Advance your work in molecular diagnostics

Enabling your molecular diagnostic workflows with catalog and customized solutions

cytiva

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Product application checklist

Products	FISH	RT-qPCR	qPCR	Microarrays	Sanger sequencing	NGS
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GenomiPhi Single Cell DNA Amplification Kits					•	•
TempliPhi 100/500 Amplification Kits					•	•
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TempliPhi Large Construct Kit					•	•
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PuReTaq Ready-To-Go PCR Beads	•	•	•	•		
Nucleotides	•	•	•	•	•	•
Amersham Ready-To-Go RT-PCR Beads	•	•	•	•		
Taq DNA Polymerase (cloned)		•	•	•	•	•
CyDye Fluorescent Nucleotides	•	•	•	•	•	
Microarray Hybridization Solution V2.0				•		
T4 DNA Ligase		•	•		•	•

Introduction

Molecular diagnostics utilizes the techniques of molecular biology to analyze biological markers in the genome of an individual's genetic code to understand how the cells express their genes as proteins. It is used to predict and diagnose disease, select treatments and monitor the effectiveness of therapies. Developing solutions for molecular diagnostics is an area of key focus for us.

The increasing availability of genome sequencing has been a key factor for the growth of molecular diagnostics. Genome sequencing allows disease diagnosis at an earlier stage, and with the discovery of relevant biomarkers it enables more targeted therapeutic interventions to be provided. The trend towards a more personalized approach to healthcare is therefore another driver for the expanding importance of molecular diagnostics.

We aim to be at the forefront of the development of technologies to support molecular diagnostic workflows in both day-to-day research and clinical settings. Our portfolio spans the collection, sample preparation and detection stages of the workflow with products that deliver reliable, robust results. With technical expertise and extensive manufacturing capabilities supported by security of supply commitments, we provide solutions, backed by validated protocols, which minimize disruption to your existing workflows and help you commercialize your assay faster.

Technologies in molecular diagnostics

Microarrays, NGS, Sanger sequencing, qPCR, and FISH are the main technologies for studying genomic abnormalities in clinical applications. Here we consider each one in turn and summarize their strengths and weaknesses.

Microarrays

DNA microarrays are chips containing tens of thousands of oligonucleotide sequences (oligos), each representing a single gene, part of a gene, or RNA transcript, as spots on a solid surface. They enable you to detect the corresponding genes or transcripts through fluorescently labeling the samples, hybridizing them to the oligos on the chip, and imaging under fluorescence excitation.

Both DNA and RNA (after converting to cDNA) can be analyzed by microarray and, using different labels, two samples (e.g., test and reference) can be compared directly in a multiplexed assay.

Pros		Cons
• The assays are well validated, and clinicians tend to be familiar with the tests and their outcomes • Enable you to query a huge number of genes simultaneously, thanks to the enormous number of oligos that can be placed on a single chip, and in high resolution, as you can use multiple probes per gene	• The technology is also well suited for detecting large chromosomal abnormalities, such as copy number variation (CNV). This is achieved by array comparative genomic hybridization (aCGH), where test and reference samples are multiplexed with different fluorescent labels. • It's also suited to detecting smaller mutations, such as single nucleotide polymorphisms (SNPs), though this requires arrays with allele-specific probes	• Dependence on (oligo) probes for detection. Though they enable high resolution assays, the results are completely dependent on the probe selection. • Unlike NGS, you need to have detailed knowledge of the mutations you're studying, making it suitable only for well-characterized aberrations

Next-generation sequencing (NGS)

DNA sequencing refers to a range of techniques that analyze sections of the genome to single-nucleotide resolution. NGS enables high-throughput whole-genome, whole-exome, transcriptome, and targeted sequencing with relative ease.

Pros		Cons
• High throughput, speed, and resolution • NGS assays can efficiently analyze the entire genome or exome or focus on a specified number of targeted locations in the genome	• NGS's single-nucleotide resolution also enables it to detect even the smallest possible mutations (SNPs) without necessarily requiring knowledge of the mutation in advance	• Doesn't yet have the long and proven track record or familiarity of other technologies • Requires expertise to run assays and interpret data

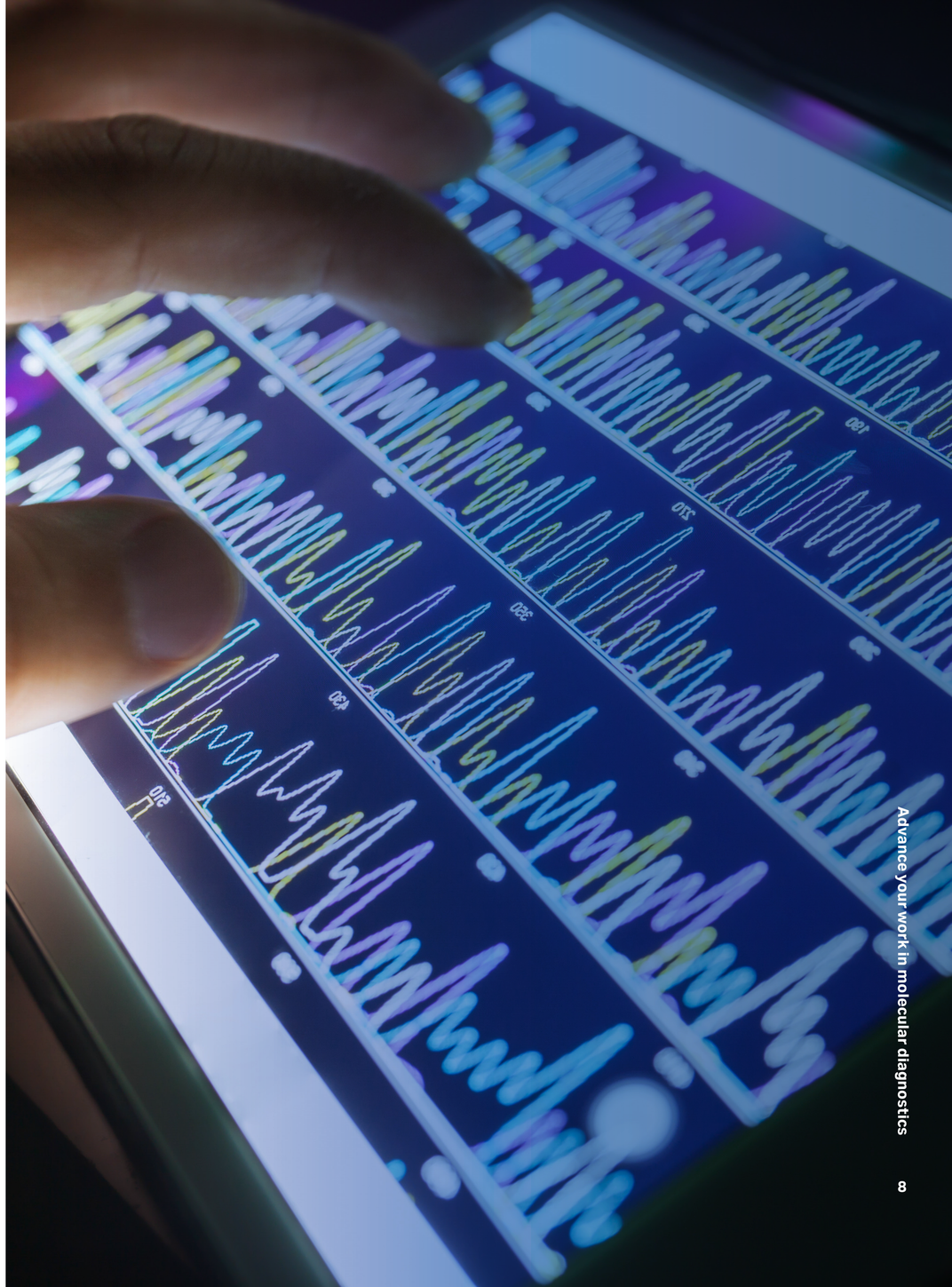
Key clinical applications of NGS

The biggest market for NGS is currently in reproductive health, more specifically non-invasive prenatal testing (NIPT), where it's gradually replacing array-based techniques such as array comparative genomic hybridization (aCGH). NIPT provides a safer alternative to invasive tests as it analyzes fetal cell-free DNA (cfDNA) from the mother's circulation, making detection of genetic disorders easier.

Use of NGS is also growing in oncology, Mendelian diseases, complex diseases, and infectious diseases. Clinical scientists can use NGS assays either for diagnosis or for decisions on treatment by studying both small mutations (e.g., SNPs and indels) and larger abnormalities (e.g., CNV) at the same time.

Refinement of cancer diagnoses is a particular growth area for NGS. As treatments become more personalized, there's a need for classifying cancers in terms of their underlying mutations to help direct treatment options in the clinic. NGS plays a key role in this trend towards precision medicine, helping to minimize the human and financial costs of ineffective cancer treatments.

Read more about the trends and clinical applications of NGS in our whitepaper



Sanger sequencing

Sanger sequencing is a method for determining the nucleotide sequence of DNA molecules. Developed by two-time Nobel laureate Frederick Sanger and his colleagues in 1977, it enabled an international collaboration of scientists to deliver the first human genome sequence.

The Sanger method relies on using dideoxy chain terminating nucleotides to produce sequence fragments of graduated lengths, each equal to the position of the base complementing the terminating nucleotide. Reading the DNA sequence involves visualizing these fragments and identifying the fluorescently labeled terminating nucleotides in order of fragment length.

Pros		Cons
• Robustness and accuracy of Sanger sequencing, which can be as high as 99.9%, helped maintain its value over the years despite the availability of more modern alternatives • Useful in small-scale sequencing applications including single-gene studies, routine sequencing for cloning and checking genotypes, and specialized and custom projects	• High accuracy, low cost and fast turnaround • Provide a benchmark to validate the accuracy of an NGS approach before making it part of routine workflow	• Pyrosequencing and illumina™ dye sequencing brought orders of magnitude increases in DNA sequencing speed and capacity which are not possible with Sanger sequencing

Find out how NGS and Sanger sequencing complement each other in our blog

Quantitative polymerase chain reaction (qPCR)

qPCR is a variation on the original PCR method developed in the 1980s that uses fluorescent probes to detect amplicons as they amplify. In diagnostics, qPCR assays can help determine the presence of genetic markers in real time, and therefore aid disease diagnosis.

qPCR is inherently analog (i.e., the output is continuous), and quantitation relies on setting a threshold against standards. Digital PCR, (dPCR) is a variation on qPCR that dilutes a single sample into many smaller reactions. Each reaction contains no more than one template molecule. Therefore, amplification can give you a discrete and absolute count of how many template molecules were present in the original sample and, importantly, a definitive answer on the presence of a marker.

Pros		Cons
• Been around since the 1990s and has remained the most popular method in molecular diagnostics • Brings high sensitivity, simplicity, speed, and cost	• Relatively inexpensive way to study genomic 'targets', even at tiny concentrations, with several reagents common to standard PCR, such as the polymerase and nucleotides. A typical protocol is also fast — often providing same-day results — and the data is easy to interpret.	• Not designed for interrogating complex or multi-gene conditions. You can only use so many probes in one assay, and so investigating many targets substantially increases PCR workload. This then impacts costs and turnaround times. • Potential for biased outcomes — the approach requires pre-selection of targets, so the outcome of any assay is limited to the probe selection for that assay. Co-infections, for example, are easy to overlook with primers designed to pick up one infection and not another.

qPCR or RT-qPCR?

If you're interested in profiling gene expression rather than the gene itself, a variation of qPCR — reverse transcriptase qPCR (RT-qPCR) — enables you to analyze the relative abundance of RNA. The reverse transcriptase converts the RNA to cDNA, which you can then treat in essentially the same way as a DNA sample.

Fluorescence *in-situ* hybridization (FISH)

FISH is a cytogenetic technique for visualizing sequences of DNA or RNA *in-situ* within the cell and tissue environment (e.g., a tissue section on a microscopy slide). It works by adding to your sample fluorescent probes that only bind to a specific nucleotide sequence. The fluorescent signal will tell you whether your sequence is present — and how much of it is there.

Pros		Cons
• Easy-to-use and inexpensive technique • Provides images rather than digital readouts which is helpful for studying genomic translocations and heterogeneous tissue samples, such as tumors	• Well suited for formalin-fixed paraffin-embedded (FFPE) samples: the high sensitivity of FISH assays means it can give clear results in FFPE as it does not damage the DNA during processing	• The options for studying multiple areas of the genome simultaneously are limited. It's possible to treat slides with multiple probes, but only as long as you can reliably distinguish the different colors under the microscope. • Limited to large genetic aberrations, such as copy number variation (CNV)

Read more about the clinical applications of the molecular diagnostics technologies and what the future holds for them

01

Sample preparation

Magnetic beads: a simple guide

Magnetic beads are made up of tiny (20 to 30 nm) particles of iron oxides, such as magnetite (Fe_3O_4), which give them superparamagnetic properties.

Superparamagnetic beads are different to more common ferromagnets in that they exhibit magnetic behavior only in the presence of an external magnetic field. This property is dependent on the small size of the particles in the beads, and enables the beads to be separated in suspension, along with anything they are bound to. Since they don't attract each other outside of a magnetic field, they can be used without any concern about unwanted clumping.

There are many types of magnetic beads available. Different surface coatings and chemistries give each type of bead its own binding properties, which can be used for magnetic separation (isolation and purification) of nucleic acids, proteins, or other biomolecules in an easy, effective, and scalable way.

This ease-of-use makes them automation friendly and well suited for a range of applications, including sample preparation for next-generation sequencing (NGS) and PCR, protein purification, molecular and immunodiagnostics, and even magnetic activated cell sorting (MACS), among many others. They also ease some of the challenges associated with extracting nucleic acids from different sample types.

Use this guide to compare the different surface chemistries and find the type of beads to suit your application.

Custom bead conjugation

Even with all these surface chemistry options, it's impossible to cover every need and eventuality. That's where custom conjugation comes in.

Do you need to conjugate a custom ligand? Or need a custom particle size?

We make it possible to customize all our Sera-Mag magnetic beads. Our dedicated customization experts can help you every step of the way, from defining the product specifications to delivery completion.

See page 83 for more information on our custom bead conjugation services.

We provide custom conjugations of enzymes or antibodies, as well as a range of custom ligands that we can develop in parallel with your projects. We also offer lyophilization of the customized microspheres as part of our Lyo-Stable services, based on Ready-To-Go stabilization technology.

Drawing on our R&D and manufacturing resources, and history of supplying magnetic beads to kit manufacturers, we will provide custom magnetic bead technology that is ready to use with little or no need for further modification. From completing complex conjugations, to performing your quality control tests before the beads leave our factory, we are equipped to meet your needs.

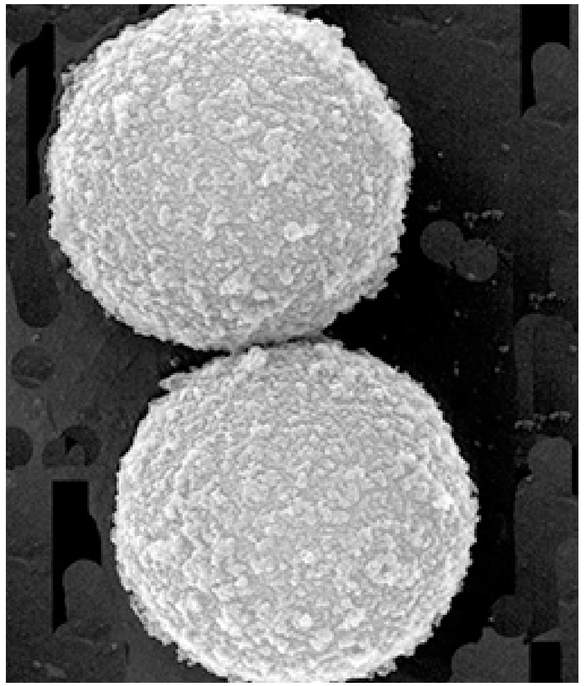


Table 1. Comparison of magnetic bead surface chemistries and applications

Type	Properties	Applications	Variations
Carboxylate-modified magnetic beads	• Can associate with nucleic acids for direct capture • Surface suitable for conjugation through covalent bonding • Can capture molecules containing amino groups	Conjugation or direct binding applications: • Covalent attachment • Affinity purification and pull-down • Nucleic acid isolation and purification • NGS size selection	High-speed version available
Amine-blocked magnetic beads	• Surface suitable for conjugation through covalent bonding • Non-surfactant, non-protein-blocked surface • Low non-specific binding	Conjugation applications, similar to carboxylate-modified beads.	High-speed version available
Oligo (dT)-coated magnetic beads	• Hybridizes with mRNA poly-A tails • High colloidal stability	mRNA binding applications: • mRNA extraction and purification • RT-PCR • cDNA library construction • Subtractive hybridization • NGS (RNA sequencing)	
Streptavidin-coated magnetic beads	• Binds biotinylated ligands such as proteins, nucleic acids, and peptides • Covalently bound streptavidin coating • Fast reaction kinetics • Low non-specific binding • High throughput and precision	Immunoassay and molecular biology applications: • Sample preparation and assay development for genomics and proteomics	High-speed version available Biotin binding ranges: • 2500 to 3500 pmol/mg • 3500 to 4500 pmol/mg • 4500 to 5500 pmol/mg
Streptavidin-blocked magnetic beads	• Binds biotinylated ligands such as proteins, nucleic acids, and peptides • Non-surfactant, non-protein-blocked surface • Lower non-specific binding than streptavidin-coated beads via additional blocking of non-specific binding sites	High-specificity biotin binding applications: • Molecular and immunodiagnostics • NGS library preparation	High-speed version available

Type	Properties	Applications	Variations
NeutrAvidin™-coated magnetic beads	• Binds biotinylated ligands such as proteins, nucleic acids, and peptides • Fast reaction kinetics • Low non-specific binding • High throughput and precision	Alternative to Streptavidin in immunoassay and molecular biology applications • Sample preparation and assay development for genomics and proteomics	High-speed version available Biotin binding range: • 3500 to 4500 pmol/mg
Protein A/G magnetic beads	• Binds IgA and IgG proteins • Coating based on IgA/IgG fusion protein • Broad binding capabilities	Antibody isolation applications • Affinity purification and pull-down • Immunoprecipitation	
Silica-coated magnetic beads	• Reversibly binds nucleic acids based on salt concentration • Monodisperse particles with narrow size ranges of 400 µm or 700 µm	Applications with low sample amounts • Nucleic acid extraction for molecular diagnostics applications such as qPCR	
Mag-sepharose™	• Broad range of ligand options • Porous, providing greater surface area than other magnetic beads	Convenient alternative to Sepharose columns, with protein purification applications including • Affinity purification or capture • Immunoprecipitation	

RNA isolation

Amersham RNAspin Kits

Our Amersham RNA purification kits are designed to ensure that you get the reproducibility, yield and purity you need, with minimal degradation in every experiment. Amersham kits accommodate a diverse range of application requirements and sample types, delivering RNA that can be used for downstream applications, such as qRT-PCR and microarray analysis.

Amersham RNAspin Mini Kits

For use in RT-qPCR, microarrays, and NGS

By identifying key elements that affect the quality of preparation the RNAspin Mini Kit allows total RNA isolation from diverse sample types, resulting in the extraction of RNA suitable for use in sensitive downstream applications such as microarray analysis and quantitative or endpoint RT-PCR. Our on-column DNase I digest improves purity by addressing issues of gDNA contamination.

Features and benefits

- Maximized yields: the inclusion of prefilters and a unique lysis buffer makes it less susceptible to foaming
- Efficient: Column-binding capacity of 100 µg and elution volumes as low as 40 µL eliminate the need to concentrate sample.
- Reliable: Well-established silica-membrane technology

Product code	Quantity	Description
25050087	10	Amersham RNAspin Mini Kit
25050070	20	Amersham RNAspin Mini Kit
25050071	50	Amersham RNAspin Mini Kit
25050072	250	Amersham RNAspin Mini Kit

Find out more

Amersham RNAspin 96 Kit

For use in RT-qPCR, microarrays, and NGS

With protocol run times that have been optimized to be as short as possible, Amersham RNAspin 96 kits support a high throughput approach, whether samples are processed under vacuum, using centrifugation, manually, or with automation. The on-column lysis for small amounts of sample improves efficiency by avoiding mechanical homogenization.

Features and benefits

- Fast and efficient: Purification in a 96-well format with high reproducibility in less than 70 minutes
- Supports automation: Integrated wash plate eliminates risk of cross contamination and is compatible with common liquid handling instruments for fast integration
- Convenient: DNase I included for convenient on-column gDNA removal, leading to pure total RNA
- Flexible and scalable: Includes prefilter accessory plate

Product code	Quantity	Description
25050075	4 × 96 preps	Amersham RNAspin 96 Kit

Find out more

Sera-Mag Oligo (dT) Coated Magnetic Particles

For use in RT-qPCR, microarrays, Sanger sequencing, and NGS

Colloidally stable Sera-Mag Oligo (dT) Coated Magnetic Particles contain covalently bound oligo (dT)14 and will remain in suspension for extended periods of time in the absence of a magnetic field, making them well suited for capturing or isolating mRNA from a variety of sources.

Oligo (dT) particles can also be used as a universal base particle for coupling unique oligo sequences. Simply synthesize the oligo with a poly-A tail for easy attachment to the oligo (dT) particles.

Features and benefits

- Versatile: Once isolated, selective purification of mRNA from total RNA for NGS, RT-PCR, cDNA library construction, or subtractive hybridization can be performed
- Performance: The approximate mRNA binding-capacity is 11 µg of mRNA per mg of particles (dependent upon sample and message length)

Product code	Quantity	Description
38152103011150	1 mL	Sera-Mag Oligo (dT) Coated Magnetic Particles
38152103010150	5 mL	Sera-Mag Oligo (dT) Coated Magnetic Particles
38152103010350	100 mL	Sera-Mag Oligo (dT) Coated Magnetic Particles

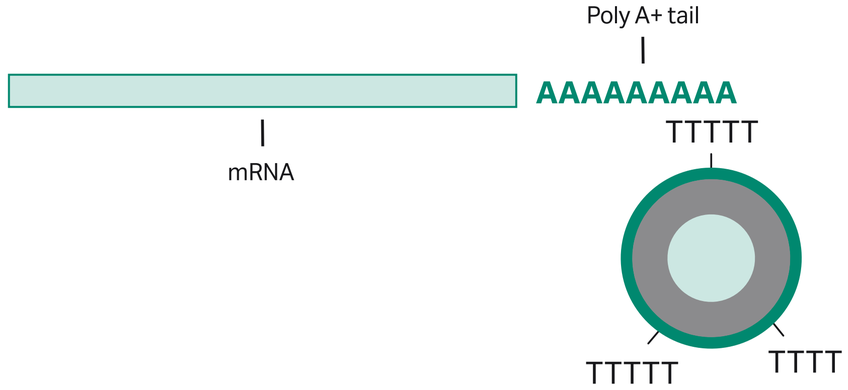


Fig 1. Oligo (dT) particles used as a universal base particle for coupling unique oligo sequences.

Find out more

SeraSil-Mag Magnetic Particles

For use in Sanger sequencing and NGS

SeraSil-Mag silica coated superparamagnetic beads deliver a high purity extraction solution for highly sensitive applications when sample is scarce. The beads provide an optimal binding surface, with regular morphology, to optimize binding efficiency and reduce variability, simplifying the transition from column purification to bead-based purification.

Features and benefits

- High iron oxide content (60 emu/g): Fast magnetic response (~5 s) shortens time of magnetic steps during isolation
- Uniformity: Particles are uniform in size (submicroscale diameter 700 nm and 400 nm [monodispersed]), providing narrow size distribution
- Low sedimentation rate: Good buoyancy enhances ease of handling, automation, and reproducibility
- Purity: Used to isolate and purify genomic DNA from whole human blood providing A_{260}/A_{280} ratios between 1.70–1.90 and A_{260}/A_{230} ratios as high as 2

Product code	Quantity	Description
29357369	5 mL	SeraSil-Mag 400
29357371	60 mL	SeraSil-Mag 400
29357372	450 mL	SeraSil-Mag 400
29357373	5 mL	SeraSil-Mag 700
29357374	60 mL	SeraSil-Mag 700
29357375	450 mL	SeraSil-Mag 700

Find out more

What is magnetic separation?

Magnetic separation uses a magnetic field to separate micrometer-sized paramagnetic particles from a suspension. In molecular biology, magnetic beads provide a simple and reliable method of purifying various types of biomolecules, including genomic DNA, plasmids, mitochondrial DNA, RNA, and proteins.

For example, under optimized conditions, DNA selectively binds to an appropriately-coated bead surface, leaving contaminants in solution. You can then use this purified DNA directly in molecular biology applications.

A key advantage to using magnetic beads is that you can isolate nucleic acids and other biomolecules directly from a crude sample, and from a variety of different types of sample, with minimal processing. This sets magnetic beads apart from other methods of nucleic acid isolation, which might have different protocols for different types of sample, and involve more hands-on time.

How does magnetic bead DNA extraction work?

Magnetic beads have been around in one form or another for decades. Their potential in nucleic acid purification was recognized in the 1990's, as demonstrated by the US patent: DNA purification and isolation using magnetic particles. The approach, largely unchanged since, relies on utilizing magnetic beads with a coating that can bind nucleic acids reversibly by just adjusting buffer conditions (Fig 2).

After binding DNA, an external magnetic field attracts the beads to the outer edge of the containing tube, immobilizing them. While the beads are immobilized, the bead-bound DNA is retained during the washing steps. Adding elution buffer then releases the DNA from the beads as a purified sample, ready for quantitation and analysis.

This approach removes the need for vacuum or centrifugation, minimizes stress or shearing forces on the target molecules, requires fewer steps and reagents than other DNA extraction protocols, and is amenable to automation in 24, 96, and 384-well plates.

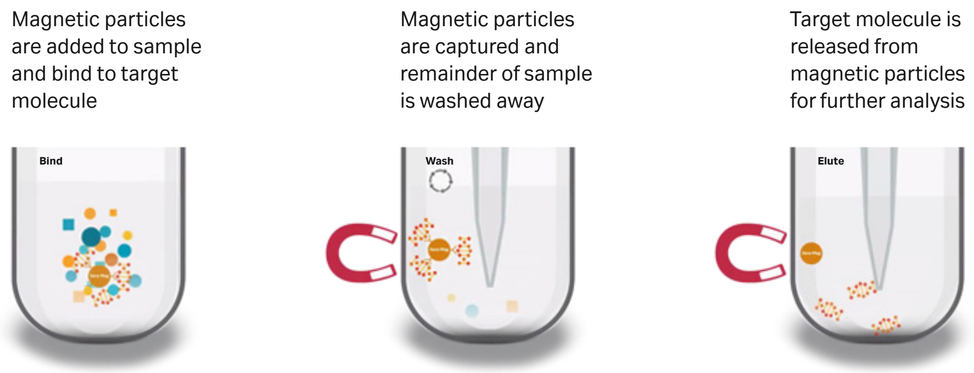


Fig 2. Overview of magnetic bead-based DNA extraction using Sera-Mag beads.

DNA isolation

GenomicPrep Mini Kits

The GenomicPrep Mini Kits deliver high quality intact high molecular weight gDNA from a variety of samples using a convenient and efficient protocol. The kit delivers high yields of highly pure gDNA suitable for use in a variety of downstream molecular biology workflows including enzyme digests, cloning, electrophoresis, qPCR, genotyping and sequencing.

Blood genomicPrep Mini Spin Kits

For use in RT-qPCR, qPCR, Sanger sequencing, and NGS

Blood genomicPrep Mini Spin Kit is designed for the rapid extraction and purification of high molecular weight genomic DNA (gDNA) from whole blood, buffy coat, bone marrow, and nucleated red blood cells. Uses chaotropic agents to extract DNA from blood cells, denature protein components, and promote the selective binding of DNA to a column-based, novel silica membrane.

Features and benefits

- Fast results: Streamlined workflow reduces the number of pipetting volume changes and the overall number of steps to deliver sample to gDNA results in 15 minutes
- Minimal shearing: Resulting in the production of 5 to 10 µg of good quality, intact genomic DNA from a 200 µL sample. One kit handles a wide range of blood sample types and volumes from 50 µL to 1 mL.
- High quality: Gentle room temperature lysis conditions deliver high-quality, > 97% intact DNA with an average size of > 20 kb

Product code	Quantity	Description
28904263	10	Blood genomicPrep Mini Spin Kit
28904264	50	Blood genomicPrep Mini Spin Kit
28904265	250	Blood genomicPrep Mini Spin Kit

Find out more

Tissue and Cells genomicPrep Mini Spin Kits

For use in RT-qPCR, qPCR, and NGS

Genomic DNA purifications performed with the Tissue and Cells genomicPrep Mini Spin Kit yield consistent results and are highly robust across different sample types.

Features and benefits

- Fast results: Reduces time from tissue sample to gDNA and produces high-quality product in just 90 minutes
- Simpler purification: Color-coded caps and bottles with matching protocol steps minimize the chance for error
- High quality and purity: Optimized tissue protocol produces intact, RNA-free gDNA that is > 20 kb in size with a purity of 1.8 (A_{260}/A_{280})

Product code	Quantity	Description
28904274	10	Tissue and Cells genomicPrep Mini Spin Kit
28904275	50	Tissue and Cells genomicPrep Mini Spin Kit
28904276	250	Tissue and Cells genomicPrep Mini Spin Kit

Find out more

Bacteria genomicPrep Mini Spin Kits

For use in RT-qPCR, qPCR, Sanger sequencing, and NGS

Bacteria genomicPrep Mini Spin Kit is designed for the rapid extraction and purification of high molecular weight genomic DNA (gDNA) from Gram-negative (G-ve) and Gram-positive (G+ve) bacteria. The procedure for G-ve bacteria can be completed in about 40 minutes (sample to gDNA).

Features and benefits

- Fast results: Streamlined workflow reduces the number of pipetting volume changes and the overall number of steps
- Optimized kit: Dedicated kit optimized for bacterial gDNA with separate protocols for G-ve and G+ve bacteria
- Ease of use: Color-coded caps and bottles with matching protocol steps minimize the chance for error
- High quality and purity: Optimized protocol produces intact, RNA-free gDNA that is > 20 kb in size with a purity > 1.8 (A_{260}/A_{280})

Product code	Quantity	Description
28904257	10	Bacteria genomicPrep Mini Spin Kit
28904258	50	Bacteria genomicPrep Mini Spin Kit
28904259	250	Bacteria genomicPrep Mini Spin Kit

Find out more

Nucleon

Nucleon systems rapidly extract high molecular weight DNA from whole blood and cultured cells. The proprietary Nucleon resin is added following cell lysis, deproteinization with sodium perchlorate, and a single chloroform extraction.

Nucleon BACC

For use in NGS

Nucleon BACC Genomic DNA Extraction Kits are designed for rapid extraction of high-quality, high molecular weight genomic DNA from blood and cell cultures. The proprietary Nucleon resin binds protein while forming a semi-solid stratum during partitioning, which facilitates removal of the aqueous phase and ensures excellent recovery of high quality DNA.

Features and benefits

- Cost effective: Non-column format makes scaling up to large sample volumes easy
- High recovery: Size of recovered DNA ranges from 23 bp to 250 kbp
- Low risk and fast: Phenol-free protocol and only 30 minutes to complete

Product code	Quantity	Description
RPN8501	25	Nucleon BACC1
RPN8512	50	Nucleon BACC3

Find out more

Nucleon HT

For use in FISH, RT-qPCR, qPCR, microarrays, Sanger sequencing, and NGS

Nucleon HT protocols have been designed to prepare high-quality DNA suitable for genomic DNA amplification from hard tissues and FFPE tissue sections. Aspiration of the top layer of nucleic acids is simplified and volume of usable sample maximized by a barrier formed between the two layers. The recovered DNA is suitable for a variety of molecular biology applications, including whole genome amplification.

Features and benefits

- Simple: Facilitates the simple, phenol-free extraction of genomic DNA from paraffin-embedded sections and hard tissue requiring proteinase K digestion
- High quality DNA recovery: Each kit is designed to recover high-quality DNA from 50 preparations of up to 25 mg of hard tissue or 50 paraffin sections
- Reproducible: Consistent chloroform extraction of high-quality, amplifiable DNA from formalin-fixed, paraffin-embedded (FFPE) tissue sections

Product code	Quantity	Description
RPN8509	1	Nucleon HT

Sera-Mag Carboxylate and SpeedBead Carboxylate

Carboxylic groups on the surface of Sera-Mag SpeedBeads and Sera-Mag Carboxylate-Modified Magnetic Beads permit easy covalent coupling to target biomolecules of interest, such as proteins and nucleic acids, using convenient carbodiimide chemistry.

The cauliflower-shaped surface, paired with proprietary Sera-Mag and SpeedBead chemistry, provides a large surface area and offers excellent sensitivity and low non-specific binding for greater accuracy. This can maximize sample retention or reduce the amount of beads required.

The beads are available with different levels of hydrophobicity/hydrophilicity and magnetite layering.

Find out more

Sera-Mag Carboxylate-Modified Magnetic Particles

For use in Sanger sequencing and NGS

Sera-Mag Carboxylate-Modified Magnetic Beads combine a fast magnetic response time and high binding capacity, sensitivity, stability and physical integrity.

Features and benefits

- Ease of use: Covalent coupling of proteins, nucleic acids, etc. to carboxyl groups on the surface using standard coupling technologies
- Convenient: Isolation, selection and clean-up of nucleic acids or direct conjugation of specific oligos and enzymes

Product code	Quantity	Description
24152105050250	15 mL	Sera-Mag Carboxylate-Modified Magnetic Particles (Hydrophylic)
24152105050350	100 mL	Sera-Mag Carboxylate-Modified Magnetic Particles (Hydrophylic)
24152105050450	1000 mL	Sera-Mag Carboxylate-Modified Magnetic Particles (Hydrophylic)
44152105050250	15 mL	Sera-Mag Carboxylate-Modified Magnetic Particles (Hydrophobic)
44152105050350	100 mL	Sera-Mag Carboxylate-Modified Magnetic Particles (Hydrophobic)
44152105050450	1000 mL	Sera-Mag Carboxylate-Modified Magnetic Particles (Hydrophobic)

Find out more

Sera-Mag SpeedBead Carboxylate-Modified Magnetic Particles

For use in Sanger sequencing and NGS

Sera-Mag SpeedBeads have a second layer of magnetite applied through the same core shell design process, allowing a reaction twice as fast as the Sera-Mag Carboxylate-Modified beads when in the presence of a magnetic field. Speedbeads are especially useful where the reaction medium is highly viscous, and in clinical assays requiring a faster magnetic response time.

Features and benefits

- Convenient: Isolation, selection and clean-up of nucleic acids or direct conjugation of specific oligos and enzymes
- Reliable: Fast, precise and high binding capacity for sample preparation, nucleic acid isolation, proteomics and immunoassay applications

Product code	Quantity	Description
45152105050250	15 mL	Sera-Mag SpeedBead Carboxylate (Hydrophylic)
45152105050350	100 mL	Sera-Mag SpeedBead Carboxylate (Hydrophylic)
65152105050250	15 mL	Sera-Mag SpeedBead Carboxylate (Hydrophobic)
65152105050350	100 mL	Sera-Mag SpeedBead Carboxylate (Hydrophobic)
65152105050450	1000 mL	Sera-Mag SpeedBead Carboxylate (Hydrophobic)

Find out more

SeraSil-Mag Magnetic Particles

For use in Sanger sequencing and NGS

SeraSil-Mag silica coated superparamagnetic beads deliver a high purity extraction solution for highly sensitive applications when sample is scarce. The beads provide an optimal binding surface, with regular morphology, to optimize binding efficiency and reduce variability, simplifying the transition from column purification to bead-based purification.

Features and benefits

- High iron oxide content (60 emu/g): Fast magnetic response (~ 5 s) shortens time of magnetic steps during isolation
- Uniformity: Particles are uniform in size (submicroscale diameter 700 nm and 400 nm [monodispersed]), providing narrow size distribution
- Low sedimentation rate: Good buoyancy enhances ease of handling, automation, and reproducibility
- Purity: Used to isolate and purify genomic DNA from whole human blood providing A_{260}/A_{280} ratios between 1.70–1.90 and A_{260}/A_{230} ratios as high as 2

Product code	Quantity	Description
29357369	5 mL	SeraSil-Mag 400
29357371	60 mL	SeraSil-Mag 400
29357372	450 mL	SeraSil-Mag 400
29357373	5 mL	SeraSil-Mag 700
29357374	60 mL	SeraSil-Mag 700
29357375	450 mL	SeraSil-Mag 700

Find out more

Clean-up and enrichment Bead-based

Sera-Mag Carboxylate and SpeedBead Carboxylate

Carboxylic groups on the surface of Sera-Mag SpeedBeads and Sera-Mag Carboxylate-Modified Magnetic Beads permit easy covalent coupling to target biomolecules of interest, such as proteins and nucleic acids, using convenient carbodiimide chemistry.

The cauliflower-shaped surface paired with proprietary Sera-Mag and SpeedBead chemistry, provides a large surface area and offers excellent sensitivity and low non-specific binding for greater accuracy. This can maximize sample retention or reduce the amount of beads required.

The beads are available with different levels of hydrophobicity/hydrophilicity and magnetite layering.

Find out more

Sera-Mag Carboxylate-Modified Magnetic Particles

For use in Sanger sequencing and NGS

Sera-Mag Carboxylate-Modified Magnetic Beads combine a fast magnetic response time and high binding capacity, sensitivity, stability and physical integrity.

Features and benefits

- Ease of use: Covalent coupling of proteins, nucleic acids, etc. to carboxyl groups on the surface using standard coupling technologies
- Convenient: Isolation, selection and clean-up of nucleic acids or direct conjugation of specific oligos and enzymes

Product code	Quantity	Description
24152105050250	15 mL	Sera-Mag Carboxylate-Modified Magnetic Particles (Hydrophylic)
24152105050350	100 mL	Sera-Mag Carboxylate-Modified Magnetic Particles (Hydrophylic)
24152105050450	1000 mL	Sera-Mag Carboxylate-Modified Magnetic Particles (Hydrophylic)
44152105050250	15 mL	Sera-Mag Carboxylate-Modified Magnetic Particles (Hydrophobic)
44152105050350	100 mL	Sera-Mag Carboxylate-Modified Magnetic Particles (Hydrophobic)
44152105050450	1000 mL	Sera-Mag Carboxylate-Modified Magnetic Particles (Hydrophobic)

Find out more

Sera-Mag SpeedBead Carboxylate-Modified Magnetic Particles

For use in Sanger sequencing and NGS

Sera-Mag SpeedBeads have a second layer of magnetite applied through the same core shell design process, allowing a reaction twice as fast as the Sera-Mag Carboxylate-Modified beads when in the presence of a magnetic field. Speedbeads are especially useful where the reaction medium is highly viscous, and in clinical assays requiring a faster magnetic response time.

Features and benefits

- Convenient: Isolation, selection and clean-up of nucleic acids or direct conjugation of specific oligos and enzymes
- Reliable: Fast, precise and high binding capacity for sample preparation, nucleic acid isolation, proteomics and immunoassay applications

Product code	Quantity	Description
45152105050250	15 mL	Sera-Mag SpeedBead Carboxylate (Hydrophylic)
45152105050350	100 mL	Sera-Mag SpeedBead Carboxylate (Hydrophylic)
65152105050250	15 mL	Sera-Mag SpeedBead Carboxylate (Hydrophobic)
65152105050350	100 mL	Sera-Mag SpeedBead Carboxylate (Hydrophobic)
65152105050450	1000 mL	Sera-Mag SpeedBead Carboxylate (Hydrophobic)

Find out more

Sera-Mag Streptavidin

Sera-Mag Streptavidin-Coated Magnetic Particles

For use in NGS

Sera-Mag Streptavidin-coated magnetic beads provide solid phase support in immunoassays and molecular biology applications.

The magnetic streptavidin particles can also be used as a universal base particle for coating biotinylated proteins, oligos or other ligands to the particle surface.

Features and benefits

- Optimized application: Contain covalently bound streptavidin with low (2500 to 3500 pmol/mg), medium (3500 to 4500 pmol/mg) or high (4500 to 5500 pmol/mg) biotin binding capacities, providing a choice of biotin-binding capacity
- High capacity and precision: For enrichment and targeted sequencing applications

Product code	Quantity	Description
30152103011150	1 mL	Sera-Mag Streptavidin-Coated - 2500 to 3500 (low) pmol per mg
30152103010150	5 mL	Sera-Mag Streptavidin-Coated - 2500 to 3500 (low) pmol per mg
30152103010350	100 mL	Sera-Mag Streptavidin-Coated - 2500 to 3500 (low) pmol per mg
30152104011150	1 mL	Sera-Mag Streptavidin-Coated - 3500 to 4500 (med) pmol per mg
30152104010150	5 mL	Sera-Mag Streptavidin-Coated - 3500 to 4500 (med) pmol per mg
30152104010350	100 mL	Sera-Mag Streptavidin-Coated - 3500 to 4500 (med) pmol per mg
30152105011150	1 mL	Sera-Mag Streptavidin-Coated - 4500 to 5500 (high) pmol per mg
30152105010150	5 mL	Sera-Mag Streptavidin-Coated - 4500 to 5500 (high) pmol per mg
30152105010350	100 mL	Sera-Mag Streptavidin-Coated - 4500 to 5500 (high) pmol per mg

Find out more

Sera-Mag SpeedBeads Streptavidin-Blocked Magnetic Particles

For use in NGS

Sera-Mag SpeedBeads Streptavidin-Blocked provide high biotin-binding capacity along with a strong affinity for targeted, biotin-labeled molecules such as nucleic acids, proteins and peptides with very low nonspecific binding.

When the beads are combined with any of these molecules the strong non-covalent associate between the Streptavidin and biotin ensures efficient capture of the target molecule.

Features and benefits

- Increased throughput and precision: The SpeedBead particles combine fast reaction kinetics and low, non-specific binding
- Optimized for demanding applications: Including bead-in PCR and enrichment

Product code	Quantity	Description
21152104011150	1 mL	Sera-Mag SpeedBeads Streptavidin-Blocked
21152104010150	5 mL	Sera-Mag SpeedBeads Streptavidin-Blocked
21152104010350	100 mL	Sera-Mag SpeedBeads Streptavidin-Blocked
21152104010450	1000 mL	Sera-Mag SpeedBeads Streptavidin-Blocked

Find out more

Sera-Mag Select

For use in NGS

Sera-Mag Select size selection and PCR clean-up reagent is based on well-known solid phase reversible immobilization technology, for selective binding of DNA fragments for applications such as NGS and PCR clean-up. It combines the convenience of magnetic bead technology, using the exceptional binding characteristics of Sera-Mag Carboxyl SpeedBeads with an optimized binding solution in a ready-to-use formulation.

Features and benefits

- Reliability: High yield in the recovery of specific fragment sizes for optimal sequencing efficiency
- Simplicity: One product for size selection and PCR clean-up instead of two separate products
- Minimal disruption: Follows standard protocols for size selection and PCR clean-up, allowing for direct integration into existing workflows

Product Code	Quantity	Description
29343045	5 mL	Sera-Mag Select 5 mL
29343052	60 mL	Sera-Mag Select 60 mL
29343057	450 mL	Sera-Mag Select 450 mL

Find out more

Clean-up and enrichment Column-based

AutoScreen, 96-well plate

For use in Sanger sequencing

AutoScreen, 96-well plate consists of a 96-well filter plate containing DNA Grade Sephadex G-50 for purification of sequencing reactions prior to analysis on ABI sequencers and can be used for other size exclusion applications.

Features and benefits

- Minimized contamination: Double-distilled water removes the chance of electrophoretic artifacts

Product code	Quantity	Description
25900598	10 × 96-well plate	AutoScreen, 96-well plate

Find out more

AutoSeq G-50 columns

For use in Sanger sequencing

AutoSeq G-50 columns are specifically designed to remove fluorescent dye-terminators from sequencing reactions prior to analysis on automated sequencers. Effective purification is essential for high-quality sequencing results since residual dye-terminators can obscure data.

AutoSeq G-50 consists of MicroSpin columns containing Sephadex G-50, pre-equilibrated in double-distilled water. This is important because even the small amount of salt in traditional buffers (such as TE buffer) can cause electrophoretic artifacts on salt-sensitive automated sequencers.

Features and benefits

- Minimized contamination: Double-distilled water removes the chance of electrophoretic artifacts
- Unobscured data: Residual fluorescent dye-terminators are removed for effective purification

Product code	Quantity	Description
27534001	50	AutoSeq G-50
27534002	250	AutoSeq G-50
27534003	1000	AutoSeq G-50

Find out more

GFX Purification Kits

GFX Purification kits utilize proprietary glass fiber technology and optimized buffer solutions to efficiently capture DNA with high recovery and purity for use in a range of downstream applications.

GFX PCR DNA and Gel Band Purification Kits

For use in FISH, qPCR, microarrays, and Sanger sequencing

Designed for the rapid purification and concentration of PCR products or DNA fragments ranging in size from 50 bp to 10 Kbp. This kit can be used to purify DNA from reaction volumes up to 100 µL or agarose gel slices up to 900 mg. Includes a capture buffer that contains a visual color indicator to ensure optimal pH for maximum DNA binding.

Features and benefits

- Versatile: With a choice of two different input samples — either DNA in solution or DNA-containing agarose gel bands — and the flexibility to use two different elution buffers and an elution volume range of 10 to 50 µL to suit the requirements of any downstream application
- High purity: Typical recoveries range between 60% and 80% for DNA fragments from agarose gel to as high as 95% for PCR products from solution. All recoveries have exceptional purity with 99.5% of contaminants removed.
- Reliability: Consistent and successful removal of dNTPs and primers from PCR mixtures

Product code	Quantity	Description
28903466	10	GFX PCR DNA and Gel Band Purification Kit
28903470	100	GFX PCR DNA and Gel Band Purification Kit
28903471	250	GFX PCR DNA and Gel Band Purification Kit

Find out more

GFX 96 PCR Purification Kit

For use in FISH, qPCR, microarrays, Sanger sequencing, and NGS

The GFX 96 PCR Purification Kit uses glass fiber matrix technology in a 96-well format for highly efficient purification of PCR products. DNA fragments from PCR are captured by the matrix in presence of a chaotropic salt and contaminants are removed by washing the matrix with a buffered ethanol solution. Purified DNA is ready for use in most applications, including fluorescent sequencing, microarrays, labeling, hybridization, ligation, and transformation.

Features and benefits

- Fast: Purification of up to 96 PCR products (0.1 to 10 kb) simultaneously in as little as 15 min
- High yield: Pure DNA recovered in a small volume of water or a low ionic strength buffer. Typical recoveries are > 85% for PCR products 100 bp to 10 kb in length; salt removal typically ≥ 99%.
- Low risk: Avoids ethanol precipitations and hazardous organic extractions

Product code	Quantity	Description
28903445	1 × 96-well plate	GFX 96 PCR Purification Kit

Find out more

Amersham MicroSpin Columns

Designed for the rapid purification of DNA for use in a wide range of applications, including desalting, buffer exchange, removal of dye terminators from cycle sequencing reactions and removal of labeled nucleotides from DNA labeling reactions.

Amersham MicroSpin G-25 Columns

For use in Sanger sequencing

Amersham MicroSpin G-25 columns are ideal for rapid buffer exchange/desalting of PCR products and other DNAs in a volume of 10 to 100 µL using spin-column chromatography. Tested in nickase, single and double-stranded exonuclease and RNase assays.

Features and benefits

- Fast: Excellent for rapid purification of newly synthesized oligonucleotides > 10-mers in 100 to 150 µL of deprotection solution
- Convenient: Prepacked with Sephadex G-25 DNA Grade and pre-equilibrated in distilled water containing 0.05% Kathon™ CG/ICP Biocide
- Ready to use: Requires less than 4 minutes from sample application to collection of purified product

Product code	Quantity	Description
27532501	50	Amersham MicroSpin G-25 Columns

Find out more

Amersham MicroSpin G-50 Columns

For use in Sanger sequencing

Amersham MicroSpin G-50 columns are ideal for rapid buffer exchange/desalting of PCR products and other DNA (> 20 bases) from unincorporated labeled nucleotides in a volume of 25 to 50 µL using spin-column chromatography. Can also be used for buffer exchange/desalting of enzymatic reactions (10 to 100 µL) following heat denaturation and phenol extraction.

Features and benefits

- Fast: Excellent for rapid purification of newly synthesized oligonucleotides
- Convenient: Prepacked with Sephadex G-50 Grade pre-equilibrated in TE buffer with 0.05% Kathon CG/ICP Biocide
- High performance: Good product yield and purity obtained with sample volumes from 12–50 µL

Product code	Quantity	Description
27533001	50	Amersham MicroSpin G-50 Columns
27533002	250	Amersham MicroSpin G-50 Columns

Find out more

Amersham MicroSpin HR Columns

Amersham MicroSpin HR columns are designed for the rapid purification of nucleic acids for use in a wide range of applications, including desalting, buffer exchange and removal of primers. Good product yield and purity is obtained with sample volumes from 25–100 µL, and from nanogram to milligram quantities of DNA.

Amersham MicroSpin S-200 HR Columns

For use in Sanger sequencing

For rapid purification of labeled single-stranded or double-stranded DNA fragments ≥ 50 bases in length using spin-column chromatography. Tested in nickase, single- and double-stranded exonuclease and RNase assays.

Features and benefits

- Fast: Rapid purification of labeled single-stranded or double-stranded DNA fragments
- Convenient: Prepacked with Sephacryl™ S-200 HR resin pre-equilibrated in TE buffer
- High performance: > 80% sample recovery

Product code	Quantity	Description
27512001	50	Amersham MicroSpin S-200 HR Columns

Find out more

Amersham MicroSpin S-300 HR Columns

For use in Sanger sequencing

For rapid purification of PCR products (> 100 bp) from unincorporated primers (< 20-mers) and nucleotides using spin-column chromatography. Accommodates 25 to 50 µL for post-PCR clean-up prior to sequencing. Useful for purification of alkaline-denatured plasmid DNA prior to sequencing. Tested in nickase, single- and double-stranded exonuclease and RNase assays.

Features and benefits

- Fast: Rapid purification of PCR products from unincorporated primers and nucleotides
- Convenient: Prepacked with Sephacryl S-300 HR pre-equilibrated in TE buffer
- Ready to use: Requires less than 4 min from sample application to collection of purified product

Product code	Quantity	Description
27513001	50	Amersham MicroSpin S-300 HR Columns

Find out more

Amersham MicroSpin S-400 HR Columns

For use in Sanger sequencing

For rapid purification of PCR products (> 200 bp) from unincorporated primers (< 32-mers) and nucleotides using spin-column chromatography. Accommodates 25 to 50 µL for post-PCR clean-up prior to cloning or a second amplification reaction or 25 to 100 µL for all other applications. Tested in nickase, single- and double-stranded exonuclease and RNase assays.

Features and benefits

- Fast: For rapid purification of PCR products from unincorporated primers and nucleotides
- Convenient: Prepacked with Sephacryl S-400 HR pre-equilibrated in TE buffer
- Ready to use: Requires less than 4 minutes from sample application to collection of purified product

Product code	Quantity	Description
27514001	50	Amersham MicroSpin S-400 HR Columns

Find out more

Amersham NAP Kits

For use in FISH, microarrays, and NGS

Amersham NAP Columns are disposable columns pre-packed with Sephadex G-25 DNA Grade resin. NAP Columns allow DNA purification by the process of gel filtration using desalting and buffer exchange, and the removal of unincorporated nucleotides from end-labeled oligonucleotides.

Available in three sizes depending on input sample volume

Amersham NAP-5	Up to 0.5 mL
Amersham NAP-10	Up to 1 mL
Amersham NAP-25	Up to 2.5 mL

Features and benefits

- Simple: Require only gravity to run
- Versatile: Used for any DNA greater than 10 bases in length and ideal for the purification of oligonucleotides or very small DNA fragments following synthesis or end-labeling reaction

Column purification process

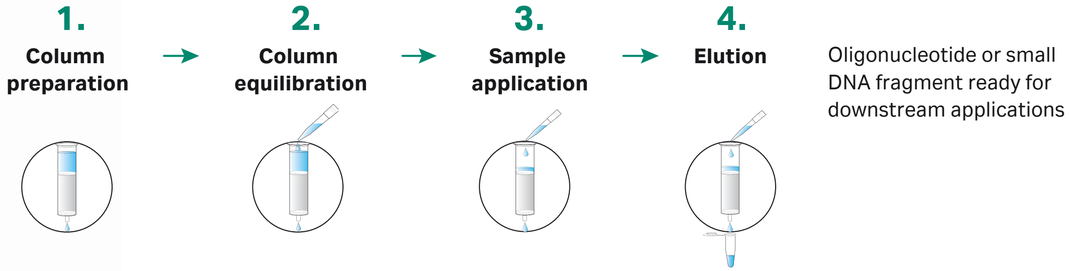


Fig 3. Column purification process.

Product code	Quantity	Description
17085301	20	Amersham NAP-5
17085302	50	Amersham NAP-5
17085401	20	Amersham NAP-10
17085402	50	Amersham NAP-10
17085201	20	Amersham NAP-25
17085202	50	Amersham NAP-25

Find out more

ProbeQuant G-50 Micro Columns

For rapid purification of labeled DNA (> 20 bases) from unincorporated labeled nucleotides in a volume of 25 to 50 µL using spin-column chromatography. In addition, a portion of the eluted DNA can be counted in a scintillation counter and compared to an unpurified sample to give an approximation of percent incorporation. Designed for use in a microcentrifuge and tested in nickase, single and double-stranded exonuclease and RNase assays.

Features and benefits

- Fast: Rapid and reliable method for purifying labeled probes from unincorporated labeled nucleotides
- Convenient: Prepacked with Sephadex G-50 DNA Grade
- Ready to use: Requires less than 4 minutes from sample application to collection of purified product

Product code	Quantity	Description
28903408	50	ProbeQuant G-50 Micro Columns

Find out more

Sephadex

Sephadex is a gel filtration resin prepared by crosslinking dextran with epichlorohydrin. Each product in the Sephadex portfolio offers different levels of cross-linking and hence variations in the degree of swelling and molecular fractionation range.

Some products within the Sephadex range come in four different particle sizes (coarse, resin [medium], fine, and superfine). Superfine has the smallest bead size for higher efficiency fractionation with shorter diffusion distances. Coarse and medium resin are preferred for large scale group separations where high flow rates and low operating pressures are required.

Features and benefits

- Fast process: Quickly desalts, removes contaminants such as dyes and radioactive labels, and transfers to a new buffer in a single step
- High performance: Excellent recovery and minimum sample dilution
- Convenience: Available in prepacked HiPrep Desalting and HiTrap Desalting columns

Sephadex G-10

For use in Sanger sequencing

Sephadex G-10 is a well established gel filtration resin for desalting and buffer exchange of peptides and small biomolecules > 700 molecular weight. It is the lowest exclusion limit in the Sephadex range.

Product code	Quantity	Description
17001001	100 g	Sephadex G-10
17001002	500 g	Sephadex G-10
17001003	5 kg	Sephadex G-10

Find out more

Sephadex G-15

For use in Sanger sequencing

Sephadex G-15 is well established gel filtration resin for desalting and buffer exchange of peptides and small biomolecules > 1500 molecular weight.

Product code	Quantity	Description
17002001	100 g	Sephadex G-15
17002003	5 kg	Sephadex G-15

Find out more

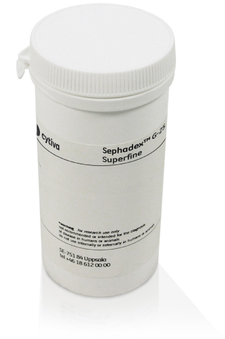
Sephadex G-25

For use in Sanger sequencing

Sephadex G-25 is well established gel filtration resin for desalting and buffer exchange in industrial applications.

Sephadex G-25 DNA Grade is used in MicroSpin G-25 Columns and NAP Columns.

Product code	Quantity	Description
17003401	100 g	Sephadex G-25 Coarse
17003402	500 g	Sephadex G-25 Coarse
17003403	5 kg	Sephadex G-25 Coarse
17003407	40 kg	Sephadex G-25 Coarse
17003301	100 g	Sephadex G-25 Medium
17003302	500 g	Sephadex G-25 Medium
17003303	5 kg	Sephadex G-25 Medium
17003201	100 g	Sephadex G-25 Fine
17003202	500 g	Sephadex G-25 Fine
17003203	5 kg	Sephadex G-25 Fine
17003101	100 g	Sephadex G-25 Superfine
17003102	500 g	Sephadex G-25 Superfine
17003103	5 kg	Sephadex G-25 Superfine
17057202	100 g	Sephadex G-25 DNA Grade Superfine



Find out more

Coarse

Find out more

Medium

Find out more

Fine

Find out more

Superfine

Find out more

DNA Grade

Sephadex G-50

For use in Sanger sequencing

Sephadex G-50 is a well established gel filtration resin for desalting and buffer exchange of biomolecules > 30 000 molecular weight.

Sephadex G-50 DNA Grade is used in AutoSeq G-50 columns, ProbeQuant G-50 Micro Columns, MicroSpin G-50 Columns, and NICK Column.

Product code	Quantity	Description
17004301	100 g	Sephadex G-50 Medium
17004302	500 g	Sephadex G-50 Medium
17004303	5 kg	Sephadex G-50 Medium
17004201	100 g	Sephadex G-50 Fine
17004202	500 g	Sephadex G-50 Fine
17004203	5 kg	Sephadex G-50 Fine
17004101	100 g	Sephadex G-50 Superfine
17004103	5 kg	Sephadex G-50 Superfine
17057402	100 g	Sephadex G-50 DNA Grade Superfine
17004502	100 g	Sephadex G-50 M DNA grade

Find out more — **Medium**

Find out more — **Fine**

Find out more — **Superfine**

Find out more — **DNA grade**

Find out more — **M DNA grade**

Sephadex G-75

For use in Sanger sequencing

Sephadex G-75 is well established gel filtration resin for desalting and buffer exchange of large biomolecules > 80 000 molecular weight.

Product code	Quantity	Description
17005001	100 g	Sephadex G-75 Medium
17005003	5 kg	Sephadex G-75 Medium
17005101	100 g	Sephadex G-75 Superfine
17005103	5 kg	Sephadex G-75 Superfine

Find out more

Medium

Find out more

Superfine

Sephadex G-100

For use in Sanger sequencing

Sephadex G-100 is well established gel filtration resin for desalting and buffer exchange of large biomolecules.

Product code	Quantity	Description
17006001	100 g	Sephadex G-100 Medium
17006101	100 g	Sephadex G-100 Superfine
17057402	100 g	Sephadex G-100 DNA Grade Superfine

Find out more

Medium

Find out more

Superfine

Find out more

DNA Grade

Clean-up and enrichment
Enzymatic clean-up

ExoProStar, ExoProStar S, and ExoProStar 1-Step

For use in Sanger sequencing and NGS

ExoProStar is optimized to purify PCR reactions in a fast and efficient way prior to Sanger sequencing reaction setup.

ExoProStar contains Alkaline Phosphatase and Exonuclease A, formulated to work together to remove unincorporated primers and nucleotides from amplification reactions in preparation for sequencing, cloning, genotyping or further DNA modifications.

ExoProStar 1-Step combines Exonuclease I and Alkaline Phosphatase in one single tube for a single-step method. This 1-step version is not available in Canada and Japan.

Features and benefits

- Simple: Enzymes provided in two separate tubes and just two simple pipetting steps are needed to prepare the reaction
- Fast: 30 min protocol or 15 min protocol with ExoProStar S and complete heat inactivation of the enzymes within 15 min
- Scalable: Suitable for different reaction sizes with no loss of PCR product

Product code	Quantity	Description
US78220	20	ExoProStar
US78210	100	ExoProStar
US78211	500	ExoProStar
US78212	2000	ExoProStar
US78225	5000	ExoProStar

Product code	Quantity	Description
US79002	20	ExoProStar S
US79010	100	ExoProStar S
US79050	500	ExoProStar S
US79200	2000	ExoProStar S
US79500	5000	ExoProStar S

Product code	Quantity	Description
US77701	20	ExoProStar 1-Step
US77702	100	ExoProStar 1-Step
US77705	500	ExoProStar 1-Step
US77720	2000	ExoProStar 1-Step
US77750	5000	ExoProStar 1-Step

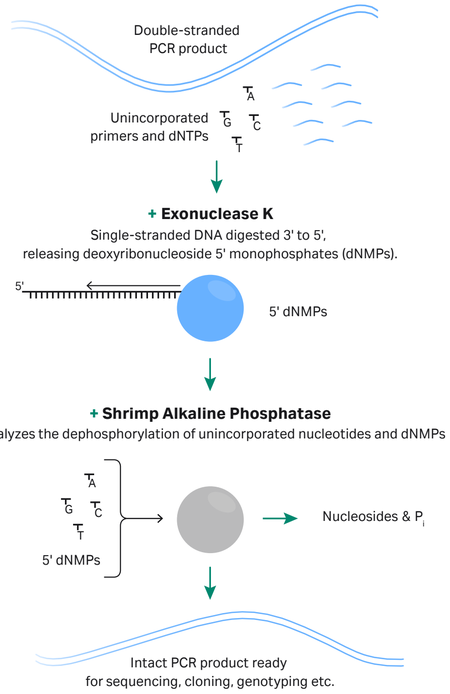


Fig 4. Purification of PCR product.

Find out more

02

Amplification and labeling

Phi29 DNA polymerase

Phi29 DNA polymerase-based isothermal DNA amplification is a simple, reliable alternative to other DNA amplification procedures. The highly processive Phi29 DNA polymerase elicits strong strand displacement enabling rapid DNA replication from multiple sites. Phi29 also has 3′-5′ exonuclease proofreading activity, resulting in 100-fold higher fidelity compared to Taq DNA polymerase.

From very small amounts of starting material, Phi29 DNA polymerase rapidly produces consistent microgram yields of high quality DNA that is ready for direct use in a range of downstream analyses, including sequencing and genotyping. Its high fidelity results in low rates of false positives and negatives in analysis, making it well-suited for identifying single nucleotide polymorphisms (SNPs) and other mutations. The one-tube, one-temperature format simplifies the DNA preparation process, facilitating automation for high-throughput sample amplification.

Our manufacturing processes, including UV and enzymatic reagent cleanup, help to ensure that all kits are free from any detectable DNA contamination and enable sensitivity of amplification down to 1 fg of gDNA.

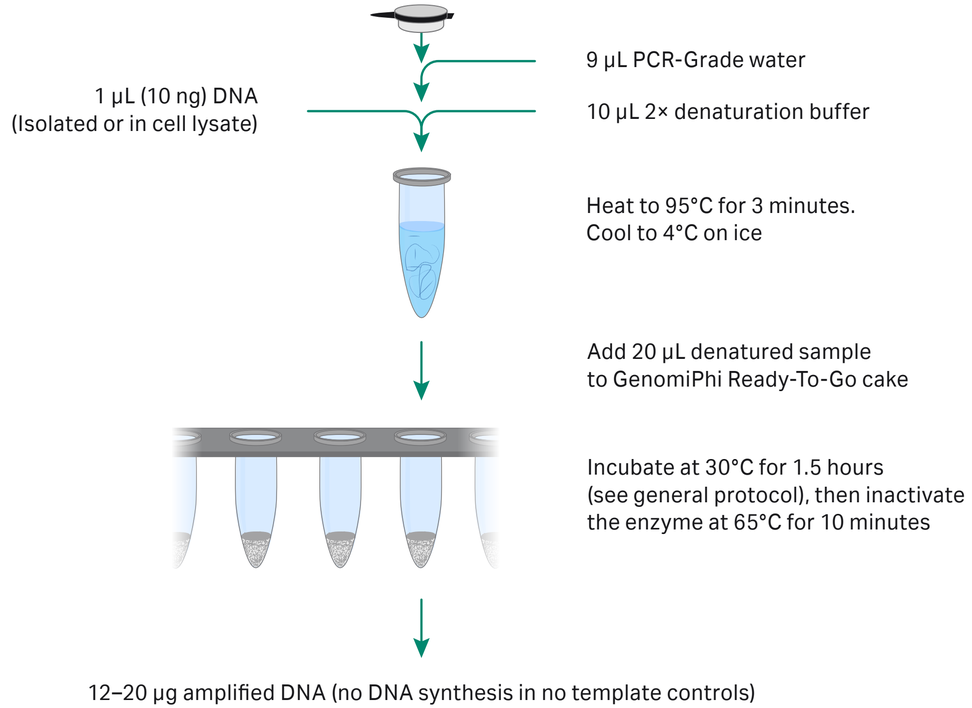


Fig 5. Isothermal DNA amplification with GenomiPhi Ready-To-Go cake.

Strand displacement amplification

GenomiPhi DNA Amplification and Ready-to-Go Amplification Kits

GenomiPhi DNA Amplification Kits are fundamental in genomic DNA preparation for genetic analysis and obtaining high quality DNA for successful downstream analysis. The kits provide an easy-to-use method that delivers highly representative and reliable whole genome amplification.

GenomiPhi HY DNA Amplification Kits

For use in Sanger sequencing and NGS

GenomiPhi HY DNA Amplification Kit contains all of the components necessary for midi-scale whole genome amplification by isothermal strand displacement amplification (Phi29). Amplification is highly uniform over the entire genome so that locus representation remains extremely close to the original DNA sample. A typical DNA yield of 40 to 50 µg DNA can be achieved in four hours with little hands-on time.

The kit was verified with DNA from various clinical samples including blood and buccal swabs to deliver a high quality yield. A protocol has been developed for amplification from Whatman™ FTA card punches with minimal handling, thus enabling a streamlined, efficient workflow for sample collection and analysis.

GenomiPhi amplified DNA is suitable for various applications such as genotyping (SNP, STR, array CGH), cloning, sequencing, and DNA archiving and outperforms PCR-based whole genome amplification techniques. The average product length is over 10 kb.

Features and benefits

- Quick procedure: High yield can be achieved with little hands-on time and a thermal cycler is not required
- Easy to use: The starting material for GenomiPhi reactions can be purified DNA from any commercial kit or homebrew method, or a non-purified cell lysate may be used

Product code	Quantity	Description
25660022	25	GenomiPhi HY DNA Amplification Kit
25660020	100	GenomiPhi HY DNA Amplification Kit
25660025	1000	GenomiPhi HY DNA Amplification Kit

Find out more

GenomiPhi HY Ready-To-Go DNA Amplification Kits

For use in Sanger sequencing and NGS

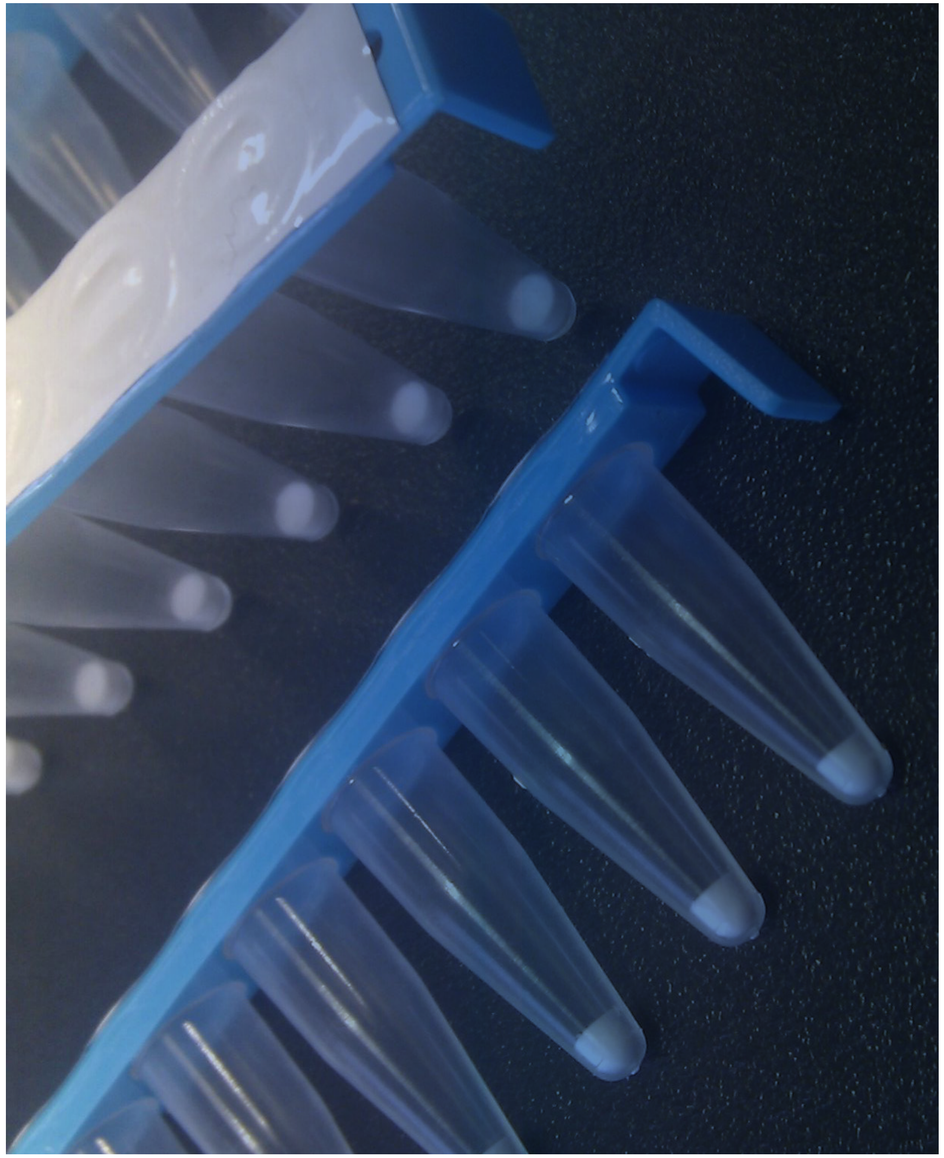
GenomiPhi HY Ready-To-Go DNA Amplification Kit supports the same applications as GenomiPhi HY DNA Amplification Kit with the added benefit that the reaction mixture is provided as pre-dispensed, single-dose, lyophilized cakes in either strips of 8 tubes, 96-well or 480-well plates.

Features and benefits

- Reproducibility: Preformulated, pre-dispensed, single dose for rapid reaction set up
- Automation-friendly protocol: Quick and simple with no thermal cycler required
- Convenient: Shipping and storage at room temperature

Product code	Quantity	Description
25660324	24	GenomiPhi HY Ready-To-Go DNA Amplification Kit
25660396	96	GenomiPhi HY Ready-To-Go DNA Amplification Kit
25660397	480	GenomiPhi HY Ready-To-Go DNA Amplification Kit

Find out more



GenomiPhi V2 DNA Amplification Kits

For use in Sanger sequencing and NGS

GenomiPhi V2 DNA Amplification Kit contains all of the components necessary for smaller scale whole genome amplification by isothermal strand displacement amplification (Phi29). A typical DNA yield of 4 to 7 µg DNA can be achieved in less than two hours with little hands-on time.

Product code	Quantity	Description
25660030	25	GenomiPhi V2 DNA Amplification Kit
25660031	100	GenomiPhi V2 DNA Amplification Kit
25660032	500	GenomiPhi V2 DNA Amplification Kit

Find out more

GenomiPhi V3 Ready-To-Go DNA Amplification Kits

For use in Sanger sequencing and NGS

GenomiPhi V3 Ready-To-Go DNA Amplification Kit supports the same applications as GenomiPhi V2 DNA Amplification Kit with the added benefit that the reaction mixture is provided as pre-dispensed, single-dose, lyophilized cakes in either strips of 8 tubes, 96-well or 480-well plates.

A typical DNA yield of 12 to 20 µg DNA can be achieved in less than two hours from only 10 ng of genomic DNA input.

Product code	Quantity	Description
25660124	24	GenomiPhi V3 Ready-To-Go DNA Amplification Kit
25660196	96	GenomiPhi V3 Ready-To-Go DNA Amplification Kit
25660197	480	GenomiPhi V3 Ready-To-Go DNA Amplification Kit

Find out more

GenomiPhi Single Cell DNA Amplification Kits

For use in Sanger sequencing and NGS

GenomiPhi Single Cell DNA Amplification kit has been optimized to wholly amplify genomic DNA from as little as a single cell in just a two-step workflow, generating micrograms of high quality DNA for use in downstream applications. High quality lysis reagents are optimized to fully release genomic DNA from the cell and subsequently denature the DNA to enable optimal amplification and coverage. Background amplification, often associated with multiple displacement amplification (MDA), is suppressed throughout the incubation so that only input DNA is amplified.

Features and benefits

- High purity: High quality reagents and an optional, proprietary enzymatic clean-up step in the protocol ensure that any potential DNA contaminants introduced during set-up are removed before each individual reaction
- Fast: The amplification process is two to four hours depending on the amount of starting DNA
- High yields: 4 to 7 µg can be achieved

Product code	Quantity	Description
29108107	25	GenomiPhi Single Cell DNA Amplification Kit
29108039	100	GenomiPhi Single Cell DNA Amplification Kit

Find out more

TempliPhi DNA Amplification Kits

TempliPhi DNA Amplification Kits are used to prepare DNA directly from plasmid or fosmid glycerol stocks or colonies, which eliminates overnight culture steps. TempliPhi kits use isothermal rolling circle amplification (RCA) for the exponential amplification of circular DNA using bacteriophage Phi29 DNA polymerase. Phi29 DNA polymerase is active at 30°C, and isothermal amplification is performed at this temperature without the need for thermal cycling.

Random hexamer primers anneal to the circular template DNA at multiple sites. Phi29 DNA polymerase extends each of these primers. When the DNA polymerase reaches a downstream extended primer, strand displacement synthesis occurs. The displaced strand is rendered single-stranded and available to be primed by more hexamer primer. The process continues, resulting in exponential, isothermal amplification (Fig 6).

The amplified DNA from bacterial or M13 liquid cultures, colonies, plaques, glycerol stocks, or purified circular (plasmid or M13) DNA can be used directly for sequencing and library construction without further purification, simplifying the process and reducing hands-on time without compromising on sequencing success and read lengths. It can also be used for enrichment of small circular viral genomes in complex samples for genotyping by sequencing.

Features and benefits

- Efficient: Prepares templates for cycle sequencing, cloning, and transformation from circular DNA starting material without the need for purification
- Simple protocol: Reduces time, labor and consumables needed for template preparation and allows for easy automation
- Quick: The TempliPhi protocol allows amplification of 96 samples from bacterial colonies with less than 20 minutes of hands-on time

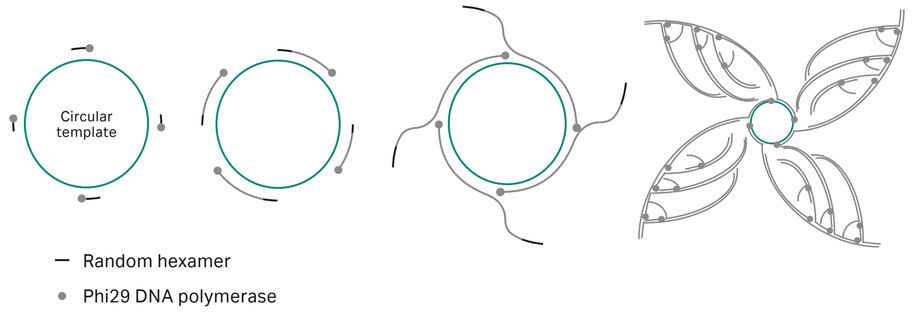


Fig 6. Exponential isothermal amplication with Phi29 DNA polymerase.

TempliPhi 100/500 Amplification Kits

For use in Sanger sequencing and NGS

TempliPhi 100/500 Amplification Kits are for low to medium throughput laboratories preparing circular DNA constructs.

Product code	Quantity	Description
25640010	100	TempliPhi 100 Amplification Kit
25640050	500	TempliPhi 500 Amplification Kit

Find out more

TempliPhi 2000 Reaction Kit

For use in Sanger sequencing and NGS

TempliPhi DNA Amplification Kit for 2000 reactions is specially formulated to minimize the number of components, thus simplifying setup on automated liquid handling platforms for high throughput applications.

Product code	Quantity	Description
28964286	2000	TempliPhi 2000 Reaction Kit

Find out more

TempliPhi Large Construct Kit

For use in Sanger sequencing and NGS

Templiphi Large Construct DNA Amplification Kit was developed specifically to prepare templates for BAC or fosmid DNA sequencing for high-throughput users.

The starting material for amplification can be a small amount of bacterial cells containing a BAC or fosmid DNA, or any circular DNA sample. Bacterial colonies can be picked from agar plates and added directly to the TempliPhi Large Construct reaction. Alternatively, microliter quantities of a saturated bacterial culture or a glycerol stock can serve as starting material. The product of the TempliPhi Large Construct reaction is high molecular weight, double-stranded concatemers of the circular template. The TempliPhi Large Construct product is double-stranded DNA that can be sequenced with forward and reverse primers.

Amplification is completed in 18 hours and generates 5 µg of total DNA.

Product code	Quantity	Description
25640080	1000	TempliPhi Large Construct Kit

Find out more

TempliPhi Sequence Resolver Kits

For use in Sanger sequencing and NGS

The TempliPhi Sequence Resolver Kit produces exceptional sequencing results from difficult templates such as those with high GC content and secondary structures. The kit resolves most of the sequencing gaps that routinely elude other commonly used finishing methods. The use of this kit eliminates the need to use dGTP chemistry, which can affect the accuracy of a sequence due to the appearance of sequence compression. In addition, it eliminates the need for additives in the sequencing reaction. The TempliPhi Sequence Resolver Kit provides a convenient, time-saving, and economical solution to the problem of sequencing difficult templates and can be used to amplify fosmid and BAC templates for downstream sequencing with slight modifications to the protocol.

Product code	Quantity	Description
28903529	20	TempliPhi Sequence Resolver Kit
28903530	50	TempliPhi Sequence Resolver Kit
28903531	200	TempliPhi Sequence Resolver Kit

Find out more

PCR amplification

Amersham Hot Start Mix RTG beads

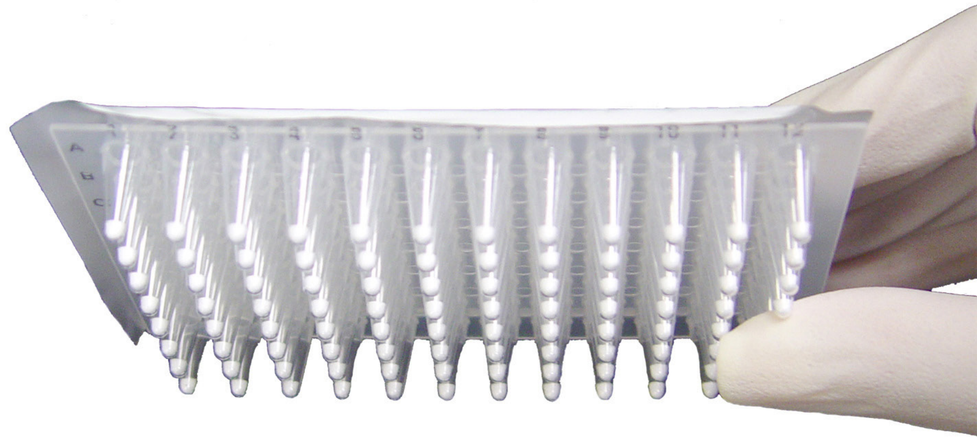
For use in RT-qPCR, qPCR, and microarrays

This premixed, pre-dispensed, ambient temperature-stable formulation can effectively reduce non-specific priming and primer-dimer formation during PCR. The system is based on a novel hot start method that uses a hot start activator protein to sequester primers prior to PCR, thereby making them unavailable for non-specific priming during the reaction preparation. This Ready-To-Go format provides reproducible and reliable performance for demanding PCR applications in which high specificity and high sensitivity are essential to success.

Features and benefits

- Fast: This method requires a 2 minute initial PCR activation step
- Robust and reliable amplification: Prolonged incubation at high temperatures is not required which avoids damage to the DNA template and improves the amplification of the target amplicons with increased yield
- Minimal contamination: The mix does not contain Taq antibody which eliminates the risk of mammalian-source contamination

Product code	Quantity	Description
28900646	100	Amersham Hot Start Mix RTG 0.5 mL
28900653	96	Amersham Hot Start Mix RTG 0.2 mL
28900654	480	Amersham Hot Start Mix RTG 0.2 mL



Find out more

PuReTaq Ready-To-Go PCR Beads

For use in FISH, RT-qPCR, qPCR, and microarrays

PuReTaq Ready-To-Go PCR Beads are long-term ambient-temperature stable, complete single-dose reactions. The beads offer flexibility while yielding robust and reproducible PCRs optimized for use with endpoint PCR and with a number of real-time PCR systems.

The PuReTaq Ready-To-Go Beads were developed to minimize nonspecific amplification by eliminating nucleic acid contamination. Nonspecific amplification generates spurious bands and background smears, reducing the overall efficiency of PCR.

Features and benefits

- Save time: Simply add template DNA solution and primers and cycle
- More reproducible results: Less risk of pipetting errors, contamination and smears to improve efficiency of PCR

Product code	Quantity	Description
27955701	Multiwell Plate, 96 Reactions	PuReTaq Ready-To-Go PCR Beads
27955702	Multiwell Plate, 5 × 96 Reactions	PuReTaq Ready-To-Go PCR Beads
27955801	100 × 0.5 mL Tubes	PuReTaq Ready-To-Go PCR Beads
27955901	96 × 0.2 mL hinged tube with cap	PuReTaq Ready-To-Go PCR Beads

Find out more

Nucleotides

For use in FISH, RT-qPCR, qPCR, microarrays, Sanger sequencing, and NGS

Amersham dNTPs are high purity deoxynucleotides for amplification, dideoxy sequencing, labeling, mutagenesis, cDNA synthesis, and expression profiling. They are free from DNase, RNase, and nicking enzyme activity.

Features and benefits

- Performance: Greater than 99% triphosphate purity (by HPLC) for consistency
- Convenient: Buffer-free, ready-to-use solutions at a variety of concentrations
- Tested: Functionally tested to produce a 20.7 kb PCR amplification product from λ DNA

Also available: high purity rNTPs providing easy to use solutions which save time for *in vitro* transcription. rNTPs are all lot tested for ribonuclease contamination.

Product code	Quantity	Description
28406501	25 µmol	Amersham dATP, Solution, 100 mM
28406502	100 mmol	Amersham dATP, Solution, 100 mM
28406503	500 µmol	Amersham dATP, Solution, 100 mM
28406512	100 mmol	Amersham dCTP, Solution, 100 mM
28406522	100 mmol	Amersham dGTP, Solution, 100 mM
28406531	25 mmol	Amersham dTTP, Solution, 100 mM
28406532	100 mmol	Amersham dTTP, Solution, 100 mM
28406541	25 µmol	Amersham dUTP, Solution, 100 mM
28406542	100 mmol	Amersham dUTP, Solution, 100 mM
28406551	4 × 25 µmol	Amersham dNTP Set (100 mM each A,C,G,T)
28406552	4 × 100 µmol	Amersham dNTP Set (100 mM each A,C,G,T)
28406553	4 × 500 µmol	Amersham dNTP Set (100 mM each A,C,G,T)
28406557	10 mmol	Amersham dNTP Set (20 mM each A,C,G,T)
28406558	4 × 10 µmol	Amersham dNTP Set (100 mM each A,C,G,T)

Find out more

Amersham Ready-To-Go RT-PCR Beads

For use in FISH, RT-qPCR, qPCR, and microarrays

Amersham Ready-To-Go RT-PCR beads are stable at ambient temperature and optimized for performing single-tube RT-PCR. The reagents are designed for full-length cDNA synthesis to > 7.5 kb and optimal sensitivity from PCR. They are suitable for use with either total RNA or mRNA isolated using a variety of methods.

RT-PCR can be applied to a variety of analyses from detecting RNA in a species to determining the relative levels of a specific RNA.

Features and benefits

- Convenience: Gene-specific PCR primers can be added at the same time as the cDNA synthesis primer to perform one-step RT-PCR, or PCR primers can be added after first-strand synthesis for two-step reactions
- Reproducibility: Beads are manufactured under highly controlled, function tested conditions, ensuring reproducible results
- Reduced risk of contamination: Individual predispensed reactions minimize sample handling and pipetting steps, thus reducing the risk of RNA degradation, contamination, and pipetting errors
- Ambient temperature stability: Amersham Ready-To-Go RT-PCR Beads can be shipped and stored at room temperature

Product code	Quantity	Description
27925901	96 × 0.2 mL Hinged Tube with Cap	Amersham Ready-To-Go RT-PCR Beads
27926601	100 × 0.5 mL Tubes	Amersham Ready-To-Go RT-PCR Beads
27926701	96 × 0.2 mL Tubes	Amersham Ready-To-Go RT-PCR Beads

Find out more

Taq DNA Polymerase (cloned)

For use in RT-qPCR, qPCR, microarrays, Sanger sequencing, and NGS

Cloned Taq DNA polymerase is the recombinant protein form of the native enzyme from Thermus aquaticus expressed in *E. coli*. Like native Taq, it polymerizes DNA from a primer annealed to a DNA template in the presence of deoxyribonucleotide triphosphates. It has an optimum temperature of 75°C and can survive repeated incubations at > 95°C.

Features and benefits

- High performance: Highly purified thermostable DNA polymerase for PCR
- Reliable: Highly purified recombinant enzyme, providing excellent batch-to-batch reproducibility and minimized nuclease contamination

Product code	Quantity	Description
27079804	250	Taq DNA Polymerase (cloned)
27079805	4 × 250	Taq DNA Polymerase (cloned)
27079806	10 × 250	Taq DNA Polymerase (cloned)
28937348	25 000	Taq DNA Polymerase (cloned)

Find out more

Labeling

CyDye Fluorescent Nucleotides

For use in FISH, RT-qPCR, qPCR, microarrays, and Sanger sequencing

CyDye is a group of bright fluorescent dyes which can be used in genomic and protein research. They are suitable for labeling DNA and RNA probes, especially for multicolor analysis, FISH, chromosome identification, whole chromosome painting, karyotyping and gene mapping.

This comprehensive portfolio of bright and stable dyes offers narrow emission bands, well suited for multiplexing within a single sample.

Features and benefits

- High sensitivity: Combine exceptional photostability with bright and intense signals, resulting in high sensitivity and a highly reproducible performance at a biologically suitable pH range of 3 to 10
- High accuracy: Narrow excitation and emission bands result in discrete signals from each fluor, which together with minimal cross-talk contributes to high accuracy
- No crosstalk: The use of multicolor CyDye fluors enables multiplexing without crosstalk
- High water solubility: Readily dissolve in aqueous buffers, which eliminates the need for organic solvents

Product code	Quantity	Description
25801086	100 nmol	Cy™3-CTP
25801087	100 nmol	Cy5-CTP
PA53021	25 nmol	Cy3-dCTP
PA53022	25 nmol	Cy3-dUTP
PA53026	100 nmol	Cy3-UTP
PA53031	250 nmol	Cy3-dCTP
PA53032	250 nmol	Cy3-dUTP
PA53521	25 nmol	Cy3.5-dCTP
PA55021	25 nmol	Cy5-dCTP

Product code	Quantity	Description
PA55022	25 nmol	Cy5-dUTP
PA55026	100 nmol	Cy5-UTP
PA55031	250 nmol	Cy5-dCTP
PA55032	250 nmol	Cy5-dUTP
PA55321	1	Value pack containing 5 × 25 nmol Cy3-dCTP + 5 × 25 nmol Cy5-dCTP
PA55322	1	Value pack containing 5 × 25 nmol Cy3-dUTP + 5 × 25 nmol Cy5-dUTP
PA55521	25 nmol	Cy5.5-dCTP

Find out more

Microarray Hybridization Solution V2.0

For use in microarrays

Microarray Hybridization Solution Version 2.0 uses a blend of proprietary components to provide high-quality automated and manual slide hybridizations for use in microarray applications. Hybridization rate enhancers improve the detection of rare targets, while proprietary blocking agents minimize non-specific background.

Features and benefits

- Saves time: Automated process
- High accuracy: Blocking agents minimize non-specific background

Product code	Quantity	Description
RPK0325	1	Microarray Hybridisation Solution v2.0

Find out more

T4 DNA Ligase

For use in RT-qPCR, qPCR, Sanger sequencing, and NGS

T4 DNA Ligase affords a quick and efficient method for performing DNA ligation reactions and can be used for a variety of ligation procedures such as conventional vector cloning, TA cloning, linker or adaptor ligation, and library construction.

Features and benefits

- Convenient: Ready-to-use format and room temperature incubation
- Flexible: Ligation products can be used directly for transformation

Product code	Quantity	Description
27036101	50	T4 DNA Ligase, reaction beads

Find out more

Nucleotides

For use in FISH, RT-qPCR, qPCR, microarrays, Sanger sequencing, and NGS

Amersham dNTPs are high purity deoxynucleotides for amplification, dideoxy sequencing, labeling, mutagenesis, cDNA synthesis, and expression profiling. They are free from DNase, RNase, and nicking enzyme activity.

Features and benefits

- Performance: Greater than 99% triphosphate purity (by HPLC) for consistency
- Convenient: Buffer-free, ready-to-use solutions at a variety of concentrations
- Tested: Functionally tested to produce a 20.7 kb PCR amplification product from λ DNA

Also available: high purity rNTPs providing easy to use solutions which save time for *in vitro* transcription. rNTPs are all lot tested for ribonuclease contamination.

Product code	Quantity	Description
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28406502	100 mmol	dATP, Solution, 100 mM
28406503	500 µmol	dATP, Solution, 100 mM
28406512	100 mmol	dCTP, Solution, 100 mM
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28406532	100 mmol	dTTP, Solution, 100 mM
28406541	25 µmol	dUTP, Solution, 100 mM
28406542	100 mmol	dUTP, Solution, 100 mM
28406551	4 × 25 µmol	dNTP Set (100 mM each A,C,G,T)
28406552	4 × 100 µmol	dNTP Set (100 mM each A,C,G,T)
28406553	4 × 500 µmol	dNTP Set (100 mM each A,C,G,T)
28406557	10 mmol	dNTP Set (20 mM each A,C,G,T)
28406558	4 × 10 µmol	dNTP Set (100 mM each A,C,G,T)

Find out more

Molecular diagnostics: its role in precision healthcare

Precision healthcare can be defined as an approach to healthcare that is patient-centric and patient-specific at every step. It applies this personalization to disease prevention, diagnosis, treatment, and monitoring.

Understanding the nuances of an individual's genetics and epigenetics is key to achieving many aspects of precision healthcare. This improved understanding, combined with increasingly easy access to genetic information, has led to a vastly expanded role of genetics in the clinic.

The potential benefits of implementing a precision healthcare approach are wide ranging. Not only can it result in improved survival rates for diseases such as cancer, it can also improve prevention through screening, reduce adverse effects of treatments, and avoid money being wasted on treatments that are ineffective for a given patient.

Precision through molecular diagnostics

The genetic information required to deliver precision healthcare can come from a range of clinical diagnostic tests. Advances in molecular *in vitro* diagnostic assays (IVD assays) have been a key driver for better genetic information, including increased precision, faster turnarounds, and reduced costs.

Assays based on polymerase chain reaction (PCR) currently have the highest market share among the most common molecular diagnostic assays for detecting genetic abnormalities. Other established methods include DNA microarrays and fluorescent *in situ* hybridization (FISH).

DNA sequencing methods such as Sanger sequencing also have a long track record in finding mutations, but Sanger sequencing has limitations in throughput. Now, the massively parallel sequencing capabilities of next-generation sequencing (NGS) approaches have largely replaced Sanger sequencing in many research applications and are making fast inroads into the clinic.

These technologies contribute to precision healthcare by identifying the genetic abnormalities underlying diseases, resulting in diagnoses and treatments based on more than just symptoms. In oncology for example, the genetic makeup of tumors can be highly variable, even when the physical appearance is similar. Characterizing tumors genetically can therefore contribute substantially to personalizing treatments and maximizing their effectiveness.

The ways in which clinicians use molecular diagnostics to deliver precision healthcare vary greatly between different clinical areas. For example, decisions on treatment for infectious diseases might require analyzing bacterial or viral genomes, whereas cancer diagnostics focus on genome markers in germline or tumor DNA.

Precision healthcare moving forward

The precision healthcare approach will undoubtedly become a mainstay of healthcare. With new genetic factors for diseases being discovered in rapid succession, molecular diagnostics will play an ever-increasing role.

Molecular assays are already enabling a personalized, high-precision approach to healthcare in the clinical areas discussed here, as well as in Mendelian diseases, complex diseases, and reproductive health. In areas where the role of genetics is currently less clear, molecular assays could see a steady increase in years to come.

One such example is Alzheimer's disease. Many cases of Alzheimer's do not have a known cause, but specific genes and mutations are increasingly linked to the disease. The causes of Alzheimer's are also highly variable, which means that the likelihood of finding a 'magic bullet' treatment, effective for all forms of the disease, is unlikely[1].

Molecular diagnostics supports the identification of biomarkers and individuals' genetic characteristics, enabling healthcare professionals to not only predict and prevent disease, but to provide these effective, biologically targeted, therapeutic interventions. Treatments will be tailored to the individual's genetic make-up to avoid adverse effects while increasing the efficacy of the treatment.

Pharmaceutical companies are becoming more supportive of these drug-diagnostic developments as they can reduce costs, increase the chance of market approval and markedly increase market uptake. There have been several FDA-approved success stories in oncology such as Trastuzumab, which combined drug development with diagnostic development to include the patients that would benefit from the treatment with fantastic results. At present, Trastuzumab is the world's eighth-largest-selling pharmaceutical product generating over 6 billion dollars each year.

Molecular diagnostics will play a critical role in delivering the accuracy and patient specificity that is necessary to sustainably implement precision medicine in a clinical setting.

[1] Hampel, H. *et al.* A Precision Medicine Initiative for Alzheimer's disease: the road ahead to biomarker-guided integrative disease modeling. Climacteric **20**, 107–118 (2017).

Read more about the role of molecular diagnostics in precision healthcare approaches towards cancer and infectious diseases in our whitepaper

03

Detection and sequencing

Detection and sequencing for molecular diagnostics

Research and clinical diagnostic laboratories face different challenges and therefore have different needs when it comes to detection and sequencing technologies. Maybe simplicity is needed on a budget, perhaps more reliable results are sought from scarce samples or possibly higher throughput is demanded for maximum productivity. Whatever the need, choosing the most appropriate detection or sequencing platform is paramount.

Detection for maximum productivity

Polymerase chain reaction (PCR) is a relatively simple and widely used molecular biology technique to amplify and detect DNA and RNA sequences. A well-optimized reaction is therefore essential for accurate results.

Quantitative PCR (qPCR) is used to detect, characterize and quantify nucleic acids for numerous applications. Reverse transcription PCR (RT-qPCR) enables RNA transcripts to be quantified by reverse transcribing them into cDNA and then applying the qPCR process. It is inherently an analogue process and quantitation relies on setting a threshold against pre-determined standards. Using algorithms, optimized master mixes, intuitive data analysis software, flexible instrumentation and commercially available fluorescence-detecting thermocyclers to amplify specific nucleic acid sequences, the power of qPCR across a diverse set of applications can be harnessed.

With real-time PCR, data is collected throughout the PCR process rather than at the end which means that reactions are characterized by the point in time during cycling when amplification of a target is first detected rather than after a fixed number of cycles. Some of the benefits of real-time PCR include the ability to measure the initial concentration of target DNA over a range of five or six orders of magnitude, no reliance on downstream analysis such as electrophoresis or densitometry, the possibility for multiple samples to be assessed simultaneously which is ideal for high throughput situations, its high sensitivity and the provision of immediate information. A disadvantage is the equipment is more expensive than traditional PCR instruments.

Manual and automated thermal cyclers and PCR products offer a direct route to reliable PCR results for researchers demanding efficiency and accuracy from sequencing to flow cytometry and real-time, digital and end point PCR — from sample prep to data analysis.

Sequencing is the process of reading the nucleotides present in DNA or RNA molecules. There are two types of sequencing technologies that are used today: Sanger sequencing and NGS. Each of these technologies has utility in today's genetic analysis environment.

Sanger sequencing

The Sanger method, developed by two-time Nobel laureate Frederick Sanger and his colleagues in 1977, relies on using dideoxy chain terminating nucleotides to produce sequence fragments of varying lengths, each equal to the position of the base complementing the terminating nucleotide. Reading the DNA sequence involves visualizing these fragments and identifying the terminating nucleotides in order of fragment length.

In the 1980s, developments in fluorescent detection, PCR, and electrophoresis improved the ease-of-use, speed, and sensitivity of Sanger sequencing. This automation-friendly approach led scientists to consider sequencing the human genome a real possibility.

Commercial Sanger sequencing equipment, such as the MegaBACE 4000 (Amersham International/Cytiva) and PRISM 3700 (Applied Biosystems™), were powerhouses of the human genome project. Started in 1990, the project completed its objective in 2003, two years ahead of schedule.

New technologies emerged. Pyrosequencing and Illumina dye sequencing brought orders of magnitude increases in DNA sequencing speed and capacity. These massively parallel sequencing, also dubbed next-generation sequencing (NGS), technologies dominated the market for years.

The robustness and accuracy of Sanger sequencing, which can be as high as 99.9%, helped maintain its value over the years despite the availability of more modern alternatives. One key area where Sanger continues to win out over NGS techniques is in small-scale sequencing applications. These include single-gene studies, routine sequencing for cloning and checking genotypes, and specialized and custom projects.

Next-generation sequencing

After the completion of the Human Genome Project, a new wave of technologies, called next-generation sequencing (NGS), came onto the market. These sequencers use massively parallel sequencing of short reads for high throughput.

Since NGS platforms can sequence entire genomic regions or even entire genomes, a single test can examine hundreds or thousands of clinically important genetic variations. This means that one test can replace multiple conventional single-gene tests, providing an advantage in price and in the amount of precious sample needed for the test itself. Maximizing the efficiency of each sequencing run and ensuring highly reliable data is generated remain the two main objectives for the majority of laboratories.

The main commercial platforms are those offered by Illumina, Thermo Fisher and Pacific Biosciences. Several companies, such as Oxford Nanopore, are developing advanced technologies based on nanopores.

Although the gigabases of data may be lower and the read lengths may be shorter, benchtop sequencers and even handheld sequencers have been well accepted by lower-throughput laboratories who may face space constraints and are looking for a lower priced option.

Single-cell sequencing: an overview

Single-cell genomics applies standard analytical techniques, including sequencing and microarrays, to the individual cell, utilizing advanced techniques for selecting and handling individual cells and maximizing the raw material (DNA, RNA, proteins) held within. Single-cell genomics has numerous applications in both basic research and clinical settings.

Single-cell genomics: applications

The heterogeneity of solid tumors is well-known. Single-cell sequencing gives researchers the ability to study individual cells from various points in a tumor's progression and its microenvironment, and opens up investigative pathways that may lead to better diagnostics, treatments and cures.

In cases where a direct biopsy would be invasive, single-cell sequencing enables clinicians to detect and monitor circulating tumor cells (CTCs), which present cancer biomarkers that can direct treatment, minimizing therapies that are unlikely to succeed.

Liquid biopsies such as in non-invasive pre-natal testing (NIPT), are also quite well-established for sequencing cell-free DNA. In this example of liquid biopsy, NIPT can detect various genetic conditions from fetal DNA that circulates in the mother's bloodstream, avoiding invasive testing.

Single-cell genomics is also an essential tool in forensic applications where a few cells might be all you have to work with from a casework sample.

As the technology improves and becomes more accessible, the areas of application will only expand. Single-cell genomics is already allowing archaeologists, anthropologists and paleontologists to utilize genomics in new and interesting ways.

Single-cell genomics: challenges

Three core processes in single-cell sequencing present challenges which can also affect sequencing outcomes:

- Careful handling through manual pipetting might be the way to go if you're working with a few individual cells. However, If you need to analyze a large sample at the single-cell level, this approach is quite labor intensive. In that case, microfluidics might be the best option. Recent developments enable these systems to handle thousands of cells in parallel.
- Current extraction techniques are quite robust, though they do need careful control for efficient release and high yield of material for amplification
- Amplification is the most challenging process in single-cell sequencing. While there are several methods available, each technique can introduce bias that may affect your results.

Single-cell sequencing: methods of amplifying DNA

There are currently three general approaches to amplifying DNA. Whichever method you choose, once you have your starting material amplified, generating a library, sequencing, and analysis are relatively straightforward, and not too different from bulk cell analysis.

1. **PCR-based amplification (Polymerase chain reaction-based amplification)** uses thermal cycling to induce DNA replication. Unfortunately, it is prone to variations in reliability across different loci, and false positives and negatives in analysis. This method has fallen out of use.
2. **Multiple displacement amplification (MDA)** amplifies DNA through multiple displacement, binding primers to newly-formed DNA while polymerization is still ongoing. MDA with generic primers and DNA polymerase Phi29 can amplify picograms of DNA to micrograms, more than enough for NGS. Phi29's high fidelity results in low rates of false positives and negatives in analysis, making it well-suited for identifying single nucleotide polymorphisms (SNPs) and other mutations. MDA is the most popular current method of amplification, but it can create non-uniform representation of genomic regions.
3. **Combinations of PCR and MDA, such as MALBAC:** The newest approaches to amplifying DNA, such as MALBEC, aim to use elements of both PCR and MDA, while mitigating the drawbacks of both methods. Although these hybrid methods do improve uniformity, they also depend on PCR, and have some of the drawbacks that entails, including a higher rate of false positives and negatives.

Interested in reading more blogs on molecular diagnostics and sequencing?

04

Customized solutions

Building on our established portfolio, our customized solutions team offers a range of solutions to provide additional value to your existing workflow. These solutions include lyophilization, conjugation, contract manufacturing and custom biology. Our resources and extensive business knowledge ensure we can provide you with solutions that help your day-to-day operations run smoothly and increase profitability.

What we do

Our team of scientists and manufacturing specialists is available to work with you to provide custom solutions that fit seamlessly into your sequencing workflows, often saving you time and cost. Not only does our designated team work closely with your R&D team, we also leverage our own R&D capabilities, ensuring that we are providing the expertise and technical support that you require throughout the development of new customized options.

Our design process

Based on your requirements we will develop your minimal viable product to assess functionality, stability and appearance. Further proof-of-principle studies will then optimize your product and ensure that we can scale the product up and meet quality standards.

We will work with you to develop a complete custom product including dispensing, packaging and labeling to provide you with a product that is customer-ready.

Tailored to your precise specifications, our custom genomics products deliver reliable performance with lot-to-lot consistency assured. Whether creating a custom bead, a specialized enzyme, or a convenient kit for a repeated workflow, we will work with you to share progress and optimize outcomes. We are committed to providing a specialist service based on collaboration and responsiveness, allowing you to focus on results.

Centre of Excellence

Our Lean Six Sigma manufacturing methods ensure that every process step, from raw material procurement to packaging and delivery, is free from wasted effort and materials. We build quality into the entire process, and manufacturing standards certified to ISO 9001:2015 attest to this.

Full documentation and process controls are available for your inspection at any time and we welcome customer audits.

Find out more about our customized solutions and get in touch

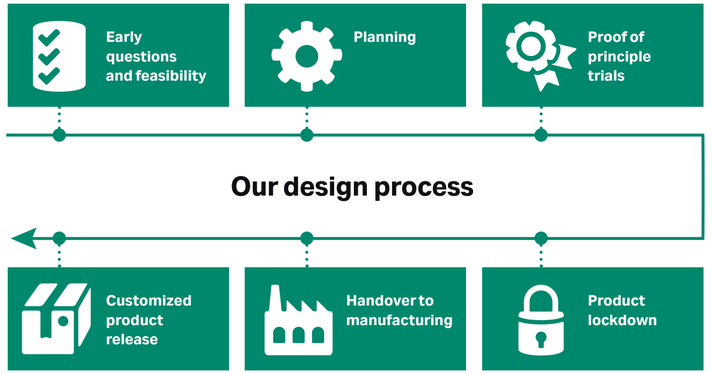

Fig 7. Our design process for customized solutions.

What is lyophilization?

Freeze drying, lyophilization, and cryodesiccation are all terms used to describe the process of removing water from a sample at low temperature. This low-temperature dehydration process maximizes product or sample stability and shelf life, maintains chemical or biological function, and enables easier transportation and storage compared to a cold chain.

The process has applications in assay kit development, where it enables room-temperature shipping and storage of reagents and complete assays. Sample stabilization by lyophilization enables the production of pre-dispensed, single-dose reagents, which help:

- Simplify assay setup
- Increase assay robustness and reliability
- Reduce the risk of sample contamination

Often, samples that require long-term storage in the biotechnology and pharmaceutical industries are highly labile. Application of heat for dehydration can, therefore, have consequences in terms of sample stability and quality.

Enzymes, for example, are used in many different assay kits and are often dehydrated to extend shelf life and ease transportation. These proteins have precise macromolecular structures required for their specific biological function. Heat stress would disrupt the noncovalent bonds and interactions that maintain these structures and in turn disrupt the *in vivo* function.

Not dehydrating samples intended for long-term storage at all is also not a viable option in many cases. Water can act as a powerful solvent and experiences a dramatic change in chemical structure when frozen. As a result, it can break covalent bonds found in biological macromolecules and, because the solid structure differs vastly from the liquid, those molecules can precipitate.

Although it is a complicated process, lyophilization has become standard practice in many industries, including pharmaceutical, biotechnology, and agriculture. Given the adverse effects of heat and water, dehydration by lyophilization offers several advantages, from improved sample stability and purity to increased shelf life and reduced costs.

Find out about the lyophilization process in our knowledge article

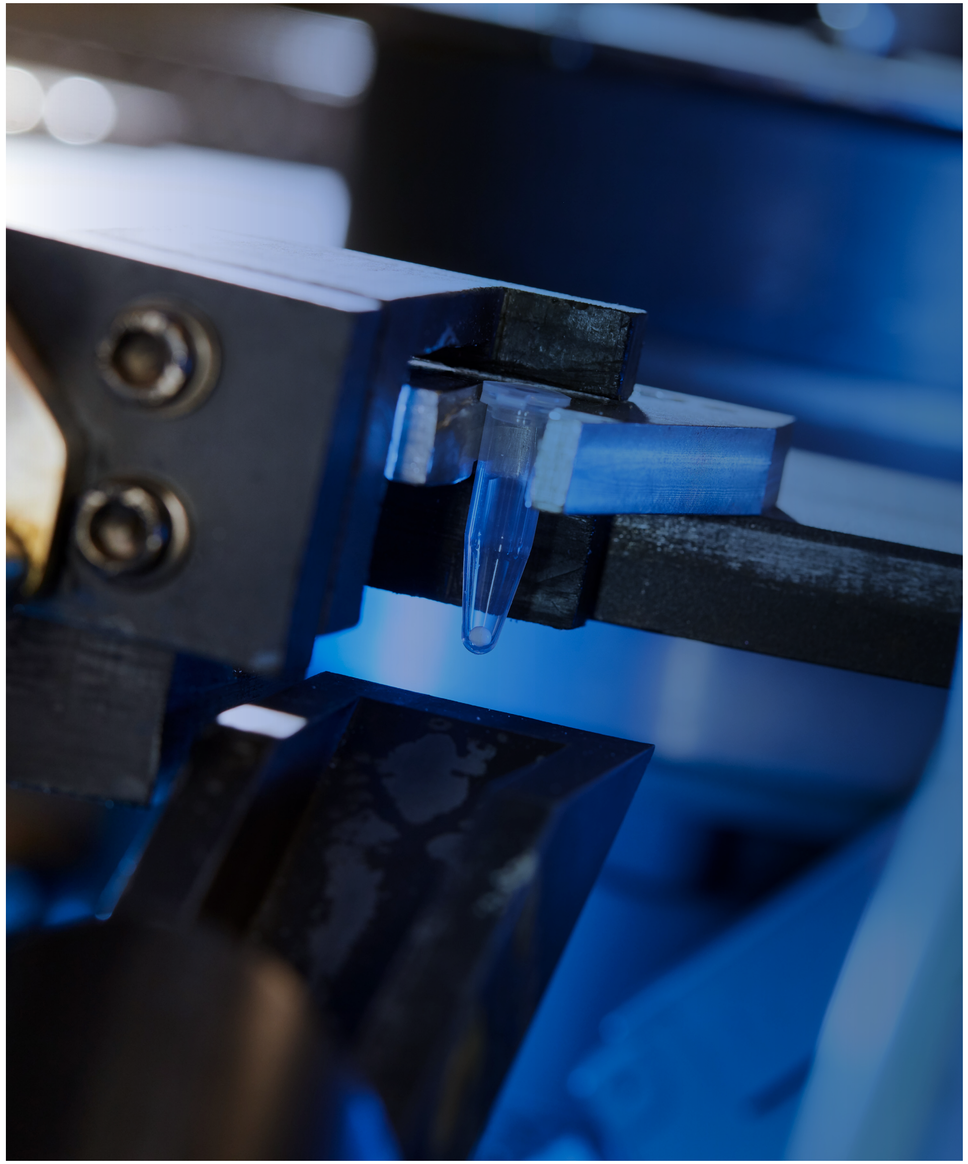

Table 2. Summary of the benefits of lyophilization*

Type	Benefit
Boost product quality	Provides batch-to-batch consistency with all samples treated uniformly
	Products are stable at a wide range of temperatures and so can be used in all climates and conditions while maintaining sample integrity
	Provides up to two years room temperature stability with no detectable activity loss
	Supports applications in the field, including remote or poorly accessible locations with insufficient infrastructure (e.g., developing countries) without affecting sample or data quality
	Improves data quality and reliability of results while also reducing contamination risks through a pre-dispensed, single dose assay
Simplify workflows and save costs	Requires less sample handling and fewer pipetting steps to simplify end-user workflows
	Reduces training requirements as the assay or sample is ready to use
	Compatible with downstream applications and automation
	Increases shelf life resulting in less waste
	Reduces transportation costs through the ability to ship without refrigeration
Reduce environmental impact	Reduced weight and volume make lyophilized samples ideal for shipping
	No dry or wet ice needed for transportation
	Shipping is less hazardous than for wet reagents and doesn't require special licenses

* Based on standard Lyo-Stable portfolio.

Lyo-Stable lyophilization services

Our patented lyophilization technology stabilizes individual proteins and reagents, as well as complete multiplex assays, by providing a molecular environment that protects against conformational changes in protein structure. From simple buffers to multi-component kits, our Lyo-Stable custom stabilization service can develop and manufacture custom products in small or large batch sizes depending on requirements.

The Lyo-Stable service provides access to expertise, equipment, proprietary excipients, and decades of experience gained from developing catalog and custom lyophilized products based on well-established Ready-To-Go technology.

Your made-to-order cake or bead will contain our proprietary excipient mix to stabilize your temperature-sensitive assay for storage and shipping at ambient temperature. All you need to add is your sample and you are ready-to-go!

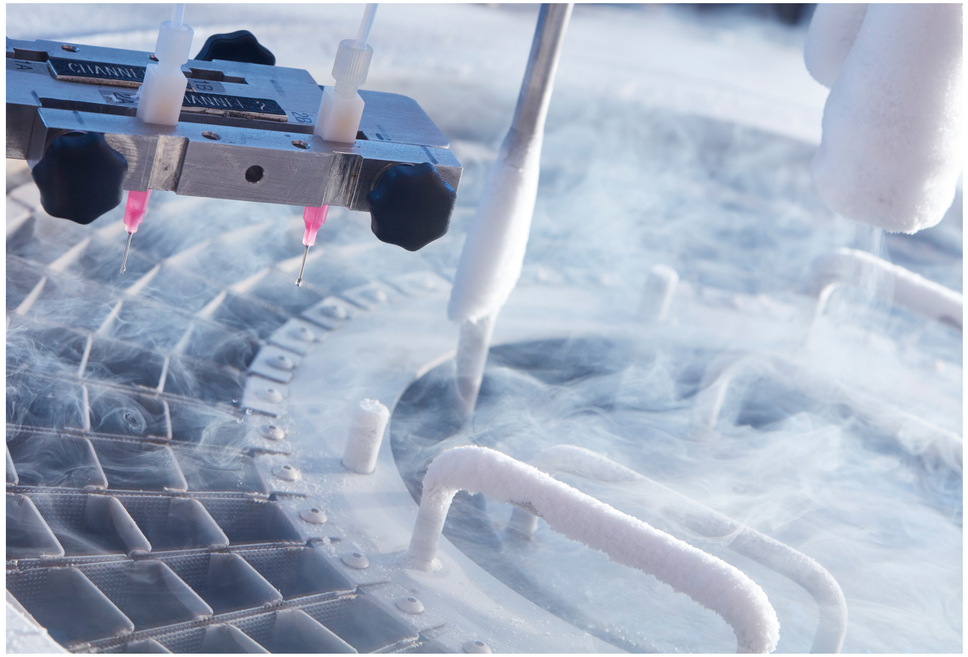

Table 3. There are two manufacturing formats available for your custom assay, either as a bead or a cake

Cakes	Beads
5000–20 000 reaction	5000–350 000 reactions
Typically, 5–100 µL dispense	10–30 µL dispense
Manual or automated dispense	Manual or automated dispense
Highly flexible formats (PCR plates, strips, single tubes, POC device)	Flexible formats (PCR plates, strips, single tubes, bulk beads)
Ideal for low to medium throughput	Ideal for medium to high throughput

Your made-to-order bead or cake will contain our proprietary excipient mix, primers/probes, enzyme(s) and any other user-defined components.

Our dedicated Proof of Principle facility is capable of small-scale optimization and validation of up to 50 plates, facilitating transition through to manufacturing and commercialization of your stabilized assay:

- HEPA filtered air
- Humidity and temperature control
- UV scrubbers
- Dry nitrogen dispensing cabinet
- Clean room environment

Find out more

Features and benefits

- Reliability: Sample integrity maintained for up to 2 years at room temperature with no activity loss
- Simplification: Requires less sample handling and fewer pipetting steps to simplify workflows
- Minimal waste: Reduced contamination risk due to pre-dispensed, single dose reagents
- Convenience: Room temperature shipping saves cost and introduces the opportunity for point of care field use

The customized solutions team will develop your assay from formulation to product testing

- Custom formulation of enzyme and reagent mixture. To date, up to 30 components can be included in a multiplex assay.
- Dispensing into microplates 96- and 384-well (96-well perforated option) or tubes (0.75–2 mL) — custom formats
- Product sealing in a controlled environment
- Product testing:
  - Visual inspection stability
  - Accelerated shelf life studies
  - Glass transition temperature
  - Karl Fisher Moisture analysis (tolerance: < 4%)
  - Functional QC

Take a tour of our Lyo-Lab

Custom Sera-Mag conjugation

Find out more

Magnetic beads are currently used in many immunoassay and NGS applications. Magnetic beads offer:

- High binding capacity: Cauliflower surface advantage
- Sensitivity: Optimized for easy covalent coupling of proteins, nucleic acids etc
- Reproducibility: Performance consistent across multiple lots
- Robustness: Not affected by sonication, drying or pH extremes
- Automatable: Can accommodate automated process and are easily scalable (simply add more particles)
- Minimized degradation: Eliminate the need for chaotropic salts or alcohols that can cause degradation in nucleic acid preparations and the requirement to centrifuge samples which can often shear genomic DNA

However, magnetic beads often need further processing before they are ready to use. Custom conjugation is possible for any of our protein and nucleic acid sample preparation, labeling and detection products, including Sera-Mag magnetic beads (Sera-Mag Carboxyl, Streptavidin, Blocked-Streptavidin, Oligo dT and NeutrAvidin). Our dedicated customization experts will partner with you every step of the way, from defining the product specifications to delivery completion.

Features and benefits

- Simplification: Custom magnetic particles can be provided that are ready to use with little or no need for further modification and no additional workflow steps
- Minimal disruption: Over 30 years of particle technology experience providing both industry and technical expertise and well-established protocols

We offer the following customization options for reagents and magnetic beads:

- Concentration: particles and reagents over a wide range of concentrations
- Formulation: modifications to buffer composition, containers, dispense volumes
- Conjugation: enzymes, antibodies and custom ligands
- Custom particles: non-standard sizes or functionalities
- Stabilization: lyophilization of the custom product — including magnetic beads — with our Lyo-Stable services
- Packaging and kitting: from lab pack to bulk, and custom kits

Contract manufacturing

Reagent and kit manufacturing in partnership with us allows you to take advantage of our extensive knowledge and experience. Paired with the ISO certified manufacturing facilities, we will guide you through the process of developing your minimum viable product to a commercial product.

Our designated team will carry out a full transfer process from the initial proof of concept through to batch validation and into production to improve your existing process and allow a more seamless transition to large scale manufacturing.

With facilities capable of accommodating manufacture of simple buffers through to multi-component kits for both low and high throughput customers, we can comfortably manufacture your specific product(s) for use in pharmaceuticals, diagnostic applications, and life science research.

Features and benefits

- Speed to market: Access expertise and manufacturing capabilities which may not be available in-house to enable your project to move to commercialization
- Reduced costs: Eliminates the need to invest in additional staff resources and equipment, bringing cost savings and productivity gains

We can provide

- Sourcing and validating raw material
- Custom design services
- Custom formulations, volumes and concentrations
- Custom packaging and labeling
- Custom testing and documentation
- Secured supply and delivery
- Scale-up capabilities to meet your needs
- Stability studies
- Full OEM services

Find out more

Custom biology

When our existing catalog products do not meet your specific application requirements, our Customized Solutions team can tailor the configurations, formulations, pack sizes or concentrations to your needs, while ensuring the same quality, performance and reliability as our standard catalog products.

Customization is possible for any of our protein and nucleic acid sample preparation, labeling and detection kits.

Features and benefits

- Speed to market: Access expertise, technology and reagents which may not be available in-house to enable your project to move to commercialization
- Peace of mind: Complete proof of principle trials and validation to ensure clinical success from your customized assay
- Reduced costs: Eliminates the need to invest in additional staff resources and equipment bringing cost savings and productivity gains

Find out more

cytiva.com/genomics-diagnostics

For local office contact information, visit cytiva.com/contact

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