

PROCESS ANALYTICAL TECHNOLOGIES FOR PHARMACEUTICALS: GLOBAL MARKETS



IAS034B
September 2014

Shalini Shahani Dewan
Project Analyst

ISBN: 1-56965-924-9



BCC Research
49 Walnut Park, Building 2
Wellesley, MA 02481 USA
866-285-7215 (toll-free within the USA),
or (+1) 781-489-7301
www.bccresearch.com
information@bccresearch.com

TABLE OF CONTENTS

TOPIC	PAGE NO.
CHAPTER 1 INTRODUCTION	2
STUDY OBJECTIVES	2
REASONS FOR DOING THIS STUDY	2
CONTRIBUTIONS OF THE STUDY AND INTENDED AUDIENCE	2
SCOPE OF THE STUDY	3
METHODOLOGY	3
INFORMATION SOURCES	3
ANALYSTS' CREDENTIALS	4
RELATED BCC RESEARCH REPORTS	4
BCC RESEARCH WEBSITE	5
DISCLAIMER	5
CHAPTER 2 EXECUTIVE SUMMARY	7
<i>SUMMARY TABLE GLOBAL MARKET FOR PROCESS ANALYTICAL TECHNOLOGY INSTRUMENTATION BY REGION, THROUGH 2019 (\$ THOUSANDS)</i>	8
<i>SUMMARY FIGURE GLOBAL MARKET FOR PROCESS ANALYTICAL TECHNOLOGY INSTRUMENTATION BY REGION, 2011-2019 (\$ THOUSANDS)</i>	8
CHAPTER 3 OVERVIEW	10
PAT PROCESS STEPS	11
<i>FIGURE 1 PAT PROCESS STEPS</i>	11
CLASSIFICATION	11
CHROMATOGRAPHY	12
High Performance Liquid Chromatography	13
Gas Chromatography	13
Gas Chromatography/Mass Spectrometry	14
Thin Layer Chromatography	14
<i>TABLE 1 ADVANTAGES AND DISADVANTAGES OF CHROMATOGRAPHIC TECHNIQUES</i>	15
SPECTROPHOTOMETRY	17
Near-Infrared	17
Ultraviolet-Visible	18
Nuclear Magnetic Resonance	18
Atomic Absorption	18
Infrared	19
X-ray Diffraction	19
Mass Spectrometry	19
Raman Spectroscopy	20
<i>TABLE 2 ADVANTAGES AND DISADVANTAGES OF SPECTROPHOTOMETRIC TECHNIQUES</i>	21
CAPILLARY ELECTROPHORESIS	24
Isoelectric Focusing	24
Isotachopheresis	25
<i>TABLE 3 ADVANTAGES AND DISADVANTAGES OF CAPILLARY ELECTROPHORESIS TECHNIQUES</i>	25
PARTICLE SIZE ANALYSIS METHODS	26

TOPIC	PAGE NO.
Laser Diffraction	26
Microscopic	27
Photozone	27
Sieving	27
Size-Exclusion Chromatography	28
<i>TABLE 4 ADVANTAGES AND DISADVANTAGES OF PARTICLE SIZE ANALYSIS TECHNIQUES</i>	28
DISSOLUTION METHODS	30
Automated	31
Ultraviolet-Visible/Ultraviolet	31
High Performance Liquid Chromatography	31
<i>TABLE 5 ADVANTAGES AND DISADVANTAGES OF DISSOLUTION METHODS</i>	32
AUTOMATED ANALYTICAL METHODS	32
Automated Analysis	33
Robots	33
Others	33
Automated Sample Preparation and Analysis	33
<i>TABLE 6 ADVANTAGES AND DISADVANTAGES OF AUTOMATED ANALYTICAL METHODS</i>	34
TITRATION TOOLS	35
<i>TABLE 7 ADVANTAGES AND DISADVANTAGES OF TITRATION TOOLS</i>	35
PROCESS ANALYTICAL TECHNOLOGY IN THE PHARMACEUTICAL MANUFACTURING PROCESS	35
RAW MATERIAL IDENTIFICATION	36
BLENDING	36
GRANULATION	36
DRYING	36
COMPRESSION	37
COATING	37
PACKAGING	37
<i>TABLE 8 BENEFITS AND CONSIDERATIONS OF PROCESS ANALYTICAL TECHNOLOGY FOR PHARMACEUTICAL PRODUCTS MANUFACTURING</i>	38
FERMENTATION	38
CRYSTALLIZATION	39
LYOPHILIZATION	39
SOLVENT RECOVERY	39
DOWNSTREAM PROCESSING	39
MEASUREMENT BY PROCESS ANALYTICAL TECHNOLOGY TOOLS AND TECHNIQUES	40
ACTIVE PHARMACEUTICAL INGREDIENT CONCENTRATION	40
CONTENT UNIFORMITY	40
COATING THICKNESS	41
BIOMASS MEASUREMENT	41
IMPURITY CONCENTRATION	41
OFF-GAS MONITORING	41
PURITY	42
LUBRICANT UNIFORMITY	42
MOISTURE	42

TOPIC	PAGE NO.
COATING COVERAGE	42
NUTRIENT CONCENTRATION	43
OPTICAL DENSITY	43
REACTION MONITORING	43
CHAPTER 4 REGULATORY ASPECTS	45
CATEGORIZATION OF TOOLS IN THE PAT FRAMEWORK	46
MULTIVARIATE TOOLS FOR DESIGN, DATA ACQUISITION AND ANALYSIS	46
PROCESS ANALYZERS	46
PROCESS CONTROL TOOLS	47
CONTINUOUS IMPROVEMENT AND KNOWLEDGE MANAGEMENT TOOLS	48
PAT SUPPORT IN EUROPE	49
EU PAT TEAM ACTIVITIES	49
REGULATORY COMPLIANCE AND DEVELOPMENTS OF PROCESS ANALYTICAL TECHNOLOGIES FOR THE PHARMACEUTICAL INDUSTRY	50
CHAPTER 5 NEW DEVELOPMENTS	52
TABLE 9 NEW DEVELOPMENTS FOR PROCESS ANALYTICAL TECHNOLOGIES IN PHARMACEUTICALS, 2013 THROUGH MARCH 2014	52
TABLE 10 AWARDS FOR PROCESS ANALYTICAL TECHNOLOGIES IN PHARMACEUTICALS, 2013 THROUGH MARCH 2014	55
TABLE 11 NEW DEVELOPMENTS IN PROCESS ANALYTICAL TECHNOLOGIES FOR PHARMACEUTICALS, 2012	57
TABLE 12 AWARDS FOR PROCESS ANALYTICAL TECHNOLOGIES IN PHARMACEUTICALS, 2012	59
TABLE 13 NEW DEVELOPMENTS IN PROCESS ANALYTICAL TECHNOLOGIES FOR PHARMACEUTICALS, 2011	60
TABLE 14 AWARDS FOR PROCESS ANALYTICAL TECHNOLOGIES IN PHARMACEUTICALS, 2011	62
CHAPTER 6 MARKET ANALYSIS	66
MARKET BY PAT CATEGORY	66
TABLE 15 GLOBAL MARKET FOR PROCESS ANALYTICAL TECHNOLOGY INSTRUMENTATION BY CATEGORY, THROUGH 2019 (\$ THOUSANDS)	68
FIGURE 2 GLOBAL MARKET FOR PROCESS ANALYTICAL TECHNOLOGY INSTRUMENTATION BY CATEGORY, 2011-2019 (\$ THOUSANDS)	68
CHROMATOGRAPHIC TOOLS AND TECHNIQUES	69
Market Overview	69
Market Revenue	69
TABLE 16 CHROMATOGRAPHIC TOOLS AND TECHNIQUES MARKET BY TYPE, THROUGH 2019 (\$ THOUSANDS)	70
FIGURE 3 CHROMATOGRAPHIC TOOLS AND TECHNIQUES MARKET BY TYPE, 2011-2019 (\$ THOUSANDS)	70
Gas Chromatography/Mass Spectrometry	70
Market Overview	71
Market Revenue	71
TABLE 17 GC/MS TOOLS AND METHODS MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)	72
FIGURE 4 GC/MS TOOLS AND METHODS MARKET BY REGION, 2011-2019 (\$ THOUSANDS)	72

TOPIC	PAGE NO.
Gas Chromatography	72
Market Overview	73
Market Revenue	73
<i>TABLE 18 GAS CHROMATOGRAPHY TOOLS AND METHODS MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)</i>	74
<i>FIGURE 5 GAS CHROMATOGRAPHY TOOLS AND METHODS MARKET BY REGION, 2011-2019 (\$ THOUSANDS)</i>	74
High Performance Liquid Chromatography	75
Market Overview	75
Market Revenue	75
<i>TABLE 19 HIGH PERFORMANCE LIQUID CHROMATOGRAPHY TOOLS AND METHODS MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)</i>	76
<i>FIGURE 6 HIGH PERFORMANCE LIQUID CHROMATOGRAPHY TOOLS AND METHODS MARKET BY REGION, 2011-2019 (\$ THOUSANDS)</i>	76
Thin Layer Chromatography	77
Market Overview	77
Market Revenue	77
<i>TABLE 20 THIN LAYER CHROMATOGRAPHY TOOLS AND METHODS MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)</i>	78
<i>FIGURE 7 THIN LAYER CHROMATOGRAPHY TOOLS AND METHODS MARKET BY REGION, 2011-2019 (\$ THOUSANDS)</i>	78
SPECTROPHOTOMETRIC TOOLS AND TECHNIQUES	79
Market Overview	79
Market Revenue	79
<i>TABLE 21 SPECTROPHOTOMETRIC TOOLS AND TECHNIQUES MARKET BY TYPE, THROUGH 2019 (\$ THOUSANDS)</i>	80
<i>FIGURE 8 SPECTROPHOTOMETRIC TOOLS AND TECHNIQUES MARKET BY TYPE, 2011-2019 (\$ THOUSANDS)</i>	80
Near-Infrared	81
Market Overview	81
Market Revenue	82
<i>TABLE 22 NEAR-INFRARED TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)</i>	82
<i>FIGURE 9 NEAR-INFRARED TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)</i>	82
Ultraviolet-Visible	83
Market Overview	83
Market Revenue	84
<i>TABLE 23 ULTRAVIOLET-VISIBLE TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)</i>	84
<i>FIGURE 10 ULTRAVIOLET-VISIBLE TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)</i>	84
Nuclear Magnetic Resonance	85
Market Overview	85
Market Revenue	86
<i>TABLE 24 NUCLEAR MAGNETIC RESONANCE TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)</i>	86
<i>FIGURE 11 NUCLEAR MAGNETIC RESONANCE TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)</i>	86
Atomic Absorption Spectrometry	87

TOPIC	PAGE NO.
Market Overview	87
Market Revenue	88
<i>TABLE 25 ATOMIC ABSORPTION TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)</i>	88
<i>FIGURE 12 ATOMIC ABSORPTION TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)</i>	89
Infrared	89
Market Overview	89
Market Revenue	90
<i>TABLE 26 INFRARED TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)</i>	90
<i>FIGURE 13 INFRARED TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)</i>	90
X-ray Diffraction	91
Market Overview	91
Market Revenue	92
<i>TABLE 27 X-RAY DIFFRACTION TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)</i>	92
<i>FIGURE 14 X-RAY DIFFRACTION TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)</i>	92
Mass Spectrometry	93
Market Overview	93
Market Revenue	94
<i>TABLE 28 MASS SPECTROMETRY TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)</i>	94
<i>FIGURE 15 MASS SPECTROMETRY TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)</i>	94
Raman Spectroscopy	95
Market Overview	95
Market Revenue	96
<i>TABLE 29 RAMAN SPECTROSCOPY TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)</i>	96
<i>FIGURE 16 RAMAN SPECTROSCOPY TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)</i>	96
CAPILLARY ELECTROPHORESIS	97
Market Overview	97
Market Revenue	98
<i>TABLE 30 CAPILLARY ELECTROPHORESIS MARKET BY TYPE, THROUGH 2019 (\$ THOUSANDS)</i>	98
<i>FIGURE 17 CAPILLARY ELECTROPHORESIS MARKET BY TYPE, 2011-2019 (\$ THOUSANDS)</i>	98
Isoelectric focusing	99
Market Overview	99
Market Revenue	100
<i>TABLE 31 ISOELECTRIC FOCUSING TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)</i>	100
<i>FIGURE 18 ISOELECTRIC FOCUSING TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)</i>	100
Isotachopheresis	101
Market Overview	101

TOPIC	PAGE NO.
Market Revenue	102
<i>TABLE 32 ISOTACHOPHORESIS TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)</i>	102
<i>FIGURE 19 ISOTACHOPHORESIS TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)</i>	102
PARTICLE SIZE ANALYSIS	103
Market Overview	103
Market Revenue	104
<i>TABLE 33 PARTICLE SIZE ANALYSIS TOOLS AND TECHNIQUES MARKET BY TYPE, THROUGH 2019 (\$ THOUSANDS)</i>	105
<i>FIGURE 20 PARTICLE SIZE ANALYSIS TOOLS AND TECHNIQUES MARKET BY TYPE, 2011-2019 (\$ THOUSANDS)</i>	105
Laser Tools and Techniques	105
Market Overview	106
Market Revenue	106
<i>TABLE 34 LASER TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)</i>	107
<i>FIGURE 21 LASER TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)</i>	107
Microscopic Tools and Techniques	107
Market Overview	108
Market Revenue	108
<i>TABLE 35 MICROSCOPIC TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)</i>	108
<i>FIGURE 22 MICROSCOPIC TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)</i>	109
Size-Exclusion Chromatography Tools and Techniques	109
Market Overview	110
Market Revenue	110
<i>TABLE 36 SIZE EXCLUSION CHROMATOGRAPHY TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)</i>	111
<i>FIGURE 23 SIZE EXCLUSION CHROMATOGRAPHY TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)</i>	111
Photozone Tools and Techniques	111
Market Overview	112
Market Revenue	112
<i>TABLE 37 PHOTOZONE TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)</i>	113
<i>FIGURE 24 PHOTOZONE TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)</i>	113
Sieving Tools and Techniques	113
Market Overview	114
Market Revenue	114
<i>TABLE 38 SIEVING TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)</i>	115
<i>FIGURE 25 SIEVING TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)</i>	115
DISSOLUTION METHODS	115
Market Overview	116
Market Revenue	116

TOPIC	PAGE NO.
<i>TABLE 39 DISSOLUTION METHOD TOOLS AND TECHNIQUES MARKET BY TYPE, THROUGH 2019 (\$ THOUSANDS)</i>	117
<i>FIGURE 26 DISSOLUTION METHOD TOOLS AND TECHNIQUES MARKET BY TYPE, 2011-2019 (\$ THOUSANDS)</i>	117
Automated Dissolution Tools and Techniques	117
Market Overview	118
Market Revenue	118
<i>TABLE 40 AUTOMATED DISSOLUTION TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)</i>	119
<i>FIGURE 27 AUTOMATED DISSOLUTION TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)</i>	119
Ultraviolet Dissolution Tools and Techniques	119
Market Overview	120
Market Revenue	120
<i>TABLE 41 UV DISSOLUTION TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)</i>	121
<i>FIGURE 28 UV DISSOLUTION TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)</i>	121
HPLC Dissolution Tools and Techniques	121
Market Overview	122
Market Revenue	122
<i>TABLE 42 HPLC DISSOLUTION TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)</i>	123
<i>FIGURE 29 HPLC DISSOLUTION TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)</i>	123
AUTOMATED ANALYTICAL METHODS	123
Market Overview	124
Market Revenue	124
<i>TABLE 43 AUTOMATED ANALYTICAL METHODS TOOLS AND TECHNIQUES MARKET BY TYPE, THROUGH 2019 (\$ THOUSANDS)</i>	124
<i>FIGURE 30 AUTOMATED ANALYTICAL METHODS TOOLS AND TECHNIQUES MARKET BY TYPE, 2011-2019 (\$ THOUSANDS)</i>	125
Automated Analysis	125
Market Overview	126
Market Revenue	126
<i>TABLE 44 AUTOMATED ANALYSIS TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)</i>	127
<i>FIGURE 31 AUTOMATED ANALYSIS TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)</i>	127
Robotics	128
Market Overview	128
Market Revenue	128
<i>TABLE 45 ROBOTICS TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)</i>	129
<i>FIGURE 32 ROBOTICS TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)</i>	129
Other Automated Analytical Methods	130
Market Overview	130
Market Revenue	130

TOPIC	PAGE NO.
<i>TABLE 46 OTHER AUTOMATED ANALYTICAL METHODS MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)</i>	131
<i>FIGURE 33 OTHER AUTOMATED ANALYTICAL METHODS MARKET BY REGION, 2011-2019 (\$ THOUSANDS)</i>	131
TITRATION TOOLS	131
Market Overview	132
Market Revenue	132
<i>TABLE 47 TITRATION TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)</i>	133
<i>FIGURE 34 TITRATION TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)</i>	133
MARKET SHARE	133
<i>TABLE 48 MARKET SHARE OF PROCESS ANALYTICAL TECHNOLOGY INSTRUMENTATION BY TYPE, 2013 (%)</i>	134
<i>FIGURE 35 MARKET SHARE OF PROCESS ANALYTICAL TECHNOLOGY INSTRUMENTATION BY TYPE, 2013 (%)</i>	134
MARKET BY REGION	134
MARKET OVERVIEW	135
MARKET REVENUE	136
<i>TABLE 49 REGIONAL BREAKDOWN OF SALES OF PROCESS ANALYTICAL TECHNOLOGY INSTRUMENTATION, THROUGH 2019 (\$ THOUSANDS)</i>	137
<i>FIGURE 36 REGIONAL BREAKDOWN FOR SALES OF PROCESS ANALYTICAL TECHNOLOGY INSTRUMENTATION, 2011-2019 (\$ THOUSANDS)</i>	137
MARKET SHARE	137
<i>TABLE 50 MARKET SHARES OF PROCESS ANALYTICAL TECHNOLOGY INSTRUMENTATION BY REGION, IN 2013 (%)</i>	138
<i>FIGURE 37 MARKET SHARES OF PROCESS ANALYTICAL TECHNOLOGY INSTRUMENTATION BY REGION, IN 2013 (%)</i>	138
CHAPTER 7 INDUSTRY STRUCTURE	140
CHROMATOGRAPHIC TOOLS AND TECHNIQUES	140
MARKET LEADERS	140
<i>TABLE 51 LEADING MANUFACTURERS/SUPPLIERS OF PAT CHROMATOGRAPHIC INSTRUMENTATION, 2013</i>	140
MARKET SHARES	141
<i>TABLE 52 MARKET SHARES OF MANUFACTURERS/SUPPLIERS OF CHROMATOGRAPHIC TOOLS AND TECHNIQUES, 2013 (%)</i>	142
<i>FIGURE 38 MARKET SHARES OF MANUFACTURERS/SUPPLIERS OF CHROMATOGRAPHIC TOOLS AND TECHNIQUES, 2013 (%)</i>	142
SPECTROPHOTOMETRIC TOOLS AND TECHNIQUES	143
MARKET LEADERS	143
<i>TABLE 53 LEADING MANUFACTURERS/SUPPLIERS OF PAT SPECTROPHOTOMETRIC TOOLS AND TECHNIQUES, 2013</i>	143
MARKET SHARES	145
<i>TABLE 54 MARKET SHARES OF MANUFACTURERS/SUPPLIERS OF SPECTROPHOTOMETRIC TOOLS AND TECHNIQUES, 2013 (%)</i>	145
<i>FIGURE 39 MARKET SHARES OF MANUFACTURERS/SUPPLIERS OF SPECTROPHOTOMETRIC TOOLS AND TECHNIQUES, 2013 (%)</i>	146
CAPILLARY ELECTROPHORESIS TOOLS AND TECHNIQUES	146
MARKET LEADERS	146

TOPIC	PAGE NO.
<i>TABLE 55 LEADING MANUFACTURERS/SUPPLIERS OF PAT CAPILLARY ELECTROPHORESIS TOOLS AND TECHNIQUES, 2013</i>	147
MARKET SHARES	147
<i>TABLE 56 MARKET SHARES OF MANUFACTURERS/SUPPLIERS OF CAPILLARY ELECTROPHORESIS TOOLS AND TECHNIQUES, 2013 (%)</i>	147
<i>FIGURE 40 MARKET SHARES OF MANUFACTURERS/SUPPLIERS OF CAPILLARY ELECTROPHORESIS TOOLS AND TECHNIQUES, 2013 (%)</i>	147
PARTICLE SIZE ANALYSIS TOOLS AND TECHNIQUES	148
MARKET LEADERS	148
<i>TABLE 57 LEADING MANUFACTURERS/SUPPLIERS OF PAT PARTICLE SIZE ANALYSIS TOOLS AND TECHNIQUES, 2013</i>	148
MARKET SHARES	150
<i>TABLE 58 MARKET SHARES OF MANUFACTURERS/SUPPLIERS OF PARTICLE SIZE ANALYSIS TOOLS AND TECHNIQUES, 2013 (%)</i>	150
<i>FIGURE 41 MARKET SHARES OF MANUFACTURERS/SUPPLIERS OF PARTICLE SIZE ANALYSIS TOOLS AND TECHNIQUES, 2013 (%)</i>	151
DISSOLUTION METHODS TOOLS AND TECHNIQUES	151
MARKET LEADERS	151
<i>TABLE 59 LEADING MANUFACTURERS/SUPPLIERS OF PAT DISSOLUTION METHODS TOOLS AND TECHNIQUES, 2013</i>	151
MARKET SHARES	152
<i>TABLE 60 MARKET SHARES OF MANUFACTURERS/SUPPLIERS OF DISSOLUTION METHODS TOOLS AND TECHNIQUES, 2013 (%)</i>	152
<i>FIGURE 42 MARKET SHARES OF MANUFACTURERS/SUPPLIERS OF DISSOLUTION METHODS TOOLS AND TECHNIQUES, 2013 (%)</i>	152
AUTOMATED ANALYTICAL METHODS TOOLS AND TECHNIQUES	153
MARKET LEADERS	153
<i>TABLE 61 LEADING MANUFACTURERS/SUPPLIERS OF PAT AUTOMATED ANALYTICAL METHODS TOOLS AND TECHNIQUES, 2013</i>	153
MARKET SHARES	155
<i>TABLE 62 MARKET SHARES OF MANUFACTURERS/SUPPLIERS OF AUTOMATED ANALYTICAL METHODS TOOLS AND TECHNIQUES, 2013 (%)</i>	156
<i>FIGURE 43 MARKET SHARES OF MANUFACTURERS/SUPPLIERS OF AUTOMATED ANALYTICAL METHODS TOOLS AND TECHNIQUES, 2013 (%)</i>	156
TITRATION TOOLS AND TECHNIQUES	157
MARKET LEADERS	157
<i>TABLE 63 LEADING MANUFACTURERS/SUPPLIERS OF PAT TITRATION TOOLS AND TECHNIQUES, 2013</i>	157
MARKET SHARES	158
<i>TABLE 64 MARKET SHARES OF MANUFACTURERS/SUPPLIERS OF TITRATION TOOLS AND TECHNIQUES, 2013 (%)</i>	158
<i>FIGURE 44 MARKET SHARES OF MANUFACTURERS/SUPPLIERS OF TITRATION TOOLS AND TECHNIQUES, 2013 (%)</i>	158
CHAPTER 8 PROCESS ANALYTICAL TECHNOLOGY MARKET BY APPLICATION	161
INDUSTRIAL PHARMACEUTICAL MANUFACTURING	161
<i>FIGURE 45 APPLICATION OF PAT IN PHARMACEUTICAL TABLET MANUFACTURING</i>	161
PHARMACEUTICAL RESEARCH AND DEVELOPMENT	162
MARKET OVERVIEW	163
MARKET REVENUE	164

TOPIC	PAGE NO.
<i>TABLE 65 GLOBAL MARKET FOR PROCESS ANALYTICAL TECHNOLOGY BY APPLICATION, THROUGH 2019 (\$ THOUSANDS)</i>	165
<i>FIGURE 46 GLOBAL MARKET FOR PROCESS ANALYTICAL TECHNOLOGY BY APPLICATION, 2011-2019 (\$ THOUSANDS)</i>	165
MARKET SHARE	166
<i>TABLE 66 MARKET SHARES OF PROCESS ANALYTICAL TECHNOLOGY BY APPLICATION, 2013 (%)</i>	166
<i>FIGURE 47 MARKET SHARES OF PROCESS ANALYTICAL TECHNOLOGY BY APPLICATION, IN 2013 (%)</i>	166
CHAPTER 9 PATENT ANALYSIS	168
PATENTS BY YEAR	169
<i>TABLE 67 NUMBER OF U.S. PATENTS ISSUED FOR PAT INSTRUMENTATION AND METHODS FOR APPLICATION IN PHARMACEUTICALS BY YEAR, 2011-2013 (NUMBER OF PATENTS)</i>	169
<i>FIGURE 48 NUMBER OF U.S. PATENTS ISSUED FOR PAT INSTRUMENTATION AND METHODS FOR APPLICATION IN PHARMACEUTICALS BY YEAR, 2011-2013 (NUMBER OF PATENTS)</i>	169
PATENTS BY TYPE	170
<i>TABLE 68 U.S. PATENTS ISSUED FOR PROCESS ANALYTICAL TECHNOLOGY INSTRUMENTATION AND TECHNIQUES BY CATEGORY, 2011-2013 (NUMBER OF PATENTS)</i>	170
<i>FIGURE 49 U.S. PATENTS ISSUED FOR PROCESS ANALYTICAL TECHNOLOGY INSTRUMENTATION AND TECHNIQUES BY CATEGORY, 2011-2013 (NUMBER OF PATENTS)</i>	171
PATENTS BY COUNTRY	171
CHROMATOGRAPHIC TOOLS AND TECHNIQUES	171
<i>TABLE 69 U.S. PATENTS ISSUED FOR CHROMATOGRAPHIC TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (NUMBER OF PATENTS)</i>	172
<i>TABLE 70 SHARES OF U.S. PATENTS ISSUED FOR CHROMATOGRAPHIC TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (NUMBER OF PATENTS/%)</i>	172
<i>FIGURE 50 SHARES OF U.S. PATENT ISSUED FOR CHROMATOGRAPHIC TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (%)</i>	173
SPECTROPHOTOMETRIC TOOLS AND TECHNIQUES	173
<i>TABLE 71 U.S. PATENTS ISSUED FOR SPECTROPHOTOMETRIC TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (NUMBER OF PATENTS)</i>	174
<i>TABLE 72 SHARES OF U.S. PATENTS ISSUED FOR SPECTROPHOTOMETRIC TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (NUMBER OF PATENTS/%)</i>	174
<i>FIGURE 51 SHARES OF U.S. PATENTS ISSUED FOR SPECTROPHOTOMETRIC TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (%)</i>	175
CAPILLARY ELECTROPHORESIS TOOLS AND TECHNIQUES	176
<i>TABLE 73 U.S. PATENTS ISSUED FOR CAPILLARY ELECTROPHORESIS TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (NUMBER OF PATENTS)</i>	176
<i>TABLE 74 SHARES OF U.S. PATENTS ISSUED FOR CAPILLARY ELECTROPHORESIS TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (NUMBER OF PATENTS/%)</i>	177
PARTICLE SIZE ANALYSIS TOOLS AND TECHNIQUES	177
<i>TABLE 75 U.S. PATENTS ISSUED FOR PARTICLE SIZE ANALYSIS TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (NUMBER OF PATENTS)</i>	177

TOPIC	PAGE NO.
<i>TABLE 76 SHARES OF U.S. PATENTS ISSUED FOR PARTICLE SIZE ANALYSIS TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (NUMBER OF PATENTS/%)</i>	178
<i>FIGURE 52 SHARES OF U.S. PATENTS ISSUED FOR PARTICLE SIZE ANALYSIS TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (%)</i>	179
DISSOLUTION METHODS TOOLS AND TECHNIQUES	179
<i>TABLE 77 U.S. PATENTS ISSUED FOR DISSOLUTION METHODS TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (NUMBER OF PATENTS)</i>	179
<i>TABLE 78 SHARES OF U.S. PATENTS ISSUED FOR DISSOLUTION METHODS TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (NUMBER OF PATENTS/%)</i>	180
<i>FIGURE 53 SHARES OF U.S. PATENTS ISSUED FOR DISSOLUTION METHODS TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (%)</i>	181
AUTOMATED ANALYTICAL METHODS TOOLS AND TECHNIQUES	181
<i>TABLE 79 U.S. PATENTS ISSUED FOR AUTOMATED ANALYTICAL METHODS TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (NUMBER OF PATENTS)</i>	181
<i>TABLE 80 SHARES OF U.S. PATENTS ISSUED FOR AUTOMATED ANALYTICAL METHODS TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (NUMBER OF PATENTS/%)</i>	182
<i>FIGURE 54 SHARES OF U.S. PATENTS ISSUED FOR AUTOMATED ANALYTICAL METHODS TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (%)</i>	183
TITRATION TOOLS AND TECHNIQUES	183
<i>TABLE 81 U.S. PATENTS ISSUED FOR TITRATION TOOLS AND TECHNIQUES TO U.S. PATENT HOLDERS, 2011-2013 (NUMBER OF PATENTS)</i>	183
<i>TABLE 82 PATENT SHARES BY COUNTRY FOR TITRATION TOOLS AND TECHNIQUES, 2011-2013 (NUMBER OF PATENTS/%)</i>	184
PATENTS BY COMPANY	184
CHROMATOGRAPHIC TOOLS AND TECHNIQUES	184
<i>TABLE 83 U.S. PATENTS ISSUED FOR CHROMATOGRAPHIC TOOLS AND TECHNIQUES BY COMPANY, 2011-2013 (NUMBER OF PATENTS)</i>	185
SPECTROPHOTOMETRIC TOOLS AND TECHNIQUES	186
<i>TABLE 84 U.S. PATENTS ISSUED FOR SPECTROPHOTOMETRIC TOOLS AND TECHNIQUES BY COMPANY, 2011-2013 (NUMBER OF PATENTS)</i>	187
CAPILLARY ELECTROPHORESIS TOOLS AND TECHNIQUES	191
<i>TABLE 85 U.S. PATENTS ISSUED FOR CAPILLARY ELECTROPHORESIS TOOLS AND TECHNIQUES BY COMPANY, 2011-2013 (NUMBER OF PATENTS)</i>	191
PARTICLE SIZE ANALYSIS TOOLS AND TECHNIQUES	192
<i>TABLE 86 U.S. PATENTS ISSUED FOR PARTICLE SIZE ANALYSIS TOOLS AND TECHNIQUES BY COMPANY, 2011-2013 (NUMBER OF PATENTS)</i>	192
DISSOLUTION METHODS TOOLS AND TECHNIQUES	193
<i>TABLE 87 U.S. PATENTS ISSUED FOR DISSOLUTION METHODS TOOLS AND TECHNIQUES BY COMPANY, 2011-2013 (NUMBER OF PATENTS)</i>	194
AUTOMATED ANALYTICAL METHODS TOOLS AND TECHNIQUES	195
<i>TABLE 88 U.S. PATENTS ISSUED FOR AUTOMATED ANALYTICAL METHODS TOOLS AND TECHNIQUES BY COMPANY, 2011-2013 (NUMBER OF PATENTS)</i>	195
TITRATION TOOLS AND TECHNIQUES	197
<i>TABLE 89 U.S. PATENTS ISSUED FOR TITRATION TOOLS AND TECHNIQUES BY COMPANY, 2011-2013 (NUMBER OF PATENTS)</i>	197
PATENTS BY ASSIGNEE	197
CHROMATOGRAPHIC TOOLS AND TECHNIQUES	197

TOPIC	PAGE NO.
<i>TABLE 90 U.S. PATENTS ISSUED FOR CHROMATOGRAPHIC TOOLS AND TECHNIQUES BY TYPE OF ASSIGNEE, 2011-2013 (NUMBER OF PATENTS)</i>	197
SPECTROPHOTOMETRIC TOOLS AND TECHNIQUES	198
<i>TABLE 91 U.S. PATENTS ISSUED FOR SPECTROPHOTOMETRIC TOOLS AND TECHNIQUES BY TYPE OF ASSIGNEE, 2011-2013 (NUMBER OF PATENTS)</i>	198
<i>FIGURE 55 U.S. PATENTS ISSUED FOR SPECTROPHOTOMETRIC TOOLS AND TECHNIQUES BY TYPE OF ASSIGNEE, 2011-2013 (NUMBER OF PATENTS)</i>	198
CAPILLARY ELECTROPHORESIS TOOLS AND TECHNIQUES	199
<i>TABLE 92 U.S. PATENTS ISSUED FOR CAPILLARY ELECTROPHORESIS TOOLS AND TECHNIQUES BY TYPE OF ASSIGNEE, 2011-2013 (NUMBER OF PATENTS)</i>	199
PARTICLE SIZE ANALYSIS TOOLS AND TECHNIQUES	199
<i>TABLE 93 U.S. PATENTS ISSUED FOR PARTICLE SIZE ANALYSIS TOOLS AND TECHNIQUES BY TYPE OF ASSIGNEE, 2011-2013 (NUMBER OF PATENTS)</i>	199
<i>FIGURE 56 U.S. PATENTS ISSUED FOR PARTICLE SIZE ANALYSIS TOOLS AND TECHNIQUES BY TYPE OF ASSIGNEE, 2011-2013 (NUMBER OF PATENTS)</i>	199
DISSOLUTION METHODS TOOLS AND TECHNIQUES	200
<i>TABLE 94 U.S. PATENTS ISSUED FOR DISSOLUTION METHODS TOOLS AND TECHNIQUES BY TYPE OF ASSIGNEE, 2011-2013 (NUMBER OF PATENTS)</i>	200
AUTOMATED ANALYTICAL METHODS TOOLS AND TECHNIQUES	201
<i>TABLE 95 U.S. PATENTS ISSUED FOR AUTOMATED ANALYTICAL METHODS TOOLS AND TECHNIQUES BY TYPE OF ASSIGNEE, 2011-2013 (NUMBER OF PATENTS)</i>	201
<i>FIGURE 57 U.S. PATENTS ISSUED FOR AUTOMATED ANALYTICAL METHODS TOOLS AND TECHNIQUES BY TYPE OF ASSIGNEE, 2011-2013 (NUMBER OF PATENTS)</i>	201
TITRATION TOOLS AND TECHNIQUES	202
<i>TABLE 96 U.S. PATENTS ISSUED FOR TITRATION TOOLS AND TECHNIQUES BY TYPE OF ASSIGNEE, 2011-2013 (NUMBER OF PATENTS)</i>	202
CHAPTER 10 CURRENT SITUATION	204
NEW TECHNOLOGIES AND PLATFORMS IN PROCESS ANALYTICAL TECHNOLOGY IMPLEMENTATION	204
DIONEX INTEGRAL PLATFORM	205
NANOPARTICLE TRACKING ANALYSIS	205
NEXION ENHANCED SECURITY SOFTWARE	205
LABSOLUTIONS DIRECT FUNCTION	205
ZYMARK MULTIDOSE AUTOMATED DISSOLUTION PLATFORM	206
FACTORS AFFECTING THE PROCESS ANALYTICAL TECHNOLOGY MARKET	206
CURRENT DRIVERS OF PROCESS ANALYTICAL TECHNOLOGY MARKET	206
COLLABORATIONS/ACQUISITIONS	207
CHAPTER 11 COMPANY PROFILES	210
ABB LTD.	210
ACCELRY'S INC.	211
AGILENT TECHNOLOGIES INC.	211
AMETEK PROCESS INSTRUMENTS	212
ANALYTIK JENA AG	213
AXIOM ANALYTICAL INC.	213
BIOTEK INSTRUMENTS INC.	214
BRUKER	215
CAMO SOFTWARE AS	216
DANAHER	217

TOPIC	PAGE NO.
EMD MILLIPORE	218
EMERSON PROCESS MANAGEMENT	219
FOSS	220
GE INTELLIGENT PLATFORMS	220
GEA PHARMA SYSTEMS	221
HITACHI HIGH-TECHNOLOGIES CORP.	222
HONEYWELL INTERNATIONAL INC.	223
HORIZON TECHNOLOGY, INC.	223
J&M ANALYTIK AG	224
JEOL LTD.	224
KAISER OPTICAL SYSTEMS INC.	225
MALVERN INSTRUMENTS LTD.	225
METROHM AG	226
METTLER-TOLEDO GMBH	227
MICROMERITICS INSTRUMENT CORP.	228
OPTIMAL INDUSTRIAL AUTOMATION LTD.	228
PANALYTICAL BV	229
PARTICLE SIZING SYSTEMS	230
PERKINELMER INC.	230
PHOTON SYSTEMS	231
PION INC.	232
PROTEINSIMPLE	232
RION CO. LTD.	233
ROCKWELL AUTOMATION	234
SELCIA LTD.	234
SHIMADZU	235
SIEMENS	236
SOTAX AG	236
SPECTRIS PLC	237
STATPOINT TECHNOLOGIES INC.	238
SYMBION SYSTEMS INC.	238
TERAVIEW LTD.	239
THERMO FISHER SCIENTIFIC INC.	240
WATERS CORP.	241
WYATT TECHNOLOGY CORP.	241
YOKOGAWA ELECTRIC CORP.	242
YSI INC.	243
ZEISS	243
CHAPTER 12 APPENDIX I: ABBREVIATIONS	246

LIST OF TABLES

TABLE HEADING	PAGE NO.
SUMMARY TABLE GLOBAL MARKET FOR PROCESS ANALYTICAL TECHNOLOGY INSTRUMENTATION BY REGION, THROUGH 2019 (\$ THOUSANDS)	8
TABLE 1 ADVANTAGES AND DISADVANTAGES OF CHROMATOGRAPHIC TECHNIQUES	15
TABLE 2 ADVANTAGES AND DISADVANTAGES OF SPECTROPHOTOMETRIC TECHNIQUES	21
TABLE 3 ADVANTAGES AND DISADVANTAGES OF CAPILLARY ELECTROPHORESIS TECHNIQUES	25
TABLE 4 ADVANTAGES AND DISADVANTAGES OF PARTICLE SIZE ANALYSIS TECHNIQUES	28
TABLE 5 ADVANTAGES AND DISADVANTAGES OF DISSOLUTION METHODS	32
TABLE 6 ADVANTAGES AND DISADVANTAGES OF AUTOMATED ANALYTICAL METHODS	34
TABLE 7 ADVANTAGES AND DISADVANTAGES OF TITRATION TOOLS	35
TABLE 8 BENEFITS AND CONSIDERATIONS OF PROCESS ANALYTICAL TECHNOLOGY FOR PHARMACEUTICAL PRODUCTS MANUFACTURING	38
TABLE 9 NEW DEVELOPMENTS FOR PROCESS ANALYTICAL TECHNOLOGIES IN PHARMACEUTICALS, 2013 THROUGH MARCH 2014	52
TABLE 10 AWARDS FOR PROCESS ANALYTICAL TECHNOLOGIES IN PHARMACEUTICALS, 2013 THROUGH MARCH 2014	55
TABLE 11 NEW DEVELOPMENTS IN PROCESS ANALYTICAL TECHNOLOGIES FOR PHARMACEUTICALS, 2012	57
TABLE 12 AWARDS FOR PROCESS ANALYTICAL TECHNOLOGIES IN PHARMACEUTICALS, 2012	59
TABLE 13 NEW DEVELOPMENTS IN PROCESS ANALYTICAL TECHNOLOGIES FOR PHARMACEUTICALS, 2011	60
TABLE 14 AWARDS FOR PROCESS ANALYTICAL TECHNOLOGIES IN PHARMACEUTICALS, 2011	62
TABLE 15 GLOBAL MARKET FOR PROCESS ANALYTICAL TECHNOLOGY INSTRUMENTATION BY CATEGORY, THROUGH 2019 (\$ THOUSANDS)	68
TABLE 16 CHROMATOGRAPHIC TOOLS AND TECHNIQUES MARKET BY TYPE, THROUGH 2019 (\$ THOUSANDS)	70
TABLE 17 GC/MS TOOLS AND METHODS MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)	72
TABLE 18 GAS CHROMATOGRAPHY TOOLS AND METHODS MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)	74
TABLE 19 HIGH PERFORMANCE LIQUID CHROMATOGRAPHY TOOLS AND METHODS MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)	76
TABLE 20 THIN LAYER CHROMATOGRAPHY TOOLS AND METHODS MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)	78
TABLE 21 SPECTROPHOTOMETRIC TOOLS AND TECHNIQUES MARKET BY TYPE, THROUGH 2019 (\$ THOUSANDS)	80
TABLE 22 NEAR-INFRARED TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)	82
TABLE 23 ULTRAVIOLET-VISIBLE TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)	84
TABLE 24 NUCLEAR MAGNETIC RESONANCE TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)	86
TABLE 25 ATOMIC ABSORPTION TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)	88
TABLE 26 INFRARED TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)	90

TABLE HEADING	PAGE NO.
TABLE 27 X-RAY DIFFRACTION TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)	92
TABLE 28 MASS SPECTROMETRY TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)	94
TABLE 29 RAMAN SPECTROSCOPY TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)	96
TABLE 30 CAPILLARY ELECTROPHORESIS MARKET BY TYPE, THROUGH 2019 (\$ THOUSANDS)	98
TABLE 31 ISOELECTRIC FOCUSING TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)	100
TABLE 32 ISOTACHOPHORESIS TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)	102
TABLE 33 PARTICLE SIZE ANALYSIS TOOLS AND TECHNIQUES MARKET BY TYPE, THROUGH 2019 (\$ THOUSANDS)	105
TABLE 34 LASER TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)	107
TABLE 35 MICROSCOPIC TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)	108
TABLE 36 SIZE EXCLUSION CHROMATOGRAPHY TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)	111
TABLE 37 PHOTOZONE TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)	113
TABLE 38 SIEVING TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)	115
TABLE 39 DISSOLUTION METHOD TOOLS AND TECHNIQUES MARKET BY TYPE, THROUGH 2019 (\$ THOUSANDS)	117
TABLE 40 AUTOMATED DISSOLUTION TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)	119
TABLE 41 UV DISSOLUTION TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)	121
TABLE 42 HPLC DISSOLUTION TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)	123
TABLE 43 AUTOMATED ANALYTICAL METHODS TOOLS AND TECHNIQUES MARKET BY TYPE, THROUGH 2019 (\$ THOUSANDS)	124
TABLE 44 AUTOMATED ANALYSIS TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)	127
TABLE 45 ROBOTICS TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)	129
TABLE 46 OTHER AUTOMATED ANALYTICAL METHODS MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)	131
TABLE 47 TITRATION TOOLS AND TECHNIQUES MARKET BY REGION, THROUGH 2019 (\$ THOUSANDS)	133
TABLE 48 MARKET SHARE OF PROCESS ANALYTICAL TECHNOLOGY INSTRUMENTATION BY TYPE, 2013 (%)	134
TABLE 49 REGIONAL BREAKDOWN OF SALES OF PROCESS ANALYTICAL TECHNOLOGY INSTRUMENTATION, THROUGH 2019 (\$ THOUSANDS)	137
TABLE 50 MARKET SHARES OF PROCESS ANALYTICAL TECHNOLOGY INSTRUMENTATION BY REGION, IN 2013 (%)	138
TABLE 51 LEADING MANUFACTURERS/SUPPLIERS OF PAT CHROMATOGRAPHIC INSTRUMENTATION, 2013	140
TABLE 52 MARKET SHARES OF MANUFACTURERS/SUPPLIERS OF CHROMATOGRAPHIC TOOLS AND TECHNIQUES, 2013 (%)	142

TABLE HEADING	PAGE NO.
TABLE 53 LEADING MANUFACTURERS/SUPPLIERS OF PAT SPECTROPHOTOMETRIC TOOLS AND TECHNIQUES, 2013	143
TABLE 54 MARKET SHARES OF MANUFACTURERS/SUPPLIERS OF SPECTROPHOTOMETRIC TOOLS AND TECHNIQUES, 2013 (%)	145
TABLE 55 LEADING MANUFACTURERS/SUPPLIERS OF PAT CAPILLARY ELECTROPHORESIS TOOLS AND TECHNIQUES, 2013	147
TABLE 56 MARKET SHARES OF MANUFACTURERS/SUPPLIERS OF CAPILLARY ELECTROPHORESIS TOOLS AND TECHNIQUES, 2013 (%)	147
TABLE 57 LEADING MANUFACTURERS/SUPPLIERS OF PAT PARTICLE SIZE ANALYSIS TOOLS AND TECHNIQUES, 2013	148
TABLE 58 MARKET SHARES OF MANUFACTURERS/SUPPLIERS OF PARTICLE SIZE ANALYSIS TOOLS AND TECHNIQUES, 2013 (%)	150
TABLE 59 LEADING MANUFACTURERS/SUPPLIERS OF PAT DISSOLUTION METHODS TOOLS AND TECHNIQUES, 2013	151
TABLE 60 MARKET SHARES OF MANUFACTURERS/SUPPLIERS OF DISSOLUTION METHODS TOOLS AND TECHNIQUES, 2013 (%)	152
TABLE 61 LEADING MANUFACTURERS/SUPPLIERS OF PAT AUTOMATED ANALYTICAL METHODS TOOLS AND TECHNIQUES, 2013	153
TABLE 62 MARKET SHARES OF MANUFACTURERS/SUPPLIERS OF AUTOMATED ANALYTICAL METHODS TOOLS AND TECHNIQUES, 2013 (%)	156
TABLE 63 LEADING MANUFACTURERS/SUPPLIERS OF PAT TITRATION TOOLS AND TECHNIQUES, 2013	157
TABLE 64 MARKET SHARES OF MANUFACTURERS/SUPPLIERS OF TITRATION TOOLS AND TECHNIQUES, 2013 (%)	158
TABLE 65 GLOBAL MARKET FOR PROCESS ANALYTICAL TECHNOLOGY BY APPLICATION, THROUGH 2019 (\$ THOUSANDS)	165
TABLE 66 MARKET SHARES OF PROCESS ANALYTICAL TECHNOLOGY BY APPLICATION, 2013 (%)	166
TABLE 67 NUMBER OF U.S. PATENTS ISSUED FOR PAT INSTRUMENTATION AND METHODS FOR APPLICATION IN PHARMACEUTICALS BY YEAR, 2011-2013 (NUMBER OF PATENTS)	169
TABLE 68 U.S. PATENTS ISSUED FOR PROCESS ANALYTICAL TECHNOLOGY INSTRUMENTATION AND TECHNIQUES BY CATEGORY, 2011-2013 (NUMBER OF PATENTS)	170
TABLE 69 U.S. PATENTS ISSUED FOR CHROMATOGRAPHIC TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (NUMBER OF PATENTS)	172
TABLE 70 SHARES OF U.S. PATENTS ISSUED FOR CHROMATOGRAPHIC TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (NUMBER OF PATENTS/%)	172
TABLE 71 U.S. PATENTS ISSUED FOR SPECTROPHOTOMETRIC TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (NUMBER OF PATENTS)	174
TABLE 72 SHARES OF U.S. PATENTS ISSUED FOR SPECTROPHOTOMETRIC TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (NUMBER OF PATENTS/%)	174
TABLE 73 U.S. PATENTS ISSUED FOR CAPILLARY ELECTROPHORESIS TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (NUMBER OF PATENTS)	176
TABLE 74 SHARES OF U.S. PATENTS ISSUED FOR CAPILLARY ELECTROPHORESIS TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (NUMBER OF PATENTS/%)	177
TABLE 75 U.S. PATENTS ISSUED FOR PARTICLE SIZE ANALYSIS TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (NUMBER OF PATENTS)	177
TABLE 76 SHARES OF U.S. PATENTS ISSUED FOR PARTICLE SIZE ANALYSIS TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (NUMBER OF PATENTS/%)	178

TABLE HEADING	PAGE NO.
TABLE 77 U.S. PATENTS ISSUED FOR DISSOLUTION METHODS TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (NUMBER OF PATENTS)	179
TABLE 78 SHARES OF U.S. PATENTS ISSUED FOR DISSOLUTION METHODS TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (NUMBER OF PATENTS/%)	180
TABLE 79 U.S. PATENTS ISSUED FOR AUTOMATED ANALYTICAL METHODS TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (NUMBER OF PATENTS)	181
TABLE 80 SHARES OF U.S. PATENTS ISSUED FOR AUTOMATED ANALYTICAL METHODS TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (NUMBER OF PATENTS/%)	182
TABLE 81 U.S. PATENTS ISSUED FOR TITRATION TOOLS AND TECHNIQUES TO U.S. PATENT HOLDERS, 2011-2013 (NUMBER OF PATENTS)	183
TABLE 82 PATENT SHARES BY COUNTRY FOR TITRATION TOOLS AND TECHNIQUES, 2011-2013 (NUMBER OF PATENTS/%)	184
TABLE 83 U.S. PATENTS ISSUED FOR CHROMATOGRAPHIC TOOLS AND TECHNIQUES BY COMPANY, 2011-2013 (NUMBER OF PATENTS)	185
TABLE 84 U.S. PATENTS ISSUED FOR SPECTROPHOTOMETRIC TOOLS AND TECHNIQUES BY COMPANY, 2011-2013 (NUMBER OF PATENTS)	187
TABLE 85 U.S. PATENTS ISSUED FOR CAPILLARY ELECTROPHORESIS TOOLS AND TECHNIQUES BY COMPANY, 2011-2013 (NUMBER OF PATENTS)	191
TABLE 86 U.S. PATENTS ISSUED FOR PARTICLE SIZE ANALYSIS TOOLS AND TECHNIQUES BY COMPANY, 2011-2013 (NUMBER OF PATENTS)	192
TABLE 87 U.S. PATENTS ISSUED FOR DISSOLUTION METHODS TOOLS AND TECHNIQUES BY COMPANY, 2011-2013 (NUMBER OF PATENTS)	194
TABLE 88 U.S. PATENTS ISSUED FOR AUTOMATED ANALYTICAL METHODS TOOLS AND TECHNIQUES BY COMPANY, 2011-2013 (NUMBER OF PATENTS)	195
TABLE 89 U.S. PATENTS ISSUED FOR TITRATION TOOLS AND TECHNIQUES BY COMPANY, 2011-2013 (NUMBER OF PATENTS)	197
TABLE 90 U.S. PATENTS ISSUED FOR CHROMATOGRAPHIC TOOLS AND TECHNIQUES BY TYPE OF ASSIGNEE, 2011-2013 (NUMBER OF PATENTS)	197
TABLE 91 U.S. PATENTS ISSUED FOR SPECTROPHOTOMETRIC TOOLS AND TECHNIQUES BY TYPE OF ASSIGNEE, 2011-2013 (NUMBER OF PATENTS)	198
TABLE 92 U.S. PATENTS ISSUED FOR CAPILLARY ELECTROPHORESIS TOOLS AND TECHNIQUES BY TYPE OF ASSIGNEE, 2011-2013 (NUMBER OF PATENTS)	199
TABLE 93 U.S. PATENTS ISSUED FOR PARTICLE SIZE ANALYSIS TOOLS AND TECHNIQUES BY TYPE OF ASSIGNEE, 2011-2013 (NUMBER OF PATENTS)	199
TABLE 94 U.S. PATENTS ISSUED FOR DISSOLUTION METHODS TOOLS AND TECHNIQUES BY TYPE OF ASSIGNEE, 2011-2013 (NUMBER OF PATENTS)	200
TABLE 95 U.S. PATENTS ISSUED FOR AUTOMATED ANALYTICAL METHODS TOOLS AND TECHNIQUES BY TYPE OF ASSIGNEE, 2011-2013 (NUMBER OF PATENTS)	201
TABLE 96 U.S. PATENTS ISSUED FOR TITRATION TOOLS AND TECHNIQUES BY TYPE OF ASSIGNEE, 2011-2013 (NUMBER OF PATENTS)	202

LIST OF FIGURES

FIGURE TITLE	PAGE NO.
SUMMARY FIGURE GLOBAL MARKET FOR PROCESS ANALYTICAL TECHNOLOGY INSTRUMENTATION BY REGION, 2011-2019 (\$ THOUSANDS)	8
FIGURE 1 PAT PROCESS STEPS	11
FIGURE 2 GLOBAL MARKET FOR PROCESS ANALYTICAL TECHNOLOGY INSTRUMENTATION BY CATEGORY, 2011-2019 (\$ THOUSANDS)	68
FIGURE 3 CHROMATOGRAPHIC TOOLS AND TECHNIQUES MARKET BY TYPE, 2011-2019 (\$ THOUSANDS)	70
FIGURE 4 GC/MS TOOLS AND METHODS MARKET BY REGION, 2011-2019 (\$ THOUSANDS)	72
FIGURE 5 GAS CHROMATOGRAPHY TOOLS AND METHODS MARKET BY REGION, 2011-2019 (\$ THOUSANDS)	74
FIGURE 6 HIGH PERFORMANCE LIQUID CHROMATOGRAPHY TOOLS AND METHODS MARKET BY REGION, 2011-2019 (\$ THOUSANDS)	76
FIGURE 7 THIN LAYER CHROMATOGRAPHY TOOLS AND METHODS MARKET BY REGION, 2011-2019 (\$ THOUSANDS)	78
FIGURE 8 SPECTROPHOTOMETRIC TOOLS AND TECHNIQUES MARKET BY TYPE, 2011-2019 (\$ THOUSANDS)	80
FIGURE 9 NEAR-INFRARED TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)	82
FIGURE 10 ULTRAVIOLET-VISIBLE TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)	84
FIGURE 11 NUCLEAR MAGNETIC RESONANCE TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)	86
FIGURE 12 ATOMIC ABSORPTION TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)	89
FIGURE 13 INFRARED TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)	90
FIGURE 14 X-RAY DIFFRACTION TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)	92
FIGURE 15 MASS SPECTROMETRY TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)	94
FIGURE 16 RAMAN SPECTROSCOPY TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)	96
FIGURE 17 CAPILLARY ELECTROPHORESIS MARKET BY TYPE, 2011-2019 (\$ THOUSANDS)	98
FIGURE 18 ISOELECTRIC FOCUSING TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)	100
FIGURE 19 ISOTACHOPHORESIS TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)	102
FIGURE 20 PARTICLE SIZE ANALYSIS TOOLS AND TECHNIQUES MARKET BY TYPE, 2011-2019 (\$ THOUSANDS)	105
FIGURE 21 LASER TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)	107
FIGURE 22 MICROSCOPIC TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)	109
FIGURE 23 SIZE EXCLUSION CHROMATOGRAPHY TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)	111
FIGURE 24 PHOTOZONE TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)	113
FIGURE 25 SIEVING TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)	115

FIGURE TITLE	PAGE NO.
FIGURE 26 DISSOLUTION METHOD TOOLS AND TECHNIQUES MARKET BY TYPE, 2011-2019 (\$ THOUSANDS)	117
FIGURE 27 AUTOMATED DISSOLUTION TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)	119
FIGURE 28 UV DISSOLUTION TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)	121
FIGURE 29 HPLC DISSOLUTION TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)	123
FIGURE 30 AUTOMATED ANALYTICAL METHODS TOOLS AND TECHNIQUES MARKET BY TYPE, 2011-2019 (\$ THOUSANDS)	125
FIGURE 31 AUTOMATED ANALYSIS TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)	127
FIGURE 32 ROBOTICS TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)	129
FIGURE 33 OTHER AUTOMATED ANALYTICAL METHODS MARKET BY REGION, 2011-2019 (\$ THOUSANDS)	131
FIGURE 34 TITRATION TOOLS AND TECHNIQUES MARKET BY REGION, 2011-2019 (\$ THOUSANDS)	133
FIGURE 35 MARKET SHARE OF PROCESS ANALYTICAL TECHNOLOGY INSTRUMENTATION BY TYPE, 2013 (%)	134
FIGURE 36 REGIONAL BREAKDOWN FOR SALES OF PROCESS ANALYTICAL TECHNOLOGY INSTRUMENTATION, 2011-2019 (\$ THOUSANDS)	137
FIGURE 37 MARKET SHARES OF PROCESS ANALYTICAL TECHNOLOGY INSTRUMENTATION BY REGION, IN 2013 (%)	138
FIGURE 38 MARKET SHARES OF MANUFACTURERS/SUPPLIERS OF CHROMATOGRAPHIC TOOLS AND TECHNIQUES, 2013 (%)	142
FIGURE 39 MARKET SHARES OF MANUFACTURERS/SUPPLIERS OF SPECTROPHOTOMETRIC TOOLS AND TECHNIQUES, 2013 (%)	146
FIGURE 40 MARKET SHARES OF MANUFACTURERS/SUPPLIERS OF CAPILLARY ELECTROPHORESIS TOOLS AND TECHNIQUES, 2013 (%)	147
FIGURE 41 MARKET SHARES OF MANUFACTURERS/SUPPLIERS OF PARTICLE SIZE ANALYSIS TOOLS AND TECHNIQUES, 2013 (%)	151
FIGURE 42 MARKET SHARES OF MANUFACTURERS/SUPPLIERS OF DISSOLUTION METHODS TOOLS AND TECHNIQUES, 2013 (%)	152
FIGURE 43 MARKET SHARES OF MANUFACTURERS/SUPPLIERS OF AUTOMATED ANALYTICAL METHODS TOOLS AND TECHNIQUES, 2013 (%)	156
FIGURE 44 MARKET SHARES OF MANUFACTURERS/SUPPLIERS OF TITRATION TOOLS AND TECHNIQUES, 2013 (%)	158
FIGURE 45 APPLICATION OF PAT IN PHARMACEUTICAL TABLET MANUFACTURING	161
FIGURE 46 GLOBAL MARKET FOR PROCESS ANALYTICAL TECHNOLOGY BY APPLICATION, 2011-2019 (\$ THOUSANDS)	165
FIGURE 47 MARKET SHARES OF PROCESS ANALYTICAL TECHNOLOGY BY APPLICATION, IN 2013 (%)	166
FIGURE 48 NUMBER OF U.S. PATENTS ISSUED FOR PAT INSTRUMENTATION AND METHODS FOR APPLICATION IN PHARMACEUTICALS BY YEAR, 2011-2013 (NUMBER OF PATENTS)	169
FIGURE 49 U.S. PATENTS ISSUED FOR PROCESS ANALYTICAL TECHNOLOGY INSTRUMENTATION AND TECHNIQUES BY CATEGORY, 2011-2013 (NUMBER OF PATENTS)	171
FIGURE 50 SHARES OF U.S. PATENT ISSUED FOR CHROMATOGRAPHIC TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (%)	173

FIGURE TITLE	PAGE NO.
FIGURE 51 SHARES OF U.S. PATENTS ISSUED FOR SPECTROPHOTOMETRIC TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (%)	175
FIGURE 52 SHARES OF U.S. PATENTS ISSUED FOR PARTICLE SIZE ANALYSIS TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (%)	179
FIGURE 53 SHARES OF U.S. PATENTS ISSUED FOR DISSOLUTION METHODS TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (%)	181
FIGURE 54 SHARES OF U.S. PATENTS ISSUED FOR AUTOMATED ANALYTICAL METHODS TOOLS AND TECHNIQUES BY PATENT HOLDER'S COUNTRY, 2011-2013 (%)	183
FIGURE 55 U.S. PATENTS ISSUED FOR SPECTROPHOTOMETRIC TOOLS AND TECHNIQUES BY TYPE OF ASSIGNEE, 2011-2013 (NUMBER OF PATENTS)	198
FIGURE 56 U.S. PATENTS ISSUED FOR PARTICLE SIZE ANALYSIS TOOLS AND TECHNIQUES BY TYPE OF ASSIGNEE, 2011-2013 (NUMBER OF PATENTS)	199
FIGURE 57 U.S. PATENTS ISSUED FOR AUTOMATED ANALYTICAL METHODS TOOLS AND TECHNIQUES BY TYPE OF ASSIGNEE, 2011-2013 (NUMBER OF PATENTS)	201