

# **SureSelect<sup>QXT</sup> Target Enrichment for Illumina Multiplexed Sequencing**

**Featuring Transposase-Based  
Library Prep Technology**

## **Protocol**

Version D0, November 2015

**SureSelect platform manufactured with Agilent  
SurePrint Technology**

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



**Agilent Technologies**

## Notices

© Agilent Technologies, Inc. 2014, 2015

No part of this manual may be reproduced in any form or by any means (including electronic storage and retrieval or translation into a foreign language) without prior agreement and written consent from Agilent Technologies, Inc. as governed by United States and international copyright laws.

### Manual Part Number

G9681-90000

### Edition

Version D0, November 2015

Printed in USA

Agilent Technologies, Inc.  
5301 Stevens Creek Blvd  
Santa Clara, CA 95051 USA

### Acknowledgement

Oligonucleotide sequences © 2006, 2008, and 2011 Illumina, Inc. All rights reserved. Only for use with the Illumina sequencer systems and associated assays.

### Technical Support

For technical product support, contact your local Agilent Support Services representative.

For US and Canada, call (800) 227-9770 (option 3,4,4). For other countries, find your support center telephone numbers at [www.agilent.com/chem/contactus](http://www.agilent.com/chem/contactus).

Or send an e-mail to:  
[SureSelect.Support@agilent.com](mailto:SureSelect.Support@agilent.com)

### Warranty

**The material contained in this document is provided “as is,” and is subject to being changed, without notice, in future editions. Further, to the maximum extent permitted by applicable law, Agilent disclaims all warranties, either express or implied, with regard to this manual and any information contained herein, including but not limited to the implied warranties of merchantability and fitness for a particular purpose. Agilent shall not be liable for errors or for incidental or consequential damages in connection with the furnishing, use, or performance of this document or of any information contained herein. Should Agilent and the user have a separate written agreement with warranty terms covering the material in this document that conflict with these terms, the warranty terms in the separate agreement shall control.**

### Technology Licenses

The hardware and/or software described in this document are furnished under a license and may be used or copied only in accordance with the terms of such license.

### Restricted Rights Legend

U.S. Government Restricted Rights. Software and technical data rights granted to the federal government include only those rights customarily provided to end user customers. Agilent provides this customary commercial license in Software and technical data pursuant to FAR 12.211 (Technical Data) and 12.212 (Computer Software) and, for the Department of Defense, DFARS 252.227-7015 (Technical Data - Commercial Items) and DFARS 227.7202-3 (Rights in Commercial Computer Software or Computer Software Documentation).

### Notice to Purchaser

This product is provided under an agreement between Bio-Rad Laboratories and Agilent Technologies, Inc., and the manufacture, use, sale or import of this product is subject to US. Pat. No. 6,627,424 and EP Pat. No. 1 283 875 B1, owned by Bio-Rad Laboratories, Inc. Purchase of this product conveys to the buyer the non-transferable right to use the purchased amount of the product and components of the product in PCR (but not real-time PCR) in the Research Field including all Applied Research Fields (including but not limited to forensics, animal testing, and food testing).

## Safety Notices

### CAUTION

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

---

### WARNING

A **WARNING** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a **WARNING** notice until the indicated conditions are fully understood and met.

---

## In this Guide...

This guide describes an optimized protocol for Illumina paired-end multiplexed library preparation using the SureSelect<sup>QXT</sup> Target Enrichment system.

This protocol is specifically developed and optimized to enrich targeted regions of the genome from repetitive sequences and sequences unrelated to the research focus prior to sample sequencing.

If you wish to prepare whole-genome libraries using the SureSelect<sup>QXT</sup> system, instead see publication part number G9682-90000 at [www.genomics.agilent.com](http://www.genomics.agilent.com).

### 1 Before You Begin

This chapter contains information (such as procedural notes, safety information, required reagents and equipment) that you should read and understand before you start an experiment.

### 2 Sample Preparation

This chapter describes the steps to prepare gDNA sequencing libraries for target enrichment.

### 3 Hybridization and Capture

This chapter describes the steps to hybridize and capture the prepared DNA library using a SureSelect or ClearSeq capture library.

### 4 Indexing and Sample Processing for Multiplexed Sequencing

This chapter describes the steps for post-capture amplification and guidelines for sequencing sample preparation.

### 5 Reference

This chapter contains reference information, including component kit contents and index sequences.

## What's New in Version D0

- Updates to custom sequencing primer mixtures for the NextSeq 500 v2 platform (see [Table 26](#) and [Table 27](#) on page 63)
- Update to P5 Index details for NextSeq 500 platform runs using BaseSpace (see [Table 35](#) on page 72)
- Support for Agilent 4200 TapeStation (see [Table 5](#) on page 16)
- Update to Qubit dsDNA Assay Kit nomenclature ([Table 1](#) on page 13 and [step 3](#) on [page 21](#))

## What's New in Version C1

- Support for ClearSeq Capture Libraries, including ClearSeq Comprehensive Cancer Libraries (see [Table 3](#) on page 15).
- Support for Human All Exon v6 Capture Libraries (see [Table 2](#) on page 14).
- Support for sequencing using NextSeq 500 v2 (see [Table 26](#) on page 62).
- Update to SBS Kit Configuration details for HiSeq 2500 Rapid Run sequencing (see [Table 22](#) on page 60).
- Update to Qubit dsDNA Assay Kit ordering information ([Table 1](#) on page 13).

## What's New in Version C0

- Support for new SureSelect<sup>QXT</sup> NSQ Reagent Kits for preparation of DNA libraries for sequencing using Illumina's NextSeq 500 platform. For kit configuration information, see [Table 1](#) on page 13 and [Table 31](#) on page 69. For information on downstream sequencing steps for the NextSeq platform, see "[Step 6. Prepare sequencing samples](#)" on page 60 and P5 index sequences in [Table 36](#) on page 72.

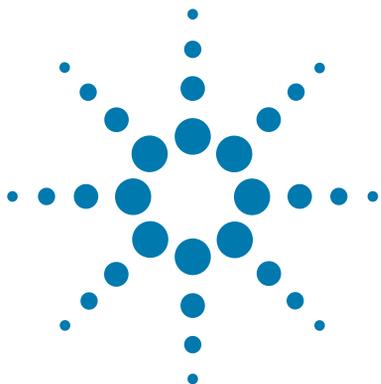
- Updates to custom sequencing primer preparation instructions for the MiSeq platform ([Table 25](#) on page 62)
- Updates to the order of Capture Library product offerings in [Table 2](#) on page 14
- Updates to the capture washing protocol to include the same protocol steps for all capture sizes (see [step 10](#) on [page 44](#)). Previous user guide versions included separate wash conditions for captures smaller than 3 Mb.
- Updates to “[Quick Reference Guide to SureSelect Protocol Differences](#)” on page 75. Revised table includes changes to the SureSelect<sup>QXT</sup> system capture wash protocol in this user guide and minor modifications to the SureSelect<sup>XT</sup> system protocol.

# Content

<b>1</b>	<b>Before You Begin</b>	<b>9</b>
	Overview of the Workflow	10
	Procedural Notes	11
	Safety Notes	12
	Required Reagents	13
	Optional Reagents	15
	Required Equipment	16
<b>2</b>	<b>Sample Preparation</b>	<b>19</b>
	Step 1. Fragment and adaptor-tag the genomic DNA samples	20
	Step 2. Purify the adaptor-tagged library using AMPure XP beads	24
	Step 3. Amplify the adaptor-tagged DNA library	26
	Step 4. Purify the amplified library with AMPure XP beads	28
	Step 5. Assess library DNA quantity and quality	30
<b>3</b>	<b>Hybridization and Capture</b>	<b>35</b>
	Step 1. Aliquot prepared DNA samples for hybridization	36
	Step 2. Hybridize DNA samples to the Capture Library	37
	Step 3. Prepare streptavidin-coated magnetic beads for DNA hybrid capture	42
	Step 4. Capture the hybridized DNA using streptavidin-coated beads	43
<b>4</b>	<b>Indexing and Sample Processing for Multiplexed Sequencing</b>	<b>47</b>
	Step 1. Amplify the captured libraries to add index tags	48
	Step 2. Purify the amplified captured libraries using AMPure XP beads	51
	Step 3. Assess indexed library DNA quantity and quality	53
	Step 4. Quantify each index-tagged library by QPCR (optional)	57
	Step 5. Pool samples for multiplexed sequencing	58
	Step 6. Prepare sequencing samples	60
	Step 7. Set up the sequencing run and trim adaptors from the reads	64

## Contents

<b>5</b>	<b>Reference</b>	<b>67</b>
	Kit Contents	68
	Nucleotide Sequences of SureSelect <sup>0XT</sup> Dual Indexes	71
	Guidelines for Multiplexing with Dual-Indexed Samples	73
	Quick Reference Guide to SureSelect Protocol Differences	75



# 1 Before You Begin

Overview of the Workflow	10
Procedural Notes	11
Safety Notes	12
Required Reagents	13
Optional Reagents	15
Required Equipment	16

Make sure you read and understand the information in this chapter and have the necessary equipment and reagents listed before you start an experiment.

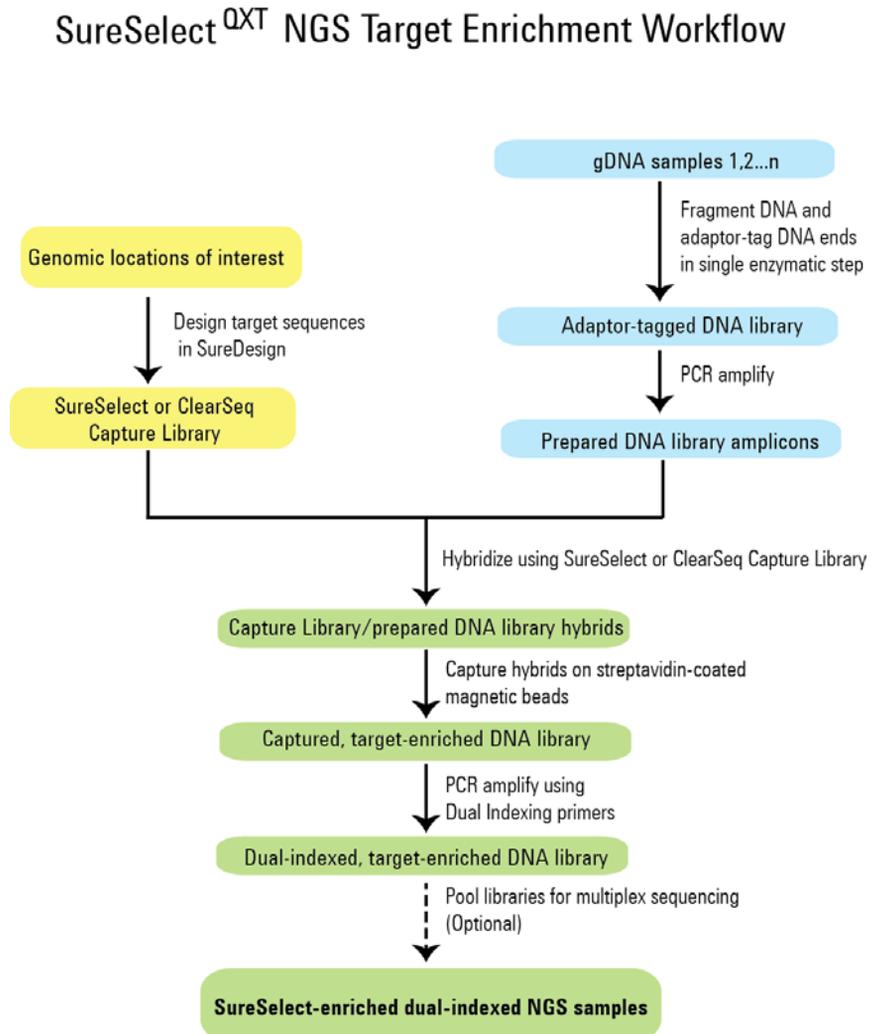
## NOTE

Agilent cannot guarantee the SureSelect Target Enrichment kits and cannot provide technical support for the use of non-Agilent protocols or instruments to process samples for enrichment.



## Overview of the Workflow

The SureSelect<sup>QXT</sup> target enrichment workflow is summarized in Figure 1.



**Figure 1** Overall target-enriched sequencing sample preparation workflow.

## Procedural Notes

- The SureSelect<sup>QXT</sup> system requires high-quality DNA samples for optimal performance. Use best practices for verifying DNA sample quality before initiating the workflow. For best practice, store diluted DNA solutions at 4°C to avoid repeated freeze-thaw cycles, which may compromise DNA quality.
- Performance of the SureSelect<sup>QXT</sup> library preparation protocol is very sensitive to variations in amounts of DNA sample and other reaction components. It is important to quantify and dilute DNA samples as described on [page 21](#). Carefully measure volumes for all reaction components, and combine components as described on [page 22](#). Use best-practices for liquid handling, including regular pipette calibration, to ensure precise volume measurement.
- Use care in handling the SureSelect QXT Enzyme Mix. After removing the vial from storage at -20°C, keep on ice or in a cold block while in use. Return the vial to storage at -20°C promptly after use.
- For each protocol step that requires removal of tube cap strips, reseal the tubes with a fresh strip of domed caps. Cap deformation may result from exposure of the cap strips to the heated lid of the thermal cycler and from other procedural steps. Reuse of strip caps can cause sample loss, sample contamination, or imprecision in sample temperatures during thermal cycler incubation steps.
- Use best-practices to prevent PCR product contamination of samples throughout the workflow:
  - 1 Assign separate pre-PCR and post-PCR work areas and use dedicated equipment, supplies, and reagents in each area. In particular, never use materials designated to post-PCR work areas for pre-PCR segments of the workflow.
  - 2 Maintain clean work areas. Clean pre-PCR surfaces that pose the highest risk of contamination daily using a 10% bleach solution.
  - 3 Always use dedicated pre-PCR pipettors with nuclease-free aerosol-resistant tips to pipette dedicated pre-PCR solutions.
  - 4 Wear powder-free gloves. Use good laboratory hygiene, including changing gloves after contact with any potentially-contaminated surfaces.

## 1 Before You Begin

### Safety Notes

- Possible stopping points, where samples may be stored at  $-20^{\circ}\text{C}$ , are marked in the protocol. Do not subject the samples to multiple freeze/thaw cycles.
- To prevent contamination of reagents by nucleases, always wear powder-free laboratory gloves and use dedicated solutions and pipettors with nuclease-free aerosol-resistant tips.
- In general, follow Biosafety Level 1 (BL1) safety rules.

### Safety Notes

#### CAUTION

- Wear appropriate personal protective equipment (PPE) when working in the laboratory.
-

## Required Reagents

**Table 1** Required Reagents for SureSelect<sup>OXT</sup> Target Enrichment

Description	Vendor and part number
SureSelect or ClearSeq Capture Library*	Select one library from <a href="#">Table 2</a> or <a href="#">Table 3</a>
SureSelect <sup>OXT</sup> Reagent Kit*	Agilent
Illumina HiSeq or MiSeq platform (ILM), 16 Samples	p/n G9681A
Illumina HiSeq or MiSeq platform (ILM), 96 Samples	p/n G9681B
Illumina NextSeq platform (NSQ), 16 Samples	p/n G9683A
Illumina NextSeq platform (NSQ), 96 Samples	p/n G9683B
Agencourt AMPure XP Kit	Beckman Coulter Genomics
5 ml	p/n A63880
60 ml	p/n A63881
450 ml	p/n A63882
Dynabeads MyOne Streptavidin T1	Life Technologies
2 ml	p/n 65601
10 ml	p/n 65602
100 ml	p/n 65603
1X Low TE Buffer (10 mM Tris-HCl, pH 8.0, 0.1 mM EDTA)	Life Technologies p/n 12090-015, or equivalent
100% Ethanol, molecular biology grade	Sigma-Aldrich p/n E7023
Qubit dsDNA HS Assay Kit <i>or</i>	Life Technologies p/n Q32851
Qubit dsDNA BR Assay Kit	Life Technologies
100 assays	p/n Q32850
500 assays	p/n Q32853
Nuclease-free Water (not DEPC-treated)	Ambion Cat #AM9930

\* SureSelect and ClearSeq reagents must be used within one year of receipt.

**1 Before You Begin**  
Required Reagents

**Table 2** SureSelect<sup>XT</sup> Capture Libraries

Capture Library	16 Reactions	96 Reactions
SureSelect <sup>XT</sup> Human All Exon v6	5190-8863	5190-8864
SureSelect <sup>XT</sup> Human All Exon v6 + UTRs	5190-8881	5190-8882
SureSelect <sup>XT</sup> Human All Exon v6 + COSMIC	5190-9307	5190-9308
SureSelect <sup>XT</sup> Human All Exon v6 Plus 1	5190-8866	5190-8867
SureSelect <sup>XT</sup> Human All Exon v6 Plus 2	5190-8869	5190-8870
SureSelect <sup>XT</sup> Clinical Research Exome	5190-7338	5190-7339
SureSelect <sup>XT</sup> Focused Exome	5190-7787	5190-7788
SureSelect <sup>XT</sup> Focused Exome Plus 1	5190-7790	5190-7791
SureSelect <sup>XT</sup> Focused Exome Plus 2	5190-7793	5190-7795
SureSelect <sup>XT</sup> Human All Exon v5	5190-6208	5190-6209
SureSelect <sup>XT</sup> Human All Exon v5 + UTRs	5190-6213	5190-6214
SureSelect <sup>XT</sup> Human All Exon v5 + lncRNA	5190-6446	5190-6447
SureSelect <sup>XT</sup> Human All Exon v5 Plus	5190-6211	5190-6212
SureSelect <sup>XT</sup> Human All Exon v4	5190-4631	5190-4632
SureSelect <sup>XT</sup> Human All Exon v4 + UTRs	5190-4636	5190-4637
SureSelect <sup>XT</sup> Mouse All Exon	5190-4641	5190-4642
SureSelect <sup>XT</sup> Human X-Chromosome	5190-4651	5190-4652
SureSelect <sup>XT</sup> Custom 1 kb up to 499 kb (reorder)	5190-4806 (5190-4811)	5190-4807 (5190-4812)
SureSelect <sup>XT</sup> Custom 0.5 Mb up to 2.9 Mb (reorder)	5190-4816 (5190-4821)	5190-4817 (5190-4822)
SureSelect <sup>XT</sup> Custom 3 Mb up to 5.9 Mb (reorder)	5190-4826 (5190-4831)	5190-4827 (5190-4832)
SureSelect <sup>XT</sup> Custom 6 Mb up to 11.9 Mb (reorder)	5190-4836 (5190-4841)	5190-4837 (5190-4842)
SureSelect <sup>XT</sup> Custom 12 Mb up to 24 Mb (reorder)	5190-4896 (5190-4901)	5190-4897 (5190-4902)

**Table 3** Compatible ClearSeq Capture Libraries

Capture Library	16 Reactions	96 Reactions
ClearSeq Comprehensive Cancer XT	5190-8011	5190-8012
ClearSeq Comprehensive Cancer Plus XT	5190-8014	5190-8015
ClearSeq Inherited Disease XT	5190-7518	5190-7519
ClearSeq Inherited Disease Plus XT	5190-7521	5190-7522
ClearSeq DNA Kinome XT	5190-4646	5190-4647

## Optional Reagents

**Table 4** Optional Reagents for SureSelect<sup>QXT</sup> Target Enrichment

Description	Vendor and part number
Agilent QPCR NGS Library Quantification Kit (Illumina GA)	Agilent p/n G4880A

## Required Equipment

**Table 5** Required Equipment for SureSelect<sup>OXT</sup> Target Enrichment

Description	Vendor and part number
SureCycler 8800 Thermal Cycler, or equivalent	Agilent p/n G8800A
96 well plate module for SureCycler 8800 Thermal Cycler	Agilent p/n G8810A
SureCycler 8800-compatible plasticware:	
96-well plates	Agilent p/n 410088
OR	
8-well strip tubes	Agilent p/n 410092
Tube cap strips, domed	Agilent p/n 410096
DNA Analysis Platform and Consumables	
Agilent 2100 Bioanalyzer Laptop Bundle	Agilent p/n G2943CA
Agilent 2100 Bioanalyzer Electrophoresis Set	Agilent p/n G2947CA
Agilent DNA 1000 Kit	Agilent p/n 5067-1504
Agilent High Sensitivity DNA Kit	Agilent p/n 5067-4626
OR	
Agilent 4200 TapeStation	Agilent p/n G2991AA
Agilent D1000 ScreenTape	Agilent p/n 5067-5582
Agilent D1000 Reagents	Agilent p/n 5067-5583
Agilent High Sensitivity D1000 ScreenTape	Agilent p/n 5067-5584
Agilent D1000 Reagents	Agilent p/n 5067-5585
OR	
Agilent 2200 TapeStation	Agilent p/n G2964AA or G2965AA
Agilent D1000 ScreenTape	Agilent p/n 5067-5582
Agilent D1000 Reagents	Agilent p/n 5067-5583
Agilent High Sensitivity D1000 ScreenTape	Agilent p/n 5067-5584
Agilent D1000 Reagents	Agilent p/n 5067-5585
Qubit Fluorometer	Life Technologies p/n Q32857
Qubit Assay Tubes	Life Technologies p/n Q32856
DNA LoBind Tubes, 1.5-ml PCR clean, 250 pieces	Eppendorf p/n 022431021 or equivalent

**Table 5** Required Equipment for SureSelect<sup>OXT</sup> Target Enrichment

Description	Vendor and part number
Centrifuge	Eppendorf Centrifuge model 5804 or equivalent
Plate or strip tube centrifuge	Labnet International MPS1000 Mini Plate Spinner p/n C1000 (requires adapter, p/n C1000-ADAPT, for use with strip tubes) or equivalent
96-well plate mixer	Eppendorf ThermoMixer C p/n 5382 000.015 and Eppendorf SmartBlock 96 PCR p/n 5306 000.006, or equivalent
Magnetic separator	Life Technologies p/n 12331D or equivalent*
Multichannel pipette	Pipetman or equivalent
P10, P20, P200 and P1000 pipettes	Pipetman P10, P20, P200, P1000 or equivalent
Vortex mixer	
Ice bucket	
Powder-free gloves	
Sterile, nuclease-free aerosol barrier pipette tips	

\* Select a magnetic separator configured to collect magnetic particles on one side of each well. Do not use a magnetic separator configured to collect the particles in a ring formation.

**1 Before You Begin**  
Required Equipment



## 2 Sample Preparation

- Step 1. Fragment and adaptor-tag the genomic DNA samples 20
- Step 2. Purify the adaptor-tagged library using AMPure XP beads 24
- Step 3. Amplify the adaptor-tagged DNA library 26
- Step 4. Purify the amplified library with AMPure XP beads 28
- Step 5. Assess library DNA quantity and quality 30

This section contains instructions for preparation of genomic DNA sequencing libraries prior to target enrichment, for subsequent sequencing on Illumina platforms.



## 2 Sample Preparation

### Step 1. Fragment and adaptor-tag the genomic DNA samples

## Step 1. Fragment and adaptor-tag the genomic DNA samples

In this step, the gDNA is enzymatically fragmented and adaptors are added to ends of the fragments in a single reaction. This step uses the SureSelect<sup>QXT</sup> Reagent Kit components listed in [Table 6](#) in addition to some reagents obtained from other suppliers (see [Table 1](#) on page 13).

**Table 6** Reagents for DNA fragmentation and adaptor-tagging

Kit Component	Storage Location	Where Used
SureSelect QXT Stop Solution	SureSelect QXT Hyb Module Box 1, Room Temperature	<a href="#">page 20</a> (below)
SureSelect QXT Buffer	SureSelect QXT Library Prep Kit Box 2, -20°C	<a href="#">page 22</a>
SureSelect QXT Enzyme Mix ILM	SureSelect QXT Library Prep Kit Box 2, -20°C	<a href="#">page 22</a>

Before you begin, remove the SureSelect QXT Enzyme Mix ILM and the SureSelect QXT Buffer tubes from storage at -20°C and place on ice. Vortex each reagent vigorously to mix before use. Remove the AMPure XP beads from storage at 4°C and allow to warm up to room temperature.

#### NOTE

While obtaining components for this step, also remove the DMSO vial from the SureSelect QXT Library Prep Kit Box 2 in -20°C storage. Leave the DMSO vial at room temperature in preparation for use on [page 26](#).

For each DNA sample to be sequenced, prepare 1 library.

- 1 Verify that the SureSelect QXT Stop Solution contains 25% ethanol, by referring to the container label and the instructions below.

Before the first use of a fresh container, add 1.5 ml of ethanol to the provided bottle containing 4.5 ml of stop solution, for a final ethanol concentration of 25%. Seal the bottle then vortex well to mix. After adding the ethanol, be sure to mark the label for reference by later users.

Keep the prepared 1X SureSelect QXT Stop Solution at room temperature, tightly sealed, until it is used on [page 23](#).

## Step 1. Fragment and adaptor-tag the genomic DNA samples

- 2 Prepare reagents for the purification protocols on [page 24](#) and [page 28](#).
  - a Transfer the AMPure XP beads to room temperature. The beads should be held at room temperature for at least 30 minutes before use. *Do not freeze the beads at any time.*
  - b Prepare 800 µl of fresh 70% ethanol per sample, plus excess, for use in the purification steps. The 70% ethanol may be used for multiple steps done on the same day, when stored in a sealed container.
- 3 Quantify and dilute gDNA samples using two serial fluorometric assays:
  - a Use the Qubit dsDNA BR Assay or Qubit dsDNA HS Assay to determine the initial concentration of each gDNA sample. Follow the manufacturer's instructions for the specific assay kit and the Qubit instrument. This step is critical for successful preparation of input DNA at the required concentration to ensure optimal fragmentation.
  - b Dilute each gDNA sample with nuclease-free water to a final concentration of 100 ng/µl in a 1.5-ml LoBind tube.
  - c Carefully measure the DNA concentration of each of the 100 ng/µl dilutions using a second Qubit dsDNA BR or HS Assay.
  - d Adjust each gDNA sample with nuclease-free water to a final concentration of 25 ng/µl in a 1.5-ml LoBind tube.

**CAUTION**

The duration and temperature of incubation for DNA fragmentation must be precisely controlled for optimal results. Make sure to preprogram the thermal cycler as directed in [step 4](#) before setting up the fragmentation reactions. **Do not exceed 10 minutes at 45°C**, as indicated in [Table 7](#).

- 4 Preprogram a SureCycler 8800 thermal cycler (with the heated lid ON) with the program in [Table 7](#). Start the program, then immediately press the *Pause* button, allowing the heated lid to reach temperature while you set up the fragmentation reactions.

**Table 7** Thermal cycler program for DNA fragmentation

Step	Temperature	Time
Step 1	45°C	10 minutes
Step 2	4°C	1 minute
Step 3	4°C	Hold

## 2 Sample Preparation

### Step 1. Fragment and adaptor-tag the genomic DNA samples

- 5 Before use, vortex the SureSelect QXT Buffer and SureSelect QXT Enzyme Mix ILM tubes vigorously at high speed. Note that the SSEL QXT Buffer is viscous and thorough and vigorous mixing is critical for optimal fragmentation.

These components are in liquid form when removed from  $-20^{\circ}\text{C}$  storage and should be returned to  $-20^{\circ}\text{C}$  storage promptly after use in [step 6](#).

#### CAUTION

Minor variations in volumes of the solutions combined in [step 6](#) below may result in DNA fragment size variation.

The SureSelect QXT Buffer and Enzyme Mix solutions are highly viscous. Be sure to follow the dispensing and mixing instructions in the steps below. Thorough mixing of the reagents and reactions is critical for optimal performance.

- 6 Set up the fragmentation reactions on ice using a PCR plate or strip tube. Components must be added in the order listed below. Do not pre-mix the SureSelect QXT Buffer and Enzyme Mix.
  - a To each sample well, add 17  $\mu\text{l}$  of SureSelect QXT Buffer.
  - b Add 2  $\mu\text{l}$  of each DNA sample to its assigned sample well. While dispensing the DNA, be sure to place the pipette tip at the bottom of the well.
  - c Add 2  $\mu\text{l}$  of SureSelect QXT Enzyme Mix, ILM to each sample well. While dispensing the enzyme mixture, place the pipette tip at the bottom of the well. After dispensing of the 2  $\mu\text{l}$  of enzyme mix, pipette up and down 8 to 10 times to ensure complete transfer of the viscous solution to the well.
- 7 Seal the wells, briefly spin, then **mix thoroughly by vortexing the plate or strip tube at high speed for 20 seconds**.
- 8 Briefly spin the samples, then immediately place the plate or strip tube in the SureCycler 8800 thermal cycler. Press the *Play* button to resume the thermal cycling program in [Table 7](#).
- 9 During the 10-minute incubation of samples in the SureCycler, vigorously vortex the AMPure XP beads at high speed to ensure homogeneous distribution of beads throughout the solution so that the beads are ready for use on [page 24](#).
- 10 When the thermal cycler has completed the 1-minute incubation at  $4^{\circ}\text{C}$ , immediately place the samples on ice and proceed to [step 11](#).

## Step 1. Fragment and adaptor-tag the genomic DNA samples

- 11** Add 32  $\mu$ l of 1X SureSelect QXT Stop Solution (containing 25% ethanol) to each fragmentation reaction. Seal the wells with fresh caps, then vortex at high speed for 5 seconds. Briefly spin the plate or strip tube to collect the liquid.

Incubate the samples at room temperature for 1 minute. Proceed directly to the purification protocol on [page 24](#).

## 2 Sample Preparation

### Step 2. Purify the adaptor-tagged library using AMPure XP beads

## Step 2. Purify the adaptor-tagged library using AMPure XP beads

Before you begin, verify that the AMPure XP beads have been incubated at room temperature for at least 30 minutes and that fresh 70% ethanol has been prepared for use in [step 6](#).

- 1 Verify that the AMPure XP bead suspension has been well mixed and appears homogeneous and consistent in color.
- 2 Add 52  $\mu\text{l}$  of the homogeneous bead suspension to each well containing the DNA samples. Seal the wells with fresh caps, then vortex for 5 seconds. Briefly spin the samples to collect the liquid, without pelleting the beads.

Check that the beads are in a homogeneous suspension in the sample wells. Each well should have a uniform color with no layers of beads or clear liquid present.

- 3 Incubate samples for 5 minutes at room temperature.
- 4 Put the plate or strip tube on the magnetic stand at room temperature. Wait for the solution to clear (approximately 3 to 5 minutes).
- 5 While keeping the plate or tubes in the magnetic stand, carefully remove and discard the cleared solution from each well. Do not disturb the beads while removing the solution.
- 6 Continue to keep the plate or tubes in the magnetic stand while you dispense 200  $\mu\text{l}$  of fresh 70% ethanol in each sample well.
- 7 Wait for 1 minute to allow any disturbed beads to settle, then remove the ethanol.
- 8 Repeat [step 6](#) and [step 7](#) once for a total of two washes. Make sure to remove all of the ethanol at each wash step.
- 9 Dry the samples on the thermal cycler (with lid open) at 37°C for 1 to 3 minutes. Do not overdry the samples.
- 10 Add 11  $\mu\text{l}$  of nuclease-free water to each sample well.
- 11 Seal the sample wells with fresh caps, then mix well on a vortex mixer and briefly spin the plate or tubes to collect the liquid.
- 12 Incubate for 2 minutes at room temperature.
- 13 Put the plate or tubes in the magnetic stand and leave for 2 minutes or until the solution in each well is clear.

## Step 2. Purify the adaptor-tagged library using AMPure XP beads

- 14 Remove each cleared supernatant (approximately 10  $\mu$ l) to wells of a fresh plate or strip tube and keep on ice. You can discard the beads at this time.

## 2 Sample Preparation

### Step 3. Amplify the adaptor-tagged DNA library

## Step 3. Amplify the adaptor-tagged DNA library

In this step, the adaptor-tagged gDNA library is repaired and PCR-amplified.

- 1 Thaw then vortex to mix the reagents listed in [Table 8](#). Keep all reagents except DMSO on ice.

**Table 8** Reagents for precapture amplification

Kit Component	Storage Location	Where Used
Herculase II Fusion DNA Polymerase	SureSelect QXT Library Prep Kit Box 2, -20°C	<a href="#">page 26</a> (below)
Herculase II 5× Reaction Buffer	SureSelect QXT Library Prep Kit Box 2, -20°C	<a href="#">page 26</a> (below)
100 mM dNTP Mix (25 mM each dNTP)	SureSelect QXT Library Prep Kit Box 2, -20°C	<a href="#">page 26</a> (below)
SureSelect QXT Primer Mix	SureSelect QXT Hyb Module Box 2, -20°C	<a href="#">page 26</a> (below)
DMSO	Transferred to Room Temperature storage on <a href="#">page 20</a>	<a href="#">page 26</a> (below)

- 2 Prepare the appropriate volume of PCR reaction mix, as described in [Table 9](#), on ice. Mix well on a vortex mixer.

**Table 9** Preparation of pre-capture PCR Reaction mix

Reagent	Volume for 1 reaction	Volume for 16 reactions (includes excess)
Nuclease-free water	25 µl	425 µl
Herculase II 5× Reaction Buffer	10 µl	170 µl
100 mM dNTP Mix (25 mM each dNTP)	0.5 µl	8.5 µl
DMSO	2.5 µl	42.5 µl
SureSelect QXT Primer Mix	1 µl	17 µl
Herculase II Fusion DNA Polymerase	1 µl	17 µl
<b>Total</b>	<b>40 µl</b>	<b>680 µl</b>

## Step 3. Amplify the adaptor-tagged DNA library

- 3 Add 40 µl of the pre-capture PCR reaction mix prepared in [step 2](#) to each 10-µl purified DNA library sample.  
Seal the wells with fresh caps and mix by vortexing gently for 5 seconds. Spin samples briefly to collect the liquid.
- 4 Incubate the plate in the thermal cycler (with the heated lid ON) and run the program in [Table 10](#).

**Table 10** Thermal cycler program for pre-capture PCR

Segment Number	Number of Cycles	Temperature	Time
1	1	68°C	2 minutes
2	1	98°C	2 minutes
3	8	98°C	30 seconds
		57°C	30 seconds
		72°C	1 minute
4	1	72°C	5 minutes
5	1	4°C	Hold

## 2 Sample Preparation

### Step 4. Purify the amplified library with AMPure XP beads

#### Step 4. Purify the amplified library with AMPure XP beads

Before you begin, verify that the AMPure XP beads have been kept at room temperature for at least 30 minutes and that fresh 70% ethanol has been prepared for use in [step 6](#).

- 1 Mix the AMPure XP bead suspension well so that the suspension appears homogeneous and consistent in color.
- 2 Transfer the samples to room temperature, then add 50  $\mu$ l of the homogeneous bead suspension to each sample well containing the 50- $\mu$ l amplified DNA samples. Seal the wells with fresh caps, then vortex for 5 seconds. Briefly spin the samples to collect the liquid without pelleting the beads.

Check that the beads are in a homogeneous suspension in the sample wells. Each well should have a uniform color with no layers of beads or clear liquid present.

- 3 Incubate samples for 5 minutes at room temperature.
- 4 Put the plate or strip tube on the magnetic stand at room temperature. Wait for the solution to clear (approximately 3 to 5 minutes).
- 5 While keeping the plate or tubes in the magnetic stand, carefully remove and discard the cleared solution from each well. Do not disturb the beads while removing the solution.
- 6 Continue to keep the plate or tubes in the magnetic stand while you dispense 200  $\mu$ l of fresh 70% ethanol in each sample well.
- 7 Wait for 1 minute to allow any disturbed beads to settle, then remove the ethanol.
- 8 Repeat [step 6](#) and [step 7](#) once for a total of two washes. Make sure to remove all of the ethanol at each wash step.
- 9 Dry the samples on the thermal cycler (with lid open) at 37°C for 1 to 3 minutes. Do not overdry the samples.
- 10 Add 13  $\mu$ l of nuclease-free water to each sample well.
- 11 Seal the sample wells with fresh caps, then mix well on a vortex mixer and briefly spin the plate or tubes to collect the liquid.
- 12 Incubate for 2 minutes at room temperature.
- 13 Put the plate or tubes in the magnetic stand and leave for 2 minutes or until the solution in each well is clear.

## Step 4. Purify the amplified library with AMPure XP beads

**14** Remove each cleared supernatant (approximately 13  $\mu$ l) to wells of a fresh plate or strip tube. You can discard the beads at this time.

**Stopping Point** If you do not continue to the next step, seal the wells and store the samples at 4°C short term or at -20°C for long term storage.

## Step 5. Assess library DNA quantity and quality

### Option 1: Analysis using the Agilent 2100 Bioanalyzer and DNA 1000 Assay

Use a Bioanalyzer DNA 1000 chip and reagent kit. For more information to do this step, see the *Agilent DNA 1000 Kit Guide* at [www.genomics.agilent.com](http://www.genomics.agilent.com).

#### NOTE

The presence of magnetic beads in the samples may adversely impact the Bioanalyzer results. If you suspect bead contamination in the samples, place the plate or strip tube on the magnetic rack before withdrawing samples for analysis.

- 1 Set up the 2100 Bioanalyzer as instructed in the reagent kit guide.
- 2 Prepare the chip, samples and ladder as instructed in the reagent kit guide, using 1  $\mu$ l of each sample for the analysis. Load the prepared chip into the 2100 Bioanalyzer and start the run within five minutes after preparation.
- 3 Verify that the electropherogram shows the peak of DNA fragment size positioned between 245 to 325 bp. Sample electropherograms are shown in [Figure 2](#). Variability of fragmentation profiles may be observed.

#### NOTE

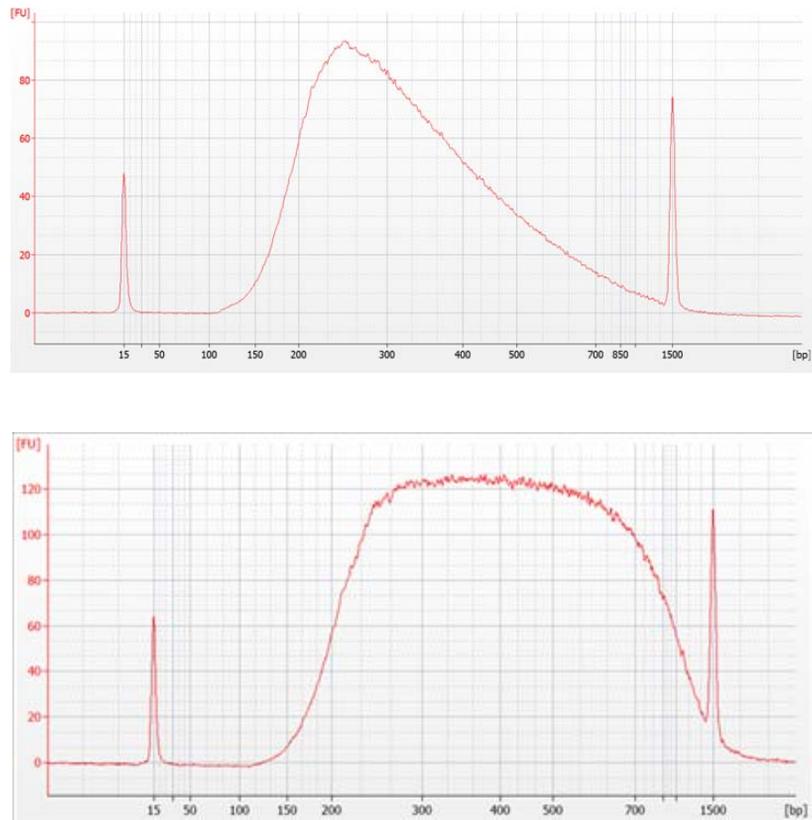
A peak DNA fragment size significantly less than 245 bp may indicate too little gDNA in the fragmentation reaction and may be associated with increased duplicates in the sequencing data. In contrast, a peak DNA fragment size significantly greater than 325 bp may indicate too much gDNA in the fragmentation reaction and may be associated with decreased percent-on-target performance in sequencing results.

- 4 Measure the concentration of each library by integrating under the entire peak. For accurate quantification, make sure that the concentration falls within the linear range of the assay.

#### Stopping Point

If you do not continue to the next step, seal the plate and store at 4°C overnight or at -20°C for prolonged storage.

## Step 5. Assess library DNA quantity and quality



**Figure 2** Representative sample electropherograms showing pre-capture analysis of amplified library DNA using the Agilent 2100 Bioanalyzer and a DNA 1000 Assay.

## 2 Sample Preparation

### Step 5. Assess library DNA quantity and quality

#### Option 2: Analysis using an Agilent TapeStation and D1000 ScreenTape

Use a D1000 ScreenTape (p/n 5067-5582) and associated reagent kit (p/n 5067-5583) to analyze the amplified libraries using the Agilent 4200 TapeStation or 2200 TapeStation. For more information to do this step, see the appropriate TapeStation user manual at [www.genomics.agilent.com](http://www.genomics.agilent.com).

- 1 Prepare the TapeStation samples as instructed in the instrument user manual. Use 1  $\mu$ l of each amplified library DNA sample diluted with 3  $\mu$ l of D1000 sample buffer for the analysis.

#### CAUTION

Make sure that you thoroughly mix the combined DNA and sample buffer on a vortex mixer for 5 seconds for accurate quantitation.

- 2 Load the sample plate or tube strips from [step 1](#), the D1000 ScreenTape, and loading tips into the TapeStation as instructed in the instrument user manual. Start the run.
- 3 Verify that the electropherogram shows the peak of DNA fragment size positioned between 245 to 325 bp. Sample electropherograms are shown in [Figure 3](#). Variability of fragmentation profiles may be observed.

#### NOTE

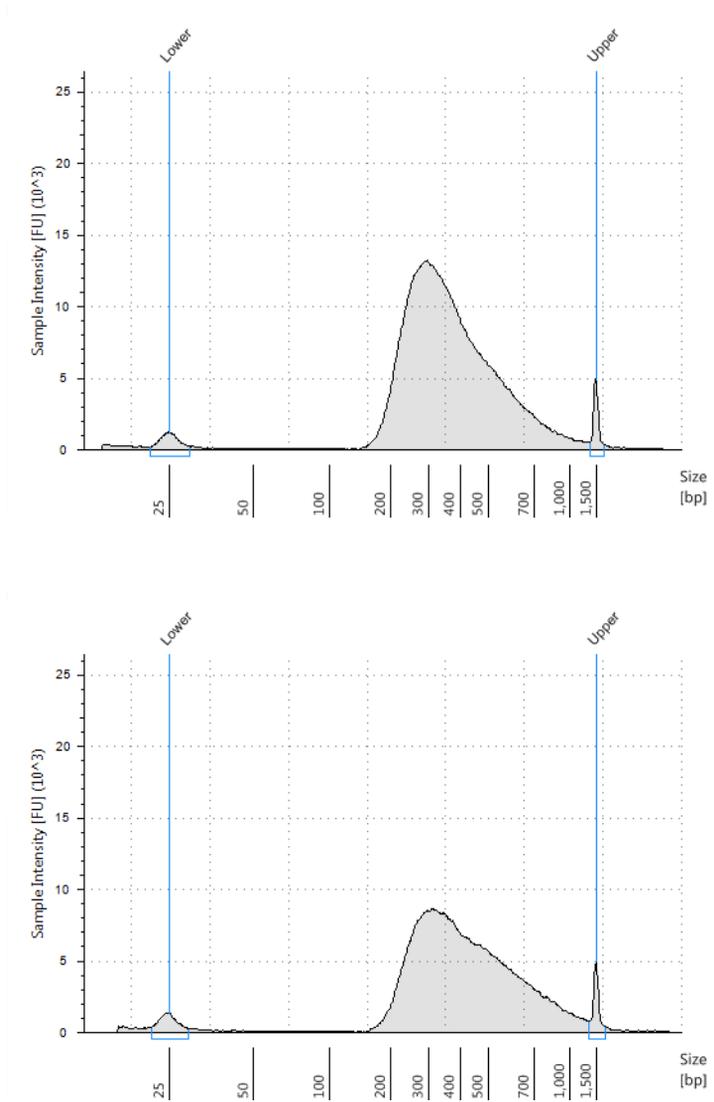
A peak DNA fragment size significantly less than 245 bp may indicate too little gDNA in the fragmentation reaction and may be associated with increased duplicates in the sequencing data. In contrast, a peak DNA fragment size significantly greater than 325 bp may indicate too much gDNA in the fragmentation reaction and may be associated with decreased percent-on-target performance in sequencing results.

- 4 Measure the concentration of each library by integrating under the entire peak.

#### Stopping Point

If you do not continue to the next step, seal the library DNA sample plate and store at 4°C overnight or at -20°C for prolonged storage.

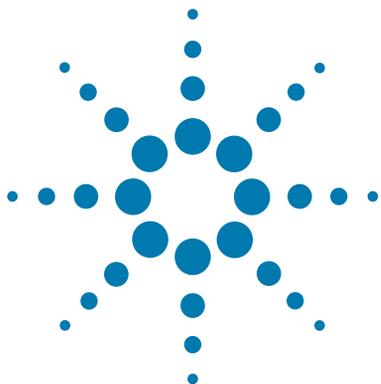
Step 5. Assess library DNA quantity and quality



**Figure 3** Representative sample electropherograms showing pre-capture analysis of amplified library DNA using the 2200 TapeStation with a D1000 ScreenTape.

## 2 **Sample Preparation**

### Step 5. Assess library DNA quantity and quality



### 3 Hybridization and Capture

- Step 1. Aliquot prepared DNA samples for hybridization 36
- Step 2. Hybridize DNA samples to the Capture Library 37
- Step 3. Prepare streptavidin-coated magnetic beads for DNA hybrid capture 42
- Step 4. Capture the hybridized DNA using streptavidin-coated beads 43

This chapter describes the steps to hybridize the prepared gDNA libraries with a target-specific Capture Library. After hybridization, the targeted molecules are captured on streptavidin beads.

#### CAUTION

The ratio of Capture Library to gDNA library is critical for successful capture.



### 3 Hybridization and Capture

#### Step 1. Aliquot prepared DNA samples for hybridization

## Step 1. Aliquot prepared DNA samples for hybridization

The amount of prepared gDNA library used in the hybridization reaction varies according to the size of the Capture Library used for hybridization as outlined in [Table 11](#) below.

**Table 11** Amount of adaptor-tagged DNA libraries used for hybridization

Capture Library Size	Amount of prepared gDNA library used in hybridization	Volume of prepared gDNA library samples added to hybridization
Libraries >3.0 Mb (except ClearSeq DNA Kinome; see below)	750 to 1500 ng DNA	12 $\mu$ l
Libraries $\leq$ 3.0 Mb and ClearSeq DNA Kinome (3.2 Mb)	500 to 750 ng DNA	12 $\mu$ l

- 1** Place the prepared gDNA library samples into the hybridization plate or strip tube wells as described below. Use the maximum possible amount of each prepped DNA, within the range listed in [Table 11](#).
  - a** For hybridization to Capture Libraries >3 Mb, place up to 1500 ng of prepared DNA library into the designated well and then bring the final volume to 12  $\mu$ l using nuclease-free water.
  - b** For hybridization to the ClearSeq DNA Kinome or Capture Libraries  $\leq$ 3.0 Mb, place up to 750 ng of prepared DNA library into the designated well and then bring the final volume to 12  $\mu$ l using nuclease-free water.

## Step 2. Hybridize DNA samples to the Capture Library

This step uses the SureSelect<sup>QXT</sup> Reagent Kit components listed in [Table 12](#). Thaw each component under the conditions indicated in the table. Vortex each reagent to mix, then spin briefly to collect the liquid.

**Table 12** Reagents for Hybridization and Capture

Kit Component	Storage Location	Thawing Conditions	Where Used
SureSelect QXT Fast Hybridization Buffer	SureSelect QXT Hyb Module Box 2, -20°C	Warm to Room Temperature (RT), then keep at RT	<a href="#">page 40</a>
SureSelect QXT Fast Blocker Mix	SureSelect QXT Hyb Module Box 2, -20°C	Thaw on ice	<a href="#">page 37</a> (below)
SureSelect RNase Block	SureSelect QXT Hyb Module Box 2, -20°C	Thaw on ice	<a href="#">page 39</a>
Capture Library	-80°C	Thaw on ice	<a href="#">page 40</a>

### CAUTION

For each protocol step that requires removal of tube cap strips, make sure to reseal the tubes with a fresh strip of domed caps. Reuse of strip caps can cause sample loss, sample contamination, or imprecision in sample temperatures during incubations.

- 1 To each adaptor-tagged DNA sample well, add 5 µl of SureSelect QXT Fast Blocker Mix. Pipette up and down 8 to 10 times to mix, then cap the wells. Vortex at high speed for 5 seconds, then spin the plate or strip tube briefly.

Sample wells now contain 17 µl of prepared DNA + Fast Blocker mixture.

### 3 Hybridization and Capture

#### Step 2. Hybridize DNA samples to the Capture Library

- 2 Transfer the sealed prepared DNA + Blocker samples to the thermal cycler and start the following program shown in [Table 13](#), using a heated lid.

**Important: The thermal cycler must be paused during Segment 3 to allow additional reagents to be added to the Hybridization wells in step 5 on page 41.**

During Segments 1 and 2 of the thermal cycling program, begin preparing the additional reagents as described in [step 3 on page 39](#) and [step 4 on page 40](#). If needed, you can finish these preparation steps after pausing the thermal cycler in Segment 3.

**Table 13** Thermal cycler program for Hybridization \*

Segment Number	Number of Cycles	Temperature	Time
1	1	95°C	5 minutes
2	1	65°C	10 minutes
3	1	65°C	1 minute <b>(PAUSE cycler here)</b>
4	60	65°C	1 minute
		37°C	3 seconds
5	1	65°C	Hold <sup>†</sup>

\* When setting up the thermal cycling program, use a reaction volume setting of 30 µL (final volume of hybridization reactions during cycling in Segment 4).

† Begin the post-hybridization capture steps on [page 43](#) when the thermal cycler starts the 65°C Hold segment.

#### CAUTION

The lid of the thermal cycler is hot and can cause burns. Use caution when working near the lid.

## Step 2. Hybridize DNA samples to the Capture Library

- 3 Prepare a 25% solution of SureSelect RNase Block (containing 1 part RNase Block:3 parts water), according to [Table 14](#). Prepare the amount required for the number of hybridization reactions in the run, plus excess. Mix well. Keep the stock vial and diluted RNase Block on ice.

**Table 14** Preparation of RNase Block solution

Reagent	Volume for 1 reaction	Volume for 16 reactions (includes excess)	Volume for 96 reactions (includes excess)
SureSelect RNase Block	0.5 µl	10 µl	50 µl
Nuclease-free water	1.5 µl	30 µl	150 µl
<b>Total</b>	<b>2 µl</b>	<b>40 µl</b>	<b>200 µl</b>

**NOTE**

Prepare the mixture described in [step 4](#), below, just before pausing the thermal cycler in Segment 3 as described on [page 38](#). It is important to prepare and keep the mixture at room temperature prior to addition to the DNA samples in [step 5](#) on [page 41](#). Solutions containing the Capture Library should not, however, be held at room temperature for extended periods.

### 3 Hybridization and Capture

#### Step 2. Hybridize DNA samples to the Capture Library

- 4 Prepare the Capture Library Hybridization Mix appropriate for your capture library size according to [Table 15](#) for  $\geq 3$  Mb Capture Libraries or [Table 16](#) for  $< 3$  Mb Capture Libraries.

**Combine the listed reagents at room temperature.** Mix well by vortexing at high speed for 5 seconds then spin down briefly. Proceed immediately to [step 5](#).

**Table 15** Preparation of Capture Library Hybridization Mix for **Capture Libraries  $\geq 3$  Mb**\*

Reagent	Volume for 1 reaction	Volume for 16 reactions (includes excess)
25% RNase Block solution (from <a href="#">step 3</a> )	2 $\mu$ l	34 $\mu$ l
Capture Library $\geq 3$ Mb	5 $\mu$ l	85 $\mu$ l
SureSelect QXT Fast Hybridization Buffer	6 $\mu$ l	102 $\mu$ l
<b>Total</b>	<b>13 <math>\mu</math>l</b>	<b>221 <math>\mu</math>l</b>

\* Includes ClearSeq DNA Kinome XT Library (3.2 Mb)

**Table 16** Preparation of Capture Library Hybridization Mix for **Capture Libraries  $< 3$  Mb**

Reagent	Volume for 1 reaction	Volume for 16 reactions (includes excess)
25% RNase Block solution (from <a href="#">step 3</a> )	2 $\mu$ l	34 $\mu$ l
Capture Library $< 3$ Mb	2 $\mu$ l	34 $\mu$ l
SureSelect QXT Fast Hybridization Buffer	6 $\mu$ l	102 $\mu$ l
Nuclease-free water	3 $\mu$ l	51 $\mu$ l
<b>Total</b>	<b>13 <math>\mu</math>l</b>	<b>221 <math>\mu</math>l</b>

## Step 2. Hybridize DNA samples to the Capture Library

- 5 Once the thermal cycler starts Segment 3 of the program in [Table 13](#) (1 minute at 65°C), press the *Pause* button. With the cycler paused, and while keeping the DNA + Blocker samples in the cycler, transfer 13 µl of the room-temperature Capture Library Hybridization Mix from [step 4](#) to each sample well.

Mix well by pipetting up and down 8 to 10 times.

- 6 Seal the wells with fresh domed strip caps. Make sure that all wells are completely sealed. Vortex at high speed for 5 seconds, and then spin the tubes or plate briefly and return the samples to the thermal cycler. The hybridization reaction wells now contain approximately 30 µl.
- 7 Press the *Play* button to resume the thermal cycling program to allow hybridization of the prepared DNA samples to the Capture Library.

**CAUTION**

Wells must be adequately sealed to minimize evaporation, or your results can be negatively impacted.

Before you do the first experiment, make sure the plasticware and capping method are appropriate for the thermal cycler. Check that no more than 4 µl is lost to evaporation under the conditions used for hybridization.

---

### 3 Hybridization and Capture

#### Step 3. Prepare streptavidin-coated magnetic beads for DNA hybrid capture

## Step 3. Prepare streptavidin-coated magnetic beads for DNA hybrid capture

The hybrid capture protocol uses the SureSelect<sup>QXT</sup> Reagent Kit components in [Table 17](#) in addition to the streptavidin-coated magnetic beads obtained from another supplier (see [Table 4](#) on page 15).

**Table 17** Reagents for hybrid capture

Kit Component	Storage Location	Where Used
SureSelect Binding Buffer	SureSelect QXT Hyb Module Box 1, RT	<a href="#">page 42</a> (below)
Wash Buffer 2*	SureSelect QXT Hyb Module Box 1, RT	<a href="#">page 43</a>
SureSelect Wash Buffer 1	SureSelect QXT Hyb Module Box 1, RT	<a href="#">page 44</a>

\* This component may be labeled as *SureSelect Wash Buffer 2* or *SureSelect QXT Fast Wash Buffer 2*.

#### NOTE

If you are equipped for higher-volume magnetic bead captures, the streptavidin beads may be batch-washed in an Eppendorf tube or conical vial. Start the batch-washing procedure using excess bead solution. After resuspending the washed beads in the appropriate volume of SureSelect Binding Buffer, aliquot 200 µl of the washed beads to plate or strip tube wells to be used for hybridization capture.

- 1 Vigorously resuspend the Dynabeads MyOne Streptavidin T1 magnetic beads on a vortex mixer. The magnetic beads settle during storage.
- 2 For each hybridization sample, add 50 µl of the resuspended beads to wells of a fresh SureCycler 8800 PCR plate or a strip tube.
- 3 Wash the beads:
  - a Add 200 µl of SureSelect Binding Buffer.
  - b Mix by pipetting up and down 10 times.
  - c Put the plate or strip tube into a magnetic separator device.
  - d Wait at least 5 minutes or until the solution is clear, then remove and discard the supernatant.
  - e Repeat [step a](#) through [step d](#) two more times for a total of 3 washes.
- 4 Resuspend the beads in 200 µl of SureSelect Binding Buffer.

## Step 4. Capture the hybridized DNA using streptavidin-coated beads

- 1 After the hybridization step is complete and the thermal cycler reaches the 65°C hold step (see [Table 13](#) on page 38), transfer the samples to room temperature.
- 2 Maintain the hybridization samples at room temperature while you use a multichannel pipette to transfer the entire volume (approximately 30 µl) of each hybridization mixture to wells containing 200 µl of washed streptavidin beads. Seal the wells with fresh caps.
- 3 Incubate the capture plate or strip tube on a 96-well plate mixer, mixing vigorously (at 1800 rpm), for 30 minutes at room temperature.

**Make sure the samples are properly mixing in the wells.**

- 4 During the 30-minute incubation for capture, prewarm Wash Buffer 2 at 65°C as described below.
  - a Place 200-µl aliquots of Wash Buffer 2 in wells of a fresh 96-well plate or strip tubes. Aliquot 3 wells of buffer for each DNA sample in the run.
  - b Cap the wells with fresh domed caps and then incubate in the thermal cycler, with heated lid ON, held at 65°C until used in [step 10](#).
- 5 When the 30-minute incubation period initiated in [step 3](#) is complete, collect the liquid at the bottom of wells using the method appropriate for your labware:
  - For samples in strip tubes, spin the samples briefly.
  - For samples in 96-well plates, collect the liquid in the wells manually, using a swift, sharp flicking motion.

### CAUTION

Do not spin the streptavidin bead-bound DNA samples held in 96-well plates using a plate spinner or centrifuge during the wash steps. Spinning the 96-well plates can over-pack the streptavidin beads, preventing complete resuspension during the washes and can adversely impact sample recovery.

- 6 Put the plate or strip tube in a magnetic separator to collect the beads from the suspension. Wait 1 minute for the solution to clear, then remove and discard the supernatant.

### 3 Hybridization and Capture

#### Step 4. Capture the hybridized DNA using streptavidin-coated beads

- 7 Resuspend the beads in 200 µl of SureSelect Wash Buffer 1 (held at room temperature) by pipetting up and down 8 to 10 times.

**Make sure the beads are in suspension before proceeding.**

- 8 Seal the wells with fresh caps, then mix by vortexing at high speed for 8 seconds. Collect the liquid at the bottom of wells using the method appropriate for your labware (spinning for strip tubes or manual collection for 96-well plates).
- 9 Put the plate or strip tube in a magnetic separator. Wait 1 minute for the solution to clear, then remove and discard the supernatant.

#### CAUTION

Make sure that the Wash Buffer 2 is pre-warmed to 65°C before use in [step 10](#) below.

- 
- 10 **Remove the plate or strip tubes from the magnetic separator and transfer to a rack at room temperature.** Wash the beads with Wash Buffer 2, using the protocol steps below.

- a Resuspend the beads in 200 µl of 65°C prewarmed Wash Buffer 2. Pipette up and down at least 10 times to resuspend the beads.

**Make sure the beads are in suspension before proceeding.**

- b Seal the wells with fresh caps and then vortex at high speed for 5 seconds. Collect the liquid at the bottom of wells using the method appropriate for your labware (spinning for strip tubes or manual collection for 96-well plates).
  - c Incubate the samples for 10 minutes at 65°C on the SureCycler thermal cycler with the heated lid on.
  - d Put the plate or strip tube in the magnetic separator at room temperature.
  - e Wait 1 minute for the solution to clear, then remove and discard the supernatant.
  - f Repeat [step a](#) through [step e](#) two more times for a total of 3 washes.
- 11 After removing the supernatant from the final wash, spin the samples briefly, return the plate or tubes to the magnetic stand, and then remove any remaining wash buffer droplets.

## Step 4. Capture the hybridized DNA using streptavidin-coated beads

- 12** Add 23  $\mu$ l of nuclease-free water to each sample well. Place the capture plate or strip tube on ice until PCR reactions are set up on [page 49](#). Proceed to “[Indexing and Sample Processing for Multiplexed Sequencing](#)” on page 47.

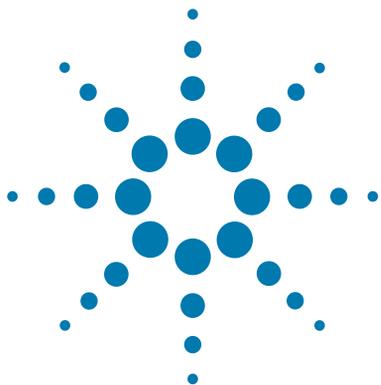
**NOTE**

Captured DNA is retained on the streptavidin beads during the post-capture amplification step. Do not separate the supernatant from the beads at this step.

---

### **3 Hybridization and Capture**

**Step 4. Capture the hybridized DNA using streptavidin-coated beads**



## 4 Indexing and Sample Processing for Multiplexed Sequencing

- Step 1. Amplify the captured libraries to add index tags 48
- Step 2. Purify the amplified captured libraries using AMPure XP beads 51
- Step 3. Assess indexed library DNA quantity and quality 53
- Step 4. Quantify each index-tagged library by QPCR (optional) 57
- Step 5. Pool samples for multiplexed sequencing 58
- Step 6. Prepare sequencing samples 60
- Step 7. Set up the sequencing run and trim adaptors from the reads 64

This chapter describes the steps to add index tags by amplification, and to purify and assess quality and quantity of the indexed libraries. Sample pooling instructions are provided to prepare the indexed samples for multiplexed sequencing, and guidelines are provided for downstream sequencing steps.



## 4 Indexing and Sample Processing for Multiplexed Sequencing

### Step 1. Amplify the captured libraries to add index tags

## Step 1. Amplify the captured libraries to add index tags

In this step, the SureSelect-enriched DNA libraries are PCR amplified using the appropriate pair of dual indexing primers.

### CAUTION

To avoid cross-contaminating libraries, set up PCR mixes in a dedicated clean area or PCR hood with UV sterilization and positive air flow.

This step uses the components listed in [Table 18](#). Thaw then vortex to mix the reagents listed below and keep on ice.

**Table 18** Reagents for post-capture indexing by PCR amplification

Kit Component	Storage Location	Where Used
Herculase II Fusion DNA Polymerase	SureSelect QXT Library Prep Kit Box 2, -20°C	<a href="#">page 49</a>
Herculase II 5× Reaction Buffer	SureSelect QXT Library Prep Kit Box 2, -20°C	<a href="#">page 49</a>
100 mM dNTP Mix (25 mM each dNTP)	SureSelect QXT Library Prep Kit Box 2, -20°C	<a href="#">page 49</a>
SureSelect QXT P7 and P5 dual indexing primers	SureSelect QXT Library Prep Kit Box 2, -20°C	<a href="#">page 49</a>

Prepare one indexing amplification reaction for each DNA library.

- 1 Determine the appropriate index assignments for each sample. See the [Reference](#) section for sequences of the index portion of the P7 and P5 indexing primers used to amplify the DNA libraries in this step (see [Table 34](#) and [Table 35](#) for sequencing on HiSeq and MiSeq platforms or see [Table 34](#) and [Table 36](#) for sequencing on the NextSeq platform).

Use a different indexing primer combination for each sample to be sequenced in the same lane.

### NOTE

For sample multiplexing, Agilent recommends maximizing index diversity on both P7 and P5 primers as required for color balance. For example, when 8-plexing, use eight different P7 index primers with two P5 index primers. See [Table 37](#) on page 73 and [Table 38](#) on page 74 for additional details.

- 2 Prepare the appropriate volume of PCR reaction mix, as described in [Table 19](#), on ice. Mix well on a vortex mixer.

**Table 19** Preparation of post-capture PCR Reaction mix

Reagent	Volume for 1 reaction	Volume for 16 reactions (includes excess)
Nuclease-free water	13.5 $\mu$ l	229.5 $\mu$ l
Herculase II 5 $\times$ Reaction Buffer	10 $\mu$ l	170 $\mu$ l
100 mM dNTP Mix (25 mM each dNTP)	0.5 $\mu$ l	8.5 $\mu$ l
Herculase II Fusion DNA Polymerase	1 $\mu$ l	17 $\mu$ l
<b>Total</b>	<b>25 <math>\mu</math>l</b>	<b>425 <math>\mu</math>l</b>

- 3 Obtain the plate or strip tube containing the bead-bound target-enriched DNA samples from ice. Add 25  $\mu$ l of the PCR reaction mix prepared in [step 2](#) to the 23- $\mu$ l of bead suspension in each sample well.
- 4 Add 1  $\mu$ l of the appropriate P7 dual indexing primer (P7 i1 to P7 i12) to each PCR reaction mixture well. Add only one of the twelve possible P7 primers to each reaction well.
- 5 Add 1  $\mu$ l of the appropriate P5 dual indexing primer (P5 i13 to P5 i20) to each PCR reaction mixture well. Add only one of the eight possible P5 primers to each reaction well.

## 4 Indexing and Sample Processing for Multiplexed Sequencing

### Step 1. Amplify the captured libraries to add index tags

- 6 Mix well by pipetting to ensure the beads are fully resuspended, then transfer the PCR plate or strip tube to a thermal cycler and run the PCR amplification program shown in [Table 20](#).

**Table 20** Post-Capture PCR cycling program

Segment	Number of Cycles	Temperature	Time
1	1	98°C	2 minutes
2	Capture Libraries >3 Mb: 10 Cycles	98°C	30 seconds
	Capture Libraries 1 to 3 Mb: 12 Cycles	58°C	30 seconds
	Capture Libraries <1 Mb: 14 Cycles	72°C	1 minute
3	1	72°C	5 minutes
4	1	4°C	Hold

- 7 When the PCR amplification program is complete, spin the plate or strip tube briefly. Remove the streptavidin-coated beads by placing the plate or strip tube on the magnetic stand at room temperature. Wait 2 minutes for the solution to clear, then remove each supernatant (approximately 50 µl) to wells of a fresh plate or strip tube.  
The beads can be discarded at this time.

## Step 2. Purify the amplified captured libraries using AMPure XP beads

- 1 Let the AMPure XP beads come to room temperature for at least 30 minutes. *Do not freeze the beads at any time.*
- 2 Prepare 400  $\mu\text{l}$  of fresh 70% ethanol per sample, plus excess, for use in [step 8](#).
- 3 Mix the AMPure XP bead suspension well so that the suspension appears homogeneous and consistent in color.
- 4 Add 60  $\mu\text{l}$  of the homogeneous AMPure XP bead suspension to each 50- $\mu\text{l}$  amplified DNA sample in the PCR plate or strip tube. Seal the wells with fresh caps, then vortex for 5 seconds. Briefly spin the samples to collect the liquid, without pelleting the beads.  
  
Check that the beads are in a homogeneous suspension in the sample wells. Each well should have a uniform color with no layers of beads or clear liquid present.
- 5 Incubate samples for 5 minutes at room temperature.
- 6 Put the plate or strip tube on the magnetic stand at room temperature. Wait for the solution to clear (approximately 3 to 5 minutes).
- 7 While keeping the plate or tubes in the magnetic stand, carefully remove and discard the cleared solution from each well. Do not disturb the beads while removing the solution.
- 8 Continue to keep the plate or tubes in the magnetic stand while you dispense 200  $\mu\text{l}$  of fresh 70% ethanol in each sample well.
- 9 Wait for 1 minute to allow any disturbed beads to settle, then remove the ethanol.
- 10 Repeat [step 8](#) and [step 9](#) once for a total of two washes. Make sure to remove all of the ethanol at each wash step.
- 11 Dry the samples on the thermal cycler (with lid open) at 37°C for 1 to 3 minutes. Do not overdry the samples.
- 12 Add 25  $\mu\text{l}$  of nuclease-free water to each sample well.
- 13 Seal the sample wells, then mix well on a vortex mixer and briefly spin the plate to collect the liquid.
- 14 Incubate for 2 minutes at room temperature.
- 15 Put the plate in the magnetic stand and leave for 2 minutes or until the solution is clear.

#### 4 Indexing and Sample Processing for Multiplexed Sequencing

##### Step 2. Purify the amplified captured libraries using AMPure XP beads

**16** Remove the cleared supernatant (approximately 25  $\mu$ l) to a fresh LoBind tube. You can discard the beads at this time.

**Stopping Point** If you do not continue to the next step, store the libraries at  $-20^{\circ}\text{C}$ .

## Step 3. Assess indexed library DNA quantity and quality

### Option 1: Analysis using the Agilent 2100 Bioanalyzer and High Sensitivity DNA Assay

Use the Bioanalyzer High Sensitivity DNA Assay to analyze the amplified indexed DNA. See the *High Sensitivity DNA Kit Guide* at [www.genomics.agilent.com](http://www.genomics.agilent.com) for more information on doing this step.

- 1 Set up the 2100 Bioanalyzer as instructed in the reagent kit guide.
- 2 Prepare the chip, samples and ladder as instructed in the reagent kit guide, using 1  $\mu$ l of each sample for the analysis.
- 3 Load the prepared chip into the 2100 Bioanalyzer and start the run within five minutes after preparation.
- 4 Verify that the electropherogram shows the peak of DNA fragment size positioned between 325 and 450 bp. A sample electropherogram is shown in [Figure 4](#).
- 5 Measure the concentration of each library by integrating under the entire peak. For accurate quantification, make sure that the concentration falls within the linear range of the assay.

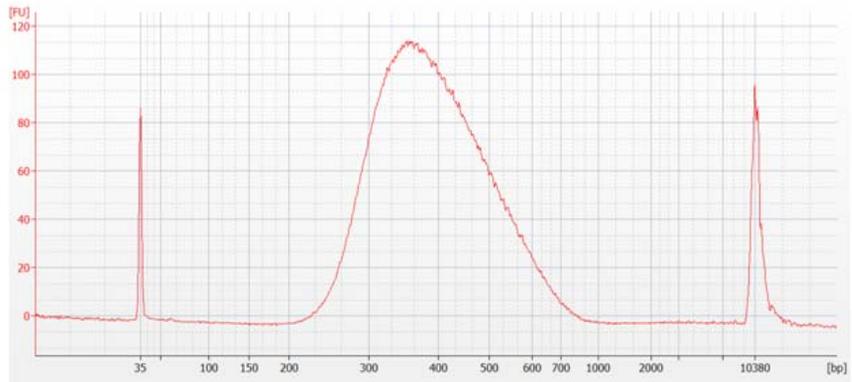
If you wish to more-precisely quantify the target enriched samples prior to pooling, proceed to “[Step 4. Quantify each index-tagged library by QPCR \(optional\)](#)” on page 57.

Otherwise, proceed to “[Step 5. Pool samples for multiplexed sequencing](#)” on page 58.

**Stopping Point** If you do not continue to the next step, store the libraries at 4°C overnight or at -20°C for prolonged storage.

#### 4 Indexing and Sample Processing for Multiplexed Sequencing

Step 3. Assess indexed library DNA quantity and quality



**Figure 4** Post-capture analysis of amplified indexed library DNA using the 2100 Bioanalyzer and a High Sensitivity DNA Assay.

**Option 2: Analysis using an Agilent TapeStation and High Sensitivity D1000 ScreenTape**

Use a High Sensitivity D1000 ScreenTape (p/n 5067-5584) and reagent kit (p/n 5067-5585) to analyze the amplified indexed DNA using the Agilent 4200 TapeStation or 2200 TapeStation. For more information to do this step, see the appropriate TapeStation user manual at [www.genomics.agilent.com](http://www.genomics.agilent.com).

- 1 Prepare the TapeStation samples as instructed in the instrument user manual. Use 2  $\mu$ l of each indexed DNA sample diluted with 2  $\mu$ l of High Sensitivity D1000 sample buffer for the analysis.

**CAUTION**

Make sure that you thoroughly mix the combined DNA and sample buffer on a vortex mixer for 5 seconds for accurate quantitation.

- 2 Load the sample plate or tube strips from [step 1](#), the High Sensitivity D1000 ScreenTape, and loading tips into the TapeStation as instructed in the instrument user manual. Start the run.
- 3 Verify that the electropherogram shows the peak of DNA fragment size positioned between 325 and 450 bp. A sample electropherogram is shown in [Figure 5](#).
- 4 Measure the concentration of each library by integrating under the entire peak.

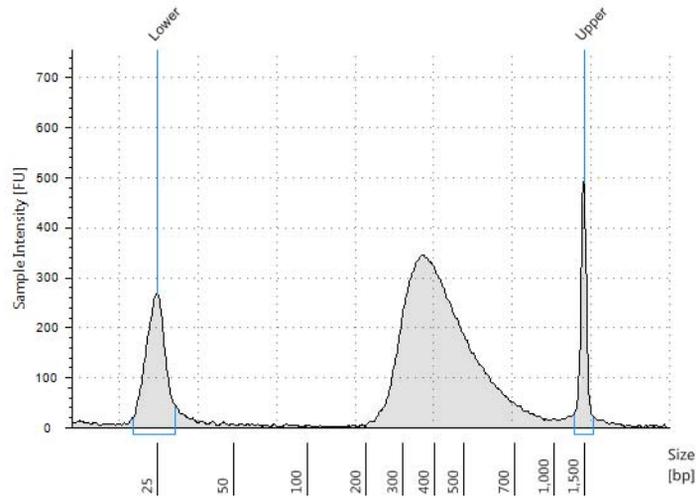
If you wish to more-precisely quantify the target enriched samples prior to pooling, proceed to “[Step 4. Quantify each index-tagged library by QPCR \(optional\)](#)” on page 57.

Otherwise, proceed to “[Step 5. Pool samples for multiplexed sequencing](#)” on page 58.

**Stopping Point**

If you do not continue to the next step, store the libraries at 4°C overnight or at -20°C for up to one month.

**4 Indexing and Sample Processing for Multiplexed Sequencing**  
**Step 3. Assess indexed library DNA quantity and quality**



**Figure 5** Post-capture analysis of amplified indexed library DNA using the 2200 TapeStation with a High Sensitivity D1000 ScreenTape.

## Step 4. Quantify each index-tagged library by QPCR (optional)

You can use the Agilent QPCR NGS Library Quantification Kit (for Illumina) to accurately determine the concentration of each index-tagged captured library. Refer to the protocol that is included with the Agilent QPCR NGS Library Quantification Kit (p/n G4880A) for more details to do this step.

- 1 Prepare a standard curve using the quantification standard included in the kit, according to the instructions provided in the user guide.
- 2 Dilute each index-tagged captured library such that it falls within the range of the standard curve.

Typically this corresponds to approximately a 1:1000 to 1:10,000 dilution of the captured DNA.

- 3 Prepare the QPCR master mix with Illumina adaptor-specific PCR primers according to instructions provided in the kit.
- 4 Add an aliquot of the master mix to PCR tubes and add template.
- 5 On a QPCR system, such as the Mx3005p, run the thermal profile outlined in the QPCR NGS Library Quantification kit user guide. Use the SYBR Green instrument setting.
- 6 Use the standard curve to determine the concentration of each unknown index-tagged library, in nM.

## Step 5. Pool samples for multiplexed sequencing

The number of indexed libraries that may be multiplexed in a single sequencing lane is determined by the output specifications of the platform used, together with the amount of sequencing data required for your research design. Calculate the number of indexes that can be combined per lane, according to the capacity of your platform and the amount of sequencing data required per sample.

Guidelines for optimal low-level multiplexing of samples indexed using the SureSelect<sup>QXT</sup> dual indexes are provided on [page 73](#).

- 1 Combine the libraries such that each index-tagged sample is present in equimolar amounts in the pool. For each library, use the formula below to determine the amount of indexed sample to use.

$$\text{Volume of Index} = \frac{V(f) \times C(f)}{\# \times C(i)}$$

where  $V(f)$  is the final desired volume of the pool,

$C(f)$  is the desired final concentration of all the DNA in the pool

$\#$  is the number of indexes, and

$C(i)$  is the initial concentration of each indexed sample.

[Table 21](#) shows an example of the amount of 4 index-tagged samples (of different concentrations) and Low TE needed for a final volume of 20  $\mu$ l at 10 nM.

**Table 21** Example of indexed sample volume calculation for total volume of 20  $\mu$ l

Component	V(f)	C(i)	C(f)	#	Volume to use ( $\mu$ l)
Sample 1	20 $\mu$ l	20 nM	10 nM	4	2.5
Sample 2	20 $\mu$ l	10 nM	10 nM	4	5
Sample 3	20 $\mu$ l	17 nM	10 nM	4	2.9
Sample 4	20 $\mu$ l	25 nM	10 nM	4	2
Low TE					7.6

- 2 Adjust the final volume of the pooled library to the desired final concentration.

- If the final volume of the combined index-tagged samples is less than the desired final volume,  $V(f)$ , add Low TE to bring the volume to the desired level.
  - If the final volume of the combined index-tagged samples is greater than the final desired volume,  $V(f)$ , lyophilize and reconstitute to the desired volume.
- 3** If you store the library before sequencing, add Tween 20 to 0.1% v/v and store at  $-20^{\circ}\text{C}$  short term.

## Step 6. Prepare sequencing samples

The optimal seeding concentration for SureSelect<sup>QXT</sup> target-enriched libraries is 8 to 12 pM on HiSeq or MiSeq instruments and 1.2 to 1.4 pM on the NextSeq platform. Seeding concentration and cluster density may also need to be optimized based on the DNA fragment size range for the library and on the desired output and data quality. Follow Illumina's recommendation for a PhiX control in a low-concentration spike-in for improved sequencing quality control.

Proceed to cluster amplification using the appropriate Illumina Paired-End Cluster Generation Kit. See [Table 22](#) for kit configurations compatible with the recommended read length plus reads for the SureSelect<sup>QXT</sup> 8-bp dual indexes. To do this step, refer to the manufacturer's instructions, using the modifications described in ["Using the SureSelect<sup>QXT</sup> Read Primers with Illumina's Paired-End Cluster Generation Kits"](#) on page 61.

**Table 22** Illumina Kit Configuration Selection Guidelines

Platform	Run Type	Read Length <sup>*</sup>	SBS Kit Configuration	Chemistry
HiSeq 2500	Rapid Run	2 × 100 bp	200 Cycle Kit	v1 or v2
HiSeq 2500	High Output	2 × 100 bp	4 × 50 Cycle Kit <sup>†</sup>	v3
HiSeq 2500	High Output	2 × 100 bp	250 Cycle Kit	v4
HiSeq 2000	All Runs	2 × 100 bp	4 × 50 Cycle Kit <sup>†</sup>	v3
MiSeq	All Runs	2 × 100 bp	300 Cycle Kit	v2
MiSeq	All Runs	2 × 76 bp	150 Cycle Kit	v3
NextSeq 500	All Runs	2 × 100 bp	300 Cycle Kit	v2

\* If your application requires a different read length, verify that you have sufficient sequencing reagents to complete Reads 1 and 2 in addition to the dual 8-bp index reads.

† A single 200-cycle kit does not include enough reagents to complete Reads 1 and 2 in addition to the dual 8-bp index reads in this format. If preferred, the additional reads may be supported by using one 200-cycle kit plus one 50-cycle kit.

### Using the SureSelect<sup>QXT</sup> Read Primers with Illumina's Paired-End Cluster Generation Kits

To sequence the SureSelect<sup>QXT</sup> libraries on Illumina's sequencing platforms, you need to use the following custom sequencing primers, provided in SureSelect QXT Library Prep Kit Box 2:

- SureSelect QXT Read Primer 1
- SureSelect QXT Read Primer 2
- SureSelect QXT Index Read Primer
- SureSelect QXT Index 2 Read Primer NSQ (NextSeq platform only)

These SureSelect<sup>QXT</sup> custom sequencing primers are provided at 100  $\mu\text{M}$  and must be diluted 1:200 in the corresponding Illumina primer solution, using the platform-specific instructions below:

**For the HiSeq platform**, combine the primers as shown in [Table 23](#) or [Table 24](#) on [page 62](#).

**For the MiSeq platform**, combine the primers as shown in [Table 25](#) on [page 62](#).

**For the NextSeq platform**, combine the primers as shown in [Table 26](#) or [Table 27](#) on [page 63](#).

#### NOTE

It is important to combine the primers precisely in the indicated ratios. Be sure to use measured volumes of each solution; do not use volumes reported on vial labels when preparing the mixtures. Vortex each mixture vigorously to ensure homogeneity for proper detection of the indexes using the custom read primers.

## 4 Indexing and Sample Processing for Multiplexed Sequencing

### Step 6. Prepare sequencing samples

**Table 23 HiSeq2000 and HiSeq 2500 High Output custom sequencing primer preparation**

Sequencing Read	Volume of SureSelect <sup>QXT</sup> Primer	Volume of Illumina TruSeq Primer	Total Volume
Read 1	5 µl SureSelect QXT Read Primer 1 (brown cap)	995 µl HP6 or HP10	1 ml*
Index	15 µl SureSelect QXT Index Read Primer (clear cap)	2985 µl HP8 or HP12	3 ml
Read 2	15 µl SureSelect QXT Read Primer 2 (black cap)	2985 µl HP7 or HP11	3 ml

\* Aliquot the mixture as directed for HP6 or HP10 in Illumina's cluster generation protocol.

**Table 24 HiSeq 2500 Rapid Mode custom sequencing primer preparation**

Sequencing Read	Volume of SureSelect <sup>QXT</sup> Primer	Volume of Illumina TruSeq Primer	Total Volume
Read 1	8.8 µl SureSelect QXT Read Primer 1 (brown cap)	1741.2 µl HP10	1.75 ml*
Index	8.8 µl SureSelect QXT Index Read Primer (clear cap)	1741.2 µl HP12	1.75 ml
Read 2	8.8 µl SureSelect QXT Read Primer 2 (black cap)	1741.2 µl HP11	1.75 ml

\* Aliquot the mixture as directed for HP10 in Illumina's cluster generation protocol.

**Table 25 MiSeq platform custom sequencing primer preparation**

Sequencing Read	Volume of SureSelect <sup>QXT</sup> Primer	Volume of Illumina TruSeq Primer	Total Volume	Final Cartridge Position
Read 1	3 µl SureSelect QXT Read Primer 1 (brown cap)	597 µl HP10 (well 12)	0.6 ml	well 18
Index	3 µl SureSelect QXT Index Read Primer (clear cap)	597 µl HP12 (well 13)	0.6 ml	well 19
Read 2	3 µl SureSelect QXT Read Primer 2 (black cap)	597 µl HP11 (well 14)	0.6 ml	well 20

**Table 26** NextSeq 500/550 High-Output v2 Kit custom sequencing primer preparation

Sequencing Read	Volume of SureSelect <sup>QXT</sup> Primer	Volume of Illumina Primer	Total Volume	Final Cartridge Position
Read 1	3.9 µl SureSelect QXT Read Primer 1 (brown cap)	1296.1 µl BP10 (from well 20)	1.3 ml	well 7
Read 2	4.2 µl SureSelect QXT Read Primer 2 (black cap)	1395.8 µl BP11 (from well 21)	1.4 ml	well 8
Index + Index 2	6 µl SureSelect QXT Index Read Primer (clear cap) + 6 µl SureSelect QXT Index 2 Read Primer NSQ (purple cap)	1988 µl BP14 (from well 22)	2 ml	well 9

**Table 27** NextSeq 500/550 Mid-Output v2 Kit custom sequencing primer preparation

Sequencing Read	Volume of SureSelect <sup>QXT</sup> Primer	Volume of Illumina Primer	Total Volume	Final Cartridge Position
Read 1	2.7 µl SureSelect QXT Read Primer 1 (brown cap)	897.3 µl BP10 (from well 20)	0.9 ml	well 7
Read 2	3.3 µl SureSelect QXT Read Primer 2 (black cap)	1096.7 µl BP11 (from well 21)	1.1 ml	well 8
Index + Index 2	4.8 µl SureSelect QXT Index Read Primer (clear cap) + 4.8 µl SureSelect QXT Index 2 Read Primer NSQ (purple cap)	1590.4 µl BP14 (from well 22)	1.6 ml	well 9

## Step 7. Set up the sequencing run and trim adaptors from the reads

Refer to Illumina protocols to set up custom sequencing primer runs, using the additional guidelines outlined below.

For SureSelect<sup>QXT</sup> dual index sequence information, see tables on [page 71](#).

Before aligning reads to the reference genome, SureSelect<sup>QXT</sup> adaptor sequences must be trimmed from the reads. You can use SureCall, Agilent's NGS data analysis software, to perform adaptor trimming, alignment of reads and variant calling of sequencing data generated from either the HiSeq or the MiSeq platform. To download SureCall free-of-charge and for additional information, including tutorials on this software, visit the [SureCall page at www.genomics.agilent.com](http://www.genomics.agilent.com).

SureCall is compatible with FASTQ files generated by both the HiSeq and MiSeq platforms. To use SureCall to analyze SureSelect<sup>QXT</sup>-generated data, you first need to define an analysis workflow. This analysis workflow identifies the libraries as SureSelect<sup>QXT</sup> libraries and enables automated adaptor trimming. The trimmed FASTQ files can then be used for alignment to generate BAMs for downstream analysis.

To create the analysis workflow, refer to [Figure 6 on page 65](#). Upon starting SureCall, click the **Analysis Workflow** tab. Choose the appropriate analysis type (single sample, paired, or trio analysis), and then click the **Import Unaligned Files** button. Within the *Select Unaligned Sample Files* window, specify your read 1 and read 2 files using the **Add** buttons. Using the menus near the bottom of the screen, select **Default SureSelect QXT Method** from the *Analysis Method* menu, choose the appropriate design description from the *Design* menu, and select **Illumina** from the *Platform* menu. Once done, refer to the SureCall guide for next steps on alignment and variant calling.

If using another pipeline for alignment and downstream analysis, refer to the platform-specific guidelines starting on [page 65](#).

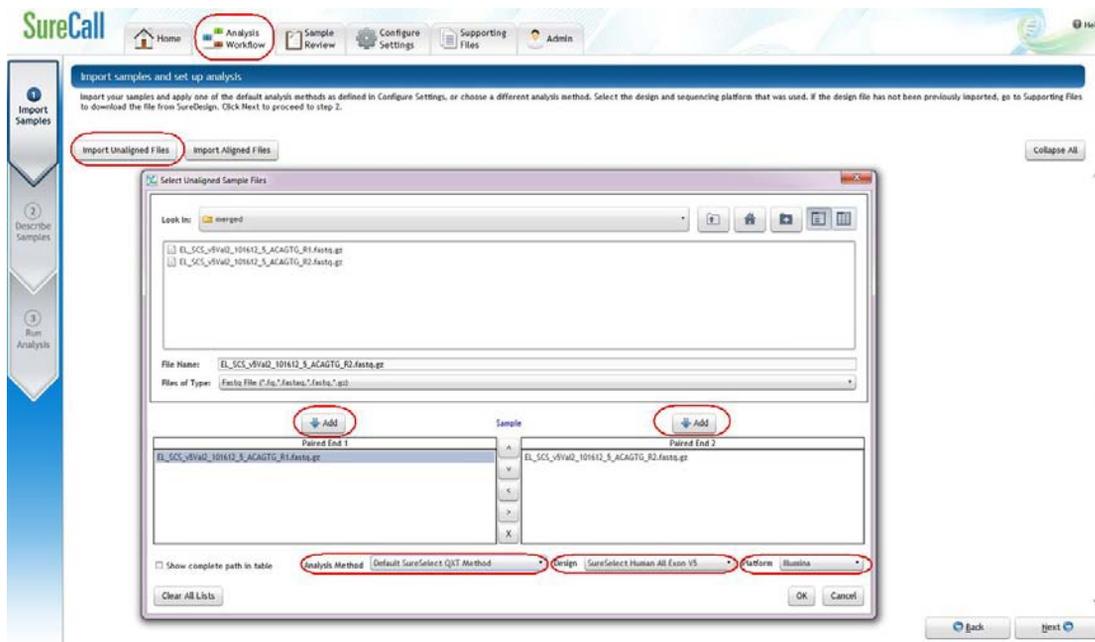


Figure 6 Analysis workflow setup in SureCall.

### MiSeq platform sequencing run setup and adaptor trimming guidelines

Use the Illumina Experiment Manager (IEM) software to generate a custom primer Sample Sheet.

Set up the run to include adaptor trimming using the IEM Sample Sheet Wizard. When prompted by the wizard, select the *Use Adaptor Trimming* option, and specify **CTGTCCTTGATCACA** as the adaptor sequence. This enables the MiSeq Reporter software to identify the adaptor sequence and trim the adaptor from reads.

### HiSeq or NextSeq 500 platform sequencing run setup and adaptor trimming guidelines

Set up sequencing runs using the *Custom* setting. Since custom primers are spiked into the standard sequencing primer tubes, no additional specialized settings are required to accommodate the use of custom primers in the run.

## 4 Indexing and Sample Processing for Multiplexed Sequencing

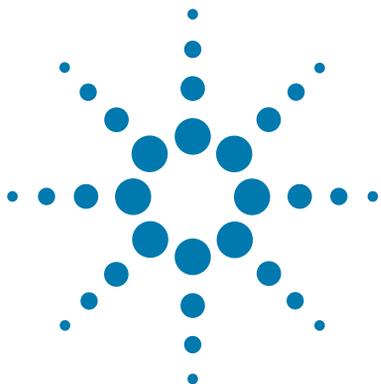
### Step 7. Set up the sequencing run and trim adaptors from the reads

Use the *Cycles* settings shown in [Table 28](#). Cycle number settings can be specified on the *Run Configuration* screen of the instrument control software interface after choosing *Custom* from the index type selection buttons.

**Table 28** Run Configuration screen Cycle Number settings

Run Segment	Cycle Number
Read 1	100
Index 1 (i7)	8
Index 2 (i5)	8
Read 2	100

After the sequencing run is complete, generate demultiplexed FASTQ data following Illumina's instructions and then trim adaptor sequences from the reads using Agilent's Read Trimmer tool. This tool takes in data in FASTQ format and removes the adaptor sequence from the ends of the sequencing reads, generating trimmed FASTQ data as output. To download the Read Trimmer tool free-of-charge and for additional information on this resource, visit [www.agilent.com/genomics](http://www.agilent.com/genomics).



## 5 Reference

Kit Contents	68
Nucleotide Sequences of SureSelect <sup>OXT</sup> Dual Indexes	71
Guidelines for Multiplexing with Dual-Indexed Samples	73
Quick Reference Guide to SureSelect Protocol Differences	75

This chapter contains reference information, including component kit contents and reference information for use during the downstream sample sequencing steps.



## Kit Contents

SureSelect<sup>QXT</sup> Reagent Kits contain the following component kits:

**Table 29** SureSelect<sup>QXT</sup> Reagent Kit Contents

Component Kits	Storage Condition	HiSeq or MiSeq (ILM) 16 Samples	HiSeq or MiSeq (ILM) 96 Samples	NextSeq (NSQ) 16 Samples	NextSeq (NSQ) 96 Samples
SureSelect QXT Library Prep Kit, Box 2 <sup>*</sup>	-20°C	5500-0120	5500-0121	5500-0126	5500-0127
SureSelect QXT Target Enrichment Kit, ILM Hyb Module, Box 1	Room Temperature	5190-7333	5190-7335	5190-7333	5190-7335
SureSelect QXT Target Enrichment Kit, ILM Hyb Module, Box 2	-20°C	5190-7332	5190-7334	5190-7332	5190-7334

\* SureSelect QXT Library Prep Kit, ILM, Box 1 is not required for the workflow described in this manual.

The contents of each of the component kits listed in [Table 29](#) are described in [Table 30](#) to [Table 33](#) below.

**Table 30** SureSelect QXT Library Prep, ILM, Box 2 Content

Kit Component	16 Reactions (p/n 5500-0120)	96 Reactions (p/n 5500-0121)
SureSelect QXT Buffer	tube with white cap	bottle
SureSelect QXT Enzyme Mix ILM	tube with orange cap	tube with orange cap
Herculase II Fusion DNA Polymerase	tube with red cap	tube with red cap
Herculase II 5× Reaction Buffer	tube with clear cap	tube with clear cap
100 mM dNTP Mix (25 mM each dNTP)	tube with green cap	tube with green cap
DMSO	tube with green cap	tube with green cap
SureSelect QXT Read Primer 1	tube with amber cap	tube with amber cap
SureSelect QXT Read Primer 2	tube with black cap	tube with black cap
SureSelect QXT Index Read Primer	tube with clear cap	tube with clear cap
SureSelect QXT P7 dual indexing primers	P7 i1 through P7 i8 provided in 8 tubes with yellow caps (one tube per primer)	P7 i1 through P7 i12 provided in 12 tubes with yellow caps (one tube per primer)
SureSelect QXT P5 dual indexing primers	P5 i13 and P5 i14 provided in 2 tubes with blue caps (one tube per primer)	P5 i13 through P5 i20 provided in 8 tubes with blue caps (one tube per primer)

**Table 31** SureSelect QXT Library Prep, NSQ, Box 2 Content

Kit Component	16 Reactions (p/n 5500-0126)	96 Reactions (p/n 5500-0127)
SureSelect QXT Buffer	tube with white cap	bottle
SureSelect QXT Enzyme Mix ILM	tube with orange cap	tube with orange cap
Herculase II Fusion DNA Polymerase	tube with red cap	tube with red cap
Herculase II 5× Reaction Buffer	tube with clear cap	tube with clear cap
100 mM dNTP Mix (25 mM each dNTP)	tube with green cap	tube with green cap
DMSO	tube with green cap	tube with green cap
SureSelect QXT Read Primer 1	tube with amber cap	tube with amber cap
SureSelect QXT Read Primer 2	tube with black cap	tube with black cap
SureSelect QXT Index Read Primer	tube with clear cap	tube with clear cap
SureSelect QXT Index 2 Read Primer NSQ	tube with purple cap	tube with purple cap
SureSelect QXT P7 dual indexing primers	P7 i1 through P7 i8 provided in 8 tubes with yellow caps (one tube per primer)	P7 i1 through P7 i12 provided in 12 tubes with yellow caps (one tube per primer)
SureSelect QXT P5 dual indexing primers	P5 i13 and P5 i14 provided in 2 tubes with blue caps (one tube per primer)	P5 i13 through P5 i20 provided in 8 tubes with blue caps (one tube per primer)

**Table 32** SureSelect QXT Hyb Module Box 1 Content

Kit Component	16 Reactions	96 Reactions
SureSelect QXT Stop Solution	bottle	bottle
SureSelect Binding Buffer	bottle	bottle
SureSelect Wash Buffer 1	bottle	bottle
SureSelect Wash Buffer 2*	bottle	bottle

\* This component may be labeled as *SureSelect Wash Buffer 2* or *SureSelect QXT Fast Wash Buffer 2*. Vials labeled with either name may be used in the target enrichment protocol.

## 5 Reference

### Kit Contents

**Table 33** SureSelect QXT Hyb Module Box 2 Content

<b>Kit Component</b>	<b>16 Reactions</b>	<b>96 Reactions</b>
SureSelect Fast Hybridization Buffer*	bottle	bottle
SureSelect QXT Fast Blocker Mix	tube with blue cap	tube with blue cap
SureSelect QXT Primer Mix	tube with clear cap	tube with clear cap
SureSelect RNase Block	tube with purple cap	tube with purple cap

\* This component may be labeled as *SureSelect Fast Hybridization Buffer* or *SureSelect QXT Fast Hybridization Buffer*. Vials labeled with either name may be used in the target enrichment protocol.

## Nucleotide Sequences of SureSelect<sup>QXT</sup> Dual Indexes

The nucleotide sequence of each SureSelect<sup>QXT</sup> index is provided in the tables below.

Note that some index number assignments of the SureSelect<sup>QXT</sup> P5 and P7 indexes differ from the index number assignments used by Illumina for indexes of similar or identical sequence.

Each index is 8 bases in length. Refer to Illumina’s sequencing run setup instructions for sequencing libraries using 8-base indexes.

**Table 34** SureSelect<sup>QXT</sup> P7 Indexes 1 to 12

Index Number	Sequence
P7 Index 1 (P7 i1)	TAAGGCGA
P7 Index 2 (P7 i2)	CGTACTAG
P7 Index 3 (P7 i3)	AGGCAGAA
P7 Index 4 (P7 i4)	TCCTGAGC
P7 Index 5 (P7 i5)	GTAGAGGA
P7 Index 6 (P7 i6)	TAGGCATG
P7 Index 7 (P7 i7)	CTCTCTAC
P7 Index 8 (P7 i8)	CAGAGAGG
P7 Index 9 (P7 i9)	GCTACGCT
P7 Index 10 (P7 i10)	CGAGGCTG
P7 Index 11 (P7 i11)	AAGAGGCA
P7 Index 12 (P7 i12)	GGACTCCT

## 5 Reference

### Nucleotide Sequences of SureSelect<sup>OXT</sup> Dual Indexes

**Table 35** SureSelect<sup>OXT</sup> P5 Indexes 13 to 20 for HiSeq platform, MiSeq platform, or NextSeq platform runs through BaseSpace

Index Number	Sequence
P5 Index 13 (P5 i13)	TAGATCGC
P5 Index 14 (P5 i14)	CTCTCTAT
P5 Index 15 (P5 i15)	TATCCTCT
P5 Index 16 (P5 i16)	AGAGTAGA
P5 Index 17 (P5 i17)	GTAAGGAG
P5 Index 18 (P5 i18)	ACTGCATA
P5 Index 19 (P5 i19)	AAGGAGTA
P5 Index 20 (P5 i20)	CTAAGCCT

**Table 36** SureSelect<sup>OXT</sup> P5 Indexes 13 to 20 for NextSeq platform\*

Index Number	Sequence
P5 Index 13 (P5 i13)	GCGATCTA
P5 Index 14 (P5 i14)	ATAGAGAG
P5 Index 15 (P5 i15)	AGAGGATA
P5 Index 16 (P5 i16)	TCTACTCT
P5 Index 17 (P5 i17)	CTCCTTAC
P5 Index 18 (P5 i18)	TATGCAGT
P5 Index 19 (P5 i19)	TACTCCTT
P5 Index 20 (P5 i20)	AGGCTTAG

\* When doing NextSeq runs through BaseSpace, use the reverse complement sequences provided in [Table 35](#).

## Guidelines for Multiplexing with Dual-Indexed Samples

Agilent recommends following the dual index sample pooling guidelines shown in [Table 37](#) for 16 reaction kits and shown in [Table 38](#) for 96 reaction kits. These are designed to maintain color balance at each cycle of the index reads on both ends. They also provide flexibility of demultiplexing as single or dual indexed samples in low-plexity experiments. One-base mismatches should also be allowed during demultiplexing in order to maximize sequencing output per sample.

**Table 37** Dual index sample pooling guidelines for 16 Reaction Kits

Plexity of Sample Pool	Recommended SureSelect <sup>QXT</sup> P7 Indexes	Recommended SureSelect <sup>QXT</sup> P5 Indexes
1-plex	Any P7 index (i1 to i8)	Either P5 index (i13 or i14)
2-plex	P7 i1 and P7 i2 OR P7 i2 and P7 i4	P5 i13 and P5 i14
3-plex	P7 i1, P7 i2 and P7 i4 OR P7 i3, P7 i4 and P7 i6 OR P7 i5, P7 i7 and P7 i8	P5 i13 and P5 i14 (as needed)
4- or 5-plex	P7 i1, P7 i2, P7 i4 and any additional P7 index(es) OR P7 i3, P7 i4, P7 i6 and any additional P7 index(es) OR P7 i5, P7 i7, P7 i8 and any additional P7 index(es)	P5 i13 and P5 i14 (as needed)
6- to 8-plex	Any combination of 6, 7, or 8 different P7 indexes	P5 i13 and P5 i14 (as needed)
9-to 16-plex	All eight P7 indexes (i1 to i8)	P5 i13 and P5 i14 (as needed)

## 5 Reference

### Guidelines for Multiplexing with Dual-Indexed Samples

**Table 38** Dual index sample pooling guidelines for 96 Reaction Kits

Plexity of Sample Pool	Recommended SureSelect <sup>QXT</sup> P7 Indexes	Recommended SureSelect <sup>QXT</sup> P5 Indexes
1-plex	Any P7 index i1 to i11	Any P5 index (i13 to i20)
2-plex	P7 i1 and P7 i2 OR P7 i2 and P7 i4	P5 i13 and P5 i14 OR P5 i15 and P5 i16 OR P5 i17 and P5 i18
3-plex	P7 i1, P7 i2 and P7 i4 OR P7 i3, P7 i4 and P7 i6 OR P7 i5, P7 i7 and P7 i8	P5 i13 and P5 i14 OR P5 i15 and P5 i16 OR P5 i17 and P5 i18 (as needed)
4-plex	P7 i1, P7 i2, P7 i3* and P7 i4 OR P7 i3, P7 i4, P7 i5* and P7 i6 OR P7 i5, P7 i6*, P7 i7 and P7 i8	P5 i13 and P5 i14 OR P5 i15 and P5 i16 OR P5 i17 and P5 i18 (as needed)
5-plex	P7 i1, P7 i2, P7 i3*, P7 i4 and P7 i5* OR P7 i3, P7 i4, P7 i5*, P7 i6 and p7 i7* OR P7 i5, P7 i6*, P7 i7, P7 i8 and p7 i9*	P5 i13 and P5 i14 OR P5 i15 and P5 i16 OR P5 i17 and P5 i18 (as needed)
6- to 11-plex	Any combination of P7 indexes i1 to i11 using each index only once	P5 i13 and P5 i14 OR P5 i15 and P5 i16 OR P5 i17 and P5 i18 (as needed)
12-to 88-plex	Any combination of P7 indexes i1 to i11 (as needed)	P5 i13 and P5 i14 and any third P5 index OR P5 i15 and P5 i16 and any third P5 index OR P5 i17 and P5 i18 and any third P5 index (as needed)
89-to 96-plex	All twelve P7 indexes (i1 to i12)	Any P5 indexes (i13 to i20, as needed)

\* The indicated indexes may be substituted with another index within range of P7 i1 to P7 i11, as long as the substitute index differs from all others used in the sample pool.

## Quick Reference Guide to SureSelect Protocol Differences

Key differences between the SureSelect<sup>QXT</sup>, SureSelect<sup>XT</sup>, and SureSelect<sup>XT2</sup> protocols are summarized below.

**Table 39** SureSelect protocol differences

Step/Feature	SureSelect <sup>QXT</sup>	SureSelect <sup>XT</sup>	SureSelect <sup>XT2</sup>
<b>Library Prep</b>			
DNA fragmentation	Transposase-mediated	Mechanical shearing (Covaris)	Mechanical shearing (Covaris)
Library Prep DNA input	50 ng	3 µg or 200 ng	1 µg or 100 ng
Library Prep steps	<ul style="list-style-type: none"> <li>• Fragmentation and adaptor tagging in single step</li> <li>• PCR</li> </ul>	<ul style="list-style-type: none"> <li>• End repair</li> <li>• dA-tailing</li> <li>• Ligation</li> <li>• PCR</li> </ul>	<ul style="list-style-type: none"> <li>• End repair</li> <li>• Sequential dA-tailing and ligation</li> <li>• PCR</li> </ul>
Number of AMPure XP purifications during Library Prep	2	5 (4 for low input protocol)	3
<b>Hybridization/Capture</b>			
Hyb DNA input	750–1500 ng for >3 Mb 500–750 ng for ≤3 Mb	750 ng for all capture sizes	1500 ng total (pools of 8 or 16 indexed samples) for all capture sizes
Indexing	Dual index (post-capture)	Single index (post-capture)	Single index (pre-capture)
Library pooling	Post-capture	Post-capture	Pre-capture (pools of 16 for captures ≤24 Mb or of 8 for exome captures); post-capture pooling optional
Hybridization buffer	1 tube	4 tubes	1 tube
Blocker	1 tube	3 tubes	1 tube
Hybridization mix preparation temperature	Hyb buffer + capture library mixed at RT	Hyb buffer + capture library mixed at RT	Hyb buffer + capture library mixed on ice
Hybridization protocol	Thermal cycling (90 minutes) using 60 cycles of 3 sec @37°C and 60 sec @65°C	Constant temperature (65°C) for 16 or 24 hours	Constant temperature (65°C) for 16 or 24 hours

## 5 Reference

### Quick Reference Guide to SureSelect Protocol Differences

**Table 39** SureSelect protocol differences

Step/Feature	SureSelect <sup>0XT</sup>	SureSelect <sup>XT</sup>	SureSelect <sup>XT2</sup>
Streptavidin bead addition conditions	Hybridization mixture transferred to RT and then added to beads	Hybridization mixture held at 65°C while added to beads	Hybridization mixture held at 65°C while added to beads
Number of capture washes	1 × Wash 1 3 × Wash 2	1 × Wash 1 3 × Wash 2	1 × Wash 1 6 × Wash 2

[www.agilent.com](http://www.agilent.com)

## In This Book

This guide contains information to run the SureSelect<sup>QXT</sup> Library Prep and target enrichment protocol.

© Agilent Technologies, Inc. 2014, 2015

Version D0, November 2015



p/n G9681-90000



**Agilent Technologies**