**UNITED STATES**
**SECURITIES AND EXCHANGE COMMISSION**
**Washington, D.C. 20549**

**FORM 10-K**

☒ **Annual report pursuant to Section 13 or 15(d) of the Securities Exchange Act of 1934**

**For the fiscal year ended December 31, 2023**
**or**

☐ **Transition report pursuant to Section 13 or 15(d) of the Securities Exchange Act of 1934**

**For the transition period from to**

**Commission File Number 001-33957**

**HARVARD BIOSCIENCE, INC.**
(Exact Name of Registrant as Specified in Its Charter)

| **Delaware** | **04-3306140** |
|---|---|
| (State or other jurisdiction of Incorporation or organization) | (I.R.S. Employer Identification No.) |

**84 October Hill Road, Holliston, Massachusetts 01746**
(Address of Principal Executive Offices, including zip code)

**(508) 893-8999**
(Registrant's telephone number, including area code)

Securities registered pursuant to Section 12(b) of the Act:

| Title of each class | Trading Symbol(s) | Name of each exchange on which registered |
|---|---|---|
| Common Stock, $0.01 par value | HBIO | The Nasdaq Global Market |

Securities registered pursuant to Section 12(g) of the Act:
**None**

Indicate by check mark if the registrant is a well-known seasoned issuer, as defined in Rule 405 of the Securities Act. Yes ☐ No ☒

Indicate by check mark if the registrant is not required to file reports pursuant to Section 13 or Section 15(d) of the Act. Yes ☐ No ☒

Indicate by check mark whether the registrant (1) has filed all reports required to be filed by Section 13 or 15(d) of the Securities Exchange Act of 1934 during the preceding 12 months (or for such shorter period that the registrant was required to file such reports), and (2) has been subject to such filing requirements for the past 90 days. Yes ☒ No ☐

Indicate by check mark whether the registrant has submitted electronically every Interactive Data File required to be submitted pursuant to Rule 405 of Regulation S-T (§232.405 of this chapter) during the preceding 12 months (or for such shorter period that the registrant was required to submit such files). ☒ Yes ☐ No

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, a smaller reporting company, or an emerging growth company. See the definitions of "large accelerated filer," "accelerated filer," "smaller reporting company," and "emerging growth company" in Rule 12b-2 of the Exchange Act. (Check one):

| | |
|---|---|
| Large accelerated filer ☐ | Accelerated filer ☒ |
| Non-accelerated filer ☐ | Smaller reporting company ☒ |
| | Emerging growth company ☐ |

If an emerging growth company, indicate by check mark if the registrant has elected not to use the extended transition period for complying with any new or revised financial accounting standards provided pursuant to Section 13(a) of the Exchange Act. ☐

Indicate by check mark whether the registrant has filed a report on and attestation to its management's assessment of the effectiveness of its internal control over financial reporting under Section 404(b) of the Sarbanes-Oxley Act (15 U.S.C. 7262(b)) by the registered public accounting firm that prepared or issued its audit report. ☒

If securities are registered pursuant to Section 12(b) of the Act, indicate by check mark whether the financial statements of the registrant included in the filing reflect the correction of an error to previously issued financial statements. ☐

Indicate by check mark whether any of those error corrections are restatements that required a recovery analysis of incentive-based compensation received by any of the registrant's executive officers during the relevant recovery period pursuant to § 240.10D-1(b). ☐

Indicate by check mark whether the registrant is a shell company (as defined in Rule 12b-2 of the Exchange Act. Yes ☐ No ☒

The aggregate market value of shares of voting common equity held by non-affiliates of the registrant as of June 30, 2023 was approximately $219.4 million based on the closing sales price of the registrant's common stock, par value $0.01 per share on that date. At March 1, 2024, there were 43,399,291 shares of the registrant's common stock issued and outstanding.

**DOCUMENTS INCORPORATED BY REFERENCE**

Portions of the Company's definitive Proxy Statement in connection with the 2024 Annual Meeting of Stockholders (the "Proxy Statement"), to be filed within 120 days after the end of the Registrant's fiscal year, are incorporated by reference into Part III of this Form 10-K. Except with respect to information specifically incorporated by reference in this Form 10-K, the Proxy Statement is not deemed to be filed as part hereof.

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*This Annual Report on Form 10-K contains statements that are not statements of historical fact and are forward-looking statements within the meaning of Section 27A of the Securities Act of 1933 and Section 21E of the Securities Exchange Act of 1934 (the "Exchange Act"), each as amended. The forward-looking statements are principally, but not exclusively, contained in "Item 1: Business" and "Item 7: Management's Discussion and Analysis of Financial Condition and Results of Operations." These statements involve known and unknown risks, uncertainties and other factors that may cause our actual results, performance or achievements to be materially different from any future results, performance or achievements expressed or implied by the forward-looking statements. Forward-looking statements include, but are not limited to, statements about management's confidence or expectations, our business strategy, our ability to raise capital or borrow funds to consummate acquisitions and the availability of attractive acquisition candidates, our expectations regarding future costs of product revenues, our anticipated compliance with the covenants contained in our credit facility, the adequacy of our financial resources and our plans, objectives, expectations and intentions that are not historical facts. In some cases, you can identify forward-looking statements by terms such as "may," "will," "should," "could," "would," "seek," "expects," "plans," "aim," "anticipates," "believes," "estimates," "projects," "predicts," "intends," "think," "strategy," "potential," "objectives," "optimistic," "new," "goal" and similar expressions intended to identify forward-looking statements. These statements reflect our current views with respect to future events and are based on assumptions and subject to risks and uncertainties. Given these uncertainties, you should not place undue reliance on these forward-looking statements. We discuss many of these risks in detail under the heading "Item 1A. Risk Factors" beginning on page 7 of this Annual Report on Form 10-K. You should carefully review all of these factors, as well as other risks described in our public filings, and you should be aware that there may be other factors, including factors of which we are not currently aware, that could cause these differences. Also, these forward-looking statements represent our estimates and assumptions only as of the date of this report. We may not update these forward-looking statements, even though our situation may change in the future, unless we have obligations under the federal securities laws to update and disclose material developments related to previously disclosed information. Harvard Bioscience, Inc. is referred to herein as "we," "our," "us," and "the Company."*

## PART I

### Item 1. *Business.*

### Overview

Harvard Bioscience, Inc., a Delaware corporation, is a leading developer, manufacturer and seller of technologies, products and services that enable fundamental advances in life science applications, including research, pharmaceutical and therapy discovery, bioproduction and preclinical testing for pharmaceutical and therapy development. Our products and services are sold globally to customers ranging from renowned academic institutions and government laboratories to the world's leading pharmaceutical, biotechnology and contract research organizations ("CROs"). With operations in the United States, Europe and China, we sell through a combination of direct and distribution channels to customers around the world.

### Our History and Strategy

Our business began in 1901, under the name Harvard Apparatus. It was founded by Dr. William T. Porter, a Professor of Physiology at Harvard Medical School and a pioneer of physiology education. We have grown over the years with the development and evolution of modern life science research and education. Our early inventions included ventilators based on Dr. Porter's design, the mechanical syringe pump for drug infusion in the 1950s, and the microprocessor-controlled syringe pump in the 1980s.

In 1996, a group of investors acquired a majority of the then existing business of our predecessor, Harvard Apparatus, Inc. Following this acquisition, our focus was redirected to acquiring complementary companies with innovative technologies while continuing to grow the existing business through internal product development. Harvard Bioscience, Inc. was incorporated in the State of Delaware in September 2000 and became the successor entity to Harvard Apparatus, Inc. by merger in November 2000.

From 1996 to 2018, we completed multiple business or product line acquisitions related to our continuing operations. In 2018, we acquired Data Sciences International, Inc. ("DSI"), a global leader in products, services and solutions focused on preclinical testing. The DSI product portfolio, which is largely complementary to our cellular and molecular technology ("CMT") product portfolio, expanded our product portfolio to address the continuum from research and discovery to preclinical testing with principal applications in pharmaceutical and therapy testing.

During 2021, we completed a restructuring program to improve operational efficiency and reduce costs which entailed consolidating and downsizing several sites and reducing headcount in Europe and North America. During 2022, we reviewed our business and product portfolio and identified opportunities to rationalize our product portfolio, improve our cost structure and optimize our sales organization. In connection with this review, we identified certain non-strategic products for discontinuation and further reduced our headcount in Europe and North America. We believe that these actions will allow us to focus on product opportunities that drive sustainable revenue growth with attractive gross margins and improved profitability.

Our strategy for driving sustainable revenue growth is focused on four areas. The first is to maintain and strengthen our existing competitive position in the areas of therapy research and pre-clinical testing, which we believe provides a base for expanding our products and technologies to address additional growth opportunities. The second is to expand our product offerings to higher-volume industrial customers such as CROs, biotechnology and pharmaceutical companies, and government laboratories engaged in the development and testing of new therapeutics, where the ability to reduce costs and improve cycle times in pre-clinical testing has the potential to drive additional demand. Third, we are expanding our product offerings for biotechnology and pharmaceutical customers in the field of bioproduction, where we believe there are opportunities to provide innovative products and services that bridge from research and development to production in applications that scale with production volume. Fourth, we are expanding our product offerings for academic, biotechnology, and pharmaceutical customers engaged in therapy, discovery, development and testing, especially in the area of streamlined *in vitro* testing from cell lines to organoids early in the development cycle.

**Our Products**

As noted above, our products, consumables, software and services enable fundamental advances in life science applications, including research, pharmaceutical and therapy discovery, bioproduction and preclinical testing.

We have organized our product line activities into two product families, CMT and Preclinical.

Our CMT product family is primarily composed of products supporting research related to molecular, cellular, organ and organoid technologies. Our CMT products also have application in the emerging field of bioproduction of pharmaceuticals and therapeutics as well as in *in vitro* testing of cell lines and organoids in the therapy development. The principal customers for our CMT products include academic and government laboratories, biotechnology and pharmaceutical companies, and CROs.

Our Preclinical product family includes products that support the preclinical research and testing phase for drug development, and in particular testing related to data collection and analysis for safety and regulatory compliance. Preclinical products are primarily sold to pharmaceutical, biotechnology and CROs, as well as larger academic labs.

We sell our products under several brand names, including Harvard Apparatus, DSI, Buxco, Biochrom, BTX, Heka, Hugo Sachs, Multichannel Systems MCS GmbH (“MCS”) and Panlab.

Our solutions range from simple to complex, and generally consist of hardware/firmware and software products, augmented with consumables, options, upgrades and post-sales (scientific, installation and data) services. Sales prices of these products and services range typically from $1,000 to over $100,000. Our products include spectrophotometers that analyze light to detect and quantify a wide range of molecules as well as cell analysis and electroporation and electrofusion systems to influence and/or analyze cellular processes. Other products and services focus on tissue and organ responses to new drugs and encompass wireless monitors, and signal acquisition and analysis functionality. We also feature products that monitor physiological processes in living organisms to study behavior. Many of our proprietary products are leaders in their fields.

In addition to our proprietarily manufactured products, we distribute products developed by other manufacturers. These distributed products accounted for approximately 13% and 15% of our revenues for the years ended December 31, 2023 and 2022, respectively. Resale of such products enables us to act as a single source for our customers’ research needs. They consist of a large variety of complementing instruments or accessories as well as consumables used in experiments involving fluid handling, molecular and cell analysis and tissue, organ and animal research.

Below is a description of each product family.

***Cellular and Molecular Technologies Product Family***

Our CMT product family includes products designed primarily to support the discovery phase of new drug development. The CMT product family includes the Harvard Apparatus, Biochrom, BTX, Heka, Hugo Sachs, and MCS brands. CMT products include:

- electroporation and electrofusion instruments, including the bioproduction configuration of our BTX electroporation system, introduced in 2022, which leverages our electroporation technology to bridge from therapy to production in the emerging field of bioproduction;
- amino acid analyzers, spectrophotometers, and other equipment which primarily support molecular level testing and research;
- high precision syringe and peristaltic infusion pump product lines;
- precision scientific measuring instrumentation and equipment in the field of electrophysiology such as: data acquisition systems with custom amplifier configurations for cellular analysis, complete micro electrode array solutions for in vivo recordings and in vitro systems for extracellular recordings; and
- our new Mesh MEA™ platform, launched in 2023, builds on our existing micro-electrode array technology to support streamlined in vitro testing from cell lines to organoids early in the therapy development cycle.

Our CMT product family made up approximately 49% and 51% of our global revenues for the years ended December 31, 2023 and 2022, respectively.

***Preclinical Product Family***

Our Preclinical product family provides a complete platform to assess physiological data from organisms for research ranging from basic research to drug discovery, and drug development services. The Preclinical product family includes the DSI, Panlab and Buxco brands. It includes:

- implantable and externally worn telemetry systems, which are commonly used in research to collect cardiovascular, central nervous system, respiratory, metabolic data;
- behavioral products; isolated organ and surgical products, a broad range of instruments and accessories for tissue, organ-based lab research, including surgical products, infusion systems, and behavior research systems;
- turn-key respiratory system solutions encompassing plethysmograph chambers, data acquisition hardware, physiological signal analysis software, and final report generation;
- inhalation and exposure systems providing precise, homogenous aerosol delivery for up to 42 subjects, while integrating respiratory parameters for the ultimate delivered dose system;
- powerful GLP-capable data acquisition and analysis systems, capable of integrating third party sensors for a more comprehensive study design; and
- our new VivaMars™ behavioral monitoring system, launched in 2023, which is directed to the high throughput testing needs of higher-volume industrial customers such as CROs, biotechnology and pharmaceutical companies, and government laboratories engaged in the development and testing of new therapeutics.

Our Preclinical product family made up approximately 51% and 49% of our global revenues for the years ended December 31, 2023 and 2022, respectively.

**Customers**

Our end-user customers are primarily research and development scientists and engineers at pharmaceutical and biotechnology companies, universities, hospitals, government laboratories, including the United States National Institutes of Health ("NIH"), U.S. Army and CROs. Our pharmaceutical and biotechnology customers include pharmaceutical companies and research laboratories such as Abbott, Amgen, AstraZeneca, Bayer, Glaxo Smith Kline, Johnson & Johnson, Merck, Novartis, Pfizer and Regeneron. Our academic customers include major colleges and universities such as Baylor College of Medicine, Cambridge University, Harvard University, Imperial College of London, Johns Hopkins University, Stanford, the University of California system, University of Pennsylvania, University of Pittsburgh, University of Texas and Yale University. Our CRO customers include Charles River Laboratories, Labcorp and Wuxi AppTec. We have a wide range of diverse customers worldwide, and no customer accounted for more than 10% of our revenues in 2023.

**Sales**

We conduct direct sales and through distributors in the United States, China and major European markets. We sell primarily through distributors in other countries. For the year ended December 31, 2023, revenues from direct sales to end-users represented approximately 65% of our revenues; and revenues from sales of our products through distributors represented approximately 35% of our revenues.

*Direct Sales*

We have a global sales organization managing both direct sales and distributors. Our websites and marketing collateral serve as the primary sales tool for our product lines, which includes both proprietary manufactured products and complementary products from various suppliers.

*Sales through Distributors*

We engage distributors for the sales of our own branded and private label products in certain areas of the world and for certain product lines.

**Marketing**

Our marketing activities encompass product management and marketing communications. Marketing maintains value-proposition based product roadmaps, collaborates with research and development on timing and investment for new products, develops marketing and sales strategies, supports direct and distributor sales activities, and sets the global pricing of our products. Our marketing team also maintains digital presence across the web and social media platforms, creates electronic leads and analyzes opportunities for new product portfolio extensions.

**Research and Development**

Our research and development activities are focused primarily on maintaining and strengthening our existing product and technology portfolio and expanding our portfolio to support new opportunities consistent with our growth strategy. We maintain development staff in many of our manufacturing facilities to design and develop new products and to re-engineer existing products to bring them to the next generation. Our research and development expenses were approximately $11.8 million and $12.3 million for the years ended December 31, 2023 and 2022, respectively. We anticipate that we will continue to make investments in research and development activities to advance our position in the industry as a provider of life science equipment, software and services. We plan to continue to pursue a balanced development portfolio strategy of originating new products from internal research and acquiring products and technologies through business and technology acquisitions or collaborations, as appropriate.

**Manufacturing**

We manufacture and test the majority of our products in our principal manufacturing facilities located in the United States, Germany and Spain. We have considerable manufacturing flexibility at our various facilities, and each facility can manufacture multiple products at the same time. We maintain in-house manufacturing expertise, technologies and resources. We seek to maintain multiple suppliers for key components that are not manufactured in-house, and while some of our products are dependent on sole-source suppliers, we have made investments in new talent in procurement and other functions to reduce exposures related to sole-source suppliers, and are accelerating these efforts given the dynamics of the global supply chain in recent years. Our manufacturing operations primarily involve assembly and testing activities along with some machine-based processes. Going forward we will continue to evaluate our manufacturing facilities and operations in order to optimize our manufacturing footprint.

See "Part I, Item 2. Properties" of this report for additional information regarding our manufacturing facilities.

**Competition**

The markets into which we sell our products are highly competitive, and we expect the intensity of competition to continue or increase. We compete with many companies engaged in developing and selling tools for life science research. Many of our competitors have greater financial, operational, sales and marketing resources and more experience in research and development and commercialization than we have. Moreover, our competitors may have broader product offerings and greater name recognition than we do, and many offer discounts as a competitive tactic. These competitors and other companies may have developed or could in the future develop new technologies that compete with our products, which could render our products obsolete. We cannot provide assurance that we will be able to make the enhancements to our technologies necessary to compete successfully with newly emerging technologies. While we provide a broad selection of differentiated products, we have numerous competitors across our product lines. We believe that we compete favorably with our competitors on the basis of product performance, including quality, reliability, speed, technical support, price and delivery time.

We compete with several companies that provide products for life science research including Becton, Dickinson and Company, Bio-Rad Laboratories, Inc., Danaher Corporation, Emka Technologies, Eppendorf AG, Instem plc, Kent Scientific Corporation, Lonza Group Ltd., PerkinElmer, Inc., Thermo Fisher Scientific, Inc. and TSE Systems.

We cannot forecast if or when these or other companies may develop competitive products. We expect that other products will compete with our products and potential products based on efficacy, safety, cost and intellectual property positions. While we believe that these will be the primary competitive factors, other factors include, in certain instances, availability of supply, manufacturing, marketing and sales expertise and capability.

**Seasonality**

Sales and earnings in our third quarter are usually flat or down from the second quarter primarily because there are a large number of holidays and vacations during such quarter, especially in Europe. Our fourth quarter revenues and earnings are often the highest in any fiscal year compared to the other three quarters, primarily because many of our customers tend to spend budgeted money before their own fiscal year ends.

**Intellectual Property**

To establish and protect our proprietary technologies and products, we rely on a combination of patent, copyright, trademark and trade secret laws, as well as confidentiality provisions in our contracts. Patents or patent applications cover certain of our new technologies. Most of our product lines are protected principally by trade names and trade secrets.

We have implemented a patent strategy designed to provide us with freedom to operate and facilitate commercialization of our current and future products. Our success depends, to a significant degree, upon our ability to develop proprietary products and technologies. We intend to continue to file patent applications covering new products and technologies where it is appropriate to do so taking into account factors such as the likely scope of coverage, strategic value, and cost.

Patents provide some degree of protection for our intellectual property. However, the assertion of patent protection involves complex legal and factual determinations and is therefore uncertain. The scope of any of our issued patents may not be sufficiently broad to offer meaningful protection. In addition, our issued patents or patents licensed to us may be successfully challenged, invalidated, circumvented or unenforceable so that our patent rights would not create an effective competitive barrier. Moreover, the laws of some foreign countries may protect our proprietary rights to a greater or lesser extent than the laws of the United States. In addition, the laws governing patentability and the scope of patent coverage continue to evolve, particularly in areas of interest to us. As a result, there can be no assurance that patents will be issued from any of our patent applications or from applications licensed to us. As a result of these factors, our intellectual property positions bear some degree of uncertainty.

We also rely in part on trade secret protection of our intellectual property. We attempt to protect our trade secrets by entering into confidentiality agreements with third parties, employees and consultants. Our employees and consultants also sign agreements requiring that they assign to us their interests in patents and copyrights arising from their work for us. Although many of our United States employees have signed agreements not to compete unfairly with us during their employment and after termination of their employment, through the misuse of confidential information, soliciting employees, soliciting customers and the like, the enforceability of these provisions varies from jurisdiction to jurisdiction and, in some circumstances, they may not be enforceable. In addition, it is possible that these agreements may be breached or invalidated and if so, there may not be an adequate corrective remedy available. Despite the measures we have taken to protect our intellectual property, we cannot provide assurance that third parties will not independently discover or invent competing technologies or reverse engineer our trade secrets or other technologies. Therefore, the measures we are taking to protect our proprietary rights may not be adequate.

We do not believe that our products infringe on the intellectual property rights of any third party. We cannot assure, however, that third parties will not claim such infringement by us or our licensors with respect to current or future products. We expect that product developers in our market will increasingly be subject to such claims as the number of products and competitors in our market segment grows and the product functionality in different market segments overlaps. In addition, patents on production and business methods are becoming more common and we expect that more patents will be issued in our technical field. Any such claims, with or without merit, could be time-consuming, result in costly litigation and diversion of management's attention and resources, cause product shipment delays or require us to enter into royalty or licensing agreements. Moreover, such royalty or licensing agreements, if required, may not be on terms advantageous to us, or acceptable at all, which could seriously harm our business or financial condition.

"Harvard" is a registered trademark of Harvard University. The marks "Harvard Apparatus" and "Harvard Bioscience" are being used pursuant to a license agreement entered into in December 2002 between us and Harvard University.

**Government Regulation**

We are generally not subject to direct governmental regulation other than the laws and regulations generally applicable to businesses in the domestic and foreign jurisdictions in which we operate. In particular, other than our amino acid analyzer product, our current products are not subject to pre-market approval by the United States Food and Drug Administration for use on human clinical patients. In addition, we believe we are materially in compliance with all relevant environmental laws.

**Employees**

As of December 31, 2023, we employed 416 employees, which included 391 full-time employees. Some of our employees in Europe have statutory collective bargaining rights. We have never experienced a general work stoppage or strike, and management believes that our relations with our employees are good. Additional information about our employees follows:

| Country | Full-time | Part-time |
|---|---|---|
| United States | 248 | 9 |
| Germany | 55 | 14 |
| United Kingdom | 35 | 2 |
| Spain | 26 | - |
| China | 17 | - |
| Rest of World | 10 | - |
| Total | 391 | 25 |

| Function | Full-time | Part-time |
|---|---|---|
| Manufacturing | 153 | 6 |
| Sales and marketing | 135 | 6 |
| Research and development | 49 | 9 |
| General and administrative | 54 | 4 |
| Total | 391 | 25 |

We make employment decisions without regard to age, color, national origin, citizenship status, physical or mental disability, race, religion, creed, gender, sex, sexual orientation, gender identity and/or expression, genetic information, marital status, status with regard to public assistance, veteran and military status or any other characteristic protected by federal, state or local law. We take steps to employ and advance in employment qualified protected veterans and qualified individuals with disabilities.

**Geographic Area**

Financial information regarding geographic areas in which we operate is provided in Notes 5 and 13 to the Consolidated Financial Statements included in "Part IV, Item 15. Exhibits, Financial Statement Schedules" of this report.

**Available Information and Website**

Our website address is www.harvardbioscience.com. Our Annual Report on Form 10-K, Quarterly Reports on Form 10-Q, Current Reports on Form 8-K, and exhibits and amendments to those reports filed or furnished with the Securities and Exchange Commission pursuant to Section 13(a) of the Exchange Act are available for review on our website and the Securities and Exchange Commission's website at www.sec.gov. Any such materials that we file with, or furnish to, the SEC in the future will be available on our website as soon as reasonably practicable after they are electronically filed with, or furnished to, the SEC. The information on our website is not incorporated by reference into this Annual Report on Form 10-K.

**Item 1A.*Risk Factors.***

*The following factors should be reviewed carefully, in conjunction with the other information contained in this Annual Report on Form 10-K. As previously discussed, our actual results could differ materially from our forward-looking statements. Our business faces a variety of risks. These risks include those described below and may include additional risks and uncertainties not presently known to us or that we currently deem immaterial. If any of the events or circumstances described in the following risk factors occur, our business operations, performance and financial condition could be adversely affected, and the trading price of our common stock could decline.*

**Risks Related to Our Industry**

***The life sciences industry is very competitive.***

We expect to encounter increased competition from both established and development-stage companies that continually enter the market. These include companies developing and marketing life science instruments, systems and lab consumables, health care companies that manufacture laboratory-based tests and analyzers, diagnostic and pharmaceutical companies, analytical instrument companies, and companies developing life science or drug discovery technologies. Currently, our principal competition comes from established companies that provide products that perform many of the same functions for which we market our products. Many of our competitors have substantially greater financial, operational, marketing and technical resources than we do. Moreover, these competitors may offer broader product lines and tactical discounts and may have greater name recognition. In addition, we may face competition from new entrants into the field. We may not have the financial resources, technical expertise or marketing, distribution or support capabilities to compete successfully in the future. In addition, we face changing customer preferences and requirements, including increased customer demand for more environmentally friendly products.

The life sciences industry is also subject to rapid technological change and discovery. The development of new or improved products, processes or technologies by other companies may render our products or proposed products obsolete or less competitive. In some instances, our competitors may develop or market products that are more effective or commercially attractive than our current or future products. To meet the evolving needs of customers, we must continually enhance our current products and develop and introduce new products. However, we may experience difficulties that may delay or prevent the successful development, introduction and marketing of new products or product enhancements. In addition, our product lines are based on complex technologies that are subject to change as new technologies are developed and introduced in the marketplace. We may have difficulty in keeping abreast of the changes affecting each of the different markets we serve or intend to serve, and our new products may not be accepted by the marketplace or may generate lower than anticipated revenues. Our failure to develop and introduce products in a timely manner in response to changing technology, market demands, or the requirements of our customers could cause our product sales to decline, and we could experience significant losses.

We offer, and plan to continue to offer, a broad range of products and have incurred, and expect to continue to incur, substantial expenses for the development of new products and enhancements to our existing products. The speed of technological change in our market may prevent us from being able to successfully market some or all of our products for the length of time required to recover development costs. Failure to recover the development costs of one or more products or product lines could decrease our profitability or cause us to experience significant losses.

***A portion of our revenues is derived from customers in the pharmaceutical and biotechnology industries and is subject to the risks faced by those industries. Such risks may adversely affect our financial results.***

We derive a significant portion of our revenues from pharmaceutical companies, biotechnology companies, and CROs serving these companies. We expect that pharmaceutical companies, biotechnology companies and CROs will continue to be a significant source of our revenues for the foreseeable future, including in our CMT and Preclinical product families. As a result, we are subject to risks and uncertainties that affect the pharmaceutical and biotechnology industries, such as government regulation, ongoing consolidation, uncertainty of technological change, and reductions and delays in research and development expenditures by companies in these industries.

In particular, the biotechnology industry is largely dependent on raising capital to fund its operations. If biotechnology companies that are our customers are unable to obtain the financing necessary to purchase our products, our business and results of operations could be adversely affected. In addition, we are dependent, both directly and indirectly, upon general health care spending patterns, particularly in the research and development budgets of the pharmaceutical and biotechnology industries, as well as upon the financial condition and purchasing patterns of various governments and government agencies. As it relates to both the biotechnology and pharmaceutical industries, many companies have significant patents that have expired or are about to expire, which could result in reduced revenues for those companies. If pharmaceutical or biotechnology companies that are our customers suffer reduced revenues as a result of these patent expirations, they may be unable to purchase our products, and our business and results of operations could be adversely affected.

***Changes in governmental regulations may reduce demand for our products, adversely impact our revenues, or increase our expenses.***

We operate in many markets in which we and our customers must comply with federal, state, local and international regulations. We develop, configure and market our products to meet customer needs created by, and in compliance with, those regulations. These requirements include, among other things, regulations regarding manufacturing practices, product labeling, and advertising and post marketing reporting. We must incur expense and spend time and effort to ensure compliance with these complex regulations. Possible regulatory actions for non-compliance could include warning letters, fines, damages, injunctions, civil penalties, recalls, seizures of our products, and criminal prosecution. These actions could result in, among other things, substantial modifications to our business practices and operations; refunds, recalls, or seizures of our products; a total or partial shutdown of production in one or more of our facilities while we or our suppliers remedy the alleged violation; and withdrawals or suspensions of current products from the market. Any of these events could disrupt our business and have a material adverse effect on our revenues, profitability and financial condition.

**Risks Related to Our Business**

***Reductions in customers' research budgets or government funding may adversely affect our business.***

Many of our customers are universities, government research laboratories, private foundations and other institutions that are dependent on grants from government agencies, such as the NIH, for funding. These customers represent a significant source of our revenue. Research and development spending by our customers may fluctuate based on spending priorities and general economic conditions. The level of government funding for research and development is unpredictable. In the past, NIH grants have been frozen or otherwise made unavailable for extended periods or directed to certain products. Reductions or delays in governmental spending could cause customers to delay or forego purchases of our products. If government funding necessary for the purchase of our products were to decrease, our business and results of operations could be materially, adversely affected. Spending by some of these customers fluctuates based on budget allocations and the timely passage of the annual federal budget. An impasse in federal government budget decisions could lead to substantial delays or reductions in federal spending.

***Our business is subject to economic, political and other risks associated with international revenues and operations.***

We manufacture and sell our products worldwide and as a result, our business is subject to risks associated with doing business internationally. A substantial amount of our revenues is derived from international operations, and we anticipate that a significant portion of our sales will continue to come from outside the United States in the future. We anticipate that revenues from international operations will likely continue to increase as a result of our efforts to expand our business in markets abroad. In addition, a number of our manufacturing facilities and suppliers are located outside the United States.

Our foreign operations subject us to certain risks, including: effects of fluctuations in foreign currency exchange rates; the impact of local economic conditions; fluctuations or reductions in economic growth in overseas markets including Asia and Europe; local product preferences and seasonality and product requirements; local difficulty to effectively establish and expand our business and operations in international markets; disruptions of capital and trading markets; restrictions and potentially negative tax implications of transfer of capital across borders; differing labor regulations; other factors beyond our control, including potential political instability, terrorism, acts of war, natural disasters and diseases, including COVID-19 discussed below; unexpected changes and increased enforcement of regulatory requirements and various state, federal and international, intellectual property, environmental, antitrust, anti-corruption, fraud and abuse (including anti-kickback and false claims laws) and employment laws; interruption to transportation flows for delivery of parts to us and finished goods to our customers; and laws and regulations on foreign investment in the United States under the jurisdiction of the Committee on Foreign Investment in the United States, or CFIUS, and other agencies, including the Foreign Investment Risk Review Modernization Act, or FIRRMA, adopted in August 2018.

A small percentage of our products are subject to export control regulations administered by the U.S. Department of the Treasury's Office of Foreign Assets Control ("OFAC") and by the Export Administration Regulations administered by the U.S. Department of Commerce's Bureau of Industry and Security ("BIS"). Based on the nature of the product, its ultimate end use and country of destination, we are sometimes subject to foreign assets control and economic sanctions regulations administered by OFAC, which restrict or prohibit our ability to transact with certain foreign countries, certain individuals and entities identified on the Treasury Department's "Denied Parties List." Under the OFAC regulations, the sale or transfer of certain equipment to a location outside the United States may require prior approval in the form of an export license issued by the BIS or the U.S. Department of State's Directorate of Defense Trade Controls. Some potential international transactions may also be restricted or prohibited based on the location, nationality or identity of the potential end user, customer or other parties to the transaction or may require prior authorization in the form of an OFAC license. These risks may be exacerbated by geopolitical tensions in various regions of the world such as China, the Asia-Pacific region and the Middle East. Any delay in obtaining required governmental approvals could affect our ability to conclude a sale or timely commence a project, and the failure to comply with all such controls could result in criminal and/or civil penalties. These international transactions may otherwise be subject to tariffs and import/export restrictions from the United States or other governments.

Our overall success as a global business depends, in part, upon our ability to succeed in differing economic, social and political conditions. In order to continue to succeed in our international sales strategy, we must continue developing and implementing policies and strategies that are effective in each location where we do business, which could negatively affect our profitability.

***Rising inflation and interest rates could negatively impact our revenues, profitability and borrowing costs. In addition, if our costs increase and we are not able to correspondingly adjust our commercial relationships to account for this increase, our net income would be adversely affected, and the adverse impact may be material.***

Inflation rates, particularly in the U.S., have increased recently to levels not seen in years. Sustained or increased inflation may result in decreased demand for our products, increased operating costs (including our labor costs), reduced liquidity, and limitations on our ability to access credit or otherwise raise debt and equity capital. In addition, the United States Federal Reserve has raised interest rates in response to concerns about inflation. Increases in interest rates have had, and could continue to have, a material impact on our borrowing costs. In an inflationary environment, we may be unable to raise the sales prices of our products at or above the rate at which our costs increase, which could reduce our profit margins and have a material adverse effect on our financial results and net income. We also may experience lower than expected sales if there is a decrease in spending on products in our industry in general or a negative reaction to our pricing. A reduction in our revenue would be detrimental to our profitability and financial condition and could also have an adverse impact on our future growth.

***We have substantial debt and other financial obligations, and we may incur even more debt. Any failure to meet our debt and other financial obligations or maintain compliance with related covenants could harm our business, financial condition and results of operations.***

Our credit agreement provides for a term loan of $40.0 million and a $25.0 million senior revolving credit facility (collectively, the "Credit Agreement") and will mature on December 22, 2025. As of December 31, 2023, we had outstanding borrowings of $37.1 million under the Credit Agreement.

Pursuant to the terms of the Credit Agreement, we are subject to various covenants, including negative covenants that restrict our ability to engage in certain transactions, which may limit our ability to respond to changing business and economic conditions. Such negative covenants include, among other things, limitations on our ability and the ability of our subsidiaries to incur debt or liens, make investments (including acquisitions), sell assets, and pay dividends on our capital stock. In addition, the Credit Agreement contains certain financial covenants, including a maximum consolidated net leverage ratio and a minimum consolidated fixed charge coverage ratio, each of which will be tested at the end of each fiscal quarter of the Company.

If we are not able to maintain compliance with the covenants under the Credit Agreement, as amended, or are unsuccessful in obtaining waivers or amendments for any covenant defaults in the future, in addition to other actions our lenders may require, the amounts outstanding under the Credit Agreement may become immediately due and payable. This immediate payment may negatively impact our financial condition. In addition, any failure to make scheduled payments of interest and principal on our outstanding indebtedness would likely harm our ability to incur additional indebtedness on acceptable terms. Our cash flow and capital resources may be insufficient to pay interest and principal on our debt in the future. If that should occur, our capital raising or debt restructuring measures may be unsuccessful or inadequate to meet our scheduled debt service obligations, which could cause us to default on our obligations and further impair our liquidity.

Further, based upon our actual performance levels, our covenants relating to leverage and fixed charges could limit our ability to incur additional debt, which could hinder our ability to execute our current business strategy.

Our ability to make scheduled payments on our debt and other financial obligations and comply with financial covenants depends on our financial and operating performance. Our financial and operating performance will continue to be subject to prevailing economic conditions and to financial, business and other factors, some of which are beyond our control. Failure within any applicable grace or cure periods to make such payments, comply with the financial covenants, or any other non-financial or restrictive covenant, would create a default under our Credit Agreement. Our cash flow and existing capital resources may be insufficient to repay our debt at maturity, in which such case prior thereto we would have to extend such maturity date, or otherwise repay, refinance and or restructure the obligations under the Credit Agreement, including with proceeds from the sale of assets, and additional equity or debt capital. If we are unsuccessful in obtaining such extension, or entering into such repayment, refinance or restructure prior to maturity, or any other default existed under the Credit Agreement, our lenders could accelerate the indebtedness under the Credit Agreement, foreclose against their collateral or seek other remedies, which would jeopardize our ability to continue our current operations.

***Ethical concerns surrounding the use of our products and misunderstanding of the nature of our business could adversely affect our ability to develop and sell our existing products and new products.***

Some of our products may be used in areas of research involving animal research and other techniques presently being explored in the life science industry. These techniques have drawn negative attention in the public forum. Government authorities may regulate or prohibit any of these activities. Additionally, the public may disfavor or reject these activities.

***Foreign currency exchange rate fluctuations may have a negative impact on our reported earnings.***

We are subject to the risks of fluctuating foreign currency exchange rates, which could have an adverse effect on the sales price of our products in foreign markets, as well as the costs and expenses of our foreign subsidiaries. A substantial amount of our revenues is derived from international operations, and we anticipate that a significant portion of revenues will continue to come from outside the United States in the future. As a result, currency fluctuations among the United States dollar, British pound, euro and the other currencies in which we do business have caused and will continue to cause foreign currency translation and transaction gains and losses. We have not used forward exchange contracts to hedge our foreign currency exposures. We attempt to manage foreign currency risk through the matching of assets and liabilities. In the future, we may undertake to manage foreign currency risk through hedging methods, including foreign currency contracts. We recognize foreign currency gains or losses arising from our operations in the period incurred. We cannot guarantee that we will be successful in managing foreign currency risk or in predicting the effects of exchange rate fluctuations upon our future operating results because of the number of currencies involved, the variability of currency exposure and the potential volatility of currency exchange rates. We cannot predict with any certainty changes in foreign currency exchange rates or the degree to which we can address these risks.

***Failure or inadequacy of our information technology infrastructure or software could adversely affect our day-to-day operations and decision-making processes and have an adverse effect on our performance.***

We depend on accurate and timely information and numerical data from key software applications to aid our day-to-day business, financial reporting and decision-making and, in many cases, proprietary and custom-designed software is necessary to operate our business.

Disruption caused by the failure of these systems, the underlying equipment, or communication networks could delay or otherwise adversely impact day-to-day business and decision making, could make it impossible for us to operate critical equipment, and could have an adverse effect on our performance. Our disaster recovery plans may not fully mitigate the effect of any such disruption. Disruptions could be caused by a variety of factors, such as catastrophic events or weather, power outages, or cyber-attacks on our systems by outside parties.

We review our information technology (“IT”) systems regularly to assess and implement opportunities to improve or upgrade our enterprise resource planning (“ERP”) or other information systems required to operate our business effectively. Our ERP systems are critical to our ability to accurately maintain books and records, record transactions, provide important information to our management and prepare our financial statements. The implementation of any IT systems, including ERP systems, has required in the past, and may continue to require, the investment of significant financial and human resources. In addition, we may not be able to successfully complete the implementation of the ERP systems without experiencing difficulties. Any disruptions, delays or deficiencies in the design and implementation of any IT system, including ERP systems could adversely affect our ability to process orders, ship products, provide services and customer support, send invoices and track payments, fulfill contractual obligations or otherwise operate our business.

***An information security incident, including a cybersecurity breach, could have a negative impact on our business or reputation.***

To meet business objectives, we rely on both internal IT systems and networks, and those of third parties and their vendors, to process and store sensitive data, including confidential research, business plans, financial information, intellectual property, and personal data that may be subject to legal protection. The extensive information security and cybersecurity threats, which affect companies globally, pose a risk to the security and availability of these IT systems and networks, and the confidentiality, integrity, and availability of our sensitive data. We continually assess these threats and make investments to increase internal protection, detection, and response capabilities, as well as ensure our third-party providers have the required capabilities and controls to address this risk. While we have been, and may continue to be, subject to cybersecurity risks and incidents related to our business, to date, we have not experienced any material impact to the business or operations resulting from information or cybersecurity incidents; however, because of the frequently evolving tactics adopted by threat actors, along with the increased volume and sophistication of attacks by such threat actors, there is the potential for us to be materially adversely impacted in the future. This impact could result in reputational, competitive, operational or other business harm as well as financial costs and regulatory action. Additionally, the California Consumer Privacy Act of 2018 (the “CCPA”), which became effective on January 1, 2020, provides private rights of action for data breaches and requires companies that process information on California residents to make new disclosures to consumers about their data collection, use and sharing practices and allow consumers to opt out of certain data sharing with third parties. Compliance with the CCPA and other current and future applicable privacy, cybersecurity and related laws can be costly and time-consuming. Significant capital investments and other expenditures could also be required to remedy cybersecurity problems and prevent future breaches, including costs associated with additional security technologies, personnel, experts and credit monitoring services for those whose data has been breached. These costs, which could be material, could adversely impact our results of operations in the period in which they are incurred and may not meaningfully limit the success of future attempts to breach our information technology systems.

***We may be unable to renew leases or enter into new leases on favorable terms.***

Our facilities are located in leased premises. Several of our leases will expire in 2024 and we may be unable to renew such leases or enter into new leases on favorable terms and conditions or at all. A significant rise in real estate prices or real property taxes could also result in an increase in lease cost, and thereby negatively impacting the Company’s results of operations and cash flow. As a result, we may incur additional costs including increased rent and other costs related to our renegotiation of lease terms for our facilities or for a new lease in a desirable location.

***We may incur additional restructuring costs or not realize the expected benefits of our initiatives to reduce operating expenses in the future.***

We may not be able to implement all of the actions that we intend to take in the restructuring of our operations, and we may not be able to fully realize the expected benefits from such realignment and restructuring plans or other similar restructurings in the future. In addition, we may incur additional restructuring costs in implementing such realignment and restructuring plans or other similar future plans in excess of our expectations. The implementation of our restructuring efforts, including the reduction of our workforce, may not improve our operational and cost structure or result in greater efficiency of our organization; and we may not be able to support sustainable revenue growth and profitability following such restructurings.

***If we are not able to manage our growth, our operating profits may be adversely impacted.***

Our success will depend on the expansion of our operations through organic growth, and we may execute acquisitions in the future to augment this growth. Effective growth management will place increased demands on our management team, operational and financial resources and expertise. To manage growth, we must optimize our operational, financial and management processes and systems, and information technology infrastructure and hire and train additional qualified personnel. While we are currently in the process of evaluating potential improvements to and consolidation of many of our processes and systems, we may not be able to implement these changes in an efficient or timely manner. Failure to manage our growth effectively, including failure to improve our systems and processes timely or efficiently, could impair our ability to generate revenues or could cause our expenses to increase more rapidly than revenues, resulting in operating losses or reduced profitability.

***We may incur a variety of costs in connection with acquisitions we may seek to consummate in the future, and we may never realize the anticipated benefits of our acquisitions due in part to difficulties integrating the businesses, operations and product lines.***

Our business strategy has historically included the acquisition of businesses, technologies, services or products that we believe are a strategic fit with our business. If we were to undertake future acquisitions, the process of integrating the acquired business, technology, service and/or product(s) may result in unforeseen operating difficulties and expenditures and potentially absorb significant management attention that would otherwise be available for ongoing development of our business. Moreover, we may fail to realize the anticipated benefits of an acquisition as rapidly as expected, or at all. Such transactions are inherently risky, and any such recent or future acquisitions could reduce stockholders' ownership, cause us to incur debt, expose us to future liabilities and result in amortization expenses related to intangible assets with definite lives, which may adversely impact our ability to undertake future acquisitions on substantially similar terms. We may also incur significant expenditures in anticipation of an acquisition that is never realized.

Our ability to achieve the benefits of acquisitions depends in part on the integration and leveraging of technology, operations, sales and marketing channels and personnel. Integration is a complex, time-consuming and expensive process and may disrupt our business if not completed in a timely and efficient manner. We may have difficulty successfully integrating acquired businesses, and their domestic and foreign operations or product lines, and as a result, we may not realize any of the anticipated benefits of the acquisitions we make. We cannot assure that our growth rate will equal the growth rates that have been experienced by us, and these other acquired companies, respectively, operating as separate companies in the past.

***Failure to raise additional capital or generate the significant capital necessary to expand our operations, invest in new products, or pursue acquisitions or other business development opportunities could reduce our ability to compete and result in less revenues.***

We anticipate that our financial resources, which include available cash, cash generated from operations, and debt and equity capacity, will be sufficient to finance operations and capital expenditures for at least the next twelve months. However, this expectation is premised on the current operating plan, which may change as a result of many factors, including market acceptance of new products and future opportunities with collaborators. Consequently, we may need additional funding sooner than anticipated. In addition, our borrowings under the Credit Agreement may not be sufficient to support our pursuit of potential acquisitions or other business development opportunities. In such case, our inability to raise sufficient capital on favorable terms and in a timely manner (if at all) could seriously harm our business, product development, and acquisition efforts. In addition, our Credit Agreement contains various negative covenants that, among other things, restrict our ability to incur additional indebtedness and make acquisitions for aggregate consideration in excess of $5.0 million. If future financing is not available or is not available on acceptable terms, we may have to alter our operations or change our business strategy. We cannot assure you that the capital required to fund operations, or our acquisition strategy will be available in the future.

***If we fail to retain key personnel and hire, train and retain qualified employees, we may not be able to compete effectively, which could result in reduced revenue or increased costs.***

Our success is highly dependent on the continued services of key management, technical and scientific personnel. Our management and other employees may voluntarily terminate their employment at any time upon short notice. The loss of the services of any member of the senior management team, including the Chief Executive Officer or Chief Financial Officer or any of our managerial, technical or scientific staff may significantly delay or prevent the achievement of product development, our growth strategies and other business objectives. Our future success will also depend on our ability to identify, recruit and retain additional qualified scientific, technical and managerial personnel. We operate in several geographic locations where labor markets are particularly competitive, including the Boston, Massachusetts and Minneapolis, Minnesota metropolitan areas, England, and Germany where demand for personnel with these skills is extremely high and is likely to remain high. Additionally, the COVID-19 pandemic and other macroeconomic factors have exacerbated these challenges, contributed to a sustained labor shortage, and increased turnover rates. As a result, competition for qualified personnel is intense, particularly in the areas of general management, finance, information technology, engineering and science, and the process of hiring suitably qualified personnel is often lengthy and expensive and may become more expensive in the future. If we are unable to hire and retain a sufficient number of qualified employees, our ability to conduct and expand our business could be seriously reduced.

***Our success will depend partly on our ability to operate without infringing on or misappropriating the intellectual property rights of others.***

We may be sued for infringing on the intellectual property rights of others, including the patent rights, trademarks and trade names of third parties. Intellectual property litigation is costly, and the outcome is uncertain. If we do not prevail in any intellectual property litigation, in addition to any damages we might have to pay, we could be required to stop the infringing activity, or obtain a license to or design around the intellectual property in question. If we are unable to obtain a required license on acceptable terms, or are unable to design around any third-party patent, we may be unable to sell some of our products and services, which could result in reduced revenue.

***Third parties may seek to hold us responsible for Harvard Apparatus Regenerative Technologies, Inc.'s ("HRGN") (formerly known as Biostage, Inc.) liabilities, including liabilities that HRGN has assumed from us.***

Third parties may continue to seek to hold us responsible for HRGN's liabilities, including any of the liabilities that HRGN agreed to retain or assume in connection with the separation of the HRGN business from our businesses, and related spin-off distribution. For example, in April 2022, we and HRGN entered into a settlement of a litigation relating to injuries allegedly caused by products produced by us and HRGN and utilized in connection with surgeries performed by third parties (the "HRGN Settlement"). The HRGN Settlement resolved and dismissed all claims by and between the parties.

***Shares of common stock of HRGN held by the Company could fluctuate considerably in value and could become worthless.***

In connection with the HRGN Settlement, HRGN issued shares of its Series E Convertible Preferred Stock (the "Series E Preferred Stock") to the Company in satisfaction of $4.0 million of HRGN's total indemnification obligations to the Company. In April 2023, all of the Series E Preferred Stock we held in HRGN were mandatorily converted into shares of HRGN common stock. As of December 31, 2023, we held shares of HRGN common stock with an estimated fair value of $3.5 million.

Due to HRGN's limited operating history, their overall financial condition, (including whether it can continue as a going concern without additional capital) and the limited trading volume and liquidity of HRGN's common stock, the value of this investment could fluctuate considerably or become worthless.

**Risks Related to Our Common Stock**

***Our stock price has fluctuated in the past and could experience substantial declines in the future.***

The market price of our common stock has experienced significant fluctuations and may become volatile and could decline in the future, perhaps substantially, in response to various factors including, but not limited to:

- volatility of the financial markets;
- uncertainty regarding the prospects of the domestic and foreign economies;
- technological innovations by competitors or in competing technologies;
- revenues and operating results fluctuating or failing to meet our expectations or financial guidance, or the expectations of securities analysts, or investors;
- comments of securities analysts and mistakes by or misinterpretation of comments from analysts, downward revisions in securities analysts' estimates or management guidance;
- conditions or trends in the biotechnology and pharmaceutical industries;
- announcements of significant acquisitions or financings or strategic partnerships;
- non-compliance with the internal control standards pursuant to the Sarbanes-Oxley Act of 2002; and
- a decrease in the demand for our common stock.

In addition, public stock markets have experienced extreme price and trading volatility. The stock market and the Nasdaq Global Market in general, and the biotechnology and life science tools industry and small cap markets in particular, have experienced significant price and volume fluctuations that at times may have been unrelated or disproportionate to the operating performance of those companies. These broad market and industry factors may further harm the market price of our common stock, regardless of our operating performance. In the past, securities class action litigation has often been instituted following periods of volatility in the market price of a company's securities. A securities class action suit against us could result in substantial costs, potential liabilities and the diversion of management's attention and resources.

***If we raise additional funds through the sale of equity or convertible debt or equity-linked securities, existing percentages of ownership in our common stock will be reduced and these transactions may dilute the value of our outstanding common stock.***

We may raise additional funds through the sale of equity or convertible debt or equity-linked securities to repay our existing indebtedness, implement our acquisition strategy, expand our operations and/or invest in new products. If we raise additional funds through such sales, existing percentages of ownership in our common stock will be reduced and these transactions may dilute the value of our outstanding common stock. We may issue securities that have rights, preferences and privileges senior to our common stock. If we raise additional funds through collaborations or licensing arrangements, we may relinquish rights to certain of our technologies or products, or grant licenses to third parties on terms that are unfavorable.

**General Risks**

***We are currently operating in a period of economic uncertainty and capital markets disruption, which has been significantly impacted by geopolitical instability due to military conflicts. Our business, financial condition and results of operations may be materially adversely affected by any negative impact on the global economy and capital markets resulting from the conflict in Ukraine, the Middle East or any other geopolitical tensions.***

U.S. and global markets are experiencing volatility and disruption following the escalation of geopolitical tensions globally, including military conflicts (such as the conflict between Russia and Ukraine and the conflicts in Israel and the Middle East). Although the length and impact of these conflicts are highly unpredictable, these conflicts could lead to market disruptions, including significant volatility in commodity prices, credit and capital markets, supply chain interruptions, and additional economic and financial sanctions.

Any of the abovementioned factors could affect our business, prospects, financial condition, and operating results. The extent and duration of the military action, sanctions and resulting market disruptions are impossible to predict, but could be substantial. Any such disruptions may also magnify the impact of other risks described in this Annual Report on Form 10-K.

***Epidemics and pandemics such as the COVID-19 pandemic have had, and in the future may have, a material adverse impact on our business.***

Our operations and financial performance have been, and in the future may be, negatively impacted by public health crises such as the COVID-19 pandemic and other epidemics and pandemics. Such events have caused, and may in the future cause, impacts such as reductions in economic activity (including volatility in demand for our products, services, and solutions, disruptions in global supply chains, and volatility in financial markets). Additionally, we have in the past experienced, and may in the future experience, operational challenges such as workplace disruptions, restrictions on the movement of people, raw materials, and goods (both at our own facilities and at those of our customers and suppliers), global supply chain disruptions, delays or disruptions in orders and order fulfillment, and price inflation.

***If we incur higher costs as a result of trade policies, treaties, government regulations or tariffs, we may become less profitable.***

There continues to be uncertainty about the relationship between the United States and foreign countries, including with respect to trade policies, treaties, government regulations and tariffs. We are unable to predict whether or when tariffs will be imposed or the impact of any such future tariff increases.

***We may be the subject of lawsuits from counterparties to acquisitions and divestitures, including an acquiring company or its stockholders, an acquired company's previous stockholders, a divested company's stockholders or our current stockholders.***

We may be the subject of lawsuits from either an acquiring company or its stockholders, an acquired company's previous stockholders, a divested company's stockholders or our current stockholders. Such lawsuits could result from the actions of the acquisition or divestiture target prior to the date of the acquisition or divestiture, from the acquisition or divestiture transaction itself or from actions after the acquisition or divestiture. Defending potential lawsuits could cost us significant expense and detract management's attention from the operation of the business. Additionally, these lawsuits could result in the cancellation of or the inability to renew certain insurance coverage that would be necessary to protect our assets.

***Rising commodity and precious metals costs could adversely impact our profitability.***

Raw material commodities, such as resins, and precious metal commodities, such as platinum, are subject to wide price variations. Increases in the costs of these commodities and the costs of energy, transportation and other necessary services may adversely affect our profit margins if we are unable to pass along any higher costs in the form of price increases or otherwise achieve cost efficiencies such as in manufacturing and distribution.

***Provisions of Delaware law, or of our charter and bylaws may make a takeover more difficult, which could cause our stock price to decline.***

Provisions in our certificate of incorporation and bylaws and in the Delaware corporate law may make it difficult and expensive for a third party to pursue a tender offer, change in control or takeover attempt, which is opposed by management and the board of directors. Public stockholders who might desire to participate in such a transaction may not have an opportunity to do so. We have a staggered board of directors that makes it difficult for stockholders to change the composition of the board of directors in any one year. These anti-takeover provisions could substantially impede the ability of public stockholders to change our management and board of directors. Such provisions may also limit the price that investors might be willing to pay for shares of our common stock in the future.

**Item 1B.*Unresolved Staff Comments.***

None.

**Item 1C.** ***Cybersecurity.***

**Cybersecurity Risk Management and Strategy**

We have implemented a cybersecurity risk management program intended to protect the confidentiality, integrity, and availability of our critical systems and information. Our cybersecurity risk management program is an element of and is integrated into our overall enterprise risk management program. Our framework is informed in part by the National Institute of Standards and Technology (NIST) Cybersecurity Framework and International Organization for Standardization 27001 (ISO 27001) Framework, although we have not been audited to, and may not be in compliance with, all technical standards, specifications or requirements under the NIST or ISO 27001 frameworks. Our cybersecurity risk management program includes:

- risk assessments designed to help identify material cybersecurity risks to our critical systems, information, products, services, and our broader enterprise information technology ("IT") environment;
- a security team that is principally responsible for managing (1) our cybersecurity risk assessment processes, (2) our security controls, and (3) our response to cybersecurity incidents;
- the use of external service providers, where appropriate, to assess, test, or otherwise assist with aspects of our security controls;
- cybersecurity awareness training for our employees, incident response personnel, and senior management;
- assessment of material cybersecurity risks posed by third-party service providers, including risks to employee, customer and financial information; and
- a cybersecurity incident response protocol that includes procedures for responding to cybersecurity incidents.

We have been, and expect to continue to be, subject to cybersecurity risks and incidents related to our business. To date, such risks and incidents have not materially affected our business strategy, results of operations or financial condition. For more information about the cybersecurity risks we face, see Item 1A – Risk Factors.

**Cybersecurity Governance**

Our Board considers cybersecurity risk as part of its enterprise risk management oversight function. This oversight includes periodic reports from management, including our Vice President of IT, concerning cybersecurity related risks.

Our management team, including our Vice President of IT, is responsible for assessing and managing risks from cybersecurity threats. Our Vice President of IT has extensive information technology and program management experience, including broad experience in corporate and consulting environments across of range of organizations and industries. Where appropriate, she engages external cybersecurity consultants to assist with cybersecurity related matters. Our management team has primary responsibility for our overall cybersecurity risk management program and, under the leadership of our Vice President of IT, supervises both our internal personnel and external cybersecurity consultants. This includes efforts to prevent, detect, mitigate, and remediate cybersecurity risks. These efforts employ information from various sources, such as security tools deployed in our IT environment, internal personnel, external security consultants, and governmental sources.

**Item 2.** ***Properties.***

Our facilities perform manufacturing, research and development, sales and marketing, and administration functions. As of December 31, 2023, we leased the following principal facilities:

| Location | Description of Facility | Approximate Square Footage | Expiration |
|---|---|---|---|
| Holliston, Massachusetts | Manufacturing facility and corporate headquarters | 83,000 | 2024 |
| New Brighton, Minnesota | Manufacturing facility | 75,000 | 2030 |
| Reutlingen, Germany | Manufacturing facility | 23,000 | 2024 |
| Barcelona, Spain | Manufacturing facility | 16,000 | 2024 |
| March-Hugstetten, Germany | Manufacturing facility | 11,000 | 2024 |

We also lease facilities in Cambridge, England; Kista, Sweden; Beijing, China; and Shanghai, China. We believe our current facilities are adequate for our needs for the foreseeable future.

**Item 3.** ***Legal Proceedings.***

For information related to legal proceedings, see the discussion in Note 15 and Note 16 to the Consolidated Financial Statements included in "Part IV, Item 15. Exhibits, Financial Statement Schedules" of this report, which information is incorporated by reference into this Item 3.

**Item 4.** ***Mine Safety Disclosures***

Not Applicable.

## PART II

**Item 5.** ***Market for Registrant's Common Equity, Related Stockholder Matters and Issuer Purchases of Equity Securities***

**Market Information**

Our common stock is quoted on the Nasdaq Global Market under the symbol "HBIO."

**Stockholders**

There were 90 holders of record of our common stock as of March 1, 2024. The number of record holders was determined from the records of our transfer agent and does not include beneficial owners of our common stock whose shares are held in the names of various security brokers, dealers, and registered clearing agencies.

**Dividend Policy**

We have never declared or paid cash dividends on our common stock in the past and do not intend to pay cash dividends on our common stock in the foreseeable future. Any future determination to pay cash dividends will be at the discretion of our board of directors and will depend on our financial condition, results of operations, capital requirements and other factors our board of directors deems relevant.

**Item 6.** ***[Reserved]***

**Item 7.** ***Management's Discussion and Analysis of Financial Condition and Results of Operations.***

**Forward-Looking Statements**

The following section of this Annual Report on Form 10-K contains statements that are not statements of historical fact and are forward-looking statements within the meaning of federal securities laws. These statements involve known and unknown risks, uncertainties and other factors that may cause our actual results, performance or achievements to be materially different from any future results, performance or achievements expressed or implied by the forward-looking statements. These statements reflect our current views with respect to future events and are based on assumptions and subject to risks and uncertainties. Factors that may cause our actual results to differ materially from those in the forward-looking statements include those factors described in "Item 1A. Risk Factors" in this Annual Report on Form 10-K. You should carefully review all of these factors, as well as the comprehensive discussion of forward-looking statements on page 1 of this Annual Report on Form 10-K.

**Overview**

Harvard Bioscience is a leading developer, manufacturer and seller of technologies, products and services that enable fundamental advances in life science applications, including research, pharmaceutical and therapy discovery, bioproduction and preclinical testing for pharmaceutical and therapy development. Our products and services are sold globally to customers ranging from renowned academic institutions and government laboratories to the world's leading pharmaceutical, biotechnology and CROs. With operations in the United States, Europe and China, we sell through a combination of direct and distribution channels to customers around the world.

**Trends and Developments**

Our business is affected by global and regional economic trends and uncertainties. The global economy has recently experienced increasing uncertainty, including inflationary pressure, rising interest rates, and fluctuations in exchange rates. Our business has also been affected by a recent softening of certain international markets, especially in China and the Asia-Pacific region, the events in Ukraine and the Middle East, as well as delays in government funding for our customers. These developments may lead to additional economic uncertainties.

Overall, our results of operations were negatively impacted by the COVID-19 pandemic. However, we experienced a period of increased demand for certain of our products due to increased COVID-19 related research activity during the pandemic, which is unlikely to be repeated. Our business has been affected by a reduced demand from our biotechnology and pharmaceutical company customers, due principally to the increased cost of capital and a reduction in spending following the COVID-19 pandemic.

If these trends are prolonged or are more severe, or if the recovery is less robust or takes longer than anticipated, our business, results of operations, and cash flow may be materially impacted.

**Restructuring Activities**

On an ongoing basis, we review our business, the global economy, the healthcare industry, and the markets in which we compete to identify operational efficiencies, enhance commercial capabilities and align our cost base and infrastructure with customer needs and our strategic plans.

During 2022, we reviewed our business and product portfolio and identified opportunities to rationalize our product portfolio, improve our cost structure and optimize our sales organization. In connection with this review, during the year ended December 31, 2022, we identified certain non-strategic products for discontinuation and recorded $1.5 million of inventory charges and also recorded $0.9 million in severance expenses in connection with headcount reductions in Europe and North America. During the year ended December 31, 2023, we incurred an additional $0.3 million in inventory charges and $0.1 million in remaining severance and other expenses related to completion of this restructuring program.

**Selected Results of Operations**

In the table below, we provide an overview of selected operating metrics for the year ended December 31, 2023, compared to the year ended December 31, 2022.

| | Year Ended December 31, | | | |
|---|---|---|---|---|
| (dollars in thousands) | 2023 | % of revenue | 2022 | % of revenue |
| Revenues | $ 112,250 | | $ 113,335 | |
| Gross profit | 66,071 | 58.9% | 60,819 | 53.7% |
| Sales and marketing expenses | 24,108 | 21.5% | 25,041 | 22.1% |
| General and administrative expenses | 22,780 | 20.3% | 24,493 | 21.6% |
| Research and development expenses | 11,764 | 10.5% | 12,329 | 10.9% |
| Amortization of intangible assets | 5,525 | 4.9% | 6,122 | 5.4% |
| Litigation settlement | - | - | (233) | -0.2% |
| Interest expense | 3,591 | 3.2% | 2,548 | 2.2% |
| Unrealized loss on equity securities | 632 | 0.6% | - | - |
| Income tax expense | 859 | 0.8% | 337 | 0.3% |

*Revenues*

Revenues decreased $1.0 million, or 1.0%, to $112.3 million for the year ended December 31, 2023, compared to $113.3 million for the year ended December 31, 2022. Revenues included a net decrease of $5.0 million from the discontinuation of non-strategic products, which was largely offset by growth in preclinical product and service revenue. Foreign exchange favorably impacted revenue by $0.7 million during the year ended December 31, 2023.

*Gross profit*

Gross profit increased $5.3 million, or 8.6%, to $66.1 million for the year ended December 31, 2023, compared with $60.8 million for the year ended December 31, 2022. Gross margin increased to 58.9% for the year ended December 31, 2023, compared with 53.7% for the year ended December 31, 2022. The increase in gross margin was due primarily to a higher mix of preclinical products, services, and software, which generally have higher gross margins than our other product lines, reduced revenue from lower margin products discontinued during the second half of 2022 and lower cost of sales resulting from restructuring activities related to discontinuing those products. Costs of goods sold for the year ended December 31, 2022, also included a $1.5 million inventory write down related to the discontinuation of certain non-strategic products.

*Sales and marketing expenses*

Sales and marketing expenses decreased $0.9 million, or 3.7%, to $24.1 million for the year ended December 31, 2023, compared to $25.0 million for the year ended December 31, 2022. A reduction in salaries due to lower headcount was partially offset by increases in variable compensation.

*General and administrative expenses*

General and administrative expenses decreased by $1.7 million, or 7.0%, to $22.8 million for the year ended December 31, 2023, compared with $24.5 million for the year ended December 31, 2022. The decrease was primarily due to reduced consulting costs and severance costs incurred with restructuring activities in the prior period, partially offset by increases in salaries and variable compensation in the current period.

*Research and development expenses*

Research and development expenses decreased $0.5 million, or 4.6%, to $11.8 million for the year ended December 31, 2023, compared with $12.3 million for the year ended December 31, 2022. The decrease was primarily due to the capitalization of software development costs. Reduced salaries and consulting costs were offset by increases in variable compensation.

*Amortization of intangible assets*

Amortization of intangible assets was $5.5 million for the year ended December 31, 2023, compared to $6.1 million for the year ended December 31, 2022. Amortization expense decreased as certain intangible assets became fully amortized during 2022.

*Litigation settlement*

During the year ended December 31, 2022, we recorded a net credit of $0.2 million related to the HRGN Settlement consisting of $5.2 million in settlement and legal expenses offset by credits of $5.4 million. The credits consisted of adjustments to the reserve against an indemnification receivable from HRGN to reflect: i) the issuance by HRGN of Series E Convertible Preferred Stock to us on June 10, 2022, in satisfaction of $4.0 million of Biostage's total indemnification obligations, ii) the payment by HRGN of legal fees associated with the HRGN Settlement, and iii) other accrual adjustments.

On April 6, 2023, all of the shares of Convertible Preferred Stock we held in HRGN were mandatorily converted into shares of common stock.

*Interest expense*

Interest expense increased $1.1 million, or 40.9%, to $3.6 million for the year ended December 31, 2023, compared with $2.5 million for the year ended December 31, 2022. The increase was the result of higher interest costs in a rising rate environment, which was partially offset by lower average borrowings during the period.

*Unrealized loss on equity securities*

In connection with the settlement discussed above, as of December 31, 2023 we held shares of HRGN common stock with an estimated fair value of $3.5 million. During the year ended December 31, 2023, we recorded an unrealized loss of $0.6 million related to these shares. We determine the fair value of our HRGN common stock based on the closing price as quoted on the OTCQB Marketplace at the reporting date. Due to HRGN's limited operating history, its overall financial condition and the limited trading volumes and liquidity of its common stock, the value of our investment in this common stock could fluctuate considerably or become worthless.

*Income tax expense*

Income tax expense for the year ended December 31, 2023, was $0.9 million compared to $0.3 million for the year ended December 31, 2022. The effective tax rates for the years ended December 31, 2023 and 2022, were (33.5)% and (3.7)%, respectively. The difference between our effective tax rates compared to the U.S. statutory tax rate of 21% was primarily due to the mix of forecasted income or losses in our U.S. and foreign tax jurisdictions, the impact of the employee retention credit, and a Global Intangible Low-Taxed Income inclusion to taxable income. The effective tax rates in both the years ended December 31, 2023 and 2022, were also impacted by changes in valuation allowances associated with our assessment of the likelihood of the recoverability of our deferred tax assets. We have valuation allowances against substantially all of our net operating loss carryforwards and tax credit carryforwards.

**Liquidity and Capital Resources**

Our primary sources of liquidity are cash and cash equivalents, internally generated cash flow from operations and our revolving credit facility. Our expected cash outlays relate primarily to cash payments due under our Credit Agreement described below, salaries, inventory, and capital expenditures.

As of December 31, 2023, we held cash and cash equivalents of $4.3 million, compared with $4.5 million at December 31, 2022. Borrowings outstanding under our Credit Agreement were $37.1 million and $47.7 million as of December 31, 2023 and 2022, respectively.

On December 22, 2020, we entered into a Credit Agreement which provides for a term loan of $40.0 million and a $25.0 million senior revolving credit facility both maturing on December 22, 2025 (See Note 9 to the Consolidated Financial Statements included in "Part IV, Item 15. Exhibits, Financial Statement Schedules" of this report). As of December 31, 2023, the weighted average interest rate on our borrowings, inclusive of the effect of our interest rate swaps, was 7.4%, and the available and unused borrowing capacity under the Credit Agreement, as amended, was $10.8 million. Total revolver borrowing capacity is limited by our consolidated net leverage ratio as defined under the Credit Agreement, as amended.

Based on our current operating plans, we expect that our available cash, cash generated from current operations and debt capacity will be sufficient to finance current operations and capital expenditures for at least the next 12 months. This assessment includes consideration of our best estimates of the impact of macroeconomic conditions on our financial results described above. Our forecast for the period of time through which our financial resources will be adequate to support our operations is a forward-looking statement that involves risks and uncertainties, and actual results could vary as a result of a number of factors.

**Condensed Consolidated Cash Flow Statements**

| (in thousands) | Year Ended December 31, 2023 | 2022 |
|---|---|---|
| Cash provided by operating activities | $ 14,028 | $ 1,152 |
| Cash used in investing activities | (1,799) | (1,590) |
| Cash used in financing activities | (12,134) | (2,837) |
| Effect of exchange rate changes on cash | (320) | (38) |
| Decrease in cash and cash equivalents | $ (225) | $ (3,313) |

Cash provided by operations was $14.0 million and $1.2 million for the years ended December 31, 2023 and 2022, respectively. Cash provided by operating activities for the year ended December 31, 2023 improved due to reductions in our net loss adjusted for non-cash items and increases in deferred revenue for service contracts. During the year ended December 31, 2022, cash used in operations was negatively impacted by the payment of approximately $4.0 million in connection with the HRGN Settlement.

Cash used in investing activities was $1.8 million for the year ended December 31, 2023, and primarily consisted of $2.3 million of capital expenditures in manufacturing, information technology infrastructure, and capitalized software costs, offset by $0.5 million from proceeds from the sale our Hoefer product line. Cash used in investing activities was $1.6 million for the year ended December 31, 2022, and primarily consisted of capital expenditures in manufacturing and information technology infrastructure.

Cash used in financing activities was $12.1 million for the year ended December 31, 2023. During this period, we made term loan installments payments under the Credit Agreement of $4.1 million, with net payments of $6.4 million under the revolving credit facility. We also received proceeds of $0.9 million from the exercise of stock options and the employee stock purchase plan and paid $2.5 million for taxes related to net share settlement of equity awards.

Cash used in financing activities was $2.8 million for the year ended December 31, 2022. During this period, we made term loan payments under the Credit Agreement of $3.2 million, with net borrowings of $1.4 million under the revolving facility. We also received proceeds of $0.6 million from the exercise of stock options and employee stock purchase plan purchases and paid $1.6 million for taxes related to net share settlement of equity awards.

**Impact of Foreign Currencies**

Our international operations in some instances operate as a natural hedge as we sell our products in many countries and a substantial portion of our revenues, costs and expenses are denominated in foreign currencies, primarily the euro and the British pound. During the year ended December 31, 2023, changes in foreign currency exchange rates resulted in a favorable effect on revenues of $0.7 million and an unfavorable effect on expenses of approximately $0.5 million.

During the years ended December 31, 2023 and 2022, the translation of foreign currency into U.S. dollars included as a component of comprehensive loss resulted in a gain (loss) of $1.5 million and $(2.6) million, respectively. In addition, the currency exchange rate fluctuations included as a component of net loss resulted in currency losses of $(0.2) million and $(0.4) million during the years ended December 31, 2023 and 2022, respectively.

**Recent Accounting Pronouncements**

For information on recent accounting pronouncements impacting our business, see “Recent Accounting Pronouncements” included in Note 2 to the Consolidated Financial Statements included in “Part IV, Item 15. Exhibits, Financial Statement Schedules” of this report.

**Critical Accounting Policies and Estimates**

The discussion and analysis of our financial condition and results of operations are based upon our consolidated financial statements, which have been prepared in accordance with accounting principles generally accepted in the United States. The preparation of these financial statements requires us to make estimates and judgments that affect the reported amounts of assets, liabilities, revenue and expenses, and related disclosure of contingent assets and liabilities. On an ongoing basis, we evaluate our estimates, including those related to revenue recognition, investments, income taxes, litigation and other contingencies. We base our estimates on historical experience and on various other assumptions that are believed to be reasonable under the circumstances, the results of which form the basis for making judgments about the carrying values of assets and liabilities that are not readily apparent from other sources. Actual results may differ from these estimates under different assumptions or conditions.

We believe the following is one of the more significant judgments and estimates used in the preparation of our consolidated financial statements:

***Income Taxes and Valuation Allowance***

We are subject to income taxes in the U.S. and numerous foreign jurisdictions. Our annual tax rate is based on income, statutory tax rates, tax reserve changes and tax planning opportunities available to us in the various jurisdictions in which we operate. We regularly assess the likelihood of tax adjustments in each of the tax jurisdictions in which we have operations and account for the related financial statement implications. We have established tax reserves that we believe are appropriate given the possibility of tax adjustments. Determining the appropriate level of tax reserves requires significant judgment regarding the uncertain application of tax laws. Reserves are adjusted when information becomes available or when an event occurs indicating a change in the reserve is appropriate. Changes in tax reserves could have a material impact on our financial condition or results of operations.

Significant judgment is also required in determining the amount of deferred tax assets that will ultimately be realized and any corresponding deferred tax asset valuation allowance. When estimating the necessary valuation allowance, we consider all available evidence for each jurisdiction including historical operating results, estimates of future taxable income and the feasibility of ongoing tax planning strategies. If new information becomes available that would alter our estimate of the amount of deferred tax assets that will ultimately be realized, we adjust the valuation allowance through income tax expense. Changes in the deferred tax asset valuation allowance could have a material impact on our financial condition or results of operations.

**Item 7A.*Quantitative and Qualitative Disclosures about Market Risk.***

Not Applicable.

**Item 8.** ***Financial Statements and Supplementary Data.***

The information required by this item is contained in the financial statements referenced in "Part IV, Item 15. Exhibits, Financial Statement Schedules" of this report, which financial statements are appended to this report. An index of those financial statements is found on page F-1.

**Item 9.** ***Changes in and Disagreements with Accountants on Accounting and Financial Disclosure.***

None.

**Item 9A.*Controls and Procedures.***

This Report includes the certifications of our Chief Executive Officer and Chief Financial Officer required by Rule 13a-14 of the Securities Exchange Act of 1934, as amended (the "Exchange Act"). See Exhibits 31.1 and 31.2. This Item 9A includes information concerning the controls and control evaluations referred to in those certifications.

**(a) Evaluation of Disclosure Controls and Procedures**

We carried out an evaluation required by the Securities Exchange Act of 1934 (the "1934 Act"), under the supervision and with the participation of our principal executive officer and principal financial officer, of the effectiveness of the design and operation of our disclosure controls and procedures, as defined in Rule 13a-15(e) of the 1934 Act, as of December 31, 2023. Based on this evaluation, our principal executive officer and principal financial officer concluded that, as of December 31, 2023, our disclosure controls and procedures were effective to provide reasonable assurance that information required to be disclosed by us in the reports that we file or submit under the 1934 Act is recorded, processed, summarized, and reported within the time periods specified in the SEC's rules and forms and to provide reasonable assurance that such information is accumulated and communicated to our management, including our principal executive officer and principal financial officer, as appropriate to allow timely decisions regarding required disclosure.

**(b) Management's Report on Internal Control Over Financial Reporting**

Management is responsible for establishing and maintaining adequate internal control over financial reporting, as defined in Rule 13a-15(f) of the 1934 Act. Management has assessed the effectiveness of our internal control over financial reporting as of December 31, 2023 based on criteria established in Internal Control — Integrated Framework (2013) issued by the Committee of Sponsoring Organizations of the Treadway Commission. As a result of this assessment, management concluded that, as of December 31, 2023, our internal control over financial reporting was effective in providing reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles. Grant Thornton LLP has independently assessed the effectiveness of our internal control over financial reporting and its report is included below.

**(c) Changes in Internal Controls Over Financial Reporting**

There were no changes in our internal control over financial reporting during the last quarter ended December 31, 2023, that materially affected, or are reasonably likely to materially affect, our internal control over financial reporting.

**(d) Limitations on Controls**

Our disclosure controls and procedures and internal control over financial reporting are designed to provide reasonable assurance of achieving their objectives as specified above. Management does not expect, however, that our disclosure controls and procedures or our internal control over financial reporting will prevent or detect all error and fraud. Any control system, no matter how well designed and operated, is based upon certain assumptions and can provide only reasonable, not absolute, assurance that its objectives will be met. Further, no evaluation of controls can provide absolute assurance that misstatements due to error or fraud will not occur or that all control issues and instances of fraud, if any, within the Company have been detected.

**(e) Report of Independent Registered Public Accounting Firm**

**REPORT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM**

Board of Directors and Stockholders
Harvard Bioscience, Inc.

**Opinion on internal control over financial reporting**

We have audited the internal control over financial reporting of Harvard Bioscience, Inc. (a Delaware corporation) and subsidiaries (the "Company") as of December 31, 2023, based on criteria established in the 2013 Internal Control—Integrated Framework issued by the Committee of Sponsoring Organizations of the Treadway Commission ("COSO"). In our opinion, the Company maintained, in all material respects, effective internal control over financial reporting as of December 31, 2023, based on criteria established in the 2013 Internal Control—Integrated Framework issued by COSO.

We also have audited, in accordance with the standards of the Public Company Accounting Oversight Board (United States) ("PCAOB"), the consolidated financial statements of the Company as of and for the year ended December 31, 2023, and our report dated March 7, 2024 expressed an unqualified opinion on those financial statements.

**Basis for opinion**

The Company's management is responsible for maintaining effective internal control over financial reporting and for its assessment of the effectiveness of internal control over financial reporting, included in the accompanying Management's Report on Internal Control over Financial Reporting. Our responsibility is to express an opinion on the Company's internal control over financial reporting based on our audit. We are a public accounting firm registered with the PCAOB and are required to be independent with respect to the Company in accordance with the U.S. federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission and the PCAOB.

We conducted our audit in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether effective internal control over financial reporting was maintained in all material respects. Our audit included obtaining an understanding of internal control over financial reporting, assessing the risk that a material weakness exists, testing and evaluating the design and operating effectiveness of internal control based on the assessed risk, and performing such other procedures as we considered necessary in the circumstances. We believe that our audit provides a reasonable basis for our opinion.

**Definition and limitations of internal control over financial reporting**

A company's internal control over financial reporting is a process designed to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles. A company's internal control over financial reporting includes those policies and procedures that (1) pertain to the maintenance of records that, in reasonable detail, accurately and fairly reflect the transactions and dispositions of the assets of the company; (2) provide reasonable assurance that transactions are recorded as necessary to permit preparation of financial statements in accordance with generally accepted accounting principles, and that receipts and expenditures of the company are being made only in accordance with authorizations of management and directors of the company; and (3) provide reasonable assurance regarding prevention or timely detection of unauthorized acquisition, use, or disposition of the company's assets that could have a material effect on the financial statements.

Because of its inherent limitations, internal control over financial reporting may not prevent or detect misstatements. Also, projections of any evaluation of effectiveness to future periods are subject to the risk that controls may become inadequate because of changes in conditions, or that the degree of compliance with the policies or procedures may deteriorate.

/s/ GRANT THORNTON LLP

Hartford, Connecticut
March 7, 2024

**Item 9B.*Other Information.***

On November 23, 2023, James Green, our Chairman, President and Chief Executive Officer, adopted a trading plan intended to satisfy the affirmative defense available under Rule 10b5-1(c) (the "Trading Plan"). The expiration date of the Trading Plan was February 7, 2025. The total number of shares of our common stock (the "Shares") to be sold under the Trading Plan was a maximum of 240,000. Mr. Green terminated the Trading Plan on January 21, 2024. No Shares were sold under the Trading Plan prior to its termination.

**Item 9C.*Disclosure Regarding Foreign Jurisdictions that Prevent Inspections.***

Not applicable.

**PART III**

**Item 10.*Directors, Executive Officers and Corporate Governance.***

Incorporated by reference to our definitive Proxy Statement to be filed pursuant to Regulation 14A under the Exchange Act in connection with our 2024 Annual Meeting of Stockholders.

**Item 11.*Executive Compensation.***

Incorporated by reference to our definitive Proxy Statement to be filed pursuant to Regulation 14A under the Exchange Act in connection with our 2024 Annual Meeting of Stockholders.

**Item 12.*Security Ownership of Certain Beneficial Owners and Management and Related Stockholder Matters.***

Incorporated by reference to our definitive Proxy Statement to be filed pursuant to Regulation 14A under the Exchange Act in connection with our 2024 Annual Meeting of Stockholders.

**Item 13.*Certain Relationships and Related Transactions, and Director Independence.***

Incorporated by reference to our definitive Proxy Statement to be filed pursuant to Regulation 14A under the Exchange Act in connection with our 2024 Annual Meeting of Stockholders.

**Item 14.*Principal Accounting Fees and Services.***

Incorporated by reference to our definitive Proxy Statement to be filed pursuant to Regulation 14A under the Exchange Act in connection with our 2024 Annual Meeting of Stockholders.

**PART IV**

**Item 15.*Exhibits, Financial Statement Schedules.***

(a) The following documents are filed as part of this Annual Report on Form 10-K or incorporated by reference as indicated:

(1) *Financial Statements, Schedules, and Exhibits.* We have listed our consolidated financial statements filed as part of this annual report in the index to consolidated financial statements on page F-1.

(2) *Financial Statement Schedules*. We have omitted all financial statement schedules because they are not applicable or not required or because we have included the necessary information in our consolidated financial statements or related notes.

(3) *Exhibits.* We have listed the exhibits filed as part of this annual report in the accompanying exhibit index, which follows the signature page to this annual report.

**Item 16.*Form 10-K Summary.***

None.

**INDEX TO CONSOLIDATED FINANCIAL STATEMENTS**
**HARVARD BIOSCIENCE, INC.**

## REPORT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

Board of Directors and Stockholders
Harvard Bioscience, Inc.

**Opinion on the financial statements**
We have audited the accompanying consolidated balance sheets of Harvard Bioscience, Inc. (a Delaware corporation) and subsidiaries (the "Company") as of December 31, 2023 and 2022, the related consolidated statements of operations, comprehensive loss, stockholders' equity, and cash flows for each of the two years in the period ended December 31, 2023, and the related notes (collectively referred to as the "financial statements"). In our opinion, the financial statements present fairly, in all material respects, the financial position of the Company as of December 31, 2023 and 2022, and the results of its operations and its cash flows for each of the two years in the period ended December 31, 2023, in conformity with accounting principles generally accepted in the United States of America.

We also have audited, in accordance with the standards of the Public Company Accounting Oversight Board (United States) ("PCAOB"), the Company's internal control over financial reporting as of December 31, 2023, based on criteria established in the 2013 Internal Control—Integrated Framework issued by the Committee of Sponsoring Organizations of the Treadway Commission ("COSO"), and our report dated March 7, 2024, expressed an unqualified opinion.

**Basis for opinion**
These financial statements are the responsibility of the Company's management. Our responsibility is to express an opinion on the Company's financial statements based on our audits. We are a public accounting firm registered with the PCAOB and are required to be independent with respect to the Company in accordance with the U.S. federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission and the PCAOB.

We conducted our audits in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement, whether due to error or fraud. Our audits included performing procedures to assess the risks of material misstatement of the financial statements, whether due to error or fraud, and performing procedures that respond to those risks. Such procedures included examining, on a test basis, evidence regarding the amounts and disclosures in the financial statements. Our audits also included evaluating the accounting principles used and significant estimates made by management, as well as evaluating the overall presentation of the financial statements. We believe that our audits provide a reasonable basis for our opinion.

**Critical audit matters**
Critical audit matters are matters arising from the current period audit of the financial statements that were communicated or required to be communicated to the audit committee and that: (1) relate to accounts or disclosures that are material to the financial statements and (2) involved our especially challenging, subjective, or complex judgments. We determined that there are no critical audit matters.

/s/ GRANT THORNTON LLP

We have served as the Company's auditor since 2017.

Hartford, Connecticut
March 7, 2024

**HARVARD BIOSCIENCE, INC.**
**CONSOLIDATED BALANCE SHEETS**
**(In thousands, except share and per share data)**

| | December 31, 2023 | December 31, 2022 |
|---|---|---|
| Assets | | |
| Current assets: | | |
| Cash and cash equivalents | $ 4,283 | $ 4,508 |
| Accounts receivable, net | 16,099 | 16,705 |
| Inventories | 24,716 | 26,439 |
| Other current assets | 3,940 | 3,472 |
| Total current assets | 49,038 | 51,124 |
| Property, plant and equipment, net | 3,981 | 3,366 |
| Operating lease right-of-use assets | 4,773 | 5,816 |
| Goodwill | 57,065 | 56,260 |
| Intangible assets, net | 16,036 | 21,014 |
| Other long-term assets | 6,473 | 7,780 |
| Total assets | $ 137,366 | $ 145,360 |
| Liabilities and Stockholders' Equity | | |
| Current liabilities: | | |
| Current portion of long-term debt | $ 5,859 | $ 3,811 |
| Current portion of operating lease liabilities | 1,416 | 2,135 |
| Accounts payable | 5,554 | 6,447 |
| Contract liabilities | 4,508 | 3,370 |
| Other current liabilities | 9,205 | 7,486 |
| Total current liabilities | 26,542 | 23,249 |
| Long-term debt, net | 30,704 | 43,013 |
| Deferred tax liability | 776 | 590 |
| Operating lease liabilities | 4,794 | 5,282 |
| Other long-term liabilities | 1,476 | 1,006 |
| Total liabilities | 64,292 | 73,140 |
| Commitments and contingencies - Note 15 | | |
| Stockholders' equity: | | |
| Preferred stock, par value $0.01 per share, 5,000,000 shares authorized | - | - |
| Common stock, par value $0.01 per share, 80,000,000 shares authorized: 43,394,509 shares issued and outstanding at December 31, 2023; 42,081,707 shares issued and outstanding at December 31, 2022 | 434 | 454 |
| Additional paid-in-capital | 232,435 | 229,008 |
| Accumulated deficit | (145,605) | (142,190) |
| Accumulated other comprehensive loss | (14,190) | (15,052) |
| Total stockholders' equity | 73,074 | 72,220 |
| Total liabilities and stockholders' equity | $ 137,366 | $ 145,360 |

See accompanying notes to condensed consolidated financial statements.

**HARVARD BIOSCIENCE, INC.**
**CONSOLIDATED STATEMENTS OF OPERATIONS**
**(In thousands, except per share data)**

| | Year Ended December 31, | |
|---|---|---|
| | **2023** | **2022** |
| Revenues | $ 112,250 | $ 113,335 |
| Cost of revenues | 46,179 | 52,516 |
| Gross profit | 66,071 | 60,819 |
| | | |
| Sales and marketing expenses | 24,108 | 25,041 |
| General and administrative expenses | 22,780 | 24,493 |
| Research and development expenses | 11,764 | 12,329 |
| Amortization of intangible assets | 5,525 | 6,122 |
| Litigation settlement - Note 16 | - | (233) |
| Total operating expenses | 64,177 | 67,752 |
| | | |
| Operating income (loss) | 1,894 | (6,933) |
| | | |
| Other (expense) income: | | |
| Interest expense | (3,591) | (2,548) |
| Unrealized loss on equity securities - Note 16 | (632) | - |
| Other (expense) income, net | (227) | 302 |
| Total other expense | (4,450) | (2,246) |
| | | |
| Loss before income taxes | (2,556) | (9,179) |
| Income tax expense | 859 | 337 |
| Net loss | $ (3,415) | $ (9,516) |
| | | |
| Loss per share: | | |
| Basic and diluted loss per share | $ (0.08) | $ (0.23) |
| | | |
| Weighted-average common shares: | | |
| Basic and diluted | 42,420 | 41,413 |

See accompanying notes to condensed consolidated financial statements.

**HARVARD BIOSCIENCE, INC.**
**CONSOLIDATED STATEMENTS OF COMPREHENSIVE LOSS**
**(In thousands)**

| | Year Ended December 31, | |
|---|---|---|
| | **2023** | **2022** |
| Net loss | $ (3,415) | $ (9,516) |
| Other comprehensive income (loss): | | |
| Foreign currency translation adjustments | 1,507 | (2,614) |
| Defined benefit pension plans, net of tax benefit of $137 and $566, respectively | (446) | (2,411) |
| Derivative instruments qualifying as cash flow hedges, net of tax of $-0- | (199) | - |
| Other comprehensive income (loss) | 862 | (5,025) |
| Comprehensive loss | $ (2,553) | $ (14,541) |

See accompanying notes to consolidated financial statements.

**HARVARD BIOSCIENCE, INC.**
**CONSOLIDATED STATEMENTS OF STOCKHOLDERS' EQUITY**
**(In thousands)**

| | Number of Shares Issued | Common Stock | Additional Paid-in Capital | Accumulated Deficit | Accumulated Other Comprehensive Loss | Total Stockholders' Equity |
|---|---|---|---|---|---|---|
| **Balance at December 31, 2021** | 41,143 | $ 452 | $ 225,650 | $ (132,674) | $ (10,027) | $ 83,401 |
| Stock option exercises | 40 | 2 | 106 | - | - | 108 |
| Stock purchase plan | 176 | - | 469 | - | - | 469 |
| Vesting of restricted stock units | 1,135 | - | - | - | - | - |
| Shares withheld for taxes | (412) | - | (1,628) | - | - | (1,628) |
| Stock-based compensation expense | - | - | 4,411 | - | - | 4,411 |
| Net loss | - | - | - | (9,516) | - | (9,516) |
| Other comprehensive loss | - | - | - | - | (5,025) | (5,025) |
| **Balance at December 31, 2022** | 42,082 | 454 | 229,008 | (142,190) | (15,052) | 72,220 |
| Stock option exercises | 214 | - | 506 | - | - | 506 |
| Stock purchase plan | 137 | - | 424 | - | - | 424 |
| Vesting of restricted stock units | 1,460 | - | - | - | - | - |
| Shares withheld for taxes | (498) | - | (2,523) | - | - | (2,523) |
| Stock-based compensation expense | - | - | 5,000 | - | - | 5,000 |
| Net loss | - | - | - | (3,415) | - | (3,415) |
| Other comprehensive income | - | - | - | - | 862 | 862 |
| Other adjustments | - | (20) | 20 | - | - | - |
| **Balance at December 31, 2023** | 43,395 | $ 434 | $ 232,435 | $ (145,605) | $ (14,190) | $ 73,074 |

See accompanying notes to consolidated financial statements.

**HARVARD BIOSCIENCE, INC.**
**CONSOLIDATED STATEMENTS OF CASH FLOWS**
**(In thousands)**

| | Year Ended December 31, | |
|---|---|---|
| | **2023** | **2022** |
| Cash flows from operating activities: | | |
| Net loss | $ (3,415) | $ (9,516) |
| Adjustments to reconcile net loss to net cash provided by operating activities: | | |
| Depreciation | 1,473 | 1,453 |
| Amortization of intangible assets | 5,525 | 6,122 |
| Amortization of deferred financing costs | 280 | 280 |
| Stock-based compensation expense | 5,000 | 4,411 |
| Deferred income taxes and other | 336 | (414) |
| Unrealized loss on equity securities - Note 16 | 632 | - |
| Convertible preferred stock received in litigation settlement - Note 16 | - | (3,900) |
| Gain on sale of product line | (403) | - |
| Changes in operating assets and liabilities: | | |
| Accounts receivable | 810 | 4,780 |
| Inventories | 1,524 | 252 |
| Other assets | 1,651 | 474 |
| Accounts payable and other current liabilities | 555 | (1,399) |
| Contract liabilities | 1,138 | (896) |
| Other liabilities | (1,078) | (495) |
| Net cash provided by operating activities | 14,028 | 1,152 |
| Cash flows from investing activities: | | |
| Additions to property, plant and equipment | (1,788) | (1,590) |
| Capitalized software development costs | (523) | - |
| Proceeds from sale of product line | 512 | - |
| Net cash used in investing activities | (1,799) | (1,590) |
| Cash flows from financing activities: | | |
| Borrowing from revolving line of credit | 4,500 | 7,800 |
| Repayment of revolving line of credit | (10,950) | (6,400) |
| Repayment of term debt | (4,091) | (3,186) |
| Proceeds from exercise of stock options and employee stock purchase plan | 930 | 577 |
| Taxes paid related to net share settlement of equity awards | (2,523) | (1,628) |
| Net cash used in financing activities | (12,134) | (2,837) |
| Effect of exchange rate changes on cash | (320) | (38) |
| Decrease in cash and cash equivalents | (225) | (3,313) |
| Cash and cash equivalents at beginning of period | 4,508 | 7,821 |
| Cash and cash equivalents at end of period | $ 4,283 | $ 4,508 |
| Supplemental disclosures of cash flow information: | | |
| Cash paid for interest | $ 3,795 | $ 2,314 |
| Cash paid for income taxes, net of refunds | $ 207 | $ 534 |

See accompanying notes to consolidated financial statements.

**HARVARD BIOSCIENCE, INC.**
**NOTES TO CONSOLIDATED FINANCIAL STATEMENTS**

## 1. Organization

Harvard Bioscience, Inc., a Delaware corporation (the "Company"), is a leading developer, manufacturer and seller of technologies, products and services that enable fundamental advances in life science applications, including research, pharmaceutical and therapy discovery, bioproduction and preclinical testing for pharmaceutical and therapy development. The Company's products and services are sold globally to customers ranging from renowned academic institutions and government laboratories to the world's leading pharmaceutical, biotechnology and contract research organizations. With operations in the United States, Europe and China, the Company sells through a combination of direct and distribution channels to customers around the world.

## 2. Summary of Significant Accounting Policies

***Principles of Consolidation***

The consolidated financial statements include the accounts of Harvard Bioscience, Inc. and its wholly-owned subsidiaries. All intercompany balances and transactions have been eliminated in consolidation.

***Use of Estimates***

The preparation of financial statements in conformity with generally accepted accounting principles in the United States requires the use of management estimates. Such estimates include the determination and establishment of certain accruals and provisions, including those for income taxes, credit losses on receivables. and defined benefit pension obligations. Estimates are also required to evaluate the value for inventories reported at lower of cost or net realizable value, stock-based compensation expense, and the recoverability of long-lived and intangible assets, including goodwill. On an ongoing basis, the Company reviews its estimates based upon currently available information. Actual results could differ materially from those estimates.

***Cash and Cash Equivalents***

The Company considers all highly liquid instruments with original maturities of three months or less to be cash equivalents. The Company has cash holdings in financial institutions that exceed insured limits for such financial institutions. The Company mitigates this risk by utilizing financial institutions of high credit quality.

Approximately 49% of the Company's cash and cash equivalents at December 31, 2023 was held by the Company's foreign subsidiaries and subject to repatriation tax considerations. These foreign funds were held primarily by subsidiaries in the United Kingdom, Germany and Spain.

***Marketable Equity Securities***

Equity securities traded in active markets are marked to market at each balance sheet date based on prices as quoted on the relevant stock exchange. Fair value mark-to-market adjustments are recorded as non-operating gains (losses) in the consolidated statement of operations. The Company's investments in marketable equity securities are classified in the consolidated balance sheet based on the nature of the securities and their availability for use in current operations.

***Allowance for Expected Credit Losses on Receivables***

The allowance for expected credit losses on receivables is used to present accounts receivable, net, at an amount that represents the Company's estimate of the receivables expected to be collected from customers. The allowance represents an estimate of expected credit losses over the lifetime of the receivables, even if the loss is considered remote, and reflects expected recoveries of amounts previously written off. The Company estimates the allowance on the basis of specifically identified receivables that are evaluated individually for impairment and an analysis of the remaining receivables determined by reference to past default experience. The Company considers the need to adjust historical information to reflect the extent to which current conditions and reasonable forecasts are expected to differ from the conditions that existed for the historical period considered. Losses on receivables have not historically been significant.

Management judgments are used to determine when to charge off uncollectible trade accounts receivable. The Company bases these judgments on the age of the receivable, credit quality of the customer, current economic conditions, and other factors that may affect a customer's ability and intent to pay. Customers are generally not required to provide collateral for purchases.

***Inventories***

The Company values inventories at the lower of cost (determined on a first-in, first-out method) or net realizable value. The Company regularly reviews inventory quantities on hand and writes down excess and obsolete inventories to estimated net realizable value if less than cost, based primarily on historical inventory usage and estimated forecast of product demand.

***Property, Plant and Equipment***

Property, plant and equipment are stated at cost and depreciated using the straight-line method over the estimated useful lives of the assets as follows:

| | |
|---|---|
| Machinery and equipment (years) | 3 - 10 |
| Computer equipment and software (years) | 3 - 7 |
| Furniture and fixtures (years) | 5 - 10 |

Leasehold improvements are amortized using the straight-line method over the shorter of the lease term or estimated useful life of the asset.

***Leases***

The Company leases office space, manufacturing facilities, automobiles and equipment. The Company concludes on whether an arrangement is a lease at inception. This determination as to whether an arrangement contains a lease is based on an assessment as to whether a contract conveys the right for the Company to control the use of the identified property, plant or equipment for a period of time in exchange for consideration. Leases with an initial term of 12 months or less are not recorded on the balance sheet. The Company recognizes these lease expenses on a straight-line basis over the lease term.

The Company has assessed its contracts and concluded that its leases consist of operating leases. Operating leases are included in operating lease right-of-use ("ROU") assets, current portion of operating lease liabilities, and operating lease liabilities in the Company's consolidated balance sheets.

ROU assets represent the Company's right to use an underlying asset for the lease term and lease liabilities represent the Company's obligation to make lease payments arising from the lease. Operating lease ROU assets and liabilities are recognized at the leases' commencement date based on the present value of lease payments over the lease term. As most of the Company's leases do not provide an implicit rate, the Company determines an incremental borrowing rate based on the information available at commencement date in determining the present value of lease payments. The incremental borrowing rate represents a significant judgment that is based on an analysis of the Company's credit rating, country risk, treasury and corporate bond yields, as well as comparison to the Company's borrowing rate on its most recent loan. The Company uses the implicit rate when readily determinable. The Company has lease agreements with lease and non-lease components, which are generally accounted for separately.

***Income Taxes***

Income taxes are accounted for under the asset and liability method. Deferred tax assets and liabilities are recognized for the future tax consequences attributable to differences between the financial statement carrying amounts of existing assets and liabilities and their respective tax bases. Deferred tax assets and liabilities are measured using enacted tax rates expected to be applied to taxable income in the years in which those temporary differences are expected to be recovered or settled. The effect on deferred tax assets and liabilities of a change in tax rates is recognized in income in the period that includes the enactment date. The Company uses the flow-through method to account for investment tax credits. Under this method, the investment tax credits are recognized as a reduction of income tax expense.

The Company recognizes the effect of income tax positions only if those positions are more likely than not of being sustained. Recognized income tax positions are measured at the largest amount that is more than 50% likely of being realized. Changes in recognition are reflected in the period in which the judgement occurs. The Company's policy is to account for Global Intangible Low-Taxed income as a period cost.

***Foreign Currency***

The functional currency of the Company's foreign subsidiaries is generally their local currency. All assets and liabilities of foreign subsidiaries are translated at exchange rates in effect at period-end. Income and expenses are translated at rates which approximate those in effect on the transaction dates. The resulting translation adjustment is recorded as a separate component of stockholders' equity in accumulated other comprehensive income (loss) ("AOCI") in the consolidated balance sheets. Gains and losses resulting from foreign currency transactions are included in other expense (income), net, in the Company's consolidated statements of operations.

***Earnings per Share***

Basic earnings per share is computed by dividing net income by the weighted average number of shares of common stock outstanding during the periods presented. The computation of diluted earnings per share is similar to the computation of basic earnings per share, except that the denominator is increased for the assumed exercise of dilutive options and other potentially dilutive securities using the treasury stock method unless the effect is antidilutive.

The following table sets forth the computation of basic and diluted earnings per share:

| | Year Ended December 31, | |
|---|---|---|
| (in thousands, except per share data) | **2023** | **2022** |
| Net loss | $ (3,415) | $ (9,516) |
| Weighted average shares outstanding - basic | 42,420 | 41,413 |
| Dilutive effect of equity awards | - | - |
| Weighted average shares outstanding - diluted | 42,420 | 41,413 |
| Basic loss per share | $ (0.08) | $ (0.23) |
| Diluted loss per share | $ (0.08) | $ (0.23) |
| Shares excluded from diluted loss per share due to their anti-dilutive effect | 3,868 | 3,661 |

***Comprehensive Income (Loss)***

Comprehensive income (loss) represents the change in equity resulting from items other than shareholder investments and distributions. The Company's foreign currency translation adjustments, interest rate swap - cash flow hedge and minimum pension liability adjustments are included in AOCI. The components of other comprehensive income are reclassified as net income, net of tax, when the underlying component impacts earnings. Comprehensive income (loss) and the components of AOCI are presented in the accompanying consolidated statements of comprehensive loss and consolidated statements of equity.

***Revenue Recognition***

*Nature of contracts and customers*

The Company's contracts are primarily of short duration and are mostly based on the receipt and fulfilment of purchase orders. The purchase orders are binding and include pricing and all other relevant terms and conditions.

The Company's customers are primarily research scientists at pharmaceutical and biotechnology companies, universities, hospitals, government laboratories and contract research organizations. The Company also has global and regional distribution partners, and original equipment manufacturer customers who incorporate its products into their products under their own brands.

*Performance obligations*

The Company's performance obligations under its revenue contracts consist of its instruments, equipment, accessories, services, software licenses and enhancements, maintenance and extended warranties. Equipment also includes software that functions together with the tangible equipment to deliver its essential functionality. Contracts with customers may contain multiple promises such as delivery of hardware, software, professional services or post-contract support services. These promises are accounted for as separate performance obligations if they are distinct. For contracts with customers that contain multiple performance obligations, the transaction price is allocated to the separate performance obligations based on estimated relative standalone selling price, which does not materially differ from the stated price in the contract. In general, the Company's list prices are indicative of standalone selling price, and the majority of the Company's contracts have a term of less than one year.

Instruments, equipment and accessories consist of a range of products that are used in life sciences research. Revenues from the sales of these items are recognized when transfer of control of these products to the customer occurs. Transfer of control occurs when the Company has a right to payment and the customer has legal title to the asset and the customer or their selected carrier has possession, which is typically upon shipment. Sales of these items are therefore generally recognized at a point in time.

The Company's equipment revenue also includes the sale of wireless implantable monitors that are used for life science research purposes. The Company sells these wireless implantable monitors to pharmaceutical companies, contract research organizations and academic laboratories. In addition to sales generated from new and existing customers, these implantable devices are also sold under a program called the "exchange program." Under this program, customers may return an implantable monitor to the Company after use, and if the returned monitor can be reprocessed and resold, they may, in exchange, purchase a replacement implantable monitor of the same model at a lower price than a new monitor. The implantable monitors that are returned by customers are reprocessed and made available for future sale. The initial sale of implantable monitors and subsequent sale of replacement implantable monitors are independent transactions. The Company has no obligation in connection with the initial sale to sell replacement implantable monitors at any future date under any fixed terms and may refuse returned implantable monitors that cannot be recovered or are obsolete. The Company has concluded that the offer to its customers that they may purchase a discounted product in the future is not a material right.

Service revenue consists of installation, training, data analysis and surgeries performed on research animals. Service revenue is recognized when the service is performed. Maintenance revenue consists of post-contract support provided in relation to software that is embedded within the equipment that is sold to the customer. The Company provides standard warranties that promise the customer that the product will work as promised and are not a separate performance obligation. Extended warranties relate to warranties that are separately priced and purchased in addition to a standard warranty, and are therefore a separate performance obligation. The Company has made the judgment that the customer benefits as the Company performs over the period of the contract, and therefore revenues from maintenance and warranty contracts are recognized over time. The Company uses the input method to recognize revenue over time, which is generally on a straight-line basis over the service period.

For sales for which transfer of control occurs upon shipment, the Company accounts for shipping and handling costs as fulfilment costs. As such, the Company records the amounts billed to the customer for shipping costs as revenue and the costs within cost of revenues upon shipment. For sales, for which control transfers to customers after shipment, the Company has elected to account for shipping and handling as activities to fulfill the promise to transfer the goods to the customer. The Company therefore accrues for the costs of shipping undelivered items in the period of shipment.

*Variable Consideration*

The nature of the Company's contracts gives rise to certain types of variable consideration, including in limited cases volume and payment discounts. The Company analyzes sales that could include variable consideration and estimates the expected or most likely amount of revenue after returns, trade-ins, discounts, rebates, credits, and incentives. Product returns are estimated and accrued for, based on historical information. In making these estimates, the Company considers whether the amount of variable consideration is constrained and is included in revenue only to the extent that it is probable that a significant reversal of the revenue recognized will not occur when the uncertainty associated with the variable consideration is subsequently resolved. Variable consideration, and its impact on the Company's revenue recognition, was not material in any of the periods presented.

The Company's payment terms are generally from zero to sixty days from the time of invoicing, which occurs at the time of shipment or prior to services being performed. Payment terms vary by the type of customers and the products or services offered.

Sales taxes, value added taxes, and certain excise taxes collected from customers and remitted to governmental authorities are accounted for on a net basis and are therefore excluded from revenues.

*Contract Liabilities*

The Company records contract liabilities when cash is collected from customers prior to satisfaction of the Company's performance obligation to the customer. Contract liabilities consist of amounts deferred related to service contracts and revenue deferred as a result of payments received in advance from customers. Contract liabilities are generally expected to be recognized within one year.

The amounts included in contract liabilities from advanced payments relate to amounts that are prepaid for wireless implantable monitors under the exchange program. The Company has made the judgment that these payments do not represent a significant financing component as the customer can exercise their discretion as to when they can obtain the products for which they have made a prepayment.

*Disaggregation of revenue*

Refer to Note 13 for revenue disaggregated by type and by geographic location as well as further information about the deferred revenue balances.

***Software Development***

Software development costs for software products to be sold, leased or otherwise marketed that are incurred before establishing technological feasibility are charged to operations. Software development costs incurred after establishing technological feasibility are capitalized on a product-by-product basis until the product is available for general release to customers at which time amortization begins.

Annual amortization, charged to cost of goods sold, is the amount computed using the ratio that current revenues for a product bear to the total current and anticipated future revenues for that product. In the event that future revenues are not estimable, such costs are amortized on a straight-line basis over the remaining estimated economic life of the product.

***Intangible Assets***

Intangible assets are comprised of existing technology, customer contracts and contractual relationships, and other definite-lived intangible assets. Identifiable intangible assets resulting from the acquisitions of entities accounted for using the purchase method of accounting are estimated by the Company based on the fair value of assets received. Identifiable definite-lived intangible assets are being amortized over the period of estimated benefit using the straight-line method and estimated useful lives ranging from four to fifteen years.

***Goodwill***

Goodwill acquired in a business combination and determined to have an indefinite useful life is not amortized, but instead is tested for impairment annually or more frequently if events or changes in circumstances indicate that the asset might be impaired.

For the purpose of its goodwill analysis, the Company has one reporting unit. The Company conducts its annual impairment analysis in the fourth quarter of the fiscal year and more frequently if there is an indicator of impairment. The Company assesses qualitative factors of the reporting unit to determine whether it is more likely than not that the fair value of the reporting unit is less than its carrying value. If the qualitative assessment indicates a potential impairment, a quantitative analysis is performed. The Company compares the fair value of the reporting unit with its carrying amount. The Company typically estimates fair value using the income approach but will also consider market approaches when appropriate. Under the income approach, the Company uses a discounted cash flows model, which indicates the fair value of the reporting unit based on the present value of the cash flows that the Company expects the reporting unit to generate in the future. The Company's significant estimates in the discounted cash flows model include weighted average cost of capital, long-term rate of growth and profitability of the reporting unit, expected income tax rates and working capital effects. If the carrying amount of a reporting unit exceeds its fair value, goodwill is impaired, and the Company would recognize a loss equal to the excess.

The Company evaluated its goodwill for impairment as of October 1, 2023 by performing a qualitative analysis and determined that it was more likely than not that the fair value of the reporting unit exceeded the carrying value.

***Impairment of Long-Lived Assets***

The Company assesses recoverability of its long-lived assets that are held for use, such as property, plant and equipment and amortizable intangible assets when events or changes in circumstances indicate that the carrying amount of an asset or asset group may not be recoverable. Factors which could trigger an impairment review include significant negative industry or economic trends, significant loss of clients, and significant changes in the manner of the Company’s use of the assets or the strategy for its overall business.

The recoverability of assets or an asset group to be held and used is measured by a comparison of the carrying amount of an asset or asset group to estimated undiscounted future cash flows expected to be generated by the asset or the asset group. Cash flow projections are based on trends of historical performance and management’s estimate of future performance. The Company’s estimate of future cash flows requires significant judgment based on historical and anticipated results and are subject to many factors.

When the Company determines that the carrying value of the assets may not be recoverable based upon the existence of one or more of the above indicators of impairment, the Company measures the potential impairment based on a projected discounted cash flow method using a discount rate determined by management to be commensurate with the risk inherent in its current business model. An impairment loss is recognized only if the carrying amount of the asset is not recoverable and exceeds its fair value. Different assumptions and judgments could materially affect the calculation of the fair value of our assets. For the years ended December 31, 2023 and 2022, the Company concluded that there were no triggering events requiring the Company to assess the recoverability of its long-lived assets.

***Derivatives***

The Company uses interest-rate-related derivative instruments to manage its exposure related to changes in interest rates on its variable-rate debt instruments. The Company only enters into derivative contracts that it intends to designate as a hedge of a forecasted transaction or the variability of cash flows to be received or paid related to a recognized asset or liability (cash flow hedge) and does not use derivative financial instruments for trading or speculative purposes. The Company recognizes all derivative instruments as either assets or liabilities in the balance sheet at their respective fair values.

The Company formally documents the hedging relationship and its risk-management objective and strategy for undertaking the hedge, the hedging instrument, the hedged transaction, the nature of the risk being hedged, how the hedging instrument's effectiveness in offsetting the hedged risk will be assessed prospectively and retrospectively, and a description of the method used to measure ineffectiveness. For derivative instruments that are designated and qualify as part of a cash flow hedging relationship, the effective portion of the gain or loss on the derivative is reported as a component of other comprehensive income (loss) ("OCI") and reclassified into earnings in the same period or periods during which the hedged transaction affects earnings. Gains and losses on the derivative representing either hedge ineffectiveness or hedge components excluded from the assessment of effectiveness are recognized in current earnings.

By using derivative financial instruments to hedge exposure to changes in interest rates, the Company exposes itself to credit risk and market risk. Credit risk is the failure of the counterparty to perform under the terms of the derivative contract. When the fair value of a derivative contract is positive, the counterparty owes the Company, which creates credit risk for the Company. When the fair value of a derivative contract is negative, the Company owes the counterparty and, therefore, the Company is not exposed to the counterparty's credit risk in those circumstances. The Company minimizes counterparty credit risk in derivative instruments by entering into transactions with major financial institutions based upon their credit profile. Market risk is the adverse effect on the value of a derivative instrument that results from a change in interest rates. The market risk associated with interest-rate contracts is managed by establishing and monitoring parameters that limit the types and degree of market risk that may be undertaken. The Company monitors interest rate risk attributable to both its outstanding and forecasted debt obligations by the use of cash flow sensitivity analysis, which estimates the expected impact of changes in interest rates on the Company's future cash flows.

***Fair Value of Financial Instruments***

Financial reporting standards define a fair value hierarchy that consists of three levels:

- Level 1 includes instruments for which quoted prices in active markets for identical assets or liabilities accessible to the Company at the measurement date.

- Level 2 includes instruments for which the valuations are based on quoted prices for similar assets or liabilities, quoted prices in markets that are not active, or other inputs that are observable or can be corroborated by observable data for substantially the full term of the assets or liabilities.

- Level 3 includes valuations based on inputs that are unobservable and significant to the overall fair value measurement.

The carrying values of the Company's cash and cash equivalents, trade accounts receivable, trade accounts payable and short-term debt approximate their fair values because of the short maturities of those instruments. The fair value of the Company's long-term debt approximates its carrying value and is based on the amount of future cash flows associated with the debt discounted using current borrowing rates for similar debt instruments of comparable maturity (Level 2).

***Stock-based Compensation***

The Company recognizes compensation expense for all stock-based payment awards made to employees and directors including stock options, restricted stock units, and restricted stock units with a market condition. The Company issues awards under the 2021 Incentive Plan (the "2021 Incentive Plan") and the Fourth Amended and Restated 2000 Stock Option and Incentive Plan (the "2000 Incentive Plan" and together with the 2021 Incentive Plan, the "Incentive Plans"), as well as issues shares for employee stock purchases related to its Employee Stock Purchase Plan (as amended, the "ESPP"). The Company issues new shares from its registered but unissued stock pool to satisfy stock option exercises and vesting of the restricted stock units. Stock-based compensation expense is recorded on a straight-line basis over the applicable service period, which ranges from one to four years. The Company has elected as an accounting policy to account for forfeitures for service-based awards as they occur, with no adjustment for estimated forfeitures.

The fair value of restricted stock units is based on the market price of the Company's stock on the date of grant. The Company values restricted stock units with a market condition using a Monte-Carlo valuation simulation. The determination of fair value of stock-based payment awards on the date of grant using a Monte-Carlo valuation simulation is affected by the Company's stock price as well as assumptions regarding certain variables including, but are not limited to, the Company's expected stock price volatility over the term of the awards, interest rate assumptions, and discounts to adjust for any holding period post-vest restrictions.

***Preferred Stock***

The Company's board of directors has the authority to issue up to 5.0 million shares of preferred stock and to determine the price privileges and other terms of the shares. The board of directors may exercise this authority without any further approval from stockholders. As of December 31, 2023 and 2022, the Company had no preferred stock issued or outstanding.

***Business Segment Information***

The Company operates in one segment which involves the design, development, production and distribution of products and services that enable fundamental advances in life science applications, including research, pharmaceutical and therapy discovery, bioproduction and preclinical testing for pharmaceutical and therapy development. The Company has a single, company-wide management team that administers all properties as a whole rather than as discrete operating segments. The chief operating decision maker, who is the Company's chief executive officer, measures financial performance as a single enterprise and allocates resources across the Company to maximize profitability, and not on geography, legal entity, or end market basis. The Company operates in a number of countries throughout the world in a variety of product lines. Information regarding product lines and geographic financial information is provided in Note 13, “Revenues” and Note 5, "Balance Sheet Information."

***Commitments and Contingencies***

Liabilities for loss contingencies arising from claims, assessments, litigation, fines and penalties, and other sources are recorded when it is probable that a liability has been incurred and the amount of the assessment can be reasonably estimated. If a loss is reasonably possible and the loss or range of loss can be reasonably estimated, the Company discloses the possible loss. If a loss is probable and the loss or range of loss cannot be reasonably estimated, the Company discloses or states that such an estimate cannot be made. Refer to Note 15 Commitments and Contingencies for additional information. The Company accrues and expenses legal costs associated with contingencies when incurred.

***Recent Accounting Pronouncements***

*Accounting Pronouncements Adopted in 2023*

In January 2017, the Financial Accounting Standards Board (“FASB”) issued Accounting Standards Update (“ASU”) ASU 2017-04, *Intangibles—Goodwill and Other (Topic 350)*: Simplifying the Test for Goodwill Impairment (ASU 2017-04), which eliminates the performance of Step 2 from the goodwill impairment test. In performing its annual or interim impairment testing, an entity will instead compare the fair value of the reporting unit with its carrying amount and recognize any impairment charge for the amount by which the carrying amount exceeds the reporting unit’s fair value. Additionally, an entity should consider income tax effects from any tax-deductible goodwill on the carrying amount of the reporting unit when measuring the goodwill impairment loss. The Company adopted ASU 2017-04 effective January 1, 2023, with no impact to the consolidated financial statements.

In September 2016, the FASB issued ASU No. 2016-13, *Financial Instruments—Credit Losses (Topic 326)*: Measurement of Credit Losses on Financial Instruments (ASU 2016-13), which amends the impairment model by requiring entities to use a forward-looking approach based on expected losses rather than incurred losses to estimate credit losses on certain types of financial instruments, including trade receivables. This may result in the earlier recognition of allowances for losses. The FASB issued several ASUs after ASU 2016-13 to clarify implementation guidance and to provide transition relief for certain entities. The Company adopted ASU 2016-13 effective January 1, 2023, which resulted in an immaterial impact to the consolidated financial statements.

*Accounting Pronouncements yet to be Adopted*

In December 2023, the FASB issued ASU No. 2023-09, *Income Taxes (Topic 740): Improvements to Income Tax*, which enhances disclosures related to the effective tax rate reconciliation, income taxes paid, as well as other disclosures. The new standard impacts footnote disclosures and is effective for the Company’s annual financial statements for the year ended December 31, 2025. The Company is currently evaluating the potential impact of adopting ASU 2023-09 will have on the disclosures in its consolidated financial statements.

***Prior Period Financial Statement Reclassifications***

During the year ended December 31, 2023, the Company identified immaterial misclassification errors in the financial statement footnote describing the components of AOCI as of December 31, 2022 and 2021. These misclassifications overstated the amount attributed to the defined benefit pension plans, net of tax, by $5.4 million and $5.1 million and understated the amount attributed to foreign currency translation adjustments by $(5.4) million and $(5.1) million as of December 31, 2022 and 2021, respectively. These misclassifications had no impact on total OCI for the year ended December 31, 2022, included in the consolidated statements of comprehensive loss, or the total AOCI included in the consolidated balance sheets as of December 31, 2022, and also had no impact on any of the Company’s previously reported consolidated statements of operations, stockholders’ equity, or cash flows. The correction of these offsetting misclassifications is included in these consolidated financial statements. See Note 3 below for further details.

### 3. Accumulated Other Comprehensive Loss

Changes in the components of accumulated other comprehensive loss, net of tax, for the years ended December 31, 2023 and 2022, respectively, are as follows:

| (in thousands) | Foreign Currency Translation Adjustments | Defined Benefit Pension Plans | Derivatives Qualifying as Hedges | Total |
|---|---|---|---|---|
| **Balance at December 31, 2021*** | $ (8,778) | $ (1,249) | $ - | $ (10,027) |
| Other comprehensive loss, net | (2,614) | (2,411) | - | (5,025) |
| **Balance at December 31, 2022*** | (11,392) | (3,660) | - | (15,052) |
| Other comprehensive income (loss), net | 1,507 | (446) | (199) | 862 |
| **Balance at December 31, 2023** | $ (9,885) | $ (4,106) | $ (199) | $ (14,190) |

* See Note 2 – *Prior Period Financial Statement Reclassifications*

### 4. Goodwill and Intangible Assets

The change in the carrying amount of goodwill is as follows:

| | December 31, | |
|---|---|---|
| (in thousands) | 2023 | 2022 |
| Carrying amount at beginning of period | $ 56,260 | $ 57,689 |
| Effect of change in currency translation | 805 | (1,429) |
| Carrying amount at end of period | $ 57,065 | $ 56,260 |

Intangible assets at December 31, 2023 and 2022 consist of the following:

| | | December 31, 2023 | | | December 31, 2022 | | |
|---|---|---|---|---|---|---|---|
| (in thousands) | Average | | Accumulated | | | Accumulated | |
| Amortizable intangible assets: | Life* | Gross | Amortization | Net | Gross | Amortization | Net |
| Distribution agreements/customer relationships | 6 | $ 16,038 | $ (9,706) | $ 6,332 | $ 16,124 | $ (8,727) | $ 7,397 |
| Existing technology & software development | 2 | 35,007 | (27,029) | 7,978 | 37,549 | (26,482) | 11,067 |
| Trade names and patents | 3 | 7,613 | (6,094) | 1,519 | 7,523 | (5,197) | 2,326 |
| Total amortizable intangible assets | | $ 58,658 | $ (42,829) | $ 15,829 | $ 61,196 | $ (40,406) | $ 20,790 |
| Indefinite-lived intangible assets: | | | | 207 | | | 224 |
| Total intangible assets | | | | $ 16,036 | | | $ 21,014 |

* Weighted average life in years as of December 31, 2023

During the year ended December 31, 2023, the Company wrote off approximately $3.7 million of fully amortized intangible assets of certain existing technology and other intangibles related to discontinued product lines. The Company capitalized $0.5 million of software development costs during the year ended December 31, 2023.

Intangible asset amortization expense was $5.5 million and $6.1 million for the years ended December 31, 2023 and 2022, respectively. Estimated amortization expense of existing amortizable intangible assets for each of the five succeeding years and thereafter is as follows:

| (in thousands) | |
|---|---|
| 2024 | $ 5,281 |
| 2025 | 4,027 |
| 2026 | 2,366 |
| 2027 | 1,269 |
| 2028 | 1,546 |
| Thereafter | 1,340 |
| Total | $ 15,829 |

## 5. Balance Sheet Information

The following tables provide details of selected balance sheet items as of the periods indicated:

| ***Inventories:*** | December 31, | |
|---|---|---|
| (in thousands) | **2023** | **2022** |
| Finished goods | $ 5,120 | $ 5,223 |
| Work in process | 4,188 | 3,776 |
| Raw materials | 15,408 | 17,440 |
| Total | $ 24,716 | $ 26,439 |

| ***Property, Plant and Equipment:*** | December 31, | |
|---|---|---|
| (in thousands) | **2023** | **2022** |
| Machinery and equipment | $ 8,154 | $ 7,500 |
| Computer equipment and software | 6,493 | 6,781 |
| Leasehold improvements | 2,417 | 2,507 |
| Furniture and fixtures | 1,244 | 1,386 |
| Automobiles | 58 | 38 |
| | 18,366 | 18,212 |
| Less: accumulated depreciation | (14,385) | (14,846) |
| Property, plant and equipment, net | $ 3,981 | $ 3,366 |

Depreciation expense was $1.5 million for each of the years ended December 31, 2023 and 2022. During the year ended December 31, 2023, the Company wrote off approximately $2.0 million of fully depreciated property and equipment from its fixed asset records.

| ***Other Current Liabilities:*** | December 31, | |
|---|---|---|
| (in thousands) | **2023** | **2022** |
| Compensation | $ 3,929 | $ 3,476 |
| Customer credits | 3,201 | 2,368 |
| Professional fees | 499 | 392 |
| Warranty costs | 336 | 268 |
| Other | 1,240 | 982 |
| Total | $ 9,205 | $ 7,486 |

***Long-lived Assets by Geographic Area:***

Long-lived assets by geographic area, which include operating lease right-of-use assets, property, plant and equipment, and amortizable intangible assets, are as follows:

| | December 31, | |
|---|---|---|
| (in thousands) | **2023** | **2022** |
| United States | $ 21,558 | $ 26,051 |
| Germany | 1,703 | 2,432 |
| Rest of the world | 1,322 | 1,489 |
| Total long-lived assets | $ 24,583 | $ 29,972 |

## 6. Restructuring and Other Exit Costs

On an ongoing basis, the Company reviews the global economy, the healthcare industry, and the markets in which it competes to identify operational efficiencies, enhance commercial capabilities and align its cost base and infrastructure with customer needs and its strategic plans. In order to realize these opportunities, the Company undertakes activities from time to time to transform its business. A portion of these transformation activities are considered restructuring costs under ASC 420, *Exit or Disposal Cost Obligations*, and are discussed below.

During the year ended December 31, 2022, the Company reviewed its product portfolio and identified certain non-strategic products for discontinuation and incurred severance expenses in connection with headcount reductions in Europe and North America. The following table summarizes the restructuring activity for the years ended December 31, 2023 and 2022:

| (in thousands) | Inventory Related | Severance | Other | Total |
|---|---|---|---|---|
| Balance at December 31, 2021 | $ - | $ - | $ - | $ - |
| Restructuring and other exit costs | 1,471 | 877 | 46 | 2,394 |
| Non-cash charges | (1,471) | - | - | (1,471) |
| Cash payments | - | (241) | (46) | (287) |
| Balance at December 31, 2022 | - | 636 | - | 636 |
| Restructuring and other exit costs | 320 | 42 | 29 | 391 |
| Non-cash charges | (142) | - | - | (142) |
| Cash payments | (94) | (678) | (29) | (801) |
| Balance at December 31, 2023 | $ 84 | $ - | $ - | $ 84 |

Substantially all of the severance and other costs detailed above have been included as a component of general and administrative expenses, and all inventory-related charges are included in cost of revenues.

## 7. Employee Benefit Plans

*Employee Retirement Savings Plans*

The Company sponsors various qualified employee retirement savings plans and makes discretionary contributions to match a certain portion of employee contributions. The Company contributed $1.1 million to these plans for each of the years ended December 31, 2023 and 2022.

*Employee Pension Plans*

The Company's subsidiary in the United Kingdom, Biochrom Ltd., maintains two defined benefit pension plans for its employees. In 2014, these defined benefit pension plans were closed to new employees, as well as closed to the future accrual of benefits for existing employees. The Company recognizes the funded status of the pension plans as an asset or liability in the consolidated balance sheets. The funded status equals the difference between the fair value of the plan's assets and their benefit obligations and has historically measured each year as of December 31. The Company records net period benefit expense (credit) as a component of other expense in the Consolidated Statement of Operations.

The components of the Company's net period benefit expense (credit) were as follows:

| | Year Ended December 31, | |
|---|---|---|
| (in thousands) | 2023 | 2022 |
| Interest cost | $ 670 | $ 371 |
| Expected return on plan assets | (788) | (818) |
| Net amortization loss | 328 | 27 |
| Net periodic benefit expense (credit) | $ 210 | $ (420) |

The following provides a reconciliation of the changes in the plans' fair value of assets and benefit obligations for the years ended December 31, 2023 and 2022, and a summary of the funded status as of December 31, 2023 and 2022:

| | December 31, | |
|---|---|---|
| (in thousands) | 2023 | 2022 |
| Change in fair value of plan assets: | | |
| Balance at beginning of year | $ 15,576 | $ 27,252 |
| Actual return on plan assets | 351 | (9,098) |
| Employer contributions | 622 | 619 |
| Benefits paid | (563) | (592) |
| Currency translation adjustment | 954 | (2,605) |
| Balance at end of year | $ 16,940 | $ 15,576 |

| | December 31, | |
|---|---|---|
| (in thousands) | 2023 | 2022 |
| Change in benefit obligation: | | |
| Balance at beginning of year | $ 13,263 | $ 22,562 |
| Interest cost | 665 | 371 |
| Actuarial loss (gain) | 479 | (6,912) |
| Benefits paid | (563) | (592) |
| Currency translation adjustment | 819 | (2,166) |
| Balance at end of year | $ 14,663 | $ 13,263 |

| | December 31, | |
|---|---|---|
| (in thousands) | 2023 | 2022 |
| Fair value of plan assets | $ 16,940 | $ 15,576 |
| Benefit obligation | 14,663 | 13,263 |
| Net funded status | $ 2,277 | $ 2,313 |

Changes in the actuarial loss (gain) disclosed above are primarily the result of changes in the discount rate and inflation assumptions due to underlying market conditions.

The amounts recognized in the consolidated balance sheets consist of:

| | December 31, | |
|---|---|---|
| (in thousands) | 2023 | 2022 |
| Other long-term assets | $ 2,277 | $ 2,313 |
| Accumulated other comprehensive loss | 5,909 | 5,326 |

The weighted average assumptions used in determining the net pension cost for these plans follows:

| | December 31, | |
|---|---|---|
| (in thousands) | 2023 | 2022 |
| Discount rate | 4.6% | 5.0% |
| Expected return on assets | 5.3% | 5.0% |

The discount rate assumptions used for pension accounting reflect the prevailing rates available on high-quality, fixed-income debt instruments with terms that match the average expected duration of the Company's defined benefit pension plan obligations.

The Company's mix of pension plan investments among asset classes also affects the long-term expected rate of return on plan assets. As of December 31, 2023, the Company's actual asset mix approximated its target mix. Differences between actual and expected returns are recognized in the calculation of net periodic pension cost over the average remaining expected future working lifetime, which is approximately 7 years for active plan participants.

The asset allocations and fair value of the Company's pension benefits as of December 31, 2023 and 2022, were as follows:

| (in thousands) | 2023 | | 2022 | |
|---|---|---|---|---|
| Asset category: | | | | |
| Debt securities | $ 11,761 | 69% | $ 11,714 | 75% |
| Equity securities | 3,567 | 21% | 3,507 | 23% |
| Cash and cash equivalents | 304 | 2% | 185 | 1% |
| Other | 1,308 | 8% | 170 | 1% |
| Total | $ 16,940 | 100% | $ 15,576 | 100% |

| (in thousands) | 2023 | 2022 |
|---|---|---|
| Quoted Prices in Active Markets for Identical Assets (Level 1) | $ 304 | $ 185 |
| Significant Other Observable Inputs (Level 2) | 16,636 | 15,391 |
| Significant Other Unobservable Inputs (Level 3) | - | - |
| Total | $ 16,940 | $ 15,576 |

Level 1 assets consist of cash and cash equivalents held in the pension plans. The Level 2 assets primarily consist of investments in private investment funds that are valued using the net asset values provided by the trust or fund, including an insurance contract. Although these funds are not traded in an active market with quoted prices, the investments underlying the net asset value are based on quoted prices.

The Company expects to contribute approximately $0.6 million to its pension plans during 2024. The benefits expected to be paid from the pension plans are $0.9 million in 2024, $0.7 million in 2025, $0.8 million in 2026, $1.0 million in 2027 and $0.8 million in 2028. The expected benefits to be paid in the five years from 2029 to 2033 are $5.0 million. The expected benefits are based on the same assumptions used to measure the Company's benefit obligations at December 31, 2023.

## 8. Leases

The Company has noncancelable operating leases for office space, manufacturing facilities, warehouse space, automobiles and equipment expiring at various dates through 2030.

The components of lease expense for the years ended December 31, 2023 and 2022, are as follows:

| | Year Ended December 31, | |
|---|---|---|
| (in thousands) | 2023 | 2022 |
| Operating lease cost | $ 2,013 | $ 1,971 |
| Short-term lease cost | 199 | 233 |
| Sublease income | (102) | (102) |
| Total lease cost | $ 2,110 | $ 2,102 |

Supplemental balance sheet information related to the Company's operating leases was as follows:

| (in thousands) | December 31, | |
|---|---|---|
| | 2023 | 2022 |
| Operating lease right-of-use assets | $ 4,773 | $ 5,816 |
| Current portion, operating lease liabilities | 1,416 | 2,135 |
| Operating lease liabilities, long-term | 4,794 | 5,282 |
| Total operating lease liabilities | $ 6,210 | $ 7,417 |
| Weighted average remaining lease term (years) | 5.7 | 6.2 |
| Weighted average discount rate | 9.5% | 9.4% |

Supplemental cash flow information related to the Company's operating leases was as follows:

| (in thousands) | Year Ended December 31, 2023 | 2022 |
|---|---|---|
| Cash paid for amounts included in the measurement of lease liabilities | $ 2,367 | $ 2,347 |
| Right-of-use assets obtained in exchange for lease obligations | 293 | 295 |

Future minimum lease payments for operating leases, with initial terms in excess of one year at December 31, 2023, are as follows:

| Year Ending December 31, (in thousands) | |
|---|---|
| 2024 | 1,938 |
| 2025 | 1,166 |
| 2026 | 1,060 |
| 2027 | 1,047 |
| 2028 | 1,057 |
| Thereafter | 1,926 |
| Total lease payments | 8,194 |
| Less imputed interest | (1,984) |
| Total operating lease liabilities | $ 6,210 |

## 9. Long-Term Debt

As of December 31, 2023 and 2022, the Company's borrowings were comprised of the following:

| (in thousands) | December 31, 2023 | December 31, 2022 |
|---|---|---|
| Long-term debt: | | |
| Term loan | $ 30,723 | $ 34,814 |
| Revolving line | 6,400 | 12,850 |
| Less: unamortized deferred financing costs | (560) | (840) |
| Total debt | 36,563 | 46,824 |
| Less: current portion of long-term debt | (6,139) | (4,091) |
| Current unamortized deferred financing costs | 280 | 280 |
| Long-term debt | $ 30,704 | $ 43,013 |

The aggregate amounts of debt maturities are as follows:

| (in thousands) | |
|---|---|
| 2024 | $ 6,139 |
| 2025 | 30,984 |
| | $ 37,123 |

On December 22, 2020, the Company entered into a Credit Agreement (the "Credit Agreement") with Citizens Bank, N.A., Wells Fargo Bank, National Association, and Silicon Valley Bank, (together, the "Lenders"). Effective March 27, 2023, all commitments and obligations under the Credit Agreement previously held by Silicon Valley Bank were assumed by First Citizens Bank & Trust Company. The Credit Agreement provides for a term loan of $40.0 million and a $25.0 million senior revolving credit facility (including a $10.0 million sub-facility for the issuance of letters of credit and a $10.0 million swingline loan sub-facility) (collectively, the "Credit Facility"). The Company's obligations under the Credit Agreement are guaranteed by certain of the Company's direct, domestic wholly-owned subsidiaries; none of the Company's direct or indirect foreign subsidiaries has guaranteed the Credit Facility. The Company's obligations under the Credit Agreement are secured by substantially all of the assets of Harvard Bioscience, Inc. and each guarantor (including all or a portion of the equity interests in certain of the Company's domestic and foreign subsidiaries). The Credit Facility matures on December 22, 2025. Issuance costs of $1.4 million are amortized over the contractual term to maturity date on a straight-line basis, which approximates the effective interest method. Available and unused borrowing capacity under the revolving line of credit was $10.8 million as of December 31, 2023, based on the Credit Agreement, as amended pursuant to the April 2022 Amendment and November 2022 Amendment as described below. Total revolver borrowing capacity is limited by the consolidated net leverage ratio as defined under the amended Credit Agreement.

Borrowings under the amended Credit Facility will, at the option of the Company, bear interest at either (i) a rate per annum based on the Secured Overnight Financing Rate ("SOFR") for an interest period of one, two, three or six months, plus an applicable interest rate margin determined as provided in the Credit Agreement, as amended (a "SOFR Loan"), or (ii) an alternative base rate plus an applicable interest rate margin, each as determined as provided in the Credit Agreement (an "ABR Loan"). SOFR interest under the Credit Agreement is subject to applicable market rates and a floor of 0.50%. The alternative base rate is based on the Citizens Bank prime rate or the federal funds effective rate of the Federal Reserve Bank of New York and is subject to a floor of 1.0%. The applicable interest rate margin varies from 2.0% per annum to 3.25% per annum for SOFR Loans, and from 1.5% per annum to 3.0% per annum for ABR Loans, in each case depending on the Company's consolidated leverage ratio and is determined in accordance with a pricing grid set forth in the Credit Agreement. Interest on SOFR Loans is payable in arrears on the last day of each applicable interest period, and interest on ABR Loans is payable in arrears at the end of each calendar quarter. There are no prepayment penalties in the event the Company elects to prepay and terminate the Credit Facility prior to its scheduled maturity date, subject to SOFR Loan breakage and redeployment costs in certain circumstances.

The effective interest rate on the Company's borrowings for the years ended December 31, 2023 and 2022, was 8.1% and 5.0%, respectively. The weighted average interest rate as of December 31, 2023, inclusive of the effect of the Company's interest rate swaps, was 7.4%. The carrying value of the debt approximates fair value because the interest rate under the obligation approximates market rates of interest available to the Company for similar instruments.

As of December 31, 2023, the term loan amortizes in quarterly installments of $1.0 million with a balloon payment at maturity. Furthermore, within ninety days after the end of the Company's fiscal year, the term loans may be permanently reduced pursuant to certain mandatory prepayment events including an annual "excess cash flow sweep", as defined in the agreement; provided that, in any fiscal year, any voluntary prepayments of the term loans shall be credited against the Company's "excess cash flow" prepayment obligations on a dollar-for-dollar basis for such fiscal year. As of December 31, 2023, the current portion of long-term debt includes an excess cash flow sweep of $2.1 million to be paid by March 31, 2024. As of December 31, 2022, the current portion of long-term debt included an excess cash flow sweep of $1.1 million which was paid on March 31, 2023. Amounts outstanding under the revolving credit facility can be repaid at any time but are due in full at maturity.

The Credit Agreement, as amended, includes customary affirmative, negative, and financial covenants binding on the Company. The negative covenants limit the ability of the Company, among other things, to incur debt, incur liens, make investments, sell assets and pay dividends on its capital stock. The financial covenants include a maximum consolidated net leverage ratio and a minimum consolidated fixed charge coverage ratio. The Credit Agreement, as amended, also includes customary events of default.

In April 2022, the Company entered into an amendment to the Credit Agreement (the "April 2022 Amendment") which modified, among other things, the financial covenant relating to the consolidated net leverage ratio, and provided consent for the HRGN Settlement (as defined in Note 16). In November 2022, the Company entered into a subsequent amendment to the Credit Agreement which modified, among other things, the financial covenant relating to the consolidated net leverage ratio, and the definition of Consolidated EBITDA used in the calculation of certain financial covenants (the "November 2022 Amendment"). The Company was in compliance with the covenants of the Credit Agreement, as amended, as of December 31, 2023.

## 10. Derivatives

On February 28, 2023, the Company entered into an interest rate swap contract to improve the predictability of cash flows from interest payments related to its variable, SOFR-based debt. The swap contract has a notional amount of $27.4 million as of December 31, 2023, and matures on December 22, 2025. This swap contract effectively converts the SOFR-based variable portion of the interest payable under the Credit Agreement into fixed-rate debt at an annual rate of 4.75%. The swap contract does not impact the additional interest related to the applicable interest rate margin as discussed above in Note 9, Long-Term Debt. The swap contract is considered an effective cash flow hedge, and as a result, net gains or losses are reported as a component of OCI in the consolidated financial statements and are reclassified as net income when the underlying hedged interest impacts earnings. An assessment is performed quarterly to evaluate the ongoing hedge effectiveness.

The following table presents the notional amount and fair value of the Company's derivative instrument as of December 31, 2023:

| (in thousands) | | December 31, 2023 | |
|---|---|---|---|
| **Derivatives Instruments** | **Balance Sheet Classification** | **Notional Amount** | **Fair Value (a)** |
| Interest rate swap | Other long-term liabilities | $ 27,375 | $ (199) |

(a) See Note 11 for the fair value measurements related to this financial instrument.

The following table summarizes the effect of derivatives designated as cash flow hedging instruments for the year ended December 31, 2023:

| **Derivatives Qualifying as Hedges, net of tax** (in thousands) | **Year Ended December 31, 2023** |
|---|---|
| Amount of loss recognized in OCI on derivatives (effective portion) | $ 199 |
| Amounts reclassified from accumulated other comprehensive loss to interest expense | 120 |

## 11. Fair Value Measurements

The following tables present the fair value hierarchy for those assets or liabilities measured at fair value on a recurring basis:

| | **Fair Value as of December 31, 2023** | | | |
|---|---|---|---|---|
| **Assets (Liabilities)** (in thousands) | **Level 1** | **Level 2** | **Level 3** | **Total** |
| Equity securities - common stock | $ 3,511 | $ - | $ - | $ 3,511 |
| Interest rate swap agreements | - | (199) | - | (199) |

The Company uses the market approach technique to value its financial assets and liabilities. The Company's financial assets and liabilities carried at fair value include, when applicable, investments in common stock and derivative instruments used to hedge the Company's interest rate risks. The fair value of the Company's investment in common stock of Harvard Apparatus Regenerative Technologies ("HRGN" formerly known as Biostage, Inc.) (see Note 16 for information regarding the HRGN Settlement) was based on the closing price as quoted on the OTCQB Marketplace at the reporting date. The fair value of the Company's interest rate swap agreements was based on SOFR-yield curves at the reporting date.

## 12. Stock-Based Compensation

Stock-based compensation expense for the years ended December 31, 2023 and 2022, is allocated as follows:

| | **Year Ended December 31,** | |
|---|---|---|
| (in thousands) | **2023** | **2022** |
| Cost of revenues | $ 308 | $ 121 |
| Sales and marketing expenses | 746 | 557 |
| General and administrative expenses | 3,560 | 3,487 |
| Research and development expenses | 386 | 246 |
| Total stock-based compensation expenses | $ 5,000 | $ 4,411 |

As of December 31, 2023, the total compensation costs related to unvested awards not yet recognized is $4.7 million and the weighted average period over which it is expected to be recognized is approximately 1.6 years. During the years ended December 31, 2023 and 2022, the Company did not capitalize any stock-based compensation.

***Equity Incentive Plans***

During 2021, the Company's board of directors and stockholders adopted the 2021 Incentive Plan which authorized additional shares available for grants to officers, employees, non-employee directors and other key persons of the Company and its subsidiaries. As of December 31, 2023, there were approximately 3.1 million shares available for issuance under the 2021 Incentive Plan.

***Restricted Stock Units with a Market Condition***

The Company grants deferred awards of market condition restricted stock units (the "Market Condition RSUs") to certain members of the Company's management team. The vesting of the Market Condition RSUs is linked to the achievement of a relative total shareholder return ("TSR") of the Company's common stock measured from the earlier of (i) the measurement period as set out in the award agreement or (ii) upon a change of control (measured relative to the Nasdaq Biotechnology or Russell 2000 index and based on a 20-day trading average price) and is subject to a one-year holding period after vesting.

For Market Condition RSUs with a measurement period that concluded during the years ended December 31, 2023, the TSR of the Company's common stock relative to the applicable index resulted in achieving 100% of the target. Market Condition RSUs outstanding as of December 31, 2023 remain subject to a TSR measurement which can result in vesting rates ranging from 0% to 150% of the target number.

The weighted average assumptions used in the valuation of the Market Condition RSUs granted during the years ended December 31, 2023 and 2022, are as follows:

| | 2023 | 2022 |
|---|---|---|
| Volatility | 56.8% | 62.6% |
| Risk-free interest rate | 4.6% | 2.1% |
| Correlation coefficient | 41.7% | 41.5% |
| Dividend yield | -% | -% |
| Liquidity discount | 14.1% | 11.7% |

The Company used historical volatility to calculate the expected volatility matching the expected holding period. The risk-free interest rate assumption is based upon observed U.S. Treasury bill interest rates (risk-free) appropriate for the term of the award. Additionally, the Company assumes a liquidity discount to adjust the fair value for the one-year holding period post-vest restrictions.

***Stock-Based Payment Awards***

RSU and Market Condition RSU activity for the years ended December 31, 2023 and 2022, is as follows:

| | Restricted Stock Units | Grant Date Fair Value | Condition Restricted Stock Units | Grant Date Fair Value |
|---|---|---|---|---|
| Balance at December 31, 2021 | 1,141,164 | $ 3.57 | 860,155 | $ 3.13 |
| Granted | 918,870 | 4.64 | 320,272 | 5.08 |
| Vested | (733,611) | 4.08 | (401,308) | 2.11 |
| Cancelled/Forfeited | (232,622) | 4.44 | (132,884) | 4.21 |
| Balance at December 31, 2022 | 1,093,801 | $ 3.94 | 646,235 | $ 4.51 |
| Granted | 1,350,125 | 2.87 | 558,958 | 2.61 |
| Vested | (1,144,065) | 3.38 | (316,210) | 4.01 |
| Cancelled/Forfeited | (134,865) | 3.71 | (87,138) | 4.64 |
| Balance at December 31, 2023 | 1,164,996 | $ 3.28 | 801,845 | $ 3.37 |

Stock option activity for the years ended December 31, 2023 and 2022, is as follows:

| | Number of Options | Weighted-Average Exercise Price | Weighted-Aveage Remaining Contractual Term (years) | Average Intrinsic Value (in thousands) |
|---|---|---|---|---|
| Outstanding at December 31, 2021 | 1,404,816 | $ 3.10 | | |
| Exercised | (40,267) | 2.64 | | |
| Cancelled/Forfeited | (125,773) | 2.77 | | |
| Outstanding at December 31, 2022 | 1,238,776 | $ 3.15 | | |
| Exercised | (213,644) | 2.38 | | |
| Cancelled/Forfeited | (101,065) | 2.71 | | |
| Outstanding and Exerciseable at December 31, 2023 | 924,067 | $ 3.37 | 3.4 | $ 1,836 |

The aggregate intrinsic value in the preceding table represents the total pre-tax intrinsic value, based on the Company's closing stock price of $5.35 as of December 31, 2023, which would have been received by the option holders had all option holders exercised their options as of that date. The aggregate intrinsic value of options exercised was $0.6 million and $0.1 million for the years ended December 31, 2023 and 2022, respectively.

***Employee Stock Purchase Plan ("ESPP")***

The Company has an employee stock purchase plan under which eligible employees may purchase a limited number of shares of common stock at a discount of up to 15% of the market value of such stock at pre-determined and plan-defined dates. There were 0.1 million and 0.2 million shares issued under the ESPP during the years ended December 31, 2023 and 2022, respectively. As of December 31, 2023, there were 0.3 million shares available for issuance under the ESPP.

## 13. Revenues

The following table represents a disaggregation of revenue from contracts with customers for the years ended December 31, 2023 and 2022:

| | Year Ended December 31, | |
|---|---|---|
| (in thousands) | 2023 | 2022 |
| Instruments, equipment, software and accessories | $ 105,716 | $ 108,165 |
| Service, maintenance and warranty contracts | 6,534 | 5,170 |
| Total revenues | $ 112,250 | $ 113,335 |

Revenues by timing of recognition are as follows:

| | Year Ended December 31, | |
|---|---|---|
| (in thousands) | 2023 | 2022 |
| Goods and services transferred at a point in time | $ 108,558 | $ 111,927 |
| Goods and services transferred over time | 3,692 | 1,408 |
| Total revenues | $ 112,250 | $ 113,335 |

Revenues by geographic destination are as follows:

| | Year Ended December 31, | |
|---|---|---|
| (in thousands) | 2023 | 2022 |
| United States | $ 48,205 | $ 49,912 |
| Europe | 32,801 | 30,687 |
| Greater China | 18,488 | 16,393 |
| Rest of the world | 12,756 | 16,343 |
| Total revenues | $ 112,250 | $ 113,335 |

***Contract Liabilities***

The following tables provide details of contract liabilities as of the periods indicated:

| | December 31, | | | December 31, | | |
|---|---|---|---|---|---|---|
| (in thousands) | 2023 | 2022 | Change | 2022 | 2021 | Change |
| Service contracts | $ 2,849 | $ 1,530 | $ 1,319 | 1,530 | $ 1,976 | $ (446) |
| Customer advances | 1,659 | 1,840 | (181) | 1,840 | 2,290 | (450) |
| Total contract liabilities | $ 4,508 | $ 3,370 | $ 1,138 | 3,370 | $ 4,266 | $ (896) |

Changes in the Company's contract liabilities are primarily due to the timing of receipt of payments under service and warranty contracts. During the years ended December 31, 2023 and 2022, the Company recognized revenue of $2.1 million and $2.5 million from contract liabilities existing at December 31, 2022 and 2021, respectively.

***Provision for Expected Credit Losses on Receivables***

Activity in the provision for expected losses on receivables is as follows:

| | December 31, | |
|---|---|---|
| (in thousands) | 2023 | 2022 |
| Balance, beginning of period | $ 191 | $ 136 |
| Provision for expected credit losses | 29 | 62 |
| Charge-offs and other | (60) | (7) |
| Balance, end of period | $ 160 | $ 191 |

***Concentrations***

No customer accounted for more than 10% of the revenues for the years ended December 31, 2023 and 2022, or for more than 10% of net accounts receivable at December 31, 2023 and 2022.

***Warranties***

Activity in the product warranty accrual is as follows:

| (in thousands) | Year Ended December 31, 2023 | 2022 |
|---|---|---|
| Balance at December 31, 2022 | $ 268 | $ 240 |
| Expense | 381 | 408 |
| Warranty claims | (313) | (380) |
| Balance at December 31, 2023 | $ 336 | $ 268 |

## 14. Income Tax

Income tax expense for the years ended December 31, 2023 and 2022, consisted of:

| (in thousands) | Year Ended December 31, 2023 | 2022 |
|---|---|---|
| Current income tax expense: | | |
| Federal and state | $ 570 | $ 641 |
| Foreign | 61 | 194 |
| | 631 | 835 |
| Deferred income tax expense (benefit): | | |
| Federal and state | 132 | (468) |
| Foreign | 96 | (30) |
| | 228 | (498) |
| Total income tax expense | $ 859 | $ 337 |

The effective tax rate for the year ended December 31, 2023 was (33.5)% as compared with (3.7)% for the same period in 2022. The difference between the Company's effective tax rate year over year was primarily attributable to changes in the mix of pre-tax income and losses at individual subsidiaries, and the impact of changes in uncertain tax positions.

Income tax expense for the years ended December 31, 2023 and 2022, differed from the amount computed by applying the U.S. federal income tax rate of 21% to pre-tax loss as a result of the following:

| (in thousands) | Year Ended December 31, 2023 | 2022 |
|---|---|---|
| Income tax benefit computed at federal statutory tax rate | $ (537) | $ (1,927) |
| Increase (decrease) in income taxes resulting from: | | |
| Permanent differences, net | (89) | 375 |
| Non-deductible executive compensation | 324 | 346 |
| Global Intangible Low-Taxed Income (GILTI) | 537 | 552 |
| State income taxes, net of federal income tax benefit | (19) | (295) |
| Stock-based compensation | (329) | 69 |
| Tax credits | (51) | 492 |
| Net operating loss true-ups and expirations | 1,140 | 431 |
| Change in reserve for uncertain tax position | 239 | 688 |
| Impact of change to prior year tax accruals | (171) | (232) |
| Change in valuation allowance allocated to income tax | 631 | (102) |
| Other | (816) | (60) |
| Total income tax expense | $ 859 | $ 337 |

Income tax expense is based on the following pre-tax (loss) income from operations:

| (in thousands) | Year Ended December 31, 2023 | 2022 |
|---|---|---|
| Domestic | $ (2,951) | $ (9,099) |
| Foreign | 395 | (80) |
| Total | $ (2,556) | $ (9,179) |

The tax effects of temporary differences that give rise to significant components of the deferred tax assets and deferred tax liabilities at December 31, 2023 and 2022, are as follows:

| (in thousands) | Year Ended December 31, 2023 | 2022 |
|---|---|---|
| Deferred income tax assets: | | |
| Inventory | $ 1,489 | $ 1,696 |
| Operating loss and credit carryforwards | 11,550 | 14,883 |
| Research and development | 3,908 | 2,000 |
| Employee retention credit | 1,435 | - |
| Lease liabilities | 1,317 | 1,538 |
| Accrued expenses | 818 | 621 |
| Stock compensation | 670 | 675 |
| Deferred interest expense | 386 | 881 |
| Other assets | 934 | 726 |
| Total gross deferred assets | 22,507 | 23,020 |
| Less: valuation allowance | (15,222) | (14,506) |
| Deferred tax assets | $ 7,285 | $ 8,514 |
| | | |
| Deferred income tax liabilities: | | |
| Indefinite-lived intangible assets | $ 1,964 | $ 1,914 |
| Definite-lived intangible assets | 3,733 | 4,875 |
| Lease right-of-use assets | 959 | 1,148 |
| Employee benefit plans | 569 | 579 |
| Other liabilities | 400 | 255 |
| Total deferred tax liabilities | 7,625 | 8,771 |
| Deferred income tax liabilities, net | $ (340) | $ (257) |

Deferred income tax assets and liabilities by classification on the consolidated balance sheets were as follows:

| (in thousands) | Year Ended December 31, 2023 | 2022 |
|---|---|---|
| Deferred tax assets (included in other long-term assets) | $ 436 | $ 333 |
| Deferred income tax liabilities | (776) | (590) |
| Deferred income tax liability, net | $ (340) | $ (257) |

At December 31, 2023, the Company had state net operating loss carryforwards of $6.3 million, which expire between 2024 and 2043. The Company had net operating loss carryforwards of $7.8 million in certain foreign jurisdictions which may be carried forward indefinitely, partially offset by valuation allowances. The Company had $7.8 million of research and development tax credit carryforwards which begin to expire in 2024, and are partially offset by a reserve of $0.8 million for uncertain tax positions. The Company had a total of $2.7 million of state investment tax credit carryforwards, research and development tax credit carryforwards, and enterprise zone credit carryforwards, which begin to expire in 2024. In addition, the Company had a total of $0.4 million international R&D credits which begin to expire in 2037. The Internal Revenue Code (“IRC”) limits the amounts of net operating loss carryforwards or credits that a company may use in any one year in the event of a change in ownership under IRC Sections 382 or 383. As a result of various acquisitions in prior years, certain losses and credit carryforwards are subject to these limitations.

As of December 31, 2023 and 2022, the Company maintained a total valuation allowance of $15.2 million and $14.5 million, respectively, which relates to foreign, federal, and state deferred tax assets in both years. The valuation allowance is based on estimates of taxable income in each of the jurisdictions in which the Company operates and the period over which deferred tax assets will be recoverable. The net change in the total valuation allowance for the years ended December 31, 2023 and 2022, was an increase of $0.7 million and a decrease of $0.2 million, respectively. During the year ended December 31, 2023, the Company increased the valuation allowance related to the estimate of realizability of German deferred tax assets and deferred tax assets related to the Employee Retention Credit, offset by the utilization and expiration of certain U.S. federal and state net operating losses and the expiration of certain U.S. credits.

As of December 31, 2023 and 2022, cash and cash equivalents held by the Company's foreign subsidiaries were $2.1 million and $2.6 million, respectively. As of December 31, 2023, the Company has determined the potential income tax and withholding liability related to available cash balances at foreign subsidiaries to be immaterial.

A summary of activity of unrecognized tax benefits is as follows:

| | (in thousands) |
|---|---|
| Balance at December 31, 2021 | $ 1,332 |
| Additions based on tax positions of prior years | 534 |
| Decreases based on tax positions of prior years | (34) |
| Additions based on tax positions of current year | 237 |
| Other decreases, net | (86) |
| Balance at December 31, 2022 | 1,983 |
| Additions based on tax positions of prior years | 13 |
| Decreases based on tax positions of prior years | 57 |
| Additions based on tax positions of current year | 245 |
| Other decreases, net | (76) |
| Balance at December 31, 2023 | $ 2,222 |

We expect the amount of unrecognized tax benefits to change within the next twelve months, including the release of reserves of approximately $0.4 million. Substantially all of the liability for uncertain tax benefits related to various federal, state and foreign income tax matters would benefit the Company's effective tax rate, if recognized. The Company classifies interest and penalties related to unrecognized tax benefits as a component of income tax expense, which has not been significant during the years ended December 31, 2023 and 2022, respectively.

With a few exceptions, the Company is no longer subject to income tax examinations by tax authorities in foreign jurisdictions for the years before 2019. In the U.S., the Company's net operating loss and tax credit carryforward amounts remain subject to federal and state examination for tax years starting in 2004 as a result of tax losses incurred in prior years. There are currently no pending federal or state tax examinations.

## 15. Commitments and Contingent Liabilities

In April 2022, the Company and HRGN executed a settlement with the plaintiffs in the HRGN Litigation (as defined below), which resolves all claims relating to the litigation as described in Note 16, Litigation Settlement.

The Company is involved in various other claims and legal proceedings arising in the ordinary course of business. After consultation with legal counsel, the Company has determined that the ultimate disposition of such proceedings is not likely to have a material adverse effect on its business, financial condition, results of operations or cash flow. Although unfavorable outcomes in the proceedings are possible, the Company has not accrued loss contingencies relating to any such matters as they are not considered to be probable and reasonably estimable. If one or more of these matters are resolved in a manner adverse to the Company, the impact on the Company's business, financial condition, results of operations and cash flows could be material.

In addition, the Company has entered into indemnification agreements with its directors. It is not possible to determine the maximum potential liability amount under these indemnification agreements due to the limited history of prior indemnification claims and the unique facts and circumstances involved in each particular agreement. The Company has not recorded any liability for costs related to contingent indemnification obligations as of December 31, 2023.

The Company is subject to unclaimed property laws in the ordinary course of its business. State escheat laws generally require entities to report and remit abandoned and unclaimed property to the state. Failure to timely report and remit the property can result in assessments that could include interest and penalties, in addition to the payment of the escheat liability itself. The Company is currently undergoing an unclaimed property audit. Based on the current stage of the audits, the Company has not accrued any significant losses related to these audits as of December 31, 2023.

**16. Litigation Settlement**

In April 2022, the Company and HRGN entered into a settlement of a litigation related to injuries allegedly caused by products produced by the Company and HRGN and utilized in connection with surgeries performed by third parties (the "HRGN Settlement"). The HRGN Settlement resolved and dismissed all claims by and between the parties. HRGN has indemnified the Company for all losses and expenses that the Company incurred in connection with such litigation and settlement.

In connection with the HRGN Settlement, in June 2022, HRGN issued 4,000 shares of Series E Convertible Preferred Stock (the "Series E Preferred Stock") to the Company in satisfaction of $4.0 million of its total indemnification obligations. The Company recorded the Series E Preferred Stock at an estimated fair value of $3.9 million using a Monte Carlo valuation simulation incorporating information from selected guideline companies. As of December 31, 2022, the book value of the shares of Series E Preferred Stock, inclusive of accrued dividends, was $4.1 million and was included in the consolidated balance sheet as a component of other long-term assets.

In April 2023, all of the shares of Series E Preferred Stock the Company held in HRGN were mandatorily converted into shares of HRGN common stock.

As of December 31, 2023, the Company held shares of HRGN common stock with an estimated fair value of $3.5 million, which are included in the consolidated balance sheet as a component of other long-term assets. During the year ended December 31, 2023, the Company recorded an unrealized loss related to these shares of $(0.6) million, which was recorded as other (expense) income, net, in the consolidated statements of operations. The Company determines the fair value of its HRGN common stock based on the closing price as quoted on the OTCQB Marketplace at the reporting date. Due to HRGN's limited operating history, its overall financial condition and the limited trading volumes and liquidity of its common stock, the value of the Company's investment in this common stock could fluctuate considerably or become worthless.

**17. Product Line Disposition**

On February 17, 2023, the Company completed the disposition of its Hoefer product line for cash consideration of $0.5 million. The carrying value of assets sold was $0.1 million resulting in a gain on disposition of $0.4 million which is recorded in other (expense) income, net, in the consolidated statement of operations for the year ended December 31, 2023. Revenue and gross profit of this disposed product line included in the condensed consolidated statement of operations for the years ended December 31, 2023 and 2022, were not significant.

**18. Government Assistance**

As there is no authoritative guidance under U.S. GAAP on accounting for grants to for profit business entities from government entities, the Company accounts for government assistance by analogy to International Accounting Standards Topic 20, *Accounting for Government Grants and Disclosure of Government* Assistance (IAS 20). Under IAS 20, grants related to income are presented as part of the consolidated statements of operations either as a deduction of the related expense or reported separately in other income. The Company recognizes government assistance that supplements salaries or research activities as a reduction of the related operating expense over the period for which it is intended to compensate. Government assistance that is not directly related to expense reimbursement or relates to costs incurred in a previous fiscal period is recorded as other income.

For the years ended December 31, 2023 and 2022, the Company received $0.2 million and $0.7 million, respectively, under government assistance programs. The majority of the assistance was a result of the Company's German subsidiaries participating in programs established to offset the negative impact of COVID-19 on profitability, to support employment during the COVID-19 pandemic, and to offset the costs of qualifying research and development activities.

In February 2024, the Company received and recorded $3.1 million for the Employee Retention Credit ("ERC"), which was enacted as part of the Coronavirus Aid, Relief, and Economic Security Act of 2020 ("CARES Act") to provide financial incentives to eligible businesses to retain their workforce through the period of financial hardship resulting from the COVID-19 pandemic.

**SIGNATURES**

Pursuant to the requirements of Section 13 or 15(d) of the Securities Exchange Act of 1934, the registrant has duly caused this report to be signed on its behalf by the undersigned thereunto duly authorized.

HARVARD BIOSCIENCE, INC.

Date: March 7, 2024

By: /s/ JAMES GREEN
James Green
Chief Executive Officer

Pursuant to the requirements of Section 13 or 15(d) of the Securities Exchange Act of 1934, this report has been signed below by the following persons on behalf of the registrant and in the capacities and on the dates indicated.

| Signature | Title | Date |
|---|---|---|
| /s/ JAMES GREEN<br>**James Green** | Chief Executive Officer and Director<br>(Principal Executive Officer) | March 7, 2024 |
| /s/ JENNIFER COTE<br>**Jennifer Cote** | Chief Financial Officer<br>(Principal Financial Officer and Principal Accounting Officer) | March 7, 2024 |
| /s/ KATHERINE A. EADE<br>**Katherine A. Eade** | Director | March 7, 2024 |
| /s/ ALAN EDRICK<br>**Alan Edrick** | Director | March 7, 2024 |
| /s/ THOMAS W. LOEWALD<br>**Thomas W. Loewald** | Director | March 7, 2024 |
| /s/ BERTRAND LOY<br>**Bertrand Loy** | Director | March 7, 2024 |

**EXHIBIT INDEX**

The following exhibits are filed as part of this Annual Report on Form 10-K. Where such filing is made by incorporation by reference to a previously filed document, such document is identified.

| Exhibit | Description | Method of Filing |
|---|---|---|
| 2.1§ | Separation and Distribution Agreement between Harvard Bioscience, Inc. and Biostage, Inc. (f/k/a Harvard Apparatus Regenerative Technology, Inc.) dated as of October 31, 2013. | Exhibit to the Current Report on Form 8-K filed November 6, 2013, and incorporated by reference thereto. |
| 3.1 | Second Amended and Restated Certificate of Incorporation of Harvard Bioscience, Inc. | Exhibit to the Registration Statement on Form S-1/A (File No. 333-45996) (filed November 9, 2000) and incorporated by reference thereto. |
| 3.2 | Amended and Restated By-laws of Harvard Bioscience, Inc. | Exhibit to the Registration Statement on Form S-1/A (File No. 333-45996) (filed November 9, 2000) and incorporated by reference thereto. |
| 3.3 | Amendment No. 1 to Amended and Restated Bylaws of Harvard Bioscience, Inc. (as adopted October 30, 2007). | Exhibit to the Current Report on Form 8-K (filed November 1, 2007) and incorporated by reference thereto. |
| 4.1 | Specimen certificate for shares of Common Stock, $0.01 par value, of Harvard Bioscience, Inc. | Exhibit to the Registration Statement on Form S-1/A (File No. 333-45996) (filed November 9, 2000) and incorporated by reference thereto. |
| 4.2 | Description of Securities. | Exhibit to the Annual Report on Form 10-K (filed March 16, 2020) and incorporated by reference thereto. |
| 10.1 # | Harvard Bioscience, Inc. Fourth Amended and Restated 2000 Stock Option and Incentive Plan. | Exhibit to the Quarterly Report on Form 10-Q filed August 10, 2020, and incorporated by reference thereto. |
| 10.2 | Harvard Bioscience, Inc. Employee Stock Purchase Plan, as amended. | Disclosed as Appendix A to the Proxy Statement on Schedule 14A filed April 7, 2022, and incorporated by reference thereto. |
| 10.3 | Form of Director Indemnification Agreement. | Exhibit to the Quarterly Report on Form 10-Q filed May 8, 2020, and incorporated by reference thereto. |
| 10.4 + | Trademark License Agreement, dated December 19, 2002, by and between Harvard Bioscience, Inc. and President and Fellows of Harvard College. | Exhibit to the Annual Report on Form 10-K filed March 9, 2023, and incorporated by reference thereto. |
| 10.5 # | Form of Incentive Stock Option Agreement (Executive Officers). | Exhibit to the Annual Report on Form 10-K filed March 16, 2006, and incorporated by reference thereto. |
| 10.6 # | Form of Non-Qualified Stock Option Agreement (Executive Officers). | Exhibit to the Annual Report on Form 10-K filed March 16, 2006, and incorporated by reference thereto. |
| 10.7 # | Form of Non-Qualified Stock Option Agreement (Non-Employee Directors). | Exhibit to the Annual Report on Form 10-K filed March 16, 2006, and incorporated by reference thereto. |
| 10.8 # | Form of Deferred Stock Award Agreement. | Exhibit to the Annual Report on Form 10-K filed March 16, 2011, and incorporated by reference thereto. |
| 10.9 # | Form of Market Condition Deferred Stock Award Agreement. | Exhibit to the Annual Report on Form 10-K filed March 16, 2020, and incorporated by reference thereto. |
| 10.10 # | Employment Agreement between Harvard Bioscience, Inc. and James Green. | Exhibit to the Current Report on Form 8-K filed July 8, 2019, and incorporated by reference thereto. |

| | | |
|---|---|---|
| 10.11# | Employment Agreement between Jennifer Cote and the Company dated June 19, 2023 | Exhibit to the Current Report on Form 8-K filed June 20, 2023, and incorporated by reference thereto. |
| 10.12 | Consulting Agreement, dated as of March 2, 2020, by and between Harvard Bioscience, Inc. and Chane Graziano. | Exhibit to the Current Report on Form 8-K filed March 6, 2020, and incorporated by reference thereto. |
| 10.13 | Credit Agreement dated as of December 22, 2020 among Harvard Bioscience, Inc., as borrower, the lenders party thereto, and Citizens Bank, N.A., as administrative agent. | Exhibit to the Current Report on Form 8-K filed December 23, 2020, and incorporated by reference thereto. |
| 10.14 | Pledge and Security Agreement dated as of December 22, 2020 among Harvard Bioscience, Inc., certain of Harvard Bioscience's direct and indirect subsidiaries and Citizens Bank, N.A., as administrative agent. | Exhibit to the Current Report on Form 8-K filed December 23, 2020, and incorporated by reference thereto. |
| 10.15 | First Amendment to Credit Agreement and Amendment to Pledge and Security Agreement, dated April 28, 2022, among Harvard Bioscience, Inc., Citizens Bank, N.A., as the administrative agent, and the lenders party thereto. | Exhibit to the Current Report on Form 8-K filed April 28, 2022, and incorporated by reference thereto. |
| 10.16 | Second Amendment to Credit Agreement and Amendment to Pledge and Security Agreement, dated November 8, 2022, among Harvard Bioscience, Inc., Citizens Bank, N.A., as the administrative agent, and the lenders party thereto. | Exhibit to the Form 10-Q filed November 9, 2022, and incorporated by reference thereto. |
| 10.17 | Guarantee Agreement dated as of December 22, 2020 among Harvard Bioscience, Inc., certain of Harvard Bioscience's direct and indirect subsidiaries and Citizens Bank, N.A., as administrative agent. | Exhibit to the Current Report on Form 8-K filed December 23, 2020, and incorporated by reference thereto. |
| 10.18# | Harvard Bioscience, Inc. 2021 Incentive Plan. | Exhibit to the Current Report on Form 8-K filed May 19, 2021, and incorporated by reference thereto. |
| 10.19# | Form of Performance RSU Award Agreement - 2021 Incentive Plan. | Exhibit to the Annual Report on Form 10-K filed March 11, 2022, and incorporated by reference thereto. |
| 10.20# | Form of Time-Based RSU Awards Agreement – 2021 Incentive Plan. | Exhibit to the Annual Report on Form 10-K filed March 11, 2022, and incorporated by reference thereto. |
| 10.21# | Form of RSU Award for Directors – 2021 Incentive Plan. | Exhibit to the Annual Report on Form 10-K filed March 11, 2022, and incorporated by reference thereto. |
| 10.22# | Separation Agreement and Release between Harvard Bioscience, Inc. and Ken Olson, dated as of January 26, 2022. | Exhibit to the Current Report on Form 8-K filed January 28, 2022, and incorporated by reference thereto. |
| 10.23# | Separation Agreement and Release between Harvard Bioscience, Inc. and Michael Rossi, dated January 18, 2023 | Exhibit to the Current Report on Form 8-K filed January 19, 2023, and incorporated by reference thereto. |
| 21.1 | Subsidiaries of the Registrant | Filed with this report |
| 23.1 | Consent of Grant Thornton LLP | Filed with this report |
| 31.1 | Certification of Chief Financial Officer of Harvard Bioscience, Inc., pursuant to Rules 13a-15(e) and 15d-15(e), as adopted pursuant to Section 302 of the Sarbanes-Oxley Act of 2002 | Filed with this report |
| 31.2 | Certification of Chief Executive Officer of Harvard Bioscience, Inc., pursuant to Rules 13a-15(e) and 15d-15(e), as adopted pursuant to Section 302 of the Sarbanes-Oxley Act of 2002 | Filed with this report |
| 32.1 | Certification of Chief Financial Officer of Harvard Bioscience, Inc., pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002 | * |

| | | |
|---|---|---|
| 32.2 | Certification of Chief Executive Officer of Harvard Bioscience, Inc., pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002 | * |
| 97 | Harvard Bioscience Inc., Dodd-Frank Clawback Policy | Filed with this report |
| 101.INS | Inline XBRL Instance Document | Filed with this report |
| 101.SCH | Inline XBRL Taxonomy Extension Schema Document | Filed with this report |
| 101.CAL | Inline XBRL Taxonomy Extension Calculation Linkbase Document | Filed with this report |
| 101.DEF | Inline XBRL Taxonomy Extension Definition Linkbase Document | Filed with this report |
| 101.LAB | Inline XBRL Taxonomy Extension Label Linkbase Document | Filed with this report |
| 101.PRE | Inline XBRL Taxonomy Extension Presentation Linkbase Document | Filed with this report |
| 104 | Cover Page Interactive Data File (formatted as Inline XBRL with applicable taxonomy extension information contained in Exhibits 101) | |

+ Portions of this exhibit have been redacted in compliance with Item 601(b)(10) of Regulation S-K.

* This certification shall not be deemed “filed” for purposes of Section 18 of the Securities Exchange Act of 1934, or otherwise subject to the liability of that section, nor shall it be deemed to be incorporated by reference into any filing under the Securities Act of 1933 or the Securities Exchange Act of 1934

# Management contract or compensatory plan or arrangement.

§ The schedules and exhibits have been omitted. A copy of any omitted schedule or exhibit will be furnished to the SEC supplementally upon request.

The Company will furnish to stockholders a copy of any exhibit without charge upon written request.

**EXHIBIT 21.1**

**Subsidiaries Of Harvard Bioscience, Inc.**

| Name | Jurisdiction |
|---|---|
| Biochrom Limited | United Kingdom |
| Biochrom US, Inc. | Delaware, United States |
| CMA Microdialysis Ab | Sweden |
| Data Sciences International, Inc. | Delaware, United States |
| Data Sciences (UK) Mn, Ltd. | United Kingdom |
| Data Sciences Eurl | France |
| Data Sciences GmbH | Germany |
| DSI (Shanghai) Trading Co Ltd. | China |
| Harvard Bioscience (Shanghai) Co. Ltd. | China |
| Hugo Sachs Elektronik - Harvard Apparatus GmbH | Germany |
| Multichannel Systems MCS GmbH | Germany |
| Panlab S.L. | Spain |

**EXHIBIT 23.1**

**CONSENT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM**

We have issued our reports dated March 7, 2024, with respect to the consolidated financial statements and internal control over financial reporting included in the Annual Report of Harvard Bioscience, Inc. on Form 10-K for the year ended December 31, 2023. We consent to the incorporation by reference of said reports in the Registration Statements of Harvard Bioscience, Inc. on Forms S-8 (File No. 333-249943, File No. 333-53848, File No. 333-104544, File No. 333-135418 File No. 333-151003, File No. 333-174476, File No. 333-189175, File No. 333-204760, File No. 333-218497, File No. 333-225365, File No. 333-231825, File No. 333-256295, and File No. 333-265487).

/s/ GRANT THORNTON LLP

Hartford, Connecticut
March 7, 2024

**EXHIBIT 31.1**

**Certification**

I, Jennifer Cote, certify that:

1. I have reviewed this annual report on Form 10-K of Harvard Bioscience, Inc.;

2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;

3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;

4. The registrant's other certifying officer(s) and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) and internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)) for the registrant and have:

   a. Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;

   b. Designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles;

   c. Evaluated the effectiveness of the registrant's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and

   d. Disclosed in this report any change in the registrant's internal control over financial reporting that occurred during the registrant's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the registrant's internal control over financial reporting; and

5. The registrant's other certifying officer(s) and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):

   a. All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and

   b. Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: March 7, 2024

/s/ JENNIFER COTE
Jennifer Cote
Chief Financial Officer

**EXHIBIT 31.2**

**Certification**

I, James Green, certify that:

1. I have reviewed this annual report on Form 10-K of Harvard Bioscience, Inc.;

2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;

3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;

4. The registrant's other certifying officer(s) and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) and internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)) for the registrant and have:

   a. Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;

   b. Designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles;

   c. Evaluated the effectiveness of the registrant's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and

   d. Disclosed in this report any change in the registrant's internal control over financial reporting that occurred during the registrant's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the registrant's internal control over financial reporting; and

5. The registrant's other certifying officer(s) and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):

   a. All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and

   b. Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: March 7, 2024

/s/ JAMES GREEN

James Green
Chief Executive Officer

**EXHIBIT 32.1**

**CERTIFICATION OF PERIODIC FINANCIAL REPORT**
**PURSUANT TO 18 U.S.C. SECTION 1350**

The undersigned officer of Harvard Bioscience, Inc. (the "Company") hereby certifies to her knowledge that the Company's annual report on Form 10-K for the year ended December 31, 2023 to which this certification is being furnished as an exhibit (the "Report"), as filed with the Securities and Exchange Commission on the date hereof, fully complies with the requirements of Section 13(a) or 15(d), as applicable, of the Securities Exchange Act of 1934, as amended (the "Exchange Act"), and that the information contained in the Report fairly presents, in all material respects, the financial condition and results of operations of the Company. This certification is provided solely pursuant to 18 U.S.C. Section 1350 and Item 601(b)(32) of Regulation S-K ("Item 601(b)(32)") promulgated under the Securities Act of 1933, as amended (the "Securities Act"), and the Exchange Act. In accordance with clause (ii) of Item 601(b)(32), this certification (A) shall not be deemed "filed" for purposes of Section 18 of the Exchange Act, or otherwise subject to the liability of that section, and (B) shall not be deemed to be incorporated by reference into any filing under the Securities Act or the Exchange Act, except to the extent that the Company specifically incorporates it by reference.

Date: March 7, 2024

/s/ JENNIFER COTE
Name: Jennifer Cote
Title: Chief Financial Officer

**EXHIBIT 32.2**

**CERTIFICATION OF PERIODIC FINANCIAL REPORT**
**PURSUANT TO 18 U.S.C. SECTION 1350**

The undersigned officer of Harvard Bioscience, Inc. (the "Company") hereby certifies to his knowledge that the Company's annual report on Form 10-K for the year ended December 31, 2023 to which this certification is being furnished as an exhibit (the "Report"), as filed with the Securities and Exchange Commission on the date hereof, fully complies with the requirements of Section 13(a) or 15(d), as applicable, of the Securities Exchange Act of 1934, as amended (the "Exchange Act"), and that the information contained in the Report fairly presents, in all material respects, the financial condition and results of operations of the Company. This certification is provided solely pursuant to 18 U.S.C. Section 1350 and Item 601(b)(32) of Regulation S-K ("Item 601(b)(32)") promulgated under the Securities Act of 1933, as amended (the "Securities Act"), and the Exchange Act. In accordance with clause (ii) of Item 601(b)(32), this certification (A) shall not be deemed "filed" for purposes of Section 18 of the Exchange Act, or otherwise subject to the liability of that section, and (B) shall not be deemed to be incorporated by reference into any filing under the Securities Act or the Exchange Act, except to the extent that the Company specifically incorporates it by reference.

Date: March 7, 2024

/s/ JAMES GREEN
Name: James Green
Title: Chief Executive Officer

**EXHIBIT 97**

# HARVARD BIOSCIENCE, INC. DODD-FRANK CLAWBACK POLICY

This document sets forth the Dodd-Frank Clawback Policy (the "Policy") as adopted by Harvard Bioscience, Inc. (the "Company") on October 31, 2023. This Policy shall be interpreted to comply with the clawback rules found in 17 C.F.R. §240.10D and the related listing rules of the national securities exchange or national securities association ("Exchange") on which the Company has listed securities, and, to the extent this Policy is any manner deemed inconsistent with such rules, this Policy shall be treated as retroactively amended to be compliant with such rules.

1. Definitions. 17 C.F.R. §240.10D-1(d) defines the terms "Executive Officer," "Financial Reporting Measures," "Incentive-Based Compensation," and "Received." As used herein, these terms shall have the same meaning as in that regulation.

2. Application of the Policy. This Policy shall only apply in the event that the Company is required to prepare an accounting restatement due to the material noncompliance of the Company with any financial reporting requirement under the securities laws, including any required accounting restatement to correct an error in previously issued financial statements that is material to the previously issued financial statements, or that would result in a material misstatement if the error were corrected in the current period or left uncorrected in the current period.

3. Recovery Period. The Incentive-Based Compensation subject to clawback is the Incentive-Based Compensation Received during the three completed fiscal years immediately preceding the date that the Company is required to prepare an accounting restatement as described in section 2, provided that the person served as an Executive Officer at any time during the performance period applicable to the Incentive-Based Compensation in question. The date that the Company is required to prepare an accounting restatement shall be determined pursuant to 17 C.F.R. §240.10D-1(b)(1)(ii).

(a) Notwithstanding the foregoing, the Policy shall only apply if the Incentive-Based Compensation is Received (1) while the Company has a class of securities listed on an Exchange and (2) on or after October 2, 2023.

(b) See 17 C.F.R. §240.10D-1(b)(1)(i) for certain circumstances under which the Policy will apply to Incentive-Based Compensation Received during a transition period arising due to a change in the Company's fiscal year.

4. Erroneously Awarded Compensation. The amount of Incentive-Based Compensation subject to recovery under this Policy ("Erroneously Awarded Compensation") is the amount of Incentive-Based Compensation Received that exceeds the amount of Incentive Based-Compensation that otherwise would have been Received had it been determined based on the restated amounts and shall be computed without regard to any taxes paid. For Incentive-Based Compensation based on the Company's stock price or total shareholder return, where the amount of Erroneously Awarded Compensation is not subject to mathematical recalculation directly from the information in an accounting restatement: (1) the amount shall be based on a reasonable estimate of the effect of the accounting restatement on the Company's stock price or total shareholder return upon which the Incentive-Based Compensation was Received; and (2) the Company must maintain documentation of the determination of that reasonable estimate and provide such documentation to the Exchange.

5. The Company shall recover reasonably promptly any Erroneously Awarded Compensation except to the extent that the conditions of paragraphs (a), (b), or (c) below apply. The Compensation Committee of the Board of Directors of the Company (the "Committee") shall determine the repayment schedule for each amount of Erroneously Awarded Compensation in a manner that complies with this "reasonably promptly" requirement. Such determination shall be consistent with any applicable legal guidance, by the U.S. Securities and Exchange Commission (the "SEC"), judicial opinion, or otherwise. The determination of "reasonably promptly" may vary from case to case and the Committee is authorized to adopt additional rules to further describe what repayment schedules satisfy this requirement.

(a) Erroneously Awarded Compensation need not be recovered if the direct expense paid to a third party to assist in enforcing the Policy would exceed the amount to be recovered and the Committee has made a determination that recovery would be impracticable. Before concluding that it would be impracticable to recover any amount of Erroneously Awarded Compensation based on expense of enforcement, the Company shall make a reasonable attempt to recover such Erroneously Awarded Compensation, document such reasonable attempt(s) to recover, and provide that documentation to the Exchange.

(b) Erroneously Awarded Compensation need not be recovered if recovery would violate home country law where that law was adopted prior to November 28, 2022. Before concluding that it would be impracticable to recover any amount of Erroneously Awarded Compensation based on violation of home country law, the Company shall obtain an opinion of home country counsel, acceptable to the Exchange, that recovery would result in such a violation and shall provide such opinion to the Exchange.

(c) Erroneously Awarded Compensation need not be recovered if recovery would likely cause an otherwise tax-qualified retirement plan, under which benefits are broadly available to employees of the registrant, to fail to meet the requirements of 26 U.S.C. 401(a)(13) or 26 U.S.C. 411(a) and regulations thereunder.

6. Committee Decisions. Decisions of the Committee with respect to this Policy shall be final, conclusive and binding on all Executive Officers subject to this policy, unless determined to be an abuse of discretion.

7. No Indemnification. Notwithstanding anything to the contrary in any other policy of the Company or any agreement between the Company and an Executive Officer, no Executive Officer shall be indemnified by the Company against the loss of any Erroneously Awarded Compensation or any claims related to the Company's enforcement of its rights under this Policy.

8. Agreement to Policy by Executive Officers. The Committee shall take reasonable steps to inform Executive Officers of this Policy and obtain their agreement to this Policy, which steps may include the inclusion of this Policy as an attachment to, or reference to this Policy in, any award that is accepted by the Executive Officer, or by reference to the Company's clawback policies in any plan or arrangement under which an award is provided.

9. Other Recovery Rights. Any employment agreement, equity award agreement, compensatory plan or any other agreement or arrangement with an Executive Officer shall be deemed to include, as a condition to the grant of any benefit thereunder, an agreement by the Executive Officer to abide by the terms of this Policy. Any right of recovery under this Policy is in addition to, and not in lieu of, any other remedies or rights of recovery that may be available to the Company under applicable law, regulation or rule or pursuant to the terms of any policy of the Company or any provision in any employment agreement, equity award agreement, compensatory plan, agreement or other arrangement (individually or collectively, an "Arrangement"). The Committee may, subject to applicable law and in its sole discretion, seek recovery under such Arrangement of amounts in excess of the amount subject to recovery under this Policy. Notwithstanding the foregoing, there shall be no duplication of recovery of the same Erroneously Awarded Compensation under this Policy, unless required by applicable law.

10. Amendments. The Committee may amend this Policy from time to time in its discretion and shall amend this Policy as it deems necessary. Notwithstanding anything in this Section 10 to the contrary, no amendment or termination of this Policy shall be effective if such amendment or termination would (after taking into account any actions taken by the Company contemporaneously with such amendment or termination) cause the Company to violate any federal securities laws, SEC rule or Exchange rule.

Adopted: October 31, 2023