



Process development

Advancing process development with the 5 L DynaDrive Single-Use Bioreactor: a paradigm shift from glass benchtop bioreactors

Keywords

Benchtop bioreactor, process development, single-use bioreactor

Introduction

The 5 L Thermo Scientific™ DynaDrive™ Single-Use Bioreactor (S.U.B.) is a transformative solution for process development laboratories that offers significant advantages over traditional glass bioreactors. The Thermo Scientific™ DynaDrive™ BioProcess Container (BPC) for the 5 L DynaDrive S.U.B. is factory-sterilized, which reduces the risk of contamination and eliminates the need for labor-intensive cleaning and sterilization. Eliminating these steps can reduce the duration of the process development workflow by 20% and increase productivity by as much as ~30%, enabling higher productivity with less environmental impact than a glass bioreactor. The 5 L DynaDrive S.U.B. also has a scalable design to enable an easy transition from benchtop to large-scale production, making it a cost-effective and environmentally friendly choice for modern bioprocessing needs.

Benchtop bioreactors play a crucial role in the development and optimization of new bioprocesses by academic and industrial researchers. Glass benchtop bioreactors have historically been the standard for cell cultivation and small-scale experiments. However, glass bioreactors require labor-intensive cleaning and sterilization because they are susceptible to contamination, and the associated operating costs are high.

In recent years, the biopharmaceutical industry has shifted toward using single-use bioreactors in a drive to find more efficient, scalable, and cost-effective production solutions [1,2]. Single-use bioreactors have factory-sterilized, disposable components that help minimize the risk of contamination and reduce downtime in the production phase. However, the availability of bench-scale single-use bioreactors has been limited. The 5 L DynaDrive S.U.B. is a benchtop bioreactor that offers process development laboratories several advantages over reusable glass bioreactors, including efficient turnaround, cost-effectiveness, and sustainability (Table 1).

Performance and scalability

The 5 L DynaDrive S.U.B. has significant advantages over glass bioreactors in terms of performance and scalability. The proprietary drilled-hole sparger and novel drivetrain are designed for high mass-transfer efficiency to support high-density cell cultures, making the 5 L DynaDrive S.U.B. suitable for both fed-batch and perfusion processes. When used with Gibco™ cell culture media and supplements, the 5 L DynaDrive S.U.B. can significantly improve cell culture performance and consistency in process development [3,4].

Ergonomically friendly components like the front-loading BPC and aseptic connectors facilitate installation and further minimize the risk of contamination. The cubic design of the 5 L DynaDrive S.U.B., which mirrors the cubic design of the 500 L and 5,000 L DynaDrive S.U.B.s, gives it a more compact facility footprint than a cylindrical glass bioreactor.

Lack of scalability is a key challenge with traditional glass bioreactors. The 5 L DynaDrive S.U.B. has a turndown ratio of 5:1, which allows scaling of experiments from 1 L to 5 L without replacing the vessel. The 5 L DynaDrive S.U.B. can also enable an easy transition from benchtop to production-scale operation because its design is similar to that of 500 L and 5,000 L DynaDrive S.U.B.s, which have turndown ratios of 10:1 and higher. This versatility and scalability can help process development laboratories optimize operations and prepare for large-scale production, ultimately improving overall scalability.



Table 1. Comparison of the 5 L DynaDrive S.U.B. and glass bioreactors.

Area of focus	Benefits of the 5 L DynaDrive S.U.B.	Benefits of glass bioreactors
Performance and scalability	<ul style="list-style-type: none">• Low risk of cross-contamination• High mass-transfer efficiency• Consistent design that streamlines scale-up from the benchtop to large-scale, single-use equipment• High turndown ratio that provides flexibility to run different batch sizes	<ul style="list-style-type: none">• Better suited for continuous production
Operational efficiency	<ul style="list-style-type: none">• No autoclaving required• Factory-sterilized consumables that enable rapid setup and turnaround	<ul style="list-style-type: none">• Reusable• Robust and durable
Investment	<ul style="list-style-type: none">• Low up-front capital expenditure (CapEx), with no need for glassware washers or autoclaves	<ul style="list-style-type: none">• Low recurring consumables cost (OpEx) due to reusability
Sustainability	<ul style="list-style-type: none">• Lower water and energy consumption with factory-sterilized BPC	<ul style="list-style-type: none">• Comparatively small consumables-related carbon footprint

Operational efficiency

Even with proper cleaning and sterilization, the contamination rates for reusable bioreactors can be as high as 17% [5]. The 5 L DynaDrive S.U.B. uses a factory-sterilized BPC made with high-quality Thermo Scientific™ Aegis™ 5-14 film, and setting up the 5 L DynaDrive S.U.B. with the BPC takes approximately 5 minutes. The 5 L DynaDrive S.U.B. can thus mitigate contamination risks and help maximize operational efficiency during process development.

Figure 1 shows a typical timeline for process development with glass bioreactors. With the 5 L DynaDrive S.U.B., a laboratory can save up to 8 days by eliminating the pressure testing, assembly, and autoclaving steps that would be required with glass bioreactors (Figure 2). The time saved typically translates to a 20% reduction in workflow duration, allowing more experiments to be completed in the same time frame. Up to 35 experiments can be completed per year with the 5 L DynaDrive S.U.B., compared to 27 experiments with a glass bioreactor, representing ~30% increase in productivity.

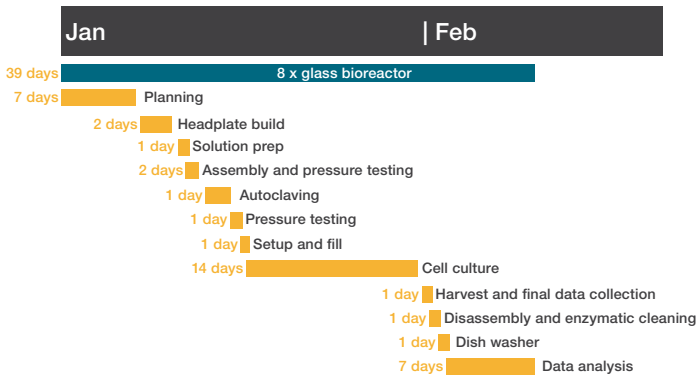


Figure 1. Experimental timeline with a glass bioreactor.

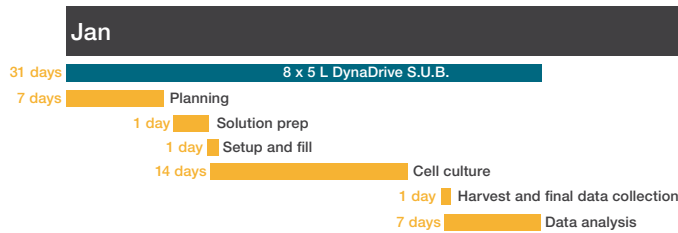


Figure 2. Experimental timeline with the 5 L DynaDrive S.U.B.



Capital investment

When the capital investment associated with glass bioreactors is considered, the 5 L DynaDrive S.U.B. has clear advantages. The initial investment in a glass bioreactor is not limited to the cost of the bioreactor. It also includes the cost of associated equipment (i.e., an autoclave and glassware washer). The 5 L DynaDrive S.U.B. eliminates the need for autoclaves and glassware washers, allowing significant savings in initial CapEx. It would cost approximately 7% more to equip a high-throughput process development laboratory with 25 glass bioreactors than it would to equip it with 25 5 L DynaDrive S.U.B.s, including the controllers (Figure 3).

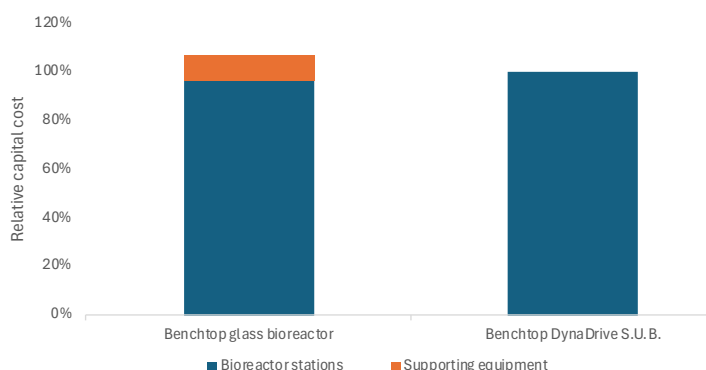


Figure 3. Capital cost of benchtop glass bioreactors relative to the 5 L DynaDrive S.U.B.

Sustainability

Incorporating the 5 L DynaDrive S.U.B. into the process development workflow can significantly reduce water and energy consumption and eliminate the need for harsh cleaning agents, making it a more environmentally sustainable option than a glass bioreactor. Autoclaving four or more bioreactors requires 250–300 L of water per sterilization cycle, and a laboratory glassware washer consumes 55–65 L per wash cycle [6,7]. This means 15,250 to 18,250 L of water would be required annually to sterilize and clean glass bioreactors in a laboratory that operates an autoclave and washer 50 times per year. In contrast, the 5 L DynaDrive S.U.B. does not require cleaning or sterilization, thereby reducing the significant environmental impact of process development.

Customers can also opt into the Thermo Scientific™ Bioproduction Sustain™ Program to reduce the carbon footprint of their plastic consumables. The Sustain program provides customers with high-quality BPCs made with biobased plastic resins, which help reduce Scope 3 emissions related to BPC production. This offers facilities a more sustainable option than using glass bioreactors, and aligns with the growing emphasis on greener technologies in the biopharmaceutical industry.



Conclusion

The overall performance of the 5 L DynaDrive S.U.B. makes a compelling case for transitioning from glass benchtop bioreactors. The combination of higher productivity, lower costs, scalability, and greater sustainability makes the 5 L DynaDrive S.U.B. an attractive option for process development laboratories. The scalability of the DynaDrive S.U.B. product line enables these benefits to extend easily from development to large-scale production, making the 5 L DynaDrive S.U.B. a valuable investment for future-ready bioprocessing. By adopting the 5 L DynaDrive S.U.B., process developers can achieve faster turnaround times with a smaller environmental footprint, all while maintaining high standards for product quality and consistency.

We offer a comprehensive portfolio of media and other products for cell culture, product storage, and production. These offerings can also benefit laboratories in the early development phase. Gibco media and supplements are designed to support high-yield cell cultures for both process development and manufacturing, and Thermo Scientific™ Nalgene™ bottles and carboys are suitable for a wide range of storage and transfer applications. All of our BPCs, including the BPC for the 5 L DynaDrive S.U.B., are made from high-quality bioprocessing films designed to support healthy cell growth. By incorporating these solutions with the 5 L DynaDrive S.U.B., process development laboratories can simplify ordering and optimize their processes from the development phase to technology transfer for production.

References

1. Solaris Biotech (2025) Choosing the right single use bioreactor system. solarisbiotechusa.com/choosing-the-right-single-use-bioreactor-system
2. Bioprocess Development Forum (2014) Trends in single-use bioreactors. processdevelopmentforum.com/resources/articles/trends-in-single-use-bioreactors
3. Thermo Fisher Scientific (2023) Bioproduction analytics: supporting optimized media development today and tomorrow. Waltham, MA. assets.thermofisher.com/TFS-Assets/BPD/Reference-Materials/bioproduction-analytics-supporting-optimized-media-white-paper.pdf
4. Thermo Fisher Scientific (2024) **Efficient-Pro Medium and Feed 1 enable rapid and seamless upstream process development and scale-up for CHO-K1 cells.** Waltham, MA.
5. PharSol Pharmaceutical Solutions (2021) How to control a bioprocess? 6 key parameters for efficient bioreactor operation. November 11, 2021. pharsol.com/knowledge-hub/blog/bioreactor-parameters
6. STERIS Life Sciences (2023) Glassware washers and dryers. sterislifesciences.com/products/equipment/washers-and-dryers
7. STERIS Life Sciences (2023) Steam sterilizers. sterislifesciences.com/products/steam-sterilizers/steam-sterilizers

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