



Irys[®] Site Preparation Guide

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Revision History

Table 1: Current Revision History

Part Number 30031 Revision	Date	Summary
E	03/17	Release per CO 0305 • Included agarase
D	07/15	Release per CO 0269 • Updated to include new plant and animal DNA extraction kits.
C	01/15	Release per CO 0112 • Updated required materials serial numbers • Updated computing requirements
B	08/14	Release per CO 0083 • Revised computing requirements for clarity and completeness
Initial Release A	06/14	Release per CO 0065

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1. Irys Site Preparation Guide

Your purchase of an Irys® System includes full installation by Bionano Genomics® Field Service Engineer (FSE) and training by Field Application Scientists (FAS) at your site. This preparation guide is to be used by site personnel to prepare for Irys instrument installation. Your FAS is available for any questions and will assist you in the preparation for installation and operation.

This site preparation guide is divided into the following sections:

1 Planning

- 1.1 Hardware and Software Computing Requirements for Instrument and Software
- 1.2 Materials needed - User-Supplied Consumables and Equipment

2 Preparing for Arrival

- 2.1 Shipping Dimensions
- 2.2 Environmental Conditions
- 2.3 Laboratory Bench Layout
- 2.4 Power/Network Connections

3 Preparing for Implementation

- 3.1 Site Preparation and Pre-Installation Checklist
- 3.2 Installation Schedule
- 3.3 Irys Installation and Training Kit

4 Post Installation Follow-Up

- 4.1 Review
- 4.2 Q&A

2. Planning

2.1 Computing Requirements

Irys Workstation Configuration

Irys, AutoDetect, and IrysView® share data using a networked drive and a server for data storage. IrysSolve® analysis pipelines process data on a separate, larger Linux-based compute resource.

 **Note:** Your information technology (IT) resource is responsible for:

- Preparing a stable and sustainable network connection speed of > 1 GB/sec
- Allowing local administration rights for software installation and firewall modification
- Providing internet connection for Bionano Genomics Technical Support services

Irys requires one computer to process images using AutoDetect and visualization of the genome maps using IrysView [Table 2]; and one computer in a cluster or cloud-based environment to perform data assembly using IrysSolve. Additionally, recommendations for server storage size and processing speed are provided [Table 3].

The typical Irys workflow includes Irys, a dedicated computer for image detection and IrysView, a dedicated server for IrysSolve, and a storage server [Figure 1]. Using the Image detection PC for storage is not recommended.

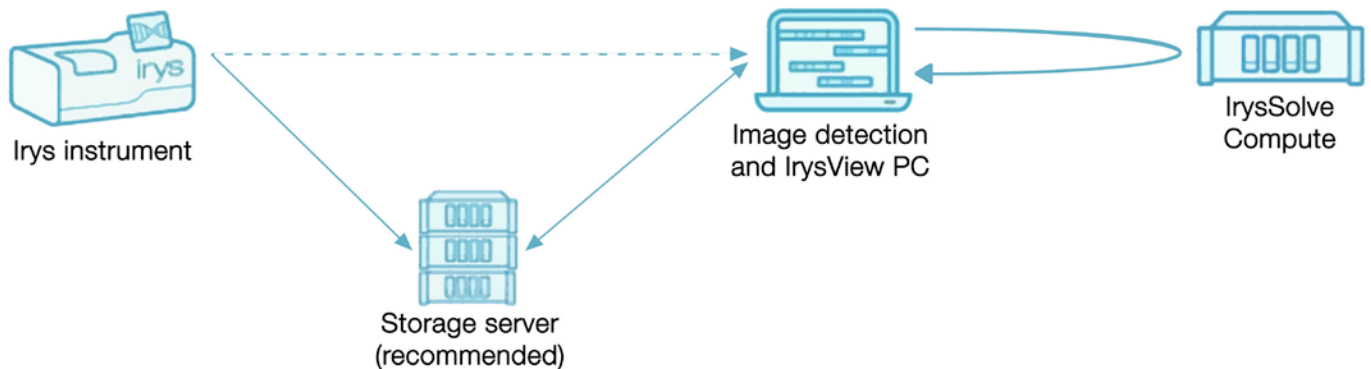


Figure 1: Computer System Workflow

AutoDetect and IrysView Workstation PC

Irys exports images, which are converted to data files with AutoDetect for analysis with IrysView. Device specifications for the two applications are listed in Table 2.



 **Note:** Bionano Genomics recommends a server storage accessible from and mapped to Irys and the IrysView computer [specifications listed in Table 3].

Table 2: Workstation Device Specifications for AutoDetect and IrysView

Device	Recommended Specifications for AutoDetect and IrysView Workstation
Operating System	Windows 7 Professional 64, Windows Server 2012, or Windows 8.1
System Language	English (US)
Regional Settings	English (US)
Processors	3 GHz 4M L3, 4.8 GT/s, HT-enabled Dual 8-Core Intel Xeon Processor capable of 32 logical threads
Memory	128 GB, DDR3 RDIMM, 1333MHz or better, ECC
Graphics	2 GB NVIDIA K2000 or better, capable of OpenGL 2.0
Hard Drive Controller	SATA RAID or non-RAID, 3.0 GB/s
Hard Drive(s)	4 TB SATA 3.0 GB/s, 7200 RPM, 32 MB Cache
Network	1 GB/s Ethernet

 **Note:** If using a Windows Virtual Machine, certain IrysView features may not be available.

IrysSolve®

IrysSolve pipeline performs *de novo* genome map assembly as well as structural variation detection and is available on an integrated Intel® Xeon Phi™ architecture available from Bionano Genomics (IrysSolve Compute™). Alternatively, it can be downloaded on a server with sufficient processor speed and memory.


 **Note:** Bionano Genomics recommends implementing our specialized cluster configuration found in IrysSolve Compute for optimal performance. Using a computer cluster configuration increases processing efficiency and reduces processing time, ultimately saving up to 7 days of processing time over comparable server options for 2 simultaneous assemblies. The results are viewable on a workstation meeting the requirements for visualization (IrysView) listed in Table 2 and secondary analysis (IrysSolve) listed in Tables 3 (IrysSolve Compute) and 4 (alternative configuration).

Table 3: IrysSolve Compute Hardware Specifications (CR-001-01)

Device	IrysSolve Compute
Basic	2U Rackmount Form Factor (Rack not provided)
	Intel® X540 Dual Port 10 GBase-T
	2000W Redundant Platinum High-efficiency Power Supply
	Dimension (WxHxD): 17.2" (437 mm) x 3.5" (89 mm) x 31.0" (787 mm)
	Gross Weight: 70 lbs (31.8 kg)
Processor	2 x Intel® Xeon E5-2600 v3 2.50 GHz 12C/24T
	6 x Xeon Phi™ 3151P Co-Processors
Memory	8 x 16 GB DDR4 2133 MHz 288-pin DIMM ECC
Hard Drive	2 x 1.0TB SATA Seagate Constellation 2 Configured as RAID 1

Table 4: Hardware Specifications for Computational Biology

Device	IrysSolve server head node minimum	IrysSolve server node minimum (4 nodes)
Operating System	Ubuntu Linux Server LTS or CentOS6.4 and above	Ubuntu Linux Server LTS or CentOS6.4 and above
Scheduler	Sun Grid Engine	Sun Grid Engine
Processors	Intel AVX or AMD Opteron 3.0 GHz processors capable of at least 32 logical threads	Intel AVX or AMD Opteron 3.0 GHz processors capable of at least 32 logical threads
Memory	128 GB DDR3 RDIMM 1600MHz or better, ECC	128 GB DDR3 RDIMM 1600MHz or better, ECC
Graphics	N/A	N/A
Hard Drive Controller	SATA RAID or non-RAID, 3.0 GB/s or DFS	SATA RAID or non-RAID, 3.0 GB/s or DFS
Hard Drive(s)	4 TB SATA 3.0 GB/s, 7200 RPM, 32 MB Cache or Distributed File System	4 TB SATA 3.0 GB/s, 7200 RPM, 32 MB Cache or Distributed File System
Network	1 GB/s Ethernet	1 GB/s Ethernet

Summary of Computing Requirements

IrysSolve requires a cluster scheduling system to speed processing beyond a single system image. Depending on the number of cluster nodes used in the cluster, schedulers can help to reduce processing time from a week to less than a day.

Scheduler requirements:

- Sun grid engine (SGE) 6.2u5
- Python-DRMAA library installed
- Grid engine allowing multi-threaded jobs on the cluster with at least 32 threads per job (larger memory host needs more threads)
- Grid engine configured to support "openmp" physical environment

Hardware requirements:

- AVX supporting processors (recommended)



Note: At the time of writing, one thread of Intel processor with AVX is approximately equivalent to 2 threads of AMD or older Intel CPU.

- One host with 128 GB of memory or larger (at least 32 logical threads) and 4 other hosts with 128 GB of memory (at least 32 threads)

General configuration:

- Python V2.7.53 or greater
- R 2.14 or greater
- glibc 2.15 or greater
- Approximately 100 GB of disk space per run
- Shared NFS file system among all the cluster nodes
- PERL 5.14.4, 5.16.3 or 5.18.2
- GCC 4.4.7 or greater
- Ubuntu LTS or CentOS6.4 or above
- No restrictions on virtual memory usage
- Cluster nodes configured to permit larger number of open file descriptors (4096)

The recommended configuration is provided above. If you are unable to meet these requirements, please contact your FAS to discuss possible options.

Storage Server

The user is responsible for allocating additional space for image and data production on a storage server. For a typical 30-cycle run on a single chip utilizing both flow cells, Irys generates approximately 100 GB of image data when scanned in a single color. Conversion of images into data files for analysis generates an additional 2-5 GB of data and when assembled, a further 25-50 GB of data for every 50x in coverage depth. For standard human-sized genomes, depending on usage, an external hard disk capable of storing approximately 100 runs worth of data (at least 2 Terabytes) is recommended.

Table 5: Estimated File Sizes

	Images	.bnx (data)	Non-Haplotype Assembly	Haplotype Assembly
Size/30-cycle/Flowcell	50 GB	2-5 GB		
Size/Experiment (effective coverage for 3 Gbp genome size)			25 GB per 50x	50 GB per 50x

2.2 Materials Needed - User-Supplied Consumables and Equipment

Material and Tools

Three weeks before scheduled installation, provide your FAS with a confirmation that the consumables and equipment listed in Tables 6 and 7 are available. Depending on sample type(s) of interest, additional materials or tools may need to be acquired per FAS recommendation (see Tables 8-13).

User-Supplied Core Materials

The following list represents the materials needed for Irys setup and operation and execution of the Bionano Prep sample preparation workflow.

Table 6: User-Supplied Core Reagents and Consumables

☑	Part Number	Supplier	Item
	1703711	Bio-Rad	Green Screened Caps for 50 mL Conicals (individual ordering)
	AM9849	Thermo Fisher	Agarase Enzyme, 100 Units, 0.5 U/μL (alternative to GELase)
	VCWP04700	Millipore	Dialysis Membrane Filter, MF, 0.1 μm
	158920	Qiagen	Proteinase K enzyme, 5 mL
	158924	Qiagen	RNase A solution, 5 mL
	82027-530	Thermo Fisher	Spatula, metal
	14-959-53A and 14-432-22	Thermo Fisher	Conical Centrifuge Tubes, 15 mL and 50 mL, PP, or similar
	AM12225	Thermo Fisher	PCR Tubes, 0.2 mL, Thin-walled, frosted lid, RNase-free
	1431160N or (28384-092)	Thermo Fisher or (VWR)	Petri dishes, sterile, 60 x 15 mm
	10977-015	Thermo Fisher	UltraPure, Nuclease Free Water, or similar
	Q32853	Thermo Fisher	Qubit® BR (Broad Range) dsDNA Assay Kit
	Q32851	Thermo Fisher	Qubit® HS (High Sensitivity) dsDNA Assay Kit
	Q32856 or (10011-830)	Thermo Fisher or (Axygen)	Qubit® Assay Tubes
	AM9849	Thermo Fisher	TE Buffer, 10 mM Tris, 1 mM EDTA, pH8.0
	1111-1810	USA Scientific	Pipette Tip, 200μL, Nonfiltered
	1605-0007	USA Scientific	Microcentrifuge tube, 0.5mL, amber, nuclease-free
		General Supplier	Pipette Tips, Aerosol-resistant 2, 10, 20 and 200 μL
	46620-642	VWR	Pipet Tips Wide-bore, filter, aerosol, 200 μl
	87003-294	VWR	1.5mL microcentrifuge tube
	22491296	Eppendorf	Pipette Tips, 200 μL, for Xplorer Pipette (recommended)
	17008604	Rainin	Pipette Tips, 10μL, C-10 for Positive Displacement (optional)

Table 7: User-Supplied Core Equipment

☑	Part Number	Supplier	Item
		See Section 1.1, Table 2	Analysis Workstation
	CPX 952-119R	Branson	Bath Sonicator, or similar
	EW-51820-30	Cole-Parmer	Orbital shaker, platform, 180 rpm
	5382000023	Eppendorf	Thermomixer with intermittent mixing
	5365000028	Eppendorf	Thermomixer 50 mL conical adapter
		General lab supplier	Centrifuge, refrigerated with 1.5 mL tube rotor
		General lab supplier	Microcentrifuge
		General lab supplier	2 Heat Blocks for 1.5 mL tubes, or 2 Water Baths
		General lab supplier	Pipettes (2, 10, 20, 200 and 1000 μL)
		General lab supplier	Ice Bucket and ice
		General lab supplier	Vortexer
		General lab supplier	Thermal cycler with heated lid
	Q33216	Life Technologies	Qubit® Fluorometer
		General lab supplier	4°C Refrigerator and -20°C freezer for reagent storage
	4861000716	Eppendorf	Xplorer Plus automated pipette (recommended)
	17008575	Rainin	Positive-Displacement Pipette MR-10 (optional)

User-Supplied Materials for Varying Tissue Types

The following items are additionally required for extraction of DNA from varying sources. Once you have identified the samples you would like to use for training, please order the appropriate items and have on-hand before training begins.

Table 8: User-Supplied Items for Human Cell Culture DNA Extraction

<input checked="" type="checkbox"/>	Part Number	Supplier	Item
	AM9624	Thermo Fisher	10x PBS, pH 7.4

Table 9: User-Supplied Items for Human Blood DNA Extraction

<input checked="" type="checkbox"/>	Part Number	Supplier	Item
	158902	Qiagen	RBC Lysis Solution
			Centrifuge swing buckets for 15 mL conical tubes
	M48725	Thermo Fisher	Vari-Mix test tube rocker, or similar
	AM9624	Thermo Fisher	10x PBS, pH 7.4
	W1214 and 113003	Hemocue	Hemocue + Cuvettes *
	51104	Qiagen	QIAamp DNA Blood Mini Kit+ Ethanol (96 – 100%)*

* Either Hemocue or QIAamp kit is required for quantitation. Hemocue is preferred.

Table 10: User-Supplied Items for Animal Soft Tissue DNA Extraction

<input checked="" type="checkbox"/>	Part Number	Supplier	Item
	RE-013-10	Bionano	Bionano Prep Animal Tissue DNA Kit
	62400-620 or 14231-358	VWR	Tissue Grinder - Dounce (7 mL) or Tenbroek (1 mL)
	E7023	Sigma Aldrich	Ethanol, 96-100%
	89259-946	VWR	Dissecting forceps
		General lab supplier	Razor blade (optional)
		General lab supplier	Liquid Nitrogen (optional)
		General lab supplier	Conical bottom cryogenic vial (optional)

Table 11: User-Supplied Items for Animal Fibrous Tissue DNA Extraction

<input checked="" type="checkbox"/>	Part Number	Supplier	Item
	RE-013-10	Bionano	Bionano Prep Animal Tissue DNA Kit
	9001271 and 990890	Qiagen	Rotor-stator homogenizer (with disposable probes)
	89259-946	VWR	Dissecting forceps
		General lab supplier	Razor blade (optional)
		General lab supplier	Liquid Nitrogen (optional)
		General lab supplier	Conical bottom cryogenic vial (optional)
	F8775	Sigma Aldrich	Formaldehyde 36.5% - 38% in H2O

Table 122: User-Supplied Items for Plant Tissue DNA Extraction

<input checked="" type="checkbox"/>	Part Number	Supplier	Item
	9001271 and 990890	Qiagen	Rotor-stator homogenizer and disposable probes
	e.g. 5804R w/ A-4-44 Rotor	Eppendorf	Centrifuge, 4C with swing bucket rotor for 50 mL conicals
	46100-832 and 46100-830	VWR	Glass centrifuge tubes, 15-16 mL and rubber adapters
	RE-014-05	Bionano	Bionano Prep Plant DNA Kit Contents
	F8775	Sigma Aldrich	Formaldehyde 36.5% - 38% in H2O
	M6250	Sigma Aldrich	β -MercaptoEthanol (BME)
	S2501 and S1141	Sigma Aldrich	Spermidine trihydrochloride and Spermine tetrahydrochloride
	Z617679	Sigma Aldrich	Petri dish, square, 12 cm x 12 cm
	82027-534	VWR	Plastic spatula
	352340 and 352360	Corning	Cell Strainers, 40 μ m and 100 μ m
		General Supplier	Small children paint brush, all plastic
		General Supplier	Razor blades

Table 133: User-Supplied Items for Bacterial DNA Extraction

<input checked="" type="checkbox"/>	Part Number	Supplier	Item
	1703597	Bio-Rad	Bacterial DNA Module Kit (Lysozyme and Buffer)

3. Preparing for Arrival

3.1 Shipping Dimensions

Irys is shipped in a crate. Using the dimensions in Table 14, ensure that the crated Irys is stored securely near the installation site before the installation date. The FSE will unpack and install Irys on installation date.

 **Note:** An individual who can lift over 100 pounds (45 kg) is required to assist the FSE in lifting Irys from the crate to the workstation.

Table 144: Irys Crate Size and Weight

	Height	Length	Width	Weight	Irys Uncrated
Crate/Packaging	24 in (61 cm)	40 in (102 cm)	33 in (84 cm)	40 lbs (18 kg)	
Including Instrument				211 lbs (96 kg)	170 lbs (77 kg)

3.2 Environmental Conditions

Ensure that the Irys working area is free of excessive dust and can be maintained within the environmental requirements listed in Table 15.

Table 155: Irys Instrument Environmental Conditions

Environmental Condition	Minimum	Maximum
Temperature	20°C (68°F)	27°C (81°F)
Relative Humidity (non-condensing)	15%	65%

3.3 Laboratory Bench Layout (recommended)

Irys operating conditions are those of a typical laboratory environment.

The Irys workstation bench should be capable of supporting the instrument weight without warping. Preferably, it can be installed on a specialized optical table or bench top vibration isolation platform. Ensure to reserve at least a 47" by 32" open area of bench space to install the instrument. Figure 4 shows the recommended laboratory bench layout for your Irys Instrument.

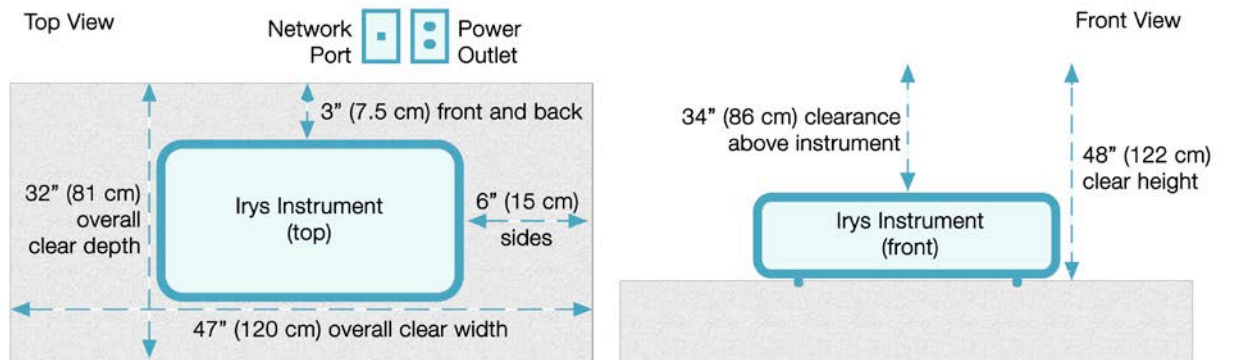


Figure 2: Irys Top and Front View

Overhead clearance required for installation and service is 34 inch (86 cm). A 22 inch (56 cm) clearance is required for non-service, daily operation. Insufficient overhead clearance will result in damage to the stage access door and inability to perform service.

Table 166: Irys Dimensions and Weight

	Height	Depth	Width	Weight
Instrument	12.8 in (32 cm)	26 in (66 cm)	34.5 in (87.6 cm)	170 lbs (77 kg)

3.4 Data Network Connections and Power



Note: Your information technology (IT) resource is responsible for:

- Connecting an uninterrupted power supply battery backup system (UPS) or line conditioner
- Allowing local administration rights for software installation and firewall modification
- Ensuring Port 21 is open for outbound
- Ensuring TCP connections to ports 80, 443 or 8200 are open for outbound

Data Network Connections

A network connection is required for transferring and archiving data. Data from Irys are transferred over your intranet or network to a designated storage location on your server by ethernet. The ethernet connection is located on the back panel of Irys. The ethernet port is a standard RJ-45 connection rated at one gigabit per second standard. Data transfer will commence once the instrument completes a scan of a flowcell. The internal hard disk is capable of storing ~ 100 runs worth of data (2 Terabytes), depending upon the number of fields of view and colors imaged. Data archiving is configured to occur automatically.



Note: Bionano Genomics employs a secure file transfer protocol (FTP) connection initiated using FileZilla to facilitate remote technical support. The FTP requires port 21 to be open for outbound communications. Additionally, Bionano Genomics service calls rely on monitoring Irys remotely in real-time using GoToAssist remote support application. GoToAssist requires outbound TCP connections to ports 80, 443 or 8200 be open.

Irys runs an embedded version of Windows XP as the operating system.

Power

Irys will draw 200-250 watts during operation depending upon the step it is at during its operating cycle.

Bionano Genomics highly recommends that Irys be connected to an uninterrupted power supply battery backup system (UPS) or line conditioner. The choice of which UPS to use depends on how long you estimate Irys will need to run during a power failure. Some examples are listed in the table below.

Table 17: Examples of Recommended UPS

Model	Power Capacity	Voltage	Runtime (hh:mm)	Model Number
APC Smart-UPS X 750VA	600 Watts / 750 VA	120VAC 230VAC	0:38 0:48	SMX750 SMX750I
APC Smart-UPS X 750VA + 48V Ext Battery	600 Watts / 750 VA	120VAC	11:44	SMX750 + (5x) SMX48RMBP2U
APC Smart-UPS XL 1000VA USB & Serial	800 Watts / 1000 VA	120VAC 230VAC	0:51 1:06	SUA1000XL SUA1000XLI
APC Smart-UPS XL 1000VA + 24V Battery	800 Watts / 1000 VA	120VAC 230VAC	14:21 14:05	SUA1000XL + (5x) SUA24XLBP SUA1000XLI + (4x) SUA24XLBP

4. Preparing for Implementation

4.1 Site Preparation Checklist

Two weeks before scheduled installation, review the Site Preparation Checklist [Table 18] to ensure your laboratory is in compliance with the requirements listed. Your FAS will contact you to review the checklist and discuss the training schedule.

Table 18: Site Preparation Checklist

Action	Refer to Section
Confirm the Irys workstation meets computing requirements and necessary privileges.	1.1
Order and confirm availability of all user-supplied materials and equipment.	1.2
Prepare for receiving the crated instrument.	2.1
Verify that the facility meets the environmental requirements.	2.2
Verify available lab bench space, power, and network access.	2.3 - 2.4
Verify personnel are available for installation and training at the scheduled time.	3.2
Verify all components have arrived, including Irys and the Bionano Prep installation kit.	3.3
Store all Irys and Bionano Prep reagents as required.	3.3

4.2 Installation and Training Schedule

Six to eight weeks before your installation and training, the FAS will contact you to discuss training, specific sample prep needs, and schedule your installation and training sessions. Standard installation and training takes 4-5 days. Generally training of between 1 and 3 scientists is preferred with approximately 6-8 hours of training per day (varies depending on sample type).

On your scheduled installation day, the FSE will install, calibrate, and verify instrument functionality over a 2-day period (before or during the FAS-led training). Once installed, your FAS will be conducting the training.

Table 19: Example 5-day FAS-led Installation and Training Schedule

Day 1: Install, DNA Extraction	Day 2: DNA Extraction Continued	Day 3: Label	Day 4: Irys, IrysView	Day 5: Training and Q&A
Unpack and move the instrument to designed installation area	Irys operation overview	DNA Labeling	Setting up a run	IrysView data analysis software continued
Irys preparation and installation	Sample DNA extraction continued		Loading cartridges and samples	
Subcomponent function verification			AutoDetect installation and configuration	
Optical alignment verification			Transferring data	
Sample DNA extraction			IrysView data analysis software	

4.3 Irys Installation and Training

All components necessary to facilitate installation and perform setup and operation during training are included with the purchase of Irys. The installation and training supplies arrive in multiple boxes with varying storage temperature conditions. Ensure compliant storage until the installation day and that the materials are readily accessible during installation and training.

Irys Installation and Training Kit Shipments:

Table 17: Irys System Installation Kit (CS-011-01)

Item	Contents	Storage Temp
IrysChip V2 Cartridge,	3 chip	-20°C
Control Sample A	1 each	4°C
Control Sample B	1 each	4°C
Control Sample D (Fluorescein)	1 each	4°C
Wash Cartridge	1 each	Room Temp
Country Specific Power Cord	1 each	Room Temp

Table 18: Irys System User Training Kit (CS-013-01)

Item	Contents	Storage Temp
Bionano Prep Kit (RE-011-10):	-Lysis buffer -Labeling and flow buffers, stop solution and H ₂ O -Labeling, repair mix, DTT, and buffers	Room Temp 4°C -20°C
Bionano Prep DNA Stain (RE-111-10):	DNA stain	-20°C
IrysChip V2 Cartridge	3 count	-20°C
Control Sample A	1 each	4°C
Control Sample C	1 each	4°C
Nt.BspQ1	1000 units	-20°C
Taq DNA Polymerase and ThermoPol Buffer	400 units	-20°C
Taq DNA Ligase	2000 units	-20°C
NAD+	0.2 mL	-20°C

5. Post Installation Follow-up

5.1 Review

During the installation and training, the FAS will schedule the follow-up review training. Most often this takes the form of a conference call or WebEx. Also, a section is provided at the end of this guide to document any questions you have as you proceed through the installation, training, and post-training period.

For the review, be prepared to provide your FAS with:

- Your first run of data produced without your FAS on-site
- Any technical follow-up post installation customization requests
- Questions, concerns, and issues regarding your understanding, comfort, and confidence with using Irys

5.2 Q&A

This section is provided to list questions the FAS can address during the post-installation follow-up.

Topic	Question
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6. Technical Support

You can contact Bionano Genomics for technical support by telephone, e-mail or through the Internet. You can retrieve Bionano Genomics user documentation, SDSs, certificates of analysis, frequently asked questions, and other related documents from www.bionanogenomics.com/support or by request through e-mail and telephone.

To contact Technical Support by E-Mail: support@bionanogenomics.com

Toll Free Telephone Technical Support: +1.858.888.7663

Technical Support Telephone Hours: Monday through Friday, 9:00am to 5:00pm, PST

Customer Support Website: www.BionanoGenomics.com/support