post-PCR area. Change pipette tips between libraries. See "Guidelines to prevent cross-contamination" on page 17 for additional guidelines to avoid cross-contamination.

1. Before pipetting, vortex each library tube for ~5 seconds, then pulse centrifuge for 3–5 seconds to collect the contents.
2. Label a new, nuclease-free 1.5-mL low-retention microcentrifuge tube with the text "RNA Combined Library" and the date.
3. Add 5 µL of the RNA Control library to the tube.
4. Add 5 µL of the RNA NTC library to the same tube.

5. Based on the number of RNA sample libraries to combine, transfer the volume shown in the following table to the tube.

   Note: The total volume of the combined libraries and controls equals 40 µL.

# of RNA sample libraries	Volume per RNA sample library
1	30 µL
2	15 µL
3	10 µL
4	7.5 µL
5	6 µL
6	5 µL

6. Vortex the combined library for ~5 seconds, then pulse centrifuge for 3–5 seconds to collect the contents.

Create a DNA combined library

Perform the following steps in a laminar flow hood. Change pipette tips between libraries. See "Guidelines to prevent cross-contamination" on page 17 for additional guidelines to avoid cross-contamination.

1. Before pipetting, vortex each library tube for ~5 seconds, then pulse centrifuge for 3–5 seconds to collect the contents.

2. Label a new, nuclease-free 1.5-mL low-retention microcentrifuge tube with the text "DNA/RNA Combined Library" and the date.

3. Add 5 µL of the DNA Control library to the tube.

4. Add 5 µL of the DNA NTC library to the tube.

5. Based on the number of DNA sample libraries to combine, add the volume shown in the following table to the tube.

   Note: The total volume of the combined libraries and controls equals 40 µL.

# of DNA sample libraries	Volume per DNA sample library
1	30 µL
2	15 µL
3	10 µL
4	7.5 µL
5	6 µL
6	5 µL

6. Vortex the combined library for ~5 seconds, then pulse centrifuge for 3–5 seconds to collect the contents.

Create a DNA/RNA combined library

1. Transfer 10 µL of the RNA combined library (from step 6, “Create an RNA combined library“ on page 26) to the tube containing 40 µL of DNA combined library (labeled "DNA/RNA Combined Library").

   Note:
   - The total volume of the DNA/RNA combined library equals 50 µL.
   - The remaining RNA combined library can be stored at –30°C to –10°C for up to 30 days.

2. Vortex the DNA/RNA combined library for ~5 seconds, then pulse centrifuge for 3–5 seconds to collect the contents.

STOPPING POINT Proceed to “Clean the Ion OneTouch™ Dx Instrument before a run“ on page 29, or store the DNA/RNA combined library at –30°C to –10°C for up to 30 days.

5 Clean the Ion OneTouch™ Dx Instrument before a run

Track use of TMPL Reagent Tubes and TMPL Sippers

TMPL Reagent Tubes and TMPL Sippers can be used up to 8 times.

1. To track use of the reagent tubes and sippers, label the tubes with the labels that are provided in the kit, then mark the labels after each use.
2. After 8 uses, discard the used reagent tubes and sippers in an appropriate waste container, then label new reagent tubes.

Power cycle the Ion OneTouch™ Dx Instrument

The Ion OneTouch™ Dx Instrument can be left on overnight and on weekends, but should be power cycled under the following conditions:

To power cycle the instrument, turn the instrument off, wait 3 seconds, then turn the instrument back on.

- Power cycle the instrument before installing TMPL Reagent Tubes from a new kit.
- Power cycle the instrument after daylight-saving time changes.

IMPORTANT! Allow up to 20 minutes for the Ion OneTouch™ Dx Instrument to resynchronize with the Ion Torrent™ Server after power cycling. Failure to resynchronize generates an alarm until synchronization is complete.

Clean the Ion OneTouch™ Dx Instrument before a run

Before you perform a new run on the Ion OneTouch™ Dx Instrument, you must clean the instrument. Until you clean the instrument, the **Run** button on the instrument remains disabled.

IMPORTANT! Change gloves after handling instrument waste during disposal and before handling samples. See the product SDS for guidance regarding proper disposal and handling of Ion OneTouch™ Dx Instrument waste products.

Note: Do not press the instrument touchscreen buttons too rapidly (>1 per second), or the touchscreen may freeze.

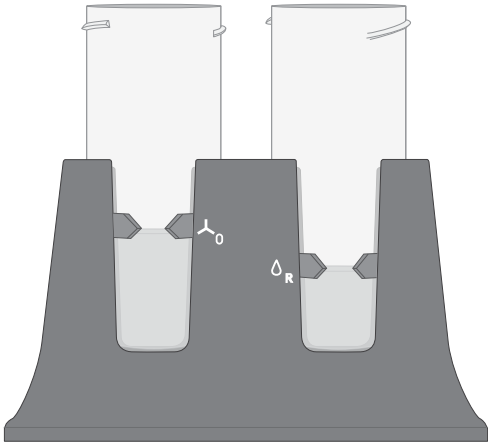
1. Log in to the instrument using the touchscreen.

2. Press the **Clean** button, then follow the touchscreen prompts.

3. Remove the TMPL Reagent Tube containing TMPL Oil from the position marked with an "O" on the instrument (the tube on the left when facing the instrument), then discard the contents in an appropriate hazardous waste container.

   IMPORTANT! When removing reagent tubes, do not touch the reagent sippers or allow them to come into contact with any surfaces. Ensure that the reagent tubes do not come into contact with the waste container when emptying contents.

4. Place the TMPL Reagent Tube in the position labeled "O" on the Ion OneTouch™ Solutions Rack.



5. Change gloves, then invert the TMPL Oil bottle (white cap) 5 times to mix. Fill the reagent tube with oil to the level marked on the rack, so the meniscus is within the fill indicator arrows (volume = 50 mL).

6. Confirm that the sipper is securely attached to the instrument, then screw the reagent tube containing the oil back into the position marked with an "O" on the instrument until the tube can no longer rotate. Press **Next**.

   CAUTION! Be careful to attach the reagent tube to the correct position on the instrument. Attaching the tube to the wrong position may damage the instrument.

7. Remove the TMPL Reagent Tube containing TMPL Recovery Solution from the position marked with an "R" on the instrument. Discard the contents in an appropriate waste container.

   IMPORTANT! When removing reagent tubes, do not touch the reagent sippers or allow the reagent sippers or reagent tubes to come into contact with any surfaces.

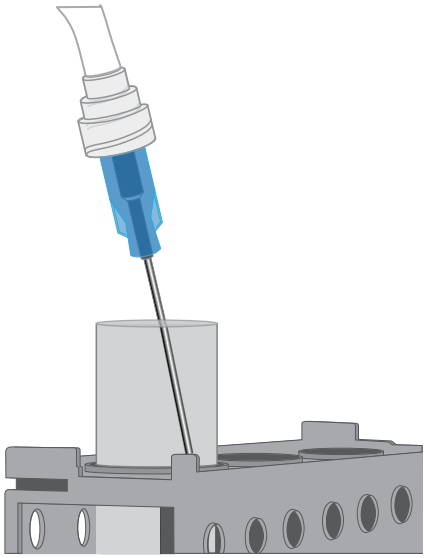
8. Place the TMPL Reagent Tube in the position marked with an "R" on the Ion OneTouch™ Solutions Rack.

9. Change gloves, then invert the TMPL Recovery Solution bottle (brown cap) 5 times to mix. Fill the reagent tube with recovery solution to the level marked with arrows on the "R" position of the rack (volume = 35 mL).

10. Confirm that the sipper is securely attached to the instrument, then screw the reagent tube containing the recovery solution back into the position marked with an "R" on the instrument until the tube can no longer rotate. Press **Next**.

11. Confirm that both the TMPL Cleaning Adapter and TMPL Amplification Plate from the post-run cleaning are in place on the instrument, then check that the tubing from the amplification plate is removed from the pinch valve.

12. Confirm that the injector tip is placed in an empty 50-mL conical tube to collect waste.



13. Press **Next** to start cleaning.

    Note: The cleaning procedure takes 13 minutes to complete, and consumes 10 mL of oil.

14. When cleaning is complete, the screen displays "Cleaning Complete". Wearing clean gloves, press **Next**.

15. Remove and appropriately discard the used TMPL Cleaning Adapter, TMPL Amplification Plate, disposable injector, and tubing from the instrument.

    CAUTION! Hot Surface. Use care when working near this area to avoid being burned by hot components.

    a. Remove the used TMPL Cleaning Adapter, then discard in an appropriate waste container.

    b. Lift, then push back the instrument handle to open the heat block.

c. Remove the disposable tubing, remove the needle, then discard each in appropriate waste containers.

> ⚠ **CAUTION! Piercing Hazard**: Remove the needle from the tubing by unscrewing it or cutting it off with scissors, and discard in an appropriate hazardous waste container for sharp objects.

d. Gently pull back the TMPL Amplification Plate from the inlet and outlet holes of the instrument.

e. Remove the plate from the heat block, then discard in an appropriate waste container.

f. Leave the heat block open.

16. Appropriately discard the 50-mL conical tube waste, then press **Next** to return to the main screen.

> **IMPORTANT!** Always change gloves after handling the waste oil, used amplification plates, and cleaning adapters.

6 Perform an Ion OneTouch™ Dx System run

This chapter describes how to prepare templated ISPs on the Ion OneTouch™ Dx Instrument from a DNA/RNA combined library, and then enrich the templated ISPs on the Ion OneTouch™ ES Dx Instrument.

Prepare reagents and library tube for template preparation

- ☐ 1. Label the library tube with the Tube Label text that you entered into the software.
- ☐ 2. Equilibrate the library, TMPL Rgnt Mix, TMPL ISP, and TMPL CF-1 to room temperature for 30 minutes.

Select the Planned Run

1. Change gloves, then press the **Run** button on the Ion OneTouch™ Dx Instrument touchscreen.

   Note: The instrument touchscreen will provide a summary of each step in the process. These steps are described below in more detail.

2. Enter the Run Short Code (generated by the Torrent Suite™ Dx Software when you executed the run). Make sure the Planned Run information on the screen is correct, then press **Next**.

3. Enter the Tube Label text that you entered into the software when you executed the run, then press **Next**.

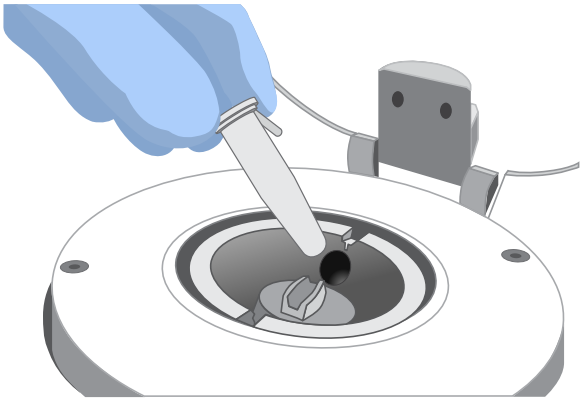
   Note: For tracking purposes, the Tube Label text must exactly match the text you entered in the **Tube Label** field in the Torrent Suite™ Dx Software.

4. Confirm the run type displayed on the instrument screen, then press **Next**.

Install the TMPL Recovery Tubes, TMPL Recovery Router, and TMPL Amplification Plate

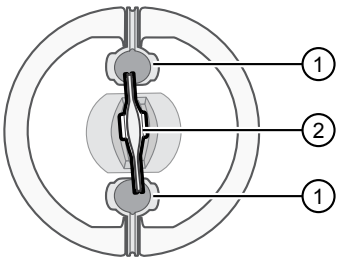
1. Label two TMPL Recovery Tubes with the Tube Label text entered into the software.

2. Insert the tubes into the holes in the Ion OneTouch™ Dx Instrument centrifuge, making the sure the tube arm is inserted into the slot next to each hole.



3. Pinch the sides of the TMPL Recovery Router, then push the router down into the center slot of the centrifuge until it is seated flat and secure in the center of the rotor.

   Note: The router is not directly aligned with the tubes, but is intentionally positioned at an angle.

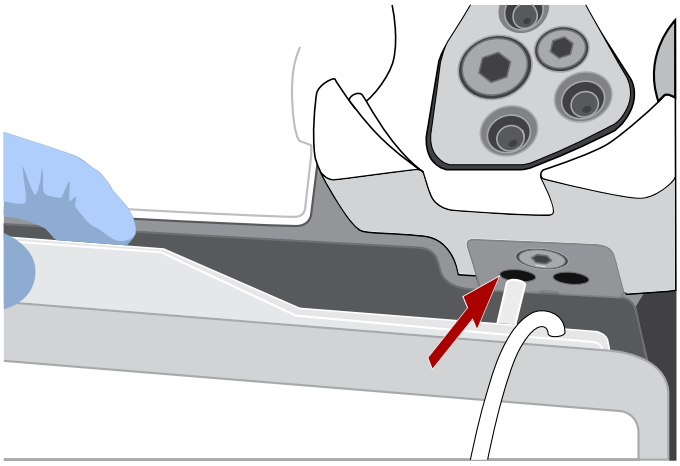


① TMPL Recovery Tube
② TMPL Recovery Router

4. Close the lid of the centrifuge, then press **Next**.

5. Insert a new TMPL Amplification Plate into the open instrument heat block.

   Note: Be careful to align the plate port with the left outlet hole on the instrument. The plate includes disposable tubing and a disposable injector.



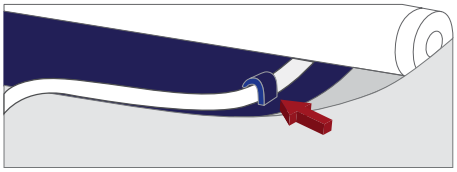
CAUTION! Hot Surface. Use care when working near the heat block to avoid burns from the hot components.

CAUTION! PHYSICAL INJURY HAZARD. The pointed end of the disposable injector can puncture your skin. Keep your hand away from the point of the injector.

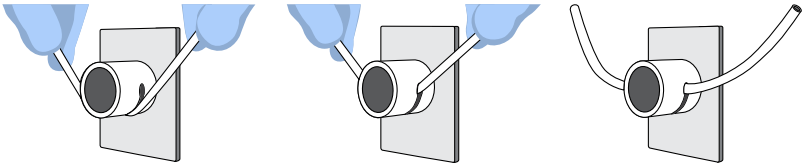
6. Pull the handle forward to secure the plate. The tubing should be under the handle. Press **Next**.

   Note: In the following steps, ensure that the tubing is not kinked or twisted at any point along its length.

7. Thread the tubing through the tubing holder.



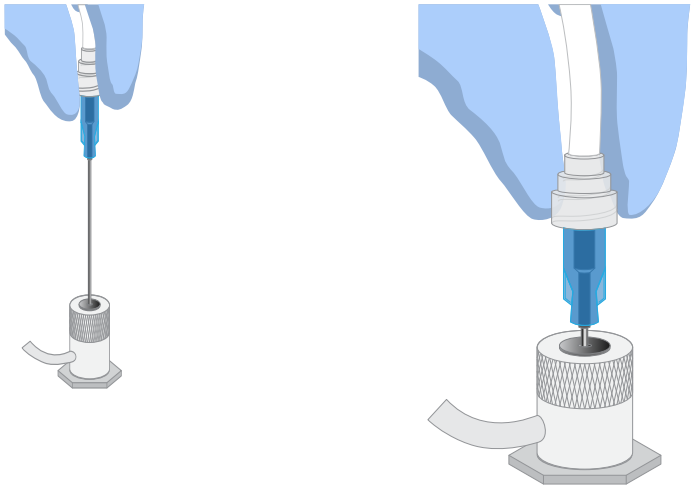
8. Align the tubing with the slot that runs along the bottom of the pinch valve. Gently pull the tubing up into the slot until it is secure in the notch.



9. Adjust the tubing so that it is straight but not too taut. The injector needle should reach the injector hub without stretching the tubing. Press **Next**.

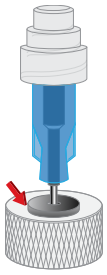
10. Ensure that the injector needle is screwed tightly onto the tubing. Hold the centrifuge lid down with one hand, and with your other hand insert the injector needle straight down into the injector hub. Push down until the injector touches the hub.

    Note: The spring-loaded top of the injector hub clicks upon release, which indicates that the tip of the needle is the correct distance from the hub surface.

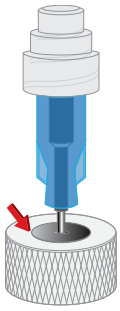


11. Gently push the injector down again and release. You should hear a click from the hub. Then press **Next**.

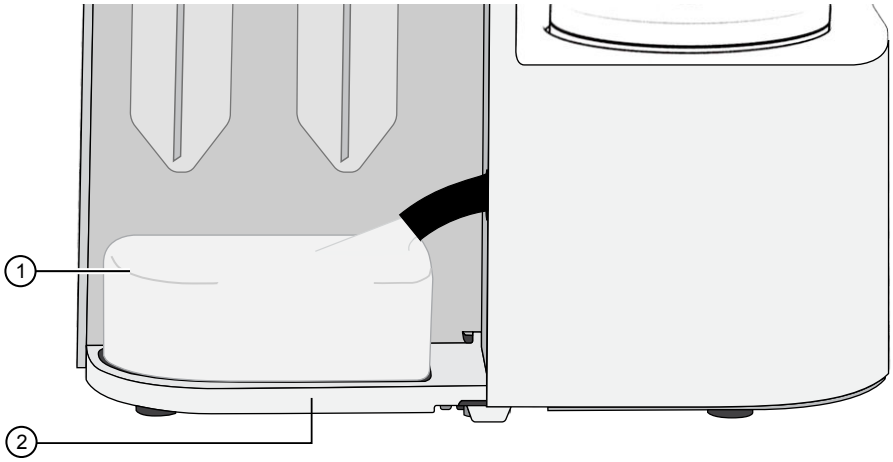
Up position



Down position



12. Pull the waste container from the external waste tubing, and empty the container into an appropriate hazardous waste receptacle.



1 Waste container
2 Oil waste tray

13. Inspect the oil waste tray on the instrument.

> **CAUTION!** If the oil waste tray is full, do not run the instrument. The instrument must be inspected and repaired by a field application specialist.

14. Put the empty waste container back on the tray, then push the waste tube back into the container port. Press **Next**, then proceed to prepare the amplification solution.

Prepare the amplification solution

Kit components used in this procedure

Kit component	Box
TMPL Water (yellow cap) TMPL Rgnt B (blue cap)	Ion OneTouch™ Dx Template Solutions (Part no. A18932; stored at 15°C to 30°C)
TMPL Rgnt Mix (violet cap) TMPL Enzyme Mix (brown cap) TMPL ISP (black cap) TMPL CF-1 (clear cap)	Ion OneTouch™ Dx Template Reagents (Part no. A18930; stored at –30°C to –10°C)

Prepare the amplification solution

Perform the following steps in a laminar flow hood in a designated preamplification area. See "Guidelines to prevent cross-contamination" on page 17 for additional guidelines to avoid cross-contamination.

IMPORTANT! The volume of TMPL ISP reagent used in the amplification solution is critical and must be accurate.

1. Put on new gloves after emptying the Ion OneTouch™ Dx Instrument waste.
2. Ensure that the library, TMPL Rgnt Mix, TMPL ISP, and TMPL CF-1 are completely thawed.
3. Vortex the TMPL Rgnt B and TMPL Rgnt Mix tubes for 5 seconds each, then pulse centrifuge for 3–5 seconds.
4. Flick the TMPL Enzyme Mix tube with the tip of your finger 4 times, then pulse centrifuge for 3–5 seconds. Place in a benchtop cold box at 2–8°C until needed.
5. In a new nuclease-free 1.5-mL low-retention microcentrifuge tube at room temperature, add the following components in the designated order:

	Order	Reagent	Cap color	Volume
☐	1	TMPL Water	Yellow	40 µL
☐	2	TMPL Rgnt Mix	Purple	500 µL
☐	3	TMPL Rgnt B	Blue	300 µL
☐	4	TMPL Enzyme Mix	Brown	50 µL

6. Cap the 1.5-mL tube and vortex for ~5 seconds, then pulse centrifuge for 3–5 seconds.
7. Vortex the TMPL ISP tube for 30 seconds, then pulse centrifuge for 3–5 seconds.
8. Vortex the library and TMPL CF-1 tubes for 5 seconds each, then pulse centrifuge for 3–5 seconds.
9. Add the following to the tube in the designated order. After each addition, cap the tube, vortex for ~5 seconds, then pulse centrifuge for 3–5 seconds.

	Order	Reagent	Cap color	Volume
☐	1	TMPL ISP	Black	100 µL
☐	2	TMPL CF-1	Clear	5 µL
☐	3	DNA/RNA combined library	—	5 µL

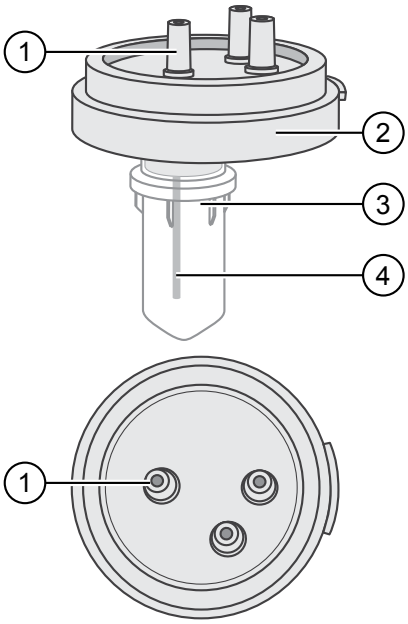
Fill the TMPL Emulsion Cartridge

1. Clean the Ion OneTouch™ Assembly Rack with fresh 10% bleach followed by two water rinses.

2. Label a pre-assembled TMPL Emulsion Cartridge with the Tube Label text entered into the software.

   Note: Make sure that the short tube is attached to the bottom of the sample port and extends into the Reaction Tube, and the Reaction Tube is securely fastened to the cartridge.

3. Use a marker to circle the sample port on the top of the TMPL Emulsion Cartridge to distinguish it from the other two ports.

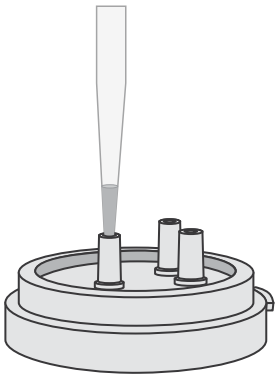


① Sample port (above the Reaction Tube)
② Reaction Filter
③ Reaction Tube
④ Short tube from the sample port into the Reaction Tube

4. Place the TMPL Emulsion Cartridge into the Ion OneTouch™ Assembly Rack with the ports facing up.

1 Sample port (marked as in step 3)

5. Collect the full volume of the amplification solution (~1000 µl) using a P1000 pipettor, then insert the pipette tip vertically into the circled sample port on the cartridge with a snug fit.



6. Slowly pipet the amplification solution into the sample port.

   Note: Keep the pipette plunger depressed when removing the tip from the port to avoid withdrawing any reaction mix or introducing air bubbles.

7. Invert the TMPL Reaction Oil 5 times to mix.

8. Using a new pipette tip, collect 750 µL of TMPL Reaction Oil using a P1000 pipettor, then insert the pipette tip vertically into the sample port on the cartridge.

9. Slowly pipet the oil into the sample port to layer the oil over the aqueous reaction mix.

   Note: Keep the pipette plunger depressed when removing the tip from the port.

10. Replace the pipette tip to avoid contamination, and repeat steps 8–9 one more time, adding another 750 µL of TMPL Reaction Oil (1.5 mL total).

11. Immediately install the TMPL Emulsion Cartridge on the instrument. Do not mix or shake the cartridge.

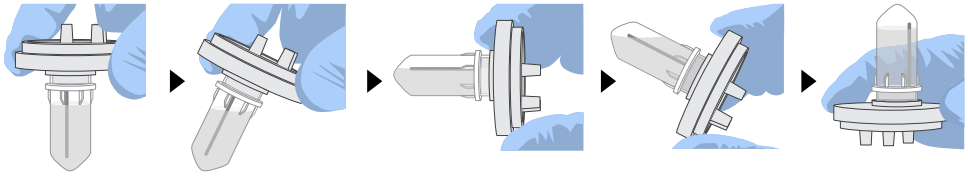
Install the filled TMPL Emulsion Cartridge

IMPORTANT! Do not mix or shake the TMPL Emulsion Cartridge during the following steps.

1. Keep the TMPL Emulsion Cartridge in the Ion OneTouch™ Assembly Rack, then orient the assembly so that the sample port is on your *left*.

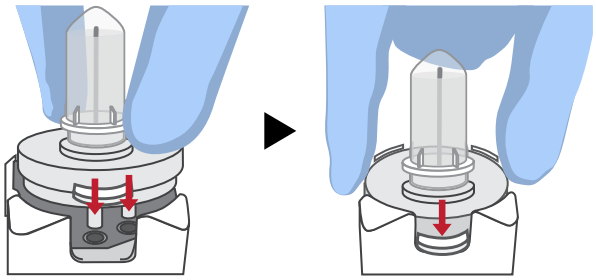
2. Lift the TMPL Emulsion Cartridge straight out of the tube rack.

3. With the short tube in the Reaction Tube to the left, slowly rotate the assembly to your *right* until the Reaction Tube is inverted.



Note: This ensures minimal exposure of the short tubing in the Reaction Tube with the aqueous phase.

4. Insert the three ports of the TMPL Emulsion Cartridge into the three holes on the top of the manifold. Press firmly on all sides to ensure a secure fit on the manifold.



Note: After inserting the TMPL Emulsion Cartridge, bubbles may shoot up into the Reaction Tube. This is normal.

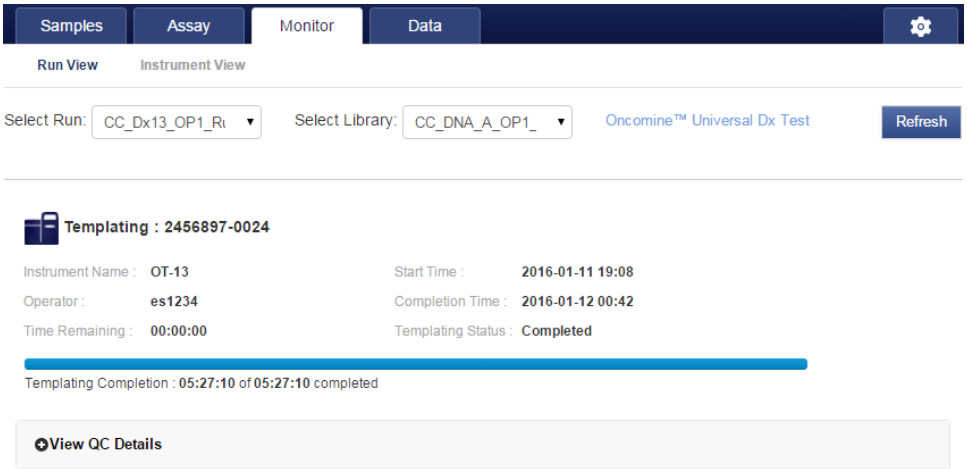
Run the Ion OneTouch™ Dx Instrument

IMPORTANT! ISPs can remain on the Ion OneTouch™ Dx Instrument for up to 24 hours after a run. You must begin enriching the ISPs on the Ion OneTouch™ ES Dx Instrument within 24 hours.

1. Ensure that the centrifuge lid of the Ion OneTouch™ Dx Instrument is closed.

2. Press **Next** on the instrument touchscreen to start the run.

   Note: The run will take approximately 5 hours and 30 minutes to complete. The time remaining and a progress bar will be displayed on the instrument screen during the run and under the **Monitor** tab on the Torrent Suite™ Dx Software.



   - To cancel a run, press **Abort**, then press **Yes** to confirm. If there is a high-pressure event on the instrument, the instrument will abort the run automatically.
   - If a run is aborted, you must power-cycle the Ion OneTouch™ Dx Instrument before repeating the run preparation and run. Not doing so may cause the next run to fail.

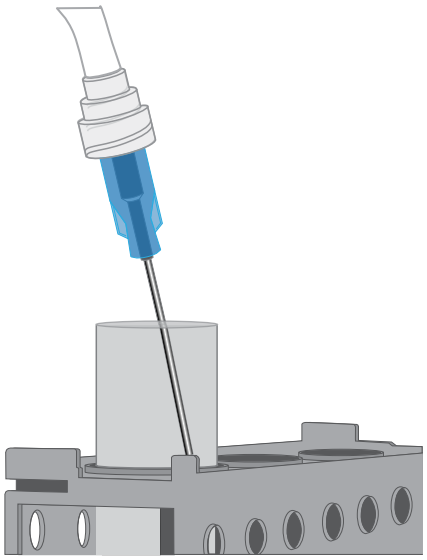
3. After the run has completed, press **Re-Spin** on the touchscreen. The time since the end of the run will be displayed (*hh:mm:ss*).

4. Based on the time displayed, do one of the following:
   - If it has been ≤30 minutes since the end of the run, no re-spin is required. Press **No**, then press **Next** to bypass this step. Proceed to recover the ISPs.
   - If it has been >30 minutes since the end of the run, press **Yes** to repellet the ISPs for 10 minutes. After re-spin is complete, press **Next** and proceed to recover the ISPs.
   - If it has been >30 minutes but the re-spin step was accidentally skipped, repellet the ISPs.
     a. Leave the ISPs in the recovery tube on the instrument, and proceed to "Clean the Ion OneTouch™ Dx Instrument after the run" on page 50. (You can perform the cleaning procedure while the ISPs remain on the instrument.)
     b. After cleaning is complete (~12 minutes), press **Options** on the touchscreen (Managers and Administrators only). Then select **Re-spin** to pellet the ISPs.
     c. When the spin is complete, proceed to recover the ISPs.

Recover the ISPs from the Ion OneTouch™ Dx Instrument

The instrument touchscreen will guide the user through each step in the process. These steps are described below in more detail.

1. Remove the disposable injector from the injector hub, and carefully release the flexible tubing from the pinch valve. Place the injector into an empty 50-mL conical tube to collect waste. Press **Next**.



2. Press **Open Lid** on the Ion OneTouch™ Dx Instrument touchscreen, and wipe up any residue from the inside of the lid with a new disposable wipe.

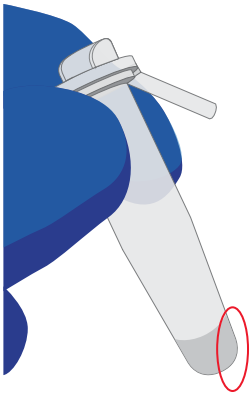
   Note: When using multiple instruments, use a new disposable wipe for every instrument.

3. Remove and discard the TMPL Recovery Router.

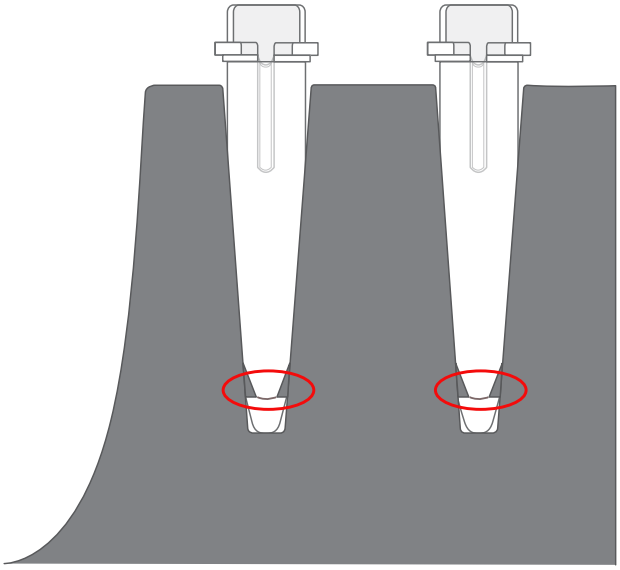
4. Carefully remove the two TMPL Recovery Tubes from the instrument and insert them in the Ion OneTouch™ Sample Rack, with each tube arm inserted into the slot on the back of the rack. Close the instrument lid.

IMPORTANT! Do not agitate the tubes when handling. Make sure the tubes are clearly labeled with the Tube Label text.

Note: The pelleted ISPs are located at the bottom of each tube on the same side as the tube arm, as shown below. The liquid in each tube may appear cloudy and the pellet will not be visible. This is normal.



5. Depress the plunger on a P-1000 pipette and carefully insert the tip into a TMPL Recovery Tube, avoiding the pelleted ISPs. Slowly remove ~1 mL of supernatant from the top down. Switch to a P-200 pipette and use the same procedure to remove the supernatant until the meniscus at the top of the liquid aligns with the bottom of the triangular arrow guides.



IMPORTANT! Top-down removal is essential to avoid loss of ISPs. Avoid the pellet and do not eject liquid back into the tube when pipetting.

Note: The volume remaining in each tube is 50 µL.

Prepare the TMPL ES Strip Tube

Kit components used in this procedure

Kit component	Box
TMPL ES Rsp Soln (orange cap) TMPL Wash Solution (white cap) TMPL Neutral Soln (red cap) TMPL Tween™ Solution (white cap)	Ion OneTouch™ Dx Template Solutions (Part no. A18932; stored at 15°C to 30°C)
TMPL ES Strip Tube	Ion OneTouch™ Dx Template Supplies (Part no. A18933; stored at 15°C to 30°C)
TMPL ES Beads (green cap)	Ion OneTouch™ Dx Template ES Beads (Part no. A18931; stored at 2°C to 8°C)

Prepare the TMPL ES Beads with TMPL ES Rsp Soln

If you are processing multiple template preparations at the same time, prepare a master mix by increasing the volumes of TMPL ES Beads and TMPL ES Rsp Soln according to the table in step 5.

1. Vortex the TMPL ES Beads (green cap) for 30 seconds to resuspend the beads.
2. In a new 1.5-mL low-retention microcentrifuge tube, add 14.3 µL of TMPL ES Beads per template preparation (13 µL of beads plus 10% extra to mitigate pipetting errors).
3. Fill the tube with 1 mL of TMPL Wash Solution.
4. Cap the tube, vortex for 10 seconds, then place the tube on the DynaMag™ Dx 16 2-mL Magnet for 1 minute to capture the beads. Without disturbing the pellet, carefully remove and discard the supernatant.
5. Add 143 µL of TMPL ES Rsp Soln (orange cap) per template preparation to the tube (130 µL of solution plus 10% extra to mitigate pipetting errors).

Number of template preparations	Volume [1]	
	TMPL ES Beads	TMPL ES Rsp Soln
1	14.3 µL	143 µL
2	28.6 µL	286 µL
3	42.9 µL	429 µL
4	57.2 µL	572 µL
5	71.5 µL	715 µL
6	85.8 µL	858 µL
7	100.1 µL	1001 µL
8	114.4 µL	1144 µL

[1] Includes 10% extra

6. Cap the tube, then vortex for 30 seconds to resuspend the pellet.
7. If some beads are stuck to the lid of the tube, pulse centrifuge the tube for 3 seconds. Leave the tube at room temperature until ready to use.

Prepare fresh Melt-Off Solution

1. Prepare 1 M NaOH by adding 1 mL of 10 M NaOH to 9 mL Nuclease-Free water. 1 M NaOH must be prepared fresh weekly.
2. In a new 1.5-mL low-retention microcentrifuge tube, combine the following components in order.

	Order	Component	Volume
☐	1	TMPL Tween™ Solution	280 µL
☐	2	1 M NaOH	40 µL
		Total	320 µL

3. Cap the tube, vortex for 10 seconds, then pulse centrifuge for 3 seconds.

Prepare the strip tube

1. Using a marker, label a TMPL ES Strip Tube on the square tab with the Tube Label text, then place it in the Ion OneTouch™ Assembly Rack.

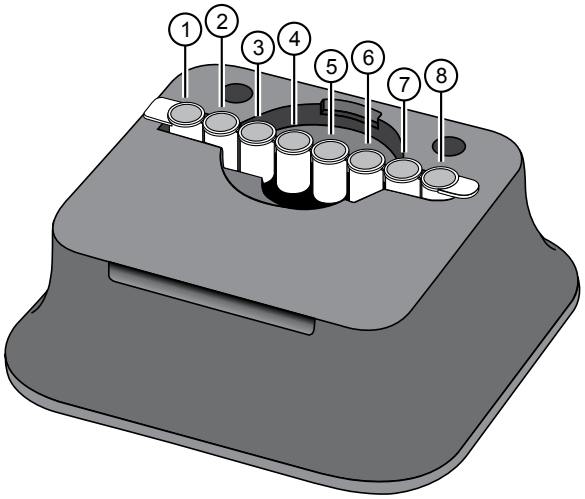
   When facing the rack, make sure that the square tab of the TMPL ES Strip Tube is on the left and the round tab is on the right.

2. Resuspend the contents of each TMPL Recovery Tube containing the templated ISPs in 50 µL (from "Recover the ISPs from the Ion OneTouch™ Dx Instrument" on page 43, step 5) by vigorously pipetting up and down 30 times.

   Note: Set a pipette to 40 µL and keep the pipette tip at the bottom of the tube when mixing to minimize air bubbles, which can lead to the loss of ISPs.

3. Pool the entire volume of templated ISPs from both recovery tubes into well 1 of the TMPL ES Strip Tube. The total pooled volume will be 100 µL.

4. Fill the remaining wells in the strip as follows:



	Well number	Reagent
☐	Well 1	Template-positive ISPs (~100 µL), added in step 3
☐	Well 2	130 µL of TMPL ES Beads in TMPL ES Rsp Soln
☐	Well 3	300 µL of TMPL Wash Solution
☐	Well 4	300 µL of TMPL Wash Solution
☐	Well 5	300 µL of TMPL Wash Solution
☐	Well 6	Empty
☐	Well 7	300 µL of freshly-prepared Melt-Off Solution
☐	Well 8	Empty

5. With a marker, label a 0.2-mL sample collection tube with the Tube Label text. Use scissors to separate each 0.2–mL tube from the tube strip.

   Note: Do not pull tubes off, as this can damage the tube.

6. Add 10 µL of TMPL Neutral Soln (red cap) to the 0.2-mL sample collection tube, then place it in the tube holder in the Ion OneTouch™ Sample Rack.

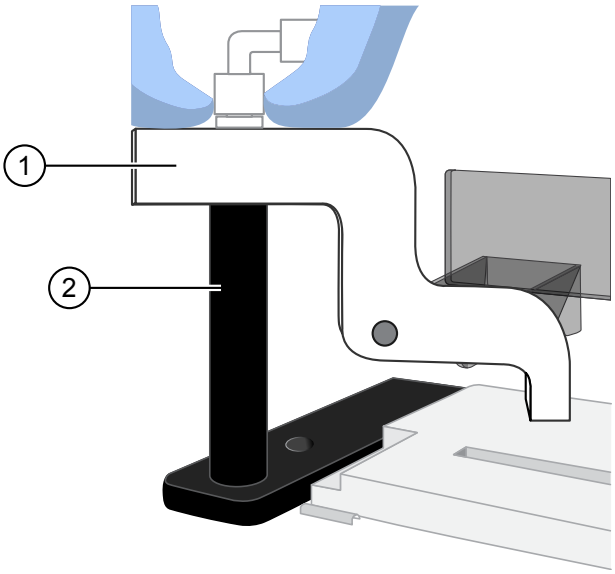
IMPORTANT! The volume of TMPL Neutral Soln added to the sample collection tube is critical and must be accurate.

Prepare the Ion OneTouch™ ES Dx Instrument and perform the run

1. Place a new TMPL ES Tip in the Tip Loader. Remove the Tip Arm from its cradle on the Ion OneTouch™ ES Dx Instrument.

2. Grip the Tip Arm with two fingers, then align the metal fitting of the Tip Arm with the top of the tip. Firmly press the Tip Arm straight down onto the tip for 3 seconds with even pressure to ensure proper installation.

IMPORTANT! Do not repeatedly jam the Tip Arm up and down onto the tip.

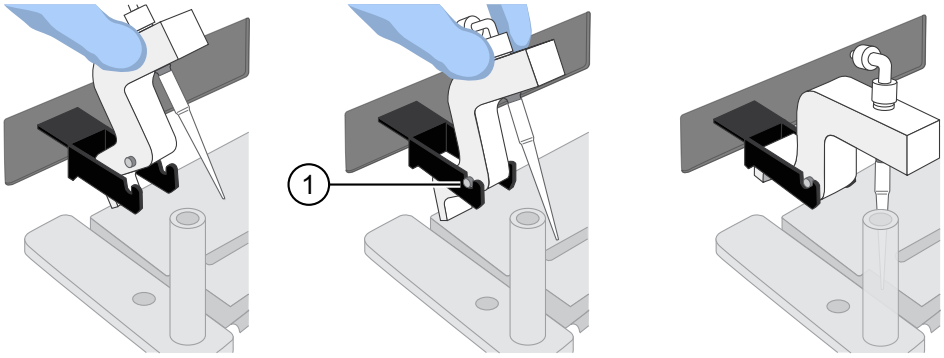


① Tip Arm
② Tip Loader

3. Lift the Tip Arm straight up to pull the installed TMPL ES Tip from the Tip Loader tube.

4. Return the Tip Arm to its cradle on the instrument. Tilt the Tip Arm back and align the pins with the round notches in the cradle, then lower the Tip Arm into the home position.

   Note: Ensure that the back end of the Tip Arm is not resting on top of the thumb screw, causing the Tip Arm to tilt forward.

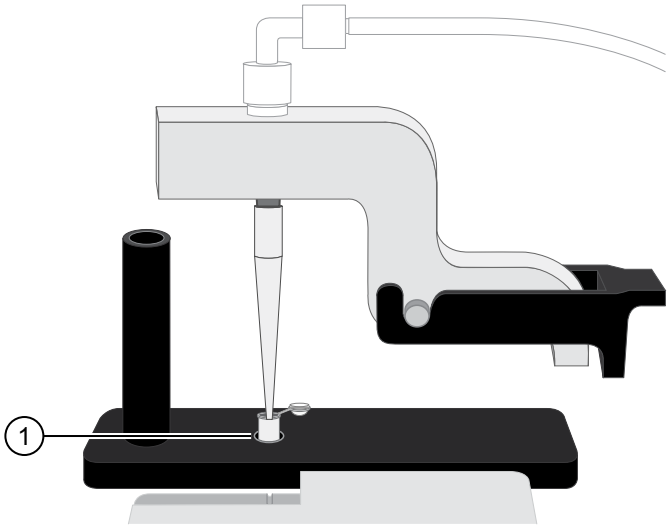


① Tip Arm pins resting in the notches in the cradle

5. Remove the 0.2-mL sample collection tube containing TMPL Neutral Soln from the Ion OneTouch™ Sample Rack. Place it in the hole in the base of the Tip Loader.

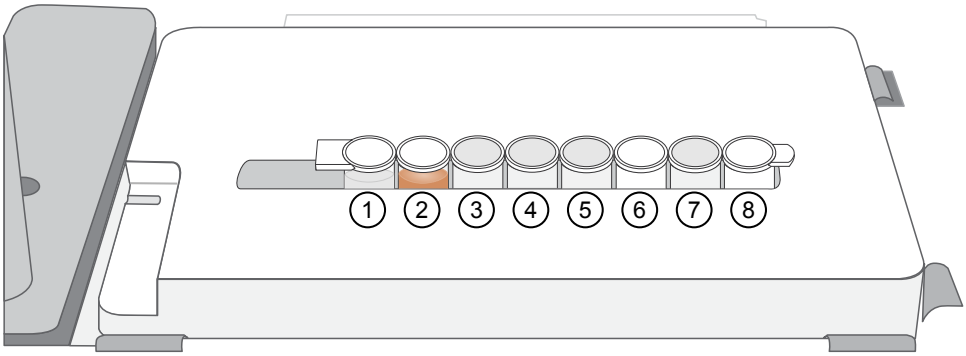
   When the Tip Arm is lowered, the tip will fit inside the sample collection tube, as shown below.

IMPORTANT! Be sure that the Tip Loader is aligned properly in its trough. If the Tip Loader is too far forward or back, the tip will miss the tube and eject sample onto the tip loader.



① 0.2-mL sample collection tube

6. Confirm that the square-shaped tab is on the left, then insert the filled 8-well strip into the right end of the slot on the Ion OneTouch™ ES Dx Instrument tray.



7. Press the **Start/Stop** button on the instrument to start the run.

   The screen displays "Run" during the run, which takes ~35 minutes.

8. If you need to stop the instrument during a run, press **Start/Stop** again. The instrument completes the current step, then stops the run and displays "End". Press **Start/Stop** again to return the Tip Arm to the home position. It is not possible to restart where you left off after stopping a run.

9. During the run, proceed to “Clean the Ion OneTouch™ Dx Instrument after the run“ on page 50.

10. At the end of the run, the Ion OneTouch™ ES Dx Instrument displays "End" and beeps every 60 seconds. Press the **Start/Stop** button to silence this alarm, then reset the instrument for the next run. Proceed to “Collect the sample from the Ion OneTouch™ ES Dx Instrument“ on page 51.

The enriched ISPs can be left on the instrument for up to 2 hours. The instrument can be left on between runs.

Clean the Ion OneTouch™ Dx Instrument after the run

IMPORTANT! Refer to the product SDS for guidance regarding proper disposal and handling of Ion OneTouch™ Dx Instrument waste products.

1. Return to the Ion OneTouch™ Dx Instrument, then press **Next** on the touchscreen to continue with the post-run cleaning procedure.

2. Wipe any residue from the inside of the lid with a disposable wipe.

3. Remove the used TMPL Emulsion Cartridge and invert it to visually inspect that the aqueous phase was completely injected. Only one phase should be present. Discard the cartridge in the appropriate waste container.

   Note: If more than one phase remains, sample injection from the assembly did not occur. See Appendix A, “Troubleshooting“.

4. Temporarily remove the used TMPL Amplification Plate and visually inspect it to check that there is no remaining emulsion or excessive air bubbles in the plate.

   Note:
   - Only clear oil should remain in the plate. Any white or cloudy areas indicate the presence of emulsion.
   - If the TMPL Amplification Plate is filled with emulsion, sample injection from the plate did not occur. See Appendix A, "Troubleshooting". Trace amounts of emulsion are okay.

5. Reinstall the TMPL Amplification Plate.

6. Check the reagent tubes to ensure that the appropriate volume of oil and recovery solution was used. Approximately 20 mL of oil and 11 mL of TMPL Recovery Solution will be left in their respective reagent tubes. Press **Next**.

   Note: Inappropriate volumes may indicate an instrument failure during the run. See Appendix A, "Troubleshooting".

7. Install a new TMPL Cleaning Adapter.

8. Confirm that the disposable injector has been placed into a 50-mL conical tube.

9. Press **Next** on the Ion OneTouch™ Dx Instrument touchscreen to start the cleaning run.

   Note: The cleaning run takes 13 minutes. During cleaning, ensure that oil is flowing from the disposable injector. No flow of oil could indicate a clog in the manifold or in the cleaning adapter. See Appendix A, "Troubleshooting".

10. When cleaning is complete, press **Next**.

    Note: If the touchscreen indicates that cleaning failed, see Appendix A, "Troubleshooting".

11. Remove the disposable injector from the 50-mL conical tube, then discard the tube and its waste into appropriate containers. Place the injector in a new 50-mL conical tube.

    IMPORTANT! Do not remove the TMPL Cleaning Adapter or TMPL Amplification Plate. Leave them on the instrument.

12. Press **Next** to return to the main screen, then log out of the instrument touchscreen.

Collect the sample from the Ion OneTouch™ ES Dx Instrument

1. After the Ion OneTouch™ ES Dx Instrument run ends, remove the 0.2-mL sample collection tube containing the enriched ISPs and securely close the tube.

   Note: The enriched ISPs can be left on the instrument for up to 2 hours.

2. Ensure that the 0.2-mL sample collection tube has >200 µL of solution.

   Note: If the tube has <200 µL of solution, see Appendix A, "Troubleshooting".

3. Remove, then discard the used tip and 8-well strip tube from the Ion OneTouch™ ES Dx Instrument.

STOPPING POINT Proceed to sequencing within 2 hours after the end of the Ion OneTouch™ ES Dx Instrument run, or transfer the template-enriched ISPs to 2–8°C storage. The ISPs may be stored for up to 1 week. If stored longer than 1 week, prepare new template-enriched ISPs from the library.

A Troubleshooting

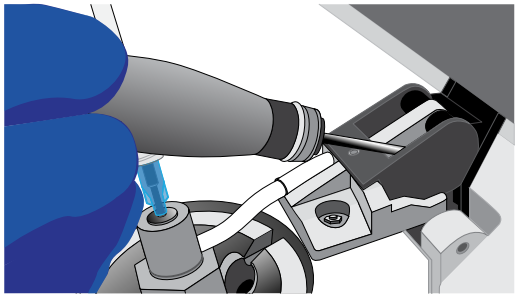
Ion OneTouch™ Dx Instrument

Observation	Possible cause	Recommended action
Display message: Sensor unable to measure pressure.	Hardware issue	Contact Technical Support (see Appendix F, "Customer and technical support"). Reboot the Ion OneTouch™ Dx Instrument to clear the alarm.
Display message: Coolant pump does not flow.	Hardware issue	Contact Technical Support (see Appendix F, "Customer and technical support"). Reboot the Ion OneTouch™ Dx Instrument to clear the alarm.
Display message: Connection failure with Torrent Server	Ion OneTouch™ Dx Instrument and Ion Torrent™ Server connection is not established	Check that a network connection to the Ion Torrent™ Server is established, then reboot the Ion OneTouch™ Dx Instrument. **Note:** A sample created during a run with this alarm raised can still be used.
Display message: Failed to connect to the Torrent Server. Check your connection.	Ion OneTouch™ Dx Instrument and Ion Torrent™ Server connection is not established during startup	Check your network connection to the Ion Torrent™ Server to make sure the connection is established, then reboot the Ion OneTouch™ Dx Instrument.
Display message: Failed to set up system time at startup. Check your connection to the Torrent Server.	Ion OneTouch™ Dx Instrument and Ion Torrent™ Server connection is not established	Check your network connection to the Ion Torrent™ Server to make sure the connection is established, then reboot the Ion OneTouch™ Dx Instrument.
	Instrument is still in the process of establishing a connection	Allow ten minutes to see if the display message clears.
Display message: Motor current too high. Reboot the instrument to clear the alarm.	Hardware issue	Contact Technical Support (see Appendix F, "Customer and technical support"). Reboot the Ion OneTouch™ Dx Instrument to clear the alarm. **Note:** A sample created during a run with this alarm raised can still be used.
Display message: Pressure too high. Reboot the instrument to clear the alarm.	• Hardware issue • Clogged TMPL Emulsion Cartridge due to contaminated reagents or defective emulsion cartridge	Reboot the Ion OneTouch™ Dx Instrument to clear the alarm. Use a new TMPL Emulsion Cartridge and fresh reagents to repeat the run. Contact Technical Support (see Appendix F, "Customer and technical support") if the issue persists.
Display message: Sensor unable to measure instrument temperature	Hardware issue	Contact Technical Support (see Appendix F, "Customer and technical support"). Reboot the Ion OneTouch™ Dx Instrument to clear the alarm.

Observation	Possible cause	Recommended action
Display message: Set temperature out of range. Reboot the instrument to clear the alarm.	Hardware issue	Contact Technical Support (see Appendix F, "Customer and technical support"). Reboot the Ion OneTouch™ Dx Instrument to clear the alarm. **IMPORTANT!** If this alarm is raised, you cannot use the prepared template.
Display message: Software versions incompatible. Go to the Options menu and update the software.	The system software was updated, but the instrument software was not.	After the system software has been updated, update the instrument software as follows: 1. On the main menu of the instrument, press **Options** and follow the instructions to check for and install updates. 2. When installation is complete, follow the onscreen prompts to reboot the instrument. **IMPORTANT!** You must reboot the instrument before proceeding.
Display message: TEC current too high. Reboot the instrument to clear the alarm.	Hardware issue	Contact Technical Support (see Appendix F, "Customer and technical support"). Reboot the Ion OneTouch™ Dx Instrument to clear the alarm. **IMPORTANT!** A sample created during a run with this alarm raised must NOT be used.
Ion OneTouch™ Dx Instrument displays a blue or grey screen with folders while the instrument is idle	Instrument issue	Power cycle the Ion OneTouch™ Dx Instrument using the On/Off switch. If alarms appear or the problem persists, contact Technical Support (see Appendix F, "Customer and technical support").
Ion OneTouch™ Dx Instrument displays a blue or grey screen with folders during cleaning or a run	Instrument issue	Power cycle the Ion OneTouch™ Dx Instrument using the On/Off switch, then restart the cleaning or run. If alarms appear or the problem persists, contact Technical Support (see Appendix F, "Customer and technical support").
Ion OneTouch™ Dx Instrument touchscreen freezes	Touchscreen button is pressed more than once per second.	Wait 5 minutes. If still unresponsive: 1. Click on the **Abort** button if displayed, and restart the process. 2. If **Abort** button is not displayed, power-cycle the instrument using the On/Off switch, then restart the process. **Note:** If the touchscreen freezes during Ion OneTouch™ Dx Instrument run setup, the software will remember that the instrument has already been cleaned and will not require the cleaning to be performed a second time.
During cleaning, no liquid comes out of the disposable injector	Loose or damaged reagent tube sipper in the "0" position	Reinstall the sipper in the "0" position, then restart cleaning. If the problem persists, install a new sipper.
	Improper installation of the TMPL Cleaning Adapter and TMPL Amplification Plate	Reinstall the TMPL Cleaning Adapter and TMPL Amplification Plate, then restart cleaning. If the problem persists, use a new TMPL Cleaning Adapter and a new TMPL Amplification Plate.

Observation	Possible cause	Recommended action
During cleaning, no liquid comes out of the disposable injector	Instrument issue	Contact Technical Support (see Appendix F, "Customer and technical support").
Run did not complete	• Operator did not power cycle the Ion OneTouch™ Dx Instrument after an "Abort" operation • Instrument issue	Power cycle the Ion OneTouch™ Dx Instrument using the On/Off switch, then start a new run. If the problem persists, contact Technical Support (see Appendix F, "Customer and technical support").
Cleaning was aborted due to high pressure	Improper installation of the TMPL Cleaning Adapter or TMPL Amplification Plate	Reinstall the TMPL Cleaning Adapter and TMPL Amplification Plate, then restart the cleaning protocol. If the problem persists, contact Technical Support (see Appendix F, "Customer and technical support").
Run was aborted due to high pressure	Clogged TMPL Emulsion Cartridge	Install a new TMPL Emulsion Cartridge, then restart the run. If the problem persists, contact Technical Support (see Appendix F, "Customer and technical support").
	Reagent contamination	Replace the TMPL Reaction Oil, TMPL Reagent Tubes, and TMPL Sippers, then restart the run.
	Instrument issue	Contact Technical Support (see Appendix F, "Customer and technical support").
Oil is leaking from the instrument	Improper installation of consumables	Wipe up any leakage and reinstall TMPL Sippers and TMPL Reagent Tubes.
	Waste was not emptied before the run	Wipe up any leakage and empty the waste container before the next run.
	Instrument issue	Contact Technical Support (see Appendix F, "Customer and technical support").
Excessive oil in waste tray	Instrument issue	Power cycle the Ion OneTouch™ Dx Instrument using the On/Off switch. If the problem persists, contact Technical Support (see Appendix F, "Customer and technical support").
Waste backup observed after completion of Ion OneTouch™ Dx Instrument run, waste leaks from the waste line after removal of the waste container	Filter in waste container clogged causing back-pressure	Remove or clean filter in waste container.
	Improper installation of consumables	Wipe up any leakage and reinstall TMPL Sippers and TMPL Reagent Tubes.
	Waste was not emptied before the run	Wipe up any leakage and empty the waste container before the next run.
	Instrument issue	Contact Technical Support (see Appendix F, "Customer and technical support").
The centrifuge keeps running and the run never completes	Instrument hardware issue	Press **Abort** and power cycle the Ion OneTouch™ Dx Instrument using the On/Off switch. Press **Open Lid** to remove and discard the recovery tubes, then restart template preparation. If the problem persists, contact Technical Support (see Appendix F, "Customer and technical support").

Observation	Possible cause	Recommended action
Two phases are present in the sample cup at the end of the Ion OneTouch™ Dx Instrument run, sample injection from the TMPL Amplification Plate did not occur	• The TMPL Emulsion Cartridge was not inserted properly into the instrument • Problem with the instrument	1. Power cycle the Ion OneTouch™ Dx Instrument using the On/Off switch. 2. Repeat run preparation, then the run, being careful to seat the TMPL Emulsion Cartridge as described. If the problem persists, contact Technical Support (see Appendix F, "Customer and technical support").
Large air gap (1 mL or greater) is present in the reaction cup	• Reagent tube not filled with TMPL Oil to start the run • Problem with the instrument	Repeat run preparation, then the run, being careful to follow all steps as described. If the problem persists, contact Technical Support (see Appendix F, "Customer and technical support").
Emulsion is detected in the TMPL Amplification Plate after completion of the Ion OneTouch™ Dx Instrument run	• Reagent tube not filled with oil to start the run • Improper installation of the consumables • Problem with the instrument	1. Ensure the consumables are installed correctly and not defective. 2. Power cycle the Ion OneTouch™ Dx Instrument using the On/Off switch. 3. Repeat run preparation, then the run, being careful to follow all steps as described. If the problem persists, contact Technical Support (see Appendix F, "Customer and technical support").
Inappropriate volumes of TMPL Oil and TMPL Recovery Solution are left after completion of the Ion OneTouch™ Dx Instrument run	Incorrect volumes of TMPL Oil and TMPL Recovery Solution used to start	Repeat the run, carefully check all volumes during run setup.
	• Improper installation of the consumables • Instrument issue	1. Ensure the consumables are installed correctly and not defective. 2. Power cycle the Ion OneTouch™ Dx Instrument using the On/Off switch. 3. Repeat run preparation, then the run, being careful to follow all steps as described. If the problem persists, contact Technical Support (see Appendix F, "Customer and technical support").
Centrifuge makes a loud sound during centrifugation	There is an obstruction in the centrifuge chassis	Turn off the instrument, then contact Technical Support (see Appendix F, "Customer and technical support").

Observation	Possible cause	Recommended action
Centrifuge lid does not open	• Power failure • Software crash	1. Slide a 1/8-inch L-wrench (hex wrench) or equivalent tool into the right-hand hole at the top edge of the centrifuge hinge:  2. Press tool into the hole until there is a slight compression of the tool against the instrument and the centrifuge lid unlocks and opens. 3. Remove the tool from the hole, then open the lid. Do *not* force the lid open. If the problem persists, Contact Technical Support (see Appendix F, "Customer and technical support").
Centrifuge does not spin	Ion OneTouch™ Dx Instrument centrifuge lid was not closed properly **Note:** Centrifuge will not operate unless the lid is fully closed.	1. Open and properly close the centrifuge lid, then press **re-spin**. 2. After re-spin completes, power cycle the Ion OneTouch™ Dx Instrument using the On/Off switch. 3. Repeat run preparation, then the run, beginning with your pooled library sample. Be careful to properly close the centrifuge lid. If the problem persists, contact Technical Support (see Appendix F, "Customer and technical support").
	Instrument failure (fuse, motor driver board, and/or interlock switch failures)	Confirm that the centrifuge is not operating. On the touchscreen press **Options**, then press **respin**. • If the centrifuge does not begin to spin, contact Technical Support (see Appendix F, "Customer and technical support"). • If the centrifuge begins to spin. After re-spin completes: a. Power cycle the Ion OneTouch™ Dx Instrument using the On/Off switch. b. Repeat run preparation, then the run, beginning with your pooled library sample. Be careful to properly close the centrifuge lid.

Ion OneTouch™ ES Dx Instrument

Observation	Possible cause	Recommended action
Final sample volume is <200 uL	Loose or cracked tip or loose tip fitting on the Ion OneTouch™ ES Dx Instrument Tip Arm	Tighten the tip and tip fitting. If the tip is cracked, replace it.
	Improper calibration	Perform a residual volume check; if the residual volume check fails, perform calibration (see "Calibrate the Ion OneTouch™ ES Dx Instrument" on page 63). If the problem persists, contact Technical Support (see Appendix F, "Customer and technical support").
Excessive foaming	Improperly calibrated or inadequate volume in one or more wells of the TMPL ES Strip Tube	Use recommended volumes for all wells. Perform a residual volume check; if the residual volume check fails, perform calibration (see "Calibrate the Ion OneTouch™ ES Dx Instrument" on page 63). If the problem persists, contact Technical Support (see Appendix F, "Customer and technical support").
	Loose or cracked tip, or loose tip fitting on the Ion OneTouch™ ES Dx Instrument Tip Arm	Tighten the tip and tip fitting. If the tip is cracked, replace it.
E4, E12, or E22 error displays when the Ion OneTouch™ ES Dx Instrument is initializing	• Fuse is installed incorrectly • Instrument is below operating temp • Bad program or calibration setting • Tip Arm is not moving	1. Ensure that the fuse module is installed correctly and that the unit is within its recommended operating temperature range of 68°F to 86°F (20°C to 30°C). 2. Reboot the instrument: Power OFF the instrument, wait 3 seconds, then power ON the instrument. 3. If the error persists, restore the factory defaults, then recalibrate the instrument (see"Calibrate the Ion OneTouch™ ES Dx Instrument" on page 63).
Solution overflow during a run	Overloaded reagent volumes in TMPL ES Strip Tube	Repeat enrichment with correct reagent volumes.
Tip is causing the 8-well strip to lift out of its slot during run	Tip is not aligned vertically	Try tightening the tip. If the problem persists, perform vertical axis calibration (see "Vertical axis calibration" on page 63).
Strip lifts up during strip push	Instrument is not calibrated properly	Perform horizontal position calibration.
Strip lifts up when tip is raised from well	Instrument is not calibrated properly	Perform vertical calibration.
Immediately after strip push, the strip is not in contact with the magnet	Instrument is not calibrated properly	Perform horizontal position calibration.

Observation	Possible cause	Recommended action
Tip grinds into the base of the instrument and Code "1999" displays	• Vertical calibration setting too low or out of range • Instrument is not calibrated properly	1. Erase the memory on the instrument: Hold down the vertical-adjust button while powering ON the instrument. The instrument beeps several times. 2. Perform a residual volume test. 3. Recalibrate the instrument if residual volume check failed.
Tip is hitting the top of tray at start of run	• Instrument tray or tip is not properly seated in the instrument • Tip adapter is loose	1. Check for debris between the tray and the instrument, then reinstall the tray and tip. 2. Check the tip adapter to make sure it is tight.
Error displays	Various	1. Power the instrument OFF then ON. 2. If the error continues to display, erase the memory on the instrument. Hold down the vertical adjust button while powering ON the instrument. The instrument beeps several times. 3. Perform residual volume check. 4. Recalibrate the instrument if the residual volume check failed.
Instrument does not aspirate or dispense liquids	Loose fittings	• Ensure that the connections at the elbow on the Tip Arm and at the tubing on the rear syringe pump are finger-tight. • Ensure that the metal tip adapter fitting on the Tip Arm is finger-tight. **IMPORTANT!** After any changes to the metal tip adapter, perform a remaining volume test, and recalibrate the instrument.
Ion OneTouch™ ES Dx Instrument has a blown fuse	Various	Contact Technical Support (see Appendix F, "Customer and technical support").

B Supplemental procedures and instruments

Fuse replacement on the Ion OneTouch™ ES Dx Instrument

IMPORTANT! The Ion OneTouch™ ES Dx Instrument is supplied with a Fuse Module and two different types of spare fuses, which should only be replaced by trained field service engineers. The Fuse Module is installed by the field service engineer into the Power Entry Module located on the back of the instrument in the proper orientation for the voltage in your area. If you are not sure of the setting that is right for your area, contact your local power company.

Line voltage	Replacement fuse type required
110/120 VAC	375 mA TT (Slow Blow) 1/4″ × 1--1/4″
220/240 VAC	160 mA TT (Slow Blow) 5 × 20 mm

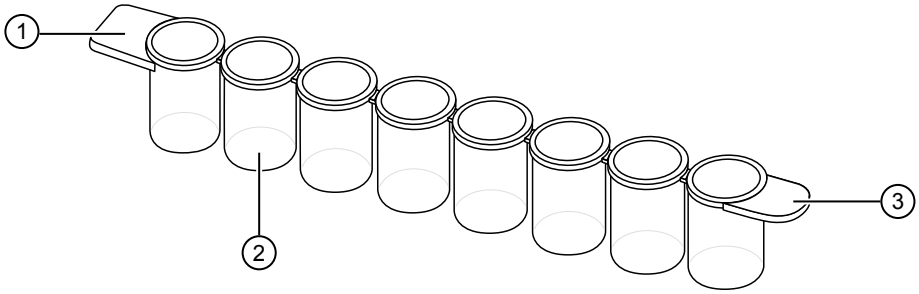
WARNING! ELECTRICAL SHOCK HAZARD. Severe electrical shock, which could cause physical injury or death, can result from working on an instrument when the high voltage power supply is operating. To avoid electrical shock, disconnect the power supply to the instrument, unplug the power cord, and wait at least 1 minute before working on the instrument.

Ion OneTouch™ ES Dx Instrument residual volume test

1. Install a new tip on the Ion OneTouch™ ES Dx Instrument Tip Arm.

   Note: For the residual volume test, you do not need to put a 0.2-mL sample collection tube in the Tip Loader.

2. Load 80 µL water or TMPL Wash Solution into the second well (Well 2) from the square-tab end of the 8-well strip:



① Square tab
② Second well
③ Round tab

3. Load the 8-well strip into the right end of the slot on the Ion OneTouch™ ES Dx Instrument tray so that the square tab is on the left and the rounded tab is on the right.

IMPORTANT! Before proceeding, carefully read and familiarize yourself with the following steps, which require you to manually start and stop the test run and manipulate the strip tube during the run. During the test, confirm that the tip is centered in the wells when moving in or out of a well.

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4. Turn the instrument ON.

5. Wait for the instrument to initialize. The screen displays "rdy". The Tip Arm performs a series of movements and returns to the home position (~5 seconds).

6. Press **Start/Stop**.

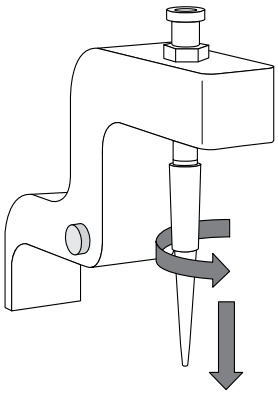
7. Wait for the instrument to aspirate the solution from Well 2 and completely remove the tip from Well 2, then *manually* push the 8-well strip to the left so that Well 4 is positioned directly under the Tip Arm.

8. Wait for the instrument to dispense the tip contents into Well 4.

9. Press **Start/Stop** to stop the test run, then press **Start/Stop** again to return the Tip Arm to the home position.

10. Using a P10 pipette, aspirate the entire residual volume from Well 2, then estimate the residual volume.

11. Remove the used tip: with the Tip Arm in its cradle and while standing above the Tip Arm, twist the tip *counterclockwise* and pull it downward to remove and discard the tip.



IMPORTANT! Improper removal of tips can loosen the metal tip adapter fitting on the Tip Arm and affect instrument operation.

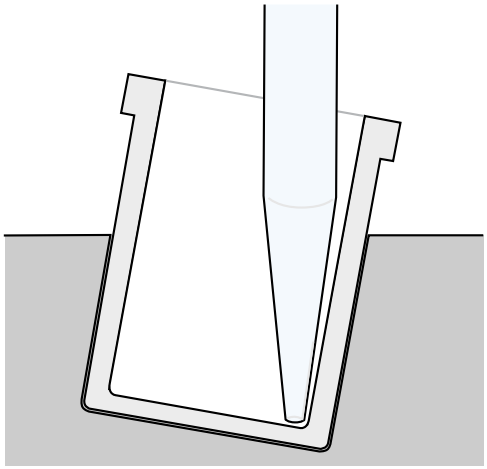
12. Remove and discard the used 8-well strip.

13. After performing the residual volume test, take one or more of the following actions:

Observation	Pass/Fail	Possible cause	Recommended actions
Residual volume in Well 2 is ≤5 µL	Pass	—	—
Residual volume in Well 2 is >5 µL **IMPORTANT!** The volume is measured from the *bottom* of the well, not from the sides.	Fail	The tip height is too high during aspiration.	Calibrate the instrument (see "Calibrate the Ion OneTouch™ ES Dx Instrument" on page 63).
The 8-well strip lifts as the tip rises to the top of the well	Fail	The tip is angled too far forward or the tip height is set too low.	Verify that the tip is vertical and positioned directly over the notch in the calibration shelf. If the tip is positioned correctly, restore defaults, then calibrate the instrument (see "Calibrate the Ion OneTouch™ ES Dx Instrument" on page 63).

Calibrate the Ion OneTouch™ ES Dx Instrument

Perform horizontal and vertical calibrations so that during operation the tip is optimally positioned in the well of the 8-well strip:



Note that the 8-well strip is always tilted at a fixed 10-degree angle in the slot. The pipette tip is vertical. When the tip is aligned properly during calibration so that it is in line with the notch in the calibration shelf, the tip touches the front-bottom edge of the well during the run.

IMPORTANT! If you use more than one Ion OneTouch™ ES Dx Instrument, do not switch Trays or Tip Arms between instruments. Each Tray and Tip Arm is calibrated with a particular instrument. To track the Tray and Tip Arm, each component has a printed label with the matching serial number of the instrument.

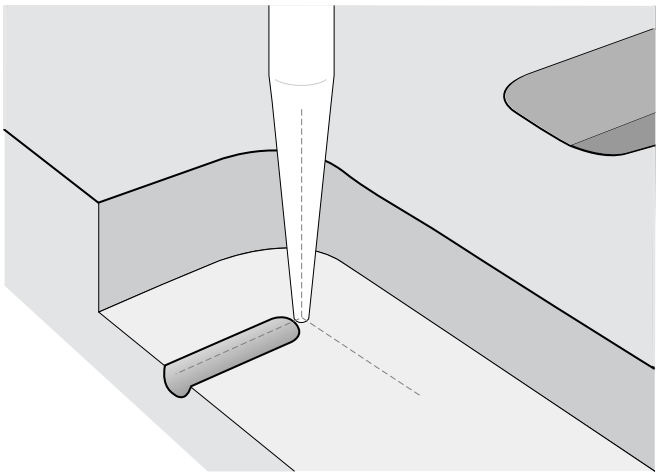
Vertical axis calibration

1. Install a new tip.
2. Restore the factory default settings:
   a. Power OFF the instrument, then wait 3 seconds.
   b. While holding down **Vert. Adjust**, power ON the instrument.
3. Put the instrument into calibration mode:
   a. Power OFF the instrument.
   b. While holding down **Select/Calibrate**, power the instrument ON. Keep holding down **Select/Calibrate** until "P1" is displayed.
   c. Press **Select/Calibrate** for ~3 seconds until the instrument beeps 2 times and "CAL" is displayed.

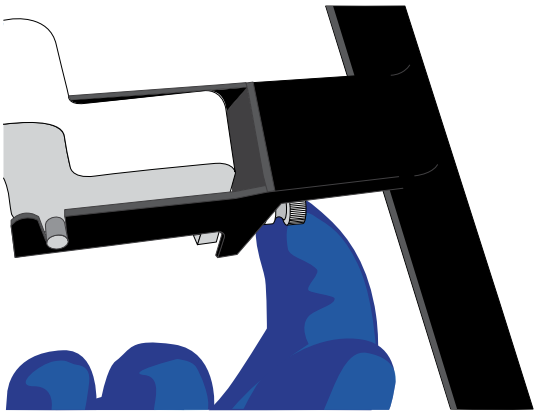
      Note: The instrument will cycle through several values before "CAL" is displayed.
4. Press **Vert. Adjust**. The instrument displays "ASP" (Aspirate or z-bottom position).

5. Press **Start/Stop**. The Tip Arm lowers to bring the tip near the notch in the calibration shelf on the left side of the Tray.

6. The tip should be positioned in line with the slot in the calibration shelf, and the tip should be touching the shelf. If necessary, adjust the tip as follows:



   a. To adjust the alignment of the tip with the slot, turn the thumbscrew at the back of the Tip Arm.



   b. To adjust the height of the tip, press the ▼ (minus) button repeatedly until the tip touches the shelf. Press the button eight more times to lower the tip further. This will account for variations in tip lengths and installation.

   Note: It is better to have the ASP (aspiration) height be too low than too high.

7. Press **Start/Stop**, then wait for the Tip Arm to stop moving and for "P1" to display.

Horizontal axis calibration

1. Press **Select/Calibrate** for ~3 seconds until the instrument beeps 2 times and “CAL” is displayed.

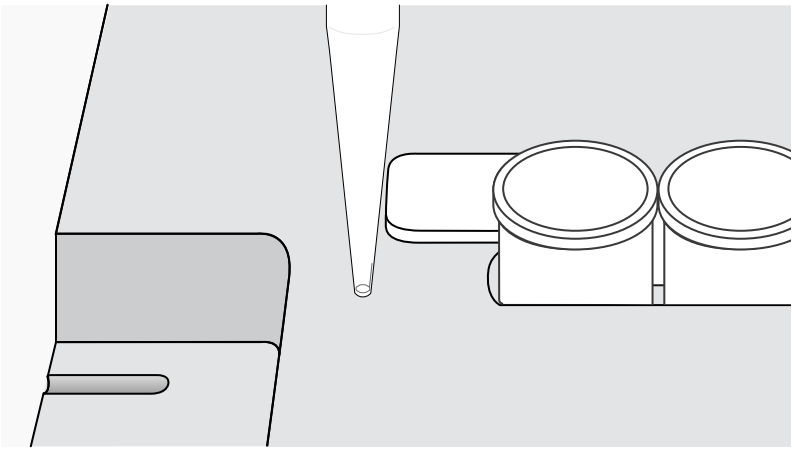
   Note: While you press the button, the instrument cycles through several values before “CAL” is displayed.

2. Press **Horiz. Adjust**. The instrument displays "FLA". Press **Start/Stop**.

3. Place an empty 8-well strip in the slot in the Tray, with the square tab on the left.

4. Push the 8-well strip as far to the left in the slot as possible.

5. Observe the position of the 8-well strip relative to the position of the tip. When properly calibrated, the 8-well strip is within 1 mm of touching the tip, but not pushing on it. To clearly see the relationship between the pipette tip, calibration shelf, and notch during calibration, mark each of them with a felt-tip pen:



6. Adjust the horizontal position of the Tip Arm so that the tip just touches the square tab on the left of the 8-well strip when the 8-well strip is pushed to the far left of the slot in the Tray*:*
   a. Apply slight pressure to keep the 8-well strip to the far left.
   b. Press the (plus) button repeatedly until the tip touches the 8-well strip. Each press of the (plus) key moves the Tip Arm to the *right* by ~0.002 inches (~50 µm), which may be difficult to detect.

7. Press **Start/Stop** to save the setting, then wait for "P1" to display.

8. Power the instrument OFF, wait >3 seconds, then power the instrument ON to return to normal operating mode.

9. Perform a residual volume test (see "Ion OneTouch™ ES Dx Instrument residual volume test" on page 60).

Removal of instruments from use for repair or disposal

To remove the Ion OneTouch™ Dx Instrument or Ion OneTouch™ ES Dx Instrument from use for repair or disposal, perform the following steps:

IMPORTANT! This procedure does not guarantee total decontamination of the Ion OneTouch™ Dx Instrument or Ion OneTouch™ ES Dx Instrument.

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1. Wear disposable gloves, safety glasses, and a lab coat.
2. Use a cleaning pad wetted with a solution of 1 part chlorine bleach in 9 parts water (10% bleach solution) to clean all outside surfaces of the Ion OneTouch™ Dx Instrument or Ion OneTouch™ ES Dx Instrument. Use care to avoid getting bleach solution inside the chassis.
3. Dry the surfaces of the instrument with paper towels or other disposable wipes.
4. Use cotton swabs to clean and dry areas that are difficult to access.
5. Properly dispose of all used consumables (including tubes, sippers, amplification plates) and cleaning materials to ensure that no one becomes exposed to contaminants.

If returning the instrument, contact your local Thermo Fisher Scientific representative to schedule a pickup of the instrument.

C

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, etc). To obtain SDSs, see the "Documentation and Support" section in this document.

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 adequate ventilation (for example, fume hood).
- Check regularly for chemical leaks or spills. If a leak or spill occurs, follow the manufacturer's 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 necessary) 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.

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 Consult the manual for further safety information.	Attention, risque de danger Consulter le manuel pour d'autres renseignements de sécurité.
⚠	Caution, risk of electrical shock	Attention, risque de choc électrique
⚠	Caution, piercing hazard	Attention, danger de perforation
⚠	Caution, hot surface	Attention, surface chaude
⚠	Potential biohazard	Danger biologique potentiel
I	On	On (marche)
O	Off	Off (arrêt)
⏚	Earth (ground) terminal	Borne de (mise à la) terre
⏚	Protective conductor terminal (main ground)	Borne de conducteur de protection (mise à la terre principale)
~	Terminal that can receive or supply alternating current or voltage	Borne pouvant recevoir ou envoyer une tension ou un courant de type alternatif

Symbol	English	Français
	Do not dispose of this product in unsorted municipal waste **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. **CAUTION!** 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 on the instrument

Conformity mark	Description
	Indicates conformity with safety requirements for Canada and U.S.A.
	Indicates conformity with European Union requirements for safety and electromagnetic compatibility.
	Indicates conformity with Australian standards for electromagnetic compatibility.

Medical device symbols

The following table describes symbols that may be displayed on instruments, consumables, or reagents. The symbols used on labels conform to standard BS EN ISO 15223-1:2012 and FDA guidance "Use of Symbols on Labels and in Labeling of In Vitro Diagnostic Devices Intended for Professional Use".

Symbol	Description	Symbol	Description
	MANUFACTURER		CONTAINS SUFFICIENT FOR <n> TESTS
	DATE OF MANUFACTURE		USE BY

Symbol	Description	Symbol	Description
LOT	BATCH CODE	REF	CATALOG NUMBER
SN	SERIAL NUMBER		FRAGILE, HANDLE WITH CARE
	LOWER LIMIT OF TEMPERATURE		PROTECT FROM LIGHT
	UPPER AND LOWER LIMITS OF TEMPERATURE		UPPER LIMIT OF TEMPERATURE
	DO NOT REUSE		BIOLOGICAL RISKS
	CAUTION, CONSULT ACCOMPANYING DOCUMENTS		CONSULT INSTRUCTIONS FOR USE
	UPPER AND LOWER LIMITS OF HUMIDITY		OBSERVE PRECAUTIONS FOR HANDLING ELECTROSTATIC SENSITIVE DEVICES
IVD	IN VITRO DIAGNOSTIC MEDICAL DEVICE		

Safety alerts on this instrument

Additional text may be used with one of the symbols described above when more specific information is needed to avoid exposure to a hazard. See the following table for safety alerts found on the instrument.

English	French translation
CAUTION! Hazardous chemicals. Read the Safety Data Sheets (SDSs) before handling.	**ATTENTION! Produits chimiques dangereux.** Lire les fiches signalétiques (FS) avant de manipuler les produits.
CAUTION! Hazardous waste. Refer to SDS(s) and local regulations for handling and disposal.	**ATTENTION! Déchets dangereux.** Lire les fiches signalétiques (FS) et la réglementation locale associées à la manipulation et à l'élimination des déchets.

Safety information for third-party instruments

Refer to the manufacturer's documentation for information on the safe use of third-party products provided with the instrument system.

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

CAUTION! ROTATION HAZARD. Wait until rotation stops before opening. Rotating parts can cause injury

Electrical

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! 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 specified in the manufacturer's user documentation. It is the responsibility of the operator (or other responsible person) to ensure the following requirements are met:

- No decontamination or cleaning agents are used that could cause a HAZARD as a result of a reaction with parts of the equipment or with material contained in the equipment.
- The instrument is properly decontaminated a) if hazardous material is spilled onto or into the equipment, and/or b) prior to having the instrument serviced at your facility or sending the instrument for repair, maintenance, trade-in, disposal, or termination of a loan (decontamination forms may be requested from customer service).
- Before using any cleaning or decontamination methods (except those recommended by the manufacturer), users should confirm with the manufacturer that the proposed method will not damage the equipment.

Laser

CAUTION! LASER HAZARD, Bar Code Scanner. The bar code scanner included with the instrument system is a Class 2 laser. To avoid damage to eyes, do not stare directly into the beam or point into another person's eyes.

Safety and electromagnetic compatibility (EMC) standards

The instrument design and manufacture complies with the standards and requirements for safety and electromagnetic compatibility as noted in the following table:

Safety

Reference	Description
Directive 2006/95/EC	*European Union "Low Voltage Directive"*
IEC 61010-1 EN 61010-1 CSA C22.2 61010-1	*Safety requirements for electrical equipment for measurement, control, and laboratory use*
IEC 61010-2-010 EN 61010-2-010 CSA C22.2 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 61010-2-020 EN 61010-2-020 CSA C22.2 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 EN 61010-2-081 CSA C22.2 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*
IEC 61010-2-101	*Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use — Part 2-101: Particular Requirements for In Vitro Diagnostic (IVD) Medical Equipment*

EMC

Reference	Description
Directive 2004/108/EC	European Union "EMC Directive"
EN 61326-1	*Electrical Equipment for Measurement, Control and Laboratory Use – EMC Requirements – Part 1: General Requirements*
EN 61326-2-6	*Electrical Equipment for Measurement, Control and Laboratory Use – EMC Requirements – Part 26: Particular requirements – In vitro diagnostic (IVD) medical equipment)requirements*
FCC Part 15	U.S. Standard "Industrial, Scientific, and Medical Equipment"
AS/NZS CISPR 22:2009	*Limits and Methods of Measurement of Electromagnetic Disturbance Characteristics of Industrial, Scientific, and Medical (ISM) Radiofrequency Equipment*
ICES-003, Issue 5	*Industrial, Scientific and Medical (ISM) Radio Frequency Generators*

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

Precaution—strong magnet

Note: Do not substitute non-IVD labeled magnets for the DynaMag™ Dx 96-Well Plate Magnet and DynaMag™ Dx 16 2-mL Magnet, provided with Ion PGM™ Dx System.

The DynaMag™ Dx 96-Well Plate Magnet and DynaMag™ Dx 16 2-mL Magnet contain very strong permanent magnets. People wearing a pacemaker or any other medical magnetized implant should not use this product unless advised by a health professional; the implant could be affected or damaged by exposure to a strong magnetic field. Keep tools and objects that could be damaged by the magnetic field out of the working area. This includes, but is not restricted to, credit cards and other products containing magnetic recording devices. Keep away from delicate instruments, watches, electronic equipment, displays and monitors. The magnet may attract steel or other magnetic material with high mechanical forces. Take care during handling. Avoid contact between two magnets. Do not pull the magnets apart if contact has been made; twist off to prevent damage to the unit or fingers. The Health and Safety Officer should take all necessary steps and full responsibility to ensure that the precautions and statements are followed and adhered to.

D Performance characteristics

For performance characteristics of the Oncomine™ Dx Target Test Kit, see the *Oncomine™ Dx Target Test Part V: Analysis and Test Reports User Guide* (Pub. No. MAN0016171).

For performance characteristics of the Ion PGM™ Dx System, see Appendix B of the *Ion PGM™ Dx System User Guide* (Pub. No. MAN0016694) and the *Ion PGM™ Dx System Performance Characteristics User Guide* (Pub. No. MAN0016697).

E Instrument warranty

For new Ion Torrent™ instruments, Life Technologies warrants to and only to buyer for twelve (12) months from the date of shipping, that the Ion Torrent™ software and Ion Torrent™ instruments are free from defects in material and workmanship and conform to Life Technologies' published specifications in all material respects. Where a valid and timely claim in respect of breach of Ion Torrent™ warranty is submitted to Life Technologies, Life Technologies may, at its discretion, replace, repair or modify the Ion Torrent™ instrument. Any agreed replacement shall be at 1:1, like-kind basis, at no cost to the buyer. For Ion Torrent™ chips or reagents reasonably determined by Life Technologies to be defective, independent of user error, shall be replaced by Life Technologies on a 1:1, like-kind basis at no cost to buyer, provided that such defective Ion Torrent™ chips or reagents were used by buyer prior to their expiration date, or if there is no expiration date, the Ion Torrent™ chips or reagents were used within six (6) months of receipt, and the defect was promptly reported with appropriate detail to Life Technologies' technical support.

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F Customer and technical support

Visit **thermofisher.com/support** for the latest in services and support, including:

- Worldwide contact telephone numbers
- Product support
- Order and web support
- Safety Data Sheets (SDSs; also known as MSDSs)

Additional product documentation, including user guides and Certificates of Analysis, are available by contacting Customer Support.

Obtaining Certificates of Analysis

The Certificate of Analysis provides detailed quality control and product qualification information for each product. Certificates of Analysis are printed and shipped with the product.

Obtaining Certificates of Conformance

The Certificate of Conformance provides information on conformance testing of each instrument provided with the system. Certificates of Conformance are shipped with the instrument, and are also available by contacting Customer Support at **thermofisher.com/support**.

iontorrent
by Thermo Fisher Scientific

Oncomine™ Dx Target Test Part IV: Sequencing

USER GUIDE

Publication Number MAN0016170

Revision B.0

IVD

For In Vitro Diagnostic Use.

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Products manufactured in Singapore:

Ion PGM™ Dx Instrument System
Ion PGM™ Dx Sequencer
Ion OneTouch™ Dx Instrument
Ion OneTouch™ ES Dx Instrument
Ion PGM™ Dx Chip Minifuge (120V)
Ion PGM™ Wireless Scanner
Ion Torrent™ Server
Veriti™ Dx Thermal Cycler

Life Technologies Corporation |
7335 Executive Way |
Frederick, MD 21704 | USA

Products manufactured in Frederick:

Oncomine™ Dx Target Test Kit
Ion Torrent Dx FFPE Sample Preparation Kit
Ion PGM™ Dx Library Kit
Ion OneTouch™ Dx Template Kit
Ion PGM™ Dx Sequencing Kit
Ion 318™ Dx Chip
Ion OneTouch™ Rack Kit
DynaMag™ Dx 96-Well Plate Magnet
DynaMag™ Dx 16 2-mL Magnet

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

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About this guide

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

Purpose of this guide

This user guide provides instructions for sequencing enriched, template-positive Ion PGM™ Dx Ion Sphere™ Particles (ISPs) that have been prepared from Oncomine™ Dx Target Test libraries. Sequencing is performed using the Ion PGM™ Dx System with the Ion PGM™ Dx Sequencing Kit and the Ion 318™ Dx Chip.

Oncomine™ Dx Target Test Kit user guides

This user guide is part of a five-guide set.

Note: The procedures in these guides supersede the instructions in the *Ion PGM™ Dx System User Guide* when using the Ion PGM™ Dx System with the Oncomine™ Dx Target Test.

- *Oncomine™ Dx Target Test Part I: Sample Preparation and Quantification User Guide*
- *Oncomine™ Dx Target Test Part II: Library Preparation User Guide*
- *Oncomine™ Dx Target Test Part III: Template Preparation User Guide*
- *Oncomine™ Dx Target Test Part IV: Sequencing User Guide*
- *Oncomine™ Dx Target Test Part V: Analysis and Test Reports User Guide*

All five guides are required to complete the entire Oncomine™ Dx Target Test workflow.

1 Product information

Product description

Oncomine™ Dx Target Test

The Oncomine™ Dx Target Test is an *in vitro* diagnostic next-generation sequencing test to detect somatic alterations in human DNA and RNA isolated from non-small cell lung cancer (NSCLC) tumor specimens in formalin-fixed, paraffin-embedded (FFPE) tissue samples. Detection of these variants is performed using the Ion PGM™ Dx System.

The Oncomine™ Dx Target Test Kit (Cat. No. A32451) provides a set of primers in two panels that target key regions of 23 cancer-related genes.

Sequencing components

The Ion PGM™ Dx Sequencing Kit, included as part of the Oncomine™ Dx Target Test Kit, is used to prepare template-positive Ion PGM™ Dx ISPs for 200 base-read sequencing on the Ion 318™ Dx Chip and Ion PGM™ Dx System.

Intended use

For the Intended Use statement for the Oncomine™ Dx Target Test, see the *Oncomine™ Dx Target Test Part I: Sample Preparation and Quantification User Guide* (Pub. No. MAN0016167).

Theory of operation

For a complete description of the Theory of Operation of the system, see the *Oncomine™ Dx Target Test Part I: Sample Preparation and Quantification User Guide* (Pub. No. MAN0016167).

Software compatibility and requirements

The procedures in this guide are designed for use with Torrent Suite™ Dx Software version 5.6 or later. To view the current software version, log in to the software as an Administrator, click on the **Settings (⚙)** tab, then select **Configuration** and click on the **Software Updates** tab. Version-specific information is provided in the software release notes for your version of the software.

Torrent Suite™ Dx Software is supported on Chrome™ browser version 39, and is best viewed with 1024 × 768 screen resolution. It has not been tested with other browsers.

The Ion Torrent™ Server operating system is Ubuntu™ 14.04 LTS.

Materials provided

Oncomine™ Dx Target Test Kit

The Oncomine™ Dx Target Test Kit (Cat. No. A32451) includes the following subkits.

IMPORTANT! Refer to the product label for the storage conditions and expiration dates of individual modules and components.

✓	Subkit	Part no.
	Oncomine™ Dx Target Test and Controls	A32447
	Ion Torrent Dx FFPE Sample Preparation Kit	A32445
	Ion PGM™ Dx Library Kit	A18975
	Ion OneTouch™ Dx Template Kit	A18976
	Ion PGM™ Dx Sequencing Kit	A18977
	Ion 318™ Dx Chip Kit	A18937
	Oncomine™ Dx Target Test User Guides and Assay Definition File	A32461

Subkits used in this guide

The procedures in this user guide use the following subkits from the Oncomine™ Dx Target Test Kit.

Ion PGM™ Dx Sequencing Kit

The Ion PGM™ Dx Sequencing Kit (Cat. No. A18977) includes the following modules and components, and is also included as a part of the Ion PGM™ Dx System consumables bundle (Cat. No. A25512):

✓	Component	Amount	Storage
Ion PGM™ Dx Sequencing Supplies (Part No. A18936)			
	SEQ Wash Bottle Sipper	8 long, 16 short	15°C to 30°C
	SEQ Reagent Tube Sipper	32	
	SEQ Reagent Tube plus label	32	
	SEQ Wash 1 Bottle (250-mL bottle)	1	
	SEQ Wash 2 Bottle (2-L bottle)	1	
	SEQ Wash 3 Bottle (250-mL bottle)	1	
Ion PGM™ Dx Sequencing Reagents (Part No. A18934)			
	SEQ dGTP (black cap)	2 × 40 µL	–30°C to –10°C
	SEQ dCTP (blue cap)	2 × 40 µL	
	SEQ dATP (green cap)	2 × 40 µL	

✓	Component	Amount	Storage
	SEQ dTTP (red cap)	2 × 40 µL	–30°C to –10°C
	SEQ Enzyme (yellow cap)	24 µL	
	SEQ Primer (white cap)	96 µL	
Ion PGM™ Dx Sequencing Solutions (Part No. A18935)			
	SEQ W2 Solution (white cap)	8 × 126.25 mL	2°C to 8°C (store SEQ W2 Solution bottles in the sealed plastic bag provided)
	SEQ Cleaning Tablet	8 tablets	
	SEQ Sample Buffer (brown cap)	160 µL	
	SEQ W3 Solution (white cap)	4 × 100 mL	

Ion 318™ Dx Chip Kit

The Ion 318™ Dx Chip Kit (Cat. No. A18937) includes the following components and is also included as a part of the Ion PGM™ Dx Consumables bundle (Cat. No. A25512):

✓	Component	Amount	Storage
	Ion 318™ Dx Chip	8	15°C to 30°C

Ion PGM™ Dx Instrument System

The Ion PGM™ Dx Instrument System (Cat. No. A25511) includes the following components, which are also sold separately.

✓	Component	Catalog no.
	Ion OneTouch™ Dx Instrument and accessories	A25483
	Ion OneTouch™ ES Dx Instrument and accessories	A25484
	Ion PGM™ Dx Sequencer and accessories	A25485
	Ion PGM™ Wireless Scanner	A25486
	Ion Torrent™ Server (software installed separately)	A28552
	Ion OneTouch™ Rack Kit • Ion OneTouch™ Solutions Rack • Ion OneTouch™ Assembly Rack • Ion OneTouch™ Sample Rack	A24694
	Ion PGM™ Dx Chip Minifuge: • 120 VAC • 230 VAC	 A25058 A25482

✓	Component	Catalog no.
	DynaMag™ Dx Kit—Tube & Plate • DynaMag™ Dx 96-Well Plate Magnet • DynaMag™ Dx 16 2-mL Magnet	A31755 A31347 A31346

Materials and equipment required but not provided

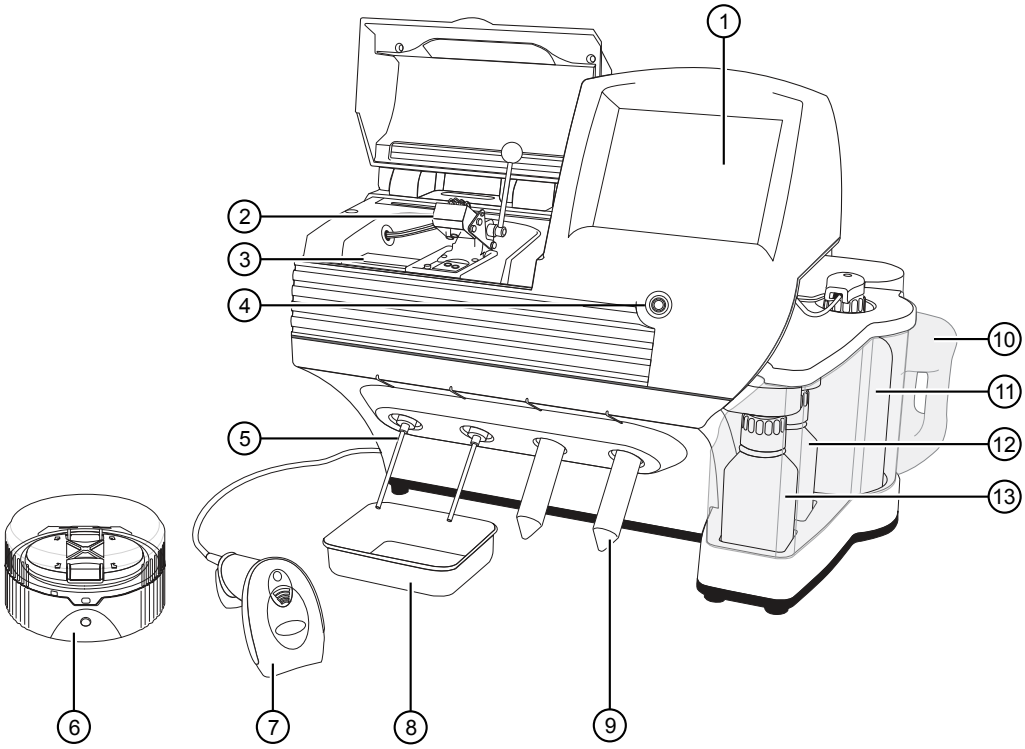
Unless otherwise indicated, all materials are available through **thermofisher.com**. MLS: Fisher Scientific (**fisherscientific.com**) or other major laboratory supplier.

✓	Description	Source
	Tank of compressed nitrogen (grade 4.8, 99.998% or better)	MLS
	Multistage (dual-stage) gas regulator (0-50 PSI, 2-3 Bar output)	VWR International 55850-422
	18-MΩ water purification system (see the following description)	MLS
	0.45-µm vacuum filtration system and filters (nylon or PVDF filters, 1 L vol.)	MLS
	Pipettes (2-, 20-, 200-, and 1000-µL)	MLS
	Aerosol-barrier pipette tips (10-, 20-, 200-, and 1000- µL)	MLS
	Vortexer with a rubber platform	MLS
	Mini centrifuge	MLS
	Microcentrifuge (must accommodate standard 1.5- and 0.2-mL tubes and generate 15,000 rcf)	MLS
	Veriti™ Dx 96-Well Thermal Cycler, 0.2 mL	4452300
	Graduated cylinders (1 L or 2 L volume)	MLS
	Glass bottle (1 L)	MLS
	15-mL conical tubes	MLS
	NaOH, ACS grade (10 M)	MLS
	Nuclease-free water	MLS
	Benchtop cold box	MLS

18-MΩ water purification system

The Ion PGM™ Dx Sequencer requires an 18-MΩ water purification system to prepare water for solutions used on the instrument. Such a system is essential to remove ions and organic carbons from the water that might interfere with the chip surface or sequencing enzyme. Water purchased from vendors or stored for any length of time is not acceptable.

Ion PGM™ Dx System with Reagent and Wash Bottles attached



1. Touchscreen
2. Chip clamp
3. Grounding plate
4. Power button
5. Reagent Tube Sipper
6. Ion PGM™ Dx Chip Minifuge
7. Barcode scanner
8. Collection tray
9. Reagent Tube
10. Waste Bottle
11. Wash 2 Bottle (W2 position)
12. Wash 3 Bottle (W3 position)
13. Wash 1 Bottle (W1 position)

2 Before you begin

Installation and special requirements

Special requirements

- The Torrent Suite™ Dx Software requires the use of Google™ Chrome™ browser.
- The Ion PGM™ Dx Sequencer requires the use of an 18-MΩ water purification system installed in the laboratory. Such a system is essential for ensuring that any ions or organic carbons that might interfere with the chip surface or sequencing enzyme are removed from the water immediately before use on the instrument. Water purchased from vendors or stored for any length of time is not acceptable.

Gas cylinders

You must supply the required nitrogen gas cylinder and accessories for the installation. This instrument requires a pressurized house line or one size 1-A nitrogen gas cylinder that holds approximately 7.2 m^3 (257 ft^3) of gas when full. Use only prepurified nitrogen of 99.998% (grade 4.8) or greater purity.

CAUTION! Damage to the instrument and its products can result from using impure gas, gases other than nitrogen, or an inadequate amount of gas.

WARNING! EXPLOSION HAZARD. Pressurized gas cylinders are potentially explosive. Always cap the gas cylinder when it is not in use, and attach it firmly to the wall or gas cylinder cart with approved brackets or chains.

WARNING! Gas cylinders are heavy and may topple over, potentially causing personal injury and tank damage. Cylinders should be firmly secured to a wall or work surface. Please contact your Environmental Health and Safety Coordinator for guidance on the proper installation of a gas cylinder.

Perform a leak test

To perform a leak test on the gas cylinder:

1. Open the main tank shutoff valve. The high-pressure gauge of the gas tank regulator reads approximately 2,000–2,500 psi for a full tank.
2. Adjust the pressure to the instrument by slowly turning the pressure adjustment valve clockwise until the low-pressure gauge reads 30 psi.
3. Close the needle valve, then close the main tank valve.

4. Monitor the high-pressure gauge of the gas tank regulator for 5 minutes. There should be no noticeable drop in pressure.

If the pressure	Action
Drops in 5 minutes	There can be a leak at either the needle valve or the gas tank regulator itself. Check the fittings and resolve any problems, then continue with step 5.
Does not drop in 5 minutes	The instrument passes the leak test. Reopen the main tank valve and skip the following steps.

5. Open the main tank valve and the needle valve for at least 15 seconds to pressurize the instrument.

6. Close the main tank valve.

7. Monitor the high-pressure gas tank regulator gauge. There should be no more than a 100-psi drop in pressure after 5 minutes. Locate, then resolve any leaks. Turn the main tank valve back on.

Electrical and environmental conditions

IMPORTANT! Protection provided by the equipment may be impaired if the instrument is operated outside the environment and use specifications, the user provides inadequate maintenance, or the equipment is used in a manner not specified by the manufacturer.

IMPORTANT! Observe current Good Clinical Laboratory Practices (GCLP) when using this instrument.

See the *Ion PGM™ Dx System Site Preparation Guide* (Pub. No. MAN0016696) for information about instrument location and setup. Instruments should be shielded from excess exposure to dust, vibration, strong magnetic fields, drafts, excessive moisture, or large temperature fluctuations. Surge protectors or line conditioners should be used if the voltage source is not stable. Sudden voltage spikes can cause damage to the electronics inside the instruments.

Ensure that the room where the instruments have been installed is maintained under correct environmental conditions. Avoid placing the instruments adjacent to heaters, cooling ducts, or in direct sunlight. Place the instruments at least a meter away from major sources of electronic noise, such as refrigerators or microwaves.

Electrical requirements

CAUTION! Do not unpack or plug in any components until a field service representative has configured them for the proper operating voltage.

WARNING! For safety, the power outlet used for powering the instrument must be accessible at all times. In case of emergency, you must be able to immediately disconnect the main power supply to all the equipment. Allow adequate space between the wall and the equipment so that the power cords can be disconnected in case of emergency.

- Electric receptacle required: 2-prong with ground pin
- Main AC line voltage tolerances must be at most ±10% percent of nominal voltage.
- Power cords are provided with the instruments. If not suitable for installation in your region, ensure any power cord you do use is:
  - Maximum 10 feet (3 meters) in length
  - Grounding type
  - Compatible with the power supply receptacles used to connect to main power
  - Suitable for the rating of the instrument and main power supply
  - Compliant with local safety requirements (for example, UL Listed for North America, JIS approved for Japan, HAR or agency certified for Europe)

- (Ion OneTouch™ Dx Instrument only) Fuse Rating: 6 A, 250 VAC, Type M. Replace only with the same fuse type and rating.

WARNING! FIRE HAZARD. For continued protection against the risk of fire, replace fuses only with fuses of the type and rating specified for the instrument.

Device	Rated voltage [1,2]	Rated frequency	Rated current [3]
Ion PGM™ Dx Sequencer	110/120VAC 220/240VAC	50/60 Hz	9 A
Ion Torrent™ Server [4]	110/120VAC 220/240VAC	50/60 Hz	11 A
Ion OneTouch™ Dx Instrument with power supply	110/120VAC 220/240VAC	50/60 Hz	5.5 A
Ion OneTouch™ ES Dx Instrument	110/120VAC 220/240VAC	50/60 Hz	375 mA 160 mA
Ion PGM™ Dx Chip Minifuge	120 VAC 220–240 VAC	50/60 Hz	130 mA 65 mA

[1] In Japan, rated voltages of 100 VAC and 200 VAC are acceptable.
[2] If the supplied power fluctuates beyond the rated voltage, a power line regulator may be required. High or low voltages can adversely affect the electronic components of the instrument.
[3] Based on rated current at minimum input voltage.
[4] Minimum Efficiency: 65% (Energy Star Qualified); 85% Efficient Power Supply.

Environmental requirements

Ensure that the room where the instruments have been installed is maintained under the correct environmental conditions. Avoid placing the instruments next to heaters, cooling ducts, or in direct sunlight. Place the sequencer at least a meter away from major sources of electronic noise, such as refrigerators or microwaves.

CAUTION! Use of the instruments in an unspecified manner may result in the protection provided by the instruments to be impaired.

Component	Acceptable range
Altitude	Between sea level and 2,000 meters (6,500 feet) above sea level
Humidity: operating	10–90% relative humidity
Humidity: transportation and storage	20–80% relative humidity

Component	Acceptable range
Temperature: operating	15–30°C (59–86°F) At or above 1,800 meters (5,906 feet), the system must not be used if the temperature is above 29.5°C.
Temperature: transportation and storage	–30°C to 60°C (–22°F to 140°F)
Vibration	Ensure that benches where instruments are to be installed are free of vibration and have no contact with equipment that causes vibration (freezers, pumps, and similar equipment). Vibration can reduce the quality of sequencing measurements.
Pollution	The system has a Pollution Degree rating of II (2). The system may only be installed in an environment that has nonconductive pollutants, such as dust particles or wood chips. Typical environments with a Pollution Degree II (2) rating are laboratories, sales, and commercial areas.
Overvoltage category	The instruments have an installation (overvoltage) category of II (2).
Other conditions	For indoor use only. Keep away from any vents that could expel particulate material on the system components.

Precautions before using the Ion PGM™ Dx System

For additional safety information, see Appendix C, "Safety".

Instrument installation by trained personnel only

IMPORTANT! The Ion PGM™ Dx System is installed by trained service personnel and must not be relocated without assistance from trained service personnel. See "Customer and technical support" on page 87.

Nucleic acid contamination

IMPORTANT! A primary source of contamination is DNA fragments from previously processed samples. Do not introduce amplified DNA into the library preparation laboratory or work area.

IMPORTANT! Possible contamination can occur during the transfer of dNTPs into Reagent Tubes. Be careful to avoid cross contamination of dNTP stocks. Barrier tips are required for all pipetting steps. Change gloves after handling concentrated dNTP stocks.

Reagent contamination

Before use, verify that any nuclease-free water used in the procedure is not cloudy, a potential indication of contamination. If the water is cloudy, use a different vial.

CO_2 contamination

IMPORTANT! Dry ice (solid CO_2) must be kept away from areas where buffers, wash solutions, or sources of molecular biology grade water for the Ion PGM™ Dx System are used. High air concentrations of subliming CO_2 may change the pH of such buffers during or after their preparation. The stability of the pH of these buffers is a critical factor in the performance of the Ion PGM™ Dx System.

Instrument vibration and clearances

IMPORTANT! Significant vibration during sequencing may add noise and reduce the quality of the measurements. The Ion PGM™ Dx Sequencer must be installed on a bench that is free from vibrations or in contact with equipment that can cause vibrations to the bench, such as freezers, pumps, large benchtop centrifuges, and other similar equipment. Mini and microcentrifuges may be used near the sequencer. An air table is not required, nor is securing the sequencer to the bench.

IMPORTANT! Position the Ion PGM™ Dx Sequencer so that the front bezel is a minimum of 12 in. (30.5 cm) and the Reagent Tubes containing dNTPs are a minimum of 8 in. (20.3 cm) from the front of the laboratory bench. Place the instrument at least 40 in. (1 meter) away from major sources of electronic noise such as refrigerators or microwaves.

Static electricity

IMPORTANT! To avoid possible damage to chips from static electricity, see "Guidelines for chip handling and use" on page 19.

Ventilation requirements

WARNING! Instrumentation must be installed and operated in a well-ventilated environment, defined as having a minimum airflow of 6–10 air changes per hour. Assess the need for ventilation or atmospheric monitoring to avoid asphyxiation accidents from inert gases and/or oxygen depletion, and take measures to clearly identify potentially hazardous areas through training or signage. Please contact your Environmental Health and Safety Coordinator to confirm that the instruments will be installed and operated in an environment with sufficient ventilation.

Procedural guidelines

Definitions

Throughout this guide:

- Room temperature is defined as the temperature range 15–30°C.
- A pulse centrifugation consists of a 3–5 second centrifugation at maximum speed in a mini centrifuge.

Guidelines to prevent cross-contamination

- Use good laboratory practices to minimize cross-contamination of products and reagents.
- When designing the laboratory layout, consider separating pre- and post-amplification activities. To significantly reduce the potential for contamination, dedicate laboratory supplies and/or equipment to the appropriate space.

Guidelines for pipetting

- Vortex all reagents *except* enzymes for ~5 seconds. Mix enzymes by flicking the tube with your finger 4 times. Briefly centrifuge to collect the contents before use.
- Ensure that all reagents are completely thawed at room temperature, such that no ice crystals are visible in the tube.
- Pipet viscous solutions slowly and ensure complete mixing.
- Change tips between pipetting steps.

Guidelines for chip handling and use

IMPORTANT! To avoid damage to Ion 318™ Dx Chips or the Ion PGM™ Dx Sequencer due to electrostatic discharge:

- **Remove your gloves when handling chips**, especially before transferring chips on or off the instrument. Follow the steps in the sequencing procedure for taking off and putting on gloves.
- **Hold chips by their edges when handling.**
- **Do not place chips directly on the bench or any other surface.** Always place chips either on the grounding plate on the Ion PGM™ Dx Sequencer or in the Ion PGM™ Dx Chip Minifuge bucket.

Note: Ion 318™ Dx Chips can be handled without gloves during all stages of chip preparation, loading, and sequencing without risk of contamination.

Used chips cannot be reused for sequencing. Used chips must be discarded or clearly marked for cleaning and initialization.

Guidelines for initializing the sequencer

- Handle the SEQ dGTP, SEQ dCTP, SEQ dATP, and SEQ dTTP tubes carefully to avoid cross-contamination. Always change gloves after removing used sippers from the Ion PGM™ Dx System to avoid cross-contamination of the nucleotides. Also change gloves after handling concentrated dNTP stocks.
- Replace the SEQ Reagent Tubes and sippers every time you initialize.
- After 8 sequencing runs, do not use the SEQ Wash 1 Bottle, SEQ Wash 2 Bottle, or SEQ Wash 3 Bottle for initialization or sequencing to avoid possible breakage or leaking. You can continue to use the SEQ Wash 1 Bottle and SEQ Wash 3 Bottle as extra cleaning bottles.

Guidelines for sequencing runs

- One or two sequencing runs may be performed from a single initialization based on the option selected when starting the initialization, but both runs must be started within 27 hours after the start of initialization.
- If you press the **Abort** button on the sequencer touchscreen, the touchscreen may freeze. You may need to restart the sequencer.

IMPORTANT! After aborting a run, do not open the chip clamp, reagent tubes, or wash bottles until a new run or cleaning is initiated. Doing so can cause a fluid or gas leak if the sequencer was in a pressurized state when the run was aborted. From the main menu, select either **Clean** or **Run**, then follow the touchscreen prompts to depressurize the system.

Reagent management

Follow the guidelines below for proper reagent storage and use.

Storage

Reagents must be stored under appropriate conditions. Refer to the Product Information section in each user guide for the storage conditions of the kit components used in the procedures in that guide. The Oncomine™ Dx Target Test Kit System includes kits with multiple component boxes that require different storage conditions. For example, the Oncomine™ Dx Target Test and Controls Kit is composed of four boxes: Oncomine™ Dx Target Test and Oncomine™ Dx Target DNA Control are stored at −30°C to −10°C, whereas the Oncomine™ Dx Target RNA Control and Ion Torrent Dx No Template Control Kit require storage at −90°C to −60°C and 15–30°C, respectively. To use the Oncomine™ Dx Target Test and Controls, retrieve all boxes from their different storage areas and confirm that they are from the same master lot.

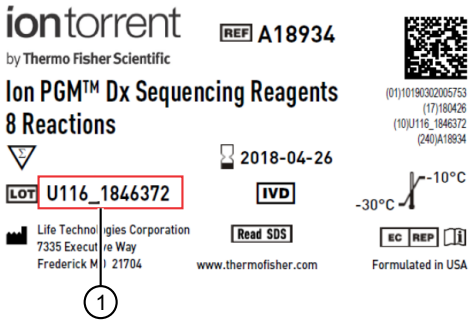
Kit and component matching

Each component box of the Oncomine™ Dx Target Test Kit lists the lot numbers of compatible component boxes on the inside of the box lid. Before use, confirm that the lot numbers of all boxes used in a sequencing run are compatible.

ATTENTION: This kit can only be used with the following lots:

REF		LOT
A18928	Ion PGM™ Dx Library Reagents	N117_1849183
A18929	Ion PGM™ Dx Library Equalizer	N117_1849184
A18930	Ion OneTouch™ Dx Template Reagents	N117_1849185
A18931	Ion OneTouch™ Dx Template ES Beads	N117_1849186
A18932	Ion OneTouch™ Dx Template Solutions	N117_1849187
A18933	Ion OneTouch™ Dx Template Supplies	N117_1849188
A18934	Ion PGM™ Dx Sequencing Reagents	N117_1849189
A18935	Ion PGM™ Dx Sequencing Solutions	N117_1849190
A18936	Ion PGM™ Dx Sequencing Supplies	N117_1849191
A32441	Oncomine™ Dx Target Test	1705001
A32442	Oncomine™ Dx Target DNA Control	R117_1867106
A32443	Oncomine™ Dx Target RNA Control	R117_1867107
A32444	Ion Torrent™ Dx No Template Control	R117_1867103

An example box label with lot information is shown below:



① Lot number

Instrument operation and maintenance

Service and maintenance

You will be alerted by the Ion PGM™ Dx System when annual maintenance service is required. A notification will appear on the instrument touchscreen and in the Torrent Suite™ Dx Software.

Shut down/restart the sequencer

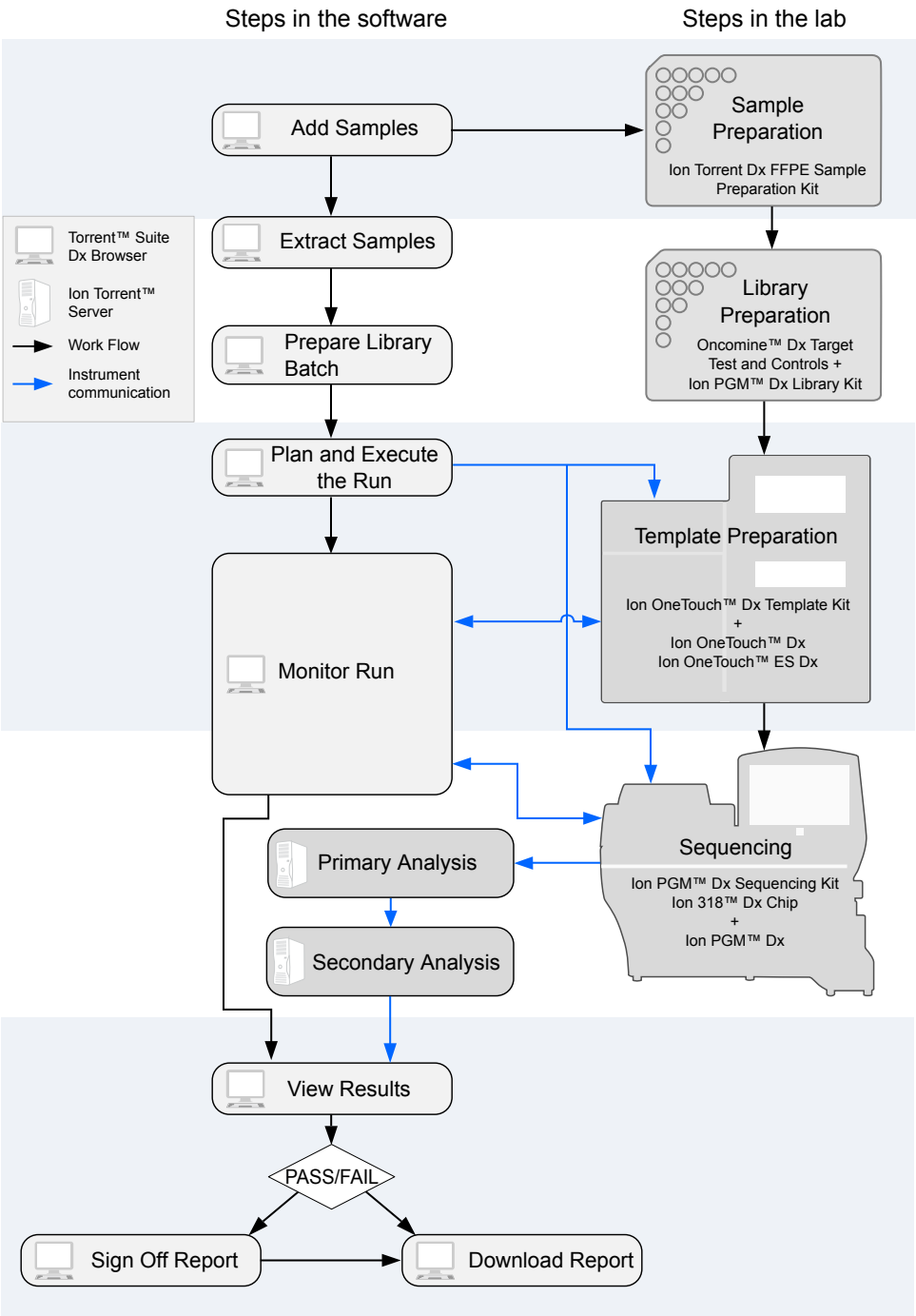
In general, the Ion PGM™ Dx Sequencer can remain on all the time, including overnight and over weekends. If shutdown is necessary, there are two methods, depending on the state of the instrument:

Type of shutdown	Typically used when	Method
Routine shutdown (Managers and Administrators only)	• The instrument will not be used for an extended period of time (>1-2 weeks). • The instrument needs to be moved or serviced.	1. Press the **Options** button on the main touchscreen and press **Shut Down**. 2. If the instrument will not be used for an extended period of time, select the **Cleaning** checkbox to perform a water clean first, then press **Shut Down**. Otherwise, just press **Shut Down**. 3. In the next screen, press the **Halt** button and then press **OK** to power down the instrument.
Forced shutdown	The instrument isn't responding normally (e.g, the touchscreen is frozen).	Hold down the power button below the touchscreen for ~5 seconds to power down the instrument.

To restart the sequencer:

- Hold down the power button below the touchscreen for ~5 seconds.

Oncomine™ Dx Target Test system diagram



Sequencing workflow

Note: Up to two sequencing runs may be performed from one initialization, if both runs are started within 27 hours after start of initialization.

Previous guide: *Oncomine™ Dx Target Test Part III: Template Preparation User Guide* (Pub. No. MAN0016169)

"Clean the Ion PGM™ System" on page 24

▼

"Initialize the sequencer" on page 31

▼

"Prepare enriched ISPs for sequencing" on page 39

▼

"Set up the sequencing run" on page 41

▼

"Load the sample on the chip" on page 44

▼

"Perform the run" on page 48

Proceed to: *Oncomine™ Dx Target Test Part V: Analysis and Test Reports User Guide* (Pub. No. MAN0016171)

3 Clean and initialize

Clean the Ion PGM™ System

Cleaning schedule

The Ion PGM™ Dx Sequencer requires cleaning with either 18 MΩ water or chlorite solution according to the following schedule.

Clean with:	Schedule:
18 MΩ water	The Ion PGM™ Dx Sequencer requires cleaning with 18 MΩ water when one of the following conditions is met: • The last water cleaning was completed more than 27 hours ago, and initialization was performed • If during the last initialization, the **One run per initialization** checkbox was selected, and one run was performed since the last water cleaning • If during the last initialization, the **Two runs per initialization** checkbox was selected, and two runs were performed since the last water cleaning
Chlorite solution	The Ion PGM™ Dx Sequencer requires cleaning with chlorite solution when one of the following conditions is met: • The last chlorite cleaning was completed more than 7 days ago, and one or more runs have been performed since that cleaning • The instrument has been left with reagent for more than 48 hours **Note:** If the Ion PGM™ Dx Sequencer will not be used for more than 3 days, a chlorite cleaning is strongly recommended within 48 hours after run completion.

Before you begin

Mark the cleaning bottles

Three 250-mL bottles are provided as part of instrument installation. Mark these bottles as described below and use them in the cleaning procedures.

Note: After you have used the 250-mL bottles provided in each sequencing kit for 8 runs, you can mark them as extra cleaning bottles.

- Write "Waste" on one 250-mL bottle, to be used for both water and chlorite washes.
- Write "Water" on one 250-mL bottle, to be used for water washes only.
- Write "Chlorite" on one 250-mL bottle, to be used for chlorite solution only.

Mark the cleaning chips

After a sequencing run, used chips can be marked for use in cleaning and initialization. (Chips cannot be reused for sequencing.) Mark used chips as described below.

- To designate a used chip for chlorite washes only, write "CL" on the corner. Do not use this chip for initialization.
- To designate a used chip for water washes and initialization, write "W" on the corner. Do not use this chip for chlorite washes.

Chip marked for chlorite wash only:

Chip marked for water wash/initialization:

Start the cleaning

The sequencer touchscreen will guide you through each step in the cleaning process. The touchscreen provides a brief summary of the steps, which are described below in more detail.

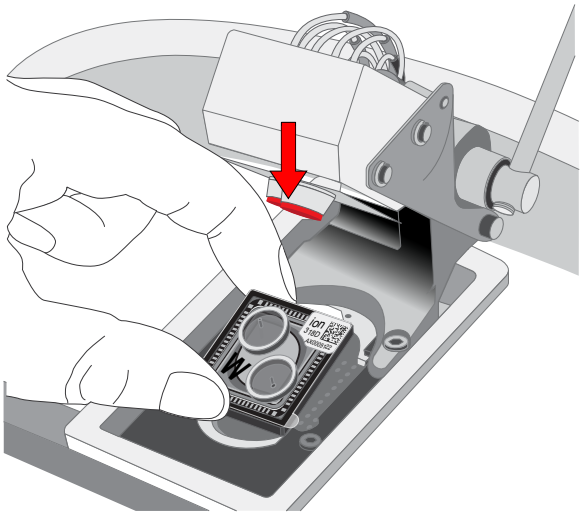
1. Log into the Ion PGM™ Dx Sequencer touchscreen.
2. On the main menu, press the **Clean** button.
   The instrument touchscreen will display the following:
   - **Last water clean: [YYYY-MM-DD] [hh]:[mm]:[ss]**
   - **Last chlorite clean: [YYYY-MM-DD] [hh]:[mm]:[ss]**
3. The type of cleaning required is selected by default (**18 MΩ water cleaning** or **Chlorite cleaning**). Press **Next**.

18-MΩ water cleaning

IMPORTANT! For all the following steps, use 18-MΩ water directly from the purification system. Do not use water that has been collected or stored in any other containers.

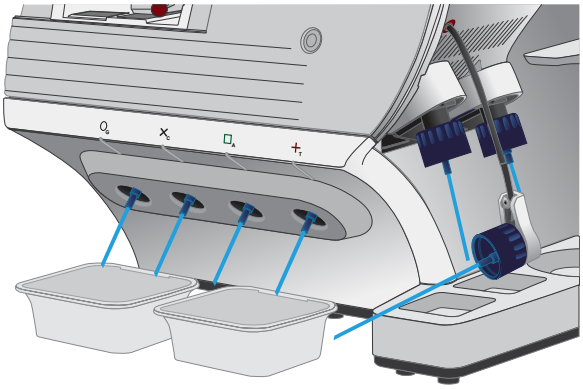
1. Touch the grounding plate on the Ion PGM™ Dx Sequencer with a bare finger, then use ungloved hands to insert the used chip marked "W" into the chip clamp.

   IMPORTANT! Confirm that both red rubber port gaskets are securely in place in the clamp. Loose or missing gaskets can result in a spill hazard and instrument damage.



2. Close the clamp, then press **Next** on the touchscreen.

3. Put on new gloves, then remove all wash bottles and reagent tubes attached to the instrument. Keep the sippers in place at all positions. Press **Next**.



4. Rinse the bottle marked "Water" twice with ~100 mL of 18-MΩ water. Press **Next**.

5. Fill the bottle marked "Water" with 250 mL of 18-MΩ water. Press **Next**.

6. Remove and rinse the W1 sipper with 18-MΩ water, then reattach the sipper. Press **Next**.

7. Attach the bottle marked "Water" to the W1 position, ensuring that the W1 cap is screwed on tightly. Press **Next**.

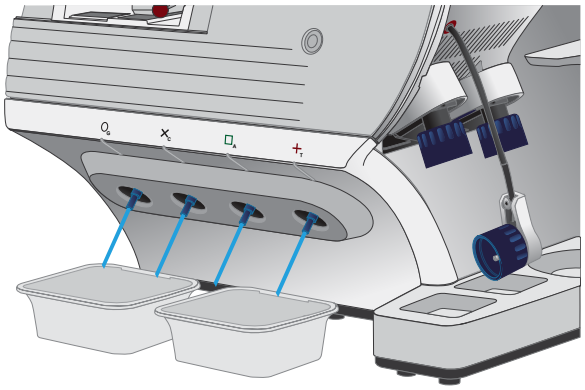
8. With the W3 sipper still in its cap, insert the sipper into the empty bottle marked "Waste". Do not screw on the cap. Insert the W2 sipper into the same bottle. Press **Next**.

9. Place collection trays below the reagent tube sippers in the dNTP positions.

   Note: To avoid spills, ensure that the collection trays are properly aligned to catch fluid flowing out from the sippers.

10. Press **Next** to begin cleaning.
    The cleaning will take ~15 minutes to complete.

11. When cleaning is complete, leave the reagent sippers and collection trays in place. Remove the bottles and sippers from the W1, W2, and W3 positions. Press **Next** to return to the main menu, then proceed to initialization.



Chlorite cleaning

Note: This procedure uses 1 M NaOH, diluted from 10 M NaOH each week using nuclease-free water. You can use the 1 M NaOH that was prepared during template preparation.

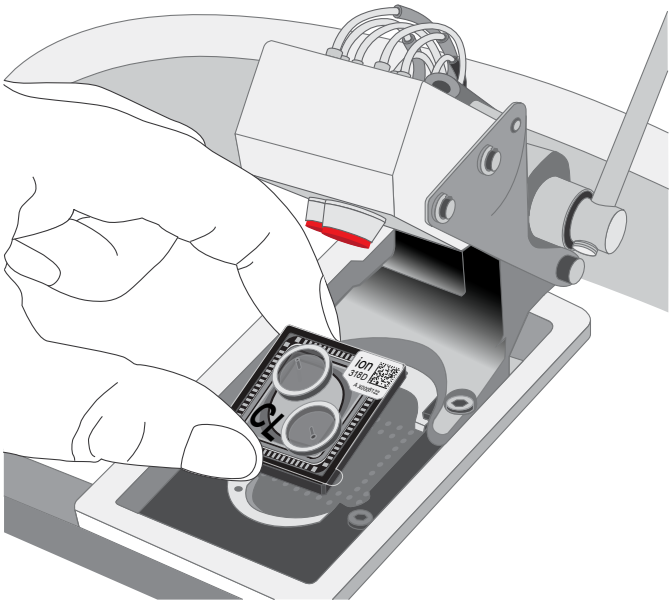
1. Fill a glass bottle with 1 L of 18-MΩ water, then add a SEQ Cleaning Tablet (chlorite tablet). Allow the tablet to completely dissolve (~10 minutes). Press **Next** on the touchscreen.

2. Add 1 mL of 1 M NaOH and filter the solution using a 0.22-µm or 0.45-µm filter. Press **Next**.

   Note: Use the chlorite solution within 2–3 hours. Discard the unused solution in an appropriate waste container after this time.

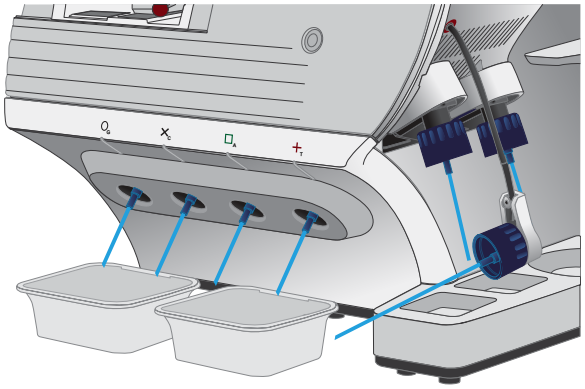
3. Touch the grounding plate on the Ion PGM™ Dx Sequencer with a bare finger, then use ungloved hands to insert the used chip marked "CL" into the chip clamp.

   IMPORTANT! Confirm that both red rubber port gaskets are securely in place in the clamp. Loose or missing gaskets can result in a spill hazard and instrument damage.



4. Close the clamp, then press **Next**.

5. Put on new gloves, then remove all wash bottles and reagent tubes that are attached to the instrument. Keep the sippers in place at all positions. Press **Next**.



6. Rinse the bottle marked "Chlorite" and the bottle marked "Water" twice each with ~150 mL of 18-MΩ water.

7. Add 250 mL of filtered chlorite solution to the bottle marked "Chlorite". Press **Next**.

8. Remove and rinse the sipper in the W1 position with 18-MΩ water, then reattach it to the instrument. Press **Next**.

9. Attach the bottle marked "Chlorite", containing the filtered chlorite solution, to the W1 position. Make sure that the W1 cap is tight. Press **Next**.

10. With the W3 sipper still in its cap, insert the tube into the empty bottle marked "Waste". Do not screw on the cap. Insert the W2 sipper into the same bottle. Press **Next**.

11. Place collection trays below the reagent tube sippers in the dNTP positions.

    Note: To avoid spills, ensure that the collection trays are properly aligned to catch fluid flowing out from the sippers.

12. Press **Next** to begin cleaning. The cleaning will take ~13 minutes to complete.

13. When prompted, remove the bottle marked "Chlorite" from the W1 position. Press **Next**.

14. Remove and rinse the W1 sipper with 18-MΩ water, then reattach the sipper. Press **Next**.

15. Fill the bottle marked "Water" with 250 mL of 18-MΩ water and attach the bottle in the W1 position. Make sure the cap is tight.

16. Press **Next**. The water rinse will take ~15 minutes to complete.

17. When cleaning is complete, leave the reagent sippers and collection trays in place. Remove the bottles and sippers from the W1, W2, and W3 positions. Press **Next** to return to the main menu.

18. Rinse the "Chlorite" and "Water" bottles twice each with ~150 mL of 18-MΩ water, then proceed to initialization.

Initialization

Initialization guidelines

- When performing one or two sequencing runs from the same initialization, the run(s) must be started within 27 hours after the start of initialization.
- Handle the SEQ dGTP, SEQ dCTP, SEQ dATP, and SEQ dTTP tubes carefully to avoid cross-contamination. Always change gloves after removing used sippers from the Ion PGM™ Dx System to avoid cross-contamination of the nucleotides. Also change gloves after handling concentrated dNTP stocks.
- Replace the SEQ Reagent Tubes and sippers every time you initialize.
- After eight sequencing runs, do not use the SEQ Wash 1 Bottle, SEQ Wash 2 Bottle, or SEQ Wash 3 Bottle for initialization or sequencing to avoid possible breakage or leaking. You can continue to use the SEQ Wash 1 Bottle and SEQ Wash 3 Bottle as extra cleaning bottles, as described in "Mark the cleaning bottles" on page 24.

Before initialization

Check the tank pressure for the nitrogen gas. When the tank pressure drops below 500 psi, change the tank (see also "Gas cylinders" on page 13).

Initialize the sequencer

The instrument touchscreen provides a summary of the steps in the initialization process, which are described below in more detail.

IMPORTANT! Do not remove the old sippers from the dNTP ports until instructed to do so. **Do not let the new sippers touch any surfaces.**

IMPORTANT! Load the bottles as quickly as possible to prevent atmospheric CO_2 from reducing the pH of the Wash 2 solution.

---

1. After cleaning is complete, the **Initialize** button on the touchscreen main menu will turn blue. Press the button to start the initialization process.

2. Depending on the number of sequencing runs per initialization, select either the **One 200 bp run per initialization** or the **Two 200 bp runs or One 400 bp run per initialization** checkbox. Press **Next**.

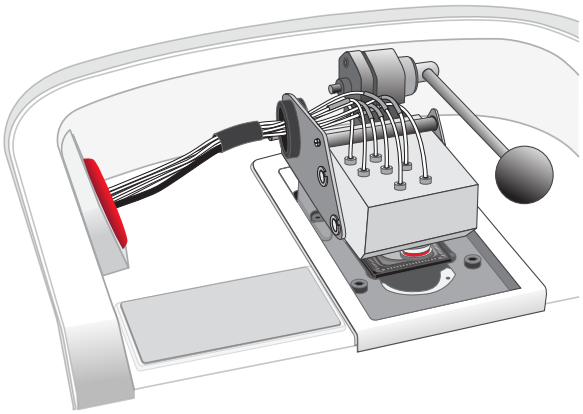
   Note: If you are performing two runs, both must start within 27 hours after start of the initialization.

   Note: 400-bp runs are performed for Assay Development purposes only and are not used with the Oncomine™ Dx Target Test.

3. Press the **Keyboard** button below the **Sequencing kit barcode** field. Using the barcode scanner attached to the sequencer, scan the barcode on the Ion PGM™ Dx Sequencing Reagents box. Press **OK**, then press **Next**.

4. Ensure that the used chip marked "W" (from the cleaning procedure) is secured in the chip clamp on the sequencer.

IMPORTANT! Do *not* use the chip marked "CL" for initialization. (Use it for chlorite cleaning only.)



5. Ensure that the old reagent sippers and collection trays are in place. Press **Next**.

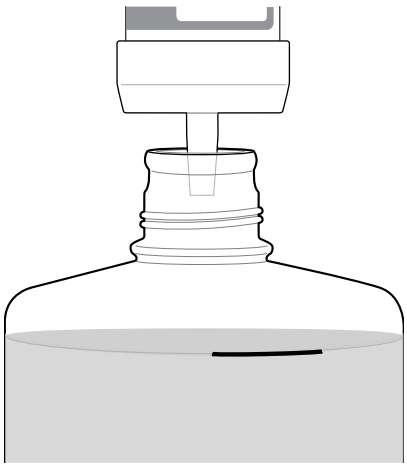
6. Rinse the SEQ Wash 1 Bottle, SEQ Wash 2 Bottle, and SEQ Wash 3 Bottle 3 times each with 18-MΩ water. Use 150 mL for the Wash 1 and Wash 3 bottles, and 500 mL for the Wash 2 bottle.

   Note: The bottles can be rinsed and reused for up to 8 sequencing runs. To track the number of uses, mark each bottle each time a run has finished as shown below. After 8 uses, the SEQ Wash 1 Bottle and SEQ Wash 3 Bottle bottles can be marked and used for cleaning only.

7. Prepare 500 µL of fresh 100 mM NaOH daily by diluting 50 µL of 1 M NaOH in 450 µL of nuclease-free water.

   Note: Prepare a stock of fresh 1 M NaOH weekly.

8. If your 18-MΩ water system has a spigot, extend it into **but not below** the neck of the SEQ Wash 2 Bottle. Otherwise, position the nozzle as close to the mouth of the bottle as possible.



IMPORTANT! If your water system has a digital display, verify that it reads "18 MΩ" when filling the bottle. If it does not, see Appendix A, “Troubleshooting“.

9. Fill the bottle to the mold line with 18-MΩ water.

   Note: The total volume of water is ~2 liters. You can mark the mold line on the bottle for clarity. If you are preparing bottles for multiple sequencers, cap each bottle immediately after filling. Leave them capped until you are ready to add SEQ W2 Solution.

10. Add an entire bottle of SEQ W2 Solution to the SEQ Wash 2 Bottle.

    Note: Store the remaining SEQ W2 Solution bottles in the sealed mylar bag they were provided in.

11. Using a P200 pipette, add 70 µL of 100 mM NaOH to the SEQ Wash 2 Bottle.

    Note: If the initialization consistently undershoots the pH target (see step 21), add more than the recommended 70 µL of 100 mM NaOH when preparing the Wash 2 Bottle. After adding the NaOH, the Wash 2 Bottle must be between pH 6.0–6.5 at first pH iteration before you start initialization.

12. Cap the bottle and invert 5 times to mix, then immediately proceed through the remainder of the initialization procedure.

    IMPORTANT! Do not store the mixed SEQ Wash 2 Bottle.

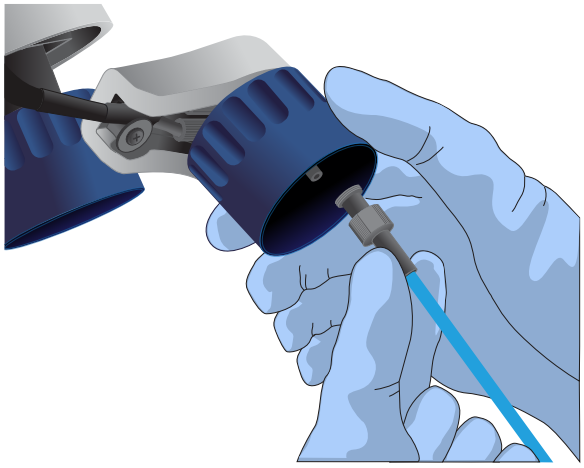
13. SEQ Wash 1 Bottle: Add 350 µL of freshly prepared 100 mM NaOH to a clean SEQ Wash 1 Bottle. Ensure that the pipette tip touches the bottom of the bottle to dispense.

14. SEQ Wash 3 Bottle: Add SEQ W3 Solution to the 50-mL line marked on a clean SEQ Wash 3 Bottle. Press **Next**.

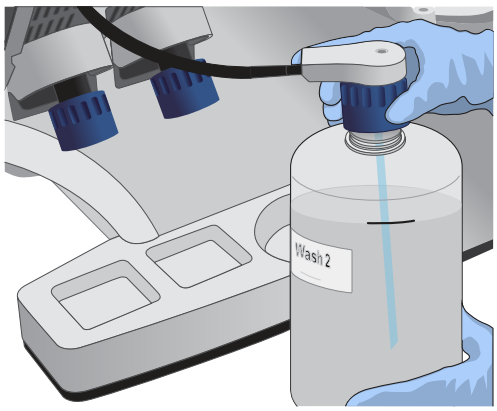
15. Remove the old sippers from the W1, W2, and W3 positions on the instrument, then discard in a waste container.

16. Wearing clean gloves, firmly attach a new, long sipper to the cap in the W2 position. **Do not let the sipper touch any surfaces.**

IMPORTANT! Loosely attached sippers can adversely affect results.



17. Immediately attach the prepared SEQ Wash 2 Bottle to the cap in the W2 position, then tighten the cap. Press **Next**.



18. Change gloves and firmly install new, short sippers to the caps in the W1 and W3 positions.

19. Immediately attach the prepared SEQ Wash 3 Bottle to the cap in the W3 position, then attach the SEQ Wash 1 Bottle to the cap in the W1 position. Tighten the caps.

20. Ensure that the collection trays are properly aligned to catch fluid flowing out of the sippers. Press **Next** to start the auto-pH process.

21. When auto-pH is complete:
    - If auto-pH fails (for example, the instrument overshoots or undershoots the target pH), the touchscreen displays an error message. Do not press **Next**. See Appendix A, "Troubleshooting" for information about specific errors.
    - If auto-PH passes, the touchscreen will display to the next step.

22. Thaw the following at room temperature until no ice crystals are visible in the tubes (~15 minutes). Keep the tubes on ice or in a chilled benchtop cold box until ready to use.
    - SEQ Primer (white cap)
    - SEQ dGTP (black cap)
    - SEQ dCTP (blue cap)
    - SEQ dATP (green cap)
    - SEQ dTTP (red cap)

23. The kit includes labels for each type of dNTP. Attach one of each label type to four SEQ Reagent Tubes.

24. Verify that no ice crystals are visible in each thawed dNTP stock solution tube (SEQ dGTP, SEQ dCTP, etc.) from step 22. Vortex each dNTP for ~5 seconds, then pulse centrifuge to collect.

    Note: To avoid cross-contamination in the next step, open only one dNTP tube at a time, and use a fresh pipette tip for each aliquot.

25. Using a P20 pipette and separate tips, aliquot each dNTP into its appropriately labeled reagent tube as follows:
    - Aliquot 10 µL of dNTP per reagent tube if performing one 200 bp run per initialization.
    - Aliquot 20 µL of dNTP per reagent tube if performing two 200 bp runs per initialization.

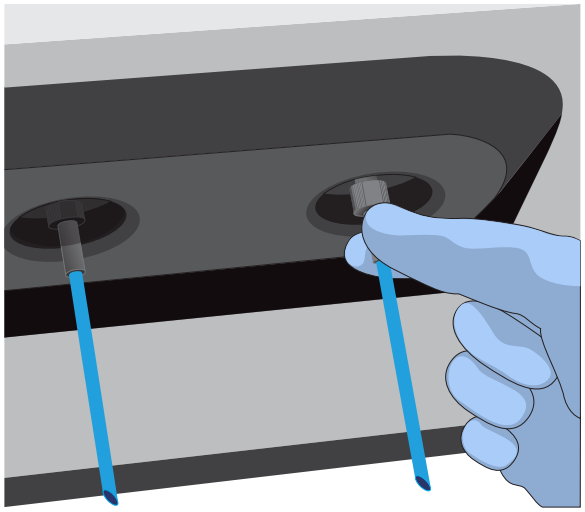
    Note: Reagent tubes can be capped and left at 2–8°C or on ice until ready for use. Place the remaining dNTP stocks back into –30°C to –10°C for storage. The dNTPs can be freeze-thawed up to 4 times. We recommend marking the box with each freeze-thaw to indicate how many have occurred.

26. Press **Next**. Remove the old reagent tube sippers, then discard them in a waste container.

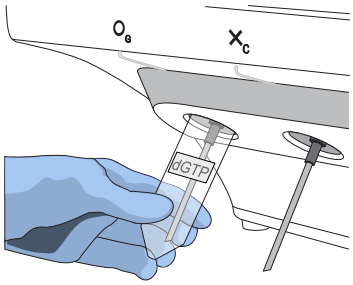
27. Remove the collection trays, discard any waste in a sink, then rinse the trays.

28. Using new gloves, firmly insert a new SEQ Reagent Tube Sipper (blue) into each dNTP port. Do not let the sipper touch any surfaces.

    IMPORTANT! Be careful to push each sipper onto the port firmly. Loosely attached sippers can adversely affect results.



29. Attach each SEQ Reagent Tube to the correct dNTP port (for example, the dGTP tube on the port marked "G"), then tighten firmly by hand until it can no longer rotate.



30. After each reagent tube is securely installed, press **Next**.

    The instrument automatically completes the rest of the initialization, which takes ~20 minutes. You can monitor the progress on the touchscreen.

    - If initialization is successful, the touchscreen indicates that initialization has "Passed" (highlighted in green). Press **Next** to return to the main menu.
    - If initialization fails, see Appendix A, “Troubleshooting“.

4 ISP preparation

Prepare enriched ISPs for sequencing

1. Confirm that the SEQ Primer is completely thawed before use. No ice crystals should be visible.

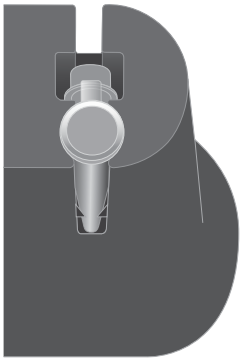
2. Vortex the SEQ Primer for ~5 seconds, then pulse centrifuge to collect the contents. Leave the tube on ice or in a chilled benchtop cold box until use.

3. Remove the enriched ISP sample in the 0.2-mL collection tube from the Ion OneTouch™ ES Dx Instrument or 2–8°C storage.

4. Place the tube in a microcentrifuge with a 0.2-mL tube adapter. Orient the tab of the tube lid so that it is pointing away from the center of the centrifuge (this will indicate where the sample ISPs are being pelleted).

5. Centrifuge at 15,000 rcf for 2 minutes.

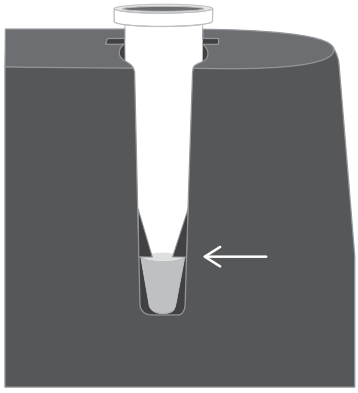
6. Open the tube lid, then fold it flat against the side of the tube. Insert the tube into the appropriate slot of the Ion OneTouch™ Sample Rack so that the lid is tucked behind the tube.



7. Use a P200 pipette and keep the pipette plunger depressed as you insert the tip into the tube containing the enriched ISPs. Carefully remove ~200 µL of supernatant from the top down, avoiding the side of the tube where the ISPs are pelleted (i.e., the side with the tab on the tube lid). Discard the supernatant.

8. Change to a P20 pipette. Keep the pipette plunger depressed as you insert the tip into the tube, and carefully remove the remaining supernatant to the volume marked by the arrow guides on the rack.

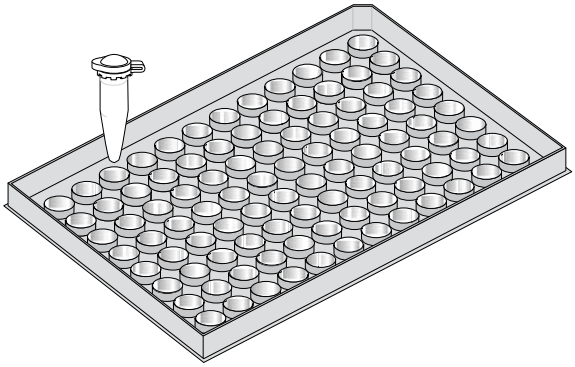
   Again, avoid the side of the tube where the ISPs are pelleted. The final volume in the tube will be ~15 µL.



9. Remove the tube from the sample rack, then add 12 µL of thawed SEQ Primer (white cap) to the ISPs in the tube and vigorously pipet the mixture up and down 30 times.

IMPORTANT! Make sure that the pipette tip is at the bottom of the tube during mixing to avoid introducing air bubbles into the sample.

10. Insert the tube into the 96-well tray supplied with the Veriti™ Dx 96-Well Thermal Cycler.



11. Load the tube and tray assembly into the thermal cycler. Select the **8 ODxTT Seq Primer Hyb** program on the thermal cycler touchscreen. Select **View** and confirm that the program steps match those listed in the table below.

Stage	Temperature	Time
Hold	95°C	2 minutes
Hold	37°C	2 minutes
Hold	25°C	Hold (up to 30 minutes)

12. When you have confirmed the program steps, run the cycling program.

After cycling, keep the tube containing the primer-annealed ISPs at room temperature. Proceed immediately to set up the sequencing run.

5 Sequencing protocol

Set up the sequencing run

The instrument touchscreen provides a summary of the steps in the process, which are described below in more detail.

IMPORTANT!

- To avoid damage to the chips or instrument due to electrostatic discharge:
  - **Remove your gloves when handling chips**, especially before transferring chips on or off the instrument. Hold chips by their edges when handling.
  - **Do not place chips directly on the bench or any other surface.** Always place chips either on the grounding plate on the Ion PGM™ Dx Sequencer or in the Ion PGM™ Dx Chip Minifuge bucket.

  Note: Steps without gloves can be performed without risk of contamination.
- When performing one or two sequencing runs from the same initialization, the runs must be started within 27 hours after the start of initialization.

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1. After initialization and sample preparation, go to the main menu of the Ion PGM™ Dx Sequencer, then press the **Run** button to begin the run setup.

2. Remove the waste bottle from the instrument and completely empty the bottle. Return the waste bottle to its position on the instrument. Press **Next**.

   IMPORTANT! Removing any waste before each run is critical. Waste overflow can result in a spill hazard and instrument damage.

3. Make sure the chip used for initialization is still in the chip clamp, then press **Next**. The instrument cleans the fluid lines, then proceeds automatically to the next screen.

4. Press the **Keyboard** button next to the **Planned Run** field. Using the barcode scanner attached to the sequencer, scan the **Run Short Code/Barcode** on the **View Planned Run** printout. Alternatively, type the code (displayed below the barcode) using the touchscreen keyboard. Press **OK**.

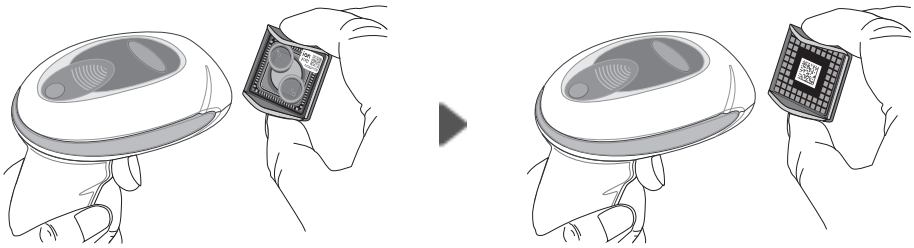
   Run Short Code/ Barcode: V0VEL

   Note: If the Ion Torrent™ Server has ≤1 terabyte (TB) of free disk space, an alert notifies the user that there is insufficient disk space to perform the run. The run cannot proceed until data on the server is archived and deleted. Contact your IT system administrator to manually archive and delete data. An administrator-level user in the software can also change the **Archive Settings** to reduce the

Auto archive after interval. See the *Oncomine™ Dx Target Test Part V: Analysis and Test Reports User Guide*.

5. Confirm the planned run information displayed on the touchscreen, then press **Next**.
   - Planned run name
   - Sample name if a single sample, or number of samples if multiple samples
   - Assay name
   - Created by [user name]
   - Created date [YYYY-MM-DD]
   - Ion PGM™ Dx Sequencing Kit barcode [scanned during initialization]
6. Remove your gloves.

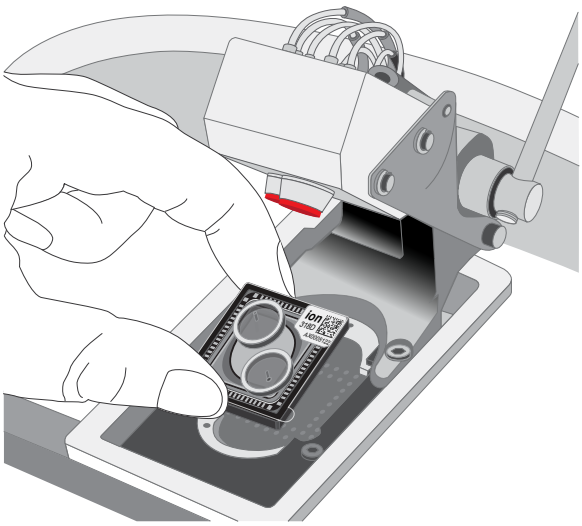
   Note: The following steps can be performed without gloves without risk of contamination.
7. Open the chip clamp, then remove the chip used for initialization. Press **Next**.
8. Touch the grounding plate with a bare finger, then remove a new chip from its packaging.
9. Press the **Keyboard** button next to the **Top barcode** field. Using the barcode scanner attached to the sequencer, scan the barcode on the top of the chip, then press **OK**.



10. Press the **Keyboard** button next to the **Bottom barcode** field. Scan the barcode on the bottom of the chip, then press **OK**.

    Note: If the barcode does not scan, use a new chip and contact Technical Support for a replacement.
11. Using a marker, label a corner of the chip with the **Tube Label** text.

12. Secure the new chip in the chip clamp.



13. Press **Next** to calibrate the chip. The screen prompts you to perform certain steps during calibration.

14. When prompted, visually inspect the chip in the clamp for liquid leaking from the chip case into and around the clamp area.

CAUTION! If a leak occurs, press the **Abort** button immediately, then see "Leak of unknown origin during chip calibration (before sample has been loaded on the chip)" on page 58.

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15. Close the instrument lid when prompted.

16. When chip calibration is complete, a "Calibration Passed" or "Calibration Failed" message appears.
    - If calibration passes, proceed to chip loading.
    - If calibration fails or you get an error message, see "Chip calibration failure (before sample has been loaded on the chip)" on page 57.

Load the sample on the chip

For additional instructions on using the Ion PGM™ Dx Chip Minifuge, see “Ion PGM™ Dx Chip Minifuge“ on page 69.

IMPORTANT! The following steps (including chip loading) should be performed without gloves, except when adding SEQ Enzyme as noted. The steps can be performed without gloves without risk of contamination.

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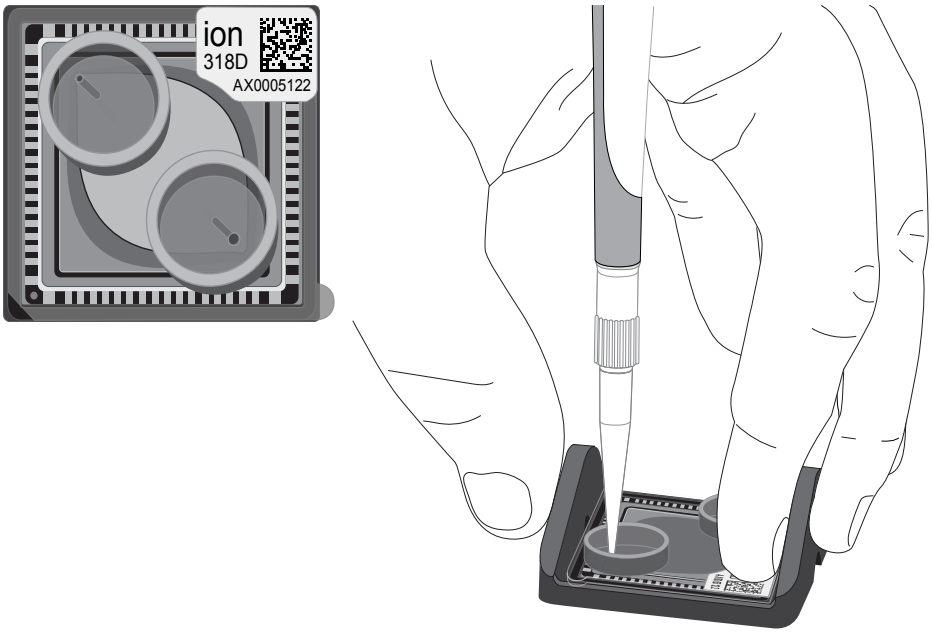
1. Enter the Tube Label text into the Ion PGM™ Dx Sequencer touchscreen. Press **Next**.
2. Touch the grounding plate on the instrument with a bare finger, then remove the new Ion 318™ Dx Chip from the clamp.
3. Insert the used chip from initialization (marked with a "W") back into the chip clamp.
4. Place the new chip in the removable bucket from the Ion PGM™ Dx Chip Minifuge, then place the bucket on a firm, flat surface.
5. Set a P200 pipette to 30 µL. Insert the tip firmly into the chip loading port while holding the bucket and chip steady with your other hand. Remove as much liquid as possible from the port, then discard the liquid.



6. Place the chip **upside-down** in the bucket, then transfer the bucket to the Ion PGM™ Dx Chip Minifuge **with the chip tab pointing out** (away from the center of the minifuge).

7. Balance the minifuge with another upside-down chip in the opposing bucket.

   Note: If you have prepared only one loaded chip, balance the minifuge with an empty used chip. Mark the used chip with a marker to differentiate it from the loaded chip.

8. Centrifuge for 3–5 seconds to completely dry the chip surface.

   CAUTION! Allow the minifuge to come to a complete stop before opening the lid.

9. Remove the bucket containing the chip from the minifuge. Remove the chip from the bucket, then wipe down the bucket with a disposable wipe to remove residual liquid. Place the chip right-side up in the bucket.

10. Put on new gloves.

11. Remove the SEQ Enzyme (yellow cap) from storage and flick 4 times to mix. Pulse centrifuge the tube to collect the contents, then place the tube on ice or in a chilled benchtop cold box until use.

12. Remove the primer-annealed ISPs from the Veriti™ Dx 96-Well Thermal Cycler (from "Prepare enriched ISPs for sequencing" on page 39).

13. Add 3 µL of SEQ Enzyme to the primer-annealed ISPs. Set a P200 pipette with a low-bind tip to 20 µL, then gently pipet the mix up and down 10 times.

    Note: If there is condensation on the walls of the tube, push down with the end of the pipette tip to mix the condensation with the sample.

14. Incubate at room temperature for 5 minutes.

15. Remove your gloves.

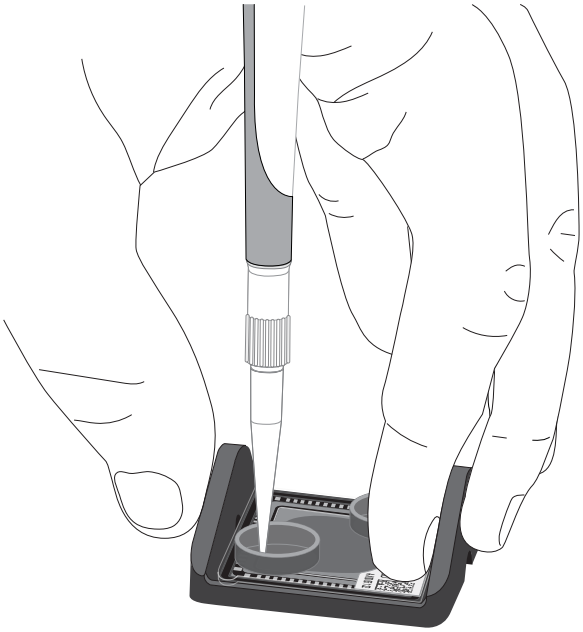
    Note: The following steps can be performed without gloves without risk of contamination.

16. Place the chip in the minifuge bucket on a firm, flat surface. Following the 5-minute polymerase incubation, collect 30 µL of sample into a P200 pipette tip. Discard any remaining sample.

    Note: If the sample is less than ~30 µL, there will be a visible air gap at the end of the tip. To correct the volume, see "Sample volume is <30 µL" on page 62.

17. Insert the pipette tip firmly into the loading port of the chip. Apply gentle pressure between the tip and chip throughout the loading process.

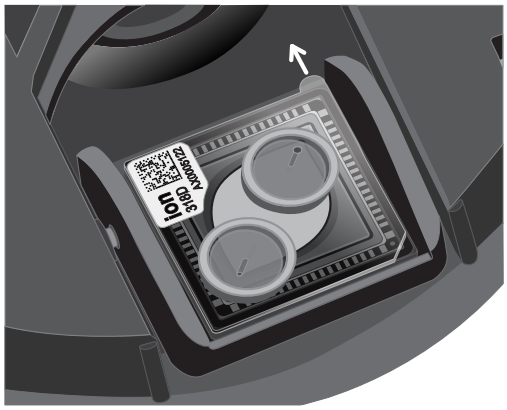
    IMPORTANT! Do not remove the pipette tip from the port or dial up the pipette during loading.



18. With the pipette unlocked, dial down the pipette to deposit the ISPs. Ensure that the entire sample is loaded onto the chip. To avoid introducing air bubbles, leave a small amount of sample in the pipette tip (~0.5 µL).

Note: Some sample may leak out of the outlet port, which is acceptable. Leave any remaining sample in the outlet port.

19. Transfer the chip in the bucket to the minifuge **right-side up with the chip tab pointing in** (toward the center of the minifuge).



20. Balance the minifuge with another right-side up chip in the opposing bucket, then centrifuge for 30 seconds.

CAUTION! Allow the minifuge to come to a complete stop before opening the lid.

21. Remove the bucket containing the chip from the minifuge and place it on a flat surface. Set a P200 pipette to 40 µL, then pipet the liquid out through the loading port. Remove as much liquid from the chip as possible.

Note: It is normal to have some liquid remain in the chip after this step.

22. Turn the chip upside-down in the bucket, then place the bucket back in the minifuge with the chip tab pointing out.

23. Balance the minifuge with another upside-down chip in the opposing bucket, then pulse centrifuge to completely dry the chip.

24. Remove the chip from the bucket, then wipe down any residual liquid left on the bucket with a disposable wipe.

Proceed immediately to "Perform the run".

Perform the run

1. On the Ion PGM™ Dx Sequencer touchscreen, press **Next**, then press the **Keyboard** button next to the **Top barcode** field. Using the barcode scanner attached to the sequencer, scan the barcode on the top of the new loaded chip, then press **OK**.

2. Remove the used chip from the instrument, then use ungloved hands to insert the loaded chip into the chip clamp.

   IMPORTANT! Confirm that both red rubber port gaskets are securely in place in the clamp.

3. Press **Next** to calibrate the loaded chip. At the start of calibration, visually inspect the chip for leaks before closing the instrument cover. Close the lid when prompted to do so.

   CAUTION! If a leak occurs, press the **Abort** button immediately, then see "Leak of unknown origin during chip calibration (after sample has been loaded on the chip)" on page 59.

4. After ~1 minute, the touchscreen indicates if calibration was successful.
   - If the chip fails calibration, reseat the chip and press **Re-try** to recalibrate. If the chip continues to fail calibration, see "Error message: Calibration failed (after sample has been loaded on the chip)" on page 60.
   - If a message says that the chip is not seated correctly, see "Error message: Calibration failed (after sample has been loaded on the chip)" on page 60.
5. When the chip passes calibration, press **Next** to start the sequencing run. The sequencing run takes ~4.5 hrs to complete.

   IMPORTANT! Confirm the run has started before leaving the sequencer. During a run, do not touch the instrument or the attached bottles or tubes, because this can reduce the quality of the measurements.

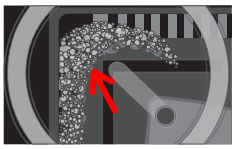
6. After the run, the touchscreen returns to the main menu. Review the run data using the Torrent Suite™ Dx Software, as described in the *Oncomine™ Dx Target Test Part V: Analysis and Test Reports User Guide* (Pub. No. MAN0016171).

Note: Used chips cannot be reused for sequencing. Used chips can be marked for cleaning and initialization as described previously.

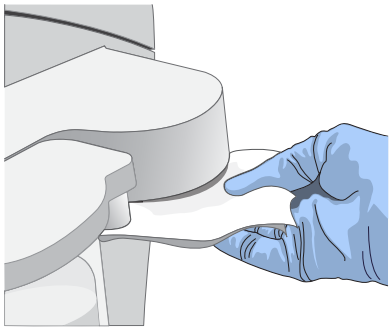
A Troubleshooting

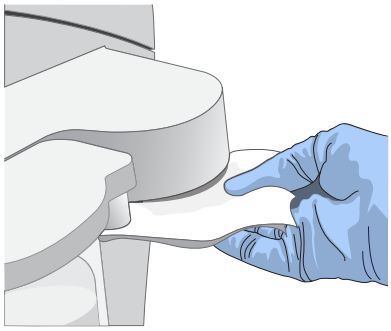
Ion PGM™ Dx Sequencer Initialization

Observation	Possible cause	Recommended action
Pressure alarm	Gas cylinder may be turned off or empty	• Verify that the cylinder has at least 500 PSI and 30 PSI at the outlet of the regulator. Confirm that all valves between the cylinder and the sequencer are open. • Once you confirm gas pressure leading into the instrument, press **Yes** to retry verification of gas pressure. If the test continues to fail, contact Technical Support (see "Customer and technical support" on page 87).
Error message: Leak check failed, make sure the reagent tubes are not attached to the sequencer and check Wash 1, 2, or 3 for leak	• Caps are not tightened on the Wash 1, 2, or 3 bottles. • Bottles may be damaged or defective.	1. Inspect all the bottles for damage or visible leaks. If a bottle appears damaged, replace it. 2. Finger-tighten all the bottle caps, make sure that the reagent tubes are not attached to the instrument, and then press **Retry**. 3. If leak check continues to fail, contact Technical Support (see "Customer and technical support" on page 87).
Error message: UNDERSHOT TARGET (instrument touchscreen may also be frozen)	Water used did not meet specifications, or insufficient amount of NaOH added	If the touchscreen is frozen, reboot the sequencer and restart initialization. If you receive the same error and the touchscreen continues to freeze, contact Technical Support (see "Customer and technical support" on page 87). Otherwise, proceed to the following steps. 1. Press **Retry** to reattempt pH adjustment. 2. If you receive the same error message after multiple attempts, press **Abort**. 3. Check your water purification system and troubleshoot per the manufacturer's directions, or identify a new source of 18-MΩ water. 4. Restart the initialization procedure and prepare new solutions, including a new aliquot of 100 mM NaOH. 5. If the problem persists, contact Technical Support (see "Customer and technical support" on page 87).

Observation	Possible cause	Recommended action
Error message: UNDERSHOT TARGET (instrument touchscreen may also be frozen)	Auto-pH did not add enough Wash 1 Solution to the Wash 2 Solution before the maximum iterations occurred.	If the touchscreen is frozen, reboot the sequencer and restart initialization. If you receive the same error and the touchscreen continues to freeze, contact Technical Support (see "Customer and technical support" on page 87). Otherwise, proceed to the following steps. 1. A blockage may have occurred. See "Error message: There may be a blockage or no NaOH in W1. Check W1 and run line clear then try again" on page 53. 2. Press **Retry** to restart the pH check. If you still get the "Undershot target pH" error, replace the chip with a new (unused) chip and restart the pH check. **Note:** The new chip can be used for sequencing after initialization completes.
	Loose W1 sipper	Tighten the sipper and retry.
Error message: Please insert a chip and press Start	Instrument cannot detect the chip in chip socket.	1. Open the chip clamp and remove the chip. 2. Check for debris under the chip and in the chip socket. **IMPORTANT!** Never rub or wipe the socket. Rubbing the socket can damage it and cause it to fail. 3. Look for liquid outside the flow cell of the chip:  4. If you see liquid, replace the chip with a new (unused) one. **Note:** The new chip can be used for sequencing after initialization completes. 5. Close the clamp, then press **Start** to restart the process. 6. If the new chip also fails, there could be a problem with the chip socket. Contact Technical Support (see "Customer and technical support" on page 87).
Error message: OVERSHOT TARGET	• Wrong amount or concentration of NaOH was added to the Wash 1 Bottle • Auto-pH added more NaOH from the Wash 1 Bottle to the Wash 2 Bottle than was needed	Do not press **Next**. Prepare fresh reagents, then press **Retry** to retry the initialization. If the problem persists, contact Technical Support (see "Customer and technical support" on page 87).

Observation	Possible cause	Recommended action
Error message: OVERSHOT TARGET	Clog in waste line(s)	Do not press **Next**. See "Error message: There may be a blockage or no NaOH in W1. Check W1 and run line clear then try again" on page 53.
	Clog in chip	Do not press **Next**. See "Error message: There may be a blockage or no NaOH in W1. Check W1 and run line clear then try again" on page 53. If the waste lines are not clogged, replace the chip, then click **Retry**.
W2 pH consistently undershoots target	pH of water is too low before any NaOH is added	• Confirm that the 18 MΩ water supply meets specifications. • If necessary, when preparing the Wash 2 Bottle, add more than the recommended 70 µL of 100 mM NaOH. After adding the NaOH, the Wash 2 Bottle must be in the range of pH 6.0–6.5 at first pH iteration before you begin initialization.

Observation	Possible cause	Recommended action
Error message: There may be a blockage or no NaOH in W1. Check W1 and run line clear then try again	The waste lines may be blocked.	1. Remove the waste bottle and place lab wipes under the waste arm. 2. Gently wipe the waste arm with a lab wipe to clear liquid from around the waste line.  3. Press **Flow check** one or more times to observe the flow rates from both lines. One line should drip slightly faster than the other. If one or both lines are blocked (no flow), or the drip rates are significantly different, go to the next step. If the flow rates are normal, see "Error message: There may be a blockage or no NaOH in W1 (continued from previous page)" on page 54 below. 4. Press **Line Clear**. Follow the prompts and use the syringe supplied with the Ion PGM™ Dx System. 5. After Line Clear, press **Flow check**, then check for normal flow rates from the waste lines. 6. If the flow rates are still not normal, perform **Line Clear** one more time. 7. If the line(s) remain blocked, contact Technical Support (see "Customer and technical support" on page 87). Otherwise, press **Start** to restart auto-pH.
	Wash 1 or Wash 2 sipper may be loose	1. Loosen the Wash 1 cap and retighten the sipper. Since the gas flows when the cap is loose, tighten the sipper as quickly as possible. (The gas is not harmful to the NaOH solution and is not a hazard.) 2. Loosen the Wash 2 cap and retighten the sipper. Since the gas flows when the cap is loose, tighten the sipper as quickly as possible. (The gas is not harmful to the W2 Solution and is not a hazard.) 3. Press **Start** to restart the auto-pH process.

Observation	Possible cause	Recommended action
Error message: There may be a blockage or no NaOH in W1 (continued from previous page)	Forgot to add NaOH to the Wash 1 Bottle: Chip does not detect a large enough pH difference between the NaOH (W1) and W2 Solutions.	1. If you forgot to add NaOH to the Wash 1 Bottle, loosen the cap and add 350 µL of 100 mM NaOH to the Wash 1 Bottle. (The flowing gas is not harmful to the NaOH solution and is not a hazard.) 2. Recap the bottle and shake gently to mix. 3. Press **Start** to restart auto-pH.
	Damaged chip	1. Replace the chip with a new (unused) one. Insert the chip in the socket, then press **Start**. **Note:** The new chip can be used for sequencing after initialization completes. 2. If the error persists, there could be a problem with the chip clamp. Contact Technical Support (see "Customer and technical support" on page 87).
Error message: W2 average not stable. Try reseating/replacing chip	Reading for W2 solution is not stabilizing quickly enough	1. Remove the waste bottle and gently wipe excess fluid from the waste lines with a lab wipe.  2. Check for leaks and reseat the chip. Replace the chip with a new (unused) one if needed. **Note:** The new chip can be used for sequencing after initialization completes. 3. Loosen the Wash 2 cap and retighten the sipper. Since the gas flows when the cap is loose, tighten the sipper as quickly as possible. (The gas is not harmful to the W2 Solution and is not a hazard.) 4. After performing one or more above steps, press **Start** to retry for auto-pH. If auto-pH fails even after replacing the chip, contact Technical Support (see "Customer and technical support" on page 87).
	The waste line may be blocked.	See "Error message: There may be a blockage or no NaOH in W1. Check W1 and run line clear then try again" on page 53.

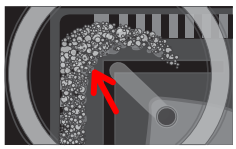
Observation	Possible cause	Recommended action
Error message: W2 out of range	• Chip measurements very unstable • Chip is damaged	See troubleshooting tips for "W2 average not stable" above.
Error message: Chip reading inconsistent. Please replace chip and try again.	• pH response of the chip is not uniform or reliable • Ran out of SEQ W3 Solution or volume too low	1. Verify that there is enough SEQ W3 Solution (>25 mL) in the Wash 3 Bottle and that the sipper is secure. 2. If necessary, loosen the Wash 3 Bottle cap, tighten the sipper, and add more SEQ W3 Solution to fill to 50 mL. Since the gas flows when the cap is loose, perform these operations as quickly as possible. (The gas is not harmful to the SEQ W3 Solution and is not a hazard.) 3. If there is enough SEQ W3 Solution, replace the chip with a new (unused) one. Insert the chip in the socket, then press "**re-try**". **Note:** The new chip can be used for sequencing after initialization completes.
Error message: Added too much W1 to W2	• Poor water quality • 18-MΩ water exposed to air for too long • Incorrect solution added to the SEQ W2 Solution • Too little NaOH added to SEQ Wash 1 Bottle • Damaged chip	1. Check whether the water meets the 18-MΩ specification and that the 100 mM NaOH and SEQ W2 Solutions were added correctly. 2. If solutions are incorrect or water does not meet specifications, correctly prepare the solution(s) and/or use 18-MΩ water. Abort the initialization and restart using correct solutions/water. 3. If the solutions and water are correct, abort the initialization and try reinitializing with a different chip.
WARNING: AutopH is within expected pH range, 0 milliliters of W1 was added to W2. Press "next" if expected, otherwise press "retry" to restart AutoPH	After auto-pH undershot the target, the user pressed the **Retry** button to restart auto-pH, but no additional NaOH was added to the Wash 2 bottle.	The pH reading was close enough to the target that no additional NaOH was added. Press **Next** to proceed with initialization.

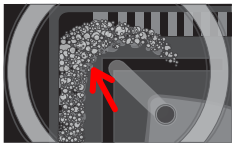
Initialization: Reagent pH verification

Observation	Possible cause	Recommended action
Failure screen	• One or more reagents are not within the target pH range • Chip is damaged	1. Press **Start** to repeat the pH measurement. 2. If the test still fails, replace the chip with a new (unused) chip and press **Start** to repeat. **Note:** The new chip can be used for sequencing after initialization completes. 3. If the test still fails with the new chip, clean and reinitialize the instrument with fresh reagents and a new chip. 4. If the test still fails, contact Technical Support (see "Customer and technical support" on page 87).

Chip calibration

Observation	Possible cause	Recommended action
Chip calibration failure (before sample has been loaded on the chip)	• Debris on the chip socket • Chip not seated correctly in the chip clamp • Chip is damaged • Problem with chip clamp or socket	1. Open the chip clamp, remove the chip, and check for damage, leaks, and/or debris under the chip and on the chip socket. • If debris or leaks are visible, gently dab the socket with a lab wipe tissue dampened with 18-MΩ water, then reseat the chip in the socket. • If no leaks or debris is visible, reseat the chip in the socket. **IMPORTANT!** Never rub or wipe the socket. Rubbing the socket can damage it and cause it to fail. 2. After reseating the chip, press **Retry**. 3. If the chip passes, press **Next** to start the experiment. If the chip still fails, reseat the chip again, then press **Retry**. 4. If chip calibration continues to fail with the same chip, retry with a new chip. 5. If the new chip fails as well: a. Press **Abort** to abort the run. **IMPORTANT!** Be sure to abort the run before rebooting the sequencer in the subsequent steps. b. Reboot the sequencer by holding down the Power button on the front to shut it down, then press again to restart. c. Restart the run with the new chip. 6. If the new chip continues to fail, there may be an issue with the chip socket. Contact Technical Support (see "Customer and technical support" on page 87).
Error message: Bad pixels error	Chip not seated correctly in the chip clamp.	1. Make sure the chip is seated correctly and the clamp is closed. 2. Press down on the chip clamp with even pressure until the message instructing to close the lid appears. 3. If the new chip continues to fail, there may be an issue with the chip socket. Contact Technical Support (see "Customer and technical support" on page 87).

Observation	Possible cause	Recommended action
Leak of unknown origin during chip calibration (before sample has been loaded on the chip)	• Chip clamp not closed properly. • Chip is damaged. • Problem with the chip clamp or socket	1. Press **Abort** to immediately stop the run. **Note:** If the system is pressurized during abort, initiate the clean step or a run to de-pressurize the system and stop the flow of buffer, then abort the clean step. 2. Open the chip clamp, remove the chip, and gently dab the chip socket with a lab wipe tissue to absorb any fluid. **IMPORTANT!** Never rub or wipe the socket. Rubbing the socket can damage it and cause it to fail. 3. Make sure that the rubber gaskets on the chip clamp are properly installed and not loose or out of position. 4. Rinse the socket with 18-MΩ water and gently absorb most of the water with the lab wipe. 5. Repeat the rinse, then gently dab the chip socket with a lab wipe until dry. 6. Place a lab wipe on the grounding plate and dampen it with 18-MΩ water. Wipe the bottom of the chip on this wipe to remove salts from the chip contacts, and then gently dab the bottom of the chip with a dry lab wipe. 7. Remove the lab wipe, dry the grounding plate, and place the chip on it. Confirm that there is no condensation outside the chip flow cell:  8. If there is condensation or fluid, the chip is damaged and cannot be run. If no chip damage is apparent, reseat the chip and press **Run** to restart the experiment. 9. When prompted to install the chip, make certain that the chip clamp is fully closed. 10. If the chip leaks again, press **Abort**, clean the chip socket, then restart the run with a different chip. If the new chip leaks, it may indicate a problem with the chip clamp or socket. Contact Technical Support (see "Customer and technical support" on page 87).

Observation	Possible cause	Recommended action
Leak of unknown origin during chip calibration (after sample has been loaded on the chip)	• Chip clamp not closed properly • Chip is damaged. • Problem with the chip clamp or socket	1. Press **Abort** to immediately stop the run. **Note:** If the system is pressurized during abort, initiate the clean step to de-pressurize the system to stop the flow of buffer, then abort the clean step. 2. Open the chip clamp, remove the chip, and gently dab the chip socket with a lab wipe tissue to absorb any fluid. **IMPORTANT!** Never rub or wipe the socket. Rubbing the socket can damage it and cause it to fail. 3. Make sure that the rubber gaskets on the chip clamp are tight and in position. 4. Place a lab wipe on the grounding plate and dampen it with 18-MΩ water. Wipe the bottom of the chip on this wipe, and then gently dab with a dry lab wipe. 5. Dry the grounding plate with a lab wipe and place the chip on it. Confirm that there is no condensation outside the chip flow cell:  6. If there is condensation or fluid, the chip is damaged and cannot be run. Prepare a new run starting with template preparation (skip the following troubleshooting steps). 7. If no chip damage is apparent, you can attempt to rerun the loaded chip. Press **Run** on the Main Menu to start a new run. 8. When prompted, place the used chip from initialization in the chip clamp and press **Next** to clean the fluid lines. 9. When prompted, scan or enter the Planned Run Short Code. 10. When prompted, scan the top and bottom barcodes on the loaded chip. 11. Secure the loaded chip in the chip clamp and proceed with initial chip calibration. 12. If the chip leaks again, press **Abort**, then clean the chip socket. There may be a problem with the chip clamp or socket. Contact Technical Support (see "Customer and technical support" on page 87). 13. If the chip does not leak and initial calibration passes, skip the chip loading steps and continue with the run.

Observation	Possible cause	Recommended action
Error message: Calibration failed (after sample has been loaded on the chip)	• Debris on the chip socket • Chip clamp not closed properly • Chip is damaged • Problem with chip clamp or socket	1. Open the chip clamp, remove the chip, and check for damage, leaks, or debris under the chip and on the chip socket. • If debris or leaks are visible, gently dab the socket with a lab wipe tissue dampened with 18-MΩ water, then re-clamp the chip. • If no leaks or debris are visible, re-clamp the chip. **IMPORTANT!** Never rub or wipe the socket. Rubbing the socket can damage it and cause it to fail. 2. After re-clamping the chip, press **Retry**. 3. If the chip passes, press **Next** to start the experiment. If the chip still fails, re-clamp the chip and press **Retry**. **Note:** You have a total of 3 attempts to retry the chip before aborting the run. 4. If calibration continues to fail, there may be an issue with the loaded chip, chip clamp, or chip socket. To test the clamp and socket: a. Abort the run, then restart the run. b. Do not use the loaded chip. Instead, place a *used* chip in the chip clamp, then follow the steps for the initial (unloaded) chip calibration. • If the used chip fails initial calibration, there may be an issue with the clamp or socket. Abort the run and contact Technical Support (see "Customer and technical support" on page 87). • If the used chip passes calibration, the previously loaded chip may be bad. Abort the run, prepare fresh template, and run with a new chip.

Observation	Possible cause	Recommended action
Error message: Chip not seated correctly. Please reset the chip and click OK to continue	• Debris on the chip socket • Chip not seated correctly in the chip clamp • Chip is damaged • Problem with chip clamp or socket	1. Open the chip clamp, remove the chip, and check for damage, leaks, and/or debris under the chip and on the chip socket. • If debris or leaks are visible, gently dab the socket with a lab wipe tissue dampened with 18-MΩ water, then reseat the chip in the socket. • If no leaks or debris are visible, reseat the chip in the socket. **IMPORTANT!** Never rub or wipe the socket. Rubbing the socket can damage it and cause it to fail. 2. Press **Retry**. 3. If the chip passes, press **Next** to start the experiment. If the chip still fails, try reseating the chip again and pressing **Retry**. **Note:** You have a total of 3 attempts to reseat the chip before aborting the run. 4. If you continue to receive the "Chip not seated correctly" error message, contact Technical Support (see "Customer and technical support" on page 87). There may be an issue with the chip clamp or socket.
Chip calibration status bar does not progress	During chip calibration, the touchscreen status progress bar does not progress.	1. Press the **Abort** button to abort the run. 2. Reboot the sequencer by holding down the **Power** button on the front to shut it down, then press the button again to restart. 3. Restart the run with the same chip. **Note:** Reinitialization is *not* required after rebooting the sequencer if the initialization successfully completed before the run was aborted.
Barcode on the bottom of the chip does not scan	The barcode is printed incorrectly.	Use a new chip and contact Technical Support for a replacement (see "Customer and technical support" on page 87).

Sample loading

Observation	Possible cause	Recommended action
Sample volume is <30 µL If the sample volume is less than <30 µL, there will be a visible air gap at the end of the pipette tip when you collect the sample for chip loading.	Volume was lost at some point during sample preparation.	**Note:** Equilibrate SEQ Sample Buffer (brown cap) to room temperature for 15 minutes before performing the following steps. 1. With the sample loaded in the pipette tip, dial down the pipette until the liquid reaches the end of the tip. Record the volume shown on the pipette (X). 2. Dispense the sample back into the sample tube. 3. Subtract the volume shown on the pipette from 30 µL (30 – X = Y µL) to determine the missing volume (Y). 4. Change the pipette tip, and add Y µL of SEQ Sample Buffer (brown cap) to the sample. 5. Pipet up and down 4 times to mix the contents, then continue loading the sample into the chip.

Warnings and alarms—Ion PGM™ Dx System

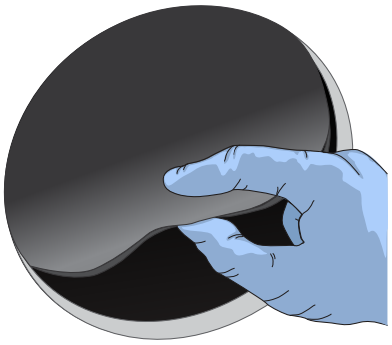
The following warnings and alarms appear on the Ion PGM™ Dx Sequencer touchscreen and in the Torrent Suite™ Dx Software under the **Monitor** tab.

Observation	Possible cause	Recommended action
Display message: Pressure too high	Internal pressure regulator was not set correctly	Contact Technical Support (see "Customer and technical support" on page 87).
Display message: Pressure too low.	• Gas line is not connected to the instrument • Gas cylinder may be turned off or empty	1. Verify that the gas line is connected to the instrument. 2. Verify that the gas cylinder has at least 500 psi on the pressure gauge inside the tank and 30 psi on the gauge that regulates pressure to the outlet. (Both pressure gauges are mounted on the gas cylinder.) 3. Confirm that the outlet valve on the regulator is turned on. 4. If the problem persists, contact Technical Support (see "Customer and technical support" on page 87).

Observation	Possible cause	Recommended action
Display message: Instrument idle temperature too high	• Room temperature is too high. • Clogged filter or blocked airway on the instrument • Hardware issue (fan is not running or running too slowly)	**Note:** The data created during a run with this alarm raised may still be used if all the QC metrics are met. See the recommended action for "Display message: Instrument temperature too high" on page 66.
Display message: Instrument idle temperature too low	• Ambient room temperature is below 20°C. • Hardware issue	Bring the ambient temperature up to 20°C. If the problem persists, contact Technical Support (see "Customer and technical support" on page 87).
Display message: Bad results data drive	• On some machines, the warning appears before the reboot completes. • There is a hardware issue.	Wait for a few minutes to see if the error message disappears. If the error message disappears, data obtained during a run with this alarm raised can still be used. If the problem persists, contact Technical Support (see "Customer and technical support" on page 87).
Display message: Kernels do not match	Hardware and/or software issue	Contact Technical Support (see "Customer and technical support" on page 87).
Display message: Failed to set up system time at startup. Check your connection to the Ion Torrent™ Server.	The connection between the Ion PGM™ Dx Sequencer and the Ion Torrent™ Server has been lost.	1. Check the network connection to the Ion Torrent™ Server to make sure the connection is established, then reboot the instrument. 2. If the problem persists, replace the network cable(s) to the instrument and server. 3. If the problem persists, contact Technical Support (see "Customer and technical support" on page 87).
	Instrument is still in the process of establishing a connection	Allow 10 minutes to see if display message clears.
Display message: Lost connection to the Ion Torrent™ Server	The connection between the instrument and the server has been lost.	Check the network connection to the Ion Torrent™ Server, and then reboot the Ion PGM™ Dx Sequencer. If this alarm appears during a run, the data created during that run can still be used.
Display message: UBoots do not match	Hardware issue	Contact Technical Support (see "Customer and technical support" on page 87).
Display message: Bad boot drive detected	Hardware issue	Contact Technical Support (see "Customer and technical support" on page 87). If this alarm appears during a run and data for the run is generated, that data may still be used.
Display message: Results drive not accessible. Reboot and try again.	• On some machines, the warning appears before the reboot completes • Hardware issue	Wait for a few minutes to see if the error message disappears. If the error message appears and disappears during a run, data obtained during that run can still be used. If the alarm persists, contact Technical Support (see "Customer and technical support" on page 87).
Display message: Lost chip connection	The instrument cannot detect a chip in the chip clamp	See the instructions under "Chip calibration failure (before sample has been loaded on the chip)" on page 57.

Observation	Possible cause	Recommended action
Display message: Sensor unable to measure instrument temperature	Hardware issue	Contact Technical Support (see "Customer and technical support" on page 87).
Display message: Results drive check failed	Hardware issue	If the error message disappears when you return to the main instrument screen, this alarm can be ignored. Otherwise, contact Technical Support (see "Customer and technical support" on page 87).
Display message: Software versions incompatible. Go to the Options menu and update the software.	The system software was updated, but the instrument software was not.	After the system software has been updated, update the instrument software as follows: 1. On the main menu of the instrument, press **Options** and follow the instructions to check for and install updates. 2. When installation is complete, follow the onscreen prompts to reboot the instrument. **IMPORTANT!** You must reboot the instrument before proceeding.
Display message: Sensor unable to measure gas pressure. Check supply gas pressure.	• Gas line is not connected to the instrument • Gas cylinder may be turned off or empty • Hardware issue	1. Verify that the gas line is connected to the instrument. 2. Verify that the gas cylinder has at least 500 psi on the pressure gauge inside the tank and 30 psi on the gauge that regulates pressure to the outlet. (Both pressure gauges are mounted on the gas cylinder.) 3. Confirm that the outlet valve on the regulator is turned on. 4. If the problem persists, contact Technical Support (see "Customer and technical support" on page 87).
Display message: Failed to locate the barcode scanner. Check if the scanner is attached.	The connection between the barcode scanner and the Ion PGM™ Dx Sequencer has been lost.	Make sure the scanner is plugged into a USB port on the instrument. If it is connected and the alarm still appears, try plugging the scanner into a second USB port. If the alarm persists, contact Technical Support (see "Customer and technical support" on page 87).
Display message: Failed to set the pressure to target range. Check the gas connection and try again.	• Gas line is not connected to the instrument • Gas cylinder may be turned off or empty • Hardware issue (regulator malfunction)	1. Verify that the gas line is connected to the instrument. 2. Verify that the gas cylinder has at least 500 psi on the pressure gauge inside the tank and 30 psi on the gauge that regulates pressure to the outlet. (Both pressure gauges are mounted on the gas cylinder.) 3. Confirm that the outlet valve on the regulator is turned on. 4. If the problem persists, contact Technical Support (see "Customer and technical support" on page 87).

Observation	Possible cause	Recommended action
Display message: Failed to set up FTP connection. Check your connection to the Ion Torrent™ Server .	The network connection is not established or an incorrect IP address was used.	Confirm that the server information is correct for the Ion Torrent™ Server. Contact your local network administrator for support if the issue persists.
Display message: Unable to mount the file system	Hardware and/or software issue	1. Reboot the instrument to clear the alarm. 2. If the alarm is not cleared after reboot, contact Technical Support (see "Customer and technical support" on page 87).
Display message: Instrument temperature too low	• Room temperature is below 20°C. • Hardware issue	**Note:** The data created during a run with this alarm raised may still be used if all the QC metrics are met. If the ambient room temperature is below 20°C, raise it. If the problem persists, contact Technical Support (see "Customer and technical support" on page 87).

Observation	Possible cause	Recommended action
Display message: Instrument temperature too high	• Room temperature is too high. • Clogged filter or blocked airway on the instrument • Hardware issue (fan is not running or running too slowly)	**Note:** The data created during a run with this alarm raised may still be used if all the QC metrics are met. 1. If the ambient room temperature is above 30°C, lower it. 2. Make sure that the round filter on the back panel of the instrument has unrestricted airflow. If the filter is clogged with dust, clean it as follows: a. Pinch the dirty filter with your fingers, then remove it from the instrument.  b. Shake the filter over a waste container to remove most of the dust. c. Rinse the filter with running water to remove any remaining dust. The water flow should be from the inside-facing surface to the outside-facing surface through the filter. d. Air dry the filter. e. Blot any remaining dust from the filter using tape. f. Reinsert the filter. If the problem persists, contact Technical Support (see "Customer and technical support" on page 87).
Display message: Chip temperature too low	Hardware issue	**IMPORTANT!** The data created during a run with this alarm raised should *not* be used. Contact Technical Support (see "Customer and technical support" on page 87).

Observation	Possible cause	Recommended action
Display message: Chip temperature too high	• Room temperature is too high. • Clogged filter or blocked airway on the instrument • Hardware issue (instrument fan is not running or running too slowly)	IMPORTANT! The data created during a run with this alarm raised should *not* be used. See the recommended action for "Display message: Instrument temperature too high" on page 66.
Display message: Lost communication with valve board	Hardware issue	Contact Technical Support (see "Customer and technical support" on page 87).
Display message: Fan current too low	Hardware issue	Contact Technical Support (see "Customer and technical support" on page 87).
Display message: Heater current too low	Hardware issue	IMPORTANT! If the chip temperature is also out of range, data created during a run should *not* be used. Contact Technical Support (see "Customer and technical support" on page 87). If no chip temperature alarms are raised, data created during a run may still be used if all the QC metrics are met.
Error message: A non-recoverable error has occurred	Hardware issue	Prepare new template from the same library and plan a new run. If the issue persists, contact Technical Support (see "Customer and technical support" on page 87).

Sequencer software issues

(For additional software anomalies, see the release notes provided with your version of the software.)

Observation	Possible cause	Recommended action
Sequencer touchscreen is frozen	The user pressed multiple buttons on the screen in rapid succession.	Wait 5 minutes for the touchscreen to unfreeze. If the touchscreen remains frozen, reboot the sequencer by holding down the **Power** button on the front to shut it down, then press again to restart.
	The touchscreen is in a locked state.	Reboot the sequencer by holding down the **Power** button on the front to shut it down, then press again to restart.

Warnings and alarms—Veriti™ Dx Thermal Cycler

Observation	Possible cause	Recommended action
"Fatal Error" message displayed by Veriti™ Dx Thermal Cycler	Various	For assistance, contact Technical Support (see "Customer and technical support" on page 87). Refer to the *Veriti™ Dx Thermal Cycler User Guide* (Pub. no. 4453697) for general troubleshooting information for this instrument.

B Ion PGM™ Dx Chip Minifuge and barcode scanner

Ion PGM™ Dx Chip Minifuge

The Ion PGM™ Dx Chip Minifuge is supplied with one custom rotor and two buckets. The buckets are designed to hold two chips: one in each bucket. The rotor and bucket design enables effective and efficient reagent loading of chips.

Safety precautions

CAUTION!

- Make sure your supply voltage matches the voltage label on the minifuge, i.e., never plug a 120V minifuge into an 220–240 VAC outlet. Operating the minifuge with a supply voltage outside the specified range may cause a fire or electric shock.
- Do not run the minifuge for more than 30 seconds.
- Never operate the minifuge without a rotor properly attached to the shaft.
- Never operate with only one chip in place. A chip must be present in each bucket to balance the rotor. If necessary, you can balance a loaded chip with a used chip of any type.
- Never put hands in the rotor area unless the rotor is completely stopped.
- Never move the minifuge while the rotor is spinning.
- Do not leave the minifuge running when not in use.

Note: The rotor can be balanced with a used chip from a previous reaction without risk of contamination.

Voltage selection

Two different minifuges are available, depending on your supply voltage: 120 VAC and 220–240 VAC. Make sure that the voltage specification on the label of your minifuge matches the supply voltage. If they do not match, change your supply voltage or contact Customer Support to request the appropriate minifuge.

CAUTION! Never plug a 120V minifuge into an 220–240 VAC outlet, or vice versa. Operating the minifuge with a supply voltage outside of the range specified on the label may cause a fire or electric shock.

Voltage, RPM, and RCF

The following tables list the revolutions per minute (RPM) and relative centrifugal force (RCF) at different voltages.

120/50 VAC, 60 Hz	RPM	RCF
90	4100	836
100	4550	1030
110	4960	1224
120	5330	1424
130	5710	1628

230/50 VAC, 60 Hz	RPM	RCF
210	5070	1279
220	5310	1403
230	5515	1513
240	5705	1619
250	5900	1732

Operation

1. Place the Ion PGM™ Dx Chip Minifuge on a level, clean surface near an accessible power outlet so that the cord and outlet are within easy reach of the operator.
2. Make sure the power switch on the minifuge is in the "off" position.
3. Load a chip into each bucket.

   IMPORTANT! A chip must be present in each bucket to balance the rotor. If necessary, you can balance a loaded chip with a used chip of any type.

4. Turn the power switch on.
5. To begin centrifugation, close the lid of the minifuge. (The centrifugation time will vary depending on the step in the chip-loading protocol.)
6. To stop centrifugation, press down on the lid release tab on the front of the minifuge.

   ⚠ **CAUTION!** Do not attempt to open the lid or remove the chips until the unit has come to a complete stop.

7. After the rotor has stopped, open the lid by grabbing it with the thumb on the front and fingers on the back, then lifting the lid back on the hinge.

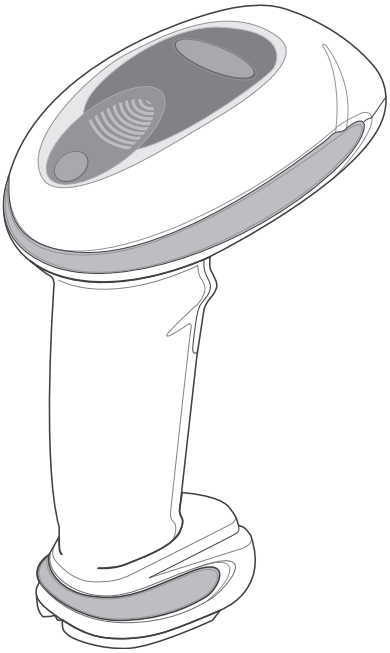
Cleaning

To clean the minifuge, use a damp cloth and a mild, noncorrosive detergent (pH <8). After cleaning, ensure that all parts are dried thoroughly before attempting to operate the unit. Do not immerse the centrifuge in liquid or pour liquids over it.

Note: Use only the cleaning protocol described above.

Barcode scanner

The barcode scanner provided with the Ion PGM™ Dx System uses a low-power, visible-light diode.



CAUTION! As with any bright light source, you should avoid staring directly into the light beam or shining the beam into other people's eyes. Momentary exposure to a Class 2 laser is not known to be harmful.

CAUTION! Use of controls, adjustments, or performance of procedures other than those specified in this guide can result in hazardous laser light exposure.

The barcode scanner specifications are listed below.

Wavelength	Rated Power
630–680 nm	1 mW

C 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, etc). To obtain SDSs, see the "Documentation and Support" section in this document.

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 adequate ventilation (for example, fume hood).
- Check regularly for chemical leaks or spills. If a leak or spill occurs, follow the manufacturer's 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 necessary) 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! PRÉCAUTIONS GÉNÉRALES EN CAS DE MANIPULATION DE PRODUITS CHIMIQUES. Pour minimiser les risques, veiller à ce que le personnel du laboratoire lise attentivement et mette en œuvre les consignes de sécurité générales relatives à l'utilisation et au stockage des produits chimiques et à la gestion des déchets qui en découlent, décrites ci-dessous. Consulter également la FDS appropriée pour connaître les précautions et instructions particulières à respecter :

- Lire et comprendre les fiches de données de sécurité (FDS) fournies par le fabricant avant de stocker, de manipuler ou d'utiliser les matériaux dangereux ou les produits chimiques. Pour obtenir les FDS, se reporter à la section « Documentation et support » du présent document.
- Limiter les contacts avec les produits chimiques. Porter des équipements de protection appropriés lors de la manipulation des produits chimiques (par exemple : lunettes de sûreté, gants ou vêtements de protection).
- Limiter l'inhalation des produits chimiques. Ne pas laisser les récipients de produits chimiques ouverts. Ils ne doivent être utilisés qu'avec une ventilation adéquate (par exemple, sorbonne).

- Vérifier régulièrement l'absence de fuite ou d'écoulement des produits chimiques. En cas de fuite ou d'écoulement d'un produit, respecter les directives de nettoyage du fabricant recommandées dans la FDS.
- Manipuler les déchets chimiques dans une sorbonne.
- Veiller à utiliser des récipients à déchets primaire et secondaire. (Le récipient primaire contient les déchets immédiats, le récipient secondaire contient les fuites et les écoulements du récipient primaire. Les deux récipients doivent être compatibles avec les matériaux mis au rebut et conformes aux exigences locales, nationales et communautaires en matière de confinement des récipients.)
- Une fois le récipient à déchets vidé, il doit être refermé hermétiquement avec le couvercle fourni.
- Caractériser (par une analyse si nécessaire) les déchets générés par les applications, les réactifs et les substrats particuliers utilisés dans le laboratoire.
- Vérifier que les déchets sont convenablement stockés, transférés, transportés et éliminés en respectant toutes les réglementations locales, nationales et/ou communautaires en vigueur.
- **IMPORTANT !** Les matériaux représentant un danger biologique ou radioactif exigent parfois une manipulation spéciale, et des limitations peuvent s'appliquer à leur élimination.

Biological hazard safety

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:
  www.cdc.gov/biosafety/publications/bmbl5/BMBL.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

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 Consult the manual for further safety information.	Attention, risque de danger Consulter le manuel pour d'autres renseignements de sécurité.
⚠	Caution, risk of electrical shock	Attention, risque de choc électrique
⚠	Caution, piercing hazard	Attention, danger de perforation
⚠	Caution, hot surface	Attention, surface chaude
⚠	Potential biohazard	Danger biologique potentiel
I	On	On (marche)
O	Off	Off (arrêt)
⏻	On/Off	On/Off (marche/arrêt)
⏚	Earth (ground) terminal	Borne de (mise à la) terre
⏚	Protective conductor terminal (main ground)	Borne de conducteur de protection (mise à la terre principale)
~	Terminal that can receive or supply alternating current or voltage	Borne pouvant recevoir ou envoyer une tension ou un courant de type alternatif

Symbol	English	Français
	Do not dispose of this product in unsorted municipal waste **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. **CAUTION!** 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 on the instrument

Conformity mark	Description
	Indicates conformity with safety requirements for Canada and U.S.A.
	Indicates conformity with European Union requirements for safety and electromagnetic compatibility.
	Indicates conformity with Australian standards for electromagnetic compatibility.

Medical device symbols

The following table describes symbols that may be displayed on instruments, consumables, or reagents. The symbols used on labels conform to standard BS EN ISO 15223-1:2012 and FDA guidance "Use of Symbols on Labels and in Labeling of In Vitro Diagnostic Devices Intended for Professional Use".

Symbol	Description	Symbol	Description
	MANUFACTURER		CONTAINS SUFFICIENT FOR <n> TESTS
	DATE OF MANUFACTURE		USE BY

Symbol	Description	Symbol	Description
LOT	BATCH CODE	REF	CATALOG NUMBER
SN	SERIAL NUMBER		FRAGILE, HANDLE WITH CARE
	LOWER LIMIT OF TEMPERATURE		PROTECT FROM LIGHT
	UPPER AND LOWER LIMITS OF TEMPERATURE		UPPER LIMIT OF TEMPERATURE
	DO NOT REUSE		BIOLOGICAL RISKS
	CAUTION, CONSULT ACCOMPANYING DOCUMENTS		CONSULT INSTRUCTIONS FOR USE
	UPPER AND LOWER LIMITS OF HUMIDITY		OBSERVE PRECAUTIONS FOR HANDLING ELECTROSTATIC SENSITIVE DEVICES
IVD	IN VITRO DIAGNOSTIC MEDICAL DEVICE		

Safety alerts on this instrument

Additional text may be used with one of the symbols described above when more specific information is needed to avoid exposure to a hazard. See the following table for safety alerts found on the instrument.

English	French translation
CAUTION! Hazardous chemicals. Read the Safety Data Sheets (SDSs) before handling.	**ATTENTION! Produits chimiques dangereux.** Lire les fiches signalétiques (FS) avant de manipuler les produits.
CAUTION! Hazardous waste. Refer to SDS(s) and local regulations for handling and disposal.	**ATTENTION! Déchets dangereux.** Lire les fiches signalétiques (FS) et la réglementation locale associées à la manipulation et à l'élimination des déchets.

Safety information for third-party instruments

Refer to the manufacturer's documentation for information on the safe use of third-party products provided with the instrument system.

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.

Electrical

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. Position the instrument such that the power cord is accessible.

WARNING! Radio interference. This equipment has been designed and tested to CISPR 11 Class A. In a domestic environment it may cause radio interference, in which case you may need to take measures to mitigate the interference.

WARNING! Electromagnetic radiation. Do not use this device in close proximity to sources of strong electromagnetic radiation (e.g., unshielded intentional RF sources), as these may interfere with proper operation.

Cleaning and decontamination

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

- No decontamination or cleaning agents are used that could cause a HAZARD as a result of a reaction with parts of the equipment or with material contained in the equipment.
- The instrument is properly decontaminated a) if hazardous material is spilled onto or into the equipment, and/or b) prior to having the instrument serviced at your facility or sending the instrument for repair, maintenance, trade-in, disposal, or termination of a loan (decontamination forms may be requested from customer service).
- Before using any cleaning or decontamination methods (except those recommended by the manufacturer), users should confirm with the manufacturer that the proposed method will not damage the equipment.

CAUTION! Nettoyage et décontamination. Utiliser uniquement les méthodes de nettoyage et de décontamination indiquées dans la documentation du fabricant destinée aux utilisateurs. L'opérateur (ou toute autre personne responsable) est tenu d'assurer le respect des exigences suivantes:

- Ne pas utiliser d'agents de nettoyage ou de décontamination susceptibles de réagir avec certaines parties de l'appareil ou avec les matières qu'il contient et de constituer, de ce fait, un DANGER.
- L'instrument doit être correctement décontaminé a) si des substances dangereuses sont renversées sur ou à l'intérieur de l'équipement, et/ou b) avant de le faire réviser sur site ou de l'envoyer à des fins de réparation, de maintenance, de revente, d'élimination ou à l'expiration d'une période de prêt (des informations sur les formes de décontamination peuvent être demandées auprès du Service clientèle).
- Avant d'utiliser une méthode de nettoyage ou de décontamination (autre que celles recommandées par le fabricant), les utilisateurs doivent vérifier auprès de celui-ci qu'elle ne risque pas d'endommager l'appareil.

Laser

CAUTION! LASER HAZARD, Bar Code Scanner. The bar code scanner included with the instrument system is a Class 2 laser. To avoid damage to eyes, do not stare directly into the beam or point into another person's eyes.

Gas safety

Verify that your installation room can accommodate gas cylinders.

WARNING! Instrumentation must be installed and operated in a well-ventilated environment as defined as having a minimum airflow of 6-10 air changes per hour. Assess the need for ventilation or atmospheric monitoring to avoid asphyxiation accidents from inert gases and/or oxygen depletion, and take measures to clearly identify potentially hazardous areas through training or signage. Please contact your Environmental Health and Safety Coordinator to confirm that the instruments will be installed and operated in an environment with sufficient ventilation.

WARNING! Pressurized gas cylinders are potentially explosive. Always cap the gas cylinder when it is not in use, and attach it firmly to the wall or gas cylinder cart with approved brackets or chains.

WARNING! Gas cylinders are heavy and may topple over, potentially causing personal injury and tank damage. Cylinders should be firmly secured to a wall or work surface. Please contact your Environmental Health and Safety Coordinator for guidance on the proper installation of a gas cylinder.

Safety and electromagnetic compatibility (EMC) standards

The instrument design and manufacture complies with the standards and requirements for safety and electromagnetic compatibility as noted in the following table:

Safety

Reference	Description
EU Directive 2006/95/EC	European Union "Low Voltage Directive"
IEC 61010-1 EN 61010-1 UL 61010-1 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 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 61010-2-101	*Safety requirements for electrical equipment for measurement, control and laboratory use - Part 2-101: Particular requirements for in vitro diagnostic (IVD) medical equipment*

EMC

Reference	Description
Directive 2004/108/EC	European Union "EMC Directive"
EN 61326-1	*Electrical Equipment for Measurement, Control and Laboratory Use – EMC Requirements – Part 1: General Requirements*
EN 61326-2-6	*Electrical Equipment for Measurement, Control and Laboratory Use – EMC Requirements – Part 26: Particular requirements – In vitro diagnostic (IVD) medical equipment)requirements*
FCC Part 15	U.S. Standard "Industrial, Scientific, and Medical Equipment"
AS/NZS CISPR 22:2009	*Limits and Methods of Measurement of Electromagnetic Disturbance Characteristics of Industrial, Scientific, and Medical (ISM) Radiofrequency Equipment*
ICES-003, Issue 5	*Industrial, Scientific and Medical (ISM) Radio Frequency Generators*

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

Precaution—strong magnet

Note: Do not substitute non-IVD labeled magnets for the DynaMag™ Dx 96-Well Plate Magnet and DynaMag™ Dx 16 2-mL Magnet, provided with Ion PGM™ Dx System.

The DynaMag™ Dx 96-Well Plate Magnet and DynaMag™ Dx 16 2-mL Magnet contain very strong permanent magnets. People wearing a pacemaker or any other medical magnetized implant should not use this product unless advised by a health professional; the implant could be affected or damaged by exposure to a strong magnetic field. Keep tools and objects that could be damaged by the magnetic field out of the working area. This includes, but is not restricted to, credit cards and other products containing magnetic recording devices. Keep away from delicate instruments, watches, electronic equipment, displays and monitors. The magnet may attract steel or other magnetic material with high mechanical forces. Take care during handling. Avoid contact between two magnets. Do not pull the magnets apart if contact has been made; twist off to prevent damage to the unit or fingers. The Health and Safety Officer should take all necessary steps and full responsibility to ensure that the precautions and statements are followed and adhered to.

D Performance characteristics

For performance characteristics of the Oncomine™ Dx Target Test Kit, see the *Oncomine™ Dx Target Test Part V: Analysis and Test Reports User Guide* (Pub. No. MAN0016171).

For performance characteristics of the Ion PGM™ Dx System, see Appendix B of the *Ion PGM™ Dx System User Guide* (Pub. No. MAN0016694) and the *Ion PGM™ Dx System Performance Characteristics User Guide* (Pub. No. MAN0016697).

E Instrument warranty

For new Ion Torrent™ instruments, Life Technologies warrants to and only to buyer for twelve (12) months from the date of shipping, that the Ion Torrent™ software and Ion Torrent™ instruments are free from defects in material and workmanship and conform to Life Technologies' published specifications in all material respects. Where a valid and timely claim in respect of breach of Ion Torrent™ warranty is submitted to Life Technologies, Life Technologies may, at its discretion, replace, repair or modify the Ion Torrent™ instrument. Any agreed replacement shall be at 1:1, like-kind basis, at no cost to the buyer. For Ion Torrent™ chips or reagents reasonably determined by Life Technologies to be defective, independent of user error, shall be replaced by Life Technologies on a 1:1, like-kind basis at no cost to buyer, provided that such defective Ion Torrent™ chips or reagents were used by buyer prior to their expiration date, or if there is no expiration date, the Ion Torrent™ chips or reagents were used within six (6) months of receipt, and the defect was promptly reported with appropriate detail to Life Technologies' technical support.

NO OTHER WARRANTIES SHALL BE APPLICABLE TO ION TORRENT PRODUCTS (WHETHER OR NOT ANY FURTHER WARRANTY DOCUMENTATION MAY BE INCLUDED IN THE SHIPMENT), WITH THE EXCEPTION OF THIRD PARTY WARRANTIES WITH RESPECT TO THIRD PARTY PRODUCT. ANY THIRD PARTY PRODUCTS ARE NOT COVERED BY THIS SECTION AND ANY WARRANTIES FOR THIRD PARTY PRODUCTS ARE PROVIDED BY THE ORIGINAL MANUFACTURER OF THE THIRD PARTY PRODUCT. Warranties are made only to buyer purchasing the Ion Torrent™ Product directly from Life Technologies, are not transferable and do not extend to the benefit of any other person or entity, unless otherwise expressly stated in writing by Life Technologies. ANY PRODUCT NOT COVERED BY AN EXPRESS WRITTEN WARRANTY IS SOLD AND PROVIDED "AS IS," WITHOUT WARRANTY OF ANY KIND, STATUTORY, EXPRESS OR IMPLIED. Any description of Ion Torrent™ Product recited in Life Technologies' quotation is for the sole purpose of identifying Ion Torrent™ Product, and any such description is not part of any contract between Life Technologies and buyer and does not constitute a warranty that Ion Torrent™ Product shall conform to that description. Any sample or model used in connection with Life Technologies' quotation is for illustrative purposes only, and is not part of any contract between Life Technologies and buyer and does not constitute a warranty that Ion Torrent™ Product will conform to the sample or model. No affirmation of fact or promise made by Life Technologies, whether or not in Life Technologies' quotation, shall constitute a warranty that Ion Torrent™ Product will conform to the affirmation or promise. Unless otherwise specified in writing in documentation shipped with Ion Torrent™ Product or otherwise agreed by Life Technologies in writing. Life Technologies does not provide service or support for custom products or other products made to buyer's specifications. THE WARRANTIES IDENTIFIED IN THIS CLAUSE ARE LIFE TECHNOLOGIES' SOLE AND EXCLUSIVE WARRANTIES WITH RESPECT TO Ion Torrent™ PRODUCT AND ARE IN LIEU OF ALL OTHER WARRANTIES, STATUTORY, EXPRESS OR IMPLIED, ALL OF WHICH OTHER WARRANTIES ARE EXPRESSLY DISCLAIMED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR

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Customer and technical support

Visit **thermofisher.com/support** for the latest in services and support, including:

- Worldwide contact telephone numbers
- Product support
- Order and web support
- Safety Data Sheets (SDSs; also known as MSDSs)

Additional product documentation, including user guides and Certificates of Analysis, are available by contacting Customer Support.

Obtaining Certificates of Analysis

The Certificate of Analysis provides detailed quality control and product qualification information for each product. Certificates of Analysis are printed and shipped with the product.

Obtaining Certificates of Conformance

The Certificate of Conformance provides information on conformance testing of each instrument provided with the system. Certificates of Conformance are shipped with the instrument, and are also available by contacting Customer Support at **thermofisher.com/support**.

iontorrent
by Thermo Fisher Scientific

Oncomine™ Dx Target Test Part V: Analysis and Test Reports

USER GUIDE

Publication Number MAN0016171

Revision C.0

IVD

For In Vitro Diagnostic Use.

Life Technologies Holdings Pte Ltd |
Block 33 |
Marsiling Industrial Estate Road 3 |
#07-06, Singapore 739256

Products manufactured in Singapore:

Ion PGM™ Dx Instrument System
Ion PGM™ Dx Sequencer
Ion OneTouch™ Dx Instrument
Ion OneTouch™ ES Dx Instrument
Ion PGM™ Dx Chip Minifuge (120V)
Ion PGM™ Wireless Scanner
Ion Torrent™ Server
Veriti™ Dx Thermal Cycler

Life Technologies Corporation |
7335 Executive Way |
Frederick, MD 21704 | USA

Products manufactured in Frederick:

Oncomine™ Dx Target Test Kit
Ion Torrent Dx FFPE Sample Preparation Kit
Ion PGM™ Dx Library Kit
Ion OneTouch™ Dx Template Kit
Ion PGM™ Dx Sequencing Kit
Ion 318™ Dx Chip
Ion OneTouch™ Rack Kit
DynaMag™ Dx 96-Well Plate Magnet
DynaMag™ Dx 16 2-mL Magnet

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

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A.0	30 September 2016	FDA submission

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About this guide

Purpose of this guide

This user guide provides instructions for using Torrent Suite™ Dx Software to analyze sequencing data generated from sample libraries prepared using the Oncomine™ Dx Target Test Kit.

Oncomine™ Dx Target Test Kit user guides

This user guide is part of a five-guide set.

Note: The procedures in these guides supersede the instructions in the *Ion PGM™ Dx System User Guide* when using the Ion PGM™ Dx System with the Oncomine™ Dx Target Test.

- *Oncomine™ Dx Target Test Part I: Sample Preparation and Quantification User Guide*
- *Oncomine™ Dx Target Test Part II: Library Preparation User Guide*
- *Oncomine™ Dx Target Test Part III: Template Preparation User Guide*
- *Oncomine™ Dx Target Test Part IV: Sequencing User Guide*
- *Oncomine™ Dx Target Test Part V: Analysis and Test Reports User Guide*

All five guides are required to complete the entire Oncomine™ Dx Target Test workflow.

1 Product information

Product description

Oncomine™ Dx Target Test

The Oncomine™ Dx Target Test is an *in vitro* diagnostic next-generation sequencing test to detect somatic alterations in human DNA and RNA isolated from non-small cell lung cancer (NSCLC) tumor specimens in formalin-fixed, paraffin-embedded (FFPE) tissue samples. Detection of these variants is performed using the Ion PGM™ Dx System.

The Oncomine™ Dx Target Test Kit (Cat. No. A32451) provides a set of primers in two panels that target key regions of 23 cancer-related genes.

Software system

Torrent Suite™ Dx Software is a software system for managing samples and libraries, as well as creating, executing, and analyzing templating and sequencing runs on the Ion PGM™ Dx System. The Oncomine™ Dx Target Test assay is a locked assay in the software that provides configuration and analysis settings for using the Oncomine™ Dx Target Test Kit.

Intended use

For the Intended Use statement for the Oncomine™ Dx Target Test, see the *Oncomine™ Dx Target Test Part I: Sample Preparation and Quantification User Guide* (Pub. No. MAN0016167).

Theory of operation

For a complete description of the Theory of Operation of the system, see the *Oncomine™ Dx Target Test Part I: Sample Preparation and Quantification User Guide* (Pub. No. MAN0016167).

Software description

Torrent Suite™ Dx Software is hosted on the Ion Torrent™ Server, part of the Ion PGM™ Dx System.

Torrent Suite™ Dx Software is used with the Oncomine™ Dx Target Test Assay Definition File, Ion OneTouch™ Dx Instrument Control software, and Ion PGM™ Dx Instrument Control software to support the system workflow from sample

preparation through library preparation, template preparation, sequencing, primary and secondary analysis, and generation of Oncomine™ Dx Target Test reports.

Software component	Main functions
Torrent Suite™ Dx Software	• Generates base calls and quality values (primary analysis) • Filters and trims reads to ensure high sequence accuracy • Performs alignments and variant calling and generates reports using parameters in the Oncomine™ Dx Target Test Assay Definition File (secondary analysis) • Hosts the Torrent Suite™ Dx Software web application
Oncomine™ Dx Target Test Assay Definition File	Installed with the Torrent Suite™ Dx Software, this file contains gene lists and parameters for sequencing and analysis of DNA and RNA variants targeted by the Oncomine™ Dx Target Test Kit
Ion OneTouch™ Dx Instrument Control software	• Provides control of the Ion OneTouch™ Dx Instrument via a touchscreen interface • Enables users to prepare template-positive Ion PGM™ Dx Ion Sphere™ Particles using the instrument • Enables users to perform instrument maintenance
Ion PGM™ Dx Instrument Control software	• Provides control of the Ion PGM™ Dx Sequencer via a touchscreen interface • Enables users to perform sequencing workflows using the instrument • Collects and compresses sequencing data, then transfers data to the Ion Torrent™ Server for primary and secondary analysis • Enables users to perform instrument maintenance

Features of Torrent Suite™ Dx Software

Torrent Suite™ Dx Software enables users to:

- Generate reports on detected sequence variations in DNA and RNA in 23 genes targeted by the Oncomine™ Dx Target Test
- Enter and manage information about samples and create libraries and library batches
- Plan runs to be executed on the Ion PGM™ Dx System instruments
- Monitor the progress of active instrument runs
- View and download run results and analysis reports

- View QC settings
- View workflow settings
- Manage user information and privileges
- View audit trails
- Configure archiving, reporting, and other administrative functions

Note: The *Oncomine™ Dx Target Test Part V: Analysis and Test Reports User Guide* provides instructions for using the Torrent Suite™ Dx Software in IVD Mode only.

Limitations and Precautions

Torrent Suite™ Dx Software contains the limitations noted below. Please ensure that any use of the software takes into consideration these limitations.

- User names can contain alphanumeric characters and underscores, periods, and hyphens. Passwords can only contain alphanumeric characters.
- Torrent Suite™ Dx Software is intended to be used only with the Ion PGM™ Dx System and will not accept any software plugins.

Software compatibility and requirements

The procedures in this guide are designed for use with Torrent Suite™ Dx Software version 5.6 or later. To view the current software version, log in to the software as an Administrator, click on the **Settings (⚙)** tab, then select **Configuration** and click on the **Software Updates** tab. Version-specific information is provided in the software release notes for your version of the software.

Torrent Suite™ Dx Software is supported on Chrome™ browser version 39, and is best viewed with 1024 × 768 screen resolution. It has not been tested with other browsers.

The Ion Torrent™ Server operating system is Ubuntu™ 14.04 LTS.

Anomalies

For Torrent Suite™ Dx Software anomalies, refer to the release notes for your version of the software, included on the software USB drive.

2 Before you begin

User-access levels

Users at this level...	Can:
Operator	• Add or select a sample library file • Import a sample library file • Create and save a Planned Run • Perform a Planned Run
Manager	Operator functions plus: • Manage sample attributes (create new, edit, obsolete) • Delete Planned Runs • Approve a report, allowing the system to release it • Access **References** information • Access **Services** information
Administrator	Manager functions plus: • **Audit records**: View, export and print • **Network settings**: Configure • **Data storage**: Manage archiving, view available disk space • **Logs**: Manage retention of instrument logs and Torrent Suite™ Dx Software logs • **User management**: Add users, assign user level, edit user information

Ion PGM™ Dx System synchronization requirement

IMPORTANT! Allow up to 20 minutes for instruments to synchronize with the Ion Torrent™ Server following power-cycling any of the Ion PGM™ Dx Sequencer, Ion OneTouch™ Dx Instrument, or Ion Torrent™ Server. Failure to allow system components to re-synchronize will generate an alarm until synchronization is complete.

Network configuration and security

The network configuration and security settings of your laboratory or facility (e.g., firewalls, anti-virus software, network passwords) are the sole responsibility of your facility administrators and IT and security personnel. Torrent Suite™ Dx Software does not provide any network or security configuration files, utilities, or instructions.

If external or network drives are connected to the Ion Torrent™ Server, it is the responsibility of your IT personnel to ensure that such drives are configured and secured correctly to prevent data corruption or loss.

If a LIMS system is configured to retrieve analysis files from the Ion Torrent™ Server, manual FTP setup or drive mapping is required. This configuration is not provided as part of Ion Torrent™ Server installation, and must be set up by your LIMS system integration or IT group.

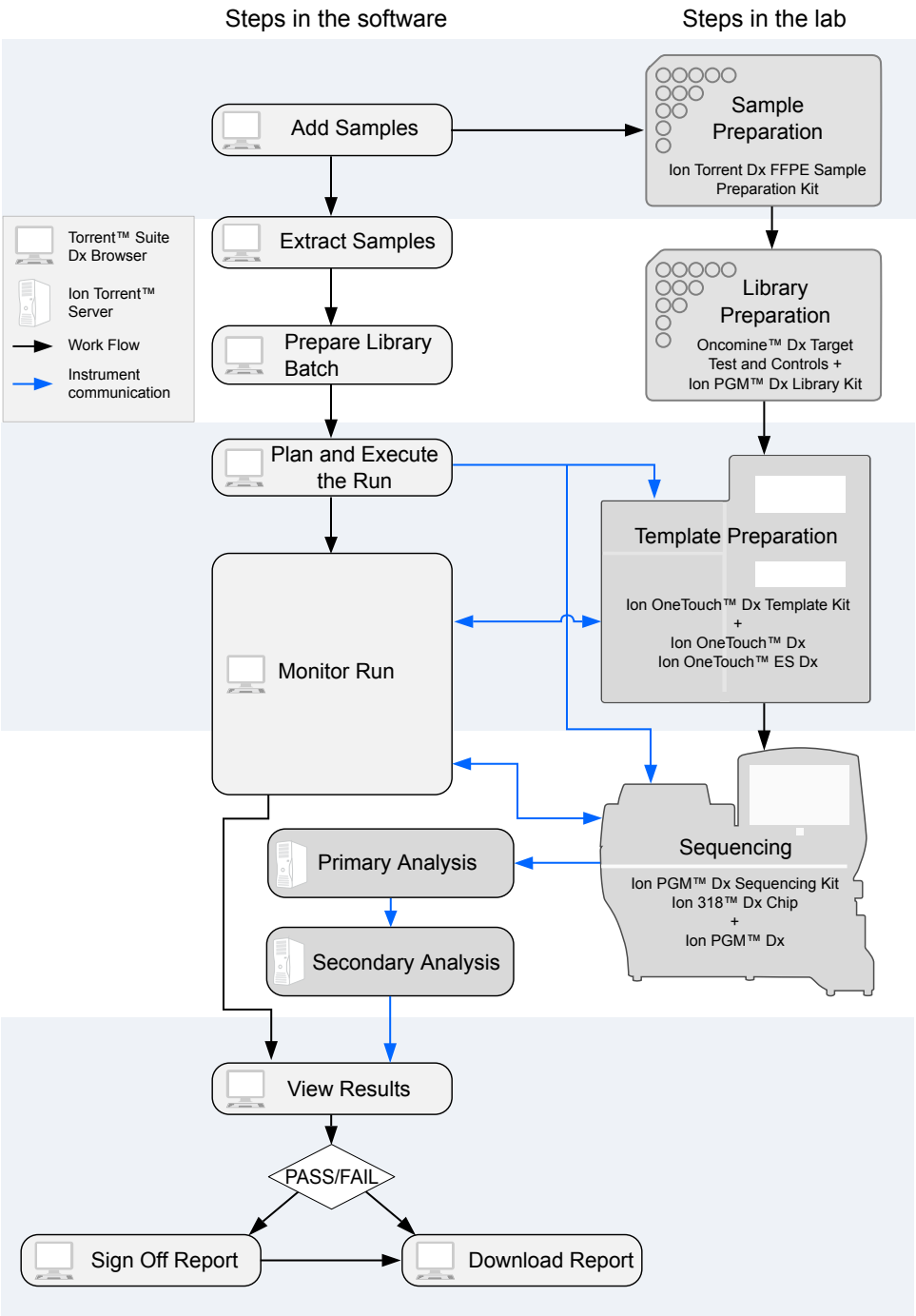
System tracking

The system tracks and checks user, sample, workflow, reagents and QC metrics for auditable records. If the software detects an error at any step—for example, a scanned barcode is inconsistent with the information given for the run—the software alerts the user and does not proceed with the run.

Reagent management

Users should put in place a reagent management system to inventory and track reagent use. Proper use of a reagent management system promotes regulatory compliance and ensures optimal use of kits, chips, and reagents.

Oncomine™ Dx Target Test system diagram



Installation and verification run

Do not attempt to power on any Ion PGM™ Dx System instruments or log on to the Torrent Suite™ Dx Software until a field service engineer (FSE) has installed and performed the initial performance qualification (PQ) verification run and provided a basic system overview.

The Torrent Suite™ Dx Software, including all associated Ion PGM™ Dx System instruments, will remain locked to the user until a verification run has been performed and the report signed by the FSE.

Register for and log into a new account

Only users with Administrator privileges can create user accounts.

Upon account creation, the Ion PGM™ Dx System will automatically send a welcome email to the email address of the new user with the new user name and password information.

- To register a new account, contact your local Administrator to request a user name and password.

  Upon account creation, the Ion PGM™ Dx System will automatically send a welcome email to the address of the new user with the new user name and password.

- To log into a new account for the first time:
  a. Go to the Torrent Suite™ Dx Software home page, and enter your user name in the **Username** field.
  b. Enter the system-generated password in the **Password** field.
  c. Press **Enter**, or click the **Sign In** button.
  d. Review and **Accept** the End User Software License Agreement to open the **Change Password** page.
  e. Enter your temporary password in the **Current Password** field. Type a new password in the **New Password** field and confirm the password.
     – Passwords must be between 6 and 10 characters.
     – Passwords must contain at least one alphabetic character (a-z, A-Z).
     – Passwords must contain at least one numeric character (0-9).
     – Passwords must contain only alphanumeric characters (numbers 0 to 9 and letters A to Z), no spaces or special characters.
     – Passwords are case sensitive.
  f. Click **Change**.
     The Torrent Suite™ Dx Software will open and you will be logged in.

Thereafter, when you return to the Torrent Suite™ Dx Software home page, enter your user name and password into the respective fields and click the **Sign In** button.

Note: For more information on creating user accounts, see "User Management (Administrator)" on page 83.

Sign in

To sign into the Torrent Suite™ Dx Software:

1. Open the software home page.
2. Under **Mode Switch** at the bottom of the page, verify that **IVD Mode** is selected.

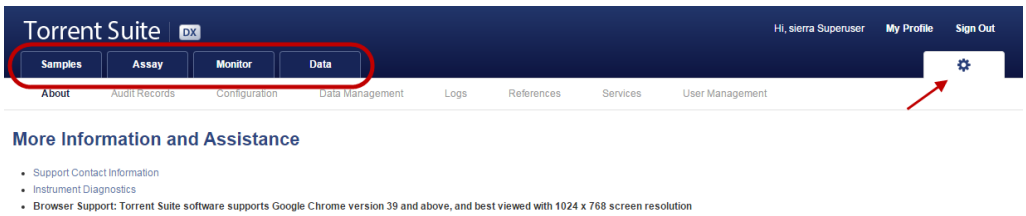
   Note: If you are not in **IVD Mode**, contact a system administrator to switch modes.
3. Select your preferred language from the dropdown list in the upper right corner of the page.
4. Enter your user name and password, then press **Enter** or click **Sign In**.

   IMPORTANT! Your user name and password must be unique and not shared with other users.

   The software will open to the **Samples** tab and the **Manage Samples** screen.

User interface

The Torrent Suite™ Dx Software has a browser-based interface that is organized according to four main phases of the sequencing lifecycle:



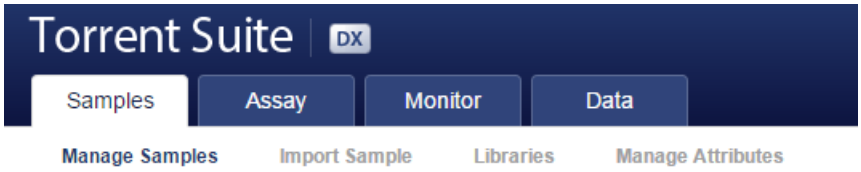
- **Samples** tab—Create and manage samples and libraries; plan new runs from libraries.
- **Assay** tab—Manage assays (protocol specifications for templating, sequencing, and data analysis) and create and manage Planned Runs (executable instructions for individual runs). The system uses the Planned Run to verify at each step of the run that the correct kit is used to perform the correct assay on the correct sample.
- **Monitor** tab—View the status of your system instrument(s) and current runs. Near real-time information is provided on your runs, so that you know early on about any instrument issues.
- **Data** tab—View summaries of completed runs, and detailed run reports; review the run plan settings; download or print output files and run reports.

Throughout the Torrent Suite™ Dx Software, click the ⚙ tab to access more information and assistance. Also, it is through the ⚙ tab that Administrator-level users can access most administrative functions.

Click on **My Profile** to view your user account information. Within the **My Profile** window, users of all privilege levels can change their password and email address.

To exit the software at any time, and return to the home page, click **Sign Out**.

3 Samples and Libraries



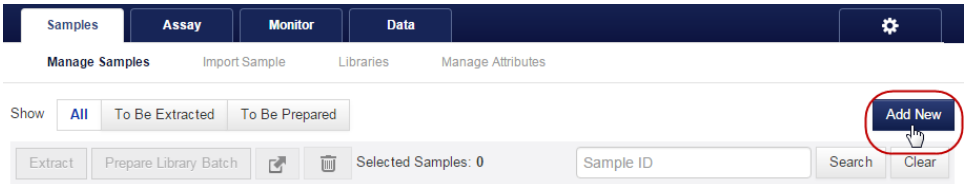
Prior to sample and library preparation, sample and library information must be entered into the Torrent Suite™ Dx Software. This information is then tracked by the software throughout the entire system workflow.

In the **Samples** tab, you can:

- Create and manage samples and their attributes
- Prepare libraries and library batches
- Create Planned Runs

Add a new sample

1. Under the **Samples** tab, in the **Manage Samples** screen, click on the **Add New** button.



2. In the **Add New Sample** dialog, fill out the fields as follows:

   Note: Fields identified with a red asterisk (*) in the dialog are required. If no information is available, substitute dummy data to complete required fields.

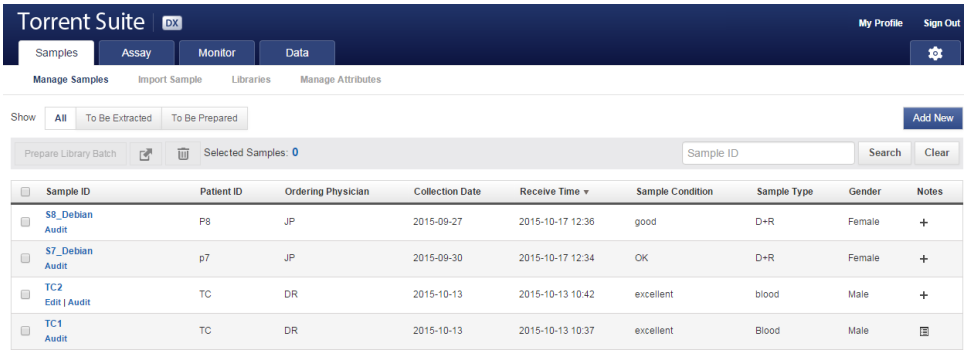
Field	Description
Sample ID*	A unique identifier representing the sample, containing only alphanumeric characters (0–9 and A to Z), full stops/periods (.), underscores (_), or hyphens (-). The Sample ID cannot contain spaces and is limited to a maximum of 20 characters. **Note:** After a Sample ID is entered into the system, it cannot be edited. It can be deleted unless it has already been used in a library. The software checks all Sample IDs entered or imported to prevent duplication and will return an error message if a non-unique Sample ID is detected.

Field	Description
Patient ID*	An identifier representing the patient. This field accepts all characters including spaces.
Date of Birth*	The patient's date of birth. Click the button to select the date in the correct format.
Ordering Physician*	The name of the ordering physician. This field accepts all characters including spaces.
Collection Date*	The date the sample was collected from the patient. Click the button to select the date in the correct format.
Sample Source **Sample Condition*** **Sample Type***	These are open-entry fields that accept all characters, including spaces.
Gender*	The biological gender of the sample. This must be Male, Female, or Unknown.
Cancer Type*	The type of cancer to be tested in the sample.
%Cellularity	The percentage of tumor cellularity in the sample.
%Necrosis	The percentage of cellular necrosis in the sample.
Reference Interval	A normal range of measure for the sample.
Notes	An open-entry field.

3. Click **Save**. The sample will be listed in the **Manage Samples** screen.

Manage samples

The tools for creating, searching, sorting, editing, deleting, exporting samples, and viewing the sample history are be found under the **Samples** tab, in the **Manage Samples** screen



Search samples

Under the **Samples** tab, in the **Manage Samples** screen:

1. Enter the full or partial sample ID into the **Sample ID** field.
2. Click **Search**.
   The sample(s) matching the search parameters will be listed.
3. Click **Clear** to return to the complete list of samples.

Sort samples

Under the **Samples** tab in the **Manage Samples** screen, the list of samples is displayed with the most recently created sample on top by default. To return to the default display, click **Manage Samples**.

- To list only those samples which have not been extracted, click **To Be Extracted**.
- To list only those samples which have not been prepared as a library, click **To Be Prepared**.
- To list all samples, click **All**.
- To sort the list:
  a. Click on a column header to sort the list by the entries in that column.
  b. Click on the column header again to reverse the order.
  c. Click **Manage Samples** to return to the default order (most recently created on top).

Export and print samples

The **Export** function generates a .xls file of the sample details.

1. Under the **Samples** tab in the **Manage Samples** screen, select the samples to be exported by clicking in the checkbox adjacent to the **Sample ID**. Select all the samples on the page by selecting the checkbox above the column.
2. Click (**Export**).
   A .xls file will be generated. Depending on your internet browser settings, the Torrent Suite™ Dx Software will automatically download the file, or ask whether you want to open or save the file.
3. Open the downloaded .xls file in an appropriate viewer, then print the record from within the open document.

Edit sample details

Under the **Samples** tab in the **Manage Samples** screen, editable samples are identified by the **Edit** button under the Sample ID. Samples that have been assigned to a library are locked and cannot be edited or deleted.

Note: The Sample ID cannot be edited.

1. Click **Edit** in the row for the sample to be edited.

   The **Edit Sample** dialog will open.

2. Click in a field to edit the information. For a description of the fields, see "Add a new sample" on page 18.

   Note: The Sample ID cannot be edited.

3. Enter a reason for the edits in the **Reason for Change** field, then click **Save**

Review sample history

The entire history of a sample is available for review, export, or printing.

1. Under the **Samples** tab in the **Manage Samples** screen, click **Audit** below the Sample ID for the sample of interest.
   The **Audit Trail** dialog window will open. Listed in the window is each modifying event for the selected sample.

2. Click on the details icon under the **Record** header to view the details of the change made.
   The **Audit Record Details** dialog will open, detailing the edits made.

3. In the **Audit Record Details** dialog, click:
   a. **Export** to export a Print-Ready PDF of the record.

   b. **Cancel** to return to the **Audit Trail** window.

4. Click **Cancel** to return to the **Manage Samples** screen.

Delete samples

Under the **Samples** tab, in the **Manage Samples** screen, you can delete samples that have not been assigned to a library.

Note: Samples assigned to libraries are locked and cannot be edited or deleted. Locked samples only display **Audit** under the **Sample ID**.

1. Select the sample(s) to be deleted by selecting the checkbox adjacent to the **Sample ID**. Select all the samples on the page by selecting the checkbox above the column.

2. Click (**Delete**).
   The **Delete Sample** dialog will open with the message "Are you sure you want to delete following Sample(s) ?"

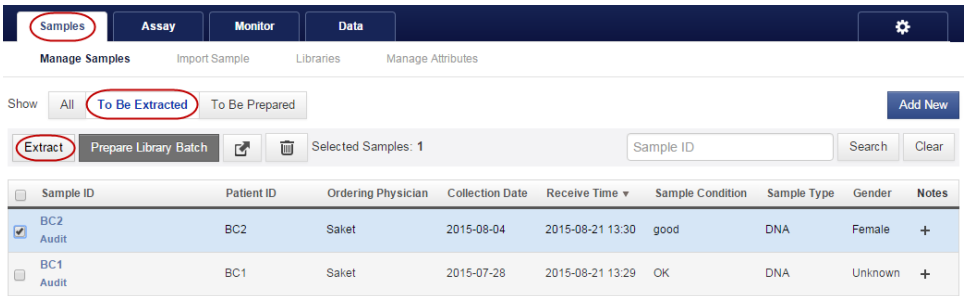
3. Click **Yes** to delete the selected sample(s). Click **No** to return without deleting.

Enter the extraction kit barcode

Under the **Samples** tab, in the **Manage Samples** screen, you can scan or enter the barcode of the kit used to extract each sample. This barcode is saved with the sample and can be viewed by clicking on the Sample ID.

1. Above the samples list, click **To Be Extracted** to display only those samples that do not have an extraction kit barcode associated with them.

2. Select the checkbox of the sample that will be extracted. Select multiple samples if using the same Sample Extraction kit.



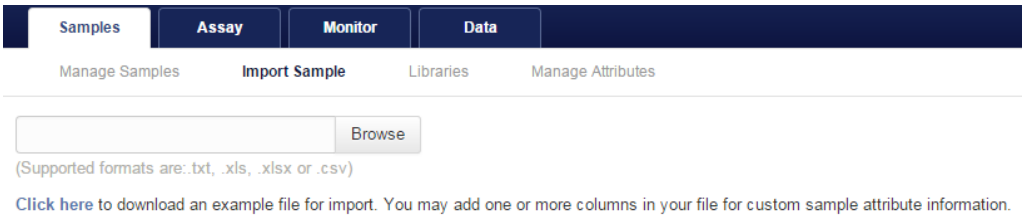
3. Click **Extract**. In the dialog box, scan the barcode printed on the Ion Torrent Dx Total Nucleic Acid Isolation Kit (box 1 of 2, Part No. A32434).

   IMPORTANT! Check the expiration date on the box. If the kit is expired, select another kit.

4. Click **Save**. The sample will no longer be listed in the **To Be Extracted** list.

Import samples

Under the **Samples** tab in the **Import Sample** screen, you can import sample data in the form of a .txt, .xls, .xlsx or .csv file. Ensure that the same sample attributes that are entered in the **Add new sample** dialog are included in the import file.



1. In the **Import Sample** screen, below the **Browse** field, click **Click here** to download a Microsoft™ Excel™ template file.

   Note: The template file contains default sample attributes as columns. If additional custom sample attributes have been configured in the software, these attributes need to be added as columns to the template file.

   a. In the template file, fill in data for each sample, one sample per row. Required attributes are flagged with an asterisk (*).

      - Sample ID*
      - Patient ID*
      - Sample Source
      - Ordering Physician*
      - Sample Condition*
      - Collection Date*
      - Gender*
      - Cancer type*
      - Notes
      - Reference Interval
      - Date Of Birth*
      - Sample Type*
      - %Cellularity
      - %Necrosis

      *Indicates a field required to be filled in during sample creation.

   b. Click **Save** or **Save As** to save the file.

2. Click **Browse**, then navigate to the saved file and click **Open**.

3. Click **Import**.

   A progress bar followed by an import report will display. If the import process fails, an error message will indicate the reason for failure (e.g., an invalid character was used). For additional troubleshooting, see "Batch sample import fails" on page 87.

4. Click **Manage Samples** to return to the sample list. Successfully imported samples will be listed.

Manage sample attributes *(Manager/Administrator)*

Torrent Suite™ Dx Software has the following predefined sample attributes, which are listed under the **Samples** tab in the **Manage Attributes** screen.

- Sample ID*
- Patient ID*
- Date Of Birth*
- Ordering Physician*
- Collection Date*
- Sample Source
- Sample Condition*
- Sample Type*
- Gender*
- Cancer Type
- %Cellularity
- %Necrosis
- Reference Interval
- Notes

*Indicates a field required to be filled in during sample creation.

Predefined attributes are locked and cannot be edited. You can create and manage custom sample attributes using the tools in the **Manage Attributes** screen.

Note: LIMS users must create custom attributes before importing sample and Planned Run information from LIMS for the attributes to be propagated through to Ion Torrent™ Server output files. The Torrent Suite™ Dx Software will ignore all input-file content that is not a recognized attribute.

Create a new sample attribute

1. Under the **Samples** tab in the **Manage Attributes** screen, click **Add New Attribute**.
2. Enter an attribute name in the dialog.

   Note: Attribute names are limited to ≤20 alphanumeric characters (0–9 and A to Z), full stops/periods (.), underscores (_), or hyphens (-).
3. Specify whether the attribute is a text or number in the **Data Type** dropdown list.
4. Select the **Required** checkbox to designate the new attribute as required in the **Add New Sample** dialog.

   Note: Users will not be able to create a new sample if this information is not entered in the **Add New Sample** dialog.
5. Click **Save**.

   The new sample attribute will be listed in the **Attribute Name** column and will be available when you add a new sample. After an attribute has been created, it cannot be deleted. To remove an attribute from use, see "Obsolete an attribute" on page 25.

   Note: When editing samples created before a new attribute was created, the new attribute will appear in the **Edit Sample** dialog. If the new attribute was designated as required, a valid entry must be entered into the new attribute field to save the sample information.

   Note: Samples are no longer editable after they have been added to a library.

Obsolete an attribute

Under the **Samples** tab in the **Manage Attributes** screen, you can obsolete user-created sample attributes to remove them from use in the software. Obsoleted attributes can be reactivated, and a record of their use is maintained in the audit trail of samples created using that attribute.

Note: You can only obsolete user-created attributes, not system-installed attributes.

- To obsolete an attribute, click **Obsolete** in the **Actions** column, and confirm the action.
  In the attributes list, **Reactivate** will replace **Edit | Obsolete** under the **Actions** header.
- To reactivate an attribute, click **Reactivate** in the **Actions** column.

  Note: All active sample attributes are listed in the **Add New Sample** dialog.

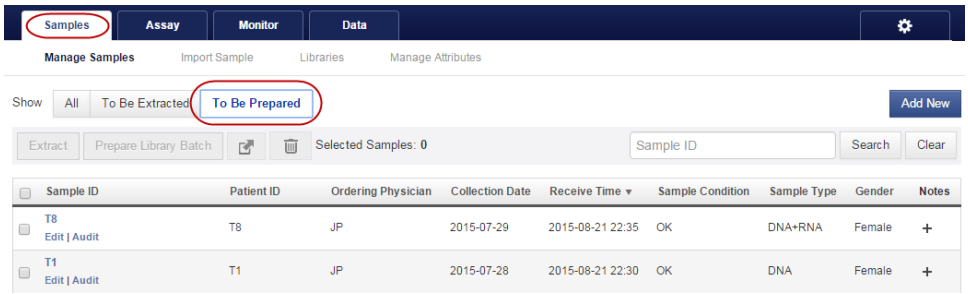
Prepare a library batch in Torrent Suite™ Dx Software

In Torrent Suite™ Dx Software, samples entered into the software are placed in library batches for processing and tracking. A library batch consists of a group of libraries that are prepared at the same time.

Note:
- Each library within a library batch must have a unique library name. When combining libraries in the same run, each must also have a unique barcode.
- Control libraries must be included in the same library batch as the sample library they control for.
- Fields identified with a red asterisk (*) are required.

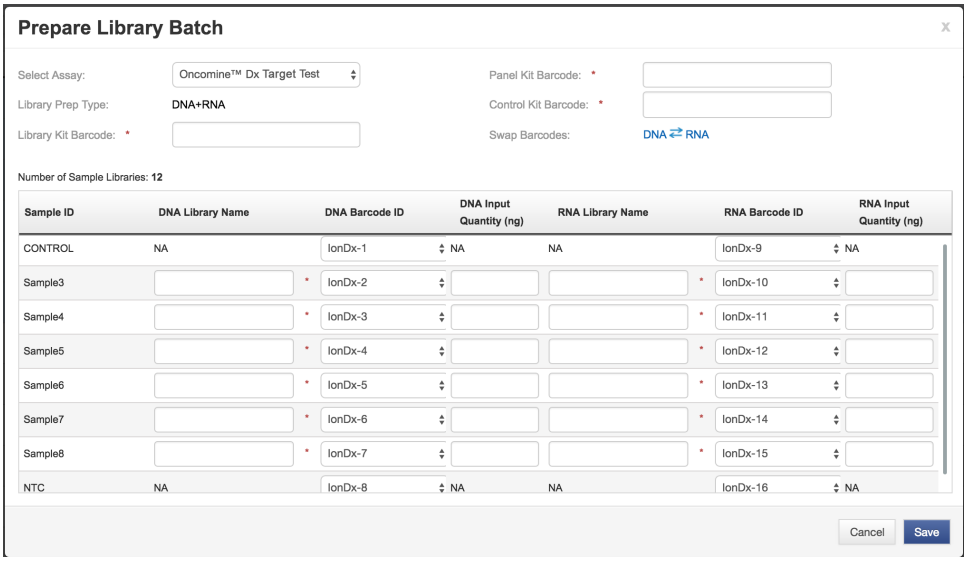
1. Sign in to the Torrent Suite™ Dx Software.
2. Under the **Samples** tab, in the **Manage Samples** screen, click **To Be Prepared** to display only those samples that have not been placed in a library batch.

   IMPORTANT! Samples that have not been queued for extraction in the software will also appear on this tab. Ensure that the samples have been queued for extraction prior to queueing them for library batch preparation.



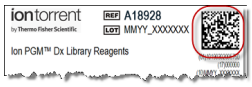
3. Select up to 6 samples in the list, then click **Prepare Library Batch**.
   The **Prepare Library Batch** dialog will open. Required fields are indicated with a red asterisk(*).

4. In the **Select Assay** dropdown list, select **Oncomine™ Dx Target Test**. The assay determines certain parameters of the run, including required controls and post-run data analysis settings.



5. Scan the barcodes from their respective kit boxes into the appropriate fields. Each library batch is associated with a kit lot by scanning the 2D barcode on the appropriate kit box.

IMPORTANT! Check the expiration date on each box. If the kit is expired, select another kit.

Barcode field	Kit	Kit box	Storage	Label scanned
Library Kit Barcode	Ion PGM™ Dx Library Kit	Ion PGM™ Dx Library Reagents	–30°C to –10°C	
Panel Kit Barcode	Oncomine™ Dx Target Test Panel	Oncomine™ Dx Target Test DNA and RNA Panel (box 1 of 3)	–30°C to –10°C	
Control Kit Barcode	Oncomine™ Dx Target Test and Controls	Oncomine™ Dx Target DNA Control (box 2 of 3)	–30°C to –10°C	

6. Type a unique library name for each library in the batch. Library names may only contain alphanumeric characters (0–9 and A to Z), full stop/period (.), underscore (_), and hyphen (-).

Note: The Oncomine™ Dx Target Test Kit requires specific controls, which are automatically listed in the dialog box shown in step 4.

7. Select the Barcode ID of the adapter used to prepare each library. Swap the default barcodes in the dialog between DNA and RNA using the DNA ⇄ RNA button.

   Note: Each library in a library batch must have a different Barcode ID. When preparing the physical libraries, we recommend swapping barcodes between DNA and RNA libraries in consecutive sequencing runs to prevent carryover contamination. See "Alternating barcodes" on page 27.

   IMPORTANT! Be careful to confirm that the actual barcodes used to create the libraries match the barcodes entered in the **Prepare Library Batch** dialog.

8. In the **Input Quantity** field, enter 10 ng for each library.

9. Click **Save** to save your selections and close the dialog.
   The **Libraries screen** will open, listing the libraries that you created. Libraries prepared in the same batch will have the same **Library Batch ID**.

Alternating barcodes

When preparing libraries, we recommend swapping barcodes between DNA and RNA libraries in consecutive sequencing runs to prevent carryover contamination. The following table provides an example of swapping barcodes between runs.

IMPORTANT! Be careful to confirm that the barcodes used to create the libraries match the barcodes entered in the **Prepare Library Batch** dialog.

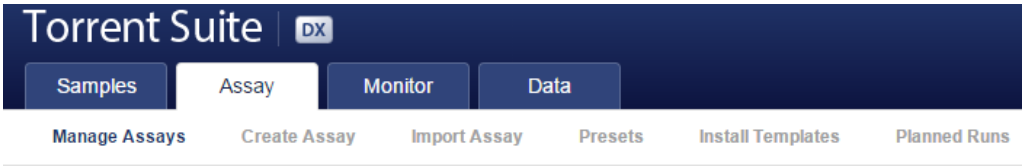
Library type	System Run 1 barcode usage		System Run 2 barcode usage	
	DNA	RNA	DNA	RNA
Positive control	1	9	9	1
Sample	2	10	10	2
Sample	3	11	11	3
Sample	4	12	12	4
Sample	5	13	13	5
Sample	6	14	14	6
Sample	7	15	15	7
No-template control (NTC)	8	16	16	8

Manage libraries

The **Libraries** screen under the **Samples** tab lists libraries that have been created but not yet sequenced. The following tools are available on the screen:

To...	Do the following...
View library information	Hover over the library name in the list to display the information.
View all libraries	Above the library list, click **All** to list all libraries.
View libraries that are not in a Planned Run	Above the library list, click **To Be Planned** to list only those samples that have not been placed in a Planned Run.
Search all libraries	1. Enter the full or partial sample ID into the Sample ID field and click **Search**. The libraries matching the search parameters will be listed. 2. Click **Clear** to return to the complete list of libraries.
Sort the samples in the list	Click on a column header to sort the list alphabetically or numerically by the information in that column.
View multiple pages of samples	Use the scroll buttons below the sample list to view multiple pages of samples in the list. The default number of samples displayed per page is 20, which can be changed by selecting from the adjacent dropdown menu.
Delete libraries	Select the checkbox next to the libraries you want to delete, then click the button. **Note:** You can only delete a library if none of the libraries in the same library batch have been assigned to a Planned Run.
View or export the audit trail of a library (i.e., the library history)	1. Click on the **Audit** button below the Library Batch ID. Each user, action performed, and timestamp of the action will be displayed in table format. 2. Click the (Audit Record Details) button to view the detail of each action. In the Audit Record Details dialog, you can click on **Export** to export the record.
Add or modify notes for a library	In the **Notes** column, click on the **+** button.

4 Assays and Planned Runs



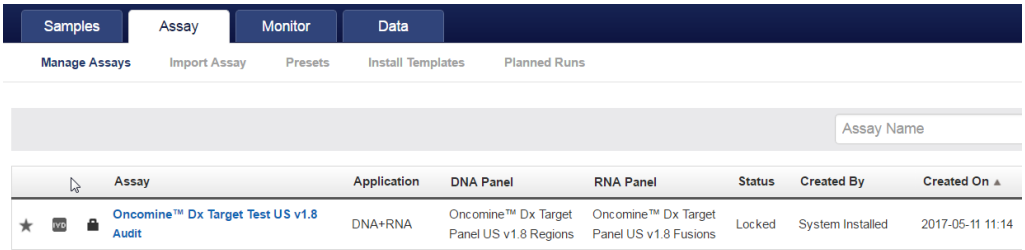
The **Assay** tab contains tools for viewing the Oncomine™ Dx Target Test assay and managing and creating Planned Runs.

Planned Runs contain all the required sample and library information for template preparation and sequencing. Each Planned Run includes a Run Short Code in alphanumeric and barcode formats. By scanning or entering the code, the Planned Run's settings are transferred to the instruments. Each run and its associated samples, libraries, and assay are tracked from template preparation through sequencing, data analysis, and export.

Oncomine™ Dx Target Test assay

The Oncomine™ Dx Target Test assay is a locked assay that contains the settings and parameters for analyzing sequencing results and determining valid variant calls for the Oncomine™ Dx Target Test. It also defines the kits and chips that can be used with the test, and specifies the threshold values for quality control and variant detection.

IMPORTANT! The assay cannot be edited or used as the basis for a Reanalysis assay.



Search and sort assays

Under the **Assay** tab in the **Manage Assays** screen, the most recently created assay is listed first by default. To return to the default display, click **Manage Assays** to refresh the screen.

- To search the assay list:
  a. Enter the full, or partial, assay name into the **Assay Name** field.
  b. Click **Search**.
     The assay(s) matching the search parameters will be listed.

c. Click **Clear** to return to the complete list of assays.

- To sort the assay list:
  a. Click on the desired column header.
     The list of assays will reorder based on the column.
  b. Click on the header name a second time to reverse the order.

View assay details

The **View Assay Details** dialog displays all the settings for an assay. To open this dialog:

1. In the **Manage Assays** screen, click an assay name in the list.
2. Scroll down to view the all the settings.

Review the assay audit trail

Managers and Administrators can review and export the details of all the actions performed on an assay.

1. In the **Manage Assays** screen, click **Audit** under the assay name.
2. Each action performed on the assay is listed in the **Audit Trail** dialog. Click in the **Record** column to view the details of each action.
3. In the **Audit Record Details** dialog, click **Export** to export a PDF of the selected record.

Assay presets

Report templates

You can create and manage custom report templates used to generate PDF reports after a run. You select a report template when you set up a Planned Run.

The tools for setting up report templates are located in the **Report Templates** subtab under the **Assay** tab in the **Presets** screen.

Manage report templates

The tools for managing report templates are located under the **Assay** tab in the **Presets** screen under the **Report Templates** subtab.

- To view the details of a report template, click on the template name.
- To make a template unavailable in the software, click **Obsolete** in the **Actions** column.
- To add notes to a template, click the **+** sign in the **Notes** column.
- To view notes for a template, click the symbol in the **Notes** column.

Create a report template

To create a report template:

1. Under the **Assay** tab in the **Presets** screen, click the **Report Templates** subtab.
   Existing report templates are listed on this page, including any system-installed templates.

2. Click **Add New**.

   Note: To plan a run with the Oncomine™ Dx Target Test assay, a report template must be created and associated with the assay by an Administrator or Manager.

3. Enter the **Report Name** and select the **Assay** from the dropdown list.

   Note: Use the **Click here** links to the right of the fields to download an example Lab Report or Test Report.

4. In the **Select Language** dropdown list, select the language for generating the report.

5. Fill out the information in the remaining sections. Fields identified with a red asterisk (*) are required.

   Note: For locked assays, some fields and attributes cannot be edited and are grayed out.

6. Under **Sample Details**, drag and drop the attributes to display in the report into one of the three column placeholders. You can also drag and drop the additional attributes below the columns into the columns. Select the checkbox next to an attribute to include the attribute in each page header.

7. When you are done, click **Save**.
   The new report template appears in Report Templates list.

System installation templates (service engineers only)

IMPORTANT! The templates used by service engineers during Ion PGM™ Dx System installation are listed under the **Assay** tab in the **Install Templates** screen. These should not be used or modified in any way.

Planned Runs

Planned Runs contain all the sample, library, and assay information required to perform a run on template preparation and sequencing instruments. The Planned Run information is tracked by the system from template preparation through sequencing, data analysis, and final results.

The **Assay** tab contains the tools for managing and creating Planned Runs.

Prerequisites for creating a Planned Run

Before creating a Planned Run, check that:

- Sample information is correctly entered
- Library batches have been prepared
- Each library has been assigned a unique Barcode ID

The software will return an error message if any of the above conditions is not met when creating a Planned Run.

The system identifies and tracks kit components and chips by barcodes. The system includes a cordless barcode reader and a barcode reader attached to the Ion PGM™ Dx Sequencer.

Note: All kits and chips used in a diagnostic assay must be uniquely identified, and the identification must be stored so that the record can be audited.

Manage Planned Runs

Under the **Assay** tab, in the **Planned Runs** screen, a list of all Planned Runs is displayed, with the most recently created run on top. In this screen, you can:

- Create Planned Runs
- Execute Planned Runs
- Sort and search the list of Planned Runs
- View the audit trail of a Planned Run
- Review a Planned Run
- Edit a Planned Run
- Delete a Planned Run (Manager/Administrator level users only)

Review/Print a Planned Run

You can review and print the information in a **Planned Run** when you execute it. Alternatively:

1. Under the **Assay** tab, in the **Planned Runs** screen, click the Planned Run name in the list.
2. In the **View Planned Run** dialog, review the information entered or generated when you created the run, then click on **Print** to print it.

Search and Sort Planned Runs

Under the **Assay** tab, in the **Planned Runs** screen, the list of Planned Runs is displayed, with the most recently created on top by default. To return to the default display, click **Planned Runs**.

- To search the Planned Run list:
  a. Enter the full, or partial, Planned Run name into the **Planned Run Name** field.
  b. Click **Search**.
     The Planned Run(s) matching the search parameters will be listed.
  c. Click **Clear** to return to the complete list of Planned Runs.
- To sort the Planned Runs list:
  a. Click on the header name of interest.
     The list of Assays will reorder alphabetically based upon the header name selected. Run Short Code, Planned Run Name, Assay, and Tube Label.

b. Click on the header name a second time to reverse the order of samples displayed.

- Click **To Be Started** to limit the list of Planned Runs to only those runs that are ready to be executed.

Review a Planned Run audit trail

The entire history of a Planned Run is available for review, export, or printing.

1. Under the **Assay** tab, in the **Planned Runs** screen, click **Audit** in the Actions column for the desired run.
   The **Audit Trail** dialog will open. Listed in the window is each modifying event for the selected Planned Run.

2. Click on the details icon under the Record header to view the details of the change made.
   The **Audit Record Details** dialog window will open detailing the edits made.

3. In the **Audit Record Details** dialog window click on the:
   a. **Export** button to export a Print-Ready PDF of the record.

   b. **Cancel** button or the icon to return to the **Audit Trail** dialog.

4. Open the downloaded PDF file in an appropriate viewer, then print the record from within the open document.

5. Click **Cancel**, or the icon, to return to the **Planned Runs** screen.

Edit a Planned Run

You can edit Planned Runs that have not been executed yet.

1. Under the **Assay** tab, in the **Planned Runs** screen, click **Edit** below the name of the Planned Run.

2. The **Edit Planned Run** dialog will open. Change the settings in the dialog, then click **Save**.

Delete a Planned Run (Manager/Administrator only)

1. Under the **Assay** tab, in the **Planned Runs** screen, select the Planned Run(s) to be deleted by clicking in the checkbox adjacent to the Planned Run. Select all the Planned Runs on the page by selecting the checkbox above the column.

2. Click (Delete).
   The **Confirm Delete** dialog will open with the message "Are you sure you want to delete the selected planned run(s)?

3. Click **Yes** to delete the Planned Run(s), or click **No** to return to the **Planned Runs** screen without deleting.

Create a Planned Run

Libraries that are ready to be entered into a Planned Run are listed under the **Samples** tab in the **Libraries** screen.

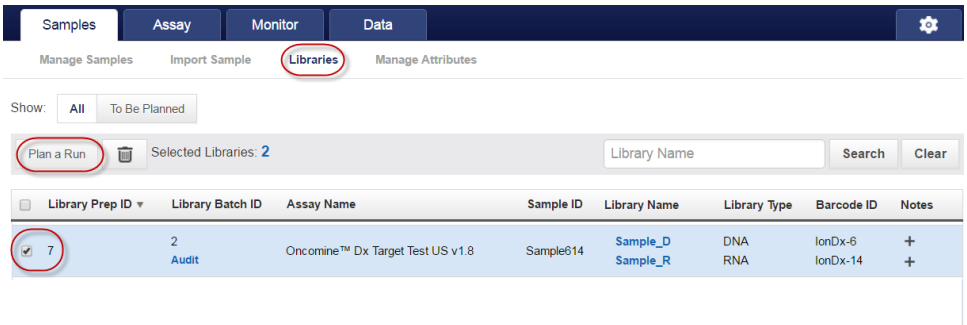
Note: You can also plan a run from the **Assay** tab in the **Planned Runs** screen (using the **Add New** button).

1. Sign in to the Torrent Suite™ Dx Software.

2. In the **Libraries** screen, select the library or libraries to be run by selecting checkboxes in the list. To view only those libraries that have not yet been added to a Planned Run, click **To Be Planned** above the list.

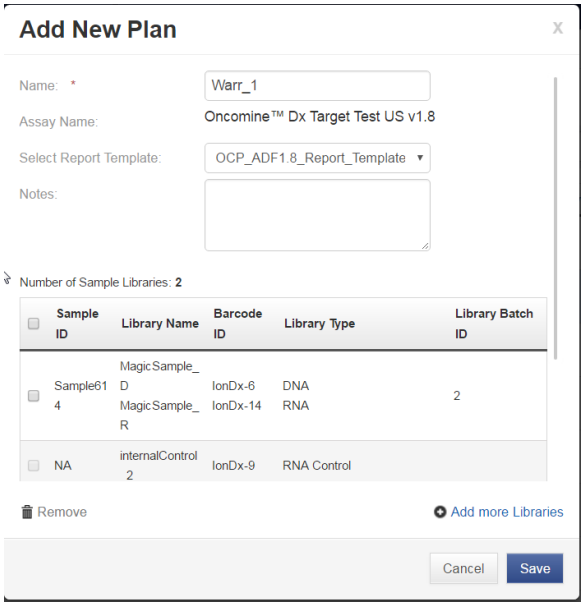
   Note:
   - Libraries prepared with the same assay in the same library batch can be combined and run together, as long as they have unique library names and Barcode IDs.
   - To plan a run with the Oncomine™ Dx Target Test assay, a report template must be created and associated with the assay by an Administrator or Manager. See the *Oncomine™ Dx Target Test Part V: Analysis and Test Reports User Guide* (Pub. No. MAN0016171).
   - Up to 16 libraries (including controls) can be sequenced in a single run.
   - If libraries need to be rerun due to a run failure, they can be added to a new Planned Run.

3. Click **Plan a Run**.



4. In the **Add New Plan** dialog, enter a name for the run, then select the appropriate report template.

   The selected library or libraries will be listed in the dialog, and the control libraries will be automatically listed.



5. To remove libraries from the run, select the appropriate checkbox(es), then click **Remove**. To add libraries, click **Add more libraries** and select them from the **Add Libraries** dialog.

   Note: Any added libraries must be from the same library batch and have unique library names and Barcode IDs.

6. Click **Save**.

   The new Planned Run is automatically assigned a Run Short Code and is displayed at the top of the list under the **Assay** tab in the **Planned Runs** screen.

Execute a Planned Run

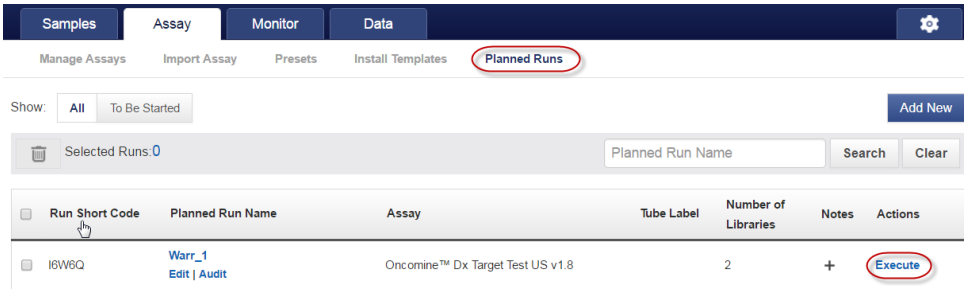
Planned Runs are listed under the **Assay** tab in the **Planned Runs** screen. Runs that are ready to be performed have the **Execute** command available in the **Actions** column.

Executing a Planned Run in the software cues the run for initiation on the Ion OneTouch™ Dx Instrument. Once a Planned Run has been cued for execution, the operator should immediately begin template preparation.

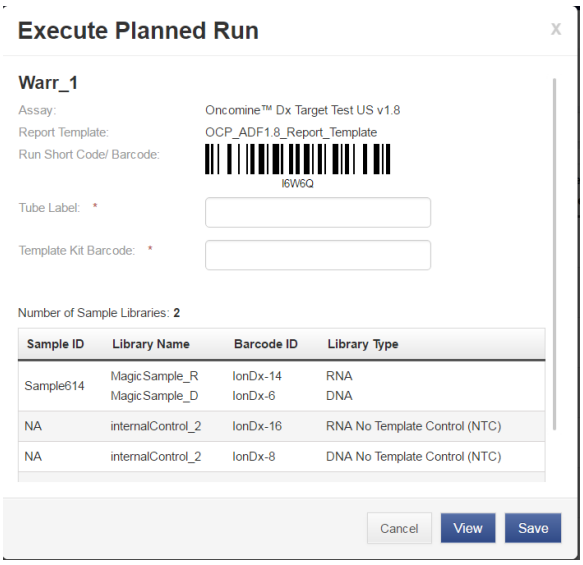
In the **Planned Runs** screen:

1. Click **To Be Started** to limit the list of Planned Runs to only those runs yet to be started.

2. Locate the Planned Run in the list, then under the **Actions** header, click **Execute**.



The **Execute Planned Run** dialog will open.



3. In the **Tube Label** field, enter the text that will be used to label the tubes that contain the final combined libraries. The tube-label text can be any combination of letters and numbers. This text is tracked by the system throughout the run, so be careful to label each tube legibly at the points noted in the procedure. The software will not allow use of the same Tube Label text within 7 days.

4. Click inside the **Template Prep Kit barcode** field, then scan the barcode from the Ion OneTouch™ Dx Template Reagents box.

   IMPORTANT! Be sure to scan the barcode from the actual Ion OneTouch™ Dx Template Reagents box that will be used in the run.

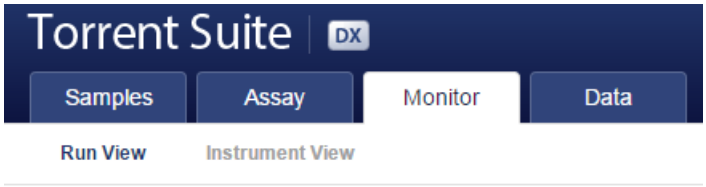
5. Click **Save** to save your changes.
   The **Review Planned Run** dialog will open.

6. Write down the **Run Short Code** and/or click the **Print** button to print the scannable barcode. The code must be entered into the Ion OneTouch™ Dx Instrument and Ion PGM™ Dx Sequencer for tracking and verification before the start of the instrument run.

7. Click **Close** to close the dialog and send the run to the instrument.

Note: The last 5 executed Planned Runs are listed under the **Monitor** tab in the software.

5 Monitor runs



In the **Monitor** tab, you can view the status of any jobs running on instruments that are connected to the Ion Torrent™ Server. To monitor the status of runs versus instruments, click **Run View** or **Instrument View** under the tab.

Run information is displayed for the last 5 runs that are in progress, have failed, or have completed data analysis.

Information displayed

The **Run View** and **Instrument View** screens under the **Monitor tab** display the following information:

View	Information displayed...
Run View	Ion OneTouch™ Dx Instrument and Ion PGM™ Dx Sequencer • Start and Completion times • Operator • Run Status • Instrument name
	Ion PGM™ Dx Sequencer only • Flow Transfer number • Analysis Status • QC Details (expand to view once analysis is complete) – Run QC – Sample QC – Internal Control QC
Instrument View	Ion OneTouch™ Dx Instrument and Ion PGM™ Dx Sequencer • Current state • Instrument status • Last cleaning • PQ Status, next due date • Instrument serial number

View a run

Under the **Monitor** tab, in the **Run View** screen, the last 5 sequencing runs (active, completed, or failed) are listed. The instrument type is indicated by either an Ion OneTouch™ Dx Instrument icon , or Ion PGM™ Dx Sequencer icon adjacent to the instrument serial number in the respective panes. To view a run:

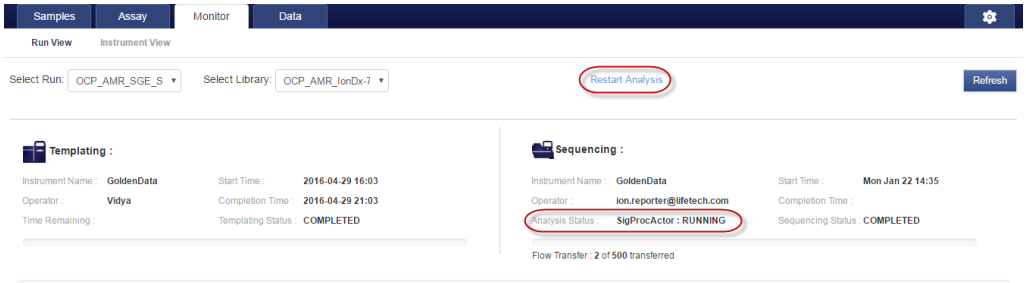
1. Click **Refresh** to update the displayed information.
2. In the **Select Run** dropdown list, select the Planned Run to be viewed.
   The instruments used for template preparation and sequencing will be displayed.
3. In the **Select Library** dropdown list, select the library in the run that you want to view.

To view details of the assay used in the designated run, click on the assay name adjacent to the dropdown lists.

Restart analysis *(Administrator)*

In the **Run View** of the **Monitor** tab, the **Analysis Status** field indicates whether data analysis has started, is running, or has completed. An analysis listed as "RUNNING" for more than 12 hours may be stuck in the pipeline. After 12 hours, a **Restart Analysis** button will appear under the tab for Administrator-level users.

Click the button to restart the analysis from the beginning.



View quality control result details

Under the **Monitor** tab, in the **Run View** screen, the quality control details for each library in a run are listed. To determine whether a library passed or failed quality control:

1. Select the Planned Run and library from the respective dropdown lists. In the **Sequencing** pane ( ), check that the **Analysis Status** reads **Completed**.
2. Click ⊕ **View QC Details** to view all quality control (QC) metrics for the run.
3. Under the **QC Status** column, check the status of all **Library QC** and **Control QC** metrics.

   All passing QC metrics are listed in green; failures are indicated in red. For detailed pass/fail criteria and a repeat testing strategy, see “Pass/fail criteria and repeat strategy“ on page 63 .
4. View the QC details for additional libraries sequenced as part of the same Run by selecting the library of interest from the dropdown list.

   The QC details for the selected library will be displayed.
5. Click ⊖ to collapse the QC details view.

Quality control metrics

In the **Run View** screen, once analysis of a sequencing run is complete, the following quality control details can be viewed.

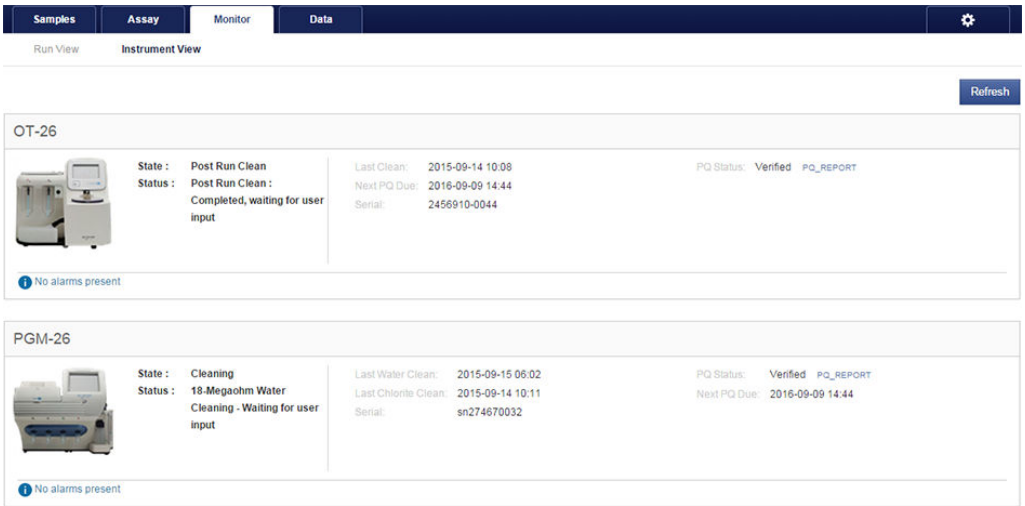
QC detail	QC metric and description
Library QC: DNA	• Mean AQ20 Read Length (bp): The average length, in base pairs, at which the error rate is ≤1% for all aligned reads of a library. • Percent Reads: The number of library reads normalized by the total addressable wells in a run.
Library QC: RNA	• Mappable Fusion Reads: The number of reads that are mapped to the fusion reference file.
Control QC: CF-1	• Mean AQ20 Read Length (bp): The average length, in base pairs, at which the error rate is ≤1% for all aligned reads of CF-1. • Percent Reads: The number of all usable library reads that aligned with the CF-1 sequence divided by the total number of addressable wells.
Control QC: DNA	• Individual COSMIC variant calls and allelic frequencies: Individual variant positions are assessed in the DNA control for presence or absence of the variant. • Mean AQ20 Read Length (bp): The average length, in base pairs, at which the error rate is ≤1% for all aligned reads of a control fragment. • Percent Reads: The number of all usable library reads that aligned with the control fragment sequence divided by the total number of addressable wells.
Control QC: RNA	• Mappable Reads: The number of reads that are mapped to the fusion reference file. • ROS1 Fusion: Detection of ROS1 fusion gene. • ROS1 Fusion Reads: The number of target reads mapping to the ROS1 gene fusion.
Control QC: DNA NTC	• Hotspot Calls: The total number of hotspots where a call was made.
Control QC: RNA NTC	• Mappable Reads: The number of reads that are mapped to the fusion reference file. • Total Fusion Calls: The total number of fusion calls made.

Quality control pass/fail criteria

Metric	Criteria
Run QC	
CF-1 Mean AQ20 Read Length (bp)	≥131
CF-1 Percent Reads (%)	≥0.03
DNA NTC	Hotspot calls = 0
RNA NTC	Total fusion calls = 0
RNA NTC Mappable Reads	≤4999
DNA Library	
Mean AQ20 Read Length (bp)	≥90
Percent Reads (%)	≥0.7
RNA Library	
Mappable Fusion Reads	≥5000
DNA Control	
COSM476_AF	Variant called and AF ≥0.05
COSM521_AF	Variant called and AF ≥0.05
COSM6223_AF	Variant called and AF ≥0.05
COSM6224_AF	Variant called and AF ≥0.05
COSM760_AF	Variant called and AF ≥0.05
Mean AQ20 Read Length (bp)	≥98
Percent Reads (%)	≥0.7
RNA Control	
Mappable Reads	≥8551
ROS1 Fusion Reads	Variant called and fusion reads ≥734

Instrument View

The instruments connected to the Ion Torrent™ Server are individually listed in the **Instrument View screen** under the **Monitor tab**. To update the information in the screen during a run or following completion of a run, click the **Refresh** button.

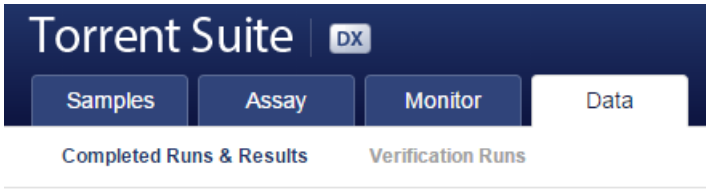


The following information is displayed in the screen:

Column	Description
State	Function the instrument is currently performing (e.g., cleaning, initializing, running etc).
Status	The current status of the active run function, including data analysis. Adminstrator-level users can restart data analysis if necessary (see "Restart analysis (Administrator) " on page 40).
Last Water Clean	Date and time the last water cleaning of the instrument was performed.
Last Chlorite Clean	Date and time the last chlorite cleaning of the instrument was performed.
Serial	Ion PGM™ Dx Sequencer or Ion OneTouch™ Dx Instrument serial number.
PQ Status	Indicates whether the PQ status of the instrument is **Verified** or **Expired**. Click the **Download Report** link to download and view the PQ result report.
Next PQ Due	Indicates the expiration date of the current PQ verification run.

Note: For the Ion OneTouch™ Dx Instrument, Last Clean refers to the pre-run cleaning and is not updated following the post-run cleaning.

6 Data and results



In the **Data** tab, you can review run results and perform data analysis and data management tasks:

- Select **Completed Runs & Results** (the default window) to review completed sample run results and reports. Run results are listed by **Sample ID**.
- Select **Verification Runs** to review data from completed verification runs performed during installation or PQ validation.

Data files and flow

During an Ion PGM™ Dx Sequencer run, sequence raw data (DAT) files are transferred to the Ion Torrent™ Server via a network cable in a process controlled by the ionCrawler service. After the data from the initial flows on the sequencer are available on the server, the Torrent Suite™ Dx Software begins processing the data, producing the <1> wells file. Basecalling is performed on the <1> wells file data, producing an unmapped BAM (uBAM) file. Subsequent analysis produces mapped reads (BAM) and variant calls (VCF) files.

The following table shows the flow of data and typical file size generated as the Torrent Suite™ Dx Software processes data from an Ion 318™ Dx Chip.

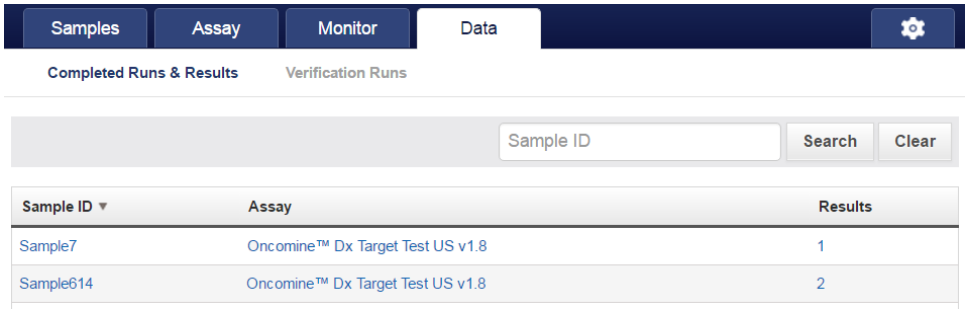
Process	File Type	File Size
		Ion 318™ Dx Chip
Sequencing[1]	DAT	~350 GB
	▼	
Signal Processing	Wells	12 GB
	▼	
Base Calls (reads)	uBAM	1.5 GB
	▼	
Mapped Reads	BAM	4.3 GB
	▼	
Variant Calls	VCF	120 Kb

[1] The sequencing raw data (DAT) files are deleted from the server 72 hours after data analysis to conserve Ion Torrent™ Server disk space.

Note: Data from approximately 200 sequencing runs using an Ion 318™ Dx Chip can be accommodated on an Ion Torrent™ Server before disk space becomes a limiting factor and data archiving is required. See "Data Management (Administrator)" on page 80 for more information.

Completed runs and results

Under the **Data tab**, in the **Completed Runs & Results screen**, samples that have been sequenced are listed by Sample ID. You can search, filter, and sort the list.



The following information is displayed in the screen:

Column	Description
Sample ID	The unique identifier created when the sample was entered into the software. Click on the Sample ID to display the details of the sample.
Assay	The assay selected when the sample was placed in a library batch prior to creating the Planned Run. Click on the assay name to display the details of the assay.
Results	The number in this column indicates the number of times the sample was sequenced with the assay. Click on the number to access the reports and results for each run.

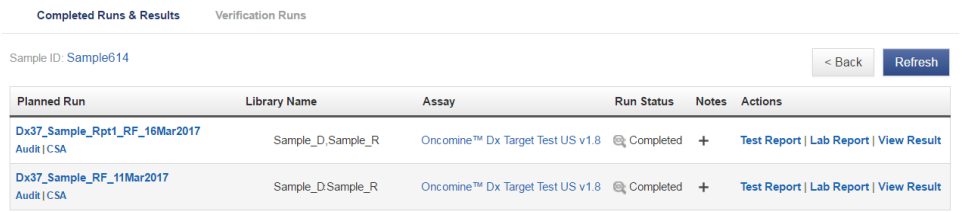
Results List

In the **Completed Runs & Results** screen, samples that have been sequenced are listed by Sample ID. The number of results for each sample is listed in the **Results** column.

There can be more than one result per sample if a sample was re-sequenced using a new Planned Run.

Sample ID	Assay	Results
Sample7	Oncomine™ Dx Target Test US v1.8	1
Sample614	Oncomine™ Dx Target Test US v1.8	2
Sample617	Oncomine™ Dx Target Test US v1.8	1

- Click the number in the **Results** column to open the **Results List** screen for that sample.



Completed Runs & Results Verification Runs

Sample ID: Sample614 < Back Refresh

Planned Run	Library Name	Assay	Run Status	Notes	Actions
Dx37_Sample_Rpt1_RF_16Mar2017 Audit | CSA	Sample_D,Sample_R	Oncomine™ Dx Target Test US v1.8	Completed	+	Test Report | Lab Report | View Result
Dx37_Sample_RF_11Mar2017 Audit | CSA	Sample_D,Sample_R	Oncomine™ Dx Target Test US v1.8	Completed	+	Test Report | Lab Report | View Result

- In the Results List, results are listed by run. The status of the run is shown in the **Run Status** column.

- In the Results List, the following options are available:

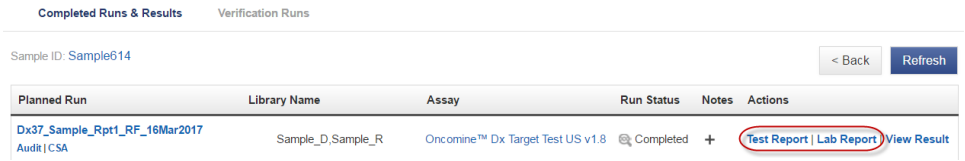
To....	Do the following...
View the audit trail for the Planned Run	Under the **Planned Run** column, click **Audit**. You can export and print the information from the **Audit Trail** dialog box.
Download the log files from the instruments used in the run	Under the **Planned Run** column, click **CSA**. CSA (Customer Support Archive) log files can be used to troubleshoot instrument issues.
View the Planned Run information	Click the Planned Run name.
View the assay details	Click the assay name.
View the Test Report	Click **Test Report** to download a PDF.
View the Lab Report	Click **Lab Report** to download a PDF.
Open the **Result Report** screen	Click **View Result**.
Update the list	Click **Refresh**. This can be used to update status of the run in the **Run Status** column.

Download the Lab Report and Test Report

If generated, the Lab Report and Test Report can be downloaded in PDF format from the Results List.

Electronically signed reports have an "Approved" watermark, and the electronic signature information is included in the footer.

1. To download the Test and Lab Reports, click the report name in the **Results List** screen. A .zip file containing all languages of the report will automatically download.



2. Extract the downloaded files, then open the PDF file of the desired language in an appropriate viewer.

Lab Report

The **Lab Report** (available from the **Results List** under the **Completed Runs & Results** screen) is a report generated by the software that can be downloaded in PDF format.

Note: It is identical to the Test Report, except that it also includes the Analytical Test Result Detail section.

The Lab Report contains the following sections and information. Certain fields of this report may be customized, as described in “Create a report template“ on page 31.

Section	Description
Sample Details	The sample information entered into the software.
Results for Sequence Variations for Therapeutic Use	The results for the clinical variants and gene fusions in the sample, and any recommended therapies. Allele frequencies are also reported.
Analytical Sequence Variations Detected	A list of the analytical variants and gene fusions detected by the assay, and associated information for each.
Laboratory comments regarding sample	Contains laboratory comments (for example, about sample quality) entered when the results were signed in the software.
Test Description	A description of the assay.
Analytical Sequence Variations Not Detected	A list of all the analytical variants and gene fusions not detected by the test, and associated information for each.

Section	Description
Sequencing Run Details	A list of all the kits and instruments used to perform the test.
QC Evaluation Metrics	A summary of the quality control metrics, which may vary by assay.

Test Report

The **Test Report** (available from the **Results List** under the **Completed Runs & Results** screen) is a clinical report generated by the software that can be downloaded in PDF format. It is identical to the Lab Report, except that it does not include the Analytical Test Result Detail section. The Test Report contains the following sections and information.

Section	Description
Sample Details	The sample and patient information entered into the software.
Results for Sequence Variations for Therapeutic Use	Displays the results for the clinical variants and/or gene fusions in the sample, and any recommended therapies.
Test Description	A description of the test and the gene variants in associated tissue types that it screens for.
Results for Analytical Sequence Variations Detected	Displays the results for analytical variants and gene fusions detected in the sample.
Results for Analytical Sequence Variations Not Detected	Displays the results for analytical variants and gene fusions not detected in the sample.

Generate the Test Report and Lab Report in other languages

By default, the Test Report and Lab Report are generated in the language selected in the report template. To create these reports in another language, do the following:

1. In the **Results List** screen, click **View Result** to open the **Result Report** screen.
2. Click **Generate Report**, select the desired language in the **Generate Report** dialog, then click **Generate**.

A message displays when the report has been generated.

Restore archived results

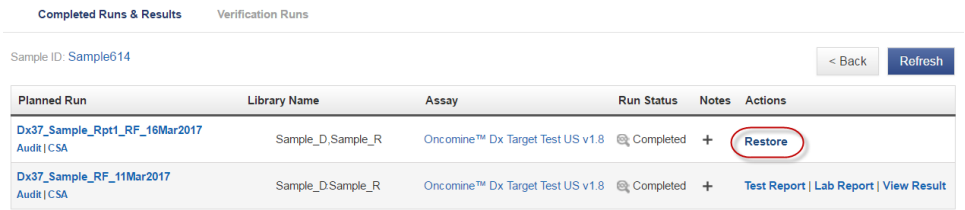
Torrent Suite™ Dx Software can be configured to automatically transfer older run data, results files, and signed reports from Ion Torrent™ Server to an external server, based on when the results were generated. The auto-archive schedule is configured by administrator-level users (see "Data archive and restore" on page 82). Archived results and reports can then be restored to the Ion Torrent™ Server and downloaded from the **Results List** screen.

IMPORTANT!

- **The software may not display all variants from restored results in the user interface, and any reports generated from those restored results may not contain all variants. Carefully review the restored data in the user interface to determine whether all variants are present. Do not generate new reports from restored results.** Note that all variants are preserved in the restored source files, and can be downloaded using the **Download Files** command.
- All results reports should be generated and signed in Torrent Suite™ Dx Software before results are archived. See "Sign the Results Report" on page 61.

Archived results are listed in the **Results List** screen with the **Restore** button active in the **Actions** column. To restore and download archived results:

1. In the **Results List** screen, locate the archived result, then click **Restore** in the **Actions** column.



2. Click **OK** in the confirmation dialog.
   In the **Actions** column, the **View Result** button is now active.

3. Click **View Result**, then click **Download Files** to download and view the restored results files.

   IMPORTANT! Before analyzing restored data in the user interface, carefully review it to determine whether all variants are present. See the previous important note for details.

Results Report

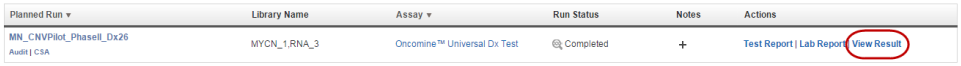
The **Results Report** screen displays all the data and results for a sample that has been sequenced.

IMPORTANT! A QC Status of "Passed" for a sequencing run does not guarantee that the genotypes of all clinically relevant variants are determined. See the **Test Result** column of the Test Report for any "No Call" results when interpreting the test results.

---

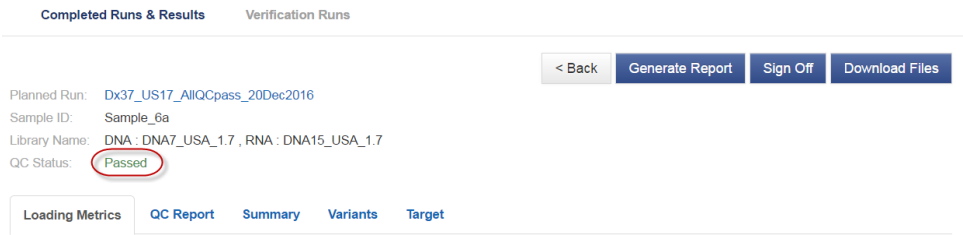
1. To open a Results Report, locate the sample in the **Completed Runs & Results** screen, then click the number in the **Results** column to view the Results List for that sample (see "Results List" on page 47).

2. Results are listed by run. In the **Action** column, click **View Result**.



The **Result Report** screen is divided into tabs by data type. The QC Status (Passed or Failed) is listed above the tabs. Failure to meet or exceed a QC metric defined in the assay may invalidate all or part of the results.

Note: For detailed Pass/Fail criteria and Repeat testing strategy see "Pass/fail criteria and repeat strategy" on page 63.



Loading metrics

The **Loading Metrics** tab in the **Results Report** screen displays the following Loading and Filtering metrics for the run:

Metric	Description
Loading Metrics	
Total Addressable Wells	The total number of wells on the chip – excluded wells.
Wells with ISPs	The number (count) and percentage of chip wells that contain ISPs. The percentage is expressed as a percent of total addressable wells.
Live ISPs	The number (count) and percentage of chip wells containing live ISPs (ISP's templated with library or control fragment), with the percentage expressed as a percent of wells with ISPs.
Control ISPs	The number (count) and percentage of ISPs that have a key signal identifying them as internal controls, with the percentage expressed as a percent of live ISPs.
Library ISPs	The number (count) and percentage of ISPs that have a key signal identical to the library key signal, with the percentage expressed as a percent of live ISPs.
Filtering Metrics[1]	
Filtered: Polyclonal	ISPs carrying clones from two or more templates, with the percentage expressed as a percent of library ISPs.
Filtered: Primer-Dimer	ISPs with an insert length of less than 8 bp, with the percentage expressed as a percent of library ISPs.
Filtered: Low Quality	ISPs with low or unrecognizable signal, with the percentage expressed as a percent of library ISPs.
Usable Library Reads[2]	Number (count) and percentage of library ISPs passing all filters.

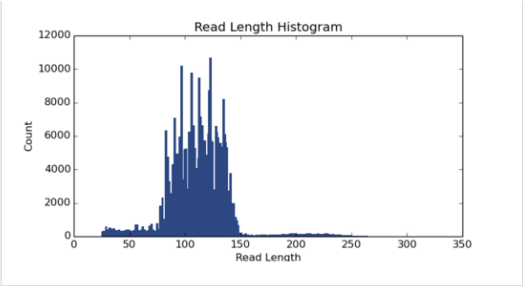
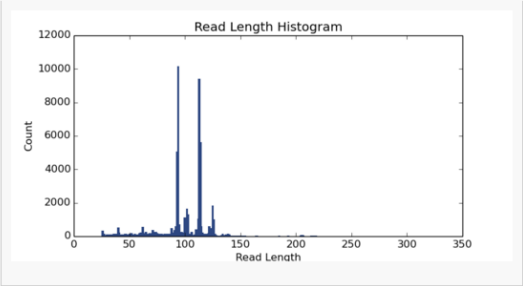
[1] Filtering Metrics only apply to ISPs templated with library fragments, not control fragment.
[2] Values in the "Filtered:" rows are subtracted from the Library ISPs value (Loading Metrics) to give the Usable Library Reads value.

QC Report tab

The **QC Report** tab in the **Results Report** screen displays the following information for both the sample libraries and the internal controls. This information is also accessible through the **Monitor** tab within 72 hours of starting the run on the Ion OneTouch™ Dx Instrument.

Metric	Description
Library QC Evaluation Metrics	
Library QC: Library DNA	• Mean AQ20 Read Length (bp): The average length, in base pairs, at which the error rate is ≤1% for all aligned reads of a library. • Percent Reads: The number of library reads normalized by the total addressable wells in a run.

Metric	Description
Library QC: Library RNA	• Mappable Fusion Reads: The number of reads that are mapped to the fusion reference file.[1]
Control QC Evaluation Metrics	
Control QC: CF-1	• Mean AQ20 Read Length (bp): average length, in base pairs, at which the error rate is ≤1% for all aligned reads of CF-1. • Percent Reads: number of all usable library reads that aligned with the CF-1 sequence divided by the total number of addressable wells.
Control QC: DNA Control	• Individual COSMIC variant calls and allelic frequencies: Individual variant positions and wild-type positions that are assessed in the DNA control reagent for presence or absence of the variant. • Mean AQ20 Read Length (bp): The average length, in base pairs, at which the error rate is ≤1% for all aligned reads of a control fragment. • Percent Reads: The number of all usable library reads that aligned with the control fragment sequence divided by the total number of addressable wells.
Control QC: RNA Control	• Mappable Reads: The number of reads that are mapped to the fusion reference file. • ROS1 Fusion: Detection of ROS1 fusion gene. • ROS1 Fusion Reads: The number of target reads mapping to the ROS1 gene fusion.
Control QC: DNA NTC	• Hotspot Calls: The total number of hotspots where a call was made.
Control QC: RNA NTC	• Mappable Reads: The number of reads that are mapped to the fusion reference file. • Total Fusion Calls: The total number of fusion calls made.

Metric	Description
Histogram of Read Length [2]	• A library-specific read-length histogram: DNA  RNA 
Sign Off Details[3]	
Sign Off Comments	If comments were entered by the manager or administrator when they signed the Results Report, they will be displayed here.
Meaning of the signature	The electronic signature of a Results Report by a manager or administrator indicates approval of the report.

[1] May not equal the sum of the individual fusions, since some detected fusions are not included in the fusion BED file.
[2] Not displayed in the Monitor tab.
[3] Only provided for reports that have been signed.

Summary tab

The **Summary** tab in the **Results Report** screen displays the following information for the run:

Field	Description
Run and Configuration Summary	
Run Name	The name of the run.
Reference Genome	The reference genome used for analysis.
Target Regions	The name of the targeted regions BED file used.
Hotspot Regions	The name of the hotspot regions BED file used.
Fusion Reference	The name of the fusion reference used for analysis when applicable.
Fusion Panel	The name of the fusion panel used when applicable.

Field	Description
Amplicon Summary	
Number of Targets	The number of amplicons in the panel.
On Target Reads	The number of reads mapped to the target amplicons.
Percent On Target Reads	The percentage of reads mapped on target to total reads.
Percent Full Length On Target Reads	The percentage of full length reads mapped on target to total reads.
Average Coverage	The ratio of the depth of coverage at each base in the target region to the length of the target region.
Target Coverage at 20X	The percentage of base positions with depth of coverage ≥20X in the target region.
No Strand Bias	The percentage of bases with Strand Bias between 30–70% to the total number of bases.
Coverage Uniformity	The ratio of passed number of targets to total number of targets. Where passed number of targets is the number of amplicons that have at least 0.2X mean coverage.
Variant Summary[1]	
Number of Fusions	The total number of fusion calls.
Number of SNVs/MNVs	The number of single- and multi-nucleotide variations (SNVs/MNVs).
Number of INDELs	The number of insertions or deletions.
Number of LONGDels	The number of long deletions.

[1] Includes both analytical and target variants (from both the Variant subtab and the Target subtab in the Results Report).

Variants tab

The **Variants** tab in the **Results Report** screen displays the following subtabs and information for the analytical variants defined by the hotspot and fusion reference files:

Column	Description
Summary subtab	
Variants Present Gene Fusion Present	Lists the analytical variants detected in the sample by hotspot ID[1, 2]
SNV/INDEL subtab[3]	
Gene	The gene name, which provides a link to the **View Annotation Sources** popup with additional information about the HotSpot ID (see "View Annotation Sources" on page 58)

Column	Description
HotSpot ID	The name of the hotspot as defined in the BED file
Amino Acid Change	Identification of the amino acid change using HGVS-nomenclature
Nucleotide Change	Identification of the DNA-level nucleotide change using HGVS-nomenclature
Test Result	Indicates the presence or absence of a variant
Locus	The one-base position of the variant in the reference genome
Type	The type of variation detected: • SNV (single nucleotide variation)/MNV (multi-nucleotide variation) • DEL (deletion)
Genotype	The genotype called at that locus
Ref	The reference base(s)
Allele Freq	The most likely frequency of the variant allele
Quality score	The relative probability of either the "reference" hypothesis interval [0,cutoff) or the "variant" hypothesis interval [cutoff,1], Phred-scaled (-10*log10). A higher score means more evidence for the variant call. Quality scores are capped at 100.
Coverage	The number of reads covering the position after down-sampling
Fusion subtab	
Gene	The gene that regulates expression of the gene fusion[4]
Type	The type of variation detected: Fusion (gene fusion)
Read Count	The total number of reads that map to the gene
Test Result	Indicates the presence or absence of a particular fusion

[1] "NA" indicates that a variant was detected but has no associated hotspot ID.

[2] The Oncomine™ Dx Target Test does not report on analytical fusion variants; therefore, the **Summary** subtab will list "None" for **Gene Fusions Present**.

[3] Note that the Oncomine™ Dx Target Test does not report insertions.

[4] Note that for the Oncomine™ Dx Target Test, no analytical fusions are reported except for expression controls.

Target tab

The **Target** tab in the **Results Report** screen displays the following subtabs and information for the locations defined by the hotspot file employed (incidental results are not reported):

The **Summary** subtab reports whether any variants or gene fusions are present. If present, the specific variants and Associated Therapy are listed.

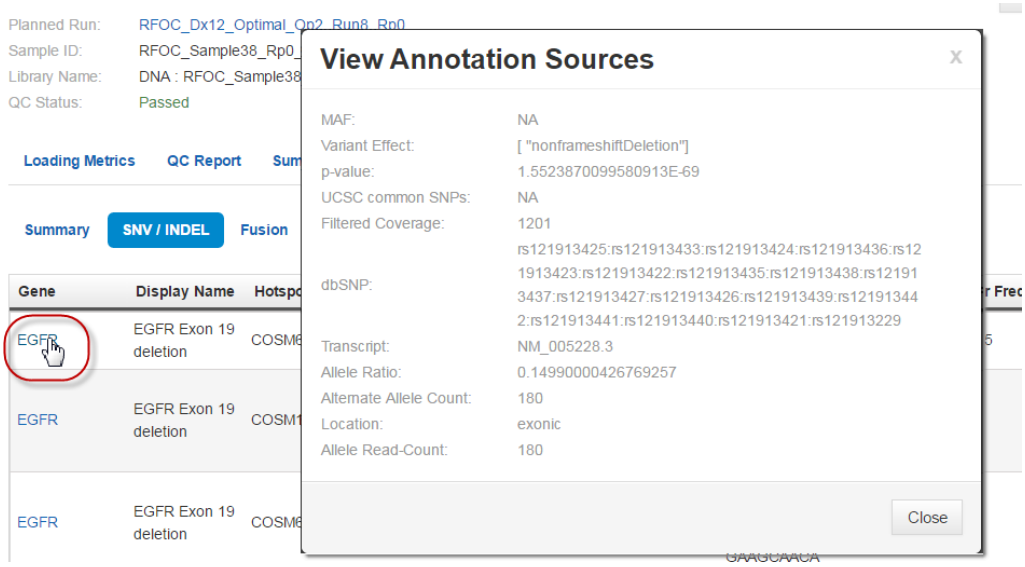
Column	Description
Summary subtab	
Variants Present Gene Fusion Present	Indicates whether these were detected in the sample, and any associated therapies
SNV/INDEL subtab[1]	
Gene	The gene name, which provides a link to the **View Annotation Sources** popup with additional information about the HotSpot ID (see "View Annotation Sources" on page 58)
Display Name	The common name for the variant
Amino Acid Change	Identification of the amino acid change using HGVS-nomenclature
Nucleotide Change	Identification of the DNA-level nucleotide change using HGVS-nomenclature
HotSpot ID	The name of the hotspot as defined in the BED file
Test Result	Indicates the presence or absence of a variant
Locus	The location of the variant
Type	The type of variation detected: • SNV (single nucleotide variation)/MNV (multi-nucleotide variation) • DEL (deletion)
Genotype	The genotype at the position
Ref	The reference base(s)
Allele Frequency	Most likely frequency of the variant allele
Quality score	The quality score is the relative probability of either the "reference" hypothesis interval [0,cutoff), or the "variant" hypothesis interval [cutoff,1], Phred-scaled (-10*log10). It is a measure of how strong the evidence for the variant call is. A higher score means more evidence for the call. The quality scores are capped at 100.
Coverage	The number of reads covering the position after down-sampling

Column	Description
Fusion subtab	
Gene	The gene that regulates expression of the gene fusion
Display Name	The name of the gene fusion variant
Read Count	The total number of reads that map to the locus
Test Result	Indicates the presence or absence of the variant

[1] Note that the Oncomine™ Dx Target Test does not report insertions.

View Annotation Sources

You can view additional information for each hotspot ID listed under the **SNV/Indel** subtab of the **Variants** and **Targets** tabs in the Results Report. The gene name in the **SNV/Indel** subtab is a link that opens the **View Annotation Sources** popup window, which provides information for the particular hotspot.



Note: The **View Annotation Sources** popup only lists a single transcript for a particular hotspot ID. However, some loci may have more than one transcript associated with them. You can view all the transcripts for each hotspot ID in the FUNC block of the VCF file (see "Example of transcript information in the VCF" on page 59). The VCF file can be downloaded using the **Download Files** command in the Results Report (see "Results files" on page 60).

Example of transcript information in the VCF

The COSM1074639 hotspot ID has multiple transcripts associated with it, which include a mutation from 'A' to 'C'. These are listed in the VCF file as shown below:

chr6 152419923 COSM1074639;COSM1074637 A C,G 122.19 PASS
AF=0,0;AO=0,0;DP=1116;FAO=0,0;FDP=1116;FR=.;FRO=1116;FSAF=0,0;FSAR=0,0;FSRF=661;FSRR=455;F
WDB=0.00426152,-
0.0087378;FXX=0;HRUN=1,1;HS;LEN=1,1;MLLD=103.308,103.438;QD=0.437949;RBI=0.0394298,0.03043
16;REFB=-2.22051E-5,-2.32713E-5;REVB=-0.0391988,-
0.0291502;RO=1115;SAF=0,0;SAR=0,0;SRF=661;SRR=454;SSEN=0,0;SSEP=0,0;SSSB=-6.44874E-8,-
6.44874E-
8;STB=0.5,0.5;STBP=1,1;TYPE=snp,snp;VARB=0,0;OID=COSM1074639,COSM1074637;OPOS=152419923,
152419923;OREF=A,A;OALT=C,G;OMAPALT=C,G;FUNC=[

{'normalizedRef':'A','transcript':'NM_001122742.1','grantham':'144.0','gene':'ESR1','location':'exonic','ori
gAlt':'C','origPos':'152419923','origRef':'A','normalizedPos':'152419923','exon':'10','function':'missense','
protein':'p.Tyr537Ser','normalizedAlt':'C','gt':'neg','codon':'TCT','coding':'c.1610A>C'},

{'normalizedRef':'A','transcript':'NM_001122742.1','grantham':'194.0','gene':'ESR1','location':'exonic','ori
gAlt':'G','origPos':'152419923','origRef':'A','normalizedPos':'152419923','exon':'10','function':'missense','
protein':'p.Tyr537Cys','normalizedAlt':'G','gt':'neg','codon':'TGT','coding':'c.1610A>G'},

{'normalizedRef':'A','transcript':'NM_001122741.1','grantham':'144.0','gene':'ESR1','location':'exonic','ori
gAlt':'C','origPos':'152419923','origRef':'A','normalizedPos':'152419923','exon':'9','function':'missense','p
rotein':'p.Tyr537Ser','normalizedAlt':'C','gt':'neg','codon':'TCT','coding':'c.1610A>C'},

{'normalizedRef':'A','transcript':'NM_001122741.1','grantham':'194.0','gene':'ESR1','location':'exonic','ori
gAlt':'G','origPos':'152419923','origRef':'A','normalizedPos':'152419923','exon':'9','function':'missense','p
rotein':'p.Tyr537Cys','normalizedAlt':'G','gt':'neg','codon':'TGT','coding':'c.1610A>G'},

{'normalizedRef':'A','transcript':'NM_001122740.1','grantham':'144.0','gene':'ESR1','location':'exonic','ori
gAlt':'C','origPos':'152419923','origRef':'A','sift':'0.0','normalizedPos':'152419923','exon':'9','function':'mi
ssense','protein':'p.Tyr537Ser','gt':'neg','normalizedAlt':'C','codon':'TCT','polyphen':'0.979','coding':'c.161
0A>C'},

{'normalizedRef':'A','transcript':'NM_001122740.1','grantham':'194.0','gene':'ESR1','location':'exonic','ori
gAlt':'G','origPos':'152419923','origRef':'A','sift':'0.0','normalizedPos':'152419923','exon':'9','function':'mi
ssense','protein':'p.Tyr537Cys','gt':'neg','normalizedAlt':'G','codon':'TGT','polyphen':'0.998','coding':'c.16
10A>G'},

Results files

The following files can be downloaded from the **Results Report** window. To download the files, click **Download Files**, select the files to download, then click **Download**.

File name	Description
Test Report	A report of the completed analysis in PDF format
Lab Report	A clinical lab report of the completed analysis in PDF format; includes both clinical and analytical results.
PlannedRun-AuditTrail.pdf	Contains all audit records pertaining to the Planned Run.
Info.csv	Contains information about the run and analysis, such as software, sequencing information, instrument information, analysis information, QC details etc.
<RNABarcode>_rawlib.basecaller.bam	Unmapped RNA BAM File; output of base calling, contains unmapped reads.
Snvindel.tab	A tab-delimited file that contains information about non-targeted SNVs and indels
<RNABarcode>_rawlib.basecaller_alignments.bam	Mapped RNABarcode BAM file; output after reads have been mapped to the fusion reference.
Target_Summary.tab	A tab-delimited file that contains a targeted test results summary
<RNABarcode>_rawlib.basecaller_alignments.bam.bai	Mapped RNABarcode BAM index file
<RNABarcode>_rawlib.basecaller.fastq	FASTQ file generated from unmapped BAM file of the RNA barcode used.
<DNABarcode>_rawlib.basecaller.bam	Unmapped DNA barcode BAM file; output of base calling, contains unmapped reads.
raw_peak_signal	Key signal gives the percentage of LiveISPs with a key signal that is identical to the library key signal.
<LibPrepID>_<analysisID>.final.vcf	A VCF file containing all the variants detected as a result of the analysis, along with information such as test result, read count, gene name, quality scores, etc.
Summary.tab	A tab-delimited file that contains the on-targeted test results summary
<LibPrepID>_rawlib.stats.cov.txt	Amplicon statistics file
Fusion.tab	A tab-delimited file that contains non-targeted (analytical) fusion details in a table format. **Note:** The information displayed in the file for each isoform of a particular fusion is identical, because specific isoform and locus information is not included in this table. Detailed isoform and locus information is available in the <LibPrepID>_<analysisID>.final.vcf file.

File name	Description
readLenHisto.png	Gives the read-length distribution of FASTQ files in the form of a histogram. A thumbnail histogram of the read lengths for a particular barcode.
<LibPrepID>_rawlib.bam.bai	Mapped DNA barcode BAM index file (index file of DNA barcode-mapped BAM file)
Basecaller.log	Base Caller log file
analysis.log	Analysis log file
sigproc.log	Signal processing log file
Bead_density_contour.png	Loading density image; a pseudo-color density image of the Ion Chip plate showing percent loading across the physical surface
<DNABarcode>_rawlib.basecaller.fastq	FASTQ file of the DNA barcode used
cnv.tab	Non-targeted CNV detail table (analytical CNV results from a sequencing run) **Note:** For use with IVD tests that include CNV reporting.
Target_fusion.tab	A tab-delimited file that contains targeted (clinical) fusion details in a table format
<LibPrepID>_rawlib.bam	Mapped DNA barcode BAM File; output after mapping reads to reference.
Iontrace_Library.png	Key incorporation trace image showing the average signal readings for flows of the bases T, C, and A in the library key.
rawtf.basecaller.fastq	FASTQ file for the test fragment

Sign the Results Report

In the **Results Report** screen, Managers/Administrators can provide their electronic signature on the results. The signature information appears in the **QC Report** subtab of the Results Report, and in the downloaded Test Report and Lab Report PDFs.

Multi-language support for .pdf report generation is provided. By default reports are generated in the language selected in the **Report Template** used. When reports are generated in multiple languages **Sign Off** will only occur in the report of the default language .

1. At the top of the **Results Report** screen, click **Sign Off**, then enter your user name, password, and comments in the dialog window. Fields identified with a red asterisk (*) are required.

2. Click **Sign Off** to confirm your electronic signature.

Files in the Reports folder

When a Manager or Administrator signs a report, a folder named with the Sample ID is created in the Reports folder on the server (`/results/analysis/output/reports`), and the following files are copied into it:

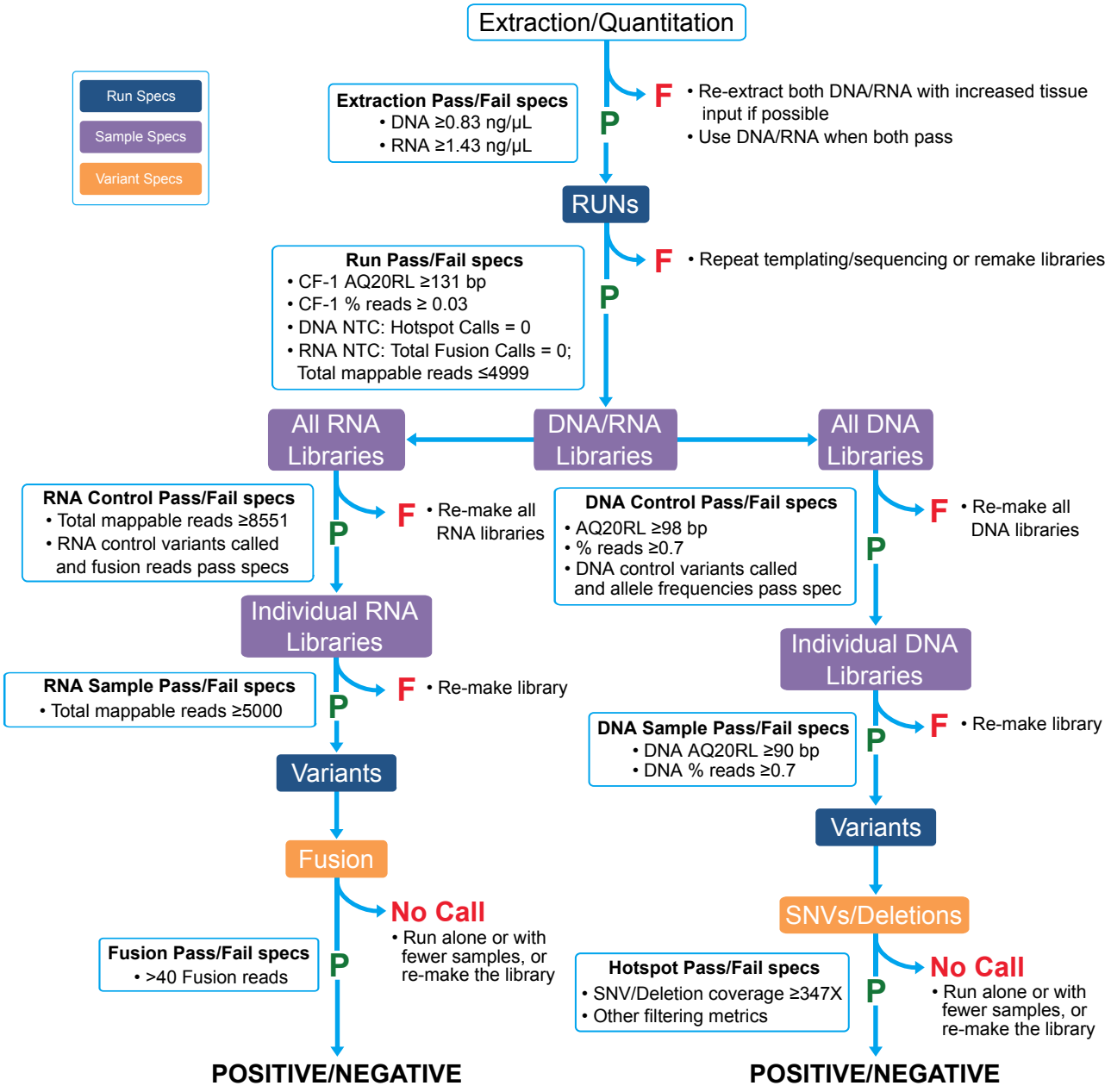
- Info file (.csv)
- Signal processing log file (.log)
- Targeted Fusion Detail Table (.tab)
- Targeted Test Results Summary (.tab)
- Analysis log file (.log)
- VCF file (.vcf)
- DNA Mapped BAM file (.bam)
- DNA Unmapped BAM file (.bam)
- Key Signal
- Key Incorporation Trace (.png)
- Fusion Detail Table (.tab)
- DNA Mapped BAM Index file (.bam.bai)
- RNA Mapped BAM Index file (.bam.bai)
- DNA FASTQ File (.fastq)
- Base Caller Log File (.log)
- Non-targeted CNV Detail Table (.tab)[1]
- SNV/INDEL Detail Table (.tab) [2]
- Loading Density Figure (.png)
- Non-targeted Test Results Summary (.tab)
- Targeted SNV/INDEL Detail Table (.tab) [2]
- Amplicon Stats (_rawlib.stats.cov.txt)
- RNA FASTQ File (.fastq)
- RNA Mapped BAM file (.bam)
- RNA Unmapped BAM file (.bam)
- Test Fragment FASTQ File (.fastq)
- Read Length Histogram (.png)
- Test PDF Report *(optional)* (.pdf)
- Lab PDF Report (.pdf)
- Planned Run Audit (.pdf)
- Basecaller command files (.json)
- checksum file
- Pipeline commands (_pipeline.json)
- Experimental log file (_final.txt)
- Wells with beads (_beadogram.png)
- Bead find stats file (.stats)

[1] For use with IVD tests that include CNV reporting.
[2] Note that the Oncomine™ Dx Target Test does not report insertions.

Pass/fail criteria and repeat strategy

In general, if you experience a run or sample failure, you can repeat the run or sample preparation at the workflow step in which the failure occurred. The number of libraries that can be made from an extracted sample for repeat testing depends on the quantity of DNA and RNA from the extraction, which varies from sample to sample.

Based on quality control results, you can determine whether a library requires repeat testing. Refer to the following flowchart to determine the best course of action.



Specification type	Passing criteria	Repeat strategy
Extraction/ Quantification	The following minimum concentrations for DNA and RNA are required: • DNA ≥0.83 ng/µL. • RNA ≥1.43 ng/µL.	If the minimum concentration requirement is not met for either DNA or RNA, the samples must be re-extracted with increased tissue input. Use the set of extracted samples where both the DNA and RNA meet the minimum concentration requirement for the test.
Run	A run must pass the following specifications to have reportable results for any sample within the run: • CF-1 Mean AQ20 Read Length (bp) must be ≥131. • CF-1 Percent Reads must be ≥0.03.	If either CF-1 specification fails, the operator may repeat the templating/sequencing run with the same library pool, or re-pool the libraries if a pooling error is suspected. If the issue persists on the repeat run, remake the libraries.
No Template Control (NTC)	A run must pass the following NTC specifications to have reportable results for any samples within the run: • DNA No Template Control (DNA NTC)—Total "Hotspot Calls" must equal zero (0). • RNA No Template Control (RNA NTC)—Mappable Reads must be ≤4999 and "Total Fusion Calls" must be zero (0).	If only the DNA NTC fails, remake all of the DNA controls and DNA sample libraries, and re-pool with previously made RNA controls and RNA sample libraries. If only the RNA NTC fails, remake all of the RNA controls and RNA sample libraries, and re-pool with previously made DNA controls and DNA sample libraries. If both the DNA NTC and RNA NTC fail, remake all of the DNA and RNA controls and sample libraries.
DNA Control	The DNA control must pass the following specifications in order for any DNA samples within the run to have any reportable results: • AQ20 Mean Read Length (bp) must be ≥98. • Percent Reads must be ≥0.7%. • All variants within the DNA control sample must be called "Present" and pass the allelic frequency range for each variant as specified in the assay definition file.	If any of these specifications fail, the operator must remake all DNA control and DNA sample libraries.

Specification type	Passing criteria	Repeat strategy
RNA Control	The RNA control must pass the following specifications for any RNA samples within the run to have any reportable results: • Mappable Reads must meet the minimum threshold required of ≥8551 reads. • All variants within the RNA control sample must be called "Present" and pass the threshold metric set for total fusion reads required for each variant as specified in the assay definition file.	If either of these specifications fails, the operator must remake all the RNA control and RNA sample libraries.
Library DNA Sample	Any individual DNA library sample must meet the following specifications to have reportable results for the DNA library: • Mean AQ20 Read Length (bp) ≥90. • Percent Reads ≥0.7.	Run the DNA library sample alone, or with fewer DNA library samples. If the DNA library sample still fails these specifications, remake the library using the same (previously extracted) DNA, if there is sufficient quantity. If not, re-extract using more tissue input, if possible. The repeat libraries must be prepared and run with new DNA controls. **Note:** Use the original passing RNA control and DNA and RNA sample libraries as placeholders when needed, and re-pool the libraries accordingly in the repeat runs. Any data resulting from the placeholder libraries must be ignored in the repeat run.
Library RNA Sample	Any individual RNA library sample must have ≥5000 Mappable Fusion Reads to have reportable results for the RNA sample library. Any sample with ≤4999 Mappable Fusion Reads will result in "No Call" for the fusion variant.	Run the RNA library sample alone, or with fewer RNA library samples. If the RNA library sample still fails this specification, re-make the library using the same (previously extracted) RNA, if there is sufficient quantity. If not, re-extract using more tissue input, if possible. The repeat libraries must be prepared and run with new RNA controls. **Note:** Use the original passing DNA control and DNA and RNA sample libraries as placeholders when needed, and repool the libraries accordingly in the repeat runs. Any data resulting from the placeholder libraries must be ignored in the repeat run.
SNV and Deletion Variant Specifications	All Single Nucleotide Variants (SNVs) and Deletions (Dels) must have coverage ≥347 reads and pass all Variant Caller filtering metrics in order to have a reportable result for the variant.	Any SNVs or deletions that do not meet the coverage criteria will result in a "No Call" for the variant. The operator may run the sample alone or with fewer samples to obtain reportable results for the variant. If the repeat run fails to meet the minimum coverage requirement, the operator may remake the library to obtain reportable results for the variant.

Verification runs

Verification runs are sequencing runs performed during Ion PGM™ Dx System installation by Thermo Fisher Scientific support specialists to validate the performance of the instruments.

Note: While verification run reports can be viewed by users, the runs themselves are only performed by qualified support specialists.

Under the **Data** tab, in the **Verifications Runs** screen, you can search, filter, sort, and view completed verification runs and reports.

The following information is displayed in the **Verification Runs** screen:

Column	Description
Planned Run	The name of the run, created when the run was created. Click on the name to open the Review Planned Run dialog. • **Audit**: Click on this link to display the list of users who created/edited the Planned Run. You can export and print information from the list from the Audit Trail dialog box. • **CSA** (Customer Support Archive): Click on this link to download all the Ion PGM™ Dx Sequencer and Ion OneTouch™ Dx Instrument log files. Log files contained within the CSA may be useful when troubleshooting issues with either instrument.
Field Engineer Name	The name of the support specialist who performed the run.
Instrument Name	The name of the Ion PGM™ Dx Sequencer/Ion OneTouch™ Dx Instrument system validated.
Templating Completion	The completion date and time of the Ion OneTouch™ Dx System run. Click on the link to open a dialog that includes additional information about the instrument, operator, and template kit used.
PGM Completion	The completion date and time of the Ion PGM™ Dx System run. Click on the link to open a dialog that includes additional information about the sequencer, operator, sequencing kit, and chip used.
Analysis Completion	The completion date and time of the Torrent Suite™ Dx Software analysis.
Run status	The current status of the full run, including analysis.
QC Status	Indicates whether a run passed or failed, based on the Sequencing QC metrics selected for the assay.
PQ Report	If the results of the run have been approved and signed off by a Manager or Administrator, the approved PQ Report will be listed in this column.
Actions	• **View Results**: This button is available for completed runs that have not yet been approved. Click on the button to view the results of the run. Managers and Administrators can also sign off on the results after viewing them. • **View Report**: Click to view the report of the run.

Verification run results

Under the **Data** tab, in the **Verifications Runs** screen, click on **View Results** in the **Actions** column to view the performance qualification (PQ) report for a verification run.

Note: Managers and Administrators can sign off on this report, at which point it will become a locked PQ Report. However, we recommend that only qualified support specialists sign off on PQ reports.

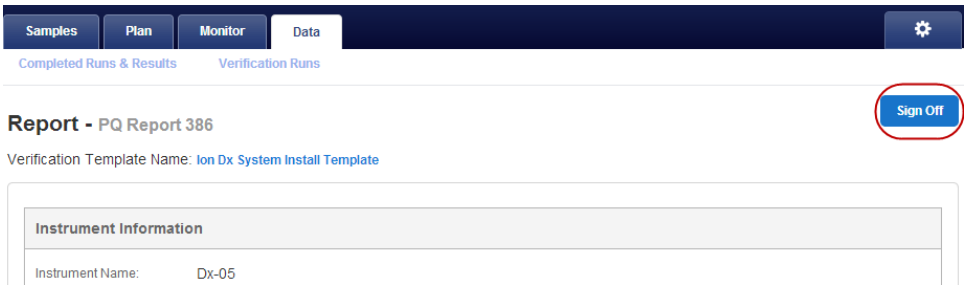
In addition to basic information about the verification run, the following data is reported for the controls used in the run:

Metric	Description
Base Call Accuracy	1 – (total number of errors for all positions in the control / total number of aligned bases)
Mean AQ20 read length (bp)	Average length, in base pairs, at which the error rate is ≤1% for all aligned reads of a control fragment
Percent Reads	Number of all usable library reads that align with the control fragment sequence, divided by the total number of addressable wells

Sign off verification run reports *(Manager/Administrator only)*

Managers and Administrators can sign off on results reports for Verification runs. However, we recommend that only qualified support specialists sign off on PQ reports.

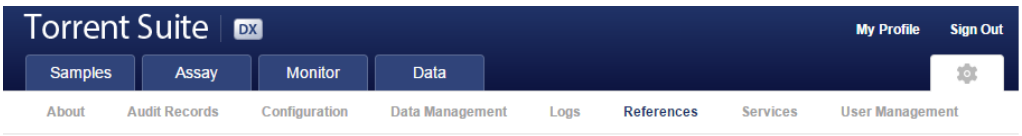
1. In the Report window, click on the **Sign Off** button in the upper right corner above the report.



   The Sign off Electronic Signature dialog will open.

2. Enter your user name, password, and any comments, then click **Sign Off.**
3. The report will be locked and listed in the PQ Report field for the run in the Verification Runs window.
4. Click on the PQ Report name to view, print, or download the report as a PDF.

7 System administration and management



In the ⚙ **tab**, Managers and Administrators can:

- View, create, and manage reference files, and include genome references, panel and hotspot BED files, primers, and others.

  Note: The Oncomine™ Dx Target Test is a locked assay. None of the files for this assay can be edited; they can only be viewed.
- View system information and settings.

In addition, Administrators can:

- View and export audit records.
- View and change configuration settings.
- Create and manage user accounts.
- Manage log files.

Access to ⚙ tab functions by user level

In the ⚙ **tab**:

Users at this level...	Can access...
Operator	**About**: More Information and Assistance • Support Contact Information: a link directing users to the **thermofisher.com/technical-resources** website. • Instrument Diagnostics: performs a diagnostic check of the Ion PGM™ Dx Sequencer. • End User License Agreement: opens the End User License Agreement (EULA).

Users at this level...	Can access...
Manager	Operator functions plus: **References**: displays and allows management of: • Reference Sequences • Panels • Hotspots • DNA barcodes • Fusion Reference • Fusion Panel • Reporting Gene List • Control Fragments • Primers **Services**: displays system status report for: • Jobs Server • Active Jobs • ionCrawler Service Details • Smart Monitoring Service Details
Administrator	Manager functions plus: **Audit Records**: perform an audit: search, sort, view, export, and print any record. **Configuration**: Configure settings for the: • Network • Email • Instruments • Lab Information • Software Updates **Data Management**: Manage archiving, view available disk space, and manually delete incomplete runs. **Logs**: Manage retention of instrument logs and Torrent Suite™ Dx Software logs. **User Management**: Add, assign user level, and edit user information.

About page

The About page contains links to webpages where the user can obtain more information and assistance.

- Support Contact Information — a link directing users to the **thermofisher.com/technical-resources** website where they can access technical support and product information.
- Instrument Diagnostics—contains the initialization logs of all Ion PGM™ Dx Sequencer instruments connected to the Ion Torrent™ Server and allows the user to:
  - download the diagnostic archive file (in .zip format).
  - view the Init.log file.
  - download the Installation Acceptance Report (.pdf format).
- End User License Agreement—opens the End User License Agreement (EULA).

References *(Manager/Administrator)*

Under the ⚙ tab in the **References** screen, Manager- and Administrator-level users can access the following reference files under the subtabs.

Note: These files are defined by the Oncomine™ Dx Target Test Assay Definition File. They are locked and can only be viewed or exported.

- Reference sequence files
- Panel files (BED format)
- Hotspots files (BED format)
- DNA barcode sequences
- Fusion reference sequences (FASTA format)
- Fusion panel files (BED format)
- Reporting Gene Lists (Microsoft Excel™ format)
- Control sequences
- Primer sequences (FASTA format)

Manage reference sequences

Under the ⚙ tab, in the **References** screen, the **References** subtab lists the DNA reference sequence files available in the software.

Manage panel files

Under the **Settings (⚙)** tab, in the **References** screen, under the **Panels** subtab, you can view the panel BED files available in the software.

- To export a panel file, click on **Export** in the **Actions** column.

Manage hotspot files

Under the ⚙ tab, in the **References** screen, under the **Hotspots** subtab, you can view the hotspot BED files available in the software.

- To export a hotspot file, click **Export** in the **Actions** column.

View DNA barcodes

Under the ⚙ tab, in the **References** screen, under the **DNA Barcodes** subtab, you can view the barcode IDs and sequences for each barcode set in the software.

1. Click on the name of a barcode set in the list.
   A new window will open showing the name and sequence of each barcode in the set.
2. Click **Back** to return to the list.

Manage the Gene List

The Gene List for the Oncomine™ Dx Target Test is the list of the genes and mutations used to generate reports for the assay.

The list located under the ⚙ tab, in the **References** screen, under the **Reporting Gene List** subtab.

- To view the contents of the Gene List:
  a. Click the name of the list in the **Name** column.
     A new screen will open showing the gene names, mutation IDs, and other information about the genes in the list.
  b. Click **Back** to return to the list.
- To export the list, click **Export** in the **Actions** column.

Control fragments

Internal controls are predefined and cannot be modified by the user. Listed in the Control Fragments pane are:

Column	Description
Name	Control fragment name
Sequence	Single letter nucleotide sequence of the control fragment
Control	Process in which the control fragment is used
Status	Indicates that the control fragment information is locked and cannot be modified by the user

Manage primers

Under the ⚙ tab, in the **References** screen, under the **primers** subtab, you can view the primer sequences in the software.

Services *(Manager/Administrator)*

Within the Services page, Manager and Administrator level users can view the status of the following: Active Jobs, ionCrawler Service, Smart Monitoring Service Details, and the Jobs Server. The information displayed here can be useful when troubleshooting error messages during an active job or why an analysis failed.

Services

Service	Function
Jobs Server	• Lists server information and active (running) software.
Active Jobs	• Lists active and queued analysis jobs on the Ion Torrent™ Server. • When no job is currently active, displays a "No active jobs" message.
ionCrawler Service Details	• Displays information about the data transfer process from the Ion PGM™ Dx Sequencer to the Ion Torrent™ Server.
Smart Monitoring Service	• Allows remote monitoring of Ion PGM™ Dx System.

To stop a running service:

1. Click **Stop** under the Actions header.
   A confirmation dialog window will open, "Are you sure you want to stop <service name>? "
2. Click **Yes** to confirm.
   The <service name> dialog will collapse and the option Start will replace Stop under the Actions header.
3. Click **No** to return to the Services window.
4. To reactivate the <service name>, click **Start.**
   A confirmation dialog window will open, "Are you sure you want to Start <service name>?"
5. Click **Yes** to confirm restarting the <service name> function.

View active jobs

To view or terminate an Active Job:

Active Jobs

Job ID	Job Name	Job Type	Status Message	
6592	job-0	Analysis	Job is running	Terminate
6595	job-1	Analysis	Job is running	Terminate

1. Click **Terminate** to stop the active job.
   A confirmation dialog will open, "Are you sure you want to terminate *Job Name* ?"
2. Click the red **Terminate** button to terminate the job.
   Click **Cancel** to return to the **Services** page without terminating the job.

Disable or enable the ionCrawler service

The ionCrawler service typically remains enabled at all times, but can be disabled by Manager- or Adminstrator-level users if required for remote service troubleshooting.

- To disable the service:
  a. Under the ⚙ tab, in the **Services** screen, below **ionCrawler Service Details**, click **Stop**.

     ionCrawler Service Details
     Status: Online Stop

  b. In the confirmation dialog, click **Yes** to disable the service.
     The **Stop** option will change to **Start**.

     ionCrawler Service Details
     Status: Offline Start

  c. Click **No** to return to the **Services** screen.

- To enable the service:
  a. In the same screen, below **ionCrawler Service Details**, click **Start**.
  b. In the confirmation dialog, click **Yes** to enable the service.
     The **Start** option will change to **Stop**.
  c. Click **No** to return to the **Services** screen.

Disable or enable the Smart Monitoring service

The Smart Monitoring service allows Thermo Fisher Scientific personnel to monitor the status of the Ion PGM™ Dx System remotely through an internet connection. Smart Monitoring employs multiple layers of security, including a Secure Sockets Layer (SSL) and Lightweight Directory Access Protocol (LDAP) authentication, to provide real-time troubleshooting and problem resolution for the Ion PGM™ Dx System.

The Smart Monitoring service is active by default and can be disabled by Manager- or Administrator-level users if required.

- To disable the service:
  a. Under the ⚙ tab, in the **Services** screen, below **Smart Monitoring Service Details**, click **Stop**.
  b. In the confirmation dialog, click **Yes** to disable the service.
     The **Stop** option will change to **Start**.
  c. Click **No** to return to the **Services** screen.

- To enable the service:
  a. In the same screen, below **Smart Monitoring Service Details**, click **Start**.
  b. In the confirmation dialog, click **Yes** to enable the service.
     The **Start** option will change to **Stop**.
  c. Click **No** to return to the **Services** screen.

Audit Records *(Administrator)*

In the **Audit Records** screen, Administrators can use the tools provided to review, sort, export, and print audit records.

Note: All components in a diagnostic assay must be uniquely identified, and the identification must be stored so that the record can be audited.

Note: Library Batches and Planned Runs created in a batch with other objects in a single LIMS transaction will not have a "Create" action listed in the Audit Records screen. However, you can view their complete audit record from the Libraries and Planned Runs screens, and any subsequent actions performed on them will be listed in the Audit Records. A Library Batch or Planned Run created individually via a LIMS transaction will be listed.

Search Audit Records

Use the Search toolbar to search for an existing record:

1. Limit the search to narrow the number of search results:
   a. Click to select a Start Date and an End Date.

      Note: Search results will include all records created since the Start Date entered up to and including the current date if an End Date is not entered.

   b. Select a Username from the dropdown list to limit the results to those actions performed by the selected user.

      Note: Search results will include records generated by all users if no selection is made.

   c. Select an Action (Edit, Create, Obsolete, Delete) from the dropdown list to limit the results to that action.

   d. Select a Data Object Name from the dropdown list to limit the results to records that only apply to that data object.
2. Click **Search**.
   The record(s) matching the search parameters will be listed.
3. Click **Clear** to return to the complete list of records.

The Search function can search based on all three criteria individually, sequentially, or collectively.

Sort Audit Records

The list of Audit Records is displayed with the oldest record on top by default. To return to the default display, click **Audit Records** or the **Clear** button.

1. Click on the column header of interest.
   The list of records will reorder based upon the header name selected. User, Action Performed, and Data Object Name sort alphabetically (**A ▸ Z**).

   Note: Clicking the **Timestamp** header will reverse the default setting, displaying the most recent record on top.

2. Click on the column header a second time to reverse the order of records displayed.

3. Click **Audit Records** or the **Clear** button to return to the default display.

Export and print Audit Records

The **Export** function generates a Print-Ready PDF file of the selected Audit Record.

1. Select the records to be exported by clicking in the checkbox adjacent to the record of interest. Select all the records on the page by selecting the checkbox above the column.

2. Click the (**Export**) button.
   A Print-Ready PDF will be generated. Depending on your internet browser settings the Torrent Suite™ Dx Software will automatically download the file, or ask whether you want to open or save the file.

3. Open the downloaded PDF file in an appropriate viewer, then print the record from within the open document.

Update the Audit Configuration

Audit Configuration allows the Administrator to require that a reason for the change is included as part of making a change to designated objects. To update the Audit Configuration:

1. Click on the **Audit Configuration** button.
   The Audit Configuration dialog will open.

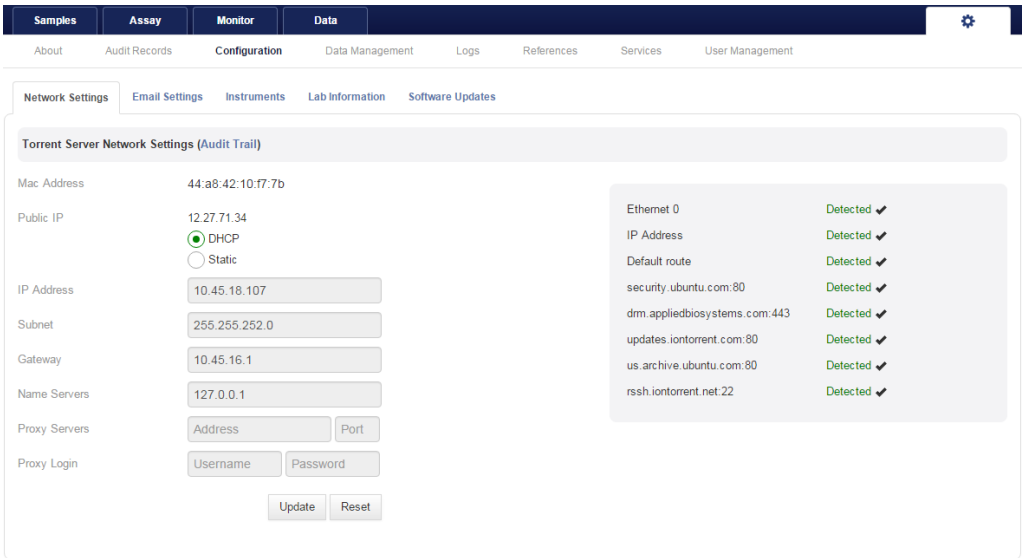
2. Click in the Require Reason checkbox adjacent to the Data Object Name.

3. Click **Save**.
   To remove a reason for change requirement, open the Audit Configuration dialog, deselect the checkbox, then click **Save**.

Configuration *(Administrator)*

Under the ⚙ tab, in the **Configuration** screen, the settings parameters are grouped by function into five tabs:

- **Network Settings**
- **Email Settings**
- **Instruments**
- **Lab Information**
- **Software Updates**



Network Settings

In the Configuration window the **Network Settings** tab is the default view. Information about the Ion Torrent™ Server is displayed in the Network Settings tab. In the event of a problem with the Ion Torrent™ Server, the information displayed here can be used to troubleshoot the cause.

The Audit Trail of the Ion Torrent™ Server Network Settings is available to view, export, and print by clicking on **Audit Trail**. For more information see "Audit Records (Administrator)" on page 75.

Configure Email Settings

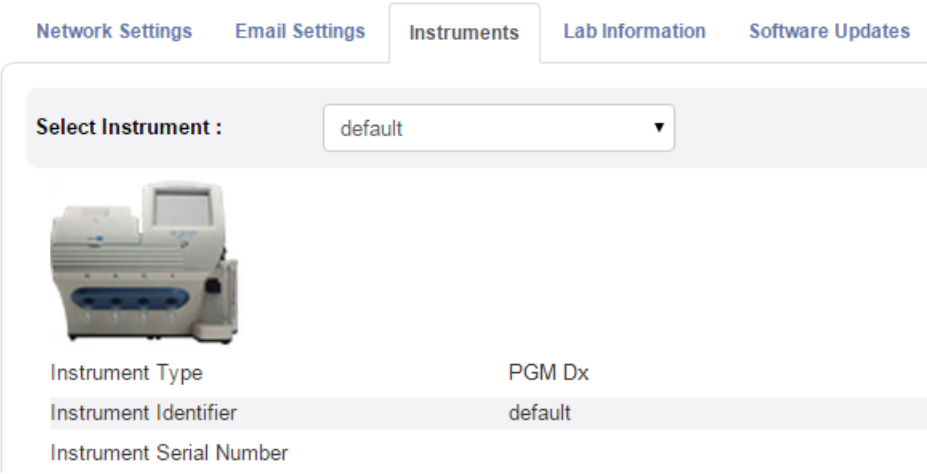
Within the Ion Torrent™ Server **Email Settings** tab, configure the server to allow sending email notifications. To enter the required information:

1. Obtain SMTP Server URL and Port information from your IT department.
2. Click in a designated field, then enter the appropriate value.
   Required fields are indicted with a red asterisk (*).
3. Click **Update**.
4. Click **Reset** to return the Email Settings to the default values.
5. Click **Send Test Email** to send a test email to the email address provided in your user account.

Instrument

From the Select Instrument drop-down list you can select and view the information for an instrument connected to the Ion Torrent™ Server such as:

- Instrument type
- Instrument identifier (name)
- Instrument State
- Last PQ Date



Lab Information

IMPORTANT! The system administrator should review the contact information periodically to ensure that it is current and accurate.

The **Lab Information** tab provides a reference for support personnel, listing points of contact if a problem with the Ion Torrent™ Server or a connected Ion PGM™ Dx System instrument occurs.

- **Lab Contact** – This is the person in your organization who should be notified during a support request of problems related to the instrument.
- **IT Contact** – This is the person in your organization who should be notified during a support request of problems related to the Ion Torrent™ Server hardware or the network environment.

Update the Software

IMPORTANT! Make sure that all instruments connected to the server are idle and no analysis jobs are running on the server or are queued to run before updating the software.

Under the ⚙ tab, in the **Configuration** screen, **Software Updates** subtab, Administrators can:

- See the currently installed software version for each software module and component application
- Check for software updates
- Install software updates from a USB drive using the following steps.

1. Click on the desired instrument software module header to expand the field.
2. After viewing the software version information, click on the software module header a second time to collapse the field.
3. To check for updates, click on the **Check for updates** button.
   If an available update is found, a **Download & Update** button will appear next to the **Check for updates** button. If no updates are found, "No updates available" will display.
4. To load an update from a USB drive, connect the USB drive, then click **Check for updates**.
   The Torrent Suite™ Dx Software will search the USB drive for updates and list them.
5. Click **Update Server**.
   A confirmation dialog window will open.
6. Click **OK** to begin the update.
   Upon successful completion of the software update, the Ion Torrent™ Server will automatically begin rebooting within two minutes.
7. After the server has rebooted (~10 minutes), click the browser's **Refresh** button to return to the Torrent Suite™ Dx Software home page.
   Once the update is complete, confirm the software version number in the **Software Updates** tab in the **Configuration screen**.

Data Management *(Administrator)*

Edit settings within the Data Management window to balance the rate of incoming new data with your needs to preserve existing results and to maintain control over your disk partitions in an orderly manner.

Note: 72 hours following completion of data analysis, raw data (DAT) files are deleted from the server to conserve Ion Torrent™ Server disk space.

Within the Data Management window, Administrators can:

- monitor Disk Space Usage.
- manually delete incomplete runs.
- manage Archive Settings, and view an Audit Trail of any changes made.
- configure the Archive Directory.

About the data output directory

Note: The Data Output Directory is locked and cannot be changed. Users should configure their LIMS to access this folder location to receive sequencing output files.

The Data Output Directory is the primary directory where outbound data from the Ion PGM™ Dx System is stored. After the sequencing run and data analysis have been completed and the report is signed off, then the software creates a separate results folder for each sample under the Data Output Directory using the following naming convention:

Dx_ <Library Name>_<Assay Name>_<PlannedRunShortCode>_ <PlannedRunShortCode/ReAnalysisAssay ID>

The following files are added to the results folder:

- Run log files: basecaller.log, sigproc.log, analysis.log
- Audit trail of the planned run in PDF format: PlannedRun-AuditTrail.pdf
- VCF file: TSVC_variant.vcf
- Variant list: Dx_variant.xls
- Allele coverage for bases in hot spot regions: Dx_allele_counts.xls for each barcode
- Report in PDF format
- A info.csv file containing sample attributes, reagent information, QC values and instrument information
- Unmapped BAM file: <barcode>_rawlib.basecaller.bam
- Mapped BAM file: <LibPrepID>_rawlib.bam
- Mapped BAM index file: <LibPrepID>_rawlib.bam.bai
- A checksum file containing checksums for each output file
- analysis.bfmask.stats: contains analysis statistics of wells in the bead find stage
- BaseCaller.json: a JSON format file of the statistics of basecaller, bead summary, filtering, phasing, and training subset
- Bead_density_contour.png: loading density figure
- datasets_pipeline.json: a JSON format file of the settings needed by the pipeline to run the basecaller module
- explog_final.txt: final run settings needed for analysis

- ion_params_00.json: a JSON format file of the detailed settings of the run and analysis arguments
- iontrace_Library.png: key incorporation traces figure
- raw_peak_signal: key signal for controls and library
- readLenHisto.png: histogram for read length
- TFStats.json: a JSON format file of control statistics
- wells_beadogram.png: a figure of statistics to characterize wells
- Test_Report(s) PDF Reports (optional, multi-language test reports if generated, filename is appended with language suffix)
- Lab_Report(s) PDF Report (multi- language lab reports if generated, filename is appended with language suffix)
- Summary.tab—Non-targeted Test Results Summary
- Snvindel.tab—Non-targeted SNV/INDEL Detail Table
- Fusion.tab—Non-targeted Fusion Detail Table
- Cnv.tab—Non-targeted CNV Detail Table [1]
- Target_summary.tab—Targeted Test Results Summary
- Target_hotspot.tab—Targeted SNV/INDEL Detail Table
- Target_fusion.tab—Targeted Fusion Detail Table
- <LibPrepID>_<AnalysisID>.final.vcf—VCF File
- Info.csv—Info File
- <barcode>_rawlib.basecaller.bam—Unmapped BAM File – DNA
- <barcode>_rawlib.basecaller.fastq—Fastq File -DNA
- <LibPrepID>_rawlib.bam—Mapped BAM File - DNA
- <LibPrepID>_rawlib.bam.bai—Mapped BAM Index File -DNA
- <barcode>_rawlib.basecaller.bam—Unmapped BAM File – RNA
- <barcode>_rawlib.basecaller.fastq—Fastq File - RNA
- <barcode>_rawlib.basecaller.alignments.bam—Mapped BAM File - RNA
- <barcode>_rawlib. basecaller.alignments.bai—Mapped BAM Index File - RNA
- Bead_density_contour.png—Loading Density Figure
- iontrace_Library.png—Key Incorporation Trace
- raw_peak_signal—Key Signal
- readLenHisto.png—Read Length Histogram
- <LibPrepID>_rawlib.stats.cov.txt—Amplicon Stats
- basecaller.log—Base Caller Log File
- sigproc.log—Signal Processing Log File
- analysis.log—Analysis Log File
- PlannedRun-AuditTrail.pdf—Planned Run Audit

[1] For use with IVD tests that include CNV reporting.

Data archive and restore

Torrent Suite™ Dx Software can be configured to automatically archive older run data, results files, and signed reports from Ion Torrent™ Server to an external file storage system, based on when the results were generated. To maintain sufficient Ion Torrent™ Server disk space, we recommend implementing a systematic plan to archive data. Consult your Field Service Engineer to discuss archive and database backup options. Your local system administrator is responsible for configuring and maintaining your data archive system.

After a data archive system has been established, administrator-level users in the software can configure the archive schedule, as described in the next section.

Note: If the Ion Torrent™ Server has ≤1 terabyte (TB) of free disk space, an alert notifies the user that there is insufficient disk space when setting up the run on the sequencer. The run cannot proceed until data on the server is archived and deleted. Contact your local system administrator to manually archive and delete data. You should also change the archive schedule as described in the next section.

Archived results and reports can be restored to the Ion Torrent™ Server and downloaded from the **Results List** screen.

IMPORTANT!

- **The software may not display all variants from restored results in the user interface, and any reports generated from those restored results may not contain all variants. Carefully review the restored data in the user interface to determine whether all variants are present. Do not generate new reports from restored results.** Note that all variants are preserved in the restored source files, and can be downloaded using the **Download Files** command.
- All results reports should be generated and signed in Torrent Suite™ Dx Software **before** results are archived. See "Sign the Results Report" on page 61.

Update the Archive Settings

Consult your Field Service Engineer to set up an database archive and backup system. To update the archive settings in the software:

1. From the **Auto archive after** dropdown list, select the number of months before data from a run is archived.
2. Click in the Archive Directory field, then enter the mounted directory path where you want to archive the data.
3. Click **Save**.

To free up additional disk space:

- Delete incomplete runs.
- Reduce the **Auto archive after** time.

Archive storage system notifications

Administrator-level users receive disk-full notification emails when the archive storage system has ≤120 gigabytes (GB) of free disk space remaining. To receive disk-full notifications, a valid administrator email address must be entered into Torrent Suite™ Dx Software (see "User Management (Administrator)" on page 83). Additionally, the Ion Torrent™ Server must be configured to allow sending emails (see "Configure Email Settings" on page 77).

Logs *(Administrator)*

Select a Log category

Within the Logs screen, choose from the Select Category dropdown list to view and set auto-deletion rules for **Torrent Suite** and **Instrument** logs.

Manage Logs

Manage logs allows the Administrator to set retention times and allow for auto-deletion of logs.

1. Click the **Manage Log** button.
   The Manage Log File dialog window will open.
2. From the **Retention Period** dropdown list, select the number of months logs are to be retained on the server.
3. Select **Enable Auto Deletion** to automatically delete log files after the designated retention period.
4. Click **Save**.

User Management *(Administrator)*

Within the User Management window, Administrators can: add users, assign user privileges (Role), edit user information, view the user account audit trail, and manage user account policies.

Add a new user

Note: To allow sending email notifications to new user's, the Ion Torrent™ Server email settings must be configured before adding new user accounts. See "Configure Email Settings" on page 77 for more information.

To create a new user account:

1. Click the **Add New** button.
   The Create New User dialog will open.
2. Enter the new:

   Note: Required fields are indicated by a red asterisk (*).

   - User Name
   - Account Information
     - First Name
     - Last Name
     - Email Address
     - Comments
3. Click the Electronic Signature checkbox to enable the ability to sign off on reports.
4. Select the user access level (Administrator, Manager, or Operator) from the **Role** dropdown list.
5. Click **Save**. The Ion Torrent™ Server will send a temporary password to the email address entered in new user's account.

Set security policies

Basic user account security policies (e.g., number of permissible failed login attempts, password lifetime, duration of inactivity before session times out) are defined within this dialog window. To make changes to these basic policies:

1. Click **Policies**.
   The Policies dialog window will pop up.
2. Select the appropriate value(s) from the dropdown lists to set the user-account Suspension, Password, and Session policies.
3. Click the Enabled checkbox to enable the Session policies.
4. Click **Save**.

Sort Users

To sort the User list:

1. Click on the header name of interest to sort alphabetically.
2. Click on the header name a second time to reverse the order of users displayed.
3. Click **User Management** to return to the default display.

Edit User Details

1. Under the User Name column, click **Edit**.
   The Edit User Details dialog will open.
2. Click in the Account Information field(s) to be edited, then make the change(s).
3. Select the user Status (Active, Suspend, or Disable) from the dropdown list.
4. Click the Electronic Signature checkbox to enable/disable the ability to sign off on reports.
5. Select the user-access level (Administrator, Manager, or Operator) from the **Role** dropdown list.
6. Click **Save** to make the changes.

Reset password

Note: Operator level users can reset their passwords by following the directions included in the system-generated email notification of a pending password expiration.

In the Edit User Details window:

1. Click **Reset Password**.
   The Reset User Password dialog will open.
2. Click **Send password in email**, to email a new password to the email address entered in the user account.
3. Alternatively, enter a new password into the **Password** field.
4. Reenter the new password into the **Re-type Password** field, then click **Save**.
   The confirmation "Password reset successfully" will appear. Click **Back**, then **Save** to return to the User Management window.

View user Audit Trail

To view the Audit Trail of a User.

1. Under the **User Name**, click **Audit**.
   The **Audit Trail** dialog window will open. Listed in the window is each modifying event for the selected User.
2. Click on the details icon under the **Record** header to view the details of the action performed.
   The **Audit Record Details** dialog will open.
3. In the **Audit Record Details** dialog click:
   a. **Export**: to export a Print-Ready PDF of the record.
   b. Open the downloaded PDF file in an appropriate viewer, then print the record from within the open document.
   c. **Cancel**: to return to the **Audit Trail** dialog window.
4. Click the **Cancel** button to return to the **User Management** window.

A Anomalies

For Torrent Suite™ Dx Software anomalies, refer to the release notes for your version of the software, included on the software USB drive.

B Troubleshooting

HotSpot ID corrections

The following HotSpot IDs reported in the software are inaccurate, and correspond to the actual COSMIC IDs listed below. These anomalies do not impact test results.

HotSpot ID in the software	Actual COSMIC ID	Gene	Amino acid change	Nucleotide change
OM3157	COSM1235478	MAP2K1	p.Lys57Asn (p. K57N)	c.171G>T
COSM1235478	N/A[1]	MAP2K1	p.Lys57Met (p. K57M)	c.170A>T
COSM1562837	COSM5077832	MAP2K1	p.Phe53Val (p. F53V)	c.157T>G

[1] This variant is not in the COSMIC database.

Torrent Suite™ Dx Software

Observation	Possible cause	Recommended action
Cannot login to the Ion Torrent™ Server	You have either forgotten your password or are logged out due to several failed login attempts.	Contact the Torrent Suite™ Dx Software system administrator.
Cannot login to the Ion PGM™ Dx Sequencer	The Ion PGM™ Dx Sequencer lost its connection to the Ion Torrent™ Server.	Contact the Torrent Suite™ Dx Software system administrator.
Data and user profiles are missing from the software	You are signed into the incorrect mode of the software. Data and user profiles created in Torrent Suite™ Dx Software will not be visible in Torrent Suite™ Assay Development Software, and vice versa.	Confirm that you are signed into the correct mode of the software.
Batch sample import fails	One or more entries in the sample-import spreadsheet contains special characters, lines breaks, unexpected spaces, incorrect entry length, incorrect date formatting, or other formatting errors.	Check each entry for correct formatting, correct any errors, and repeat the import.

Observation	Possible cause	Recommended action
Batch sample import fails	Blank rows were copied into the sample-import template file from a different source.	Rows that appear empty may contain hidden formatting that conflicts with the import function. Start with a clean sample-import template file, and be careful to copy only those rows that contain actual data.
	The sample import spreadsheet contains a nonunique Sample ID.	Every Sample ID in the software must be unique. Make sure the spreadsheet does not contain any duplicate IDs, and repeat the import. Note that the system check is not case-sensitive, so a Sample ID of ABC1 conflicts with abc1.
	The headings in the sample import spreadsheet do not match the sample attributes in the software.	The headings must match the sample attributes in the software exactly. Check the headings for spelling or other errors.
Cannot execute my Planned Run "System error" message is displayed	The Tube Label you assigned the **Planned Run** is not unique **Note:** The Ion PGM™ Dx Instrument Control software will not allow use of the same Tube Label text within 7 days	Assign the **Planned Run** a new, unique Tube Label.
	Incorrect template prep kit barcode was entered.	Rescan the correct template prep kit barcode.
The results of my run are not showing up in the Data tab	Ion Torrent™ Server disk space is full.	Clear disk space on the Ion Torrent™ Server. Once sufficient disk space has been cleared, data transfer from the Ion PGM™ Dx Sequencer to the Ion Torrent™ Server will commence and data analysis proceed.
	Ion PGM™ Dx Sequencer lost connection to the Ion Torrent™ Server.	Reestablish the Ion PGM™ Dx Sequencer Ethernet connection to the Ion Torrent™ Server. Once the connection has been restored, data transfer from the Ion PGM™ Dx Sequencer to the Ion Torrent™ Server will recommence and data analysis proceed.
Cannot find file links to the BAM and VCF file	The run failed. Links to BAM and VCF files are not available for runs that fail QC.	Repeat the run.
Loading metrics are reported as 0	• Chip failure • Defective pariposer • Chip leak	Refer to sequencing troubleshooting for possible causes of chip or pariposer failure.
	Sample preparation failure resulting in loss of sample	Refer to troubleshooting for sample, library, and template preparation.

Library preparation

Observation	Possible cause	Recommended action
Display message: Invalid kit barcode or Expired kit	Kit is beyond expiration date.	Use a nonexpired kit.
	Incorrect kit scanned.	Rescan the barcode of the correct kit.
Run QC passed but low coverage uniformity (<95%)	Poor purification causes loss of short amplicons	Vortex AMPure™ XP reagent thoroughly before use, and be sure to dispense accurate volume.
Run QC passed, low percent full length On Target Reads, but Control passed	Library prep failure	Reprepare the sample library.
Samples passed but CF-1 Mean AQ20 Read Length failed	Reads filtered out due to high polyclonal ISPs caused by too much library added to the Ion OneTouch™ Dx amplification reaction	Repeat Ion OneTouch™ Dx run using less library in the amplification reaction.
Run QC passed, but one or more sample libraries failed Percent Reads QC metric	Library prep failed due to unwashed beads.	Be sure to wash the library beads prior to use.
	Library preparation failed due to wrong library amplification primers.	Use the LIB Primers provided in the Ion PGM™ Dx Library Kit.
	Library prep failed due to residual salt after wash.	Carefully remove all wash solution prior to elution.
	Library prep failed due to mis-quantification of input DNA.	Requantify input DNA.
	Library prep failed due to inefficient PCR, digestion, or ligation.	Ensure that you properly dispense and mix the viscous components at each step.
		Ensure that you use the correct thermal cycling conditions.
	Library prep failed due to the library being discarded during purification of the amplified library.	Be sure to save the supernatant during first-round purification and save the library pellet during the second round purification of the amplified library.
	Library prep failed due to over-drying of the AMPure™ XP beads.	Do not dry the AMPure™ XP beads more than 5 minutes.
		Ensure that you dispense exactly 10 µL of capture reagent to the amplified library.
	Library failed due to ineffective capture of the amplified library.	Ensure that the library capture reagent is at room temperature before use.
		Ensure that you dispense exactly 10 µL of capture reagent to the amplified library.
		Make sure to mix completely and incubate for 5 minutes at room temperature.
Run QC passed, but one or more library samples failed Percent Reads QC metric - continued	Reads filtered out due to primer-dimers.	In unamplified library purification, ensure that you use the correct amount of AMPure™ XP reagent.
		Do not combine Barcode Adapters, LIB DNA Ligase, and LIB Switch Soln prior to addition.

Observation	Possible cause	Recommended action
Run QC passed, but one or more library samples failed Percent Reads QC metric - continued		Ensure that Barcode Adapters are diluted properly.
	Reads filtered out due to low quality ISPs.	Repeat the Ion OneTouch™ Dx run. If it still happens, then reprepare the library.
	Reads filtered out due to high polyclonal ISPs caused by failed consumables.	Repeat the Ion OneTouch™ Dx run. If it still happens, then reprepare the library.
	Reads filtered out due to high polyclonal ISPs caused by too much library added to the Ion OneTouch™ Dx amplification reaction.	Requantify input DNA or RNA, and remake the library.
	Forgot to add the library to amplification reaction.	Repeat the Ion OneTouch™ Dx run. If observation recurs, then reprepare the library.

Template preparation

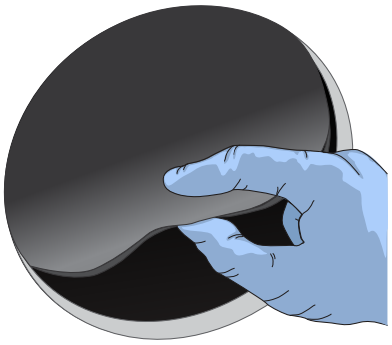
Observation	Possible cause	Recommended action
Display message: Failed to set up system time at startup. Check your connection to the Torrent Server.	Ion OneTouch™ Dx Instrument and Ion Torrent™ Server connection is not established	Check your network connection to the Ion Torrent™ Server to make sure the connection is established, then reboot the Ion OneTouch™ Dx Instrument.
	Instrument is still in the process of establishing a connection	Allow ten minutes to see if the display message clears.
Display message: Failed to connect to the Torrent Server. Check your connection.	Ion OneTouch™ Dx Instrument and Ion Torrent™ Server connection is not established during startup	Check your network connection to the Ion Torrent™ Server to make sure the connection is established, then reboot the Ion OneTouch™ Dx Instrument.
Display message: Pressure too high. Reboot the instrument to clear the alarm.	• Hardware issue • Clogged TMPL Emulsion Cartridge due to contaminated reagents or defective emulsion cartridge	Reboot the Ion OneTouch™ Dx Instrument to clear the alarm. Use a new TMPL Emulsion Cartridge and fresh reagents to repeat the run. Contact Technical Support (see "Customer and technical support" on page 130) if the issue persists.
Display message: TEC current too high. Reboot the instrument to clear the alarm.	Hardware issue	Contact Technical Support (see "Customer and technical support" on page 130). Reboot the Ion OneTouch™ Dx Instrument to clear the alarm. **IMPORTANT!** A sample created during a run with this alarm raised must NOT be used.
Display message: Coolant pump does not flow.	Hardware issue	Contact Technical Support (see "Customer and technical support" on page 130). Reboot the Ion OneTouch™ Dx Instrument to clear the alarm.

Observation	Possible cause	Recommended action
Display message: Sensor unable to measure instrument temperature	Hardware issue	Contact Technical Support (see "Customer and technical support" on page 130). Reboot the Ion OneTouch™ Dx Instrument to clear the alarm.
Display message: Software versions incompatible. Go to the Options menu and update the software.	The system software was updated, but the instrument software was not.	After the system software has been updated, update the instrument software as follows: 1. On the main menu of the instrument, press **Options** and follow the instructions to check for and install updates. 2. When installation is complete, follow the onscreen prompts to reboot the instrument. **IMPORTANT!** You must reboot the instrument before proceeding.
Display message: Sensor unable to measure pressure.	Hardware issue	Contact Technical Support (see "Customer and technical support" on page 130). Reboot the Ion OneTouch™ Dx Instrument to clear the alarm.
Display message: Connection failure with Torrent Server	Ion OneTouch™ Dx Instrument and Ion Torrent™ Server connection is not established	Check that a network connection to the Ion Torrent™ Server is established, then reboot the Ion OneTouch™ Dx Instrument. **Note:** A sample created during a run with this alarm raised can still be used.
Display message: Motor current too high. Reboot the instrument to clear the alarm.	Hardware issue	Contact Technical Support (see "Customer and technical support" on page 130). Reboot the Ion OneTouch™ Dx Instrument to clear the alarm. **Note:** A sample created during a run with this alarm raised can still be used.
Display message: Set temperature out of range. Reboot the instrument to clear the alarm.	Hardware issue	Contact Technical Support (see "Customer and technical support" on page 130). Reboot the Ion OneTouch™ Dx Instrument to clear the alarm. **IMPORTANT!** If this alarm is raised, you cannot use the prepared template.
TMPL CF-1 fails QC metric(s); all sample libraries pass QC metrics	TMPL CF-1 reagent not added	Repeat Ion OneTouch™ Dx Instrument run and Ion PGM™ Dx Sequencer run, and ensure that the TMPL CF-1 reagent is added per procedure description.
	The minimum Key Signal value of the CF-1 control required for the assay is >0.	• The minimum Key Signal value for the CF-1 control (i.e., the Templating Control) is set to 0 in all preinstalled assays and new custom assays in Torrent Suite™ Dx Software 5.6. Custom assays created in previous versions of the software may have a higher Key Signal value for the control.

Sequencing

Observation	Possible cause	Recommended action
Cannot import my sample	**Sample ID** is greater than 20 characters.	Limit **Sample ID** to 20 characters or fewer.
	Expired library kit.	Use a nonexpired library kit.
	Incorrect library kit barcode.	Rescan the correct library kit barcode.
Run report says run failed	Run failed because one or more QC metrics were not met	
I created a Planned Run but the Ion PGM™ Dx Sequencer does not recognize the Short Code	**Planned Run** was not executed.	In the Torrent Suite™ Dx Software: 1. Select the **Planned Run**, then click **Execute**. 2. Fill out the information in the dialog, then click **Save**.
	The Ion PGM™ Dx Sequencer and Ion Torrent™ Server have lost connection.	Check the network connection to the Ion Torrent™ Server to make sure the connection is established, then reboot the instrument.
TMPL CF-1 fails QC metric(s); all sample libraries fail QC metrics	• Forgot Enzyme • Forgot Seq primer • Used wrong annealing program	Repeat Ion OneTouch™ Dx Instrument run and Ion PGM™ Dx Sequencer run.
Display message: Lost connection to the Ion Torrent™ Server	The connection between the instrument and the server has been lost.	Check the network connection to the Ion Torrent™ Server, and then reboot the Ion PGM™ Dx Sequencer. If this alarm appears during a run, the data created during that run can still be used.
Display message: Failed to set up system time at startup. Check your connection to the Ion Torrent™ Server.	The connection between the Ion PGM™ Dx Sequencer and the Ion Torrent™ Server has been lost.	1. Check the network connection to the Ion Torrent™ Server to make sure the connection is established, then reboot the instrument. 2. If the problem persists, replace the network cable(s) to the instrument and server. 3. If the problem persists, contact Technical Support (see "Customer and technical support" on page 130).
	Instrument is still in the process of establishing a connection	Allow 10 minutes to see if display message clears.
Display message: Bad boot drive detected	Hardware issue	Contact Technical Support (see "Customer and technical support" on page 130). If this alarm appears during a run and data for the run is generated, that data may still be used.
Display message: UBoots do not match	Hardware issue	Contact Technical Support (see "Customer and technical support" on page 130).
Display message: Kernels do not match	Hardware and/or software issue	Contact Technical Support (see "Customer and technical support" on page 130).

Observation	Possible cause	Recommended action
Display message: Bad results data drive	• On some machines, the warning appears before the reboot completes. • There is a hardware issue.	Wait for a few minutes to see if the error message disappears. If the error message disappears, data obtained during a run with this alarm raised can still be used. If the problem persists, contact Technical Support (see "Customer and technical support" on page 130).
Display message: Lost chip connection	The instrument cannot detect a chip in the chip clamp.	Refer to the *Oncomine™ Dx Target Test Part IV: Sequencing User Guide* troubleshooting section.
Display message: Lost communication with valve board	Hardware issue	Contact Technical Support (see "Customer and technical support" on page 130).
Run aborted during presequencing step	Critical alarm present on the Ion PGM™ Dx Sequencer	Reboot the Ion PGM™ Dx Sequencer to clear the alarm, then restart the sequencing run.
Display message: Sensor unable to measure instrument temperature	Hardware issue	Contact Technical Support (see "Customer and technical support" on page 130).

Observation	Possible cause	Recommended action
Display message: Instrument temperature too high	• Room temperature is too high. • Clogged filter or blocked airway on the instrument • Hardware issue (fan is not running or running too slowly)	**Note:** The data created during a run with this alarm raised may still be used if all the QC metrics are met. 1. If the ambient room temperature is above 30°C, lower it. 2. Make sure that the round filter on the back panel of the instrument has unrestricted airflow. If the filter is clogged with dust, clean it as follows: a. Pinch the dirty filter with your fingers, then remove it from the instrument.  b. Shake the filter over a waste container to remove most of the dust. c. Rinse the filter with running water to remove any remaining dust. The water flow should be from the inside-facing surface to the outside-facing surface through the filter. d. Air dry the filter. e. Blot any remaining dust from the filter using tape. f. Reinsert the filter. If the problem persists, contact Technical Support (see "Customer and technical support" on page 130).
Display message: Instrument temperature too low	• Room temperature is below 20°C. • Hardware issue	**Note:** The data created during a run with this alarm raised may still be used if all the QC metrics are met. If the ambient room temperature is below 20°C, raise it. If the problem persists, contact Technical Support (see "Customer and technical support" on page 130).

Observation	Possible cause	Recommended action
Display message: Chip temperature too high	• Room temperature is too high. • Clogged filter or blocked airway on the instrument • Hardware issue (instrument fan is not running or running too slowly)	IMPORTANT! The data created during a run with this alarm raised should *not* be used. See the recommended action for "Display message: Instrument temperature too high" on page 94.
Display message: Chip temperature too low	Hardware issue	IMPORTANT! The data created during a run with this alarm raised should *not* be used. Contact Technical Support (see "Customer and technical support" on page 130).
Display message: Instrument idle temperature too high	• Room temperature is too high. • Clogged filter or blocked airway on the instrument • Hardware issue (fan is not running or running too slowly)	**Note:** The data created during a run with this alarm raised may still be used if all the QC metrics are met. See the recommended action for "Display message: Instrument temperature too high" on page 94.
Display message: Instrument idle temperature too low	• Ambient room temperature is below 20°C. • Hardware issue	Bring the ambient temperature up to 20°C. If the problem persists, contact Technical Support (see "Customer and technical support" on page 130).
Display message: Fan current too low	Hardware issue	Contact Technical Support (see "Customer and technical support" on page 130).
Display message: Heater current too low	Hardware issue	IMPORTANT! If the chip temperature is also out of range, data created during a run should *not* be used. Contact Technical Support (see "Customer and technical support" on page 130). If no chip temperature alarms are raised, data created during a run may still be used if all the QC metrics are met.
Display message: Pressure too high	Internal pressure regulator was not set correctly	Contact Technical Support (see "Customer and technical support" on page 130).
Display message: Pressure too low.	• Gas line is not connected to the instrument • Gas cylinder may be turned off or empty	1. Verify that the gas line is connected to the instrument. 2. Verify that the gas cylinder has at least 500 psi on the pressure gauge inside the tank and 30 psi on the gauge that regulates pressure to the outlet. (Both pressure gauges are mounted on the gas cylinder.) 3. Confirm that the outlet valve on the regulator is turned on. 4. If the problem persists, contact Technical Support (see "Customer and technical support" on page 130).

Observation	Possible cause	Recommended action
Display message: Sensor unable to measure gas pressure. Check supply gas pressure.	• Gas line is not connected to the instrument • Gas cylinder may be turned off or empty • Hardware issue	1. Verify that the gas line is connected to the instrument. 2. Verify that the gas cylinder has at least 500 psi on the pressure gauge inside the tank and 30 psi on the gauge that regulates pressure to the outlet. (Both pressure gauges are mounted on the gas cylinder.) 3. Confirm that the outlet valve on the regulator is turned on. 4. If the problem persists, contact Technical Support (see "Customer and technical support" on page 130).
Display message: Failed to set the pressure to target range. Check the gas connection and try again.	• Gas line is not connected to the instrument • Gas cylinder may be turned off or empty • Hardware issue (regulator malfunction)	1. Verify that the gas line is connected to the instrument. 2. Verify that the gas cylinder has at least 500 psi on the pressure gauge inside the tank and 30 psi on the gauge that regulates pressure to the outlet. (Both pressure gauges are mounted on the gas cylinder.) 3. Confirm that the outlet valve on the regulator is turned on. 4. If the problem persists, contact Technical Support (see "Customer and technical support" on page 130).
Display message: Failed to locate the barcode scanner. Check if the scanner is attached.	The connection between the barcode scanner and the Ion PGM™ Dx Sequencer has been lost.	Make sure the scanner is plugged into a USB port on the instrument. If it is connected and the alarm still appears, try plugging the scanner into a second USB port. If the alarm persists, contact Technical Support (see "Customer and technical support" on page 130).
Display message: Results drive not accessible. Reboot and try again.	• On some machines, the warning appears before the reboot completes • Hardware issue	Wait for a few minutes to see if the error message disappears. If the error message appears and disappears during a run, data obtained during that run can still be used. If the alarm persists, contact Technical Support (see "Customer and technical support" on page 130).
Display message: Results drive check failed	Hardware issue	If the error message disappears when you return to the main instrument screen, this alarm can be ignored. Otherwise, contact Technical Support (see "Customer and technical support" on page 130).
Display message: Unable to mount the file system	Hardware and/or software issue	1. Reboot the instrument to clear the alarm. 2. If the alarm is not cleared after reboot, contact Technical Support (see "Customer and technical support" on page 130).
Display message: Failed to set up FTP connection. Check your connection to the Ion Torrent™ Server .	The network connection is not established or an incorrect IP address was used.	Confirm that the server information is correct for the Ion Torrent™ Server. Contact your local network administrator for support if the issue persists.

C Performance characteristics

Analytical studies

Limit of Blank (LoB) study

To ensure that a variant-free ("blank") sample does not generate an analytical signal that might be classified as a mutation, wild-type (WT) samples were evaluated at each variant location that can be detected by the Oncomine™ Dx Target Test. Samples that are WT at all locations should produce a "variant not detected" call at each location. By definition (EP17-A2), the 95th percentile of test results on blank samples equals zero.

Operators extracted and sequenced nucleic acid from 5 WT cell lines prepared as FFPE sections on slides. The cell lines have well-characterized genomes and contain no known cancer biomarker sequences.

The study was conducted using two different lots of the Oncomine™ Dx Target Test Kit. For each lot, each cell-line sample was extracted once and made into 6 DNA and 6 RNA libraries. Operators sequenced each library in duplicate, generating 24 different sets of results across the two reagent lots per sample.

For all 5 samples, there were no positive calls at any of the variant locations analyzed by the test. The false positive rate was therefore zero.

Additionally, operators extracted and sequenced nucleic acid from 3 FFPE clinical samples prepared on slides. Each sample was tested using 24 replicates and 2 reagent lots of the Oncomine™ Dx Target Test Kit, resulting in 144 sequencing replicates each for DNA and RNA.

For all replicates, there were no positive calls at any of the variant locations. The false positive rate was therefore zero, and the LoB of the test was determined to be zero.

Tissue input study

Sixty slide-mounted FFPE samples were analyzed to determine if samples extracted using the Ion Torrent Dx Total Nucleic Acid Isolation Kit yield DNA and RNA at the concentrations required by the Oncomine™ Dx Target Test when tissue input requirements are met. The test requires DNA at a concentration of ≥0.83 ng/µL and RNA at a concentration of ≥1.43 ng/µL.

Thirty resection samples with ≥20% tumor content were prepared without macrodissection, 15 resection samples with <20% to ≥10% tumor cell content were macrodissected, and 15 samples were collected by core needle biopsy (CNB). For the resection samples, 2 × 5 µm sections were used per extraction. For CNBs, 9 × 5 µm sections were used per extraction. DNA and RNA concentrations were determined using the Ion Torrent Dx DNA and RNA Quantification Kits, respectively. No sequencing was performed on the extracted samples.

Of the 60 samples tested, 98.3% (59/60) had a DNA concentration of ≥0.83 ng/µL and an RNA concentration of ≥1.43 ng/µL. One CNB sample failed the minimum DNA and RNA concentration specifications, with values of 0.52 ng/µL and 1.23 ng/µL

respectively. The low concentrations were likely caused by the small tissue size and low tumor content (5%).

DNA and RNA input study

Eight cell-line samples were prepared as FFPE sections, and DNA and RNA were extracted and quantified from multiple sections from each cell line for blending and testing. Sample blends were prepared with known variants at various DNA and RNA input-level combinations within the range of 5–15 ng. The DNA and RNA blends had a target allele frequency of 15% for SNVs and deletions and target fusion reads of 300–600 for the ROS1 variant. A total of 540 individual DNA and RNA libraries were tested, including positive controls and NTC controls, with 6 replicate libraries each for DNA and RNA per test condition.

The study demonstrated a 100% positive variant call rate within the input range tested, supporting the specified input amount of 10 ng each for DNA and RNA for the Oncomine™ Dx Target Test.

The negative variant call rate was >95% for all except 4 sample and DNA/RNA input-level combinations. All cases with a negative variant call rate of <95% were due to no calls, 3 of which occurred with a DNA or RNA input amount of 5 ng and 1 of which occurred in a single sample with DNA and RNA inputs of 10 ng each. There were no false-positive calls.

Additionally, 4 clinical samples prepared as FFPE sections were tested: two samples containing DNA variants and two containing the CD74-ROS1 fusion variant.

The DNA variant samples were paired with wild-type RNA from the same sample at various input combinations within the range of 5–15 ng, and the RNA variant samples were paired with wild-type DNA at input combinations within the same range.

The study demonstrated positive and negative call rates of >95% for the DNA variants at all input combinations, and 100% for one of the CD74-ROS1 fusion variants at all input combinations. The second CD74-ROS1 clinical sample showed 100% negative call rates for all test conditions, and 100% positive call rates except for Test Condition 4 (8.5 ng RNA/15 ng DNA), where the call rate was 83%, and Test Condition 6 (15 ng RNA/15 ng DNA), where the call rate was 50%. The false negatives for these test conditions were possibly due to operator error during library preparation, since the remaining replicates in these test conditions had both high total mappable reads and fusion reads, but the cause was not definitively determined.

The results support the DNA and RNA 10-ng input requirement for the Oncomine™ Dx Target Test.

In silico specificity study

An *in silico* cross-reactivity analysis was performed that evaluated the 833 primers in the Oncomine™ Dx Target Test Kit DNA and RNA panels to determine the specificity of the primers to their targeted sequences. The primers were checked for specificity to the human genome, the human transcriptome, and genomes from representative bacteria, fungi, and viruses frequently found in human tissue and lung specimens.

Any unintended amplification products were required to have ≥2 base-pair (bp) mismatches to intended amplification product sequences generated by the panels, because mismatches of ≥2 bp prevent mapping to the same location on the genome due to a low mapping score.

For the DNA panel primers, *in silico* analysis predicted 20 unintended potential amplicon-generating primer pairings against the human genome. Nineteen of these had unintended amplification products with ≥2 bp mismatches, and therefore would have low mapping scores and not cause false results. One unintended primer pairing

was predicted to amplify regions identical to an intended product, and therefore would detect the same WT and variant locations and not cause false results.

For the RNA panel primers, analysis predicted 63 unintended primer pairings against the human genome and 7 unintended primer pairings against the human transcriptome. All of these predicted amplicons had mismatches of ≥42 bp to intended amplicons, and therefore would not cause false results.

Analysis of representative bacterial, fungi, and viral genomes resulted in one predicted unintended primer pairing with a mismatch of ≥61 bp to intended amplicons, which would not cause false results.

Based on these results, the primers in the Oncomine™ Dx Target Test Kit DNA and RNA panels were deemed specific.

Cross-contamination study

A total of 8 FFPE cell line samples were evaluated to determine the percentage of false positive results caused by cross-contamination (contamination from one sample to another within the same sequencing run) and carryover contamination (contamination from a previous run on the same instrument system). Samples that were WT and mutant were tested in consecutive runs on the same instruments, and 5 DNA variant locations and 2 RNA variant locations that were expected to be WT for a sample were evaluated for contamination.

Out of 100 DNA and 80 RNA data points analyzed, no false positive results were reported in the DNA variants, and 1 false positive result was reported in a ROS1 fusion variant. The false positive was likely caused by sample cross-contamination from an adjacent well. Therefore, the false-positive rate at DNA variant locations was 0% (0/100) and the false-positive rate at RNA variant locations was 1.25% (1/80).

Tissue fixation study

A study was performed to evaluate the effect of 10% neutral buffered formalin (NBF) fixation times on cytosine deamination events at the hotspot locations targeted by the Oncomine™ Dx Target Test, and any effect these potential events would have on assay performance. Pellets from the wild-type cell line GM24385 were fixed with 10% NBF for 12, 24, 48, 72, and 84 hours. Sections from each block were cut, mounted on slides, and tested with the Oncomine™ Dx Target Test. These results were compared to results from cell line GM24385 that had not undergone any fixation with 10% NBF.

The average allelic frequency (AF) observed at each of the 103 cytosine deamination-susceptible hotspots was determined for each fixation time tested. The results showed 2 G>A deamination events as a result of the fixation process, one at a 24-hour fixation time for COSM232755 (AF 0.050%) and the other at a 48-hour fixation time for COSM181063 (AF 0.073%). Each resulted in a "no call". DNA and RNA sequencing quality was evaluated by measuring percent reads, no calls, and total mappable reads for each condition tested. Both DNA and RNA demonstrated valid sequencing results with all NBF fixation times tested in this study. Therefore, it was determined that NBF fixation times did not cause deamination events that negatively impacted sequencing results.

Sample processing reproducibility study

The reproducibility and repeatability of variant detection using the Oncomine™ Dx Target Test were assessed with 2 WT samples and 10 variant-positive samples at 4 testing sites. Each site had 4 Ion PGM™ Dx instrument systems and 4 operators.

Each sample was tested 8 times at each site, for a total of 32 replicates per sample. After repeat testing, the final number of invalid reactions was 15/768 (1.95%), possibly due to low sample quality or lack of sample, though the cause was not definitively determined.

The call rate, no call rate, positive call rate, negative call rate, and within-run repeatability were computed at each variant location of interest. Including no calls and excluding known positive variant locations, the negative call rate at each clinical variant location for all samples was 100%.

The results at positive variant locations are shown in Table 2. Including no calls, all positive call rates from positive variant locations were >84%.

Excluding no calls and combining data across all study samples, the estimate of repeatability was 100% for DNA variants and 87.5% for the RNA variant. The lower limit of the 95% two-sided confidence interval (CI) for repeatability exceeded 96% at all variant locations.

Including no calls from the data, the estimate of repeatability was 100% at 218 out of 605 variant locations, 94–99.9% at 186 out of 605 variant locations, and 71.6–93.9% at 184 out of 605 variant locations. Including no calls, the lower limit of the 95% two-sided confidence interval for repeatability exceeded 64.6% at all variant locations.

Table 2 Call rates at positive variant locations

Sample	Variant identification	Variant location	# of valid sample results (N)	# of positive calls (A)	# of negative calls (B)	# of No Calls (C)	Positive call rate + 95% CI		Negative call rate + 95% CI		Within-run repeatability + 95% CI	
							Including no calls (A/N)	Excluding no calls (A/(A+B))	Including no calls (B/N)	Excluding no calls (B/(A+B))	Including no calls	Excluding no calls
B	COSM6223	EGRF Exon19del	32	32	0	0	100% (89.1%, 100%)	100% (89.1%, 100%)	0% (0%, 10.9%)	0% (0%, 10.9%)	100% (79.4%, 100%)	100% (79.4%, 100%)
B	COSM763	PIK3CA E545K	32	32	0	0	100% (89.1%, 100%)	100% (89.1%, 100%)	0% (0%, 10.9%)	0% (0%, 10.9%)	100% (79.4%, 100%)	100% (79.4%, 100%)
C	ROS1	N/A	32	30	2	0	93.8% (79.2%, 99.2%)	93.8% (79.2%, 99.2%)	6.3% (0.8%, 20.8%)	6.3% (0.8%, 20.8%)	87.5% (61.7%, 98.4%)	87.5% (61.7%, 98.4%)
D	COSM6225	EGFR Exon19del	32	32	0	0	100% (89.1%, 100%)	100% (89.1%, 100%)	0% (0%, 10.9%)	0% (0%, 10.9%)	100% (79.4%, 100%)	100% (79.4%, 100%)
E	COSM476	BRAF V600E	32	32	0	0	100% (89.1%, 100%)	100% (89.1%, 100%)	0% (0%, 10.9%)	0% (0%, 10.9%)	100% (79.4%, 100%)	100% (79.4%, 100%)
F	COSM521	KRAS G12D	32	30	0	2	93.8% (79.2%, 99.2%)	100% (88.4%, 100%)	0% (0%, 10.9%)	0% (0%, 11.6%)	87.5% (61.7%, 98.4%)	100% (76.8%, 100%)
F	COSM29313	PIK3CA M1043I	32	30	0	2	93.8% (79.2%, 99.2%)	100% (88.4%, 100%)	0% (0%, 10.9%)	0% (0%, 11.6%)	87.5% (61.7%, 98.4%)	100% (76.8%, 100%)
G	COSM6224	EGFR L858R	32	32	0	0	100% (89.1%, 100%)	100% (89.1%, 100%)	0% (0%, 10.9%)	0% (0%, 10.9%)	100% (79.4%, 100%)	100% (79.4%, 100%)
J	COSM87298	KRAS Q61K	32	32	0	0	100% (89.1%, 100%)	100% (89.1%, 100%)	0% (0%, 10.9%)	0% (0%, 10.9%)	100% (79.4%, 100%)	100% (79.4%, 100%)

Sample	Variant identification	Variant location	# of valid sample results (N)	# of positive calls (A)	# of negative calls (B)	# of No Calls (C)	Positive call rate + 95% CI		Negative call rate + 95% CI		Within-run repeatability + 95% CI	
							Including no calls (A/N)	Excluding no calls (A/(A+B))	Including no calls (B/N)	Excluding no calls (B/(A+B))	Including no calls	Excluding no calls
J	COSM172423	ERBB3 V104M	32	32	0	0	100% (89.1%, 100%)	100% (89.1%, 100%)	0% (0%, 10.9%)	0% (0%, 10.9%)	100% (79.4%, 100%)	100% (79.4%, 100%)
K	COSM775	PIK3 H1047R	30[1]	29	0	1	96.7% (82.8%, 99.9%)	100% (88.1%, 100%)	0% (0%, 11.6%)	0% (0%, 11.9%)	93.3% (68.1%, 99.8%)	100% (76.8%, 100%)
M	COSM715	FGR3 S249C	32	32	0	0	100% (89.1%, 100%)	100% (89.1%, 100%)	0% (0%, 10.9%)	0% (0%, 10.9%)	100% (79.4%, 100%)	100% (79.4%, 100%)

Interfering substances study

Five potentially interfering substances used to extract DNA and RNA from FFPE tissue samples were evaluated using the Oncomine™ Dx Target Test on the Ion PGM™ Dx System.

The guidelines for testing are defined in section 7.1 of CLSI EP07A2E, which describes testing substances at a relatively high concentration as an interference screen. One potentially interfering endogenous substance, hemoglobin, was tested at twice the concentration recommended in CLSI EP07A2E, Appendix D.

In addition to the substances tested in this study, data from the clinical studies demonstrated that 10-20% necrotic tissue in the region of interest in FFPE tissue samples does not appear to interfere with the assay. However, users should macrodissect highly necrotic areas or select alternate samples if possible.

Table 3 Interfering substances and amounts

Potential interfering substance	Step	Amount of substance
Paraffin	At the deparaffinization step, extra paraffin was added to the xylene bath that contained 250 mL of xylene.	4X of normally expected levels
Xylene	Extra xylene was added into the ethanol bath that contained 250 mL of ethanol.	6X of normally expected residual volume
Ethanol	Extra ethanol was added into the Protease digestion step before digestion.	>4X of normally expected residual volume
Hemoglobin	After deparaffinization, hemoglobin was added to the Digestion Buffer used to pre-wet the tissue section	4 mg/mL
Protease	Extra Protease was added into the reaction after the digestion step and before column purification.	>10X of expected residual Protease after the heat-kill step
Wash buffer	Wash buffer used to isolate DNA and RNA from deparaffinized and digested samples was added into an aliquot of Dilution Solution, which was subsequently used to dilute the RNA and DNA to the appropriate concentration before library preparation.	1% wash buffer (equivalent to ~10% wash buffer carried over into eluate)
Control	Tissue sections were processed using the standard protocol, without the addition of any potentially interfering substances.	N/A

A total of 8 FFPE samples (1 WT and 7 mutants) with 6 replicates each were processed through the entire assay workflow. The mutant samples included variants from all variant categories that can be detected by the test. The samples were spiked with additional concentrations or amounts of the listed substances at the relevant processing step, as shown in the table. Replicates of a control sample with no spiked substances were also analyzed. The concordance between variant calls in samples with and without interfering substances was computed for each substance under investigation.

With no calls excluded, for each potential interferent used in sample extraction, the positive and negative concordance with the control condition across all samples was 100%, and the overall concordance with the control condition across all samples was 100%

With no calls excluded, the results of testing with hemoglobin showed positive concordance with the control condition of 100% (only samples with a positive control condition were analyzed), negative concordance of 99.99%, and overall concordance of 99.99%.

Limit of Detection (LoD) study

The LoD was evaluated for 17 representative variants detected by the Oncomine™ Dx Target Test in clinical samples. The LoD is the lowest AF of SNV, MNP, or deletion variants, and the lowest number of reads of RNA fusion variants that can be detected at least 95% of the time. Variant-containing samples were blended with WT samples at multiple levels and used as the input DNA or RNA for the test.

Due to the large number of variants detected by the Oncomine™ Dx Target Test and the rarity of some of the variants, the LoD was established using a representative variant approach. Variants were selected in the following categories:

- Simple SNVs
- Complex SNVs and MNPs (SNVs in di- or tri-nucleotide repeat regions, SNVs in high-GC (>60%) or low-GC (<40%) content regions, and MNPs)
- Deletions (including deletions of 6, 9, 15, and 18 bp)
- RNA fusion

Clinical specimens were tested for all variants for which clinical claims are being sought. Seven variants for which analytical claims are being sought were unavailable in clinical specimens, and so plasmid constructs were substituted.

A minimum of 120 data points were generated for each representative variant by testing 6 or more titration levels, 2 reagent lots, and 10 replicates (per level per lot). The claimed LoD for all but one variant is the maximum of the two LoDs obtained from testing each of the two lots in this study.

Based on 14 representative DNA variants in 6 genes assessed in clinical samples, the LoDs for DNA variants tested in clinical samples (supported by the results from the assay reproducibility study) were determined to have allelic frequencies (AFs) of 6–13%. Based on testing 3 clinical samples, the LoD for the RNA fusion was measured at 732 fusion reads.

Tumor content study

To determine the minimum tumor cell content required in FFPE samples used as input material, 55 pre-characterized clinical samples were analyzed using the Oncomine™ Dx Target Test. They contained SNVs, deletions, and fusions confirmed by validated reference methods. The tumor cell content of each specimen and region of interest was estimated before the study by an external pathology lab.

The samples were analyzed with and without macrodissection. Fifty-four samples contained DNA variants and 1 contained an RNA variant. Three samples contained 2 SNV or deletion variants, for a total of 58 variants analyzed. The observed tumor content had the following distribution:

- 10 samples with tumor content <10%
- 16 samples with tumor content 10–19%
- 13 samples with tumor content 20–29%
- 9 samples with tumor content 30–39%
- 3 samples with tumor content 40–49%
- 4 samples with tumor content 50–60%

In the samples without macrodissection, all 58 variants were detected (called positive) by the Oncomine™ Dx Target Test. In the macrodissected samples, there was one "no call" in a BRAF V600E variant sample with a tumor content of 16%.

Assay reproducibility study

The reproducibility and repeatability of the Oncomine™ Dx Target Test was evaluated for 30 representative variants from 18 DNA and 9 RNA samples.

The study was designed to evaluate within-run precision performance (repeatability) and variability across sites, operators, and instrument platforms (reproducibility). Six of the 18 DNA samples were mixtures of plasmid and clinical DNA. Seven of the 12 deletion variants were represented by these plasmid blends. All other variant types were represented by clinical sample DNA.

Due to the large number of variants detected by the test and the rarity of some of the variants, a representative variant approach was used. Variants were selected in the following categories:

Variant Category	No. of Plasmid Blends Used	No. of Clinical Samples Used
6-bp deletion	6	0
9-bp deletion	4	2
15-bp deletion	2	4
18-bp deletion	2	4
Simple SNV	0	8
Complex SNVs and MNPs[1]	0	6
Fusion	0	12

[1] Including SNVs in di- or tri-nucleotide repeat regions and SNVs in high-GC (>60%) or low-GC (<40%) content regions

Two of the 18 DNA samples were WT at all locations, and the remaining 16 contained DNA from one or more DNA variants. One of the 9 RNA samples contained no fusion molecules, and the remaining 8 each contained RNA from an RNA variant. Each pre-extracted DNA or RNA sample was sequenced at 4 sites by 4 operators on 2 systems at each site.

At each site, operators were grouped into 2 pairs, with each pair assigned to 2 instrument systems and responsible for testing 9 DNA samples and all 9 RNA samples. Samples were run in duplicate using 2 different reagent lots at 3 of the study sites and on all 3 reagent lots at one study site. The design resulted in a total of 72 test determinations per DNA sample. Because there were half as many RNA samples as DNA samples, each RNA sample was tested twice as many times (n=144). In total, at least 1,296 sequencing reactions were performed, and all variant locations were assessed for each sample.

The reproducibility results are summarized in the following table.

Table 4 Reproducibility results

Description	No. of variant samples	Call rate excluding no calls		Call rate including no calls	
		Mean	Median	Mean	Median
DNA positive variants (positive calls)	46	96.60%	97.10%	94.50%	95.80%
RNA positive variants (positive calls)	6	94.80%	95.50%	94.80%	95.50%
WT DNA variant locations (negative calls)	872	96.10%	95.00%	96.10%	95.00%
WT RNA variant locations (negative calls)	170	99.30%	99.30%	99.30%	99.30%

Excluding no calls, the estimate of repeatability at each DNA variant location across all the samples was ≥98.8% (95% CI lower limit of ≥97.5%). The coefficient of variation (CV) across all DNA clinical variants ranged from 9.8% to 39%. The highest CVs (24.9–39.2%) were observed for the BRAF V600E variant. The higher percent CV for this sample was possibly due to poor sample quality, but the cause was not definitively determined. The CVs for the EGFR L858R variant ranged from 9.8% to 11.3%, and the CVs for the EGFR deletion variants ranged from 11.2% to 25.5%.

Excluding no calls, the estimate of repeatability at each RNA clinical variant location was 94.4%. The CV across all RNA locations ranged from 72% to 78%.

Panel accuracy study

To evaluate the ability of the Oncomine™ Dx Target Test DNA and RNA panels to identify somatic variants in human specimens, 290 FFPE tumor samples were analyzed using the Oncomine™ Dx Target Test to demonstrate positive percent agreement (PPA) and negative percent agreement (NPA) concordance with validated reference detection methods.

The following reference detection methods were used:

- A validated NGS assay, to detect SNV and deletion hotspot variants
- A ROS1 FISH reference test, to detect ROS1 fusions

Variants detected by the Oncomine™ Dx Target Test that were not covered by the reference methods were not included in the PPA/NPA concordance calculation. Variants detected by the Oncomine™ test for which the reference method testing failed and did not yield a valid result were not included in the PPA/NPA calculation.

Accuracy data was analyzed by the following:

- Each variant location
- Bins (or categories) of variants: RNA fusions , simple SNVs, complex SNVs, and deletions
- Each FFPE sample

The results are shown in the following tables.

Table 5 PPA results

PPA measure	Excluding no calls		Including no calls	
	Percent agreement	95% CI	Percent agreement	95% CI
Variant	98.5% (195/198)	(95.6%, 99.7%)	98.5% (195/198)	(95.6%, 99.7%)
Bin	97.2% (176/181)	(93.7%, 99.1%)	97.2% (176/181)	(93.7%, 99.1%)
Sample	96.9% (158/163)	(93.0%, 99.0%)	96.9% (158/163)	(93.0%, 99.0%)

Table 6 NPA results

NPA measure	Excluding no calls		Including no calls	
	Percent agreement	95% CI	Percent agreement	95% CI
Variant	100.0% (118,155/118,159)	(99.99%,100.0%)	96.8% (118,155/122,012)	(96.7%, 96.9%)
Bin	99.8% (942/944)	(99.2%, 100.0%)	70.0% (657/939)	(66.9%, 72.9%)
Sample	98.4% (124/126)	(94.4%, 99.8%)	23.4% (29/124)	(16.3%, 31.8%)

Table 7 OPA results

OPA measure	Excluding no calls		Including no calls	
	Percent agreement	95% CI	Percent agreement	95% CI
Variant	100.0% (118,350/118,357)	(99.99%, 100.0%)	96.8% (118,350/122,210)	(96.74%, 96.94%)
Bin	99.4% (1,118/1,125)	(98.72%,99.75%)	74.4% (833/1,120)	(71.71%, 76.91%)
Sample	97.6% (282/289)	(95.07%,99.02%)	65.2% (187/287)	(59.34%, 70.66%)

Clinical studies

ROS1 clinical study

ROS1 study—concordance evaluation

To evaluate the ability of the Oncomine™ Dx Target Test to identify the ROS1 biomarker in NSCLC tumor samples, 19 specimens from patients in the Phase 1 Pfizer Study A8081001 that tested positive using a ROS1 FISH assay were used, together with 13 archival specimens that also tested positive. These 32 positive specimens and 126 archival specimens that tested negative using the ROS1 FISH assay were analyzed using the Oncomine™ Dx Target Test.

Of the ROS1-positive samples, 25 generated valid results from both the FISH assay and the Oncomine™ test. Of the remaining samples, 4 generated invalid sequencing results due to a control or library QC failure, 2 generated insufficient material for FISH assay analysis, and 1 was subsequently determined to be a false positive for ROS1.

Of the ROS1-negative samples, 119 generated valid results from both the FISH assay and the test, while 7 generated invalid sequencing results due to a control or library QC failure. A total of 144 samples were used to evaluate concordance between the assay and the test. Of these, 139 were FFPE specimens and 5 were extracted RNA samples.

The PPA was defined as the proportion of ROS1-positive specimens called by the ROS1 FISH assay that were also called by the Oncomine™ Dx Target Test, and the NPA was defined as the proportion of ROS1-negative specimens called by the ROS1 FISH assay that were also called by the Oncomine™ test. The 95% CIs were determined for PPA, NPA, and overall percent agreement (OPA), and the results are shown in the following table:

Table 8 Concordance between the ROS1 FISH assay and the Oncomine™ Dx Target Test

Agreement measure[1]	Percent agreement	95% CI
PPA	80.0% (20/25)	59.3%, 93.2%
NPA	100% (119/119)	96.9%, 100%
OPA	96.5% (139/144)	92.08%,98.86%

[1] There were zero no calls reported for the Oncomine™ Dx Target Test.

Of the 20 concordant ROS1-positive samples, 17 were from FFPE tissue samples and 3 were from RNA extracts. For FFPE specimens alone, excluding invalids, the PPA was 85.0% (17/20) and the NPA was 100% (119/119). For the extracted RNA specimens alone, excluding invalids, the PPA was 60.0% (3/5) and the NPA was not evaluable because all specimens were ROS1 positive. The results from the 5 RNA extraction specimens should be interpreted with caution due to the limited sample size.

All 5 discordant samples were positive for the FISH assay and negative for the Oncomine™ test. Three of these also tested negative using a probe hybridization fusion detection method.

ROS1 study—clinical outcomes evaluation

Clinical outcomes as measured by objective response rate (ORR) and duration of response (DOR) with XALKORI® (crizotinib) were evaluated for 11 patients whose tumors were designated as ROS1-positive by the ROS1 FISH assay and whose tumors were evaluable by the Oncomine™ Dx Target Test. Of these, 6 samples tested positive by both tests.

The ORR for patients with tumor specimens determined to be ROS1-positive using both tests was 83.3% (5/6) (95% CI: 35.88%, 99.58%).

The mean DOR (N=5) was 17.5 months (95% CI: 10.9, 24.1).

Refer to the **Drugs@FDA database** for the most recent therapeutic product labeling.

BRAF clinical study

BRAF study—concordance evaluation

A method comparison evaluated the accuracy of the Oncomine™ Dx Target Test compared to the NSCLC BRAF V600E PCR Assay for the detection of the BRAF V600E mutation in NSCLC samples. Patient samples from the NSCLC BRF113928 clinical trial and an acquired set of negative samples were measured by both assays.

There were a total of 230 samples available for analysis. Of these, 181 samples (67 + 114) provided valid results for both the BRAF V600E PCR assay and the Oncomine™ test. All valid results correlated. Of the remaining samples, 27 samples had invalid results with the Oncomine™ test due to failed control or library QC metrics for the sequencing runs, 9 samples had no calls due to insufficient coverage at the BRAF variant location, and 13 samples were not tested due to insufficient DNA concentration.

The PPA was defined as the proportion of BRAF-positive samples called by the BRAF V600E PCR Assay that were also called by the Oncomine™ Dx Target Test, and the NPA was defined as the proportion of BRAF-negative samples called by the PCR assay that were also identified by the Oncomine™ Dx Target Test. The 95% two-sided exact CIs were determined for PPA, NPA and OPA, and the results are shown in the following table:

Table 9 Concordance between the NSCLC BRAF V600E PCR Assay and the Oncomine™ Dx Target Test

Agreement measure	Excluding no calls		Including no calls	
	Percent agreement	95% CI[1]	Percent agreement	95% CI[1]
PPA	100.0% (67/67)	(94.6%, 100.0%)	91.8%(67/73)	(83.0%, 96.9%)
NPA	100% (114/114)	(96.7%, 100.0%)	97.4%(114/117)	(92.7%, 99.5%)
OPA	100.0% (181/181)	(97.9%, 100.0%)	95.3%(181/190)	(91.2%, 97.8%)

[1] The 95% CI was calculated using the Pearson-Clopper Exact method.

BRAF study—clinical efficacy

The clinical efficacy of the Oncomine™ Dx Target Test was evaluated by measuring the objective response rate (ORR) for patients with stage IV NSCLC who tested positive for the BRAF V600E mutation by both the Local Laboratory Tests (LLTs) and the Oncomine™ test. The ORR was calculated for patients in two cohorts (B and C) who were selected for treatment with TAFINLAR® (dabrafenib) administered in combination with MEKINIST® (trametinib).

The ORR for Cohort B was 68.2% (15/22), which is similar to the 63.2% ORR (36/57) observed in the overall population tested as positive by LLTs. The ORR for Cohort C was 60.9% (14/23), which is similar to the 61.1% ORR (22/36) observed in the overall population tested as positive by LLT.

A secondary objective of the bridging study was to determine the clinical efficacy of the Oncomine™ Dx Target Test in selecting NSCLC patients for treatment with dabrafenib administered as a single agent and in combination with trametinib by evaluating progression-free survival (PFS), duration of response (DoR), and overall survival (OS) by both investigator assessment and independent review.

For the 15 Cohort B patients with a confirmed tumor response based on independent assessment, the median DoR was not estimable, with an event rate less than 50%. The median DoR for the overall LLT(+) population was 12.6 months. PFS was similar between the Oncomine™ Dx Target Test(+)/LLT(+) population (N = 22) and the total LLT(+) population (N = 57) for both independent and investigator review. Also, the ORR observed by independent assessment was similar to that observed by investigator assessment. The median follow-up time for Cohort B was 16.6 months.

For the 14 Cohort C patients with a confirmed tumor response based on independent assessment, the median DoR was not estimable with an event rate less than 50%. The median DoR for the overall LLT(+) was also not estimable with an event rate less than 50%. PFS was similar between the Oncomine™ Dx Target Test(+)/LLT(+) population (N = 23) and the total LLT(+) population (N = 36) for both independent and investigator review. Also, the ORR observed by independent assessment was similar to that observed by investigator assessment. The median follow-up time for Cohort C was 10.4 months.

Refer to the **Drugs@FDA database** for the most recent therapeutic product labeling.

EGFR clinical study

To evaluate the ability of the Oncomine™ Dx Target Test to identify the EGFR biomarker in FFPE NSCLC tumor specimens, 92 specimens from patients that tested positive using the Qiagen *therascreen* EGFR RGQ PCR Kit were analyzed using the Oncomine™ Dx Target Test. In addition, 142 specimens that tested negative using the Qiagen EGFR PCR assay were analyzed using the Oncomine™ Dx Target Test.

Of the EGFR-positive samples, 72 generated valid results from both the Qiagen EGFR PCR assay and the Oncomine™ Dx Target Test. Twenty samples had invalid results due to failed control or library QC metrics for the sequencing runs, or generated no calls due to insufficient coverage.

Of the EGFR-negative samples, 121 generated valid results from both the Qiagen assay and the Oncomine™ test, while 12 had invalid results due to failed QC metrics for the sequencing runs or generated no calls due to insufficient coverage.

In all, 193 samples were used to evaluate concordance between the Oncomine™ test as an investigational method and the Qiagen EGFR PCR assay as the reference method. A total of 70 samples were excluded, and 32 samples were invalid or generated no calls.

The PPA was defined as the proportion of EGFR-positive specimens as called by the EGFR PCR assay that were also EGFR-positive as called by the Oncomine™ Dx Target Test, and the NPA was defined as the proportion of EGFR-negative specimens as called by the EGFR PCR assay that were also EGFR-negative as called by the Oncomine™ test. The concordances by variant and overall concordance are shown in the following tables:

Table 10 Exon 19 deletion—Concordance

Agreement measure	Excluding no calls		Including no calls	
	Percent agreement	95% CI	Percent agreement	95% CI
PPA	97.6% (41/42)	(87.43%, 99.94%)	74.6% (41/55)	(61.00%, 85.33%)
NPA	99.3% (147/148)	(96.29%, 99.98%)	94.2% (147/156)	(89.33%, 97.33%)
OPA	99.0% (188/190) [1]	(96.25%, 99.87%)	89.1% (188/211)	(84.09%, 92.96%)

[1] Two samples were found to be discordant in this analysis, where one was called a false negative and the other a false positive with the Oncomine™ test.

Table 11 EGFR L858R—Concordance

Agreement measure	Excluding no calls		Including no calls	
	Percent agreement	95% CI	Percent agreement	95% CI
PPA	100% (30/30)	(88.43%, 100%)	93.8% (30/32)	(79.19%, 99.23%)
NPA	100% (167/167)	(97.82%, 100%)	93.3% (167/179)	(88.58%, 96.49%)
OPA	100% (197/197)	(98.14%, 100%)	93.4% (197/211)	(89.12%, 96.33%)

Table 12 Overall concordance

Agreement measure	Excluding no calls		Including no calls	
	Percent agreement	95% CI	Percent agreement	95% CI
PPA	98.6% (71/72)	(92.5%, 100.0%)	81.6% (71/87)	(71.86% , 89.11%)
NPA	99.2% (120/121)	(95.5%, 100.0%)	96.8% (120/124)	(91.95% , 99.11%)
OPA	99.0% (191/193)	(96.31%, 99.87%)	90.5% (191/211)	(85.74% , 94.11%)

D Additional variant tables

All variants reported in the panel

Gene	Amino Acid Change	Nucleotide Change	Variant ID
AKT1	p.Glu17Lys	c.49G>A	COSM33765
ALK	p.Cys1156Tyr	c.3467G>A	COSM99136 **Note:** Some "no calls" were observed for this analytical variant due to strand bias with plasmid targets. This does not impact clinical test results.
ALK	p.Phe1174Cys	c.3521T>G	COSM28059
ALK	p.Phe1174Ile	c.3520T>A	COSM28491
ALK	p.Phe1174Leu	c.3522C>G	COSM28061
ALK	p.Phe1174Leu	c.3522C>A	COSM28055
ALK	p.Phe1174Leu	c.3520T>C	COSM28057
ALK	p.Phe1174Ser	c.3521T>C	COSM53063
ALK	p.Phe1174Val	c.3520T>G	COSM28054
ALK	p.Phe1245Cys	c.3734T>G	COSM28500
ALK	p.Phe1245Ile	c.3733T>A	COSM28492
ALK	p.Phe1245Leu	c.3735C>G	COSM28062
ALK	p.Phe1245Leu	c.3735C>A	COSM28493
ALK	p.Phe1245Val	c.3733T>G	COSM28499
ALK	p.Gly1128Ala	c.3383G>C	COSM98475
ALK	p.Gly1202Arg	c.3604G>A	COSM144250
ALK	p.Ile1171Asn	c.3512T>A	COSM28498

Gene	Amino Acid Change	Nucleotide Change	Variant ID
ALK	p.Ile1171Thr	c.3512T>C	COSM4381100 **Note:** Some "no calls" were observed for this analytical variant due to strand bias with plasmid targets. This does not impact clinical test results.
ALK	p.Leu1152Pro	c.3455T>C	COSM1407659
ALK	p.Leu1152Arg	c.3455T>G	COSM97185
ALK	p.Leu1196Met	c.3586C>A	COSM99137
ALK	p.Leu1196Gln	c.3587T>A	COSM1169447
ALK	p.Arg1275Leu	c.3824G>T	COSM28060
ALK	p.Arg1275Gln	c.3824G>A	COSM28056
ALK	p.Ser1206Tyr	c.3617C>A	COSM144251
ALK	p.Val1180Leu	c.3538G>C	COSM4381101
BRAF	p.Asp594Gly	c.1781A>G	COSM467
BRAF	p.Asp594Asn	c.1780G>A	COSM27639
BRAF	p.Gly466Glu	c.1397G>A	COSM453
BRAF	p.Gly466Val	c.1397G>T	COSM451
BRAF	p.Gly469Ala	c.1406G>C	COSM460
BRAF	p.Gly469Arg	c.1405G>A	COSM457
BRAF	p.Gly469Val	c.1406G>T	COSM459
BRAF	p.Lys601Glu	c.1801A>G	COSM478
BRAF	p.Val600_Lys601delinsGlu	c.1799_1801delTGA	COSM1133
BRAF	p.Val600Glu	c.1799T>A	COSM476
BRAF	p.Val600Glu	c.1799_1800delTGinsAA	COSM475
BRAF	p.Val600Lys	c.1798_1799delGTinsAA	COSM473
BRAF	p.Val600Arg	c.1798_1799delGTinsAG	COSM474
CDK4	p.Lys22Met	c.65A>T	COSM3463915
CDK4	p.Lys22Gln	c.64A>C	OM3153
CDK4	p.Lys22Arg	c.65A>G	COSM232013
CDK4	p.Arg24Cys	c.70C>T	COSM1677139
CDK4	p.Arg24His	c.71G>A	COSM1989836

Gene	Amino Acid Change	Nucleotide Change	Variant ID
CDK4	p.Arg24Leu	c.71G>T	COSM363684
CDK4	p.Arg24Ser	c.70C>A	COSM3463914
DDR2	p.Arg124Leu	c.371G>T	COSM400880
DDR2	p.Arg124Trp	c.370C>T	COSM4024594
EGFR	p.Ala289Asp	c.866C>A	COSM21685
EGFR	p.Ala289Thr	c.865G>A	COSM21686
EGFR	p.Ala289Val	c.866C>T	COSM21687
EGFR	p.Glu709Ala	c.2126A>C	COSM13427
EGFR	p.Glu709Gly	c.2126A>G	COSM13009
EGFR	p.Glu709Lys	c.2125G>A	COSM12988
EGFR	p.Glu709Val	c.2126A>T	COSM12371
EGFR	p.Glu746_Ala750del	c. 2235_2249delGGAATTAAGAGAAGC	COSM6223
EGFR	p.Glu746_Ala750del	c. 2236_2250delGAATTAAGAGAAGCA	COSM6225
EGFR	p.Glu746_Glu749del	c.2235_2246delGGAATTAAGAGA	COSM28517
EGFR	p.Glu746_Arg748del	c.2239_2247delTTAAGAGAA	COSM6218
EGFR	p.Glu746_Ser752delinsAsp	c. 2238_2255delATTAAGAGAAGCAAC ATC	COSM6220
EGFR	p.Glu746_Ser752delinsVal	c. 2237_2255delAATTAAGAGAAGCAA CATCinsT	COSM12384
EGFR	p.Glu746_Thr751del	c. 2236_2253delGAATTAAGAGAAGCA ACA	COSM12728
EGFR	p.Glu746_Thr751delinsAla	c. 2237_2251delAATTAAGAGAAGCAA	COSM12678 **Note:** False negative calls were observed for this analytical variant with plasmid targets. This does not impact clinical test results.

Gene	Amino Acid Change	Nucleotide Change	Variant ID
EGFR	p.Glu746_Thr751delinsIle	c. 2235_2252delGGAATTAAGAGAAGCAACinsAAT	COSM13551 **Note:** The nucleotide change of COSM13551 overlaps that of COSM6223, so a positive COSM13551 sample will also result in a positive call for COSM6223.
EGFR	p.Glu746_Thr751delinsValAla	c. 2237_2253delAATTAAGAGAAGCAACAinsTTGCT	COSM12416
EGFR	p.Gly598Ala	c.1793G>C	COSM3412196
EGFR	p.Gly598Val	c.1793G>T	COSM21690
EGFR	p.Gly719Ala	c.2156G>C	COSM6239
EGFR	p.Gly719Cys	c.2155G>T	COSM6253
EGFR	p.Gly719Asp	c.2156G>A	COSM18425
EGFR	p.Gly719Ser	c.2155G>A	COSM6252
EGFR	p.Lys745_Ala750delinsThr	c. 2234_2248delAGGAATTAAGAGAAG	COSM1190791
EGFR	p.Lys745_Glu749del	c. 2233_2247delAAGGAATTAAGAGAA	COSM26038
EGFR	p.Leu747_Ala750delinsPro	c.2239_2248delTTAAGAGAAGinsC	COSM12382
EGFR	p.Leu747_Ala750delinsPro	c. 2238_2248delATTAAGAGAAGinsGC	COSM12422
EGFR	p.Leu747_Pro753delinsGln	c. 2239_2258delTTAAGAGAAGCAACATCTCCinsCA	COSM12387 **Note:** The nucleotide change of COSM12387 overlaps that of COSM6255, so a positive COSM12387 sample will also result in a positive call for COSM6255.
EGFR	p.Leu747_Pro753delinsSer	c. 2240_2257delTAAGAGAAGCAACATCTC	COSM12370
EGFR	p.Leu747_Ser752del	c. 2239_2256delTTAAGAGAAGCAACATCT	COSM6255
EGFR	p.Leu747_Thr751del	c. 2240_2254delTAAGAGAAGCAACAT	COSM12369

Gene	Amino Acid Change	Nucleotide Change	Variant ID
EGFR	p.Leu747_Thr751delinsPro	c. 2239_2251delTTAAGAGAAGCAAinsC	COSM12383
EGFR	p.Leu747_Thr751delinsGln	c. 2238_2252delATTAAGAGAAGCAACinsGCA	COSM12419
EGFR	p.Leu747_Thr751delinsSer	c.2240_2251delTAAGAGAAGCAA	COSM6210
EGFR	p.Leu858Met	c.2572C>A	COSM12366
EGFR	p.Leu858Arg	c.2573T>G	COSM6224
EGFR	p.Leu861Gln	c.2582T>A	COSM6213
EGFR	p.Leu861Arg	c.2582T>G	COSM12374
EGFR	p.Arg108Gly	c.322A>G	COSM1451536
EGFR	p.Arg108Lys	c.323G>A	COSM21683
EGFR	p.Ser492Arg	c.1474A>C	COSM236671
EGFR	p.Ser492Arg	c.1476C>A	COSM236670
EGFR	p.Ser768Ile	c.2303G>T	COSM6241
ERBB2	p.Asp769His	c.2305G>C	COSM13170
ERBB2	p.Asp769Tyr	c.2305G>T	COSM1251412
ERBB2	p.Gly776Val	c.2327G>T	COSM18609
ERBB2	p.Leu755Met	c.2263T>A	COSM1205571
ERBB2	p.Leu755Pro	c.2263_2264delTTinsCC	COSM683
ERBB2	p.Arg678Gln	c.2033G>A	COSM436498
ERBB2	p.Arg896Cys	c.2686C>T	COSM14066
ERBB2	p.Arg896His	c.2687G>A	COSM119971
ERBB2	p.Ser310Phe	c.929C>T	COSM48358
ERBB2	p.Ser310Tyr	c.929C>A	COSM94225
ERBB2	p.Thr733Ile	c.2198C>T	COSM14059
ERBB2	p.Val777Leu	c.2329G>T	COSM14062
ERBB2	p.Val842Ile	c.2524G>A	COSM14065
ERBB3	p.Ala232Thr	c.694G>A	COSM4043440
ERBB3	p.Ala232Val	c.695C>T	COSM1242239
ERBB3	p.Asp297Val	c.890A>T	COSM941490

Gene	Amino Acid Change	Nucleotide Change	Variant ID
ERBB3	p.Asp297Tyr	c.889G>T	COSM160822
ERBB3	p.Glu332Lys	c.994G>A	COSM254677
ERBB3	p.Met60Lys	c.179T>A	COSM254678
ERBB3	p.Met60Leu	c.178A>T	COSM1606366
ERBB3	p.Met60Arg	c.179T>G	COSM941484
ERBB3	p.Met91Ile	c.273G>A	COSM122890
ERBB3	p.Met91Ile	c.273G>C	COSM1299636
ERBB3	p.Val104Leu	c.310G>C	COSM160824
ERBB3	p.Val104Leu	c.310G>T	COSM191840
ERBB3	p.Val104Met	c.310G>A	COSM172423
FGFR2	p.Ala314Asp	c.941C>A	COSM49171
FGFR2	p.Cys382Arg	c.1144T>C	COSM36906
FGFR2	p.Cys382Tyr	c.1145G>A	COSM915493
FGFR2	p.Lys659Glu	c.1975A>G	COSM36909
FGFR2	p.Lys659Met	c.1976A>T	COSM49175
FGFR2	p.Lys659Asn	c.1977G>T	COSM49173
FGFR2	p.Lys659Asn	c.1977G>C	COSM683054
FGFR2	p.Asn549His	c.1645A>C	COSM250083
FGFR2	p.Asn549Lys	c.1647T>G	COSM36902
FGFR2	p.Asn549Lys	c.1647T>A	COSM36912
FGFR2	p.Asn549Ser	c.1646A>G	COSM3665553
FGFR2	p.Pro253Leu	c.758C>T	COSM537801
FGFR2	p.Pro253Arg	c.758C>G	COSM49170
FGFR2	p.Ser252Trp	c.755C>G	COSM36903
FGFR2	p.Tyr375Cys	c.1124A>G	COSM36904
FGFR2	p.Tyr375His	c.1123T>C	COSM1560916
FGFR3	p.Gly697Cys	c.2089G>T	COSM24802
FGFR3	p.Lys650Glu	c.1948A>G	COSM719
FGFR3	p.Lys650Asn	c.1950G>T	COSM1428730
FGFR3	p.Lys650Gln	c.1948A>C	COSM726

Gene	Amino Acid Change	Nucleotide Change	Variant ID
FGFR3	p.Arg248Cys	c.742C>T	COSM714
FGFR3	p.Ser249Cys	c.746C>G	COSM715
HRAS	p.Gly12Ala	c.35G>C	COSM485
HRAS	p.Gly12Cys	c.34G>T	COSM481
HRAS	p.Gly12Asp	c.35G>A	COSM484
HRAS	p.Gly12Arg	c.34G>C	COSM482
HRAS	p.Gly12Ser	c.34G>A	COSM480
HRAS	p.Gly12Val	c.35G>T	COSM483
HRAS	p.Gly13Cys	c.37G>T	COSM488
HRAS	p.Gly13Asp	c.38G>A	COSM490
HRAS	p.Gly13Arg	c.37G>C	COSM486
HRAS	p.Gly13Ser	c.37G>A	COSM487
HRAS	p.Gly13Val	c.38G>T	COSM489
HRAS	p.Gln61His	c.183G>T	COSM502
HRAS	p.Gln61His	c.183G>C	COSM503
HRAS	p.Gln61Lys	c.181C>A	COSM496
HRAS	p.Gln61Leu	c.182A>T	COSM498
HRAS	p.Gln61Pro	c.182A>C	COSM500
HRAS	p.Gln61Arg	c.182A>G	COSM499
KIT	p.Asp419_Arg420del	c.1255_1260delGACAGG	COSM1578132
KIT	p.Asp419del	c.1255_1257delGAC	COSM29014
KIT	p.Asp579del	c.1735_1737delGAT	COSM1294
KIT	p.Asp816His	c.2446G>C	COSM1311
KIT	p.Asp816Val	c.2447A>T	COSM1314
KIT	p.Asp816Tyr	c.2446G>T	COSM1310
KIT	p.Lys642Glu	c.1924A>G	COSM1304
KIT	p.Leu576Pro	c.1727T>C	COSM1290
KIT	p.Asn822Lys	c.2466T>A	COSM1321
KIT	p.Asn822Lys	c.2466T>G	COSM1322
KIT	p.Arg796Lys	c.2387G>A	COSM1600411

Gene	Amino Acid Change	Nucleotide Change	Variant ID
KIT	p.Val559Ala	c.1676T>C	COSM1255
KIT	p.Val559Asp	c.1676T>A	COSM1252
KIT	p.Val559del	c.1679_1681delTTG	COSM1247
KIT	p.Val559Gly	c.1676T>G	COSM1253
KIT	p.Val560Asp	c.1679T>A	COSM1257
KIT	p.Val654Ala	c.1961T>C	COSM12706
KIT	p.Val825Ala	c.2474T>C	COSM1323
KIT	p.Trp557_Lys558del	c.1669_1674delTGGAAG	COSM1217
KIT	p.Trp557_Val559delinsPhe	c.1670_1675delGGAAGG	COSM1226
KIT	p.Trp557Gly	c.1669T>G	COSM1221
KIT	p.Trp557Arg	c.1669T>A	COSM1216
KIT	p.Trp557Arg	c.1669T>C	COSM1219
KRAS	p.Ala146Pro	c.436G>C	COSM19905
KRAS	p.Ala146Thr	c.436G>A	COSM19404
KRAS	p.Ala146Val	c.437C>T	COSM19900
KRAS	p.Ala59Glu	c.176C>A	COSM547
KRAS	p.Ala59Gly	c.176C>G	COSM28518
KRAS	p.Ala59Thr	c.175G>A	COSM546
KRAS	p.Gly12Ala	c.35G>C	COSM522
KRAS	p.Gly12Cys	c.34G>T	COSM516
KRAS	p.Gly12Asp	c.35G>A	COSM521
KRAS	p.Gly12Phe	c.34_35delGGinsTT	COSM512 **Note:** The nucleotide change of COSM512 overlaps that of COSM516, so a positive COSM512 sample will also result in a positive call for COSM516.
KRAS	p.Gly12Arg	c.34G>C	COSM518
KRAS	p.Gly12Ser	c.34G>A	COSM517
KRAS	p.Gly12Val	c.35G>T	COSM520
KRAS	p.Gly13Ala	c.38G>C	COSM533

Gene	Amino Acid Change	Nucleotide Change	Variant ID
KRAS	p.Gly13Cys	c.37G>T	COSM527
KRAS	p.Gly13Asp	c.38_39delGCinsAT	COSM531 **Note:** The nucleotide change of COSM531 overlaps that of COSM532, so a positive COSM531 sample will also result in a positive call for COSM532.
KRAS	p.Gly13Asp	c.38G>A	COSM532
KRAS	p.Gly13Arg	c.37G>C	COSM529
KRAS	p.Gly13Ser	c.37G>A	COSM528
KRAS	p.Gly13Val	c.38G>T	COSM534
KRAS	p.Lys117Asn	c.351A>T	COSM28519
KRAS	p.Lys117Asn	c.351A>C	COSM19940
KRAS	p.Gln61Glu	c.181C>G	COSM550
KRAS	p.Gln61His	c.183A>T	COSM555
KRAS	p.Gln61His	c.183A>C	COSM554
KRAS	p.Gln61Lys	c.180_181delTCinsAA	COSM87298
KRAS	p.Gln61Lys	c.181C>A	COSM549
KRAS	p.Gln61Leu	c.182A>T	COSM553
KRAS	p.Gln61Pro	c.182A>C	COSM551
KRAS	p.Gln61Arg	c.182A>G	COSM552
MAP2K1	p.Glu203Lys	c.607G>A	COSM232755
MAP2K1	p.Glu203Val	c.608A>T	COSM3386991
MAP2K1	p.Phe53Ile	c.157T>A	COSM3503329
MAP2K1	p.Phe53Leu	c.157T>C	COSM555604
MAP2K1	p.Phe53Leu	c.159T>A	COSM1725008
MAP2K1	p.Phe53Leu	c.159T>G	OM3154

Gene	Amino Acid Change	Nucleotide Change	Variant ID
MAP2K1	p.Phe53Val	c.157T>G	COSM1562837 **Note:** The base change c. 157T>G in MAP2K1 is associated with Mutation ID COSM5077832 in the COSMIC v.76 database, even though it has been given the Variant HotSpot ID COSM1562837 in the software. This does not impact the test results.
MAP2K1	p.Lys57Met	c.170A>T	COSM1235478 **Note:** The base change c. 170A>T in MAP2K1 is *not* associated with Mutation ID COSM1235478 in the COSMIC v.76 database, even though it has been given the Variant HotSpot ID COSM1235478 in the software. The actual base change for Mutation ID COSM1235478 is c.171G>T in MAP2K1 (see OM3157 below). This does not impact the test results.
MAP2K1	p.Lys57Asn	c.171G>C	OM3156
MAP2K1	p.Lys57Asn	c.171G>T	OM3157 **Note:** The base change c. 171G>T in MAP2K1 is associated with Mutation ID COSM1235478 in the COSMIC v.76 database, even though it has been given the Variant HotSpot ID OM3157 in the software. This does not impact the test results.
MAP2K1	p.Lys57Thr	c.170A>C	OM3155
MAP2K1	p.Pro124Leu	c.371C>T	COSM1315861
MAP2K1	p.Pro124Gln	c.371C>A	COSM1167912
MAP2K1	p.Pro124Ser	c.370C>T	COSM235614
MAP2K2	p.Phe57Leu	c.171T>G	OM3158
MAP2K2	p.Phe57Leu	c.171T>A	COSM3389034
MAP2K2	p.Phe57Leu	c.169T>C	COSM1235618
MAP2K2	p.Phe57Val	c.169T>G	COSM3534171

Gene	Amino Acid Change	Nucleotide Change	Variant ID
MAP2K2	p.Gln60Pro	c.179A>C	COSM145610
MET	p.His1112Leu	c.3335A>T	COSM698
MET	p.His1112Arg	c.3335A>G	COSM703
MET	p.His1112Tyr	c.3334C>T	COSM696
MET	p.Met1268Ile	c.3804G>A	COSM694
MET	p.Met1268Thr	c.3803T>C	COSM691
MET	p.Thr1010Ile	c.3029C>T	COSM707
MET	p.Tyr1021Phe	c.3062A>T	COSM339515
MET	p.Tyr1021Asn	c.3061T>A	COSM48564
MET	p.Tyr1248Cys	c.3743A>G	COSM699
MET	p.Tyr1248His	c.3742T>C	COSM690
MET	p.Tyr1253Asp	c.3757T>G	COSM700
MET	p.?[1]	c.3082+1G>A[2]	COSM29633
MET	p.?[1]	c.3082+1G>T[2]	COSM24687
MET	p.?[1]	c.3082+2T>C [3]	COSM35468
MTOR	p.Cys1483Phe	c.4448G>T	COSM462616
MTOR	p.Cys1483Arg	c.4447T>C	COSM3747775
MTOR	p.Cys1483Trp	c.4449C>G	OM3149
MTOR	p.Cys1483Tyr	c.4448G>A	COSM462615
MTOR	p.Glu1799Lys	c.5395G>A	COSM180789
MTOR	p.Phe1888Ile	c.5662T>A	COSM3358968
MTOR	p.Phe1888Leu	c.5664C>G	COSM462604
MTOR	p.Phe1888Leu	c.5664C>A	COSM893813
MTOR	p.Phe1888Leu	c.5662T>C	COSM3358967
MTOR	p.Phe1888Val	c.5662T>G	COSM893814
MTOR	p.Leu2427Gln	c.7280T>A	COSM1185313
MTOR	p.Leu2427Arg	c.7280T>G	OM3148
MTOR	p.Ser2215Phe	c.6644C>T	COSM1686998
MTOR	p.Ser2215Pro	c.6643T>C	COSM1560108
MTOR	p.Ser2215Tyr	c.6644C>A	COSM20417

Gene	Amino Acid Change	Nucleotide Change	Variant ID
MTOR	p.Thr1977Lys	c.5930C>A	COSM462601
MTOR	p.Thr1977Arg	c.5930C>G	COSM462602 **Note:** Some "no calls" were observed for this analytical variant due to strand bias with plasmid targets. This does not impact clinical test results.
MTOR	p.Thr1977Ser	c.5929A>T	COSM1289945 **Note:** Some "no calls" were observed for this analytical variant due to strand bias with plasmid targets. This does not impact clinical test results.
MTOR	p.Val2006Phe	c.6016G>T	COSM249481
MTOR	p.Val2006Ile	c.6016G>A	COSM893804
MTOR	p.Val2006Leu	c.6016G>C	COSM1134662
NRAS	p.Ala146Thr	c.436G>A	COSM27174
NRAS	p.Ala146Val	c.437C>T	COSM4170228
NRAS	p.Ala59Thr	c.175G>A	COSM578
NRAS	p.Gly12Ala	c.35G>C	COSM565
NRAS	p.Gly12Cys	c.34G>T	COSM562
NRAS	p.Gly12Asp	c.35G>A	COSM564
NRAS	p.Gly12Arg	c.34G>C	COSM561
NRAS	p.Gly12Ser	c.34G>A	COSM563
NRAS	p.Gly12Val	c.35G>T	COSM566
NRAS	p.Gly13Ala	c.38G>C	COSM575
NRAS	p.Gly13Cys	c.37G>T	COSM570
NRAS	p.Gly13Asp	c.38G>A	COSM573
NRAS	p.Gly13Arg	c.37G>C	COSM569
NRAS	p.Gly13Ser	c.37G>A	COSM571
NRAS	p.Gly13Val	c.38G>T	COSM574
NRAS	p.Lys117Asn	c.351G>T	MAN13
NRAS	p.Gln61Glu	c.181C>G	COSM581
NRAS	p.Gln61His	c.183A>T	COSM585

Gene	Amino Acid Change	Nucleotide Change	Variant ID
NRAS	p.Gln61His	c.183A>C	COSM586
NRAS	p.Gln61Lys	c.181C>A	COSM580
NRAS	p.Gln61Leu	c.182A>T	COSM583
NRAS	p.Gln61Pro	c.182A>C	COSM582
NRAS	p.Gln61Arg	c.182A>G	COSM584
PDGFRA	p.Asp842_His845del	c.2526_2537delCATCATGCATGA	COSM737
PDGFRA	p.Asp842_Met844del	c.2524_2532delGACATCATG	COSM12401
PDGFRA	p.Asp842Val	c.2525A>T	COSM736
PDGFRA	p.Asp842Tyr	c.2524G>T	COSM12396
PDGFRA	p.Ile843_Asp846del	c.2527_2538delATCATGCATGAT	COSM12400
PDGFRA	p.Ile843_Ser847delinsThr	c.2528_2539delTCATGCATGATT	COSM12407
PDGFRA	p.Asn659Lys	c.1977C>A	COSM22415
PDGFRA	p.Asn659Lys	c.1977C>G	COSM22414
PDGFRA	p.Asn659Tyr	c.1975A>T	COSM22416
PDGFRA	p.Val561Asp	c.1682T>A	COSM739
PIK3CA	p.Cys378Phe	c.1133G>T	COSM21450
PIK3CA	p.Cys378Arg	c.1132T>C	COSM756
PIK3CA	p.Cys378Tyr	c.1133G>A	COSM1041478
PIK3CA	p.Cys420Arg	c.1258T>C	COSM757
PIK3CA	p.Cys901Phe	c.2702G>T	COSM769
PIK3CA	p.Cys901Arg	c.2701T>C	COSM1420899
PIK3CA	p.Cys901Tyr	c.2702G>A	COSM1420901
PIK3CA	p.Glu365Gly	c.1094A>G	COSM1420797
PIK3CA	p.Glu365Lys	c.1093G>A	COSM86044
PIK3CA	p.Glu365Val	c.1094A>T	COSM1484860
PIK3CA	p.Glu39Lys	c.115G>A	COSM30625
PIK3CA	p.Glu542Lys	c.1624G>A	COSM760
PIK3CA	p.Glu542Val	c.1625A>T	COSM762
PIK3CA	p.Glu545Ala	c.1634A>C	COSM12458
PIK3CA	p.Glu545Asp	c.1635G>C	COSM27374

Gene	Amino Acid Change	Nucleotide Change	Variant ID
PIK3CA	p.Glu545Asp	c.1635G>T	COSM765
PIK3CA	p.Glu545Gly	c.1634A>G	COSM764
PIK3CA	p.Glu545Lys	c.1633G>A	COSM763
PIK3CA	p.Glu545Gln	c.1633G>C	COSM27133
PIK3CA	p.Glu547Lys	c.1639G>A	COSM29315
PIK3CA	p.Glu726Gly	c.2177A>G	COSM1420887
PIK3CA	p.Glu726Lys	c.2176G>A	COSM87306
PIK3CA	p.Glu81Lys	c.241G>A	COSM27502
PIK3CA	p.Gly1049Arg	c.3145G>C	COSM12597
PIK3CA	p.Gly1049Ser	c.3145G>A	COSM777
PIK3CA	p.Gly106Val	c.317G>T	COSM748
PIK3CA	p.His1047Leu	c.3140A>T	COSM776
PIK3CA	p.His1047Arg	c.3140A>G	COSM775
PIK3CA	p.His1047Tyr	c.3139C>T	COSM774
PIK3CA	p.His701Pro	c.2102A>C	COSM778
PIK3CA	p.His701Arg	c.2102A>G	COSM1420881
PIK3CA	p.Lys111Glu	c.331A>G	COSM13570
PIK3CA	p.Met1043Ile	c.3129G>A	COSM29313
PIK3CA	p.Met1043Ile	c.3129G>T	COSM773
PIK3CA	p.Met1043Val	c.3127A>G	COSM12591
PIK3CA	p.Asn1044Lys	c.3132T>A	COSM12592
PIK3CA	p.Asn345Ile	c.1034A>T	COSM94978
PIK3CA	p.Asn345Lys	c.1035T>A	COSM754
PIK3CA	p.Pro539Arg	c.1616C>G	COSM759
PIK3CA	p.Gln546Glu	c.1636C>G	COSM6147
PIK3CA	p.Gln546Lys	c.1636C>A	COSM766
PIK3CA	p.Gln546Pro	c.1637A>C	COSM767
PIK3CA	p.Gln546Arg	c.1637A>G	COSM12459
PIK3CA	p.Arg108His	c.323G>A	COSM27497
PIK3CA	p.Arg38Cys	c.112C>T	COSM744

Gene	Amino Acid Change	Nucleotide Change	Variant ID
PIK3CA	p.Arg38Gly	c.112C>G	COSM40945
PIK3CA	p.Arg38His	c.113G>A	COSM745
PIK3CA	p.Arg38Ser	c.112C>A	COSM87310
PIK3CA	p.Arg88Gln	c.263G>A	COSM746
PIK3CA	p.Arg93Gln	c.278G>A	COSM86041
PIK3CA	p.Arg93Trp	c.277C>T	COSM27493
PIK3CA	p.Thr1025Ala	c.3073A>G	COSM771
PIK3CA	p.Val344Ala	c.1031T>C	COSM86951
PIK3CA	p.Val344Gly	c.1031T>G	COSM22540
PIK3CA	p.Tyr1021Cys	c.3062A>G	COSM12461
RAF1	p.Ser257Leu	c.770C>T	COSM181063
RAF1	p.Ser257Trp	c.770C>G	COSM581519
RAF1	p.Thr421Met	c.1262_1263delCCinsTG	MAN9
RET	p.Ala883Phe	c.2646_2648delAGCinsTTT	COSM981
RET	p.Ala883Ser	c.2647G>T	COSM133167
RET	p.Cys618Arg	c.1852T>C	COSM29803
RET	p.Cys618Tyr	c.1853G>A	COSM980
RET	p.Cys620Arg	c.1858T>C	COSM29804
RET	p.Cys634Arg	c.1900T>C	COSM966
RET	p.Asp898_Glu901del	c.2694_2705delTGTTTATGAAGA	COSM962
RET	p.Glu768Asp	c.2304G>C	COSM21338
RET	p.Glu768Gly	c.2303A>G	COSM1347811
RET	p.Met918Thr	c.2753T>C	COSM965
ROS1	p.Gly2032Arg	c.6094G>C	MAN11
ROS1	p.Gly2032Arg	c.6094G>A	MAN10
ROS1	p.Leu1951Met	c.5851C>A	COSM1072521

[1] The variant is in an intronic region, and its effect as reported in the COSMIC database is unknown.
[2] +1 indicates the first nucleotide in the intron.
[3] +2 indicates the second nucleotide in the intron.

Fusion isoforms detected by the panel

The following isoforms of the ROS1 fusion can be detected by the panel.

- CCDC6-ROS1.C5R35
- CD74-ROS1.C4R33.NGS
- CD74-ROS1.C6R32.COSF1202
- CD74-ROS1.C6R34.COSF1200
- CD74-ROS1.C6R35
- CEP85L-ROS1.C8R36
- CLIP1-ROS1.C19R36
- CLTC-ROS1.C31R35
- ERC1-ROS1.E11R36
- EZR-ROS1.E10R34.COSF1267
- EZR-ROS1.E10R35
- GOPC-ROS1.G4R36.COSF1188
- GOPC-ROS1.G8R35.COSF1139
- HLA_A-ROS1.H7R34
- KDELR2-ROS1.K5R35
- KIAA1598-ROS1.K11R36
- LRIG3-ROS1.L16R35.COSF1269
- MSN-ROS1.M9R34
- MYO5A-ROS1.M23R35
- PPFIBP1-ROS1.P9R35
- PWWP2A-ROS1.P1R36
- SDC4-ROS1.S2R32.COSF1265
- SDC4-ROS1.S2R34
- SDC4-ROS1.S4R32.COSF1278
- SDC4-ROS1.S4R34.COSF1280
- SLC34A2-ROS1.S13R32.COSF1259
- SLC34A2-ROS1.S13R34.COSF1261
- SLC34A2-ROS1.S4R32.COSF1197
- SLC34A2-ROS1.S4R34.COSF1198
- TFG-ROS1.T4R35
- TPM3-ROS1.T3R36
- TPM3-ROS1.T7R35.COSF1273
- ZCCHC8-ROS1.Z2R36
- CD74-ROS1.C7R34

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