Plasmid solutions

Free up your plasmid purification workflows with our manual and automated solutions

Hands on breakthroughs, hands off bottlenecks

thermo scientific

Contents

Introduction

Hands on research, hands off repetition

Throughout the history of biologics and biologics research, various scientists discovered bacteriophages and other unusual loops of somatic DNA. These microscopic elements were new and without a standardized name, leaving scientists to call them by myriad names: pangenes, bioblasts, plasmagenes, plastogenes, choncriogenes, cytogenes, proviruses, and episomes.

But then, in 1952, a geneticist Joshua Lederberg introduced the term **“plasmid,”** as we know it today. Lederberg published his paper in *Physiological Reviews*, describing “any extrachromosomal hereditary element” with its iconic name, plasmid.

Since then, the demand for biologics in key applications, such as cell and gene therapies, vaccines, and immunotherapies, among others, has surged. Now more than ever, laboratories face increasing pressure to speed up workflows and deliver breakthroughs faster than previously possible.

The growing demand for speed and scalability in biologics

As a result, plasmid DNA (pDNA) purification—a fundamental step in creating many of these biologics—has become a focal point for optimization. pDNA, a small, circular, double-stranded DNA molecule that is distinct from a cell's chromosomal DNA, is found in bacterial cells, and is made special by their ability to replicate independently of chromosomes. For this reason, plasmids are used by scientists to manipulate genes of interest—turning them on, off, or editing them to perform differently. Since pDNA can carry and express genes of interest, it is an invaluable tool for those working in fields like basic molecular biology and advanced medical research applications.

Researchers are not just seeking quality results but also ways to scale up production and achieve these results more efficiently. As labs navigate these new demands, there is an urgent need to rethink traditional sample preparation methods, adapting them to the growing need for speed and scalability.

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The evolution of plasmid purification: from manual to automation

While manual and automated plasmid purification methods seek the same result, their approaches are fundamentally different.

As the name suggests, manual purification is a hands-on and often tedious process that involves performing each step of the plasmid extraction workflow manually, typically using spin columns, centrifugation, and reagents. This method requires significant time and user involvement to handle multiple steps such as cell lysis, binding, washing, and elution.

Automated purification, on the other hand, relies on specialized instruments to streamline the process, handling the plasmid extraction workflow with minimal user intervention.

Automated systems perform key steps such as sample preparation, binding, washing, and elution, offering increased consistency, scalability, and walkaway convenience compared to manual methods.

While manual purification has long been the standard, it may not always be the most efficient solution. As biologic research becomes increasingly complex, the demand for innovation grows, making automated pDNA purification essential. This shift towards automation is driven by the necessity to improve efficiency and meet the evolving needs of scientific research.

The difference between:

Manual pDNA purification	Includes many requisite user touchpoints and needs constant human oversight
Automated pDNA purification	Requires **minimal** user touchpoints with limited pre-processing steps, allowing users to **walk away**

Along with the rising demand for life-changing treatments, automated solutions both accelerate and streamline the purification process while also meeting the heightened demands for throughput. By automating key parts of the plasmid purification process, labs can significantly reduce the time spent on tedious and repetitive tasks, freeing up resources to focus on more complex research and development efforts.

So, the key for laboratories today is twofold: (1) recognizing which projects would best benefit from automation and (2) learning how to streamline manual methods when appropriate. Both approaches are necessary for workflows, such as drug production, with the project scale size being the deciding factor. As labs scale up or down, the need for greater consistency and speed grows. Automated solutions help maximize throughput efficiency, ensuring reliable and scalable plasmid purification.

In this eBook, we will explore the qualities of and common scenarios for both purification methods, as well as how automated solutions can accelerate results without compromising quality or accuracy when and where it matters most.

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Chapter 1

Methods of plasmid purification: The future is automated

Purifying DNA is unlike isolating genomic DNA (gDNA). While both methods involve a lysis step, they are used for fundamentally different applications.

pDNA exists extrachromosomally, meaning it is separate from chromosomal DNA, and is commonly used as a vector in genetic engineering to introduce or modify specific genes into target cells. In contrast, gDNA is located in a cell's nucleus and consists of chromosomal DNA that carries an organism's native genetic information.

Purifying pDNA can be more complex than gDNA purification. This is because plasmid purification requires additional steps to ensure selective isolation of the small, circular pDNA while simultaneously removing larger chromosomal DNA and other cellular components. It's a process that requires careful optimization of lysis conditions, precise neutralization, and multiple centrifugation steps to achieve high purity and yield, making it more labor-intensive compared to gDNA purification. Given pDNA's widespread use in research and therapeutic applications, there is a growing demand for faster, more efficient purification methods. As a result, many scientists are now asking: will the future of pDNA purification be fully automated?

Prep ranges for manual and automated pDNA purification

To answer this, it is essential to first understand the scale preparation (prep) range that defines the size of pDNA purification projects. In other words: how much purified pDNA will you require to support your downstream application(s)?

For a perspective on scale, a lab needs around 100 to 1,000 g of pDNA annually to meet the full demand of products produced from viral vectors. Additionally, more than 1 kg of pDNA is required per billion doses of mRNA vaccine.

There are five scale sizes, each defined by how much bacterial culture sample input is required, or how much output (i.e., purified pDNA) is desired. See Table 1 for details.

Table 1: Plasmid prep sizes

Size	Input	Output
Mini	1-5 mL	≤ 40 µg
Midi	25-100 mL	≤ 400 µg
Maxi	100-500 mL	≤ 1.5 mg
Mega	500 mL – 2.5 L	≤ 5 mg
Giga	2.5-5 L	≤ 15 mg

Efficiency gained through automation can ultimately help accelerate the pace of scientific discovery.

Full automation for mini, midi, and maxi preps

When it comes to mini, midi, and maxi prep sizes, the future *is* fully automated. Advancements in automation, like robotic liquid handlers and automated extraction and purification systems, have undeniably transformed lab workflows, unlocking exceptional speed and consistency.

These automated, walkaway systems are especially valuable for laboratories that consistently take on small prep sizes, but at large volumes. In environments with scale-up requirements, the volume of samples and the demand for rapid turnaround make manual methods more inefficient. This inefficiency is punctuated by the inherent risk of human error—an unavoidable reality when leveraging human scientists rather than automated technology. In chapters 2 and 3, we will discuss this variability associated with human error in greater detail, as well as demonstrate how automated systems eliminate this risk and ensure reliable, reproduceable results.

Moreover, by leveraging automation for these prep sizes, researchers can significantly reduce the time and effort spent on repetitive, labor-intensive tasks associated with manual purification, freeing up their schedules to focus on high-impact scientific work, ranging from data analysis, to experimental design, to results interpretation.

Beyond time savings, automation can also help labs operate more efficiently by reducing the need for additional technicians while still supporting scalability. By streamlining workflows, automated purification ultimately accelerates the pace of scientific discovery. It may also reduce a lab's need to hire more technicians, all while still continuing to scale up their work. In turn, this efficiency gained through automation can ultimately help accelerate the pace of scientific discovery.

Advantages and challenges of manual purification

Still, it is important to understand why manual, column-based methods are necessary in pDNA purification. Oftentimes, technicians choose manual methods for flexibility and cost effectiveness for small-scale operations. However, a key reason manual purification is chosen involves the final two scale sizes: mega and giga preps.

These sizes require manual methods because no automated solutions currently exist at this scale, given their need for such high-volume input. Thus, manual intervention is a vital step of the process. Mega and giga preps are not the only reason for manual purification, however.

Another important reason is that some recombinant plasmid hybrids can only be addressed with manual purification. Likewise, for labs experiencing monetary restraints that inhibit their ability to upgrade technology will also rely on manual methods. We'll discuss these scenarios further in the next chapter.

Even with the advantages of manual purification, there are trade-offs that can make projects feel tedious and frustrating to the technicians that perform them. Namely, manual pDNA purification is a labor-intensive process due to its many time-consuming steps.

- **Harvest bacteria:** 20–30 minutes of centrifugation
- **Resuspend for lysing and neutralization:** 15–20 minutes via manipulation at bench
- **Clarify lysate:** 5–10 minutes using centrifuge, syringe, or vacuum; "ER reduction"
- **Bind, wash, and then elute precipitate:** 45–60 minutes using drip technique and/or centrifugation
- **Resuspend in solution:** 10 minutes of manipulation at bench
- **Total estimated time:** 95–130 minutes

Across this workflow, scientists must use myriad equipment and techniques to successfully purify pDNA, including but not limited to centrifugation, bench manipulation, pipetting, and more.

Fortunately, there is technology in place to aid in manual purification, making it simpler and more efficient. For example, a vacuum manifold is one technology that streamlines manual pDNA purification by increasing flow rates, enabling simultaneous processing of multiple samples, and reducing hands-on time. As a result, technicians can experience faster, more consistent, and higher throughput purification with cleaner DNA extracts. The vacuum-driven process effectively removes contaminants, making the overall procedure more efficient and less labor-intensive.

Still, from start to finish, it can take anywhere from 95 to 130 minutes to complete manual purification—and that still does not include the time it would take to adjust the experiment if errors or missteps should occur.

Not to mention, scaling becomes a challenge for those conducting manual experiments, making growth difficult if not impossible. Chapter 3 of this eBook will expand upon the pitfalls of manual methods and how automated systems are solving for many of these persistent challenges.

The bottom line is that manual workflows remain a necessity for many applications despite its challenges. Today, researchers that still manually purify pDNA are in search of high-quality sample prep products that help save time and effort in the lab when automation is not an option. Thus, while automation is undoubtedly a powerful tool, the widespread need for improved manual purification solutions cannot be understated.

Vacuum manifold benefits

- Increases flow rates
- Processes multiple samples at once
- Reduces hands-on time
- Delivers cleaner DNA extracts

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Chapter 2

The need for manual purification and the benefits of automation

Once a lab understands the size and scale of their pDNA purification needs, they can make informed decisions about the purification method(s) that will optimally meet the criteria of their downstream goals.

Scenarios for manual purification methods

1. Working with mega- and giga-prep scale sizes

In some research scenarios, the sheer scale of plasmid purification surpasses the capabilities of existing automated technologies. Mega and giga prep sizes are required for applications demanding exceptionally large volumes of plasmid DNA. These scales, often used in lead optimization and/or pre-clinical development settings, currently have very limited solutions.

The absence of automation for these workflows necessitates reliance on manual methods, despite their associated difficulties and risk factors.

While this limitation underscores the need for innovation in automation technologies, manual workflows remain the most widely accepted solution for researchers working on these large-batch processes.

2. Using specific recombinant pDNA hybrids

Certain complex plasmid DNA hybrids, such as bacterial artificial chromosomes (BACs), cosmids, and phagemids as seen in Table 2, require specialized purification methods that have not yet been automated. These hybrids play a critical role in advanced genetic research, making manual purification indispensable for labs working with these unique constructs.

Table 2: Recombinant plasmid hybrids and their characteristics

Bacterial artificial chromosomes (BACs)	Cosmids	Phagemids
BACs are engineered plasmid hybrids designed to carry large DNA fragments (100–300 kb), such as entire viral genomes. Their size and low copy number origin of replication make them invaluable for mapping and sequencing applications. However, their unique properties and requirements mean that no automated system has been developed to handle BAC purification.	Combining features of plasmids and bacteriophages, cosmids are used to clone DNA fragments (35–40 kb) into vectors that can be packaged into lambda phage particles. This dual functionality allows cosmids to infect bacterial cells and replicate like plasmids. They are critical for genomic library creation and sequencing projects, but their hybrid nature demands specialized manual workflows.	This plasmid hybrid incorporates both plasmid and bacteriophage components, enabling unique functionalities such as producing single-stranded DNA and expressing proteins on phage surfaces. This versatility makes phagemids essential for sequencing, site-directed mutagenesis, and antibody binding studies. Currently, these intricate workflows rely on manual purification kits due to the absence of automated solutions.

Manual purification offers the broader range of chemistries and protocols necessary to accommodate these complex DNA hybrids, ensuring researchers can achieve high-purity results for their specialized projects.

3. Working with budgetary challenges

In publicly funded labs and academic settings, budget constraints often make automation inaccessible. These labs frequently rely on grants and operate with a labor pool of undergraduates, graduate students, and postdoctoral researchers who can perform manual plasmid purifications using column-based methods.

For these environments, the focus is less on efficiency, scalability, or speed, and more on affordability and accessibility. Manual methods offer a cost-effective solution, allowing labs to complete their work without significant capital investment in automation technology. Furthermore, academic labs are less pressured by commercialization timelines, making manual workflows a pragmatic choice for their research needs.

By understanding these distinct use cases, it becomes clear that manual plasmid purification continues to hold significant value in modern research. Whether driven by scale, specificity, or budget, manual workflows provide the adaptability and control that certain projects demand, ensuring that labs can achieve their goals despite the challenges they face. Later in chapter 4, we will specifically discuss some of the most efficient, high-quality product options for manual purification.

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Hands on productivity, hands off process: The shift towards automation

Fully automated systems for plasmid purification offer a transformative approach, using robotics that enable labs to achieve unprecedented levels of efficiency, precision, and scalability. By automating this critical step, researchers can capitalize on three primary benefits: accelerating therapeutic development, reallocating time to high-value tasks, and mitigating a wide range of contamination and variability risks.

1. Fast-tracking commercialization of new drugs and therapeutics

For pharmaceutical and biotech companies, the introduction of fully automated systems is often driven by the desire and necessity to accelerate drug development.

Automation plays a pivotal role in expediting the journey to pre-clinical development—a process that can take anywhere from three to six years, costing approximately $200 million. By streamlining plasmid purification workflows, automation can help reduce overhead labor, minimize human error, and shorten timelines, contributing towards companies achieving critical milestones sooner.

This acceleration not only improves cost-efficiency but also strengthens a company's competitive edge in delivering life-saving therapies to market faster.

Automation plays a pivotal role in expediting the journey to pre-clinical development.

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2. Reallocating time to high-value research tasks

The time saved through automation also allows researchers to focus on tasks that drive breakthroughs and innovation. Fully automated purification systems handle repetitive processes, enabling scientists to dedicate more attention to high-impact activities, such as:

Target screening

With automation, labs can screen a greater volume of targets and leads, improving the chances of identifying promising candidates for further development.

Initial transfection

Researchers can quickly verify whether a target or lead produces the desired outcome, allowing for faster decision-making.

Plasmid modification (cloning)

If a target does not yield the expected results, researchers can efficiently iterate through cloning, transformation, and transfection steps to refine their approach. Automation accelerates each phase, enabling rapid adjustments and improved workflow efficiency.

This shift from manual processes to high-value tasks fosters innovation, accelerates problem-solving, and empowers researchers to tackle more complex scientific challenges.

3. Mitigating risks through automation

Finally, automation significantly reduces the risks associated with manual plasmid purification, ensuring consistent, high-quality results. The pre-programmed protocols and enclosed environments of automated systems address key contamination and variability concerns, including:

Cross-contamination between samples: Manual workflows increase the likelihood of cross-contamination through pipette reuse or improper reagent handling. Automated systems use dedicated consumables and sealed environments to mitigate this risk.

Environmental contamination: Open manual workflows expose samples to airborne particulates, dust, and microbes. Automation minimizes exposure by operating in controlled environments, often with HEPA-filtered air systems.

Human error: Manual workflows are prone to inconsistencies in pipetting, reagent handling, and washing. Automation eliminates variability, ensuring reproducibility across samples.

Endotoxin contamination: Manual methods can co-purify endotoxins, compromising sample quality. Automated systems integrate optimized wash steps and sterile consumables to address this issue.

Nuclease contamination: DNases and RNases introduced through manual handling can degrade plasmid DNA. Automation reduces contact with reagents, preserving sample integrity.

Reagent contamination: Improper handling of buffers and reagents in manual workflows can introduce impurities. Automated systems employ pre-loaded, sealed cartridges for sterility and consistency.

Operator-induced variability: Variations in technique across operators affect sample quality. Automation standardizes protocols, reducing variability and ensuring uniform results.

With fully automated plasmid purification, labs can move beyond the bottlenecks of manual workflows, empowering researchers to focus on innovation, accelerate therapeutic development, and deliver consistent, high-quality results. This leap forward in efficiency and reliability underscores the transformative potential of automation in modern science.

Chapter 3

Improved plasmid handling through automation

Hands on innovation, hands off limitation

Today, labs are consistently realizing the value of fully automated plasmid purification systems. In various studies, automation has been shown to streamline research processes in countless ways when compared to manual, spin-column methods, but most importantly, it has enabled significant improvements in three key areas: time savings and throughput, quality and reproducibility at scale, and contamination risks.

Time savings across high-throughput workflows

In one study by Cohen et al., scientists leveraged an Automated Miniprep Plasmid Station (AMPS) for high-throughput plasmid purification and quantification—something that is typically a labor-intensive and time-consuming process—which significantly reduced the time required for DNA purification compared to manual methods.[1]

The AMPS processed large batches of pDNA with minimal human intervention, enabling the lab to complete purification in a fraction of the time previously required for manual workflows.[1]

This benefit of speed is critical for industries like gene therapy and vaccine development, where **rapid processing can accelerate research and production timelines.**

Similarly, in an application note by Wolff and Flammersfeld, plasmid purification was achieved with transfection-grade purity by the end of their automated protocol. To do this, they leveraged an automated workstation for vacuum-based processing, which included a liquid handler, an arm for plate manipulation, a shaker, and a reader for real-time quantification. Additionally, the protocol used two plasmid purification kits, one for standard pDNA applications and the other optimized for low endotoxin levels suitable for transfection.[2]

Combining these key technologies, Wolff and Flammersfeld were able to process up to 96 pDNA samples per run in just 70 minutes, including tedious steps like resuspension, lysis, neutralization, and binding, all with minimal human intervention.[2] This is a process that would take hours or even days to complete using traditional, manual methods, something that would also introduce variability, further hindering the purification results.

This benefit of speed is critical for industries like gene therapy and vaccine development, where rapid processing can accelerate research and production timelines.

Enhanced consistency and reproducibility at scale

Cohen et al.'s study utilized pre-programmed workflows to standardize every step of the purification process. As a result, the AMPS eliminated variability usually caused by human error.[1] This ensured all samples achieved consistent quality and purity, which is vital for downstream applications such as cell transfection and genomic analysis. And, because AMPS automated the reagent handling and pipetting, it enabled reproducible results even across large batches.

Like Cohen et al., the protocol conducted by Wolff and Flammersfeld also used pre-programmed workflows meticulously designed to ensure consistent execution of every step, from bacterial cell lysis to pDNA elution.

The use of vacuum processing helped ensure efficient and uniform lysate filtration and plasmid binding, two crucial steps for achieving consistent DNA quality and yield. Additionally, the reader utilized quantified and normalized pDNA in real time through UV spectrophotometry, enabling researchers to verify that each sample met purity and yield standards.[2]

With consistent quality and reproducibility, labs can handle the demands of high-throughput environments while maintaining the flexibility to pursue exploratory research.

As a result, Wolff and Flammersfeld were able to demonstrate exceptional reproducibility even at high throughputs, **averaging 14.97 ± 1.1µg of pDNA per sample in a 96-sample run.** Its high purity ratios were also compelling (A260/A280 = 2.02 ± 0.02), meaning that the DNA was pure and free of protein contaminants.[2]

Reproducible results aren't just important for safety reasons, but also for scaling efforts. Technology like the AMPS in Cohen et al.'s study can allow labs to scale their operations without the need for additional staffing or infrastructure. With consistent quality and reproducibility, labs can handle the demands of high-throughput environments while maintaining the flexibility to pursue exploratory research.

3 primary risks mitigated by automation

Both aforementioned studies also saw a decrease in contamination risk, a factor enabled by their respective automated purification methods. In total, there are three primary risks mitigated by automation:

1. Human error and/or inconsistency

Because the onus of automation is to reduce user touchpoints, the systems used by both Cohen et al. and Wolff and Flammersfeld significantly limited human involvement, thus reducing risks like improper reagent handling or pipetting errors.[1,2]

Similarly, using pre-programmed protocols also helped scientists reduce contamination risk by ensuring consistency in reagent handling and washing steps. By reducing operator (e.g., human) error, these automated systems mitigated a common source of contamination present in manual workflows.

2. Environmental contaminants

Another important reason these automated systems helped minimize contamination risk was their use of dedicated, single-use consumables. These included pipette tips, plates, and cartridges, all designed for one-time use, which eliminated the risk of cross-contamination between batches.

3. Presence of endotoxins

Perhaps one of the more important details from Wolff and Flammersfeld's protocol was their use of transfection-grade plasmid purification kits. These kits include an integrated endotoxin removal step via washing to effectively remove endotoxins. These are debris released from lysed bacteria which, "can negatively impact cell growth, cell viability, transfection efficiency, protein expression, and even mimic sepsis."[3]

These examples illustrate how the integration of automation into plasmid purification workflows not only streamlines processes but also enhances the overall consistency, safety, and reliability of purified pDNA.

Chapter 4

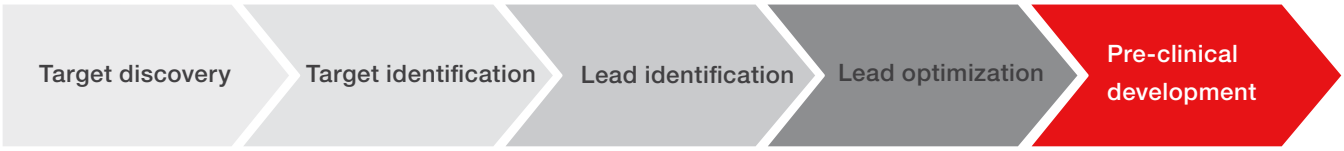
Find automated plasmid solutions with Thermo Fisher Scientific

Hands on reclaimed time, hands off human intervention

From exploratory research and discovery to clinical research and monitoring, Thermo Fisher Scientific offers solutions that span all phases of biotherapeutic and/or drug development. But no matter your downstream application—the development of cell and gene therapies or vaccines alike—all begin with a concept rooted in plasmid construction, irrespective of the field.

This is why Thermo Fisher is committed to accelerating the pace of research and biotherapeutic development through radically simplifying plasmid purification. With product options for both fully automated purification systems and manual, spin-column methods, we are constantly leveraging state-of-the-art robotic technology and advanced chemistry to meet this goal.

Stages of drug development



The stages of drug development are often as follows:

- **Target discovery**—Identify biological molecules (proteins, genes, RNA, etc.) that are involved in a disease process.
- **Target identification**—Verify the biological relevance of the discovered targets.
- **Lead identification**—Find potential compounds that interact with the target and have the desired biological effect.
- **Lead optimization**—Improve the properties of lead compounds to enhance their efficacy, reduce side effects, and improve pharmacokinetics.
- **Pre-clinical development**—Explore the biological activity and characteristics of lead compounds in research studies.

The last step is focused on advanced research applications that may inform future drug development.

The KingFisher PlasmidPro processor

Our latest plasmid purification technology is the Thermo Scientific™ KingFisher™ PlasmidPro Maxi Processor. This fully automated system ushers researchers into the future of pDNA purification, offering a walkaway solution that delivers purified pDNA in less than 75 minutes, needing only five minutes of hands-on time.

Incorporating just this one processor into a lab can free scientists from laborious, time-consuming plasmid prep, saving time and improving efficiency all without compromising quality. Because the automated KingFisher PlasmidPro system helps simplify the entire purification process—from sample loading to elution—it can also enhance the reproducibility of pDNA isolation, making for more reliable results that are crucial to data analysis and interpretation.

Additionally, the KingFisher PlasmidPro processor is a benchtop system, making it a convenient option for most lab sizes across biotech, biopharma, research, service, and beyond. The system is also user-friendly and intuitively designed, making maxi-scale pDNA purification accessible to users of all skill levels.

Steps of automated purification

Other KingFisher purification solutions

The Thermo Scientific™ KingFisher™ Presto Sample Purification System* is another benchtop solution that brings hands-free automation to the forefront of sample prep. Integrating with a compatible liquid handler, this instrument offers consistent and ultrahigh-throughput extraction and purification of DNA, RNA, proteins, and cells for a variety of downstream applications.

The KingFisher Presto system* is compatible with many commercial robotic liquid handlers, making the instrument a convenient option for labs wanting to automate their pDNA purification workflows without a fully automated system.

MagMAX Pro HT NoSpin kit

The Applied Biosystems™ MagMAX™ Pro HT NoSpin Miniprep Kit can be automated on liquid handling platforms and KingFisher Presto systems.* In addition, the system integrates seamlessly with the Tecan Fluid 780 Liquid Handler, enabling the processing of 384 samples in approximately 55 minutes. This setup offers a complete walkaway solution for increased efficiency and time savings.

Enabling the processing of

384 samples in approximately

55 minutes

Supporting your protein expression workflow

The protein expression workflow, comprised of cloning, expression, purification, and analysis steps, is a foundational process for generating a recombinant protein—a required step for many downstream applications.

	Typical research goals	Typical areas of research	
Cell and gene therapies (CGT)	• Develop effective therapies for a wide range of diseases, including genetic disorders, cancers, and other chronic conditions	• CAR-T cell therapy development • mRNA therapies development • Production of viral vectors • Gene editing (CRISPR/Cas9)	• Stem cell modification • *Ex vivo* gene therapy development • Regenerative medicine development
Drug discovery	• Identify and analytically validate new drug targets • Develop new therapeutic agents	• DNA/mRNA vaccine development • Therapeutic biologics development • High-throughput surveillance • Target identification	• Lead optimization • Cross-functional studies • Validation study reagents
Protein production	• Produce high-quality proteins for industrial, research, or therapeutic development use	• Enzyme production • Therapeutic protein production development • Research reagents	• Industrial biocatalysts • Research into the diagnosis of disease enzymes • Structural biology studies
GMO	• Enhance agricultural productivity and sustainability • Advance environmental bioremediation • Improve nutritional content and food security	• Enhanced crop yield • Pest resistance • Disease control • Biofortification	• Stress tolerance (drought, salinity) • Bioremediation • Biofuel production

This is especially true for plasmid purification processes, no matter if you are completing it manually or through automation. With a diverse product portfolio and solutions to support you from gene synthesis to expression systems, Thermo Fisher helps optimize the protein expression workflow, so that your final product is exactly what you need.

Invitrogen™ GeneArt™ gene synthesis	Plasmid purification technologies	Transfection reagents	Gibco™ cell culture media	Expression system
• Vector design and synthesis • Cloning • Sequence verification • Services	• Endotoxin-free • Low-endotoxin • Maximum yields • High quality • Fast prep times	• Efficient delivery • Broad range of cell types • Difficult-to-transfect cells • Superior cell viability	• Support growth and maintenance of a variety of mammalian cells and cell lines • Qualified supplements • Effective formulations	• Provides high protein yields in low volumes • Scalable • Innovative transient expression work

An alternative solution: GeneArt Gene and Protein Synthesis Services

Even for those without pDNA purification capabilities, there are still ways to automate your workflows. Our Invitrogen™ GeneArt services offer a cost-effective solution to help you save time and improve your existing processes across all parts of your cloning and protein expression workflows.

GeneArt services use a combination of our convenient online ordering system and Invitrogen™ GeneOptimizer technology to provide you with custom products for gene synthesis, DNA libraries and mutagenesis, protein expression and purification, and of course, plasmid purification. Powered by our patented Invitrogen™ GeneOptimizer algorithm, this fast and custom process utilizes a unique multivariable approach that goes beyond codon optimization to maximize expression of synthetic genes.

Best of all, labs can easily transition between in-house and outsourced work without lengthy revalidation since all GeneArt services use our commercially available tools. From sequence to DNA or protein without lifting a pipette, our suite of GeneArt services can unleash the potential of automation in any lab.

Case study: Manual, bead-based extraction using the MagMAX Pro HT NoSpin Miniprep Kit and automated KingFisher system

Laboratory A and Laboratory B have the same high-throughput demand to purify plasmid DNA. Each laboratory has adopted its own methodology:

Laboratory A has adopted automation, choosing to use the Thermo Scientific™ MagMAX™ Pro HT NoSpin Miniprep Kit in conjunction with a KingFisher Sample Prep Purification System **to complete 96 purifications in 35 minutes.**

Laboratory B chose to manually purify pDNA using a competing solution, taking them anywhere from **70 to 130 minutes to complete 96 purifications.**

In this scenario, **Laboratory A saw 50–73% time saved** as a result of adopting automation. That leaves time for Laboratory A to purify more plasmid samples per day while using less physical resources.

On the contrary, **it took Laboratory B more than double the time to complete the same 96 purifications.** Successfully meeting their demand would require increasing their headcount—an expensive endeavor, considering the average salary for a scientist who routinely performs pDNA purification ranges from 100K to 140K or more, especially in metropolitan areas.

What comes next:

Free up your future with automated plasmid purification

Our exploration of the transformative potential brought about by automated plasmid purification systems has shown one thing is for certain: the advancements in both fully automated and traditional, manual workflows are trending in an exciting direction.

However, with the growing demand for speed, scalability, and consistency in plasmid purification—driven by the increasing need for better gene therapies, vaccines, and other groundbreaking biologics—there still remains space for further innovation. Fortunately, that very gap has been a driving force for Thermo Fisher Scientific, placing its solutions at the forefront of progress that can unlock greater efficiency and productivity at scale.

Hands on reliability, hands off inconsistencies

As you think about how you can improve your processes around plasmid purification, it is crucial to consider how pivoting to automation could bolster your bottom line:

Greater efficiency:

Automated systems can handle high-throughput demands with minimal human intervention, allowing labs to scale without adding staff or infrastructure.

Reliability and reproducibility:

With consistent protocols and minimized contamination risks, automation ensures uniform quality, critical for sensitive applications like cell transfection and gene therapy.

Innovation-driven research:

By freeing up time from repetitive tasks, labs can focus on strategic initiatives that push the boundaries of science.

Automation is not just a tool—it is a pathway to reimagining what is possible in plasmid purification and biologics research. By adopting automation, labs can position themselves on the cutting edge of scientific discovery, advancing research while meeting the demands of a rapidly evolving industry.

The future of plasmid purification is here. Now is the time to step into it and discover the full potential of automation for your lab.

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