UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
WASHINGTON, DC 20549

FORM 10-Q

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

For the quarterly period ended June 30, 2020

☐ **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

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.

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 is a shell company (as defined in Rule 12b-2 of the Exchange Act). Yes ☐ No ☒

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

As of July 31, 2020, there were 38,942,683 shares of the registrant's common stock issued and outstanding.

HARVARD BIOSCIENCE, INC.

FORM 10-Q

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PART I. FINANCIAL INFORMATION

Item 1. Financial Statements.

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

	June 30, 2020	December 31, 2019
Assets		
Current assets:		
Cash and cash equivalents	$ 2,629	$ 8,335
Accounts receivable, net	14,710	20,704

Inventories	23,181	22,061
Other current assets	3,582	2,472
Total current assets	44,102	53,572
Property, plant and equipment, net	4,222	4,776
Operating lease right-of-use assets	8,165	8,463
Goodwill	56,958	57,381
Intangible assets, net	35,495	38,405
Other long-term assets	1,743	2,273
Total assets	$ 150,685	$ 164,870
Liabilities and Stockholders' Equity		
Current liabilities:		
Current portion of long-term debt	$ 2,807	$ 6,900
Current portion of operating lease liabilities	2,249	2,424
Accounts payable	6,596	5,339
Deferred revenue	3,652	3,949
Accrued income taxes	969	609
Other current liabilities	6,390	6,091
Total current liabilities	22,663	25,312
Long-term debt	40,921	46,917
Deferred tax liability	2,276	1,974
Operating lease liabilities	7,887	8,224
Other long-term liabilities	870	749
Total liabilities	74,617	83,176
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; 46,413,908 and 45,933,715 shares issued and 38,668,401 and 38,188,208 shares outstanding, respectively	438	438
Additional paid-in-capital	230,675	229,189
Accumulated deficit	(130,673)	(124,576)
Accumulated other comprehensive loss	(13,704)	(12,689)
Treasury stock at cost, 7,745,507 common shares	(10,668)	(10,668)
Total stockholders' equity	76,068	81,694
Total liabilities and stockholders' equity	$ 150,685	$ 164,870

See accompanying notes to condensed consolidated financial statements.

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HARVARD BIOSCIENCE, INC.
CONSOLIDATED STATEMENTS OF OPERATIONS AND COMPREHENSIVE LOSS
(Unaudited, in thousands, except share and per share data)

	Three Months Ended June 30,		Six Months Ended June 30,	
	2020	**2019**	**2020**	**2019**
Revenues	$ 23,308	$ 29,584	$ 47,079	$ 57,786
Cost of revenues	9,452	13,629	20,241	25,677
Gross profit	13,856	15,955	26,838	32,109
Operating expenses:				
Sales and marketing expenses	4,279	5,770	9,858	12,076
General and administrative expenses	5,670	4,809	12,429	10,612
Research and development expenses	1,897	2,771	4,387	5,506
Amortization of intangible assets	1,454	1,436	2,881	2,866
Impairment charges	-	941	-	941
Total operating expenses	13,300	15,727	29,555	32,001
Operating income (loss)	556	228	(2,717)	108
Other expense:				
Interest expense, net	(1,233)	(1,376)	(2,532)	(2,781)
Other (income) expense, net	(191)	16	(80)	(253)
Total other expense	(1,424)	(1,360)	(2,612)	(3,034)

Loss before income taxes	(868)	(1,132)	(5,329)	(2,926)
Income tax expense (benefit)	713	(885)	768	(309)
Net loss	$ (1,581)	$ (247)	$ (6,097)	$ (2,617)
Loss per share:				
Basic loss per share	$ (0.04)	$ (0.01)	$ (0.16)	$ (0.07)
Diluted loss per share	$ (0.04)	$ (0.01)	$ (0.16)	$ (0.07)
Weighted-average common shares:				
Basic	38,468	37,736	38,389	37,683
Diluted	38,468	37,736	38,389	37,683
Comprehensive income (loss):				
Net loss	$ (1,581)	$ (247)	$ (6,097)	$ (2,617)
Other comprehensive income/(loss):				
Foreign currency translation adjustments	619	(195)	(957)	(191)
Derivatives qualifying as hedges, net of tax:				
Loss on derivative instruments designated and qualifying as cash flow hedges	(11)	(298)	(227)	(494)
Amounts reclassified from accumulated other comprehensive loss to net loss	97	19	169	36
Derivatives qualifying as hedges, net of tax	86	(279)	(58)	(458)
Other comprehensive income/(loss)	705	(474)	(1,015)	(649)
Comprehensive loss	$ (876)	$ (721)	$ (7,112)	$ (3,266)

See accompanying notes to condensed consolidated financial statements.

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HARVARD BIOSCIENCE, INC.
CONSOLIDATED STATEMENTS OF STOCKHOLDERS' EQUITY
(Unaudited, in thousands)

Three Months Ended June 30, 2020

	Number of Shares Issued	Common Stock	Additional Paid-in Capital	Accumulated Deficit	Accumulated Other Comprehensive Loss	Treasury Stock	Total Stockholders' Equity
Balance at March 31, 2020	46,121	$ 438	$ 229,740	$ (129,092)	$ (14,409)	$ (10,668)	$ 76,009
Stock option exercises	7	-	19	-	-	-	19
Stock purchase plan	64	-	167	-	-	-	167
Vesting of restricted stock units	246	-	-	-	-	-	-
Shares withheld for taxes	(24)	-	(20)	-	-	-	(20)
Stock compensation expense	-	-	769	-	-	-	769
Net loss	-	-	-	(1,581)	-	-	(1,581)
Other comprehensive income	-	-	-	-	705	-	705
Balance at June 30, 2020	**46,414**	**$ 438**	**$ 230,675**	**$ (130,673)**	**$ (13,704)**	**$ (10,668)**	**$ 76,068**

Three Months Ended June 30, 2019

	Number of Shares Issued	Common Stock	Additional Paid-in Capital	Accumulated Deficit	Accumulated Other Comprehensive Loss	Treasury Stock	Total Stockholders' Equity
Balance at March 31, 2019	45,433	$ 436	$ 226,547	$ (122,259)	$ (13,707)	$ (10,668)	$ 80,349
Stock option exercises	-	-	-	-	-	-	-
Stock purchase plan	94	-	89	-	-	-	89
Vesting of restricted stock units	114	-	-	-	-	-	-
Shares withheld for taxes	(1)	-	(2)	-	-	-	(2)
Stock compensation expense	-	-	615	-	-	-	615
Net loss	-	-	-	(247)	-	-	(247)
Other comprehensive loss	-	-	-	-	(474)	-	(474)
Balance at June 30, 2019	**45,640**	**$ 436**	**$ 227,249**	**$ (122,506)**	**$ (14,181)**	**$ (10,668)**	**$ 80,330**

Six Months Ended June 30, 2020

	Number of Shares Issued	Common Stock	Additional Paid-in Capital	Accumulated Deficit	Accumulated Other Comprehensive Loss	Treasury Stock	Total Stockholders' Equity
Balance at December 31, 2019	45,934	$ 438	$ 229,189	$ (124,576)	$ (12,689)	$ (10,668)	$ 81,694
Stock option exercises	7	-	19	-	-	-	19
Stock purchase plan	64	-	167	-	-	-	167
Vesting of restricted stock units	514	-	-	-	-	-	-
Shares withheld for taxes	(105)	-	(262)	-	-	-	(262)
Stock compensation expense	-	-	1,562	-	-	-	1,562
Net loss	-	-	-	(6,097)		-	(6,097)
Other comprehensive loss	-	-	-		(1,015)	-	(1,015)
Balance at June 30, 2020	**46,414**	**$ 438**	**$ 230,675**	**$ (130,673)**	**$ (13,704)**	**$ (10,668)**	**$ 76,068**

Six Months Ended June 30, 2019

	Number of Shares Issued	Common Stock	Additional Paid-in Capital	Accumulated Deficit	Accumulated Other Comprehensive Loss	Treasury Stock	Total Stockholders' Equity
Balance at December 31, 2018	45,124	$ 436	$ 226,377	$ (119,889)	$ (13,532)	$ (10,668)	$ 82,724
Stock option exercises	3	-	-	-	-	-	-
Stock purchase plan	94	-	89	-	-	-	89
Vesting of restricted stock units	554	-		-	-	-	-
Shares withheld for taxes	(135)	-	(423)	-	-	-	(423)
Stock compensation expense	-	-	1,206	-	-	-	1,206
Net loss	-	-	-	(2,617)	-	-	(2,617)
Other comprehensive loss	-	-	-	-	(649)	-	(649)
Balance at June 30, 2019	**45,640**	**$ 436**	**$ 227,249**	**$ (122,506)**	**$ (14,181)**	**$ (10,668)**	**$ 80,330**

See accompanying notes to condensed consolidated financial statements.

HARVARD BIOSCIENCE, INC.
CONSOLIDATED STATEMENTS OF CASH FLOWS
(Unaudited, in thousands)

	Six Months Ended June 30, 2020	Six Months Ended June 30, 2019
Cash flows from operating activities:		
Net Loss	$ (6,097)	$ (2,617)
Adjustments to reconcile net loss to net cash provided by operating activities:		
Depreciation	982	972
Impairment charges	-	941
Amortization of intangible assets	2,881	2,866
Amortization of deferred financing costs	197	189
Stock-based compensation expense	1,562	1,206
Provision for allowance for doubtful accounts	4	368
Other non-cash charges	419	9
Changes in operating assets and liabilities:		
Accounts receivable	5,855	2,681
Inventories	(1,374)	(209)
Other assets	(601)	150
Accounts payable	1,250	(1,382)
Accrued income taxes	343	(361)
Other current liabilities	332	(1,371)
Deferred revenue	(276)	(288)
Other long-term liabilities	(233)	(487)
Net cash provided by operating activities	5,244	2,667
Cash flows from investing activities:		
Additions to property, plant and equipment	(524)	(423)

Disposition	-	1,020
Other	-	(9)
Net cash (used in) provided by investing activities	(524)	588
Cash flows from financing activities:		
Proceeds from issuance of debt	6,115	2,300
Repayments of debt	(16,411)	(8,503)
Taxes paid for net share settlement of equity awards	(75)	(334)
Net cash used in financing activities	(10,371)	(6,537)
Effect of exchange rate changes on cash	(55)	43
Decrease in cash and cash equivalents	(5,706)	(3,239)
Cash and cash equivalents at beginning of period	8,335	8,173
Cash and cash equivalents at end of period	$ 2,629	$ 4,934
Supplemental disclosures of cash flow information:		
Cash paid for interest	$ 2,549	$ 2,861
Cash paid for income taxes	$ 98	$ 299

See accompanying notes to condensed consolidated financial statements.

HARVARD BIOSCIENCE, INC.

NOTES TO UNAUDITED CONSOLIDATED FINANCIAL STATEMENTS

1. Basis of Presentation, Risks and Uncertainties, and Summary of Significant Accounting Policies

Basis of Presentation

The unaudited consolidated financial statements of Harvard Bioscience, Inc. and its wholly-owned subsidiaries (collectively, Harvard Bioscience or the Company) as of June 30, 2020 and for the three and six months ended June 30, 2020 and 2019, have been prepared by the Company pursuant to the rules and regulations of the Securities and Exchange Commission (SEC). Certain information and footnote disclosures normally included in financial statements prepared in accordance with U.S. generally accepted accounting principles (U.S. GAAP) have been condensed or omitted pursuant to such rules and regulations. The December 31, 2019 consolidated balance sheet was derived from audited financial statements but does not include all disclosures required by U.S. GAAP. However, the Company believes that the disclosures are adequate to make the information presented not misleading. These unaudited consolidated financial statements should be read in conjunction with the consolidated financial statements and the notes thereto included in the Company's Annual Report on Form 10-K for the fiscal year ended December 31, 2019, which was filed with the SEC on March 16, 2020.

In the opinion of management, all adjustments, which include normal recurring adjustments necessary to present a fair statement of financial position as of June 30, 2020, results of operations and comprehensive income (loss) for the three and six months ended June 30, 2020 and 2019 and cash flows for the six months ended June 30, 2020 and 2019, as applicable, have been made. The results of operations for the three and six months ended June 30, 2020 are not necessarily indicative of the operating results for the full fiscal year or any future periods.

Risks and Uncertainties

On March 11, 2020, the World Health Organization declared the outbreak of a novel coronavirus (COVID-19) as a pandemic. The COVID-19 pandemic has had a negative impact on the Company's operations to date and the future impacts of the pandemic and any resulting economic impact are largely unknown and rapidly evolving. Since the COVID-19 outbreak in the United States, Europe and elsewhere, many customers, particularly academic research institutions, have been unable to maintain laboratory work which has, and will continue to, negatively impact our sales. Additionally, to ensure business continuity while maintaining a safe environment for employees aligned with guidance from government and health organizations, the Company transitioned the majority of its workforce to work-from-home while implementing social distancing requirements and other measures in factories to allow manufacturing and other personnel essential to production to continue work within our facilities. Business travel was significantly reduced during this period. While the Company has maintained operations under these conditions, these measures represent disruptions which can impact productivity including sales and marketing activities. Accordingly, these conditions in addition to the overall impact on the global economy has negatively impacted our results of operations and cash flows.

As a result of these market and economic conditions, in accordance with the guidelines set forth in ASC 350 and ASC 360, the Company performed an analysis for potential interim impairment indicators of its intangible and other long-lived assets. As of June 30, 2020, the Company concluded there were no impairments of goodwill, other indefinite-lived intangibles, or long-lived assets that resulted from triggering events due to the COVID-19 pandemic.

Summary of Significant Accounting Policies

The accounting policies underlying the accompanying unaudited consolidated financial statements are those set forth in Note 2 to the consolidated financial statements included in the Company's Annual Report on Form 10-K for the year ended December 31, 2019, which was filed with the SEC on March 16, 2020. There have been no material changes in the Company's significant accounting policies during the three and six months ended June 30, 2020.

2. Recently Issued Accounting Pronouncements

Accounting Pronouncements to be Adopted

In June 2016, the FASB issued ASU No. 2016-13, *Financial Instruments—Credit Losses (Topic 326): Measurement of Credit Losses on Financial Instruments*, 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. ASU 2016-13 is effective for the Company for fiscal years beginning after December 15, 2022, with early adoption permitted. The Company is evaluating the impact of adopting ASU 2016-13 and related amendments will have on its consolidated financial position, results of operations and cash flows.

In August 2018, the FASB issued ASU No. 2018-14, *Disclosure Framework—Changes to the Disclosure Requirements for Defined Benefit Plans*, which amends ASC 715 to add, remove and clarify disclosure requirements related to defined benefit pension and other postretirement plans. The ASU is effective for public entities for fiscal years beginning after December 15, 2020, with early adoption permitted. Management has not yet completed its assessment of the impact of the new standard on the Company's Consolidated Financial Statements.

In December 2019, the FASB issued ASU 2019-12, *Income Taxes (Topic 740): Simplifying the Accounting for Income Taxes*, which enhances and simplifies various aspects of the income tax accounting guidance related to intra-period tax allocation, interim period accounting for enacted changes in tax law, and the year-to-date loss limitation in interim period tax accounting. ASU 2019-12 also amends other aspects of the guidance to reduce complexity in certain areas. ASU 2019-12 will become effective for the Company on January 1, 2021. Early adoption is permitted. The Company is evaluating the impact of adopting this guidance to its financial statements and related disclosures.

3. Accumulated Other Comprehensive Loss

Changes in each component of accumulated other comprehensive loss, net of tax, for the six months ended June 30, 2020 are as follows:

(in thousands)	Foreign currency translation adjustments	Derivatives qualifying as hedges	Defined benefit pension plans	Total
Balance at December 31, 2019	$ (13,173)	$ (603)	$ 1,087	$ (12,689)
Other comprehensive (loss) income before reclassifications	(957)	(227)	-	(1,184)
Amounts reclassified from AOCI into Income	-	169	-	169
Net other comprehensive (loss) income	(957)	(58)	-	(1,015)
Balance at June 30, 2020	$ (14,130)	$ (661)	$ 1,087	$ (13,704)

4. Goodwill and Intangible Assets

Goodwill

The change in the carrying amount of goodwill for the six months ended June 30, 2020 is as follows:

(in thousands)	
Balance at December 31, 2019	$ 57,381
Effect of change in currency translation	(423)
Balance at June 30, 2020	$ 56,958

Intangible Assets

Amortizable intangible assets:	Weighted Average Life*	June 30, 2020 Gross	June 30, 2020 Accumulated Amortization	June 30, 2020 Net	December 31, 2019 Gross	December 31, 2019 Accumulated Amortization	December 31, 2019 Net
		(in thousands)					
Distribution agreements/customer relationships	9.3 Years	$ 17,886	$ (6,987)	$ 10,899	$ 17,891	$ (6,340)	$ 11,551
Existing technology	5.7 Years	40,976	(21,277)	19,699	41,222	(19,698)	21,524
Trade names	5.9 Years	8,586	(3,924)	4,662	7,692	(3,497)	4,195
Patents	- Years	205	(205)	-	218	(218)	-
Total amortizable intangible assets		$ 67,653	$ (32,393)	$ 35,260	$ 67,023	$ (29,753)	$ 37,270
Indefinite-lived intangible assets:				235			1,135
Total intangible assets				$ 35,495			$ 38,405

* Weighted average life as of June 30, 2020.

Effective January 1, 2020, the Company determined that $0.9 million of tradenames previously classified as indefinite-lived should be classified as amortizing due to anticipated changes in worldwide marketing programs and estimated an economic life of 4 years for this intangible asset.

Intangible asset amortization expense was $1.5 million and $1.4 million for the three months ended June 30, 2020 and 2019, respectively. Intangible asset amortization expense was $2.9 million for each of the six months ended June 30, 2020 and 2019.

Estimated amortization expense of existing amortizable intangible assets for each of the five succeeding years and thereafter as of June 30, 2020 is as follows:

Year Ending December 31,	Amortization Expense
2020 (remainder of year)	$ 2,844
2021	5,703
2022	5,672
2023	5,569
2024	5,267
Thereafter	10,205
Total	$ 35,260

5. Balance Sheet Information

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

Inventories:

	June 30, 2020	December 31, 2019
	(in thousands)	
Finished goods	$ 5,749	$ 5,561
Work in process	3,929	3,153
Raw materials	13,503	13,347
Total	$ 23,181	$ 22,061

Other Current Liabilities:

	June 30, 2020	December 31, 2019
	(in thousands)	
Compensation and payroll	$ 2,924	$ 2,554
Professional fees	563	395
Warranty costs	193	252
Customer related costs	996	963
Interest	415	425
Other	1,299	1,502
Total	$ 6,390	$ 6,091

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 restructuring-type activities from time-to-time to transform its business.

The following table summarizes the activity for restructuring liabilities as of June 30, 2020, substantially all of which relates to employee severance and other employee costs:

(in thousands)	Severance Costs	Other	Total
Balance at December 31, 2019	$ 364	$ 4	$ 368
Restructuring charges	834	40	874
Adjustments	(45)	-	(45)
Cash payments	(569)	(36)	(605)
Balance at March 31, 2020	$ 584	$ 8	$ 592
Restructuring charges	562	186	748
Non-cash portion	-	(168)	(168)
Cash payments	(531)	(26)	(557)
Balance at June 30, 2020	$ 615	$ -	$ 615

As of June 30, 2020, the Company had a restructuring liability of $0.6 million which is payable within the next twelve months and has been included in other current liabilities in the consolidated balance sheet.

7. Related Party Transactions

In connection with the 2014 acquisitions of Multi Channel Systems MCS GmbH (MCS) and Triangle BioSystems, Inc.(TBSI), the Company entered into facility lease agreements with the former principal owners of these companies and both became employees of the Company. The TBSI agreement expired on September 30, 2019, and the MCS agreement expires on December 31, 2024. Pursuant to these lease agreements, the Company made rent payments of approximately $0.1 million and $0.2 million for the three and six months ended June 30, 2020, and $0.1 million and $0.2 million for the three and six months ended June 30, 2019, respectively.

8. Leases

The Company has noncancelable operating leases for office, manufacturing facilities, warehouse space, automobiles and equipment expiring at various dates through 2024 and thereafter.

The components of lease expense for the three and six months ended June 30, 2020 and 2019 are as follows:

	Three Months Ended June 30, 2020	Three Months Ended June 30, 2019	Six Months Ended June 30, 2020	Six Months Ended June 30, 2019
	(in thousands)		(in thousands)	
Operating lease cost	$ 544	$ 515	$ 1,079	$ 1,038
Short term lease cost	43	51	85	127
Sublease income	(25)	(103)	(132)	(205)
Total lease cost	$ 562	$ 463	$ 1,032	$ 960

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

	Six Months Ended June 30, 2020	Six Months Ended June 30, 2019
	(in thousands)	
Cash paid for amounts included in the measurement of lease liabilities	$ 1,381	$ 1,367
Right of use assets obtained in exchange for lease obligations operating leases	387	-

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

	June 30, 2020	December 31, 2019
	(in thousands)	
Operating lease right-of use assets	$ 8,165	$ 8,463
Current portion, operating lease liabilities	$ 2,249	$ 2,424
Operating lease liabilities, long term	7,887	8,224
Total operating lease liabilities	$ 10,136	$ 10,648
Weighted average remaining lease term (years)	7.7	8.1
Weighted average discount rate	9.2%	9.2%

Future minimum lease payments for operating leases, with initial or remaining terms in excess of one year at June 30, 2020, are as follows:

	Operating Leases
	(in thousands)
2021	$ 2,241
2022	1,988
2023	1,929
2024	1,923
2025	1,244
Thereafter	5,314
Total lease payments	14,639
Less interest	(4,503)
Total operating lease liabilities	$ 10,136

9. Capital Stock and Stock-Based Compensation

Fourth Amended and Restated 2000 Stock Option and Incentive Plan

On June 11, 2020, the stockholders of the Company approved the Fourth Amended and Restated 2000 Stock Option and Incentive Plan (the Fourth A&R Plan), which plan authorizes the grant of stock options and stock-based awards to officers, employees, non-employee directors and other key persons of the Company and its subsidiaries. The Fourth A&R Plan modified the Company’s Third Amended and Restated 2000 Stock Option and Incentive Plan to, among other things, increase the aggregate number of shares authorized for issuance by 3,700,000 shares to 24,608,929 and reduce the fungible share ratio for deferred stock awards from 1.79 to 1.49. As of June 30, 2020, there were up to 3,264,267 shares available for issuance under the Fourth A&R Plan.

Stock-Based Payment Awards

Stock option and restricted stock unit activity for the six months ended June 30, 2020 were as follows:

	Stock Options		Restricted Stock Units		Market Condition RSU's	
	Stock Options Outstanding	Weighted Average Exercise Price	Restricted Stock Units Outstanding	Grant Date Fair Value	Market Condition RSU's Outstanding	Grant Date Fair Value
Balance at December 31, 2019	2,266,122	$ 3.93	1,590,450	$ 2.27	529,491	$ 1.67
Granted	894,154	2.61	994,513	2.73	332,622	2.98
Exercised	(7,359)	2.56	-	-	-	-
Expired	(15,819)	2.59	-	-	-	-
Vested (RSUs)	-	-	(513,779)	2.59	-	-
Cancelled / forfeited	(233,080)	3.55	(70,313)	3.24	(39,286)	3.03
Balance at June 30, 2020	2,904,018	$ 3.56	2,000,871	$ 2.38	822,827	$ 2.13

As of June 30, 2020, the total compensation costs related to unvested awards not yet recognized is $6.5 million and the weighted average period over which it is expected to be recognized is approximately 2.5 years.

Valuation and Expense Information under Stock-Based-Payment Accounting

Stock-based compensation expense for the three and six months ended June 30, 2020 and 2019 was allocated as follows:

	Three Months Ended June 30,		Six Months Ended June 30,	
	2020	2019	2020	2019
	(in thousands)		(in thousands)	
Cost of revenues	$ 14	$ 8	$ 24	$ 21
Sales and marketing expenses	62	36	113	29
General and administrative expenses	645	529	1,341	1,080
Research and development expenses	48	42	84	76
Total stock-based compensation expenses	$ 769	$ 615	$ 1,562	$ 1,206

The Company did not capitalize any stock-based compensation.

The weighted-average estimated fair value per share of stock options granted during the six months ended June 30, 2020 and six months ended June 30, 2019 was $1.21 and $0.97, respectively. The weighted average estimated fair value per share of stock options granted during the six months ended June 30, 2020 and June 30, 2019 was $1.21 and $1.56, respectively.

The following assumptions were used to estimate the fair value of the options granted during the six months ended June 30, 2020:

Volatility	58.5%
Risk-free interest rate	0.3%
Expected holding period (in years)	4.4 years
Dividend Yield	-%

The weighted average fair value of the 2020 Market Condition RSUs that were granted during the six months ended June 30, 2020 was $2.98. The weighted average fair value of the 2019 Market Condition RSUs that were granted during the six months ended June 30, 2019 was $4.16.

The following assumptions were used to estimate the fair value, using a Monte-Carlo valuation simulation, of the Market Condition RSUs granted during the six months ended June 30, 2020:

Volatility	80.6%
Risk-free interest rate	0.2%
Correlation coefficient	0.3
Dividend yield	-%

Earnings (Loss) Per Share

Basic earnings (loss) per share is calculated by dividing net income (loss) by the number of weighted average common shares outstanding during the period. The calculation of diluted earnings per share assumes conversion of stock options, restricted stock units and Market Condition RSUs into common stock using the treasury method. The weighted average number of shares used to compute basic and diluted earnings per share consists of the following:

	Three Months Ended June 30,		Six Months Ended June 30,	
	2020	2019	2020	2019
Basic	38,467,686	37,735,717	38,389,358	37,682,539
Dilutive effect of equity awards	-	-	-	-
Diluted	38,467,686	37,735,717	38,389,358	37,682,539

Excluded from the shares used in calculating the diluted earnings per common share in the above table are options, restricted stock units and Market Condition RSUs of approximately 5,727,716 and 3,300,586 as of June 30, 2020 and 2019, respectively, as the impact of these shares would be anti-dilutive.

10. Long Term Debt

As of June 30, 2020, and December 31, 2019, the Company's borrowings were comprised of:

	June 30, 2020	December 31, 2019
	(in thousands)	
Long-term debt:		
Term loan	$ 44,711	54,997
Revolving line	-	-
Less: unamortized deferred financing costs	(983)	(1,180)
Total debt	43,728	53,817
Less: current installments	(3,200)	(3,200)
Less: excess cash flow sweep	-	(4,093)
Current unamortized deferred financing costs	393	393
Long-term debt	$ 40,921	$ 46,917

On January 31, 2018, the Company entered into a financing agreement by and among the Company and certain subsidiaries of the Company as borrowers (collectively, the Borrower), certain subsidiaries of the Company as guarantors, various lenders from time to time (the Lenders), and Cerberus Business Finance, LLC, as collateral agent and administrative agent for the Lenders (the Financing Agreement).

The Financing Agreement provided for senior secured credit facilities comprised of a $64.0 million term loan and up to a $25.0 million revolving line of credit subject to available borrowing base. The revolving facility is available for use by the Company and its subsidiaries for general corporate and working capital needs, and other purposes to the extent permitted by the Financing Agreement. Borrowings available under the revolving line of credit are limited to a borrowing base derived from the Company's eligible accounts receivable and inventory, as defined in the Financing Agreement. As of June 30, 2020, borrowings available under the revolving facility were $7.5 million.

The Financing Agreement contains certain restrictive covenants, including a requirement to maintain a maximum leverage ratio among other financial and non-financial covenants, as defined in the Financing Agreement. The Company is compliant with all covenants under the Financing Agreement as of June 30, 2020. The maximum permitted leverage is the ratio of total debt to consolidated EBITDA, as defined in the Financing Agreement. The maximum permitted leverage ratio is 3.25 as of June 30, 2020 and for all quarters thereafter until the maturity of the Financing Agreement in 2023. Due to the negative impact of the COVID-19 pandemic on the Company's revenue and consolidated EBITDA, the gap between the leverage ratio and maximum permitted leverage has reduced. During the three months ended June 30, 2020, the Company made an additional principal payment of $4.7 million on its term loan.

Based on the Company's current operating plans, including actions taken to mitigate the negative impact of the COVID-19 pandemic on the Company's business and financial condition, it expects that available cash, cash generated from current operations and debt capacity will be sufficient to finance current operations, any costs associated with restructuring activities and capital expenditures. This assessment includes consideration of the Company's best estimates of the impact of the COVID-19 pandemic on its financial results. If the negative impact of the COVID-19 pandemic is more significant than anticipated it may impact the Company's ability to comply with financial covenants in the future, which would require the Company to seek an amendment or waivers from its lenders, limit access to or require accelerated repayment of the existing credit facilities, or require the Company to pursue alternative financing. There are no assurances that any such alternative financing, if required, could be obtained at terms acceptable to the Company, or at all.

As of June 30, 2020, the weighted effective interest rate, net of the impact of the Company's interest rate swap, on its borrowings was 8.9%. 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.

On April 18, 2020, the Company entered into a promissory note with PNC Bank, National Association, which provided for a loan in the amount of $6.1 million (the PPP Loan) pursuant to the Paycheck Protection Program (the PPP) of the CARES Act administered by the U.S. Small Business Administration (the SBA). On April 23, 2020, the SBA, in consultation with the U.S. Department of the Treasury issued guidance regarding consideration of alternate available sources of liquidity and its impact on qualification for PPP loans. The Company reassessed its business plans and liquidity available under its existing credit facility and elected to repay all PPP funds. The PPP Loan was repaid in full on May 4, 2020.

11. 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 does not enter into derivative instruments for any purpose other than cash flow hedging. The Company does not speculate using derivative instruments.

By using derivative financial instruments to hedge exposures 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 carefully selected 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 assesses interest rate risk by continually identifying and monitoring changes in interest rate exposures that may adversely impact expected future cash flows and by evaluating hedging opportunities. The Company maintains risk management control systems to monitor interest rate risk attributable to both the Company's outstanding and forecasted debt obligations as well as the Company's offsetting hedge positions. The risk management control systems involve the use of analytical techniques, including cash flow sensitivity analysis, to estimate the expected impact of changes in interest rates on the Company's future cash flows.

The Company uses variable-rate LIBOR debt to finance its operations. The debt obligations expose the Company to variability in interest payments due to changes in interest rates. Management believes that it is prudent to limit the variability of a portion of its interest payments. To meet this objective, management enters into LIBOR based interest rate swap agreements to manage fluctuations in cash flows resulting from changes in the benchmark interest rate of LIBOR. These swaps change the variable-rate cash flow exposure on the debt obligations to fixed cash flows. Under the terms of the interest rate swaps, the Company receives LIBOR based variable interest rate payments and makes fixed interest rate payments, thereby creating the equivalent of fixed-rate debt for the notional amount of its debt hedged.

As disclosed in Note 10, on January 31, 2018, the Company entered into a Financing Agreement comprised of a $64.0 million term loan and up to a $25.0 million revolving line of credit. Shortly after entering into this Financing Agreement, the Company entered into an interest rate swap contract with PNC Bank with a notional amount of $36.0 million and a termination date of January 1, 2023 in order to hedge the risk of changes in the effective benchmark interest rate (LIBOR) associated with the Company's term loan. The swap contract converted specific variable-rate debt into fixed-rate debt and fixed the LIBOR rate associated with a portion of the term loan under the Financing Agreement at 2.72%. The interest rate swap was designated as a cash flow hedge instrument in accordance with ASC 815 "Derivatives and Hedging".

The following table presents the notional amount and fair value of the Company's derivative instruments as of June 30, 2020 and December 31, 2019.

		June 30, 2020	
		Notional Amount	**Fair Value (a)**
Derivatives instruments	**Balance sheet classification**	(in thousands)	
Interest rate swaps	Other long-term liabilities	$ 25,683	$ (661)

		December 31, 2019	
		Notional Amount	**Fair Value (a)**
Derivatives instruments	**Balance sheet classification**	(in thousands)	
Interest rate swaps	Other long-term liabilities	$ 28,821	$ (603)

(a) See Note 12 for the fair value measurements related to these financial instruments.

All of the Company's derivative instruments are designated as hedging instruments. The Company has structured its interest rate swap agreements to be 100% effective and as a result, there was no impact to earnings resulting from hedge ineffectiveness. Changes in the fair value of interest rate swaps designated as hedging instruments that effectively offset the variability of cash flows associated with variable-rate, long-term debt obligations are reported in accumulated other comprehensive income (AOCI). These amounts subsequently are reclassified into interest expense as a yield adjustment of the hedged interest payments in the same period in which the related interest affects earnings. The Company's interest rate swap agreement was deemed to be fully effective in accordance with ASC 815, and, as such, unrealized gains and losses related to these derivatives were recorded as AOCI.

The following table summarizes the effect of derivatives designated as cash flow hedging instruments and their classification within comprehensive loss for the three and six months ended June 30, 2020 and 2019:

Derivatives in Hedging Relationships	**Amount of gain (loss) recognized in OCI on derivative (effective portion)**			
	Three Months Ended June 30,		**Six Months Ended June 30,**	
	2020	**2019**	**2020**	**2019**
	(in thousands)			
Interest rate swaps	$ (11)	$ (298)	$ (227)	$ (494)

The following table summarizes the reclassifications out of accumulated other comprehensive loss for the three and six months ended June 30, 2020 and 2019:

Details about AOCI Components	**Amount reclassified from AOCI into income (effective portion)**				
	Three Months Ended June 30,		**Six Months Ended June 30,**		**Location of amount reclassified from AOCI into income (effective portion)**
	2020	**2019**	**2020**	**2019**	
	(in thousands)				
Interest rate swaps	$ 97	$ 19	$ 169	$ 36	Interest expense

As of June 30, 2020, $0.3 million of deferred losses on derivative instruments accumulated in AOCI are expected to be reclassified to earnings during the next twelve months. Transactions and events expected to occur over the next twelve months that will necessitate reclassifying these derivatives' losses to earnings include the repricing of variable-rate debt.

12. Fair Value of Financial Instruments

The carrying values of the Company's cash and cash equivalents, trade accounts receivable and 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 is 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.

Fair value measurement is defined as the price that would be received to sell an asset or paid to transfer a liability in the principal or most advantageous market for the asset or liability in an orderly transaction between market participants at the measurement date. A fair value hierarchy is established, which prioritizes the inputs used in measuring fair value into three broad levels as follows:

Level 1—Quoted prices in active markets for identical assets or liabilities.

Level 2—Inputs, other than the quoted prices in active markets, that are observable either directly or indirectly.

Level 3—Unobservable inputs based on the Company's own assumptions.

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 June 30, 2020			
(in thousands)	Level 1	Level 2	Level 3	Total
Assets (Liabilities):				
Interest rate swap agreements	$ -	$ (661)	$ -	$ (661)

	Fair Value as of December 31, 2019			
(in thousands)	Level 1	Level 2	Level 3	Total
Assets (Liabilities):				
Interest rate swap agreements	$ -	$ (603)	$ -	$ (603)

The Company uses the market approach technique to value its financial liabilities. The Company's financial assets and liabilities carried at fair value include derivative instruments used to hedge the Company's interest rate risks. The fair value of the Company's interest rate swap agreements was based on LIBOR yield curves at the reporting date.

13. Revenues

The following table represents a disaggregation of revenue from contracts with customers. Revenue originating from the following geographic areas for the three and six months ended June 30, 2020 and 2019 consist of:

	Three Months Ended June 30, 2020 (in thousands)				
	United States	United Kingdom	Germany	Rest of the world	Total
Instruments, equipment, software and accessories	$ 16,490	$ 1,992	$ 2,382	$ 1,205	$ 22,069
Service, maintenance and warranty contracts	970	211	34	24	1,239
Total revenues	$ 17,460	$ 2,203	$ 2,416	$ 1,229	$ 23,308

	Three Months Ended June 30, 2019 (in thousands)				
	United States	United Kingdom	Germany	Rest of the world	Total
Instruments, equipment, software and accessories	$ 20,920	$ 2,399	$ 3,271	$ 1,753	$ 28,343
Service, maintenance and warranty contracts	910	236	79	16	1,241
Total revenues	$ 21,830	$ 2,635	$ 3,350	$ 1,769	$ 29,584

	Six Months Ended June 30, 2020 (in thousands)				
	United States	United Kingdom	Germany	Rest of the world	Total
Instruments, equipment, software and accessories	$ 32,446	$ 4,499	$ 4,955	$ 3,106	$ 45,006
Service, maintenance and warranty contracts	1,545	415	73	40	2,073
Total revenues	$ 33,991	$ 4,914	$ 5,028	$ 3,146	$ 47,079

	Six Months Ended June 30, 2019 (in thousands)				
	United States	United Kingdom	Germany	Rest of the world	Total
Instruments, equipment, software and accessories	$ 39,591	$ 5,528	$ 6,184	$ 3,798	$ 55,101
Service, maintenance and warranty contracts	2,053	426	176	30	2,685
Total revenues	$ 41,644	$ 5,954	$ 6,360	$ 3,828	$ 57,786

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Deferred revenue

The Company had deferred revenue from service contracts and advance payments from customers of approximately $3.7 million and $3.5 million as of June 30, 2020 and 2019, respectively. Changes in deferred revenue from service contracts and advance payments from customers were as follows:

	Three Months Ended June 30, 2020 (in thousands)		
	Service Contracts	**Customer Advances**	**Total**
Balance at March 31, 2020	$ 1,410	$ 2,263	$ 3,673
Deferral of revenue	522	121	643
Recognition of deferred revenue	(489)	(145)	(634)
Effect of foreign currency translation	(30)	-	(30)
Balance at June 30, 2020	$ 1,413	$ 2,239	$ 3,652

	Three Months Ended June 30, 2019 (in thousands)		
	Service Contracts	**Customer Advances**	**Total**
Balance at March 31, 2019	$ 1,666	$ 2,049	$ 3,715
Deferral of revenue	281	140	421
Recognition of deferred revenue	(344)	(250)	(594)
Effect of foreign currency translation	(10)	-	(10)
Balance at June 30, 2019	$ 1,593	$ 1,939	$ 3,532

	Six Months Ended June 30, 2020 (in thousands)		
	Service Contracts	**Customer Advances**	**Total**
Balance at December 31, 2019	$ 1,587	$ 2,362	$ 3,949
Deferral of revenue	830	344	1,174
Recognition of deferred revenue	(988)	(467)	(1,455)
Effect of foreign currency translation	(16)	-	(16)
Balance at June 30, 2020	$ 1,413	$ 2,239	$ 3,652

	Six Months Ended June 30, 2019 (in thousands)		
	Service Contracts	**Customer Advances**	**Total**
Balance at December 31, 2018	$ 1,659	$ 2,161	$ 3,820
Deferral of revenue	1,126	251	1,377
Recognition of deferred revenue	(1,192)	(473)	(1,665)
Effect of foreign currency translation	-	-	-
Balance at June 30, 2019	$ 1,593	$ 1,939	$ 3,532

Allowance for Doubtful Accounts

Allowance for doubtful accounts is based on the Company's assessment of the collectability of accounts receivable. A rollforward of allowance for doubtful accounts is as follows:

	Six Months Ended June 30,	
	2020	2019
	(in thousands)	
Balance, beginning of period	$ 325	$ 332
Bad debt expense	4	368
Charge-offs and other recoveries	(40)	(329)
Effect of foreign currency translation	1	(1)
Balance, end of period	$ 290	$ 370

Concentrations

No customer accounted for more than 10% of the revenues for the three and six months ended June 30, 2020, and 2019, respectively. At June 30, 2020, and December 31, 2019, no customer accounted for more than 10% of net accounts receivable.

14. Income Tax

Income tax expense was approximately $0.7 million for the three months ended June 30, 2020 and income tax benefit was $(0.9) million for the three months June 30, 2019. The effective tax rate was (82.1)% for the three months ended June 30, 2020 compared with 78.2% for the same period in 2019.

Income tax expense was approximately $0.8 million for the six months ended June 30, 2020 and income tax benefit was $(0.3) million for the six months ended June 30, 2019. The effective tax rate was (14.4)% for the six months ended June 30, 2020 compare with 10.6% for the same period in 2019.

The difference between the Company's effective tax rates in 2020 and 2019 compared to the U.S. statutory tax rate of 21% is primarily due to the mix of 2020 forecasted income or losses in the U.S. and foreign tax jurisdictions, the impact of different tax rates in certain foreign jurisdictions, changes to uncertain tax positions, and the impact of the inclusion of foreign income in U.S. taxable income under the GILTI (Global Intangible Low-Taxed Income) tax rules. The effective tax rate in 2020 was also impacted by increases to valuation allowances and changes made by the Coronavirus Aid, Relief, and Economic Security Act (the CARES Act) to the limitation on interest expense deductions, including a retroactive change to the calendar year 2019 deduction.

15. Commitments and Contingent Liabilities

On April 14, 2017, representatives for the estate of an individual plaintiff filed a wrongful death complaint with the Suffolk Superior Court, in the County of Suffolk, Massachusetts, against the Company and other defendants, including Biostage, Inc. (f/k/a Harvard Apparatus Regenerative Technology, Inc.), the Company's former subsidiary that was spun off in 2013, as well as another third party. The complaint seeks payment for an unspecified amount of damages and alleges that the plaintiff sustained terminal injuries allegedly caused by products, including synthetic trachea scaffolds and bioreactors, provided by certain of the named defendants and utilized in connection with surgeries performed by third parties in 2012 and 2013. The litigation is at an early stage and the Company intends to vigorously defend this case and has contacted its liability insurance carrier to request defense and indemnification of any losses incurred in connection with this lawsuit. While the Company believes that such claim is without merit, the Company is unable to predict the ultimate outcome of this litigation.

The Company is involved in various other claims and legal proceedings arising in the ordinary course of business. Based on the consultation with the Company's legal counsel, the ultimate disposition of such proceedings is not likely to have a material adverse effect on the Company's business, financial condition, results of operations or cash flows. The Company has not accrued for loss contingencies relating to any such matters because the Company believes that, although unfavorable outcomes in the proceedings are possible, they are not considered by management 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 its business, financial condition, results of operations and cash flows could be material.

Item 2. Management's Discussion and Analysis of Financial Condition and Results of Operations.

Forward-Looking Statements

This Quarterly Report on Form 10-Q 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). The forward-looking statements are principally, but not exclusively, contained in "Item 2: 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, 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," *"potential," "objectives," "optimistic," "strategy," "goals," "sees," "new," "guidance," "future," "continue," "drive," "growth," "long-term," "projects," "develop," "possible," "emerging," "opportunity," "pursue" 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. Factors that may cause our actual results to differ materially from those in the forward-looking statements include the duration and severity of the COVID-19 pandemic and its impact on our business; reductions in customers' research budgets or government funding; domestic and global economic conditions; economic, political and other risks associated with international revenues and operations; recently enacted U.S. government tax reform; currency exchange rate fluctuations; economic and political conditions generally and those affecting pharmaceutical and biotechnology industries; the seasonal nature of purchasing in Europe; our failure to expand into foreign countries and international markets; our inability to manage our growth; competition from our competitors; our substantial debt and our ability to meet the financial covenants contained in our credit facility; failure or inadequacy of the our information technology structure; impact of difficulties implementing our enterprise resource planning systems; information security incidents or cybersecurity breaches; our failure to identify potential acquisition candidates and successfully close such acquisitions with favorable pricing or integrate acquired businesses or technologies; unanticipated costs relating to acquisitions and known and unknown costs arising in connection with our consolidation of business functions and our current and any future restructuring initiatives; failure of any banking institution in which we deposit our funds or its failure to provide services; our failure to raise or generate capital necessary to implement our acquisition and expansion strategy; the failure of Biostage to indemnify us for any liabilities associated with Biostage's business; impact of any impairment of our goodwill or intangible assets; our ability to retain key personnel; failure or inadequacy or our information technology structure; rising commodity and precious metals costs; our ability to protect our intellectual property and operate without infringing on others' intellectual property; exposure to product and other liability claims; global stock market volatility, currency exchange rate fluctuations and regulatory changes caused by the United Kingdom's exit from the European Union; plus other factors described under the heading "Item 1A. Risk Factors" in our Annual Report on Form 10-K for year ended December 31, 2019, and our Quarterly Report on Form 10-Q for the quarter ended March 31, 2020, or described in our other public filings. Our results may also be affected by factors of which we are not currently aware. 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.*

Unless the context requires otherwise, references in this Quarterly Report to "we," "us" and "our" refer to Harvard Bioscience, Inc., and its subsidiaries.

Overview

Harvard Bioscience is a leading developer, manufacturer and seller of technologies, products and services that enable fundamental research, discovery, and pre-clinical testing for drug development. Our customers range from renowned academic institutions and government laboratories, to the world's leading pharmaceutical, biotechnology and contract research organizations. With operations in North America, Europe, and China, we sell through a combination of direct and distribution channels to customers around the world.

Recent Developments

COVID-19

On March 11, 2020, the World Health Organization declared the outbreak of a novel coronavirus (COVID-19) as a pandemic. The COVID-19 pandemic has had a negative impact on our operations to date and the future impacts of the pandemic and any resulting economic impact are largely unknown and rapidly evolving. Since the COVID-19 outbreak in the United States, Europe and elsewhere, many customers, particularly academic research institutions, have been unable to maintain laboratory work which has, and will continue to, negatively impact our sales. Additionally, to ensure business continuity while maintaining a safe environment for employees aligned with guidance from government and health organizations, we transitioned the majority of our workforce to work-from-home while implementing social distancing requirements and other measures in factories to allow manufacturing and other personnel essential to production to continue work within our facilities. Business travel was significantly reduced during this period. While we have maintained operations under these conditions, these measures represent disruptions which can impact productivity including sales and marketing activities. Accordingly, these conditions in addition to the overall impact on the global economy has negatively impacted our results of operations and cash flows.

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As a result of market and economic conditions, in accordance with the guidelines set forth in ASC 350 and ASC 360, we performed an analysis for potential interim impairment indicators of our intangible and other long-lived assets. As of June 30, 2020, we concluded there were no impairments of goodwill, other indefinite-lived intangibles, or long-lived assets that resulted from triggering events due to COVID-19.

We currently believe revenue for the three months ending September 30, 2020 will significantly decline year over year due to the conditions noted and to begin recovering as academic research institutions reopen. In April 2020, we implemented a COVID-19 mitigation plan designed to reduce expenses. Actions taken to date include work hour and salary reductions, reductions-in-force and a realignment of our organizational structure to reduce management layers. These cost reductions are in addition to the significant restructuring actions we initiated in the fourth quarter of 2019 as discussed below. The combined impact of COVID-19 mitigation actions and previously announced restructuring actions reduced expenses by over $3.0 million during the three months ending June 30, 2020 as compared to the three months ending March 31, 2020. If business interruptions resulting from COVID-19 were to be prolonged or expanded in scope, our business, financial condition, results of operations and cash flows would be negatively impacted. We will continue to actively monitor this situation and will implement actions necessary to maintain business continuity.

Restructuring Plan

In July 2019, we announced the appointment by the Board of Directors of James Green as President and Chief Executive Officer and the appointment of Michael Rossi as Chief Financial Officer. Immediately thereafter we began a process to identify opportunities to improve profitability, increase cash flow and enhance internal capabilities to position the business for organic growth. As a result of this assessment, in September 2019 we announced a strategic action plan for 2020 and 2021. Key elements of this plan include:

- Capitalizing on the strong existing Harvard Bioscience and Data Science franchises and products;

- Adding new senior leadership with significant experience with turnarounds and driving growth and operational improvements within global, middle market life science manufacturing businesses;

- Consolidation of sub-scale operations and integration of existing functions and processes to drive scale and reduce fixed costs;

- Increasing effectiveness of sales and product management to deliver organic sales growth; and

- Improve cash flow and reduce debt.

In December 2019, the Board of Directors approved a restructuring program ("2019 Restructuring Plan") to support delivery of the strategic action plan. The 2019 Restructuring Plan includes consolidation of our Connecticut manufacturing plant to our existing Massachusetts site, downsizing of operations in the United Kingdom and a reduction in force across the business amounting to approximately a 10% overall reduction in headcount. The 2019 Restructuring Plan is expected to deliver annualized run-rate savings of $4.0 million to $5.0 million. A portion of the savings generated is expected to be reinvested to drive profitable growth.

We have continued to execute the 2019 Restructuring Plan during the COVID-19 pandemic, and expanded the scope of the restructuring by realigning our organizational structure to reduce management layers and accelerated our efforts to move to a leaner organization and operation. As a result of this expanded scope, we eliminated additional headcount, which is expected to generate additional annualized cost savings of approximately $1.0 million.

As a result of the actions taken under the 2019 Restructuring Plan and incremental cost reduction actions taken to date in 2020, we expect to incur costs associated with headcount reductions, program management and other transition costs required to affect the site consolidations and other business improvements totaling $5.0 million to $6.0 million, substantially all of which is expected to result in cash outlays. Through the six months ended June 30, 2020, approximately $3.9 million of cash payments were made related to these restructuring activities.

We believe these strategic actions will improve our profitability and position the business for improved organic revenue growth.

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Selected Results of Operations

Three months ended June 30, 2020 compared to three months ended June 30, 2019

	Three Months Ended June 30,			
	2020	**% of revenue**	**2019**	**% of revenue**
	(dollars in thousands)			
Revenues	$ 23,308		$ 29,584	
Cost of revenues	9,452	40.6%	13,629	46.1%
Sales and marketing expenses	4,279	18.4%	5,770	19.5%
General and administrative expenses	5,670	24.3%	4,809	16.3%
Research and development expenses	1,897	8.1%	2,771	9.4%
Amortization of intangible assets	1,454	6.2%	1,436	4.9%
Impairment charges	-	-	941	3.2%
Interest expense	1,233	5.3%	1,376	4.7%
Income tax expense (benefit)	713	3.1%	(885)	-3.0%

Revenues

Revenues for the three months ended June 30, 2020 were $23.3 million, a decrease of approximately $6.3 million, or 21.2%, compared to revenues of $29.6 million for the three months ended June 30, 2019. The decrease in revenue was primarily due to the impact of the COVID-19 pandemic on our business, and in particular, lower sales to academic labs and other institutions that were temporarily closed or operating at reduced levels as a result of the pandemic.

Cost of revenues

Cost of revenues were $9.5 million for the three months ended June 30, 2020, a decrease of $4.1 million, or 30.6% compared with $13.6 million for the three months ended June 30, 2019. Gross margin as a percentage of revenues increased to 59.4% for the three months ended June 30, 2020 compared with 53.9% for the three months ended June 30, 2019. The increase in gross margin was primarily due to improved product mix with a higher percentage of revenue from higher end systems and software.

Sales and marketing expenses

Sales and marketing expenses decreased $1.5 million or 25.8% to $4.3 million for the three months ended June 30, 2020 compared to $5.8 million during the same period in 2019. The decrease in these expenses was primarily due to ongoing restructuring and cost reduction initiatives, as well as lower variable sales costs due to revenue reductions noted.

General and administrative expenses

General and administrative expenses were $5.7 million for the three months ended June 30, 2020, an increase of $0.9 million, or 17.9%, compared with $4.8 million for the three months ended June 30, 2019. The increase was primarily due to higher employee severance, other restructuring costs and stock-based compensation. Excluding these costs, general and administrative costs declined due to ongoing restructuring and cost reduction initiatives.

Research and development expenses

Research and development expenses were $1.9 million for the three months ended June 30, 2020, a decrease of $0.9 million, or 31.5%, compared with $2.8 million for the three months ended June 30, 2019. The decrease was primarily due to lower employee compensation and related costs due to ongoing restructuring and cost reduction initiatives.

Amortization of intangible assets

Amortization of intangible asset expenses was $1.5 million for the three months ended June 30, 2020 and did not change materially as compared to the three months ended June 30, 2019.

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Interest expense

Interest expense was $1.2 million for the three months ended June 30, 2020, a decrease of $0.2 million, or 10.4%, compared with $1.4 million for the three months ended June 30, 2019. The decrease was primarily due to reduced borrowings under our financing agreement.

Income tax expense (benefit)

Income tax expense was approximately $0.7 million for the three months ended June 30, 2020 and income tax benefit was approximately $(0.9) million for the three months ended June 30, 2019. The effective tax rate was (82.1)% for the three months ended June 30, 2020 compared with 78.2% % for the same period in 2019. The difference between our effective tax rates in 2020 and 2019 compared to the U.S. statutory tax rate of 21% is primarily due to the mix of 2020 forecasted income or losses in the U.S. and foreign tax jurisdictions, the impact of different tax rates in certain foreign jurisdictions, changes to uncertain tax positions, and the impact of the inclusion of foreign income in U.S. taxable income under the GILTI (Global Intangible Low-Taxed Income) tax rules. The effective tax rate in 2020 was also impacted by increases to valuation allowances and changes made by the Coronavirus Aid, Relief, and Economic Security Act (the CARES Act) to the limitation on interest expense deductions, including a retroactive change to our calendar year 2019 deduction.

Six months ended June 30, 2020 compared to six months ended June 30, 2019

	Six Months Ended June 30,			
	2020	**% of revenue**	**2019**	**% of revenue**
	(dollars in thousands)			
Revenues	$ 47,079		$ 57,786	
Cost of revenues	20,241	43.0%	25,677	44.4%
Sales and marketing expenses	9,858	20.9%	12,076	20.9%
General and administrative expenses	12,429	26.4%	10,612	18.4%
Research and development expenses	4,387	9.3%	5,506	9.5%
Amortization of intangible assets	2,881	6.1%	2,866	5.0%
Impairment charges	-	0.0%	941	1.6%
Interest expense	2,532	5.4%	2,781	4.8%
Income tax expense (benefit)	768	1.6%	(309)	-0.5%

Revenues

Revenues for the six months ended June 30, 2020 were $47.1 million, a decrease of approximately $10.7 million, or 18.5%, compared to revenues of $57.8 million for the six months ended June 30, 2019. The decrease in revenue was primarily due to the impact of the COVID-19 pandemic and in particular, lower sales to academic labs and other institutions that are temporarily closed as a result of the pandemic.

Cost of revenues

Cost of revenues were $20.2 million for the six months ended June 30, 2020, a decrease of $5.5 million, or 21.2% compared with $25.7 million for the six months ended June 30, 2019. Gross margin as a percentage of revenues increased to 57.0% for the six months ended June 30, 2020 compared with 55.6% for the six months ended June 30, 2019. The increase in gross margin was primarily due to improved product mix with a higher percentage of revenue from higher end systems and software.

Sales and marketing expenses

Sales and marketing expenses decreased $2.2 million or 18.4% to $9.9 million for the six months ended June 30, 2020 compared to $12.1 million during the same period in 2019. The decrease in these expenses was primarily due to ongoing restructuring and cost reduction initiatives, as well as lower variable sales costs due to revenue reductions noted.

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General and administrative expenses

General and administrative expenses were $12.4 million for the six months ended June 30, 2020, an increase of $1.8 million, or 17.1%, compared with $10.6 million for the six months ended June 30, 2019. The increase was primarily due to higher employee severance, other restructuring costs and stock-based compensation. Excluding these costs, general and administrative costs declined due to ongoing restructuring and cost reduction initiatives.

Research and development expenses

Research and development expenses were $4.4 million for the six months ended June 30, 2020, a decrease of $1.1 million, or 20.3%, compared with $5.5 million for the six months ended June 30, 2019. The decrease was primarily due to lower employee compensation and related costs due to ongoing restructuring and cost reduction initiatives,

Amortization of intangible assets

Amortization of intangible asset expenses was $2.9 million for each of the six months ended June 30, 2020 and June 30, 2019.

Interest expense (benefit)

Interest expense was $2.5 million for the six months ended June 30, 2020, a decrease of $0.3 million, or 9%, compared with $2.8 million for the six months ended June 30, 2019. The decrease was primarily due to reduced borrowings under our financing agreement.

Income tax expense

Income tax expense was $0.8 million for the six months ended June 30, 2020 and income tax benefit was $(0.3) million for the six months ended June 30, 2019. The effective tax rate was (14.4)% for the six months ended June 30, 2020 compared with 10.6% for the same period in 2019. The difference between our effective tax rates in 2020 and 2019 compared to the U.S. statutory tax rate of 21% is primarily due to the mix of 2020 forecasted income or losses in the U.S. and foreign tax jurisdictions, the impact of different tax rates in certain foreign jurisdictions, changes to uncertain tax positions, and the impact of the inclusion of foreign income in U.S. taxable income under the GILTI (Global Intangible Low-Taxed Income) tax rules. The effective tax rate in 2020 was also impacted by increases to valuation allowances and changes made by the CARES Act to the limitation on interest expense deductions, including a retroactive change to our calendar year 2019 deduction.

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 financing agreement described below as well as capital expenditures, severance and other payments associated with ongoing restructuring and cost reduction initiatives.

On January 31, 2018, we and certain of our subsidiaries entered into a financing agreement with Cerberus Business Finance, LLC, as collateral agent and administrative agent for the lenders under the agreement (the “Financing Agreement”), which comprised of a $64.0 million term loan which was used in connection with the acquisition of Data Sciences International in 2018 and a line of credit of up to $25.0 million.

As of June 30, 2020, we held cash and cash equivalents of $2.6 million, compared with $8.3 million at December 31, 2019. As of June 30, 2020, and December 31, 2019, we had $44.7 million and $55.0 million of term loan borrowings outstanding under our credit facility, respectively. Total debt, net of cash and cash equivalents was $42.1 million at June 30, 2020, compared to $46.7 million at December 31, 2019.

Cash provided by operations was $5.2 million and $2.7 million for the six months ended June 30, 2020 and 2019, respectively. The increase in net cash flow from operations was primarily due to reductions in working capital as a result of lower revenue volume due to the COVID-19 pandemic, as well as improved cash management discipline.

Cash used in investing activities was $0.5 million for the six months ended June 30, 2020 consisting of capital expenditures. Our investing activities provided cash of $0.6 million for the six months ended June 30, 2019 primarily consisting of $0.6 million cash used for capital expenditures, and the receipt of $1.0 million in connection with the release of an escrow amount associated with the sale of substantially all of the assets of our wholly-owned subsidiary, Denville Scientific, Inc. (the “Denville Transaction”).

Cash used in financing activities during the six months ended June 30, 2020 included $10.3 million of payments to reduce our term loan borrowings under our credit facility. These payments included $1.6 million in installment payments, an excess cash flow payment of $4.0 million, and an additional payment of $4.7 million.

On April 18, 2020, we entered into a promissory note with PNC Bank, National Association (which provided for a loan in the amount of $6.1 million (the PPP Loan) pursuant to the Paycheck Protection Program (the PPP) of the CARES Act administered by the U.S. Small Business Administration (the SBA). On April 23, 2020, the SBA, in consultation with the U.S. Department of the Treasury issued guidance regarding consideration of alternate available sources of liquidity and its impact on qualification for PPP loans. We reassessed our business plans and liquidity available under our existing credit facility and elected to repay all PPP funds. The PPP Loan was repaid in full on May 4, 2020.

During the six months ended June 30, 2019, we borrowed $2.3 million and repaid $8.5 million of debt.

Borrowing Arrangements

See Note 10 to the consolidated financial statements for a detailed discussion regarding our Financing Agreement and credit facilities.

As of June 30, 2020, we had borrowings of $43.7 million, net of deferred financing costs of $1.0 million and as of December 31, 2019, we had borrowings of $53.8 million, net of deferred financing costs of $1.2 million. We had available borrowing capacity under the revolving line of credit of $7.5 million as of June 30, 2020. As of June 30, 2020, the weighted effective interest rate on our borrowings, net of the impact of our interest rate swap, was 8.9%.

We are compliant with all covenants under the Financing Agreement as of June 30, 2020.

Our covenants under the Financing Agreement include a requirement to maintain a maximum leverage ratio among other financial and non-financial covenants, as defined in the Financing Agreement. The maximum permitted leverage is the ratio of total debt to consolidated EBITDA, as defined in the Financing Agreement. The maximum permitted leverage ratio is 3.25 as of June 30, 2020 and for all quarters thereafter until the maturity of the Financing Agreement in 2023. Due to the negative impact of the COVID-19 pandemic on our revenue and consolidated EBITDA, the gap between the leverage ratio and maximum permitted leverage has reduced. During the three months ended June 30, 2020, we made an additional payment of $4.7 million.

Based on our current operating plans, including actions taken to mitigate the impact of COVID-19, we expect that our available cash, cash generated from current operations and debt capacity will be sufficient to finance current operations, any costs associated with restructuring activities and capital expenditures for at least the next 12 months. This assessment includes consideration of our best estimates of the impact of the COVID-19 pandemic on our financial results described above. If the negative impact of the COVID-19 pandemic is more significant than anticipated it may impact our ability to comply with financial covenants in the future, which would require us to seek an amendment or waivers from our lenders, limit access to or require accelerated repayment of the existing credit facilities, or require us to pursue alternative financing. There are no assurances that any such alternative financing, if required, could be obtained at terms acceptable to us, or at all.

Our forecast of 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.

Critical Accounting Policies

The critical accounting policies underlying the accompanying unaudited consolidated financial statements are those set forth in Part II, Item 7 included in our Annual Report on Form 10-K for the fiscal year ended December 31, 2019, which was filed with the SEC on March 16, 2020.

Impact of Foreign Currencies

Our international operations in some instances operate in 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, especially the British pound, the euro, the Canadian dollar and the Swedish krona.

During the three months ended June 30, 2020, changes in foreign currency exchange rates resulted in an unfavorable translation effect on our consolidated revenues of approximately $0.1 million and a favorable effect on expenses of approximately $0.3 million. During the six months ended June 30, 2020, changes in foreign currency exchange rates resulted in an unfavorable translation effect on our consolidated revenues of approximately $0.3 million and a favorable effect on expenses of approximately $0.3 million.

The gain associated with the translation of foreign equity into U.S. dollars included as a component of comprehensive loss during the three months ended June 30, 2020, was approximately $0.7 million, compared to a loss of $(0.2) million for the three months ended June 30, 2019. The loss associated with the translation of foreign equity into U.S. dollars included as a component of comprehensive loss during the six months ended June 30, 2020, was approximately $(1.0) million, compared to a loss of $(0.2) million for the six months ended June 30, 2019.

In addition, currency exchange rate fluctuations included as a component of net income resulted in currency (losses) of approximately $(0.1) million during each of the three months ended June 30, 2020 and 2019, and currency gains of approximately $0.1 million during each of the six months ended June 30, 2020 and 2019, respectively.

Recently Issued Accounting Pronouncements

For information on recent accounting pronouncements impacting our business, see "Recent Accounting Pronouncements" included under Note 2 to our Condensed Consolidated Financial Statements.

Item 3. Quantitative and Qualitative Disclosures about Market Risk.

Most of our manufacturing and testing of products occurs in our facilities in the United States, Germany, Sweden and Spain. We sell our products globally through our distributors, direct sales force, websites and catalogs. As a result, our financial results are affected by factors such as changes in foreign currency exchange rates and weak economic conditions in foreign markets. In addition, we are subject to the broad market risk that is created by the global market disruptions and uncertainties resulting from the COVID-19 pandemic.

We collect amounts representing a substantial portion of our revenues and pay amounts representing a substantial portion of our operating expenses in foreign currencies. As a result, changes in currency exchange rates from time to time may affect our operating results.

We are exposed to market risk from changes in interest rates primarily through our financing activities. As of June 30, 2020, we had $44.7 million outstanding under our Financing Agreement. We entered into an interest rate swap contract with PNC Bank with an initial notional amount of $36.0 million and a termination date of January 31, 2023 in order to hedge a portion of the risk of changes in the effective benchmark interest rate (LIBOR) associated with the Financing Agreement. The notional value of the interest rate swap contract as of June 30, 2020 was $25.7 million. The swap contract converted specific variable-rate debt into fixed-rate debt and fixed the LIBOR rate associated with a portion of the term loan under the Financing Agreement at 2.72%.

As of June 30, 2020, the weighted effective interest rates, net of the impact of our interest rate swaps, on our term loan under the Financing Agreement was 8.9%. Assuming no other changes which would affect the margin of the interest rate, the estimated effect of interest rate fluctuations on outstanding borrowings under our Financing Agreement as of June 30, 2020 is quantified and summarized as follows:

If compared to the rate as of June 30, 2020	Interest expense increase	
	(in thousands)	
Interest rates increase by 1%	$	190
Interest rates increase by 2%	$	381

Item 4. Controls and Procedures.

Evaluation of Disclosure Controls and Procedures

As of June 30, 2020, the end of the period covered by this report, our management, including our Chief Executive Officer and our Chief Financial Officer, reviewed and evaluated the effectiveness of our disclosure controls and procedures (as defined in Rule 13a-15(e) or 15d-15(e) of the Exchange Act). Based upon management's review and evaluation, our Chief Executive Officer and Chief Financial Officer have concluded that, as of the end of the period covered by this Quarterly Report on Form 10-Q, our disclosure controls and procedures were effective to provide reasonable assurance that information required to be disclosed in our Exchange Act reports is recorded, processed, summarized and reported within the time periods specified by the SEC and is accumulated and communicated to management, including the Chief Executive Officer and Chief Financial Officer, as appropriate, to allow timely decisions regarding required disclosure.

Changes in Internal Control over Financial Reporting

There were no changes in our internal control over financial reporting during the second quarter of fiscal 2020 that have materially affected, or are reasonably likely to materially affect, our internal control over financial reporting.

Limitations on Effectiveness of Controls and Procedures

In designing and evaluating our controls and procedures, management recognizes that any controls and procedures, no matter how well designed and operated, can provide only reasonable assurance of achieving the desired control objectives, and management is required to apply its judgment in evaluating the cost-benefit relationship of possible controls and procedures. Because of the inherent limitations in all control systems, no evaluation of controls can provide absolute assurance that all control issues and instances of fraud within the Company have been detected.

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PART II. OTHER INFORMATION

Item 1. Legal Proceedings.

The information included in Note 15 to the Condensed Consolidated Financial Statements (Unaudited) included in Part I, Item 1 of this quarterly report is incorporated herein by reference.

Item 1A. Risk Factors.

You should carefully consider the factors discussed in Part I, “Item 1A. Risk Factors” in our Annual Report on Form 10-K for the fiscal year ended December 31, 2019, and in Part II, “Item 1A. Risk Factors” in our Quarterly Report on Form 10-Q for the fiscal quarter ended March 31, 2020,which could materially affect our business, financial position, or future results of operations. The risks described in those filings are not the only risks we face. Additional risks and uncertainties not currently known to us or that we currently deem to be immaterial also may materially adversely affect our business, financial position, or future results of operations. To our knowledge, and except to the extent additional factual information disclosed in this Quarterly Report on Form 10-Q relates to such risk factors, there have been no material changes in the risk factors described in our Annual Report on Form 10-K for the fiscal year ended December 31, 2019 and in our Quarterly Report on Form 10-Q for the fiscal quarter ended March 31, 2020.

Item 2. Unregistered Sales of Equity Securities and Use of Proceeds.

There were no unregistered sales of equity securities during the period covered by this report.

Item 3. Defaults Upon Senior Securities.

None.

Item 4. Mine Safety Disclosures.

Not applicable.

Item 5. Other Information.

None.

Item 6. Exhibits

10.1 #	Harvard Bioscience Inc. Fourth Amended and Restated 2000 Stock Option and Incentive Plan
31.1	Certification of Chief Financial Officer of Harvard Bioscience, Inc., pursuant to Rules 13a-14(a) and 15d-14(a), as adopted pursuant to Section 302 of the Sarbanes-Oxley Act of 2002.
31.2	Certification of Chief Executive Officer of Harvard Bioscience, Inc., pursuant to Rules 13a-14(a) and 15d-14(a), as adopted pursuant to

	Section 302 of the Sarbanes-Oxley Act of 2002.
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.
101.INS	XBRL Instance Document
101.SCH	XBRL Taxonomy Extension Schema Document
101.CAL	XBRL Taxonomy Extension Calculation Linkbase Document
101.DEF	XBRL Taxonomy Extension Definition Linkbase Document
101.LAB	XBRL Taxonomy Extension Labels Linkbase Document
101.PRE	XBRL Taxonomy Extension Presentation Linkbase Document
104	Cover Page Interactive Data File (formatted in Inline XBRL and contained in Exhibit 101)

\# Management contract or compensatory plan or arrangement.

* 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.

SIGNATURES

Pursuant to the requirements of the Securities Exchange Act of 1934, the registrant has duly caused this report to be signed on its behalf by undersigned thereunto duly authorized.

Date: August 10, 2020

HARVARD BIOSCIENCE, INC.

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

By: /S/ MICHAEL A. ROSSI
Michael A. Rossi
Chief Financial Officer

EXHIBIT 10.1

HARVARD BIOSCIENCE, INC.

FOURTH AMENDED AND RESTATED
2000 STOCK OPTION AND INCENTIVE PLAN

1) *GENERAL PURPOSE OF THE PLAN; DEFINITIONS*

The name of the plan is the Harvard Bioscience, Inc. Fourth Amended and Restated 2000 Stock Option and Incentive Plan (the "Plan"). The purpose of the Plan is to encourage and enable the officers, employees, Independent Directors and other key persons (including consultants) of Harvard Bioscience, Inc. (the "Company") and its Subsidiaries upon whose judgment, initiative and efforts the Company largely depends for the successful conduct of its business to acquire a proprietary interest in the Company. It is anticipated that providing such persons with a direct stake in the Company's welfare will assure a closer identification of their interests with those of the Company, thereby stimulating their efforts on the Company's behalf and strengthening their desire to remain with the Company.

The following terms shall be defined as set forth below:

"*Act*" means the Securities Act of 1933, as amended, and the rules and regulations thereunder.

"*Administrator*" is defined in Section 2(a).

"*Award*" or "*Awards,*" except where referring to a particular category of grant under the Plan, shall include Incentive Stock Options, Non-Qualified Stock Options, Stock Appreciation Rights, Deferred Stock Awards, Restricted Stock Awards, Unrestricted Stock Awards, Performance Share Awards and Dividend Equivalent Rights.

"*Board*" means the Board of Directors of the Company.

"*Cash-Based Award*" means an Award entitling the recipient to receive a cash-denominated payment.

"*Change of Control*" is defined in Section 19.

"*Code*" means the Internal Revenue Code of 1986, as amended, and any successor Code, and related rules, regulations and interpretations.

"*Committee*" means the Compensation Committee of the Board or a similar committee performing the functions of the Compensation Committee and that is comprised of not less than two Independent Directors.

"*Covered Employee*" means an employee who is a "Covered Employee" within the meaning of Section 162(m) of the Code.

"*Deferred Stock Award*" means Awards granted pursuant to Section 8.

"*Dividend Equivalent Right*" means Awards granted pursuant to Section 13.

"*Effective Date*" means the date on which the Plan is approved by stockholders as set forth in Section 21.

"*Exchange Act*" means the Securities Exchange Act of 1934, as amended, and the rules and regulations thereunder.

"*Fair Market Value*" of the Stock on any given date means the fair market value of the Stock determined in good faith by the Administrator; provided, however, that if the Stock is traded on a national securities exchange the Fair Market Value of the Stock will equal the closing sales price as reported on the principal exchange or market for the Stock on such date. If there is no trading on such date, the determination shall be made by reference to the last date preceding such date for which there was trading.

“*Full Value Award*” means any Deferred Stock Award, Restricted Stock Awards, Unrestricted Stock Awards, Performance Share Awards or other Award that results in the Company transferring the full value of any underlying share granted pursuant to such Award, but shall not include Stock Options, Non-Qualified Stock Options, Stock Appreciation Rights.

“*Incentive Stock Option*” means any Stock Option designated and qualified as an “incentive stock option” as defined in Section 422 of the Code.

“*Independent Director*” means a member of the Board who is not also an employee of the Company or any Subsidiary and who is independent.

“*Non-Qualified Stock Option*” means any Stock Option that is not an Incentive Stock Option.

“*Option*” or “*Stock Option*” means any option to purchase shares of Stock granted pursuant to Section 5.

“*Performance Share Award*” means Awards granted pursuant to Section 11.

“*Performance Cycle*” means one or more periods of time, which may be of varying and overlapping durations, as the Administrator may select, over which the attainment of one or more performance criteria will be measured for the purpose of determining a grantee’s right to and the payment of a Performance Share Award, Restricted Stock Award or Deferred Stock Award. Each such period shall not be less than three months.

“*Restricted Stock Award*” means Awards granted pursuant to Section 7.

“*Section 409A*” means Section 409A of the Code and the regulations and other guidance promulgated thereunder.

“*Stock*” means the Common Stock, par value $.01 per share, of the Company, subject to adjustments pursuant to Section 3.

“*Stock Appreciation Right*” means any Award granted pursuant to Section 6.

“*Subsidiary*” means any corporation or other entity (other than the Company) in any unbroken chain of corporations or other entities beginning with the Company if each of the corporations or entities (other than the last corporation or entity in the unbroken chain) owns stock or other interests possessing 50 percent or more of the economic interest or the total combined voting power of all classes of stock or other interests in one of the other corporations or entities in the chain.

“*Unrestricted Stock Award*” means any Award granted pursuant to Section 9.

2) *ADMINISTRATION OF PLAN; ADMINISTRATOR AUTHORITY TO SELECT GRANTEES AND DETERMINE AWARDS*

a) *Committee*. The Plan shall be administered by either the Board or a committee of not less than two Independent Directors (in either case, the “Administrator”).

b) *Powers of Administrator.* The Administrator shall have the power and authority to grant Awards consistent with the terms of the Plan, including the power and authority:

i) to select the individuals to whom Awards may from time to time be granted;

ii) to determine the time or times of grant, and the extent, if any, of Incentive Stock Options, Non-Qualified Stock Options, Stock Appreciation Rights, Restricted Stock Awards, Deferred Stock Awards, Unrestricted Stock Awards, Performance Share Awards and Dividend Equivalent Rights, or any combination of the foregoing, granted to any one or more grantees;

iii) to determine the number of shares of Stock to be covered by any Award;

iv) to determine and modify from time to time the terms and conditions, including restrictions, not inconsistent with the terms of the Plan, of any Award, which terms and conditions may differ among individual Awards and grantees, and to approve the form of written instruments evidencing the Awards;

v) to accelerate at any time the exercisability or vesting of all or any portion of any Award, provided that, other than by reason of, or in connection with, any death, disability, retirement, employment termination (without cause or by the employee for good reason), Sale Event or Change of Control, the Administrator shall not accelerate or waive any restriction period applicable to any outstanding Restricted Stock Award, Deferred Stock Award or Performance Share Award granted to an employee beyond the minimum restriction periods set forth in Section 7(d), Section 8(a) and Section 11(a), respectively, or accelerate the exercisability or vesting of unvested Stock Options which in the aggregate, when combined with the aggregate number of shares of Stock issued pursuant to Section 9, exceed ten percent (10%) of the maximum number of shares of stock reserved and available for issuance under the Plan pursuant to Section 3(a);

vi) subject to the provisions of Section 5(a)(ii), to extend at any time the period in which Stock Options may be exercised; and

vii) at any time to adopt, alter and repeal such rules, guidelines and practices for administration of the Plan and for its own acts and proceedings as it shall deem advisable; to interpret the terms and provisions of the Plan and any Award (including related written instruments); to make all determinations it deems advisable for the administration of the Plan; to decide all disputes arising in connection with the Plan; and to otherwise supervise the administration of the Plan.

All decisions and interpretations of the Administrator shall be binding on all persons, including the Company and Plan grantees.

c) *Delegation of Authority to Grant Awards.* The Administrator, in its discretion, may delegate to the Chief Executive Officer of the Company all or part of the Administrator's authority and duties with respect to the granting of Awards at Fair Market Value, to individuals who are not subject to the reporting and other provisions of Section 16 of the Exchange Act or "covered employees" within the meaning of Section 162(m) of the Code. Any such delegation by the Administrator shall include a limitation as to the amount of Awards that may be granted during the period of the delegation and shall contain guidelines as to the determination of the exercise price of any Stock Option or Stock Appreciation Right, the conversion ratio or price of other Awards and the vesting criteria. The Administrator may revoke or amend the terms of a delegation at any time but such action shall not invalidate any prior actions of the Administrator's delegate or delegates that were consistent with the terms of the Plan.

d) *Indemnification.* Neither the Board nor the Committee, nor any member of either or any delegatee thereof, shall be liable for any act, omission, interpretation, construction or determination made in good faith in connection with the Plan, and the members of the Board and the Committee (and any delegatee thereof) shall be entitled in all cases to indemnification and reimbursement by the Company in respect of any claim, loss, damage or expense (including, without limitation, reasonable attorneys' fees) arising or resulting therefrom to the fullest extent permitted by law and/or under the Company's organizational documents or any directors' and officers' liability insurance coverage which may be in effect from time to time and/or any indemnification agreement between such individual and the Company.

3) *STOCK ISSUABLE UNDER THE PLAN; MERGERS; SUBSTITUTION*

a) *Stock Issuable.* Subject to adjustment as provided in Section 3(b), the maximum number of shares of Stock reserved and available for issuance under the Plan shall be 24,608,929 shares of Stock which number reflects the total of 3,750,000 shares originally reserved, plus the effect of an evergreen provision through December 31, 2005, plus an additional 2,000,000 shares added to the Plan in 2006, plus an additional 2,500,000 shares added to the Plan in 2008 plus an additional 3,700,000 shares added to the Plan in 2011 plus an additional 1,941,254 shares to account for the adjustment required by Section 3(b) pertaining to the Awards issued in connection with the spin-off of Harvard Apparatus Regenerative Technology, Inc. by Harvard Bioscience, Inc. plus an additional 2,500,000 shares added to the Plan in 2015, plus an additional 3,400,000 shares added to the Plan in 2018, plus an additional 3,700,000 shares added to the Plan in 2020. To the extent an Award expires or terminates or is surrendered or forfeited (other than by exercise), in whole or in part, the shares subject to such Award or portion thereof so forfeited, expired, terminated or surrendered again will become available for future grant or sale under the Plan. Should the exercise price of an Option be paid with shares underlying such Option, then the authorized reserve of shares under the Plan shall be reduced by the gross number of shares for which that Option is exercised, and not by the net number of shares issued under the exercised Option. If shares otherwise issuable under the Plan are withheld by the Company in satisfaction of the withholding taxes incurred in connection with an Award, then the number of shares available for issuance under the Plan shall be reduced by the gross number of shares issuable under the Award, calculated in each instance prior to any such share withholding and, to the extent such shares are issued pursuant to a Full-Value Award issued on or after May 25, 2011, after giving effect to the last sentence of this Section 3(a). In addition, upon exercise of Stock Appreciation Rights, the gross number of shares exercised shall be deducted from the total number of shares remaining available for issuance under the Plan. Shares of Stock may be issued up to such maximum number pursuant to any type or types of Award; provided, however, that Stock Options or Stock Appreciation Rights with respect to no more than 1,000,000 shares of Stock may be granted to any one individual grantee during any one calendar year period. The shares available for issuance under the Plan may be authorized but unissued shares of Stock or shares of Stock reacquired by the Company and held in its treasury. Any shares underlying Full-Value Awards granted on or after May 25, 2011 will be counted against the foregoing authorized reserve of shares under the Plan as 1.49 shares.

b) *Changes in Stock*. Subject to Section 3(c) hereof, if, as a result of any reorganization, recapitalization, reclassification, stock dividend, stock split, reverse stock split or other similar change in the Company's capital stock, the outstanding shares of Stock are increased or decreased or are exchanged for a different number or kind of shares or other securities of the Company, or additional shares or new or different shares or other securities of the Company or other non-cash assets are distributed with respect to such shares of Stock or other securities, or, if, as a result of any merger or consolidation, sale of all or substantially all of the assets of the Company, the outstanding shares of Stock are converted into or exchanged for a different number or kind of securities of the Company or any successor entity (or a parent or subsidiary thereof), the Administrator shall make an appropriate or proportionate adjustment in (i) the maximum number of shares reserved for issuance under the Plan, including the maximum number of shares that may be issued in the form of Unrestricted Stock Awards, Restricted Stock Awards or Performance Share Awards, (ii) the number of Stock Options or Stock Appreciation Rights that can be granted to any one individual grantee and the maximum number of shares that may be granted under a Performance-based Award, (iii) the number and kind of shares or other securities subject to any then outstanding Awards under the Plan, (iv) the repurchase price per share subject to each outstanding Restricted Stock Award, and (v) the price for each share subject to any then outstanding Stock Options and Stock Appreciation Rights under the Plan, without changing the aggregate exercise price (i.e., the exercise price multiplied by the number of Stock Options and Stock Appreciation Rights) as to which such Stock Options and Stock Appreciation Rights remain exercisable in a manner that will trigger tax under Section 409A. The adjustment by the Administrator shall be final, binding and conclusive. No fractional shares of Stock shall be issued under the Plan resulting from any such adjustment, but the Administrator in its discretion may make a cash payment in lieu of fractional shares.

The Administrator shall also adjust the number of shares subject to outstanding Awards and the exercise price and the terms of outstanding Awards to take into consideration material changes in accounting practices or principles, extraordinary dividends, acquisitions or dispositions of stock or property or any other event if it is determined by the Administrator that such adjustment is appropriate to avoid distortion in the operation of the Plan, provided that no such adjustment shall be made in the case of an Incentive Stock Option, without the consent of the grantee, if it would constitute a modification, extension or renewal of the Option within the meaning of Section 424(h) of the Code.

c) *Mergers and Other Transactions*. In the case of and subject to the consummation of (i) the dissolution or liquidation of the Company, (ii) the sale of all or substantially all of the assets of the Company on a consolidated basis to an unrelated person or entity, (iii) a merger, reorganization or consolidation in which the outstanding shares of Stock are converted into or exchanged for a different kind of securities of the successor entity and the holders of the Company's outstanding voting power immediately prior to such transaction do not own a majority of the outstanding voting power of the successor entity immediately upon completion of such transaction, or (iv) the sale of all of the Stock of the Company to an unrelated person or entity (in each case, a "Sale Event"), all Options and Stock Appreciation Rights that are not exercisable immediately prior to the effective time of the Sale Event shall become fully exercisable as of the effective time of the Sale Event and all other Awards with conditions and restrictions relating solely to the passage of time and continued employment shall become fully vested and nonforfeitable as of the effective time of the Sale Event, except as the Administrator may otherwise specify with respect to particular Awards. Upon the effective time of the Sale Event, the Plan and all outstanding Awards granted hereunder shall terminate, unless provision is made in connection with the Sale Event in the sole discretion of the parties thereto for the assumption or continuation of Awards theretofore granted by the successor entity, or the substitution of such Awards with new Awards of the successor entity or parent thereof, with appropriate adjustment as to the number and kind of shares and, if appropriate, the per share exercise prices, as such parties shall agree (after taking into account any acceleration hereunder). In the event of such termination, each grantee shall be permitted, within a specified period of time prior to the consummation of the Sale Event as determined by the Administrator, to exercise all outstanding Options and Stock Appreciation Rights held by such grantee, including those that will become exercisable upon the consummation of the Sale Event; provided, however, that the exercise of Options and Stock Appreciation Rights not exercisable prior to the Sale Event shall be subject to the consummation of the Sale Event.

Notwithstanding anything to the contrary in this Section 3.2(c), in the event of a Sale Event pursuant to which holders of the Stock of the Company will receive upon consummation thereof a cash payment for each share surrendered in the Sale Event, the Company shall have the right, but not the obligation, to make or provide for a cash payment to the grantees holding Options and Stock Appreciation Rights, in exchange for the cancellation thereof, in an amount equal to the difference between (A) the value as determined by the Administrator of the consideration payable per share of Stock pursuant to the Sale Event (the "Sale Price") times the number of shares of Stock subject to outstanding Options and Stock Appreciation Rights (to the extent then exercisable at prices not in excess of the Sale Price) and (B) the aggregate exercise price of all such outstanding Options and Stock Appreciation Rights.

d) *Substitute Awards.* The Administrator may grant Awards under the Plan in substitution for stock and stock based awards held by employees, directors or other key persons of another corporation in connection with the merger or consolidation of the employing corporation with the Company or a Subsidiary or the acquisition by the Company or a Subsidiary of property or stock of the employing corporation. The Administrator may direct that the substitute awards be granted on such terms and conditions as the Administrator considers appropriate in the circumstances. Any substitute Awards granted under the Plan shall not count against the share limitation set forth in Section 3(a).

4) *ELIGIBILITY*

Grantees under the Plan will be such full or part-time officers and other employees, Independent Directors and key persons (including consultants and prospective employees) of the Company and its Subsidiaries as are selected from time to time by the Administrator in its sole discretion.

With respect to the Awards ("Adjustment Awards") modified or issued in connection with any equitable adjustment by the Company, in accordance herewith and with the formulas and provisions set forth in the Separate and Distribution Agreement that may be entered into by and between the Company and Harvard Apparatus Regenerative Technology, Inc. ("HART"), of certain Awards previously granted by the Company, notwithstanding any other provision of the Plan or Award to the contrary, for purposes of exercisability, vesting and the post-termination exercise periods applicable to any Awards, continued employment with, or service to, the Company (or its subsidiaries) or HART (or its subsidiaries) is considered to be continued employment with, and service to, the other, provided that the failure to exercise Incentive Stock Options within the applicable deadline following any separation from service from the Company shall cause such options to be treated thereafter as Non-Qualified Stock Options

5) *STOCK OPTIONS*

Any Stock Option granted under the Plan shall be in such form as the Administrator may from time to time approve.

Stock Options granted under the Plan may be either Incentive Stock Options or Non-Qualified Stock Options. Incentive Stock Options may be granted only to employees of the Company or any Subsidiary that is a “subsidiary corporation” within the meaning of Section 424(f) of the Code. To the extent that any Option does not qualify as an Incentive Stock Option, it shall be deemed a Non-Qualified Stock Option.

a) *Stock Options Granted to Employees and Key Persons.* The Administrator in its discretion may grant Stock Options to eligible employees and key persons of the Company or any Subsidiary. Stock Options granted pursuant to this Section 5(a) shall be subject to the following terms and conditions and shall contain such additional terms and conditions, not inconsistent with the terms of the Plan, as the Administrator shall deem desirable. If the Administrator so determines, Stock Options may be granted in lieu of cash compensation at the optionee’s election, subject to such terms and conditions as the Administrator may establish.

i) *Exercise Price.* The exercise price per share for the Stock covered by a Stock Option granted pursuant to this Section 5(a) shall be determined by the Administrator at the time of grant but shall not be less than 100 percent of the Fair Market Value on the date of grant. If an employee owns or is deemed to own (by reason of the attribution rules of Section 424(d) of the Code) more than 10 percent of the combined voting power of all classes of stock of the Company or any parent or subsidiary corporation and an Incentive Stock Option is granted to such employee, the option price of such Incentive Stock Option shall be not less than 110 percent of the Fair Market Value on the grant date.

ii) *Option Term.* The term of each Stock Option shall be fixed by the Administrator, but no Stock Option shall be exercisable more than 10 years after the date the Stock Option is granted. If an employee owns or is deemed to own (by reason of the attribution rules of Section 424(d) of the Code) more than 10 percent of the combined voting power of all classes of stock of the Company or any parent or subsidiary corporation and an Incentive Stock Option is granted to such employee, the term of such Stock Option shall be no more than five years from the date of grant.

iii) *Exercisability; Rights of a Stockholder.* Stock Options shall become exercisable at such time or times, whether or not in installments, as shall be determined by the Administrator at or after the grant date. Subject to Section 2(b)(v), the Administrator may at any time accelerate the exercisability of all or any portion of any Stock Option. An optionee shall have the rights of a stockholder only as to shares acquired upon the exercise of a Stock Option and not as to unexercised Stock Options.

iv) *Method of Exercise.* Stock Options may be exercised in whole or in part, by giving written notice of exercise to the Company, specifying the number of shares to be purchased. Payment of the purchase price may be made by one or more of the following methods to the extent provided in the Option Award agreement:

(1) In cash, by certified or bank check or other instrument acceptable to the Administrator;

(2) Through the delivery (or attestation to the ownership) of shares of Stock that have been purchased by the optionee on the open market or that have been beneficially owned by the optionee for at least six months and are not then subject to restrictions under any Company plan. Such surrendered shares shall be valued at Fair Market Value on the exercise date; or

(3) By the optionee delivering to the Company a properly executed exercise notice together with irrevocable instructions to a broker to promptly deliver to the Company cash or a check payable and acceptable to the Company for the purchase price; provided that in the event the optionee chooses to pay the purchase price as so provided, the optionee and the broker shall comply with such procedures and enter into such agreements of indemnity and other agreements as the Administrator shall prescribe as a condition of such payment procedure.

Payment instruments will be received subject to collection. The transfer to the optionee on the records of the Company or of the transfer agent of delivery of certificates representing the shares of Stock to be purchased pursuant to the exercise of a Stock Option will be contingent upon receipt from the optionee (or a purchaser acting in his stead in accordance with the provisions of the Stock Option) by the Company of the full purchase price for such shares and the fulfillment of any other requirements contained in the Option Award agreement or applicable provisions of laws (including the satisfaction of any withholding taxes that the Company is obligated to withhold with respect to the optionee). In the event an optionee chooses to pay the purchase price by previously-owned shares of Stock through the attestation method, the number of shares of Stock transferred to the optionee upon the exercise of the Stock Option shall be net of the number of attested shares. In the event that the Company establishes, for itself or using the services of a third party, an automated system for the exercise of Stock Options, such as a system using an internet website or interactive voice response, then the paperless exercise of Stock Options may be permitted through the use of such an automated system.

v) *Annual Limit on Incentive Stock Options.* To the extent required for "incentive stock option" treatment under Section 422 of the Code, the aggregate Fair Market Value (determined as of the time of grant) of the shares of Stock with respect to which Incentive Stock Options granted under this Plan and any other plan of the Company or its parent and subsidiary corporations become exercisable for the first time by an optionee during any calendar year shall not exceed $100,000. To the extent that any Stock Option exceeds this limit, it shall constitute a Non-Qualified Stock Option.

b) Reserved

c) *Non-transferability of Options.* No Stock Option shall be transferable by the optionee otherwise than by will or by the laws of descent and distribution and all Stock Options shall be exercisable, during the optionee's lifetime, only by the optionee, or by the optionee's legal representative or guardian in the event of the optionee's incapacity. Notwithstanding the foregoing, the Administrator, in its sole discretion, may provide in the Award agreement regarding a given Option that the optionee may transfer his Non-Qualified Stock Options to members of his immediate family, to trusts for the benefit of such family members, or to partnerships in which such family members are the only partners, provided that the transferee agrees in writing with the Company to be bound by all of the terms and conditions of this Plan and the applicable Option.

6) *STOCK APPRECIATION RIGHTS.*

a) *Nature of Stock Appreciation Rights.* A Stock Appreciation Right is an Award entitling the recipient to receive shares of Stock having a value equal to the excess of the Fair Market Value of the Stock on the date of exercise over the exercise price Stock Appreciation Right, which price shall not be less than 100 percent of the Fair Market Value of the Stock on the date of grant multiplied by the number of shares of Stock with respect to which the Stock Appreciation Right shall have been exercised.

b) *Grant and Exercise of Stock Appreciation Rights.* Stock Appreciation Rights may be granted by the Administrator independently of any Stock Option granted pursuant to Section 5 of the Plan.

c) *Terms and Conditions of Stock Appreciation Rights.* Stock Appreciation Rights shall be subject to such terms and conditions as shall be determined from time to time by the Administrator, provided that during the grantee's lifetime all Stock Appreciation Rights shall be exercisable only by the grantee or the grantee's legal representative.

(d) *Stock Appreciation Rights Term.* The term of each Stock Appreciation Right shall be fixed by the Administrator, but no Stock Appreciation Right shall be exercisable more than ten years after the date the Stock Appreciation Right is granted.

7) *RESTRICTED STOCK AWARDS*

a) *Nature of Restricted Stock Awards.* A Restricted Stock Award is an Award entitling the recipient to acquire, at such purchase price as determined by the Administrator, shares of Stock subject to such restrictions and conditions as the Administrator may determine at the time of grant ("Restricted Stock"). Conditions may be based on continuing employment (or other service relationship) and/or achievement of pre-established performance goals and objectives. The grant of a Restricted Stock Award is contingent on the grantee executing the Restricted Stock Award agreement. The terms and conditions of each such agreement shall be determined by the Administrator, and such terms and conditions may differ among individual Awards and grantees.

b) *Rights as a Stockholder.* Upon execution of a written instrument setting forth the Restricted Stock Award and payment of any applicable purchase price, a grantee shall have the rights of a stockholder with respect to the voting of the Restricted Stock, subject to such conditions contained in the written instrument evidencing the Restricted Stock Award. Unless the Administrator shall otherwise determine, (i) uncertificated Restricted Stock shall be accompanied by a notation on the records of the Company or the transfer agent to the effect that they are subject to forfeiture until such Restricted Stock are vested as provided in Section 7(d) below, and (ii) certificated Restricted Stock shall remain in the possession of the Company until such Restricted Stock is vested as provided in Section 7(d) below, and the grantee shall be required, as a condition of the grant, to deliver to the Company a stock power endorsed in blank.

c) *Restrictions.* Restricted Stock may not be sold, assigned, transferred, pledged or otherwise encumbered or disposed of except as specifically provided herein or in the Restricted Stock Award agreement. If a grantee's employment (or other service relationship) with the Company and its Subsidiaries terminates for any reason, any Restricted Stock that has not vested at the time of termination shall automatically and without any requirement of notice to such grantee from or other action by or on behalf of, the Company be deemed to have been reacquired by the Company at its original purchase price (if any) from such grantee or such grantee's legal representative simultaneously with such termination of employment (or other service relationship), and thereafter shall cease to represent any ownership of the Company by the grantee or rights of the grantee as a stockholder. Following such deemed reacquisition of unvested Restricted Stock that are represented by physical certificates, a grantee shall surrender such certificates to the Company upon request without consideration.

d) *Vesting of Restricted Stock.* The Administrator at the time of grant shall specify the date or dates and/or the attainment of pre-established performance goals, objectives and other conditions on which the non-transferability of the Restricted Stock and the Company's right of repurchase or forfeiture shall lapse. Notwithstanding the foregoing, in the event that any such Restricted Stock granted to an employee shall have a performance-based goal, the restriction period with respect to such shares shall not be less than one year, and in the event any such Restricted Stock granted to an employee shall have a time-based restriction, the restriction period with respect to such shares shall not be less than three years; provided, however, that Restricted Stock with a time-based restriction may become vested incrementally over such three-year period. The minimum vesting requirements set forth in the foregoing sentence will not apply to Restricted Stock granted to an Independent Director. Subsequent to such date or dates and/or the attainment of such pre-established performance goals, objectives and other conditions, the shares on which all restrictions have lapsed shall no longer be Restricted Stock and shall be deemed "vested." Except as may otherwise be provided by the Administrator either in the Award agreement or, subject to Section 17 below, in writing after the Award agreement is issued, a grantee's rights in any shares of Restricted Stock that have not vested shall automatically terminate upon the grantee's termination of employment (or other service relationship) with the Company and its Subsidiaries and such shares shall be subject to the Company's right of repurchase as provided in Section 7(c) above.

e) *Waiver, Deferral and Reinvestment of Dividends.* The Restricted Stock Award agreement may require or permit the immediate payment, waiver, deferral or investment of dividends paid on the Restricted Stock.

8) *DEFERRED STOCK AWARDS*

a) *Nature of Deferred Stock Awards.* A Deferred Stock Award is an Award of phantom stock units to a grantee, subject to restrictions and conditions as the Administrator may determine at the time of grant. Conditions may be based on continuing employment (or other service relationship) and/or achievement of pre-established performance goals and objectives. The grant of a Deferred Stock Award is contingent on the grantee executing the Deferred Stock Award agreement. The terms and conditions of each such agreement shall be determined by the Administrator, and such terms and conditions may differ among individual Awards and grantees. Notwithstanding the foregoing, in the event that any such Deferred Stock Award granted to an employee shall have a performance-based goal, the restriction period with respect to such award shall not be less than one year, and in the event any such Deferred Stock Award granted to an employee shall have a time-based restriction, the restriction period with respect to such award shall not be less than three years; provided, however, that any such Deferred Stock Award with a time-based restriction may become vested incrementally over such three-year period. The minimum vesting requirements set forth in the foregoing sentence will not apply to Deferred Stock Awards granted to Independent Directors. At the end of the deferral period, the Deferred Stock Award, to the extent vested, shall be paid to the grantee in the form of shares of Stock. To the extent that a Deferred Stock Award is subject to Section 409A, it may contain such additional terms and conditions as the Administrator shall determine in its sole discretion in order for such Award to comply with the requirements of Section 409A.

b) *Election to Receive Deferred Stock Awards in Lieu of Compensation.* The Administrator may, in its sole discretion, permit a grantee to elect to receive a portion of the cash compensation or Restricted Stock Award otherwise due to such grantee in the form of a Deferred Stock Award. Any such election shall be made in writing and shall be delivered to the Company no later than the date specified by the Administrator and in accordance with Section 409A and such other rules and procedures established by the Administrator. Any such future cash compensation that the grantee elects to defer shall be converted to a fixed number of phantom stock units based on the Fair Market Value of Stock on the date the compensation would otherwise have been paid to the grantee if such payment had not been deferred as provided herein. The Administrator shall have the sole right to determine whether and under what circumstances to permit such elections and to impose such limitations and other terms and conditions thereon as the Administrator deems appropriate.

c) *Rights as a Stockholder.* During the deferral period, a grantee shall have no rights as a stockholder; provided, however, that the grantee may be credited with Dividend Equivalent Rights with respect to the phantom stock units underlying his Deferred Stock Award, subject to such terms and conditions as the Administrator may determine.

d) *Restrictions.* A Deferred Stock Award may not be sold, assigned, transferred, pledged or otherwise encumbered or disposed of during the deferral period.

e) *Termination.* Except as may otherwise be provided by the Administrator either in the Award agreement or, subject to Section 17 below, in writing after the Award agreement is issued, a grantee’s right in all Deferred Stock Awards that have not vested shall automatically terminate upon the grantee’s termination of employment (or cessation of service relationship) with the Company and its Subsidiaries for any reason.

9) *UNRESTRICTED STOCK AWARDS*

The Administrator may, in its sole discretion, grant (or sell at par value or such higher purchase price determined by the Administrator) an Unrestricted Stock Award to any grantee pursuant to which such grantee may receive shares of Stock free of any restrictions (“Unrestricted Stock”) under the Plan. Unrestricted Stock Awards may be granted in respect of past services or other valid consideration, or in lieu of cash compensation due to such grantee. The aggregate number of shares of Stock issuable pursuant to this Section 9, when combined with the number of shares of underlying unvested Stock Options accelerated pursuant to Section 2(b)(v) other than by reason of, or in connection with, any death, disability, retirement, employment termination (without cause or by the employee for good reason), Sale Event or Change of Control, is limited to ten percent (10%) of the maximum number of shares of Stock reserved and available for issuance under the Plan pursuant to Section 3(a).

10) *CASH-BASED AWARDS*

The Administrator may, in its sole discretion, grant Cash-Based Awards to any grantee in such number or amount and upon such terms, and subject to such conditions, as the Administrator shall determine at the time of grant. The Administrator shall determine the maximum duration of the Cash-Based Award, the amount of cash to which the Cash-Based Award pertains, the conditions upon which the Cash-Based Award shall become vested or payable, and such other provisions as the Administrator shall determine. Each Cash-Based Award shall specify a cash-denominated payment amount, formula or payment ranges as determined by the Administrator. Payment, if any, with respect to a Cash-Based Award shall be made in accordance with the terms of the Award and may be made in cash or in shares of Stock, as the Administrator determines.

11) *PERFORMANCE SHARE AWARDS*

a) *Nature of Performance Share Awards.* A Performance Share Award is an Award entitling the recipient to acquire shares of Stock upon the attainment of specified performance goals. The Administrator may make Performance Share Awards independent of or in connection with the granting of any other Award under the Plan. The Administrator in its sole discretion shall determine whether and to whom Performance Share Awards shall be made, the performance goals, the periods during which performance is to be measured, and all other limitations and conditions. Notwithstanding the foregoing, any Performance Share Award granted to an employee shall have a restriction period of not less than one year. The minimum vesting requirements set forth in the foregoing sentence will not apply to Performance Share Awards granted to Independent Directors.

b) *Rights as a Stockholder.* A grantee receiving a Performance Share Award shall have the rights of a stockholder only as to shares actually received by the grantee under the Plan and not with respect to shares subject to the Award but not actually received by the grantee. A grantee shall be entitled to receive a stock certificate evidencing the acquisition of shares of Stock under a Performance Share Award only upon satisfaction of all conditions specified in the Performance Share Award agreement (or in a performance plan adopted by the Administrator).

c) *Termination.* Except as may otherwise be provided by the Administrator either in the Award agreement or, subject to Section 17 below, in writing after the Award agreement is issued, a grantee's rights in all Performance Share Awards shall automatically terminate upon the grantee's termination of employment (or cessation of service relationship) with the Company and its Subsidiaries for any reason.

12) Reserved.

13) *DIVIDEND EQUIVALENT RIGHTS*

a) *Dividend Equivalent Rights.* A Dividend Equivalent Right is an Award entitling the grantee to receive credits based on cash dividends that would have been paid on the shares of Stock specified in the Dividend Equivalent Right (or other award to which it relates) if such shares had been issued to and held by the grantee. A Dividend Equivalent Right may be granted hereunder to any grantee only as a component of Unrestricted Stock Awards, Restricted Stock Awards, Deferred Stock Awards or Performance Share Awards. The terms and conditions of Dividend Equivalent Rights shall be specified in the Award agreement. Dividend equivalents credited to the holder of a Dividend Equivalent Right may be paid currently or may be deemed to be reinvested in additional shares of Stock, which may thereafter accrue additional equivalents. Any such reinvestment shall be at Fair Market Value on the date of reinvestment or such other price as may then apply under a dividend reinvestment plan sponsored by the Company, if any. Dividend Equivalent Rights may be settled in cash or shares of Stock or a combination thereof, in a single installment or installments. A Dividend Equivalent Right granted as a component of another Award may provide that such Dividend Equivalent Right shall be settled upon exercise, settlement, or payment of, or lapse of restrictions on, such other award, and that such Dividend Equivalent Right shall expire or be forfeited or annulled under the same conditions as such other award. A Dividend Equivalent Right granted as a component of another Award may also contain terms and conditions different from such other award.

b) *Interest Equivalents.* Any Award under this Plan that is settled in whole or in part in cash on a deferred basis may provide in the grant for interest equivalents to be credited with respect to such cash payment. Interest equivalents may be compounded and shall be paid upon such terms and conditions as may be specified by the grant.

c) *Termination.* Except as may otherwise be provided by the Administrator either in the Award agreement or, subject to Section 17 below, in writing after the Award agreement is issued, a grantee's rights in all Dividend Equivalent Rights or interest equivalents shall automatically terminate upon the grantee's termination of employment (or cessation of service relationship) with the Company and its Subsidiaries for any reason.

14) *TAX WITHHOLDING*

a) *Payment by Grantee.* Each grantee shall, no later than the date as of which the value of an Award or of any Stock or other amounts received thereunder first becomes includable in the gross income of the grantee for Federal income tax purposes, pay to the Company, or make arrangements satisfactory to the Administrator regarding payment of, any Federal, state, or local taxes of any kind required by law to be withheld by the Company with respect to such income. The Company and its Subsidiaries shall, to the extent permitted by law, have the right to deduct any such taxes from any payment of any kind otherwise due to the grantee. The Company's obligation to deliver evidence of book entry (or stock certificates) to any grantee is subject to and conditioned on tax withholding obligations being satisfied by the grantee.

b) *Payment in Stock.* Subject to approval by the Administrator, a grantee may elect to have the Company's minimum required tax withholding obligation satisfied, in whole or in part, by (i) authorizing the Company to withhold from shares of Stock to be issued pursuant to any Award a number of shares with an aggregate Fair Market Value (as of the date the withholding is effected) that would satisfy the withholding amount due, or (ii) transferring to the Company shares of Stock owned by the grantee with an aggregate Fair Market Value (as of the date the withholding is effected) that would satisfy the withholding amount due.

15) *SECTION 409A AWARDS.*

To the extent that any Award is determined to constitute "nonqualified deferred compensation" within the meaning of Section 409A (a "409A Award"), the Award shall be subject to such additional rules and requirements as specified by the Administrator from time to time in order to comply with Section 409A. In this regard, if any amount under a 409A Award is payable upon a "separation from service" (within the meaning of Section 409A) to a grantee who is then considered a "specified employee" (within the meaning of Section 409A), then no such payment shall be made prior to the date that is the earlier of (i) six months and one day after the grantee's separation from service, or (ii) the grantee's death, but only to the extent such delay is necessary to prevent such payment from being subject to interest, penalties and/or additional tax imposed pursuant to Section 409A. Further, the settlement of any such Award may not be accelerated except to the extent permitted by Section 409A.

16) *TRANSFER, LEAVE OF ABSENCE, ETC.*

For purposes of the Plan, the following events shall not be deemed a termination of employment:

a) a transfer to the employment of the Company from a Subsidiary or from the Company to a Subsidiary, or from one Subsidiary to another; or

b) an approved leave of absence for military service or sickness, or for any other purpose approved by the Company, if the employee's right to re-employment is guaranteed either by a statute or by contract or under the policy pursuant to which the leave of absence was granted or if the Administrator otherwise so provides in writing.

17) *AMENDMENTS AND TERMINATION*

The Board may, at any time, amend or discontinue the Plan and the Administrator may, at any time, amend or cancel any outstanding Award for the purpose of satisfying changes in law or for any other lawful purpose, but no such action shall adversely affect rights under any outstanding Award without the holder's consent. Except as provided in Section 3(b) or 3(c), in no event may the Administrator exercise its discretion to reduce the exercise price of outstanding Stock Options or Stock Appreciation Rights or effect repricing through cancellation and regrants or by exchanging a Stock Option or Stock Appreciation Right for any other Award, without stockholder approval. If and to the extent determined by the Administrator to be required by the Code to ensure that Incentive Stock Options granted under the Plan are qualified under Section 422 of the Code or to ensure that compensation earned under Awards qualifies as performance-based compensation under Section 162(m) of the Code, if and to the extent intended to so qualify, and to the extent required under the applicable rules of Nasdaq, or such other securities exchange or market system on which the Stock is then principally listed, Plan amendments shall be subject to approval by the Company stockholders entitled to vote at a meeting of stockholders. Nothing in this Section 17 shall limit the Administrator's authority to take any action permitted pursuant to Section 3(c).

18) *STATUS OF PLAN*

With respect to the portion of any Award that has not been exercised and any payments in cash, Stock or other consideration not received by a grantee, a grantee shall have no rights greater than those of a general creditor of the Company unless the Administrator shall otherwise expressly determine in connection with any Award or Awards. In its sole discretion, the Administrator may authorize the creation of trusts or other arrangements to meet the Company's obligations to deliver Stock or make payments with respect to Awards hereunder, provided that the existence of such trusts or other arrangements is consistent with the foregoing sentence.

19) *CHANGE OF CONTROL PROVISIONS*

Upon the occurrence of a Change of Control as defined in this Section 19:

a) Except as otherwise provided in the applicable Award agreement, each outstanding Stock Option and Stock Appreciation Right shall automatically become fully exercisable.

b) Except as otherwise provided in the applicable Award Agreement, conditions and restrictions on each outstanding Restricted Stock Award, Deferred Stock Award and Performance Share Award which relate solely to the passage of time and continued employment will be removed. Performance or other conditions (other than conditions and restrictions relating solely to the passage of time and continued employment) will continue to apply unless otherwise provided in the applicable Award agreement.

c) "Change of Control" shall mean the occurrence of any one of the following events:

i) any "Person," as such term is used in Sections 13(d) and 14(d) of the Act (other than the Company, any of its Subsidiaries, or any trustee, fiduciary or other person or entity holding securities under any employee benefit plan or trust of the Company or any of its Subsidiaries), together with all "affiliates" and "associates" (as such terms are defined in Rule 12b-2 under the Exchange Act) of such person, shall become the "beneficial owner" (as such term is defined in Rule 13d-3 under the Exchange Act), directly or indirectly, of securities of the Company representing 25 percent or more of the combined voting power of the Company's then outstanding securities having the right to vote in an election of the Company's Board of Directors ("Voting Securities") (in such case other than as a result of an acquisition of securities directly from the Company); or

ii) persons who, as of the Effective Date, constitute the Company's Board of Directors (the "Incumbent Directors") cease for any reason, including, without limitation, as a result of a tender offer, proxy contest, merger or similar transaction, to constitute at least a majority of the Board, provided that any person becoming a director of the Company subsequent to the Effective Date shall be considered an Incumbent Director if such person's election was approved by or such person was nominated for election by either (A) a vote of at least a majority of the Incumbent Directors or (B) a vote of at least a majority of the Incumbent Directors who are members of a nominating committee comprised, in the majority, of Incumbent Directors; but provided further, that any such person whose initial assumption of office is in connection with an actual or threatened election contest relating to the election of members of the Board of Directors or other actual or threatened solicitation of proxies or consents by or on behalf of a Person other than the Board, including by reason of agreement intended to avoid or settle any such actual or threatened contest or solicitation, shall not be considered an Incumbent Director; or

iii) the consummation of a consolidation, merger or consolidation or sale or other disposition of all or substantially all of the assets of the Company (a "Corporate Transaction"); excluding, however, a Corporate Transaction in which the stockholders of the Company immediately prior to the Corporate Transaction, would, immediately after the Corporate Transaction, beneficially own (as such term is defined in Rule 13d-3 under the Act), directly or indirectly, shares representing in the aggregate more than 50 percent of the voting shares of the corporation issuing cash or securities in the Corporate Transaction (or of its ultimate parent corporation, if any); or

iv) the approval by the stockholders of any plan or proposal for the liquidation or dissolution of the Company.

Notwithstanding the foregoing, a "Change of Control" shall not be deemed to have occurred for purposes of the foregoing clause (i) solely as the result of an acquisition of securities by the Company which, by reducing the number of shares of Voting Securities outstanding, increases the proportionate number of shares of Voting Securities beneficially owned by any person to 25 percent or more of the combined voting power of all then outstanding Voting Securities; *provided, however,* that if any person referred to in this sentence shall thereafter become the beneficial owner of any additional shares of Voting Securities (other than pursuant to a stock split, stock dividend, or similar transaction or as a result of an acquisition of securities directly from the Company) and immediately thereafter beneficially owns 25 percent or more of the combined voting power of all then outstanding Voting Securities, then a "Change of Control" shall be deemed to have occurred for purposes of the foregoing clause (i).

20) *GENERAL PROVISIONS*

a) *No Distribution; Compliance with Legal Requirements.* The Administrator may require each person acquiring Stock pursuant to an Award to represent to and agree with the Company in writing that such person is acquiring the shares without a view to distribution thereof.

No shares of Stock shall be issued pursuant to an Award until all applicable securities law and other legal and stock exchange or similar requirements have been satisfied. The Administrator may require the placing of such stop-orders and restrictive legends on certificates for Stock and Awards as it deems appropriate.

b) *Delivery of Stock Certificates.* Stock certificates to grantees under this Plan shall be deemed delivered for all purposes when the Company or a stock transfer agent of the Company shall have mailed such certificates in the United States mail, addressed to the grantee, at the grantee's last known address on file with the Company. Uncertificated Stock shall be deemed delivered for all purposes when the Company or a Stock transfer agent of the Company shall have given to the grantee by electronic mail (with proof of receipt) or by United States mail, addressed to the grantee, at the grantee's last known address on file with the Company, notice of issuance and recorded the issuance in its records (which may include electronic "book entry" records). Notwithstanding anything herein to the contrary, the Company shall not be required to issue or deliver any certificates evidencing shares of Stock pursuant to the exercise of any Award, unless and until the Administrator has determined, with advice of counsel (to the extent the Administrator deems such advice necessary or advisable), that the issuance and delivery of such certificates is in compliance with all applicable laws, regulations of governmental authorities and, if applicable, the requirements of any exchange on which the shares of Stock are listed, quoted or traded. All Stock certificates delivered pursuant to the Plan shall be subject to any stop-transfer orders and other restrictions as the Administrator deems necessary or advisable to comply with federal, state or foreign jurisdiction, securities or other laws, rules and quotation system on which the Stock is listed, quoted or traded. The Administrator may place legends on any Stock certificate to reference restrictions applicable to the Stock. In addition to the terms and conditions provided herein, the Administrator may require that an individual make such reasonable covenants, agreements, and representations as the Administrator, in its discretion, deems necessary or advisable in order to comply with any such laws, regulations, or requirements. The Administrator shall have the right to require any individual to comply with any timing or other restrictions with respect to the settlement or exercise of any Award, including a window-period limitation, as may be imposed in the discretion of the Administrator.

c) *Stockholder Rights.* Until Stock is deemed delivered in accordance with Section 20(b), no right to vote or receive dividends or any other rights of a stockholder will exist with respect to shares of Stock to be issued in connection with an Award, notwithstanding the exercise of a Stock Option or any other action by the grantee with respect to an Award.

d) *Other Compensation Arrangements; No Employment Rights.* Nothing contained in this Plan shall prevent the Board from adopting other or additional compensation arrangements, including trusts, and such arrangements may be either generally applicable or applicable only in specific cases. The adoption of this Plan and the grant of Awards do not confer upon any employee any right to continued employment with the Company or any Subsidiary.

e) *Trading Policy Restrictions.* Option exercises and other Awards under the Plan shall be subject to such Company's insider trading policy, as in effect from time to time.

f) *Forfeiture of Awards under Sarbanes-Oxley Act.* If the Company is required to prepare an accounting restatement due to the material noncompliance of the Company, as a result of misconduct, with any financial reporting requirement under the securities laws, then, to the extent required by law, any grantee who is one of the individuals subject to automatic forfeiture under Section 304 of the Sarbanes-Oxley Act of 2002 shall reimburse the Company for the amount of any Award received by such individual under the Plan during the 12-month period following the first public issuance or filing with the United States Securities and Exchange Commission, as the case may be, of the financial document embodying such financial reporting requirement.

g) *Designation of Beneficiary.* Each grantee to whom an Award has been made under the Plan may designate a beneficiary or beneficiaries to exercise any Award or receive any payment under any Award payable on or after the grantee's death. Any such designation shall be on a form provided for that purpose by the Administrator and shall not be effective until received by the Administrator. If no beneficiary has been designated by a deceased grantee, or if the designated beneficiaries have predeceased the grantee, the beneficiary shall be the grantee's estate.

21) *EFFECTIVE DATE OF PLAN*

This Plan shall become effective upon approval by the holders of a majority of the votes cast at a meeting of stockholders at which a quorum is present. Subject to such approval by the stockholders and to the requirement that no Stock may be issued hereunder prior to such approval, Stock Options and other Awards may be granted hereunder on and after adoption of this Plan by the Board. No Incentive Stock Options may be granted under the Plan after the 10-year anniversary of the most recent prior date on which the Plan was approved by the Board of Directors (provided that the Plan was approved by stockholders within one year of such date) and no other Award may be granted under the Plan after the 10-year anniversary of the most recent prior date on which the Plan was approved by stockholders.

22) *GOVERNING LAW*

This Plan and all Awards and actions taken thereunder shall be governed by, and construed in accordance with, the laws of the State of Delaware, applied without regard to conflict of law principles.

DATE APPROVED BY BOARD OF DIRECTORS: October 26, 2000

DATE APPROVED BY STOCKHOLDERS: November 29, 2000

DATE AMENDMENT AND RESTATEMENT APPROVED BY BOARD OF DIRECTORS: April 5, 2006

DATE AMENDMENT AND RESTATEMENT APPROVED BY STOCKHOLDERS: May 18, 2006

DATE SECOND AMENDMENT AND RESTATEMENT APPROVED BY BOARD OF DIRECTORS: April 10, 2008

DATE SECOND AMENDMENT AND RESTATEMENT APPROVED BY STOCKHOLDERS: May 15, 2008

DATE FIRST AMENDMENT TO SECOND AMENDED AND RESTATED 2000 STOCK OPTION AND INCENTIVE PLAN APPROVED BY BOARD OF DIRECTORS: February 24, 2009

DATE THIRD AMENDMENT AND RESTATEMENT APPROVED BY BOARD OF DIRECTORS: April 13, 2011

DATE THIRD AMENDMENT AND RESTATEMENT APPROVED BY STOCKHOLDERS: May 25, 2011

DATE FIRST AMENDMENT TO HARVARD BIOSCIENCE, INC. THIRD AMENDED AND RESTATED 2000 STOCK OPTION AND INCENTIVE PLAN APPROVED BY BOARD OF DIRECTORS: March 9, 2013.

DATE SECOND AMENDMENT TO HARVARD BIOSCIENCE, INC. THIRD AMENDED AND RESTATED 2000 STOCK OPTION AND INCENTIVE PLAN APPROVED BY BOARD OF DIRECTORS: APRIL 3, 2015.

DATE SECOND AMENDMENT TO HARVARD BIOSCIENCE, INC. THIRD AMENDED AND RESTATED 2000 STOCK OPTION AND INCENTIVE PLAN APPROVED BY STOCKHOLDERS: MAY 28, 2015.

DATE THIRD AMENDMENT TO HARVARD BIOSCIENCE, INC. THIRD AMENDED AND RESTATED 2000 STOCK OPTION AND INCENTIVE PLAN APPROVED BY BOARD OF DIRECTORS: APRIL 2, 2018.

DATE THIRD AMENDMENT TO HARVARD BIOSCIENCE, INC. THIRD AMENDED AND RESTATED 2000 STOCK OPTION AND INCENTIVE PLAN APPROVED BY STOCKHOLDERS: MAY 17, 2018.

DATE FOURTH AMENDMENT AND RESTATEMENT APPROVED BY BOARD OF DIRECTORS: APRIL 20, 2020.

DATE FOURTH AMENDMENT AND RESTATEMENT APPROVED BY STOCKHOLDERS: JUNE 11, 2020.

EXHIBIT 31.1

Certification

I, Michael A. Rossi, certify that:

1. I have reviewed this Quarterly Report on Form 10-Q 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: August 10, 2020

/s/ MICHAEL A. ROSSI

Michael A. Rossi
Chief Financial Officer

EXHIBIT 31.2

Certification

I, James Green, certify that:

1. I have reviewed this Quarterly Report on Form 10-Q 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: August 10, 2020

/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 his knowledge that the Company's Quarterly Report on Form 10-Q for the quarterly period ended June 30, 2020 (the Report) to which this certification is being furnished as an exhibit, 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: August 10, 2020	/s/ MICHAEL A. ROSSI
	Name: Michael A. Rossi 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 Quarterly Report on Form 10-Q for the quarterly period ended June 30, 2020 (the Report) to which this certification is being furnished as an exhibit, 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: August 10, 2020

/s/ JAMES GREEN

Name: James Green
Title: Chief Executive Officer