

# **SureSelect<sup>XT</sup> Low Input Target Enrichment System for Illumina Paired-End Multiplexed Sequencing Library**

**For Illumina Multiplexed  
Sequencing Platforms**

## **Protocol**

Version A0, July 2017

**SureSelect platform manufactured with Agilent  
SurePrint Technology**

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## Manual Part Number

G9703-90000

## Edition

Version A0, July 2017

Printed in USA

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

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# In this Guide...

This guide provides an optimized protocol for preparation of target-enriched Illumina paired-end multiplexed sequencing libraries using SureSelect<sup>XT</sup> Low Input Reagent Kits.

The SureSelect<sup>XT</sup> Low Input Reagent Kits and protocol support molecular barcoding of indexed library samples prior to target enrichment and amplification.

## 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 indexed, molecular-barcoded 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 Post-Capture Sample Processing for Multiplexed Sequencing

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

## 5 Appendix: Using FFPE-derived DNA Samples

This chapter describes the protocol modifications for gDNA isolated from FFPE samples.

## 6 Reference

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

# Content

<b>1</b>	<b>Before You Begin</b>	<b>7</b>
	Overview of the Workflow	8
	Procedural Notes	10
	Safety Notes	10
	Required Reagents	11
	Required Equipment	14
	Optional Reagents and Equipment	16
<b>2</b>	<b>Sample Preparation</b>	<b>17</b>
	Step 1. Prepare and analyze quality of genomic DNA samples	18
	Step 2. Shear the DNA	21
	Step 3. Repair and dA-Tail the DNA ends	24
	Step 4. Ligate the molecular-barcoded adaptor	28
	Step 5. Purify the sample using AMPure XP beads	29
	Step 6. Amplify the adaptor-ligated library	31
	Step 7. Purify the amplified library with AMPure XP beads	34
	Step 8. Assess quality and quantity	36
<b>3</b>	<b>Hybridization and Capture</b>	<b>41</b>
	Step 1. Hybridize DNA samples to the Capture Library	42
	Step 2. Prepare streptavidin-coated magnetic beads	47
	Step 3. Capture the hybridized DNA using streptavidin-coated beads	48

<b>4</b>	<b>Post-Capture Sample Processing for Multiplexed Sequencing</b>	<b>51</b>
Step 1. Amplify the captured libraries	52	
Step 2. Purify the amplified captured libraries using AMPure XP beads	55	
Step 3. Assess sequencing library DNA quantity and quality	57	
Step 4. Pool samples for multiplexed sequencing	61	
Step 5. Prepare sequencing samples	63	
Step 6. Do the sequencing run and analyze the data	65	
Sequence analysis resources	70	
<b>5</b>	<b>Appendix: Using FFPE-derived DNA Samples</b>	<b>71</b>
Protocol modifications for FFPE Samples	72	
Methods for FFPE Sample Qualification	72	
Sequencing Output Recommendations for FFPE Samples	73	
<b>6</b>	<b>Reference</b>	<b>75</b>
Kit Contents	76	
Nucleotide Sequences of SureSelect XT Low Input Indexes	81	
Troubleshooting Guide	83	
Quick Reference Protocol	87	

## 1 Before You Begin

Overview of the Workflow	8
Procedural Notes	10
Safety Notes	10
Required Reagents	11
Required Equipment	14
Optional Reagents and Equipment	16

Make sure you have the most current protocol. Go to [genomics.agilent.com](http://genomics.agilent.com) and search for G9703-90000.

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**

This protocol differs from the Illumina Multiplexed Paired-End sequencing manual and other SureSelect protocols at several steps. Pay close attention to the primers used for each amplification step and the blocking agents used during hybridization.

**NOTE**

Agilent guarantees performance and provides technical support for the SureSelect reagents required for this workflow only when used as directed in this Protocol.



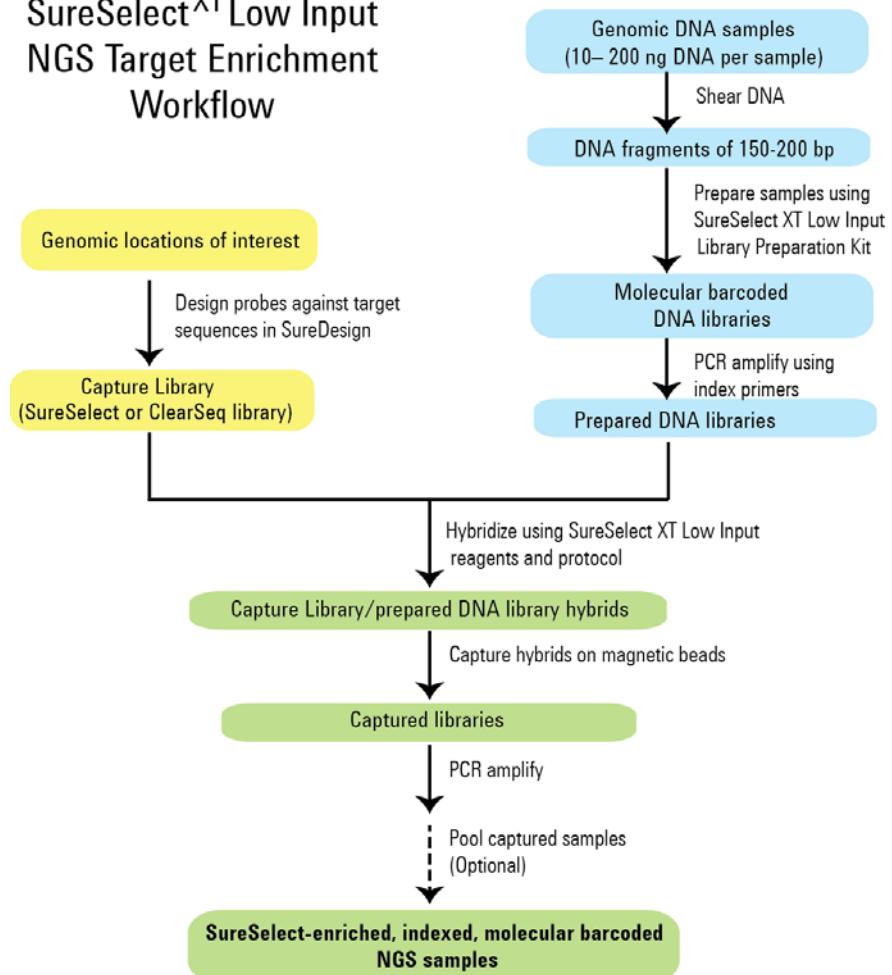
## 1 Before You Begin

### Overview of the Workflow

# Overview of the Workflow

The SureSelect<sup>XT</sup> Low Input target enrichment workflow is summarized in **Figure 1**. The estimated time requirements for each step are summarized in **Table 1**.

## SureSelect<sup>XT</sup> Low Input NGS Target Enrichment Workflow



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

**Table 1** Estimated time requirements (up to 16 sample run size)

Step	Time
Library Preparation	3.5 hours
Hybridization and Capture	3.5 hours
Post-capture amplification	1 hour
QC using Bioanalyzer or TapeStation platform and sample pooling	1.5 hours

## Procedural Notes

- 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.
- 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.
- 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.
- In general, follow Biosafety Level 1 (BL1) safety rules.
- 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.

## Safety Notes

### CAUTION

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

# Required Reagents

**Table 2** Required Reagents--All Sample Types

Description	Vendor and part number
SureSelect <sup>XT</sup> Low Input Reagent + Capture Library Kit for Illumina (ILM) platforms <sup>*</sup>	Select one kit from <a href="#">Table 4</a>
96 reactions <sup>†</sup> , with Index Primers 1–96	p/n G9707A through G9707L
96 reactions <sup>†</sup> , with Index Primers 97–192	p/n G9708A through G9708L
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	Thermo Fisher Scientific
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)	Thermo Fisher Scientific p/n 12090-015, or equivalent
100% Ethanol (Ethyl Alcohol, 200 proof)	Millipore p/n EX0276
Qubit BR dsDNA Assay Kit	Thermo Fisher Scientific
100 assays	p/n Q32850
500 assays	p/n Q32853
Nuclease-free Water (not DEPC-treated)	Ambion Cat #AM9930

\* Compatible with HiSeq, MiSeq and NextSeq 500 platforms.

† 96-reaction kits contain enough reagents for 4 runs containing 24 samples per run.

## 1 Before You Begin

### Required Reagents

**Table 3** Required Reagents--FFPE DNA Samples Only

Description	Vendor and part number
FFPE DNA integrity assessment system:	
Agilent NGS FFPE QC Kit	Agilent
16 reactions	p/n G9700A
96 reactions	p/n G9700B
<b>OR</b>	
TapeStation Genomic DNA Analysis Consumables:	
Genomic DNA ScreenTape	Agilent
Genomic DNA Reagents	p/n 5067-5365
Genomic DNA Reagents	p/n 5067-5366
QIAamp DNA FFPE Tissue Kit, 50 Samples	Qiagen p/n 56404
Deparaffinization Solution	Qiagen p/n 19093

**Table 4** SureSelect<sup>XT</sup> Low Input Reagent + Capture Library Kits

<b>Included SureSelect (SSel) XT Low Input Capture Library</b>	<b>Included SureSelect<sup>XT</sup> Low Input Reagent Kit</b>	
	<b>96 Reactions, with Index Primers 1–96</b>	<b>96 Reactions, with Index Primers 97–192</b>
<b>Custom 1–499 kb</b>	G9707A	G9708A
<b>Custom 0.5–2.9 Mb</b>	G9707B	G9708B
<b>Custom 3–5.9 Mb</b>	G9707C	G9708C
<b>Custom 6–11.9 Mb</b>	G9707D	G9708D
<b>Custom 12–24 Mb</b>	G9707E	G9708E
<b>ClearSeq Comp Cancer</b>	G9707G	G9708G
<b>Clinical Research Exome V2</b>	G9707H	G9708H
<b>Clinical Research Exome V2 Plus</b>	G9707J	G9708J
<b>Human All Exon V6</b>	G9707K	G9708K
<b>Human All Exon V6 Plus</b>	G9707L	G9708L

**1 Before You Begin**  
Required Equipment

## Required Equipment

**Table 5** Required Equipment

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
Qubit Fluorometer	Thermo Fisher Scientific p/n Q32857
Qubit Assay Tubes	Thermo Fisher Scientific p/n Q32856
DNA LoBind Tubes, 1.5-ml PCR clean, 250 pieces	Eppendorf p/n 022431021 or equivalent
Microcentrifuge	Eppendorf microcentrifuge, model 5417C 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
Covaris Sample Preparation System	Covaris model E220
Covaris microTUBE sample holders	Covaris p/n 520045

**Table 5** Required Equipment

Description	Vendor and part number
DNA Analysis Platform and Consumables	
Agilent 2100 Bioanalyzer Instrument	Agilent p/n G2939BA
Agilent 2100 Expert SW Laptop Bundle (optional)	Agilent p/n G2953CA
DNA 1000 Kit	Agilent p/n 5067-1504
High Sensitivity DNA Kit	Agilent p/n 5067-4626
OR	
Agilent 4200 TapeStation*	Agilent p/n G2991AA
96-well sample plates	Agilent p/n 5042-8502
96-well plate foil seals	Agilent p/n 5067-5154
8-well tube strips	Agilent p/n 401428
8-well tube strip caps	Agilent p/n 401425
D1000 ScreenTape	Agilent p/n 5067-5582
D1000 Reagents	Agilent p/n 5067-5583
High Sensitivity D1000 ScreenTape	Agilent p/n 5067-5584
High Sensitivity D1000 Reagents	Agilent p/n 5067-5585
Magnetic separator	Thermo Fisher Scientific p/n 12331D or equivalent <sup>†</sup>
Multichannel pipette	Rainin Pipet-Lite Multi Pipette or equivalent
Single channel pipettes (10-, 20-, 200-, and 1000- $\mu$ l capacity)	Rainin Pipet-Lite Pipettes or equivalent
Vortex mixer	
Vacuum concentrator	Savant SpeedVac, model DNA120, or equivalent
Ice bucket	
Powder-free gloves	
Sterile, nuclease-free aerosol barrier pipette tips	

\* DNA samples may also be analyzed using the Agilent 2200 TapeStation, p/n G2964AA or G2965AA. ScreenTape devices and associated reagents listed in this table are compatible with both platforms.

† 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

### Optional Reagents and Equipment

# Optional Reagents and Equipment

**Table 6** Supplier Information for Optional Materials

Description	Vendor and part number
High-quality gDNA purification system, for example:	
QIAamp DNA Mini Kit	Qiagen
50 Samples	p/n 51304
250 Samples	p/n 51306
Ethylene Glycol	American Bioanalytical p/n AB00455
Tween 20	Sigma-Aldrich p/n P9416-50ML
Optical Caps, 8× strip (flat)	Agilent p/n 401425*
Tube-strip capping tool	Agilent p/n 410099
PlateLoc Thermal Microplate Sealer with Small Hotplate	Agilent p/n G5402A
Peelable Aluminum Seal for PlateLoc Sealer	Agilent p/n 24210-001
MicroAmp Clear Adhesive Film	Thermo Fisher Scientific p/n L12-20

\* Flat strip caps may be used instead of domed strip caps for protocol steps performed outside of the thermal cycler. Adhesive film may be applied over the flat strip caps for improved sealing properties.

## 2

# Sample Preparation

Step 1. Prepare and analyze quality of genomic DNA samples 18

Step 2. Shear the DNA 21

Step 3. Repair and dA-Tail the DNA ends 24

Step 4. Ligate the molecular-barcoded adaptor 28

Step 5. Purify the sample using AMPure XP beads 29

Step 6. Amplify the adaptor-ligated library 31

Step 7. Purify the amplified library with AMPure XP beads 34

Step 8. Assess quality and quantity 36

The sample preparation protocol is used to prepare DNA libraries for sequencing using the Illumina paired-read platform. For each sample to be sequenced, an individual indexed and molecular-barcoded library is prepared. For an overview of the SureSelect<sup>XT</sup> Low Input target enrichment workflow, see [Figure 1](#) on page 8.

The library preparation protocol is compatible with both high-quality gDNA prepared from fresh or fresh frozen samples and lower-quality DNA prepared from FFPE samples. Modifications required for FFPE samples are included throughout the protocol steps. For a summary of modifications for FFPE samples see [Chapter 5, “Appendix: Using FFPE-derived DNA Samples”](#) on page 71.

The protocol requires 10 ng to 200 ng of input DNA, with adjustments to DNA input amount or quantification method required for some FFPE samples. For optimal sequencing results, use the maximum amount of input DNA available within the recommended range.



## 2 Sample Preparation

### Step 1. Prepare and analyze quality of genomic DNA samples

## Step 1. Prepare and analyze quality of genomic DNA samples

### Preparation of high-quality gDNA from fresh biological samples

- 1 Prepare high-quality gDNA using a suitable purification system, such as Qiagen's QIAamp DNA Mini Kit, following the manufacturer's protocol.

#### NOTE

Make sure genomic DNA samples are of high quality with an OD 260/280 ratio ranging from 1.8 to 2.0.

- 2 Use the Qubit BR dsDNA Assay Kit to determine the concentration of each gDNA sample. Follow the manufacturer's instructions for the instrument and assay kit.
- 3 Prepare each DNA sample for the library preparation protocol by diluting 10 ng to 200 ng gDNA with 1X Low TE Buffer to a final volume of 50  $\mu$ l. Vortex well to mix, then spin briefly to collect the liquid. Keep the samples on ice.

Additional qualification of DNA samples is not required for DNA derived from fresh biological samples. Proceed to ["Step 2. Shear the DNA"](#) on page 21.

### Preparation and qualification of gDNA from FFPE samples

- 1 Prepare gDNA from FFPE tissue sections using Qiagen's QIAamp DNA FFPE Tissue Kit and Qiagen's Deparaffinization Solution, following the manufacturer's protocol. Elute the final gDNA samples from the MinElute column in two rounds, using 30  $\mu$ l Buffer ATE in each round, for a final elution volume of approximately 60  $\mu$ l.

#### NOTE

If tissue lysis appears incomplete after one hour of digestion with Proteinase K, add an additional 10  $\mu$ l of Proteinase K and continue incubating at 56°C, with periodic mixing, for up to three hours.

Store the gDNA samples on ice for same-day library preparation, or at -20°C for later processing.

2 Assess the quality (DNA integrity) for each FFPE DNA sample using one of the methods below.

**Option 1: Qualification using the Agilent NGS FFPE QC Kit (Recommended Method)**

The Agilent NGS FFPE QC Kit provides a qPCR-based assay for DNA sample integrity determination. Results include a  $\Delta\Delta Cq$  DNA integrity score and the precise quantity of amplifiable DNA in the sample, allowing direct normalization of DNA input for each sample. DNA input recommendations based on  $\Delta\Delta Cq$  scores for individual samples are summarized in [Table 7](#).

- a Use the Qubit BR dsDNA Assay Kit to determine the concentration of each gDNA sample. Follow the manufacturer's instructions for the instrument and assay kit.
- b Remove a 1  $\mu$ l aliquot of the FFPE gDNA sample for analysis using the Agilent NGS FFPE QC Kit to determine the  $\Delta\Delta Cq$  DNA integrity score. See the kit user manual at [www.genomics.agilent.com](http://www.genomics.agilent.com) for more information.
- c For all samples with  $\Delta\Delta Cq$  DNA integrity score  $\leq 1$ , use the Qubit-based gDNA concentration determined in [step a](#), above, to determine volume of input DNA needed for the protocol.
- d For all samples with  $\Delta\Delta Cq$  DNA integrity score  $> 1$ , use the qPCR-based concentration of amplifiable gDNA, reported by the Agilent NGS FFPE QC Kit results, to determine amounts of input DNA for the protocol.

**Table 7** SureSelect XT Low Input DNA input modifications based on  $\Delta\Delta Cq$  DNA integrity score

Protocol Parameter	non-FFPE Samples		FFPE Samples
	$\Delta\Delta Cq \leq 1^*$	$\Delta\Delta Cq > 1$	
DNA input for Library Preparation	10 ng to 200 ng DNA, based on Qubit Assay	10 ng to 200 ng DNA, based on Qubit Assay	10 ng to 200 ng of amplifiable DNA, based on qPCR quantification

\* FFPE samples with  $\Delta\Delta Cq$  scores  $\leq 1$  should be treated like non-FFPE samples for DNA input amount determinations. For samples of this type, make sure to use the DNA concentration determined by the Qubit Assay, instead of the concentration determined by qPCR, to calculate the volume required for 10–200 ng DNA.

## 2 Sample Preparation

### Step 1. Prepare and analyze quality of genomic DNA samples

#### Option 2: Qualification using Agilent's Genomic DNA ScreenTape assay DIN score

Agilent's Genomic DNA ScreenTape assay, used in conjunction with Agilent's 4200 TapeStation, provides a quantitative electrophoretic assay for DNA sample integrity determination. This assay reports a DNA Integrity Number (DIN) score for each sample which is used to estimate the appropriate normalization of DNA input required for low-integrity DNA samples.

- a Use the Qubit BR dsDNA Assay Kit to determine the concentration of each gDNA sample. Follow the manufacturer's instructions for the instrument and assay kit.
- b Remove a 1  $\mu$ l aliquot of the FFPE gDNA sample and analyze using the Genomic DNA ScreenTape assay. See the user manual at [www.genomics.agilent.com](http://www.genomics.agilent.com) for more information.
- c Using the DIN score reported for each sample in the Genomic DNA ScreenTape assay, consult **Table 8** to determine the recommended amount of input DNA for the sample.

**Table 8** SureSelect XT Low Input DNA input modifications based on DNA Integrity Number (DIN) score

Protocol Parameter	non-FFPE Samples	FFPE Samples		
		DIN > 8*	DIN 3–8	DIN < 3
DNA input for Library Preparation	10 ng to 200 ng DNA, quantified by Qubit Assay	10 ng to 200 ng DNA, quantified by Qubit Assay	Use at least 15 ng for more intact samples and at least 40 ng for less intact samples. Use the maximum amount of DNA available, up to 200 ng, for all samples. Quantify by Qubit Assay.	Use at least 50 ng for more intact samples and at least 100 ng for the least intact samples. Use the maximum amount of DNA available, up to 200 ng, for all samples. Quantify by Qubit Assay.

\* FFPE samples with DIN>8 should be treated like non-FFPE samples for DNA input amount determinations.

- 3 Prepare each FFPE DNA sample for the library preparation protocol by diluting the appropriate amount of gDNA with 1X Low TE Buffer to a final volume of 50  $\mu$ l. See **Table 7** or **Table 8** above for FFPE DNA input guidelines based on the measured DNA quality in each sample. Vortex each sample dilution to mix, then spin briefly to collect the liquid. Keep the samples on ice.

## Step 2. Shear the DNA

In this step, the 50- $\mu$ l gDNA samples are sheared using conditions optimized for either high-quality or FFPE DNA. The target DNA fragment size is 150 to 200 bp.

### NOTE

This protocol has been optimized using a Covaris model E220 instrument and the 130- $\mu$ l Covaris microTUBE. Consult the manufacturer's recommendations for use of other Covaris instruments or sample holders to achieve the same target DNA fragment size.

### 1 Set up the Covaris E220 instrument.

- a Check that the water in the Covaris tank is filled with fresh deionized water to the appropriate fill line level according to the manufacturer's recommendations for the specific instrument model and sample tube or plate in use.
- b Check that the water covers the visible glass part of the tube.
- c On the instrument control panel, push the Degas button. Degas the instrument for least 30 minutes before use, or according to the manufacturer's recommendations.
- d Set the chiller temperature to between 2°C to 5°C to ensure that the temperature reading in the water bath displays 5°C.
- e *Optional.* Supplement the circulated water chiller with ethylene glycol to 20% volume to prevent freezing.

Refer to the instrument user guide for more details.

## 2 Sample Preparation

### Step 2. Shear the DNA

**2** Complete the DNA shearing steps below for each of the gDNA samples.

Each high-quality DNA sample or FFPE DNA sample should contain 10–200 ng gDNA (adjusted as required for DNA integrity) in 50 µl of 1X Low TE Buffer.

- a** Transfer the 50-µl DNA sample into a Covaris microTUBE, using a tapered pipette tip to slowly transfer the sample through the pre-split septa of the cap.
- b** Spin the microTUBE for 30 seconds to collect the liquid and to remove any bubbles from the bottom of the tube.
- c** Secure the microTUBE in the tube holder and shear the DNA with the settings in [Table 9](#).

**Table 9** Shear settings for Covaris E-series instrument (SonoLab software v7 or later)

Setting	High-quality DNA	FFPE DNA
Duty Factor	10%	10%
Peak Incident Power (PIP)	175	175
Cycles per Burst	200	200
Treatment Time	2 × 120 seconds	240 seconds
Bath Temperature	2° to 8° C	2° to 8° C

Use the steps below for two-round shearing of **high-quality DNA samples only**:

- Shear for 120 seconds
- Spin the microTUBE for 10 seconds
- Vortex the microTUBE at high speed for 5 seconds
- Spin the microTUBE for 10 seconds
- Shear for additional 120 seconds
- Spin the microTUBE for 10 seconds
- Vortex the microTUBE at high speed for 5 seconds
- Spin the microTUBE for 10 seconds

- d** After completing the shearing step(s), put the Covaris microTUBE back into the loading and unloading station.
- e** While keeping the snap-cap on, insert a pipette tip through the pre-split septa, then slowly remove the sheared DNA.
- f** Transfer the sheared DNA sample (approximately 50  $\mu$ l) to a 96-well plate or strip tube sample well. Keep the samples on ice.
- g** After transferring the DNA sample, spin the microTUBE briefly to collect any residual sample volume. Transfer any additional collected liquid to the sample well used in **step f**.

## 2 Sample Preparation

### Step 3. Repair and dA-Tail the DNA ends

## Step 3. Repair and dA-Tail the DNA ends

This step uses the components listed in [Table 10](#). Thaw and mix each component as directed in [Table 10](#) before use.

**Table 10** Reagents thawed before use in protocol

Kit Component	Storage Location	Thawing Conditions	Mixing Method	Where Used
End Repair-A Tailing Buffer (bottle)	SureSelect XT HS and XT Low Input Library Preparation Kit for ILM (Pre PCR), -20°C	Thaw on ice (may require >10 minutes) then keep on ice	Vortexing	<a href="#">page 26</a>
Ligation Buffer (purple cap)	SureSelect XT HS and XT Low Input Library Preparation Kit for ILM (Pre PCR), -20°C	Thaw on ice (may require up to 10 minutes) then keep on ice	Vortexing	<a href="#">page 25</a>
End Repair-A Tailing Enzyme Mix (orange cap)	SureSelect XT HS and XT Low Input Library Preparation Kit for ILM (Pre PCR), -20°C	Place on ice just before use	Inversion	<a href="#">page 26</a>
T4 DNA Ligase (blue cap)	SureSelect XT HS and XT Low Input Library Preparation Kit for ILM (Pre PCR), -20°C	Place on ice just before use	Inversion	<a href="#">page 25</a>

To process multiple samples, prepare reagent mixtures with overage at each step, without the DNA sample. Mixtures for preparation of 8 samples (including excess) are shown in each table as an example.

- 1 Before starting the end-repair protocol, prepare the Ligation master mix to allow equilibration to room temperature before use.
  - a Vortex the thawed vial of Ligation Buffer for 5 seconds at high speed to ensure homogeneity.

**CAUTION**

The Ligation Buffer used in this step is viscous. Mix thoroughly by vortexing at high speed for 5 seconds before removing an aliquot for use. When combining with other reagents, mix well by pipetting up and down 15–20 times using a pipette set to at least 80% of the mixture volume.

- b Prepare the appropriate volume of Ligation master mix by combining the reagents in [Table 11](#).

Slowly pipette the Ligation Buffer into a 1.5-ml Eppendorf tube, ensuring that the full volume is dispensed. Slowly add the T4 DNA Ligase, rinsing the enzyme tip with buffer solution after addition. Mix well by slowly pipetting up and down 15–20 times. Spin briefly to collect the liquid.

**Keep at room temperature for 30–45 minutes before use on page 28.**

**Table 11** Preparation of Ligation master mix

Reagent	Volume for 1 reaction	Volume for 8 reactions (includes excess)
Ligation Buffer (purple cap)	23 µl	207 µl
T4 DNA Ligase (blue cap)	2 µl	18 µl
<b>Total</b>	<b>25 µl</b>	<b>225 µl</b>

- 2 Preprogram a SureCycler 8800 thermal cycler (with the heated lid ON) for the End Repair and dA-Tailing steps with the program in [Table 12](#).

## 2 Sample Preparation

### Step 3. Repair and dA-Tail the DNA ends

Start the program, then immediately press the *Pause* button, allowing the heated lid to reach temperature while you set up the reactions.

**Table 12** Thermal cycler program for End Repair/dA-Tailing \*

Step	Temperature	Time
Step 1	20°C	15 minutes
Step 2	72°C	15 minutes
Step 3	4°C	Hold

\* When setting up the thermal cycling program, use a reaction volume setting of 70  $\mu$ L.

**3** Vortex the thawed vial of End Repair-A Tailing Buffer for 5 seconds at high speed to ensure homogeneity. Visually inspect the solution; if any solids are observed, continue vortexing until all solids are dissolved.

#### CAUTION

The End Repair-A Tailing Buffer used in this step must be mixed thoroughly by vortexing at high speed for 5 seconds before removing an aliquot for use. When combining with other reagents, mix well by pipetting up and down 15–20 times using a pipette set to at least 80% of the mixture volume.

**4** Prepare the appropriate volume of End Repair/dA-Tailing master mix, by combining the reagents in **Table 13**.

Slowly pipette the End Repair-A Tailing Buffer into a 1.5-ml Eppendorf tube, ensuring that the full volume is dispensed. Slowly add the End Repair-A Tailing Enzyme Mix, rinsing the enzyme tip with buffer solution after addition. Mix well by pipetting up and down 15–20 times. Spin briefly to collect the liquid and keep on ice.

**Table 13** Preparation of End Repair/dA-Tailing master mix

Reagent	Volume for 1 reaction	Volume for 8 reactions (includes excess)
End Repair-A Tailing Buffer (yellow cap or bottle)	16 $\mu$ l	144 $\mu$ l
End Repair-A Tailing Enzyme Mix (orange cap)	4 $\mu$ l	36 $\mu$ l
<b>Total</b>	<b>20 <math>\mu</math>l</b>	<b>180 <math>\mu</math>l</b>

- 5 Add 20  $\mu$ l of the End Repair/dA-Tailing master mix to each sample well containing approximately 50  $\mu$ l sheared DNA. Mix by pipetting up and down 15–20 times using a pipette set to 60  $\mu$ l.
- 6 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 12](#).

## 2 Sample Preparation

### Step 4. Ligate the molecular-barcoded adaptor

- 1 Once the thermal cycler reaches the 4°C Hold step, transfer the samples to ice while setting up this step.
- 2 Preprogram a SureCycler 8800 thermal cycler (with the heated lid ON) for the Ligation step with the program in [Table 14](#). Start the program, then immediately press the *Pause* button, allowing the heated lid to reach temperature while you set up the reactions.

**Table 14** Thermal cycler program for Ligation\*

Step	Temperature	Time
Step 1	20°C	30 minutes
Step 2	4°C	Hold

\* When setting up the thermal cycling program, use a reaction volume setting of 100 µL.

- 3 To each end-repaired/dA-tailed DNA sample (approximately 70 µL), add 25 µL of the Ligation master mix that was prepared on [page 25](#) and kept at room temperature. Mix by pipetting up and down at least 10 times using a pipette set to 85 µL, then briefly spin the samples.
- 4 Add 5 µL of Adaptor Oligo Mix (white capped tube) to each sample. Mix by pipetting up and down 15–20 times using a pipette set to 85 µL.

#### NOTE

Make sure to add the Ligation master mix and the Adaptor Oligo Mix to the samples in separate addition steps as directed in [step 3](#) and [step 4](#) above, mixing after each addition.

---

- 5 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 14](#).

#### NOTE

A unique molecular barcode sequence is incorporated into each library DNA fragment at this step.

## Step 5. Purify the sample 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  $\mu$ l of 70% ethanol per sample, plus excess, for use in step 8.

### NOTE

The freshly-prepared 70% ethanol may be used for subsequent purification steps run on the same day. The complete Library Preparation protocol requires 0.8 ml of fresh 70% ethanol per sample.

- 3 Mix the AMPure XP bead suspension well so that the reagent appears homogeneous and consistent in color.
- 4 Add 80  $\mu$ l of homogeneous AMPure XP beads to each DNA sample (approximately 100  $\mu$ l) in the PCR plate or strip tube. Pipette up and down 15–20 times to mix.
- 5 Incubate samples for 5 minutes at room temperature.
- 6 Put the plate or strip tube into a magnetic separation device. Wait for the solution to clear (approximately 5 to 10 minutes).
- 7 Keep the plate or strip tube in the magnetic stand. Carefully remove and discard the cleared solution from each well. Do not touch the beads while removing the solution.
- 8 Continue to keep the plate or strip tube in the magnetic stand while you dispense 200  $\mu$ l of freshly-prepared 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 to step 9 once.
- 11 Seal the wells with strip caps, then briefly spin the samples to collect the residual ethanol. Return the plate or strip tube to the magnetic stand for 30 seconds. Remove the residual ethanol with a P20 pipette.

## 2 Sample Preparation

### Step 5. Purify the sample using AMPure XP beads

- 12 Dry the samples by placing the unsealed plate or strip tube on the thermal cycler, set to hold samples at 37°C, until the residual ethanol has just evaporated (typically 1–2 minutes).

#### NOTE

Do not dry the bead pellet to the point that the pellet appears cracked during any of the bead drying steps in the protocol. Elution efficiency is significantly decreased when the bead pellet is excessively dried.

---

- 13 Add 35 µl nuclease-free water to each sample well.
- 14 Seal the wells with strip caps, then mix well on a vortex mixer and briefly spin the plate or strip tube to collect the liquid.
- 15 Incubate for 2 minutes at room temperature.
- 16 Put the plate or strip tube in the magnetic stand and leave for approximately 5 minutes, until the solution is clear.
- 17 Remove the cleared supernatant (approximately 34.5 µl) to a fresh PCR plate or strip tube sample well and keep on ice. You can discard the beads at this time.

#### NOTE

It may not be possible to recover the entire 34.5-µl supernatant volume at this step; transfer the maximum possible amount of supernatant for further processing. To maximize recovery, transfer the cleared supernatant to a fresh well in two rounds of pipetting, using a P20 pipette set at 17.25 µl.

---

## Step 6. Amplify the adaptor-ligated library

This step uses the components listed in [Table 15](#). Before you begin, thaw the reagents listed below and keep on ice.

**Table 15** Reagents for pre-capture PCR amplification

Component	Storage Location	Where Used
Herculase II Fusion DNA Polymerase (red cap)	SureSelect XT HS and XT Low Input Library Preparation Kit for ILM (Pre PCR), -20°C	<a href="#">page 33</a>
5× Herculase II Reaction Buffer (clear cap)	SureSelect XT HS and XT Low Input Library Preparation Kit for ILM (Pre PCR), -20°C	<a href="#">page 33</a>
100 mM dNTP Mix (green cap)	SureSelect XT HS and XT Low Input Library Preparation Kit for ILM (Pre PCR), -20°C	<a href="#">page 33</a>
Forward Primer (brown cap)	SureSelect XT HS and XT Low Input Library Preparation Kit for ILM (Pre PCR), -20°C	<a href="#">page 33</a>
SureSelect XT Low Input Index Primers	SureSelect XT Low Input Index Primers for ILM (Pre PCR), -20°C	<a href="#">page 33</a>

\* Indexing primers are provided in 96-well plates containing either indexes 1–96 (yellow *Index Plate 1*) or indexes 97–192 (red *Index Plate 2*).

- 1 Determine the appropriate index assignments for each sample. See [Table 44](#) and [Table 45](#) in the “Reference” chapter for sequences of the 8 bp index portion of the SureSelect XT Low Input Index Primers used to amplify the DNA libraries in this step.

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

### CAUTION

The SureSelect XT Low Input Index Primers are provided in single-use aliquots. To avoid cross-contamination of libraries, use each well for a single library preparation reaction. Do not re-use any residual volume for subsequent experiments.

## 2 Sample Preparation

### Step 6. Amplify the adaptor-ligated library

2 Preprogram a SureCycler 8800 thermal cycler (with the heated lid ON) with the program in [Table 16](#). Start the program, then immediately press the *Pause* button, allowing the heated lid to reach temperature while you set up the reactions.

**Table 16** Pre-Capture PCR Thermal Cycler Program<sup>\*</sup>

Segment	Number of Cycles	Temperature	Time
1	1	98°C	2 minutes
2	8 to 14, based on input DNA quality and quantity (see <a href="#">Table 17</a> )	98°C	30 seconds
		60°C	30 seconds
		72°C	1 minute
3	1	72°C	5 minutes
4	1	4°C	Hold

\* When setting up the thermal cycling program, use a reaction volume setting of 50 µL.

**Table 17** Pre-capture PCR cycle number recommendations

Quality of Input DNA	Quantity of Input DNA	Cycles
Intact DNA from fresh sample	100 to 200 ng	8 cycles
	50 ng	9 cycles
	10 ng	11 cycles
FFPE sample DNA	100 to 200 ng <sup>*</sup>	11 cycles
	50 ng	12 cycles
	10 ng	14 cycles

\* qPCR-determined quantity of amplifiable DNA or DIN value-adjusted amount of input DNA

**CAUTION**

To avoid cross-contaminating libraries, set up PCR reactions (all components except the library DNA) in a dedicated clean area or PCR hood with UV sterilization and positive air flow.

**3** Prepare the appropriate volume of pre-capture PCR reaction mix, as described in [Table 18](#), on ice. Mix well on a vortex mixer.

**Table 18** Preparation of Pre-Capture PCR Reaction Mix

Reagent	Volume for 1 reaction	Volume for 8 reactions (includes excess)
5× Herculase II Reaction Buffer (clear cap)	10 $\mu$ l	90 $\mu$ l
100 mM dNTP Mix (green cap)	0.5 $\mu$ l	4.5 $\mu$ l
Forward Primer (brown cap)	2 $\mu$ l	18 $\mu$ l
Herculase II Fusion DNA Polymerase (red cap)	1 $\mu$ l	9 $\mu$ l
<b>Total</b>	<b>13.5 <math>\mu</math>l</b>	<b>121.5 <math>\mu</math>l</b>

**4** Add 13.5  $\mu$ l of the PCR reaction mixture prepared in [Table 18](#) to each purified DNA library sample (34.5  $\mu$ l) in the PCR plate wells.

**5** Add 2  $\mu$ l of the appropriate SureSelect XT Low Input Index Primer to each reaction.

Cap the wells then vortex at high speed for 5 seconds. Spin the plate or strip tube briefly to collect the liquid release any bubbles.

**6** Place the plate or strip tube in the SureCycler 8800 thermal cycler. Press the *Play* button to resume the thermal cycling program in [Table 16](#).

## 2 Sample Preparation

### Step 7. Purify the amplified library with AMPure XP beads

#### Step 7. Purify the amplified library with 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  $\mu$ l of 70% ethanol per sample, plus excess, for use in [step 8](#).
- 3 Mix the AMPure XP bead suspension well so that the reagent appears homogeneous and consistent in color.
- 4 Add 50  $\mu$ l of homogeneous AMPure XP beads to each 50- $\mu$ l amplification reaction in the PCR plate or strip tube. Pipette up and down 15–20 times to mix.
- 5 Incubate samples for 5 minutes at room temperature.
- 6 Put the plate or strip tube into a magnetic separation device. Wait for the solution to clear (approximately 5 minutes).
- 7 Keep the plate or strip tube in the magnetic stand. Carefully remove and discard the cleared solution from each well. Do not touch the beads while removing the solution.
- 8 Continue to keep the plate or strip tube in the magnetic stand while you dispense 200  $\mu$ l of freshly-prepared 70% ethanol into 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](#) step once.
- 11 Seal the wells with strip caps, then briefly spin the samples to collect the residual ethanol. Return the plate or strip tube to the magnetic stand for 30 seconds. Remove the residual ethanol with a P20 pipette.
- 12 Dry the samples by placing the unsealed plate or strip tube on the thermal cycler, set to hold samples at 37°C, until the residual ethanol has just evaporated (typically 1–2 minutes).
- 13 Add 15  $\mu$ l nuclease-free water to each sample well.
- 14 Seal the wells with strip caps, then mix well on a vortex mixer and briefly spin the plate or strip tube to collect the liquid.
- 15 Incubate for 2 minutes at room temperature.
- 16 Put the plate or strip tube in the magnetic stand and leave for 2 to 3 minutes, until the solution is clear.

## Step 7. Purify the amplified library with AMPure XP beads

**17** Remove the cleared supernatant (approximately 15  $\mu$ l) to a fresh PCR plate or strip tube sample well and keep on ice. You can discard the beads at this time.

**NOTE**

It may not be possible to recover the entire 15- $\mu$ l supernatant volume at this step; transfer the maximum possible amount of supernatant for further processing.

---

## 2 Sample Preparation

### Step 8. Assess quality and quantity

## Step 8. Assess quality and quantity

Sample analysis can be done with either the 2100 Bioanalyzer instrument or an Agilent TapeStation instrument.

### NOTE

Using either analysis method, observation of a low molecular weight peak, in addition to the expected library fragment peak, indicates the presence of adaptor-dimers in the library. Adaptor-dimer removal is not required for libraries that will be target-enriched in later steps of the workflow. However, for libraries being prepared for whole-genome sequencing (not specifically supported by this user guide), samples with an adaptor-dimer peak must be subjected to an additional round of SPRI-purification. To complete, first dilute the sample to 50  $\mu$ l with nuclease free water, then follow the SPRI purification procedure on [page 34](#).

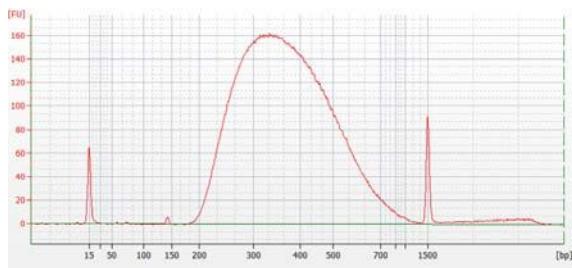
### Option 1: Analysis using the 2100 Bioanalyzer instrument and DNA 1000 Assay

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).

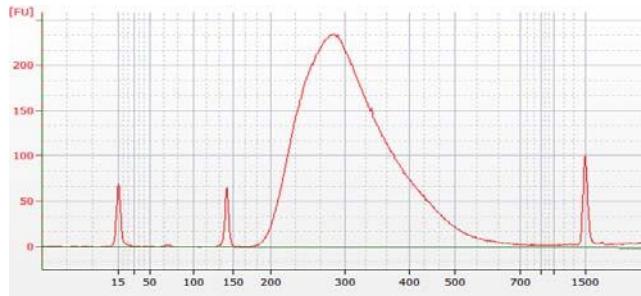
- 1 Set up the 2100 Bioanalyzer instrument as instructed in the reagent kit guide.
- 2 Prepare the chip, samples and ladder as instructed in the reagent kit guide, using 1  $\mu$ l of each sample for the analysis. Load the prepared chip into the instrument and start the run within five minutes after preparation.
- 3 Verify that the electropherogram shows the peak of DNA fragment size positioned between 300 to 400 bp for high-quality DNA and approximately 200 to 400 bp for FFPE DNA. Sample electropherograms are shown in [Figure 2](#) (library prepared from high-quality DNA), [Figure 3](#) (library prepared from medium-quality FFPE DNA), and [Figure 4](#) (library prepared from low-quality FFPE DNA).

The appearance of an additional low molecular weight peak indicates the presence of adaptor-dimers in the library. It is acceptable to proceed to target enrichment with library samples for which adaptor-dimers are observed in the electropherogram at low abundance, similar to that seen in sample electropherograms on [page 37](#). See Troubleshooting information on [page 85](#) for additional considerations.

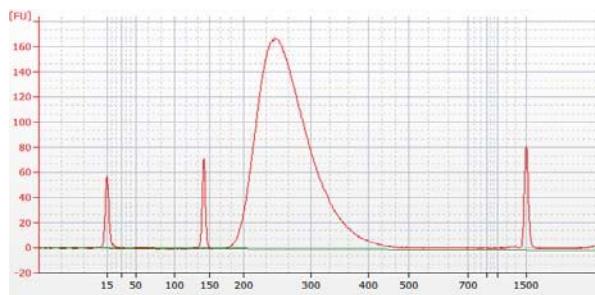
- 4 Determine the concentration of each library by integrating under the entire peak. For accurate quantification, make sure that the concentration falls within the linear range of the assay.



**Figure 2** Pre-capture library prepared from a high-quality gDNA sample analyzed using a DNA 1000 Bioanalyzer assay.



**Figure 3** Pre-capture library prepared from a typical FFPE gDNA sample analyzed using a DNA 1000 Bioanalyzer assay.



**Figure 4** Pre-capture library prepared from a low-quality FFPE gDNA sample analyzed using a DNA 1000 Bioanalyzer assay.

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

## 2 Sample Preparation

### Step 8. Assess quality and quantity

#### Option 2: Analysis using an Agilent 4200 TapeStation or 2200 TapeStation and D1000 ScreenTape

Use a D1000 ScreenTape and associated reagent kit. 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 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.

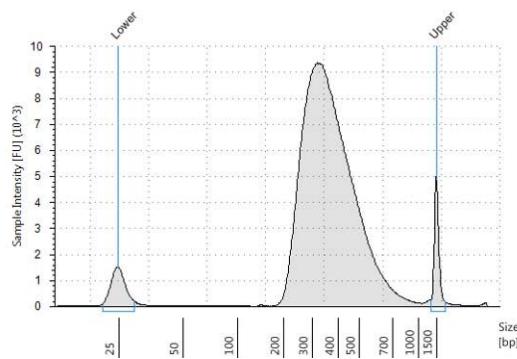
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- 2 Load the sample plate or tube strips from [step 1](#), the D1000 ScreenTape, and loading tips into the TapeStation as instructed in the instrument user manual. Start the run.

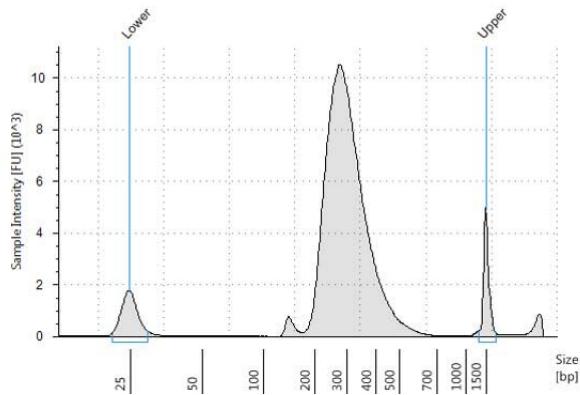
- 3 Verify that the electropherogram shows the peak of DNA fragment size positioned between 300 to 400 bp for high-quality DNA and approximately 200 to 400 bp for FFPE DNA. Sample electropherograms are shown in [Figure 5](#) (library prepared from high-quality DNA), [Figure 6](#) (library prepared from medium-quality FFPE DNA), and [Figure 7](#) (library prepared from low-quality FFPE DNA).

The appearance of an additional low molecular weight peak indicates the presence of adaptor-dimers in the library. It is acceptable to proceed to target enrichment with library samples for which adaptor-dimers are observed in the electropherogram at low abundance, similar to that seen in sample electropherograms on [page 39](#) to [page 40](#). See Troubleshooting information on [page 85](#) for additional considerations.

- 4 Determine the concentration of the library DNA by integrating under the peak.



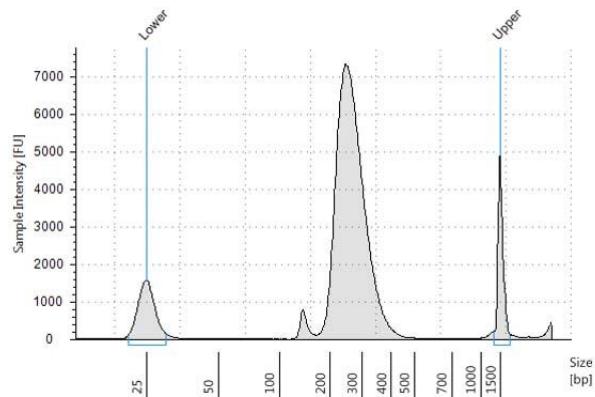
**Figure 5** Pre-capture library prepared from a high-quality gDNA sample analyzed using a D1000 ScreenTape assay.



**Figure 6** Pre-capture library prepared from a typical FFPE gDNA sample analyzed using a D1000 ScreenTape assay.

## 2 Sample Preparation

### Step 8. Assess quality and quantity



**Figure 7** Pre-capture library prepared from a low-quality FFPE gDNA sample analyzed using a D1000 ScreenTape assay.

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

## 3

# Hybridization and Capture

Step 1. Hybridize DNA samples to the Capture Library 42

Step 2. Prepare streptavidin-coated magnetic beads 47

Step 3. Capture the hybridized DNA using streptavidin-coated beads 48

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. Each DNA library sample must be hybridized and captured individually.

## CAUTION

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

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### 3 Hybridization and Capture

#### Step 1. Hybridize DNA samples to the Capture Library

## Step 1. Hybridize DNA samples to the Capture Library

In this step, the prepared gDNA libraries are hybridized to a target-specific Capture Library. For each sample library prepared, do one hybridization and capture. Do not pool samples at this stage.

The hybridization reaction requires 500–1000 ng of prepared DNA in a volume of 12 µl. Use the maximum amount of prepared DNA available within this range.

This step uses the components listed in [Table 19](#). Thaw each component under the conditions indicated in the table. Vortex each reagent to mix, then spin tubes briefly to collect the liquid.

**Table 19** Reagents for Hybridization

Kit Component	Storage Location	Thawing Conditions	Where Used
SureSelect XT HS and XT Low Input Blocker Mix (blue cap)	SureSelect XT HS and XT Low Input Target Enrichment Kit ILM Hyb Module, Box 2 (Post PCR), –20°C	Thaw on ice	<a href="#">page 43</a>
SureSelect RNase Block (purple cap)	SureSelect XT HS and XT Low Input Target Enrichment Kit ILM Hyb Module, Box 2 (Post PCR),* –20°C	Thaw on ice	<a href="#">page 44</a>
SureSelect Fast Hybridization Buffer (bottle)	SureSelect XT HS and XT Low Input Target Enrichment Kit ILM Hyb Module, Box 2 (Post PCR),* –20°C	Thaw and keep at Room Temperature	<a href="#">page 45</a>
Capture Library	–80°C	Thaw on ice	<a href="#">page 45</a>

1 Preprogram a SureCycler 8800 thermal cycler (with the heated lid ON) with the program in **Table 20**. Start the program, then immediately press the *Pause* button, allowing the heated lid to reach temperature while you set up the reactions.

**Table 20** Pre-programmed 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
4	60	65°C <sup>†</sup>	1 minute
		37°C	3 seconds
5	1	65°C <sup>†</sup>	Hold

\* 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).

† Reducing the hybridization temperature to 60°C (Segments 4 and 5) may improve coverage for AT-rich regions of some libraries.

2 Place 500–1000 ng of each prepared gDNA library sample into the hybridization plate or strip tube wells and then bring the final volume in each well to 12 µl using nuclease-free water. Use the maximum possible amount of each prepped DNA, within the 500–1000 ng range.

3 To each DNA library sample well, add 5 µl of SureSelect XT HS and XT Low Input Blocker Mix. Cap the wells then vortex at high speed for 5 seconds. Spin the plate or strip tube briefly to collect the liquid release any bubbles.

### 3 Hybridization and Capture

#### Step 1. Hybridize DNA samples to the Capture Library

#### CAUTION

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

**4** Transfer the sealed sample plates or strips to the thermal cycler and press the *Play* button to resume the thermal cycling program set up on [page 43](#) and shown in [Table 21](#) below.

**Important:** Notice that the thermal cycler must be paused during Segment 3 (see [Table 21](#)) to allow additional reagents to be added to the Hybridization wells, as described in [step 7 on page 46](#).

During Segments 1 and 2 of the thermal cycling program below, begin preparing the additional reagents as described in [step 5](#) and [step 6](#) on [page 45](#). If needed, you can finish these preparation steps after pausing the thermal cycler in Segment 3.

**Table 21** Thermal cycler program for Hybridization with required pause

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 (PAUSE cycler here)
4	60	65°C	1 minute
		37°C	3 seconds
5	1	65°C	Hold <sup>*</sup>

<sup>\*</sup> Begin the capture steps on [page 47](#) when the thermal cycler starts the 65°C Hold segment.

**5** Prepare a 25% solution of SureSelect RNase Block (containing 1 part RNase Block:3 parts water), according to [Table 22](#). Prepare the amount required for the number of hybridization reactions in the run, plus excess. Mix well and keep on ice.

**Table 22** Preparation of RNase Block solution

Reagent	Volume for 1 reaction	Volume for 8 reactions (includes excess)
SureSelect RNase Block	0.5 µl	4.5 µl
Nuclease-free water	1.5 µl	13.5 µl
<b>Total</b>	<b>2 µl</b>	<b>18 µl</b>

## NOTE

Prepare the mixture described in [step 6](#), below, just before pausing the thermal cycler in Segment 3 as described on [page 44](#). Keep the mixture at room temperature briefly until the mixture is added to the DNA samples in [step 7](#) on [page 46](#). Do not keep solutions containing the Capture Library at room temperature for extended periods.

**6** Prepare the Capture Library Hybridization Mix appropriate for your capture library type according to [Table 23](#) for Capture Libraries  $\geq 3$  Mb or [Table 24](#) for Capture Libraries  $< 3$  Mb.

**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 7](#).

**Table 23** Preparation of Capture Library Hybridization Mix for **Capture Libraries  $\geq 3$  Mb**

Reagent	Volume for 1 reaction	Volume for 8 reactions (includes excess)
25% RNase Block solution (from <a href="#">step 5</a> )	2 $\mu$ l	18 $\mu$ l
Capture Library $\geq 3$ Mb	5 $\mu$ l	45 $\mu$ l
SureSelect Fast Hybridization Buffer	6 $\mu$ l	54 $\mu$ l
<b>Total</b>	<b>13 <math>\mu</math>l</b>	<b>117 <math>\mu</math>l</b>

**Table 24** Preparation of Capture Library Hybridization Mix for **Capture Libraries  $< 3$  Mb**

Reagent	Volume for 1 reaction	Volume for 8 reactions (includes excess)
25% RNase Block solution (from <a href="#">step 5</a> )	2 $\mu$ l	18 $\mu$ l
Capture Library $< 3$ Mb	2 $\mu$ l	18 $\mu$ l
SureSelect Fast Hybridization Buffer	6 $\mu$ l	54 $\mu$ l
Nuclease-free water	3 $\mu$ l	27 $\mu$ l
<b>Total</b>	<b>13 <math>\mu</math>l</b>	<b>117 <math>\mu</math>l</b>

### 3 Hybridization and Capture

#### Step 1. Hybridize DNA samples to the Capture Library

- Once the thermal cycler starts Segment 3 of the program in [Table 21](#) (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 6](#) to each sample well.

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

The hybridization reaction wells now contain approximately 30 µl.

- Seal the wells with fresh domed strip caps. Make sure that all wells are completely sealed. Vortex briefly, then spin the plate or strip tube briefly to remove any bubbles from the bottom of the wells. Immediately return the plate or strip tube to the thermal cycler.
- 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.

---

## Step 2. Prepare streptavidin-coated magnetic beads

The remaining hybridization capture steps use the components listed in [Table 25](#).

Begin the bead preparation steps described below approximately one hour after starting hybridization in [step 9](#) on [page 46](#).

**Table 25** Reagents for Capture

Kit Component	Storage Location	Where Used
SureSelect Binding Buffer	SureSelect XT HS and XT Low Input Target Enrichment Kit ILM Hyb Module, Box 1 (Post PCR), RT	<a href="#">page 47</a>
SureSelect Wash Buffer 1	SureSelect XT HS and XT Low Input Target Enrichment Kit ILM Hyb Module, Box 1 (Post PCR),* RT	<a href="#">page 48</a>
SureSelect Wash Buffer 2	SureSelect XT HS and XT Low Input Target Enrichment Kit ILM Hyb Module, Box 1 (Post PCR),* RT	<a href="#">page 48</a>
Dynabeads MyOne Streptavidin T1	Follow storage recommendations provided by supplier (see <a href="#">Table 2</a> <a href="#">page 47</a> on <a href="#">page 11</a> )	

- 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  $\mu$ l of the resuspended beads to wells of a fresh SureCycler 8800 PCR plate or a strip tube.
- 3 Wash the beads:
  - a Add 200  $\mu$ l of SureSelect Binding Buffer.
  - b Mix by pipetting up and down 20 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  $\mu$ l of SureSelect Binding Buffer.

**NOTE**

If you are equipped for higher-volume magnetic bead captures, the streptavidin beads may instead be batch-washed in an Eppendorf tube or conical vial.

### 3 Hybridization and Capture

Step 3. Capture the hybridized DNA using streptavidin-coated beads

## Step 3. 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 21](#) on page 44), transfer the samples to room temperature.
- 2 Immediately transfer the entire volume (approximately 30 µl) of each hybridization mixture to wells containing 200 µl of washed streptavidin beads using a multichannel pipette.  
Pipette up and down 5–8 times to mix then seal the wells with fresh caps.
- 3 Incubate the capture plate or strip tube on a 96-well plate mixer, mixing vigorously (at 1400–1800 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 SureSelect Wash Buffer 2 at 70°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 6 wells of buffer for each DNA sample in the run.
  - b Cap the wells and then incubate in the thermal cycler, with heated lid ON, held at 70°C until used in [step 9](#).
- 5 When the 30-minute incubation period initiated in [step 3](#) is complete, spin the samples briefly to collect the liquid.
- 6 Put the plate or strip tube in a magnetic separator to collect the beads. Wait until the solution is clear, then remove and discard the supernatant.
- 7 Resuspend the beads in 200 µl of SureSelect Wash Buffer 1. Mix by pipetting up and down 15–20 times, until beads are fully resuspended.
- 8 Put the plate or strip tube in the magnetic separator. Wait for the solution to clear (approximately 1 minute), then remove and discard the supernatant.

**CAUTION**

It is important to maintain bead suspensions at 70°C during the washing procedure below to ensure specificity of capture.

Make sure that the SureSelect Wash Buffer 2 is pre-warmed to 70°C before use.

Do not use a tissue incubator, or other devices with significant temperature fluctuations, for the incubation steps.

**9 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 70°C prewarmed Wash Buffer 2. Pipette up and down 15–20 times, until beads are fully resuspended.
- b** Seal the wells with fresh caps and then vortex at high speed for 8 seconds. Spin the plate or strip tube briefly to collect the liquid at without pelleting the beads.

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

- c** Incubate the samples for 5 minutes at 70°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** five more times for a total of 6 washes.

**10** After verifying that all wash buffer has been removed, add 25 µl of nuclease-free water to each sample well. Pipette up and down 8 times to resuspend the beads.

Keep the samples on ice until they are used on [page 54](#).

**NOTE**

Captured DNA is retained on the streptavidin beads during the post-capture amplification step.

### 3 Hybridization and Capture

Step 3. Capture the hybridized DNA using streptavidin-coated beads

## 4

# Post-Capture Sample Processing for Multiplexed Sequencing

- Step 1. Amplify the captured libraries [52](#)
- Step 2. Purify the amplified captured libraries using AMPure XP beads [55](#)
- Step 3. Assess sequencing library DNA quantity and quality [57](#)
- Step 4. Pool samples for multiplexed sequencing [61](#)
- Step 5. Prepare sequencing samples [63](#)
- Step 6. Do the sequencing run and analyze the data [65](#)

This chapter describes the steps to amplify, purify, and assess quality and quantity of the captured libraries. Sample pooling instructions are provided to prepare the indexed, molecular barcoded samples for multiplexed sequencing.



## 4 Post-Capture Sample Processing for Multiplexed Sequencing

### Step 1. Amplify the captured libraries

## Step 1. Amplify the captured libraries

In this step, the SureSelect-enriched DNA libraries are PCR amplified.

This step uses the components listed in [Table 26](#). Before you begin, thaw the reagents listed below and keep on ice.

**Table 26** Reagents for pre-capture PCR amplification

Component	Storage Location	Where Used
Herculase II Fusion DNA Polymerase (red cap)	SureSelect XT HS and XT Low Input Target Enrichment Kit, ILM Hyb Module Box 2 (Post PCR), -20°C	<a href="#">page 54</a>
5× Herculase II Reaction Buffer (clear cap)	SureSelect XT HS and XT Low Input Target Enrichment Kit, ILM Hyb Module Box 2 (Post PCR), -20°C	<a href="#">page 54</a>
100 mM dNTP Mix (green cap)	SureSelect XT HS and XT Low Input Target Enrichment Kit, ILM Hyb Module Box 2 (Post PCR), -20°C	<a href="#">page 54</a>
SureSelect Post-Capture Primer Mix (clear cap)	SureSelect XT HS and XT Low Input Target Enrichment Kit, ILM Hyb Module Box 2 (Post PCR), -20°C	<a href="#">page 54</a>

Prepare one amplification reaction for each DNA library.

### 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.

1 Preprogram a SureCycler 8800 thermal cycler (with the heated lid ON) with the program in [Table 27](#). Start the program, then immediately press the *Pause* button, allowing the heated lid to reach temperature while you set up the reactions.

**Table 27** Post-capture PCR Thermal Cycler Program

Segment	Number of Cycles	Temperature	Time
1	1	98°C	2 minutes
2	9 to 14 See <a href="#">Table 28</a> for recommendations based on Capture Library size	98°C 60°C 72°C	30 seconds 30 seconds 1 minute
3	1	72°C	5 minutes
4	1	4°C	Hold

**Table 28** Post-capture PCR cycle number recommendations

Capture Library Size/Description	Cycles
Libraries <0.2 Mb	14 cycles
Libraries 0.2–3 Mb (includes SSe XT HS and XT Low Input ClearSeq Comp Cancer)	12 cycles
Libraries 3–5 Mb	10 cycles
Libraries >5 Mb (includes SSe XT HS and XT Low Input Human All Exon V6 and Clinical Research Exome V2 libraries)	9 cycles

## 4 Post-Capture Sample Processing for Multiplexed Sequencing

### Step 1. Amplify the captured libraries

2 Prepare the appropriate volume of PCR reaction mix, as described in [Table 29](#), on ice. Mix well on a vortex mixer.

**Table 29** Preparation of post-capture PCR Reaction mix

Reagent	Volume for 1 reaction	Volume for 8 reactions (includes excess)
Nuclease-free water	12.5 $\mu$ l	112.5 $\mu$ l
5 $\times$ Herculase II Reaction Buffer (clear cap)	10 $\mu$ l	90 $\mu$ l
Herculase II Fusion DNA Polymerase (red cap)	1 $\mu$ l	9 $\mu$ l
100 mM dNTP Mix (green cap)	0.5 $\mu$ l	4.5 $\mu$ l
SureSelect Post-Capture Primer Mix (clear cap)	1 $\mu$ l	9 $\mu$ l
<b>Total</b>	<b>25 <math>\mu</math>l</b>	<b>225 <math>\mu</math>l</b>

3 Add 25  $\mu$ l of the PCR reaction mix prepared in [Table 29](#) to each sample well containing 25  $\mu$ l of bead-bound target-enriched DNA (prepared on [page 49](#) and held on ice).

4 Mix the PCR reactions well by pipetting up and down until the bead suspension is homogeneous. Avoid splashing samples onto well walls; do not spin the samples at this step.

5 Place the plate or strip tube in the SureCycler 8800 thermal cycler. Press the *Play* button to resume the thermal cycling program in [Table 27](#).

6 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  $\mu$ l) 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  $\mu$ 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 50  $\mu$ l of the homogeneous AMPure XP bead suspension to each amplified DNA sample (approximately 50  $\mu$ l) in the PCR plate or strip tube. Mix well by pipetting up and down 15–20 times.

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  $\mu$ l of freshly-prepared 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 Seal the wells with strip caps, then briefly spin to collect the residual ethanol. Return the plate or strip tube to the magnetic stand for 30 seconds. Remove the residual ethanol with a P20 pipette.
- 12 Dry the samples by placing the unsealed plate or strip tube on the thermal cycler, set to hold samples at 37°C, until the residual ethanol has just evaporated (typically 1–2 minutes).
- 13 Add 25  $\mu$ l of nuclease-free water to each sample well.
- 14 Seal the sample wells, then mix well on a vortex mixer and briefly spin to collect the liquid without pelleting the beads.

#### 4 Post-Capture Sample Processing for Multiplexed Sequencing

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

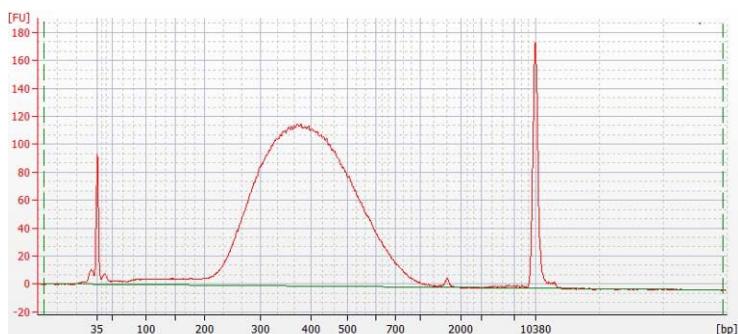
- 15** Incubate for 2 minutes at room temperature.
- 16** Put the plate or strip tube in the magnetic stand and leave for 2 minutes or until the solution is clear.
- 17** Remove the cleared supernatant (approximately 25  $\mu$ l) to a fresh well. You can discard the beads at this time.

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

### Option 1: Analysis using the Agilent 2100 Bioanalyzer instrument 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.

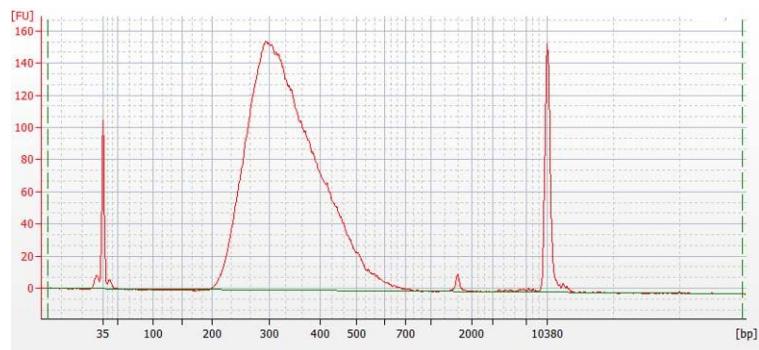
- 1 Set up the 2100 Bioanalyzer instrument as instructed in the reagent kit guide.
- 2 Prepare the chip, samples and ladder as instructed in the reagent kit guide, using 1  $\mu$ l of each sample for the analysis.
- 3 Load the prepared chip into the instrument and start the run within five minutes after preparation.
- 4 Verify that the electropherogram shows the peak of DNA fragment size positioned between 200 and 400 bp. Sample electropherograms are shown in [Figure 8](#) (library prepared from high-quality DNA), [Figure 9](#) (library prepared from medium-quality FFPE DNA), and [Figure 10](#) (library prepared from low-quality FFPE DNA).
- 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.



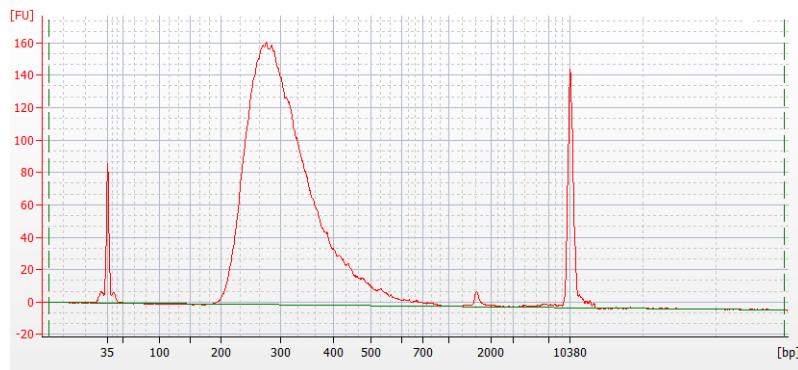
**Figure 8** Post-capture library prepared from a high-quality gDNA sample analyzed using a Bioanalyzer system High Sensitivity DNA assay.

## 4 Post-Capture Sample Processing for Multiplexed Sequencing

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



**Figure 9** Post-capture library prepared from a typical FFPE gDNA sample analyzed using a Bioanalyzer system High Sensitivity DNA assay.



**Figure 10** Post-capture library prepared from a low-quality FFPE gDNA sample analyzed using a Bioanalyzer system High Sensitivity DNA 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.

**Option 2: Analysis using an Agilent 4200 TapeStation or 2200 TapeStation and High Sensitivity D1000 ScreenTape**

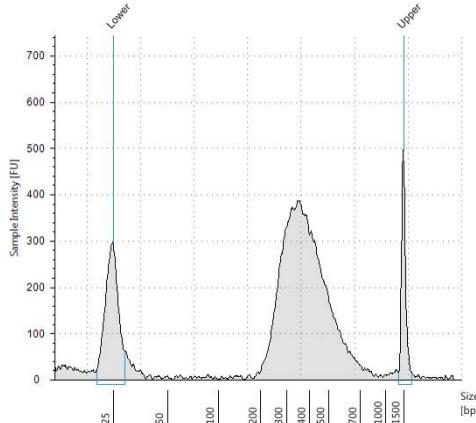
Use a High Sensitivity D1000 ScreenTape and associated reagent kit. For more information to do this step, see the appropriate TapeStation user manual at [www.genomics.agilent.com](http://www.genomics.agilent.com).

- 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.

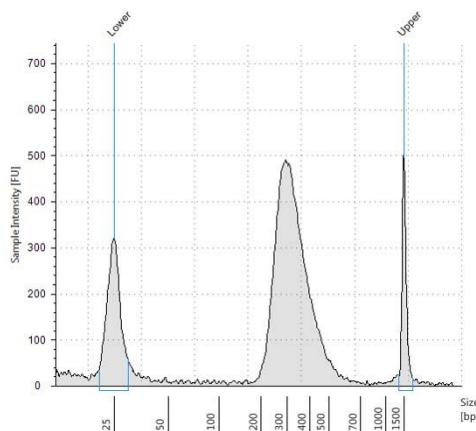
- 2 Load the sample plate or tube strips from [step 1](#), the High Sensitivity D1000 ScreenTape, and loading tips into the TapeStation as instructed in the instrument user manual. Start the run.
- 3 Verify that the electropherogram shows the peak of DNA fragment size positioned between 200 and 400 bp. Sample electropherograms are shown in [Figure 8](#) (library prepared from high-quality DNA), [Figure 9](#) (library prepared from medium-quality FFPE DNA), and [Figure 10](#) (library prepared from low-quality FFPE DNA).
- 4 Determine the concentration of each library by integrating under the entire peak.



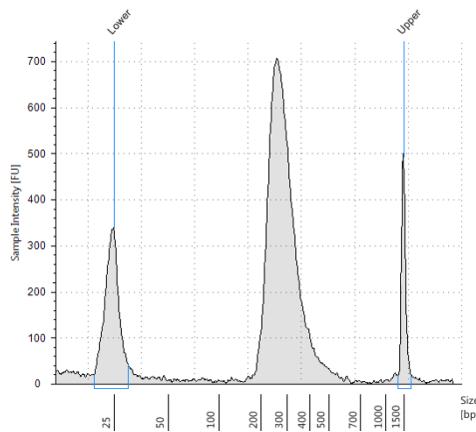
**Figure 11** Post-capture library prepared from a high-quality gDNA sample analyzed using a High Sensitivity D1000 ScreenTape assay.

## 4 Post-Capture Sample Processing for Multiplexed Sequencing

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



**Figure 12** Post-capture library prepared from a typical FFPE gDNA sample analyzed using a High Sensitivity D1000 ScreenTape assay.



**Figure 13** Post-capture library prepared from a low-quality FFPE gDNA sample analyzed using a High Sensitivity D1000 ScreenTape 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 4. 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.

Combine the libraries such that each index-tagged sample is present in equimolar amounts in the pool using one of the following methods:

**Method 1:** Dilute each sample to be pooled to the same final concentration (typically 4 nM–15 nM, or the concentration of the most dilute sample) using Low TE, then combine equal volumes of all samples to create the final pool.

**Method 2:** Starting with samples at different concentrations, add the appropriate volume of each sample to achieve equimolar concentration in the pool, then adjust the pool to the desired final volume using Low TE. The formula below is provided for determination of the amount of each indexed sample to add to the pool.

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

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 (typically 4 nM–15 nM or the concentration of the most dilute sample)

$\#$  is the number of indexes, and

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

**Table 30** 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 DNA.

## 4 Post-Capture Sample Processing for Multiplexed Sequencing

### Step 4. Pool samples for multiplexed sequencing

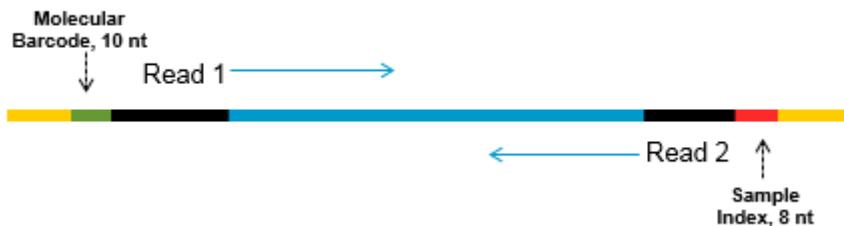
**Table 30** Example of volume calculation for total volume of 20  $\mu$ l at 10 nM concentration

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

If you store the library before sequencing, add Tween 20 to 0.1% v/v and store at -20°C short term.

## Step 5. Prepare sequencing samples

The final SureSelect<sup>XT</sup> Low Input library pool is ready for direct sequencing using standard Illumina paired-end primers and chemistry. Each fragment in the prepared library contains one target insert surrounded by sequence motifs required for multiplexed sequencing using the Illumina platform, as shown in [Figure 14](#).



**Figure 14** Content of SureSelect XT Low Input sequencing library. Each fragment contains one target insert (blue) surrounded by the Illumina paired-end sequencing elements (black), the sample index (red), the molecular barcode (green) and the library bridge PCR primers (yellow).

Libraries can be sequenced on the Illumina HiSeq, MiSeq, or NextSeq platform using the run type and chemistry combinations shown in [Table 31](#).

### CAUTION

Reduced molecular barcode quality has been observed when SureSelect<sup>XT</sup> Low Input libraries are sequenced on the HiSeq2500 instrument in high-output run mode (v4 chemistry). Lower Q scores have been shown to impact coverage and sensitivity of variant calls, especially for aberrations present at less than 10% frequency. Please contact Agilent Technical Support for further information.

Proceed to cluster amplification using the appropriate Illumina Paired-End Cluster Generation Kit. See [Table 31](#) for kit configurations compatible with the recommended read length.

## 4 Post-Capture Sample Processing for Multiplexed Sequencing

### Step 5. Prepare sequencing samples

The optimal seeding concentration for SureSelect<sup>XT</sup> Low Input target-enriched libraries varies according to sequencing platform, run type, and Illumina kit version. See [Table 31](#) for guidelines. 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.

**Table 31** Illumina Kit Configuration Selection Guidelines

Platform	Run Type	Read Length	SBS Kit Configuration	Chemistry	Seeding Concentration
HiSeq 2500	Rapid Run	2 × 100 bp	200 Cycle Kit	v2	9–10 pM
HiSeq 2500	High Output	2 × 100 bp	4×50 Cycle Kits <sup>*</sup>	v3	9–10 pM
HiSeq 2500	High Output <sup>†</sup>	2 × 100 bp	250 Cycle Kit	v4	12–14 pM
HiSeq 2000	All Runs	2 × 100 bp	4×50 Cycle Kits*	v3	6–9 pM
HiSeq 2000	All Runs	2 × 100 bp	250 Cycle Kit	v4	8–12 pM
MiSeq	All Runs	2 × 100 bp	300 Cycle Kit	v2	9–10 pM
MiSeq	All Runs	2 × 75 bp	150 Cycle Kit	v3	12–16 pM
NextSeq 500/550	All Runs	2 × 100 bp	300 Cycle Kit	v2	1.5–1.8 pM
HiSeq 3000/4000	All Runs	2 × 100 bp	300 Cycle Kit	v1	180–190 pM

\* A single 200-cycle kit does not include enough reagents to complete Reads 1 and 2 in addition to the 8-bp i7 and 10-bp i5 index reads in this format. If preferred, the additional reads may be supported by using one 200-cycle kit plus one 50-cycle kit.

† Reduced molecular barcode sequence quality and lowered Q scores have been observed in sequences obtained from HiSeq 2500 High Output (v4 chemistry) runs. Contact Agilent Technical Support for further information.

Use the guidelines below for SureSelect<sup>XT</sup> Low Input library sequencing run setup and analysis.

- The sample-level index (i7) requires an 8-bp index read. For complete i7 index sequence information, see [Table 44](#) on page 81 and [Table 45](#) on page 82.

**CAUTION**

The 8-bp index sequences in SureSelect XT Low Input Index Primers 1-96 and 97-192 differ from the 8-bp index sequences in index primers A01 through H12 in Agilent's SureSelect XT system.

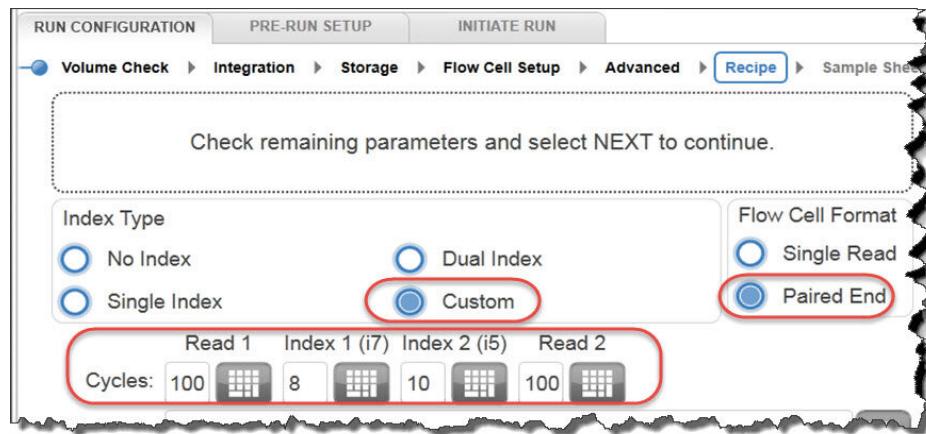
- The degenerate molecular barcode (i5) requires a 10-bp index read. Enter NNNNNNNNNN for the i5 degenerate molecular barcode for all samples.
- For the HiSeq and NextSeq platforms, set up the run using the instrument's user interface, following the guidelines on [page 66](#).
- For the MiSeq platform, set up the run using Illumina Experiment Manager (IEM) using the steps detailed on [page 67](#) to [page 69](#) to generate a custom sample sheet.
- Before aligning reads to the reference genome, trim the reads from Illumina adaptor sequences. See [page 70](#) for information on Agilent's SureCall data analysis software, which may be used for this task.

## 4 Post-Capture Sample Processing for Multiplexed Sequencing

Step 6. Do the sequencing run and analyze the data

### HiSeq and NextSeq platform sequencing run setup guidelines

Set up sequencing runs using the instrument control software interface. A sample run setup for the HiSeq platform using 100 + 100 bp paired-end sequencing is shown below.



If using the NextSeq platform, locate the same parameters on the *Run Setup* screen, then use the settings shown in HiSeq platform example above. BaseSpace currently does not support the sequencing of molecular barcodes as index reads. Set up NextSeq runs using the stand-alone mode.

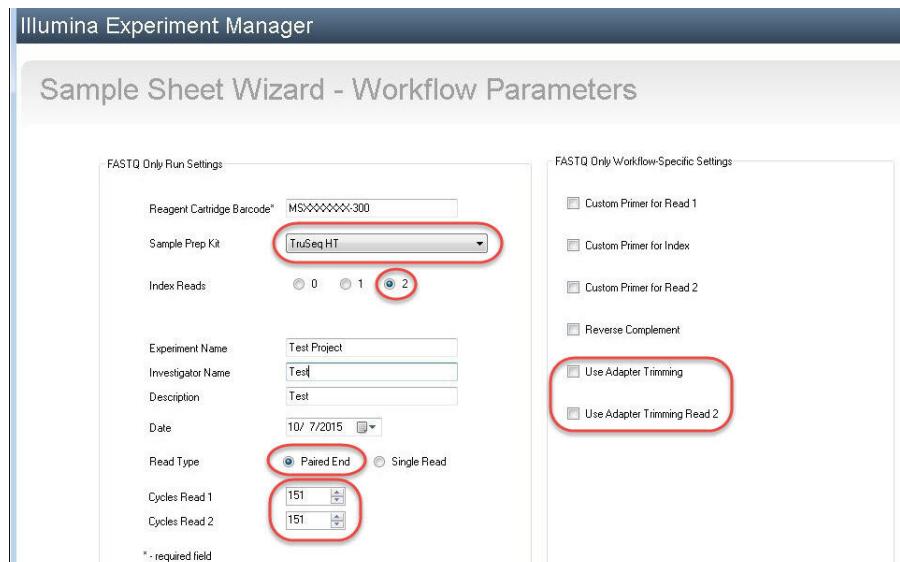
To generate FASTQ files using the `bcl2fastq` software, it is necessary to set **mask-short-adapter-reads** to value of 0 and use the following base mask: Y\*, I8, Y10, Y\*.

### MiSeq platform sequencing run setup guidelines

Use the Illumina Experiment Manager (IEM) software to generate a custom Sample Sheet according to the guidelines below. Once a Sample Sheet has been generated, index sequences need to be manually changed to the SureSelect XT Low Input indexes used for each sample. See [Table 44](#) on page 81 and [Table 45](#) on page 82 for nucleotide sequences of the SureSelect XT Low Input system indexes.

**Setting up a custom Sample Sheet:**

- 1 In the IEM software, create a Sample Sheet for the MiSeq platform using the following Workflow selections.
  - Under **Category**, select *Other*.
  - Under **Application**, select *FASTQ Only*.
- 2 On the **Workflow Parameters** screen, enter the run information, making sure to specify the key parameters highlighted below. In the *Cycles Read 1* and *Cycles Read 2* fields, enter 101 for 100 bp read length. Clear all of the *FASTQ Only Workflow-Specific Settings* checkboxes. Make sure that both adaptor-trimming checkboxes (circled below) are cleared, since these are selected by default.

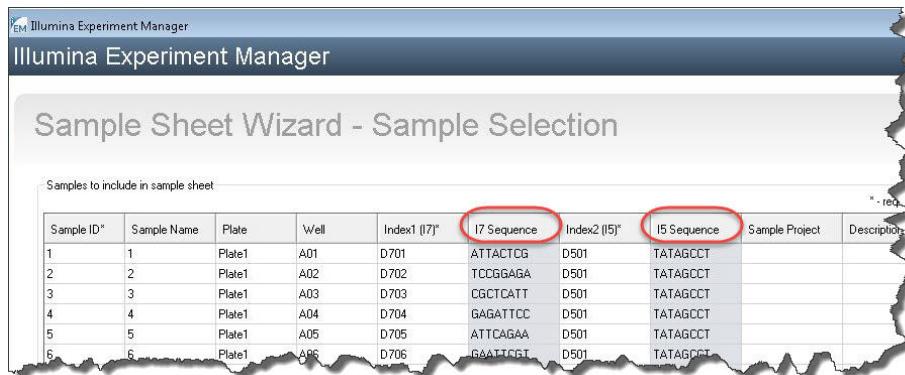


- 3 Using the **Sample Sheet Wizard**, set up a New Plate, entering the required information for each sample to be sequenced. In the **I7 Sequence** column, assign each sample to any of the Illumina i7 indexes. The index will be corrected to a SureSelect XT Low Input index at a later stage.

#### 4 Post-Capture Sample Processing for Multiplexed Sequencing

##### Step 6. Do the sequencing run and analyze the data

Likewise, in the **I5 Sequence** column, assign any of the Illumina i5 indexes, to be corrected to the degenerate molecular barcode at a later stage.



- 4 Finish the sample sheet setup tasks and save the sample sheet file.

### Editing the Sample Sheet to include SureSelect XT Low Input indexes and molecular barcodes

- 1 Open the Sample Sheet file in a text editor and edit the i7 and i5 index information for each sample in columns 5–8 (highlighted below).
- In column 5 under **I7\_Index\_ID**, enter the name of the SureSelect XT Low Input index assigned to the sample. In column 6 under **index**, enter the corresponding SureSelect XT Low Input Index sequence. See **Table 44** on page 81 and **Table 45** on page 82 for nucleotide sequences of the SureSelect XT Low Input indexes.
- In column 7 under **I5\_Index\_ID**, enter *MolBC* for all samples. In column 8 under **index2**, enter text “NNNNNNNNNN” for all samples to represent the degenerate 10-nucleotide molecular barcode tagging each fragment.

[Header]									
Investigator Name	NN								
Project Name	Sequencing Project A								
Experiment Name	Experiment 1								
Date	4/1/2017								
Workflow	GenerateFASTQ								
Assay	SureSelect XTHS								
Chemistry	SureSelect XTHS								
[Reads]									
101									
101									
[Settings]									
OnlyGenerateFASTQ	1								
[Data]									
Sample_ID	Sample_Name	Sample_Plate	Sample_Well	I7_Index_ID	index	I5_Index_ID	index2	Sample_Project	Description
Sample 1	Sample1	Plate1	A01	A01	AACGTGAT	MolBC	NNNNNNNNNN		
Sample 2	Sample2	Plate1	A02	A02	AAACATCG	MolBC	NNNNNNNNNN		
Sample 3	Sample3	Plate1	A03	A03	A	MolBC	NNNNNNNNNN		

**Figure 15** Sample sheet for SureSelect XT Low Input library sample sequencing

- 2 Save the edited Sample Sheet in an appropriate file location for use in the MiSeq platform run.

## 4 Post-Capture Sample Processing for Multiplexed Sequencing

### Sequence analysis resources

#### Additional MiSeq platform sequencing run setup requirements

Before the first use of the MiSeq instrument for SureSelect XT Low Input library sequencing, you must adjust the MiSeq Reporter settings to generate FASTQ files for index reads. Once changed, this setting is retained for future runs.

To change this setting, open the file **MiSeq Reporter.exe.config**. Under the **<appSettings>** tag, add **<add key="CreateFastqForIndexReads" value="1"/>**. You must restart the instrument for this setting change to take effect.

#### NOTE

If you are using the MiSeqDx platform, run the instrument in research mode to make changes to MiSeq Reporter settings. If research mode is not available on your instrument, you may need to upgrade the system to include the dual boot configuration to allow settings changes in research mode.

## Sequence analysis resources

Agilent SureCall NGS data analysis software is designed to perform adaptor trimming, alignment of reads, and variant calling of sequencing data generated from SureSelect<sup>XT</sup> Low Input libraries. To download SureCall free-of-charge and for additional information, including SureCall software tutorials, visit [www.agilent.com/genomics/surecall](http://www.agilent.com/genomics/surecall).

If using another pipeline for alignment and downstream analysis, Agilent provides the Agilent Genomics NextGen Toolkit (AGeNT), with certain of the Agilent SureCall capabilities in a flexible command-line interface for integration into your bioinformatics pipeline. AGeNT is a Java-based software module that has been designed to provide adaptor and low-quality bases trimming and duplicate read removal for high-sensitivity (HS) and non-HS data. This tool is explicitly designed for users with established in-house bioinformatics experts with the capability to build, integrate, maintain, and troubleshoot internal analysis pipelines. Moreover, the module is designed specifically for users with sufficient computing infrastructure and IT support to troubleshoot all issues unrelated to the execution of the AGeNT algorithms. Because Agilent provides limited support of AGeNT, users with limited bioinformatics expertise should instead use Agilent SureCall software. Agilent does not guarantee the usability of third party tools (open- or closed-source) in upstream/downstream analysis of data in conjunction with AGeNT. For additional information on this tool, visit the [AGeNT page at www.genomics.agilent.com](http://www.genomics.agilent.com).

## 5

# Appendix: Using FFPE-derived DNA Samples

Protocol modifications for FFPE Samples 72

Methods for FFPE Sample Qualification 72

Sequencing Output Recommendations for FFPE Samples 73

This chapter summarizes the protocol modifications to apply to FFPE samples based on the integrity of the FFPE sample DNA.



## 5 Appendix: Using FFPE-derived DNA Samples

### Protocol modifications for FFPE Samples

## Protocol modifications for FFPE Samples

Protocol modifications that should be applied to FFPE samples are summarized in [Table 32](#).

**Table 32** Summary of protocol modifications for FFPE samples

Workflow Step and page	Parameter	Condition for non-FFPE Samples	Condition for FFPE Samples
gDNA Sample Preparation <a href="#">page 19</a>	Qualification of DNA Integrity	Not required	Required
DNA input for Library Preparation <a href="#">page 19</a>	Input amount and means of quantification	10 ng to 200 ng, quantified by Qubit assay	Based on determined DNA integrity (see <a href="#">Table 7</a> on page 19 and <a href="#">Table 8</a> on page 20)
DNA Shearing <a href="#">page 22</a>	Mode of DNA Shearing	2 × 120 seconds	240 seconds (continuous)
Pre-capture PCR <a href="#">page 32</a>	Cycle number	8–11	11–14
Sequencing <a href="#">page 73</a>	Output augmentation	Per project requirements	1× to 10× based on determined DNA integrity (see <a href="#">Table 33</a> and <a href="#">Table 34</a> on page 73)

## Methods for FFPE Sample Qualification

DNA integrity may be assessed using the Agilent NGS FFPE QC Kit or using the Agilent 4200 TapeStation system and Genomic DNA ScreenTape.

The Agilent NGS FFPE QC Kit provides a qPCR-based assay for DNA sample integrity determination. Results include the precise quantity of amplifiable DNA in the sample to allow direct normalization of input DNA amount and a  $\Delta\Delta Cq$  DNA integrity score used to design other protocol modifications.

The Agilent 4200 TapeStation system, combined with the Genomic DNA ScreenTape assay, provides a microfluidics-based method for determination of a DNA Integrity Number (DIN) score used to estimate amount of input DNA required for sample normalization and to design other protocol modifications.

## Sequencing Output Recommendations for FFPE Samples

After determining the amount of sequencing output required for intact DNA samples to meet the goals of your project, use the guidelines below to determine the amount of extra sequencing output required for FFPE DNA samples.

**Samples qualified using  $\Delta\Delta Cq$ :** For samples qualified based on the  $\Delta\Delta Cq$  DNA integrity score, use the guidelines in [Table 33](#). For example, if your workflow demands 100 Mb output for intact DNA samples to achieve the required coverage, an FFPE sample with  $\Delta\Delta Cq$  score of 1 requires 200–400 Mb of sequencing output to achieve the same coverage.

**Table 33** Recommended sequencing augmentation for FFPE-derived DNA samples

$\Delta\Delta Cq$ value	Recommended fold increase for FFPE-derived sample
<0.5	No extra sequencing output
between 0.5 and 2	Increase sequencing allocation by 2 $\times$ to 4 $\times$
>2	Increase sequencing allocation by 5 $\times$ to 10 $\times$ or more

**Samples qualified using DIN:** For samples qualified based on the Genomic DNA ScreenTape assay DIN integrity score, use the guidelines in [Table 34](#). For example, if your workflow demands 100 Mb output for intact DNA samples to achieve the required coverage, an FFPE sample with DIN score of 4 requires approximately 200–400 Mb of sequencing output to achieve the same coverage.

**Table 34** Recommended sequencing augmentation for FFPE-derived DNA samples

DIN value	Recommended fold increase for FFPE-derived sample
$\geq 8$	No extra sequencing output
between 3 and 8	Increase sequencing allocation by 2 $\times$ to 4 $\times$
<3	Increase sequencing allocation by 5 $\times$ to 10 $\times$ or more

## 5 Appendix: Using FFPE-derived DNA Samples

### Sequencing Output Recommendations for FFPE Samples

## 6 Reference

- Kit Contents 76
- Nucleotide Sequences of SureSelect XT Low Input Indexes 81
- Troubleshooting Guide 83
- Quick Reference Protocol 87

This chapter contains reference information, including component kit contents, index sequences, troubleshooting information, and a quick-reference protocol for experienced users.



## Kit Contents

SureSelect<sup>XT</sup> Low Input Reagent + Capture Library Kits contain the following component kits:

**Table 35** Contents of SureSelect<sup>XT</sup> Low Input Reagent + Capture Library Kits p/n G9707A–L (96 Reactions)

Component Kit Name	Storage Condition	Component Kit p/n
SureSelect XT HS and XT Low Input Library Preparation Kit for ILM (Pre PCR)	–20°C	5500-0140
SureSelect XT Low Input Index Primers 1–96 for ILM (Pre PCR)	–20°C	5190-6444
SureSelect XT HS and XT Low Input Target Enrichment Kit ILM Hyb Module, Box 1 (Post PCR)	Room Temperature	5190-9687
SureSelect XT HS and XT Low Input Target Enrichment Kit ILM Hyb Module, Box 2 (Post PCR)	–20°C	5190-9686
SSel XT HS and XT Low Input Capture Library	–80°C	see Table 41

**Table 36** Contents of SureSelect<sup>XT</sup> Low Input Reagent + Capture Library Kits p/n G9708A–L (96 Reactions)

Component Kit Name	Storage Condition	Component Kit p/n
SureSelect XT HS and XT Low Input Library Preparation Kit for ILM (Pre PCR)	–20°C	5500-0140
SureSelect XT Low Input Index Primers 97–192 for ILM (Pre PCR)	–20°C	5190-6445
SureSelect XT HS and XT Low Input Target Enrichment Kit ILM Hyb Module, Box 1 (Post PCR)	Room Temperature	5190-9687
SureSelect XT HS and XT Low Input Target Enrichment Kit ILM Hyb Module, Box 2 (Post PCR)	–20°C	5190-9686
SSel XT HS and XT Low Input Capture Library	–80°C	see Table 41

The contents of each of the component kits listed in [Table 35](#) and [Table 36](#) are described in the tables below.

**Table 37** SureSelect XT HS and XT Low Input Library Preparation Kit (Pre PCR) Content

Kit Component	Format
End Repair-A Tailing Enzyme Mix	tube with orange cap
End Repair-A Tailing Buffer	bottle
T4 DNA Ligase	tube with blue cap
Ligation Buffer	bottle
Adaptor Oligo Mix	tube with white cap
Forward Primer	tube with brown cap
100 mM dNTP Mix (25 mM each dNTP)	tube with green cap
Herculase II Fusion DNA Polymerase	tube with red cap
5× Herculase II Reaction Buffer	tube with clear cap

**Table 38** SureSelect XT Low Input Index Primers for ILM Kits (Pre PCR) Content

Kit Component	Index Primers 1-96 (p/n 5190-6444)	Index Primers 97-192 (p/n 5190-6445)
SureSelect XT Low Input Index Primers for ILM (reverse primers containing 8-bp index sequence)	Index Primers 1 through 96, provided in yellow plate (Index Plate 1) <sup>*</sup>	Index Primers 97 through 192, provided in red plate (Index Plate 2) <sup>†</sup>

<sup>\*</sup> See [Table 42](#) on page 80 for a plate map and see [Table 44](#) on page 81 for index sequences.

<sup>†</sup> See [Table 43](#) on page 80 for a plate map and see [Table 45](#) on page 82 for index sequences.

## CAUTION

The SureSelect XT Low Input Index Primers are provided in single-use aliquots. To avoid cross-contamination of libraries, use each well for a single library preparation reaction. Do not re-use any residual volume for subsequent experiments.

**6 Reference**  
**Kit Contents**

**Table 39** Target Enrichment Kit, ILM Hyb Module Box 1 (Post PCR) Content

Kit Component	Format
SureSelect Binding Buffer	bottle
SureSelect Wash Buffer 1	bottle
SureSelect Wash Buffer 2	bottle

**Table 40** SureSelect XT HS and XT Low Input Target Enrichment Kit, ILM Hyb Module Box 2 (Post PCR) Content

Kit Component	Format
SureSelect Fast Hybridization Buffer	bottle
SureSelect XT HS and XT Low Input Blocker Mix	tube with blue cap
SureSelect RNase Block	tube with purple cap
SureSelect Post-Capture Primer Mix	tube with clear cap
100 mM dNTP Mix (25 mM each dNTP)	tube with green cap
Herculase II Fusion DNA Polymerase	tube with red cap
5× Herculase II Reaction Buffer	tube with clear cap

**Table 41** Capture Library part numbers for kits G9707A–L and G9708A–L

Catalog No. Suffix	Capture Library	Part number
A	<b>SSel XT HS and XT Low Input Custom 1–499 kb</b>	5190-9927 (5190-9932 for reorder)
B	<b>SSel XT HS and XT Low Input Custom 0.5–2.9 Mb</b>	5190-9928 (5190-9933 for reorder)
C	<b>SSel XT HS and XT Low Input Custom 3–5.9 Mb</b>	5190-9929 (5190-9934 for reorder)
D	<b>SSel XT HS and XT Low Input Custom 6–11.9 Mb</b>	5190-9930 (5190-9935 for reorder)
E	<b>SSel XT HS and XT Low Input Custom 12–24 Mb</b>	5190-9931 (5190-9936 for reorder)
G	<b>SSel XT HS and XT Low Input ClearSeq Comp Cancer</b>	5190-9950
H	<b>SSel XT HS and XT Low Input Clinical Research Exome V2</b>	5190-9952
J	<b>SSel XT HS and XT Low Input Clinical Research Exome V2 Plus</b>	5190-9945 (5190-9946 for reorder)
K	<b>SSel XT HS and XT Low Input Human All Exon V6</b>	5190-9954
L	<b>SSel XT HS and XT Low Input Human All Exon V6 Plus</b>	5190-9947 (5190-9948 for reorder)

## 6 Reference

### Kit Contents

**Table 42** Plate map for SureSelect XT Low Input Index Primers 1-96, provided in yellow plate (Index Plate 1)

	1	2	3	4	5	6	7	8	9	10	11	12
A	1	9	17	25	33	41	49	57	65	73	81	89
B	2	10	18	26	34	42	50	58	66	74	82	90
C	3	11	19	27	35	43	51	59	67	75	83	91
D	4	12	20	28	36	44	52	60	68	76	84	92
E	5	13	21	29	37	45	53	61	69	77	85	93
F	6	14	22	30	38	46	54	62	70	78	86	94
G	7	15	23	31	39	47	55	63	71	79	87	95
H	8	16	24	32	40	48	56	64	72	80	88	96

**Table 43** Plate map for SureSelect XT Low Input Index Primers 97-192, provided in red plate (Index Plate 2)

	1	2	3	4	5	6	7	8	9	10	11	12
A	97	105	113	121	129	137	145	153	161	169	177	185
B	98	106	114	122	130	138	146	154	162	170	178	186
C	99	107	115	123	131	139	147	155	163	171	179	187
D	100	108	116	124	132	140	148	156	164	172	180	188
E	101	109	117	125	133	141	149	157	165	173	181	189
F	102	1110	118	126	134	142	150	158	166	174	182	190
G	103	111	119	127	135	143	151	159	167	175	183	191
H	104	112	120	128	136	144	152	160	168	176	184	192

## Nucleotide Sequences of SureSelect XT Low Input Indexes

Each index is 8 nt in length. See [page 65](#) for sequencing run setup requirements for sequencing libraries using 8-bp indexes.

**Table 44 SureSelect XT Low Input Indexes 1–96, provided in yellow 96-well plate (Index Plate 1)**

Index	Well	Sequence	Index	Well	Sequence	Index	Well	Sequence	Index	Well	Sequence
1	A01	GTCTGTCA	25	A04	CCGTGAGA	49	A07	ATGCCTAA	73	A10	ACAGCAGA
2	B01	TGAAGAGA	26	B04	GAATAGTA	50	B07	ATCATTCC	74	B10	AAGAGATC
3	C01	TTCACGCA	27	C04	GATAGACA	51	C07	AACTCACC	75	C10	CAAGACTA
4	D01	AACGTGAT	28	D04	GCTCGGTA	52	D07	AACGCTTA	76	D10	AAGACGGA
5	E01	ACCACTGT	29	E04	GGTGCGAA	53	E07	CAGCGTTA	77	E10	GCCAAGAC
6	F01	ACCTCCAA	30	F04	AACAACCA	54	F07	CTCAATGA	78	F10	CTGTAGCC
7	G01	ATTGAGGA	31	G04	CGGATTGC	55	G07	AATGTTGC	79	G10	CGCTGATC
8	H01	ACACAGAA	32	H04	AGTCACTA	56	H07	CAAGGAGC	80	H10	CAACCACA
9	A02	GCGAGTAA	33	A05	AAACATCG	57	A08	GAATCTGA	81	A11	CCTCCTGA
10	B02	GTCGTAGA	34	B05	ACGTATCA	58	B08	GAGCTGAA	82	B11	TCTTCACA
11	C02	GTGTTCTA	35	C05	CCATCCTC	59	C08	GCCACATA	83	C11	GAACAGGC
12	D02	TATCAGCA	36	D05	GGAGAACCA	60	D08	GCTAACGA	84	D11	ATTGGCTC
13	E02	TGGAACAA	37	E05	CGAACTTA	61	E08	GTACGCAA	85	E11	AAGGACAC
14	F02	TGGTGGTA	38	F05	ACAAGCTA	62	F08	TCCGTCTA	86	F11	ACACGACC
15	G02	ACTATGCA	39	G05	CTGAGCCA	63	G08	CAGATCTG	87	G11	ATAGCGAC
16	H02	CCTAATCC	40	H05	ACATTGGC	64	H08	AGTACAAG	88	H11	CCGAAGTA
17	A03	AGCAGGAA	41	A06	CATACCAA	65	A09	AGGCTAAC	89	A12	CCTCTATC
18	B03	AGCCATGC	42	B06	CAATGGAA	66	B09	CGACTGGA	90	B12	AACCGAGA
19	C03	TGGCTTCA	43	C06	ACGCTCGA	67	C09	CACCTTAC	91	C12	GATGAATC
20	D03	CATCAAGT	44	D06	CCAGTTCA	68	D09	CACTTCGA	92	D12	GACAGTGC
21	E03	CTAAGGTC	45	E06	TAGGATGA	69	E09	GAGTTAGC	93	E12	CCGACAAAC
22	F03	AGTGGTCA	46	F06	CGCATAACA	70	F09	CTGGCATA	94	F12	AGCACCTC
23	G03	AGATCGCA	47	G06	AGAGTCAA	71	G09	AAGGTACA	95	G12	ACAGATTG
24	H03	ATCCTGTA	48	H06	AGATGTAC	72	H09	CGACACAC	96	H12	AATCCGTC

## 6 Reference

### Nucleotide Sequences of SureSelect XT Low Input Indexes

**Table 45 SureSelect XT Low Input Indexes 97–192, provided in red 96-well plate (Index Plate 2)**

Index	Well	Sequence	Index	Well	Sequence	Index	Well	Sequence	Index	Well	Sequence
97	A01	CCACACGA	121	A04	CTGTCAGT	145	A07	TCGAACGC	169	A10	GACCTCCT
98	B01	GACCACAC	122	B04	TCTAGTGT	146	B07	GCCTAAAT	170	B10	ACAAGGAC
99	C01	GTGCGACA	123	C04	GGATGATA	147	C07	CGTGATAA	171	C10	CCAAACCT
100	D01	GCTTCATG	124	D04	TACAGCGT	148	D07	TCCGCTGA	172	D12	CACCAAGT
101	E01	ACTAAGTC	125	E04	AGTACCGA	149	E07	GCTCATTG	173	E10	TGGACGAC
102	F01	CAGGAAAG	126	F04	GAGCCAAG	150	F07	AATCGATG	174	F10	GTTACAGC
103	G01	GATCCGCT	127	G04	AGCGACAT	151	G07	TTCCATCA	175	G10	GAACAATG
104	H01	GTATCAAC	128	H04	TTACCACC	152	H07	ATTCACAG	176	H10	CAATGACT
105	A02	TAGAGTCG	129	A05	AGACGCCA	153	A08	CGGAAAGA	177	A11	GCTCGAAC
106	B02	TCGACACT	130	B05	CATACTGG	154	B08	GTCAAGTG	178	B11	TCGGTAGC
107	C02	CTGACCTC	131	C05	CACGCATT	155	C08	CATCTTCA	179	C11	TACGAACT
108	D02	CATGGCTT	132	D05	TGGTCAAG	156	D08	GATAGGAT	180	D11	GCCGGATT
109	E02	GTACAGAT	133	E05	GACGGAAA	157	E08	CAAGTGGT	181	E11	TAGCTCGG
110	F02	TAGTGTTC	134	F05	AGTAGACT	158	F08	GCGTTACA	182	F11	TTGCCGGA
111	G02	ATCGAACAC	135	G05	TACAAAGG	159	G08	TATGCAAC	183	G11	GGTATGGT
112	H02	TCAAGTCA	136	H05	CGCAAGAT	160	H08	GAGACCGT	184	H11	TCACTAAG
113	A03	GGAACAAT	137	A06	TGTTGCAA	161	A09	TCGATGAA	185	A12	CCTCCCAT
114	B03	TAGCGAGT	138	B06	ATCAACGT	162	B09	TCAAAGAG	186	B12	GTTCTAGT
115	C03	TACCGAAG	139	C06	GACGACTG	163	C09	GTGGTATG	187	C12	GAGAAACC
116	D03	TAAGTCAC	140	D06	ACTGGACG	164	D09	CTGAGAAT	188	D12	CCTGTAAT
117	E03	ATAACGTG	141	E06	TGATAACG	165	E09	TCTATCCG	189	E12	CCTTACCA
118	F03	GGTAGCTC	142	F06	ACATAGCG	166	F09	GCAATGTT	190	F12	ATGATAGG
119	G03	GAAGTACC	143	G06	ACACAAGG	167	G09	CACATAGC	191	G12	TATGGTGG
120	H03	CAACGTAT	144	H06	GAACGCTC	168	H09	TCCTGACC	192	H12	TGAGGAAT

## Troubleshooting Guide

### If recovery of gDNA from samples is low

- ✓ Using excess tissue for gDNA isolation can reduce yield. Use only the amount of each specific tissue type recommended by the gDNA isolation protocol.
- ✓ Tissue sample lysis may not have been optimal during gDNA isolation. Monitor the extent of sample lysis during the Proteinase K digestion at 56°C by gently pipetting the digestion reaction every 20–30 minutes, visually inspecting the solution for the presence of tissue clumps. If clumps are still present after the 1-hour incubation at 56°C, add another 10 µl of Proteinase K and continue incubating at 56°C, with periodic mixing and visual inspections, for up to two additional hours. When the sample no longer contains clumps of tissue, move the sample to room temperature until lysis is complete for the remaining samples. Do not over-digest. Individual samples may be kept at room temperature for up to 2 hours before resuming the protocol. Do not exceed 3 hours incubation at 56°C for any sample.

### If yield of pre-capture libraries is low

- ✓ The library preparation protocol includes specific thawing, temperature control, pipetting, and mixing instructions which are required for optimal performance of the highly viscous buffer and enzyme solutions used in the protocol. Be sure to adhere to all instructions when setting up the reactions.
- ✓ Ensure that the ligation master mix (see [page 25](#)) is kept at room temperature for 30–45 minutes before use.
- ✓ PCR cycle number may require optimization. Repeat library preparation for the sample, increasing the pre-capture PCR cycle number by 1 to 2 cycles. If a high molecular weight peak (>500 bp) is observed in the electropherogram for a sample with low yield, the DNA may be overamplified. Repeat library preparation for the sample, decreasing the pre-capture PCR cycle number by 1 to 3 cycles.
- ✓ DNA isolated from degraded samples, including FFPE tissue samples, may be over-fragmented or have modifications that adversely affect library preparation processes. Use the Agilent NGS FFPE QC Kit to determine the precise quantity of amplifiable DNA in the sample and allow direct normalization of input DNA amount.

- ✓ Performance of the solid-phase reversible immobilization (SPRI) purification step may be poor. Verify the expiration date for the vial of AMPure XP beads used for purification. Adhere to all bead storage and handling conditions recommended by the manufacturer. Ensure that the beads are kept at room temperature for at least 30 minutes before use. Use freshly-prepared 70% ethanol for each SPRI procedure.
- ✓ DNA elution during SPRI purification steps may be incomplete. Ensure that the AMPure XP beads are not overdried just prior to sample elution.

#### If solids observed in the End Repair-A Tailing Buffer

- ✓ Vortex the solution at high speed until the solids are dissolved. The observation of solids when first thawed does not impact performance, but it is important to mix the buffer until all solutes are dissolved.

#### If pre-capture library fragment size is larger than expected in electropherograms

- ✓ Shearing may not be optimal. For intact, high-quality DNA samples, ensure that shearing is completed using the two-round shearing protocol provided, including all spinning and vortexing steps.
- ✓ Any bubbles present on the microTUBE filament may disrupt complete shearing. Spin the microTUBE for 30 seconds before the first round of shearing to ensure that any bubbles are released.

#### If pre-capture library fragment size is different than expected in electropherograms

- ✓ FFPE DNA pre-capture libraries may have a smaller fragment size distribution due to the presence of DNA fragments in the input DNA that are smaller than the target DNA shear size.
- ✓ DNA fragment size selection during SPRI purification depends upon using the correct ratio of sample to AMPure XP beads. Before removing an aliquot of beads for the purification step, mix the beads until the suspension appears homogeneous and consistent in color and verify that you are using the bead volume recommended for pre-capture purification on [page 34](#).

**If low molecular weight adaptor-dimer peak is present in pre-capture library electropherograms**

- ✓ The presence of a low molecular weight peak, in addition to the expected peak, indicates the presence of adaptor-dimers in the library. It is acceptable to proceed to target enrichment with library samples for which adaptor-dimers are observed in the electropherogram at low abundance, similar to the samples analyzed on [page 37](#) to [page 40](#). The presence of excessive adaptor-dimers in the samples may be associated with reduced yield of pre-capture libraries. If excessive adaptor-dimers are observed, verify that the adaptor ligation protocol is being performed as directed on [page 28](#). In particular, ensure that the Ligation master mix is mixed with the sample prior to adding the Adaptor Oligo Mix to the mixture. Do not add the Ligation master mix and the Adaptor Oligo Mix to the sample in a single step.
- ✓ For whole-genome sequencing (not specifically supported by this protocol), samples with an adaptor-dimer peak must be subjected to an additional round of SPRI-purification. To complete, first dilute the sample to 50 µl with nuclease free water, then follow the SPRI purification procedure on [page 34](#).

**If yield of post-capture libraries is low**

- ✓ PCR cycle number may require optimization. Repeat library preparation and target enrichment for the sample, increasing the post-capture PCR cycle number by 1 to 2 cycles.
- ✓ The RNA Capture Library used for hybridization may have been compromised. Verify the expiration date on the Capture Library vial or Certificate of Analysis. Adhere to the recommended storage and handling conditions. Ensure that the Capture Library Hybridization Mix is prepared immediately before use, as directed on [page 45](#), and that solutions containing the Capture Library are not held at room temperature for extended periods.

**If post-capture library fragment size is different than expected in electropherograms**

- ✓ DNA fragment size selection during SPRI purification depends upon using the correct ratio of sample to AMPure XP beads. Before removing an aliquot of beads for the purification step, mix the beads until the suspension appears homogeneous and consistent in color and verify that you are using the bead volume recommended for post-capture purification on [page 55](#).

**If low % on-target is observed in library sequencing results**

- ✓ Stringency of post-hybridization washes may have been lower than required. Complete the wash steps as directed, paying special attention to the details of SureSelect Wash Buffer 2 washes listed below:
  - SureSelect Wash Buffer 2 is pre-warmed to 70°C (see [page 48](#))
  - Samples are maintained at 70°C during washes (see [page 49](#))
  - Bead suspensions are mixed thoroughly during washes by pipetting up and down **and** vortexing (see [page 49](#))
- ✓ Minimize the amount of time that hybridization reactions are exposed to RT conditions during hybridization setup. Locate a vortex and plate spinner or centrifuge in close proximity to thermal cycler to retain the 65°C sample temperature during mixing and transfer steps ([step 8](#) to [step 9](#) on [page 46](#)).

**If low uniformity of coverage with high AT-dropout is observed in library sequencing results**

- ✓ High AT-dropout may indicate that hybridization conditions are too stringent to obtain the desired level of coverage for AT-rich targets. Repeat target enrichment at lower stringency using a modified thermal cycler program for hybridization, reducing the hybridization temperature in segments 4 and 5 from 65°C to 62.5°C or 60°C (see [Table 20](#) on [page 43](#)).

# Quick Reference Protocol

An abbreviated summary of the protocol steps is provided below for experienced users. Use the complete protocol on [page 18](#) to [page 69](#) until you are familiar with all of the protocol details such as reagent mixing instructions and instrument settings.

Step	Summary of Conditions
<b>Library Prep</b>	
Prepare and qualify DNA samples	Prepare 10–200 ng gDNA in 50 $\mu$ l Low TE For FFPE DNA, qualify integrity and adjust input amount as directed on <a href="#">page 19</a> and <a href="#">page 20</a>
Shear DNA	Use shearing conditions on <a href="#">page 22</a> , with two rounds of duration 120 seconds for high-quality DNA and single round of duration of 240 seconds for FFPE DNA
Prepare Ligation master mix	Per reaction: 23 $\mu$ l Ligation Buffer + 2 $\mu$ l T4 DNA Ligase Keep at room temperature 30–45 min before use
Prepare End-Repair/dA-Tailing master mix	Per reaction: 16 $\mu$ l End Repair-A Tailing Buffer + 4 $\mu$ l End Repair-A Tailing Enzyme Mix Keep on ice
End-Repair and dA-Tail the sheared DNA	50 $\mu$ l sheared DNA sample + 20 $\mu$ l End Repair/dA-Tailing master mix Incubate in thermal cycler: 15 min @ 20°C, 15 min @ 72°C, Hold @ 4°C
Ligate adaptor	70 $\mu$ l DNA sample + 25 $\mu$ l Ligation master mix + 5 $\mu$ l Adaptor Oligo Mix Incubate in thermal cycler: 30 min @ 20°C, Hold @ 4°C
Purify DNA	100 $\mu$ l DNA sample + 80 $\mu$ l AMPure XP bead suspension Elute DNA in 35 $\mu$ l nuclease-free H <sub>2</sub> O
Prepare PCR master mix	Per reaction: 10 $\mu$ l 5 $\times$ Herculase II Reaction Buffer + 0.5 $\mu$ l 100 mM dNTP Mix + 2 $\mu$ l Forward Primer + 1 $\mu$ l Herculase II Fusion DNA Polymerase Keep on ice
Amplify the purified DNA	34.5 $\mu$ l purified DNA + 13.5 $\mu$ l PCR master mix + 2 $\mu$ l assigned SureSelect XT Low Input Index Primer Amplify in thermal cycler using program on <a href="#">page 32</a>
Purify amplified DNA	50 $\mu$ l amplified DNA + 50 $\mu$ l AMPure XP bead suspension Elute DNA in 15 $\mu$ l nuclease-free H <sub>2</sub> O
Quantify and qualify DNA	Analyze 1 $\mu$ l using Agilent 2100 Bioanalyzer or 4200 TapeStation instrument

## 6 Reference

### Quick Reference Protocol

Step	Summary of Conditions
<b>Hybridization/Capture</b>	
Program thermal cycler	Input thermal cycler program on <a href="#">page 43</a> and pause program
Prep DNA in hyb plate	Adjust 500–1000 ng purified prepared library to 12 $\mu$ l volume with nuclease-free H <sub>2</sub> O
Run pre-hybridization blocking protocol	12 $\mu$ l library DNA + 5 $\mu$ l SureSelect XT HS and XT Low Input Blocker Mix Run paused thermal cycler program segments 1 through 3; start new pause during segment 3 (1 min @ 65°C)
Prepare Capture Library Hyb Mix	Prepare 25% RNase Block dilution, then prepare appropriate mixture below: <b>Capture Libraries <math>\geq</math>3 Mb:</b> 2 $\mu$ l 25% RNase Block + 5 $\mu$ l Capture Library + 6 $\mu$ l SureSelect Fast Hybridization Buffer <b>Capture Libraries &lt;3 Mb:</b> 2 $\mu$ l 25% RNase Block + 2 $\mu$ l Capture Library + 3 $\mu$ l nuclease-free H <sub>2</sub> O + 6 $\mu$ l SureSelect Fast Hybridization Buffer
Run the hybridization	With cycler paused and samples retained in cycler, add 13 $\mu$ l Capture Library Hyb Mix to wells Resume the thermal cycler program, completing segments 4 (hybridization) and 5 (65°C hold)
Prepare streptavidin beads	Wash 50 $\mu$ l Dynabeads MyOne Streptavidin T1 beads 3 $\times$ in 200 $\mu$ l SureSelect Binding Buffer
Capture hybridized libraries	Add hybridized samples (~30 $\mu$ l) to washed streptavidin beads (200 $\mu$ l) Incubate 30 min at RT with vigorous shaking (1400–1800 rpm) During incubation, pre-warm 6 $\times$ 200 $\mu$ l aliquots per sample of SureSelect Wash Buffer 2 to 70°C
Wash captured libraries	Collect streptavidin beads with magnetic stand, discard supernatant Wash beads 1 $\times$ with 200 $\mu$ l SureSelect Wash Buffer 1 at RT Wash beads 6 $\times$ with 200 $\mu$ l pre-warmed SureSelect Wash Buffer 2 (5 minutes at 70°C per wash) Resuspend washed beads in 25 $\mu$ l nuclease-free H <sub>2</sub> O
<b>Post-capture amplification</b>	
Prepare PCR master mix	Per reaction: 12.5 $\mu$ l nuclease-free H <sub>2</sub> O + 10 $\mu$ l 5 $\times$ Herculase II Reaction Buffer + 0.5 $\mu$ l 100 mM dNTP Mix + 1 $\mu$ l SureSelect Post-Capture Primer Mix + 1 $\mu$ l Herculase II Fusion DNA Polymerase Keep on ice
Amplify the bead-bound captured libraries	25 $\mu$ l DNA bead suspension + 25 $\mu$ l PCR master mix Amplify in thermal cycler using conditions on <a href="#">page 53</a>
Purify amplified DNA	Remove streptavidin beads using magnetic stand; retain supernatant 50 $\mu$ l amplified DNA + 50 $\mu$ l AMPure XP bead suspension Elute DNA in 25 $\mu$ l nuclease-free H <sub>2</sub> O
Quantify and qualify DNA	Analyze 1 $\mu$ l using Agilent 2100 Bioanalyzer or 4200 TapeStation instrument

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## In This Book

This guide contains information to run the SureSelect<sup>XT</sup> Low Input target enrichment protocol.

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Version A0, July 2017



p/n G9703-90000



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