

Volume X: The World Market for Flowmeters, 3rd Edition



Flow Research, Inc.

Wakefield, Massachusetts

Volume X: The World Market for Flowmeters, 3rd Edition

**Flow Research, Inc.
Wakefield, Massachusetts**

October 2010

Researched by:

Flow Research, Inc.
27 Water Street – Suite B7
Wakefield, MA 01880
United States

781-245-3200
781-224-7552 (fax)
info@flowresearch.com
www.flowresearch.com

Project Team

Jesse Yoder, PhD. - Project Director
Belinda Burum
Norman Weeks
Leslie Buchanan
Nicole Riordan

Published by



October 2010

Copyright © 2010

Flow Research, Inc.

All data and information in this study is proprietary and copyrighted by Flow Research, Inc. No part of this study may be reproduced orally or in written form to anyone outside the internal organization of the client for five years from the date of this study without the prior written consent of Flow Research, Inc.

Disclaimer

While every effort has been made to insure that this study is accurate and complete, Flow Research, Inc. accepts no liability for consequences of any actions that are based on the findings in this study.

TABLE OF CONTENTS

<u><i>Chapter</i></u>	<u><i>Description</i></u>	<u><i>Page Number</i></u>
One	Executive Summary.....	1-1
	Overview.....	1-1
	A Complete Analysis of the Flowmeter Market.....	1-2
	Study Objectives.....	1-3
	Methodology.....	1-3
	Geographic Regions of the World	1-4
	Shipments of Flowmeters by Flowmeter Type	
	Worldwide: Figures 1-1 to 1-4.....	1-5
	Shipments of New-Technology Flowmeters by Flowmeter	
	Type: Figure 1-5	1-6
	Shipments of Traditional Technology Flowmeters by Flowmeter	
	Type: Figure 1-6	1-6
Two	Scope and Method.....	2-1
	Overview.....	2-1
	A Complete Analysis of the Flowmeter Market.....	2-2
	The Role of Viewpoint Pluralism	2-3
	The Importance of Multi-Technology Research.....	2-4
	Leading Suppliers vs. All Suppliers.....	2-6
	Study Objectives	2-7
	Methodology	2-7
	Geographic Regions of the World	2-9
	Definitions.....	2-20
	Flowmeter Types	2-20
	Segmentation by Technology	2-20
	Flow Research, Inc.....	2-23
	Team History and Experience.....	2-23
	Flow Research Instrumentation Articles.....	2-24
	Flow Research Studies.....	2-29
	Custom Projects	2-30
	Worldflow Monitoring Service.....	2-30

TABLE OF CONTENTS
(continued)

<u>Chapter</u>	<u>Description</u>	<u>Page Number</u>
Three	Flowmeter Paradigm Case Analysis..... 3-1 Overview 3-1 New-Technology Flowmeters 3-2 Coriolis Flowmeters 3-3 Magnetic Flowmeters 3-4 Ultrasonic Flowmeters 3-5 Vortex Flowmeters 3-7 Thermal Flowmeters 3-7 Paradigm Case Selection Method 3-13	
Four	Worldwide Flowmeter Market..... 4-1 Getting a Look from 20,000 Feet 4-1 A New All-Technology Flow Study 4-2 Shipments of Flowmeters by Flowmeter Type Worldwide: Figures 4-1 to 4-7 4-3	
Five	New-Technology Flowmeters..... 5-1 Defining New-Technology Flowmeters 5-1 Coriolis Flowmeters 5-1 Magnetic Flowmeters 5-2 Ultrasonic Flowmeters 5-3 Vortex Flowmeters 5-4 Thermal Flowmeters 5-5 A ‘Magic Bullet’ Technology? 5-6 Shipments of New-Technology Flowmeters by Type Worldwide: Figures 5-1 to 5-5 5-6	

TABLE OF CONTENTS
(continued)

<u>Chapter</u>	<u>Description</u>	<u>Page Number</u>
Six		
	Coriolis Flowmeters	6-1
	Why Measure Mass Flow?.....	6-1
	Coriolis Remains the Most Accurate Flowmeter.....	6-2
	Coriolis Flowmeter Suppliers	6-2
	Coriolis Flowmeter Suppliers	6-5
	ABB	6-5
	Brooks Instrument.....	6-6
	Emerson Process Management, Micro Motion.....	6-7
	Endress+Hauser	6-9
	Foxboro (Invensys Process Systems).....	6-9
	GE Measurement and Control Solutions	6-10
	Itron.....	6-11
	KROHNE	6-11
	OVAL Corporation	6-12
	Siemens	6-13
	Yokogawa	6-14
	Market Size and Growth Forecasts	6-15
	Growth Factors for the Coriolis Market.....	6-15
	Custody Transfer of Natural Gas is a Potential Boon for Coriolis Flowmeters.....	6-16
	Suppliers Continue to Make Technological Improvements in Coriolis Flowmeters.....	6-17
	Straight Tube Meters are Addressing Some Issues with Bent Tube Meters.....	6-17
	Growth in Coriolis Meters for Larger Line Sizes	6-18
	Introduction of Low Cost Coriolis Meters	6-19
	Users Are Looking for Low Maintenance	6-20
	Factors Limiting Growth.....	6-20
	Market Forecasts	6-21
	Shipments of Coriolis Flowmeters by Region: Figures 6-1 to 6-5	6-21
	Average Selling Prices of Coriolis Flowmeters by Region: Figure 6-6.....	6-22

TABLE OF CONTENTS
(continued)

<u>Chapter</u>	<u>Description</u>	<u>Page Number</u>
Seven	Magnetic Flowmeters.....	7-1
	Magnetic Flowmeters Are Popular in Europe	7-1
	Magnetic Flowmeter Suppliers.....	7-2
	Magnetic Flowmeter Suppliers.....	7-6
	ABB	7-7
	Badger Meter	7-7
	Bopp & Reuther	7-8
	Emerson Process Management, Rosemount Division	7-9
	Endress+Hauser	7-9
	FTI Flow Technology Inc.	7-10
	Foxboro (Invensys Process Systems).....	7-10
	Itron.....	7-11
	KROHNE.....	7-11
	McCrometer Inc (subsidiary of Danaher).	7-12
	OVAL Corporation	7-13
	Racine Federated Inc., Dynasonics Division	7-13
	Siemens	7-14
	Spirax Sarco, EMCO Flow Systems division.....	7-15
	Yamatake (azbil).....	7-15
	Yokogawa	7-16
	Market Size and Growth Forecasts	7-17
	Growth Factors for the Magnetic Flowmeter Market	7-17
	Magnetic Flowmeters Are Replacing Traditional Technology Flowmeters.....	7-18
	New Product Types.....	7-18
	Many Types of Liners Available	7-19
	Magnetic Flowmeter Installed Base.....	7-19
	The Large Number of Magnetic Flowmeter Suppliers	7-20
	Market Forecasts	7-21
	Shipments of Magnetic Flowmeters by Region: Figures 7-1 to 7-5.....	7-21
	Average Selling Price of Magnetic Flowmeters by Region: Figure 7-6.....	7-21

TABLE OF CONTENTS
(continued)

<u>Chapter</u>	<u>Description</u>	<u>Page Number</u>
Eight	Ultrasonic Flowmeters.....	8-1
	Overview.....	8-1
	History.....	8-1
	Advantages of Ultrasonic Flowmeters.....	8-2
	Types of Ultrasonic Flowmeters.....	8-4
	Ultrasonic Flowmeter Suppliers	8-5
	Ultrasonic Flowmeter Suppliers	8-8
	Accusonic Technologies, IDEX Corporation	8-9
	Badger Meter	8-9
	Cameron, Measurement Systems division.....	8-10
	Elster Instromet.....	8-11
	Emerson Process Management, Daniel Measurement and Control.....	8-12
	Endress+Hauser	8-13
	Faure Herman (IDEX Corporation, Liquid Controls Group)	8-13
	FMC Technologies.....	8-14
	FTI Flow Technology, Inc.	8-15
	Fuji Electric Group	8-15
	GE Measurement & Control Solutions	8-16
	KROHNE.....	8-17
	OVAL	8-18
	Racine Federated Inc.....	8-18
	Sensus	8-19
	SICK	8-19
	Siemens.....	8-20
	Sierra Instruments	8-21
	Spirax Sarco, EMCO Flow Systems division.....	8-22
	Thermo Fisher Scientific.....	8-23
	Tokyo Keiki Inc.	8-24
	Tokyo Keiso.....	8-25
	Yokogawa	8-25
	Growth Factors for the Ultrasonic Flowmeter Market	8-27
	Successful User Experience Serves as a Paradigm for the Industry	8-27
	Multipath Ultrasonic Flowmeters Used for Custody Transfer	8-27
	Improvements in Transit Time Technology	8-28

TABLE OF CONTENTS
(continued)

<u>Chapter</u>	<u>Description</u>	<u>Page Number</u>
	More Calibration Facilities Available.....	8-29
	Ultrasonic Flowmeters Gain Industry Approvals	8-29
	Factors Limiting Growth.....	8-30
	Market Size and Growth Forecasts	8-31
	Shipments of Ultrasonic Flowmeters by Region:	
	Figures 8-1 to 8-5.....	8-31
	Average Selling Prices of Ultrasonic Flowmeters by Region:	
	Figure 8-6.....	8-31
Nine	Vortex Flowmeters.....	9-1
	Overview.....	9-1
	Vortex Flowmeter Suppliers	9-1
	Vortex Flowmeter Suppliers	9-5
	ABB	9-5
	Bopp & Reuther	9-6
	Emerson Process Management, Rosemount Division	9-6
	Endress+Hauser	9-7
	Foxboro (Invensys Process Systems).....	9-8
	KROHNE	9-9
	OVAL Corporation	9-10
	Racine Federated Inc.....	9-10
	Sierra Instruments	9-11
	Spirax Sarco, Inc., EMCO Flow Systems division	9-12
	Yamatake (azbil).....	9-13
	Yokogawa	9-14
	Growth Forecasts in the Vortex Market.....	9-15
	Vortex Flowmeters Provide Accurate and Reliable Flow	
	Measurement at a Competitive Price	9-15
	Vortex Flowmeters Are the Lowest Cost New-Technology	
	Meter	9-16
	Vortex Flowmeters Are Widely Used for Steam Applications	9-17
	More Suppliers Now in the Market	9-17

TABLE OF CONTENTS
(continued)

<u>Chapter</u>	<u>Description</u>	<u>Page Number</u>
	More Multivariable Vortex Flowmeters Now Available.....	9-18
	Users Are Moving Towards New-Technology Flowmeters.....	9-19
	Users Are Looking for Low Maintenance	9-20
	Industry-Wide Standards Have Been Developed for the Use of Vortex Flowmeters for Custody Transfer Applications.....	9-20
	Vortex Flowmeters Used for District Heating Applications.....	9-21
	Market Size and Growth Forecasts	9-22
	Shipments of Vortex Flowmeters by Region: Figures 9-1 to 9-5	9-22
	Average Selling Price of Vortex Flowmeters by Region: Figure 9-6.....	9-22
Ten	Thermal Flowmeters.....	10-1
	Advantages and Disadvantages.....	10-2
	Why Thermal Is an Interesting Technology	10-2
	Thermal Flowmeter Suppliers.....	10-2
	Thermal Flowmeter Suppliers.....	10-4
	ABB	10-4
	Endress+Hauser	10-5
	Fluid Components International LLC	10-5
	Sierra Instruments	10-6
	Tokyo Keiso.....	10-7
	Continuous Emissions Monitoring (CEM) Boosts Thermal Flowmeter Sales.....	10-8
	A New Age of Environmental Awareness.....	10-9
	Market Forecasts	10-11
	Shipments of Thermal Flowmeters by Region: Figures 10-1 to 10-5.....	10-11
	Average Selling Prices of Thermal Flowmeters by Region:	Figure 10-6

TABLE OF CONTENTS
(continued)

<u>Chapter</u>	<u>Description</u>	<u>Page Number</u>
Eleven	Traditional Technology Flowmeters.....	11-1
	Familiarity Breeds Respect	11-2
	Switching Technologies Has a Cost	11-3
	Differential Pressure	11-3
	Positive Displacement.....	11-4
	Turbine.....	11-4
	Open Channel.....	11-4
	Variable Area.....	11-5
	Recent Developments among Positive Displacement and Positive Displacement Flowmeters.....	11-6
	Turbine Flowmeter Suppliers	11-6
	Mergers and Acquisitions in the PD and Turbine Markets.....	11-7
	Selecting a Flowmeter.....	11-16
	Differential Pressure	11-16
	Market Size and Forecast.....	11-18
	Shipments of Traditional Technology Flowmeters by Flowmeter Type Worldwide: Figures 11-1 to 11-5	11-18
Twelve	Differential Pressure Flowmeters.....	12-1
	Four Types of Pressure Transmitters	12-1
	Differential Pressure Flowmeters	12-2
	History of DP Flowmeters	12-2
	Theory of Differential Pressure Measurement.....	12-4
	What Is a Differential Pressure Flowmeter?	12-4
	Differential Pressure Flow Transmitter Suppliers	12-6
	Differential Pressure Flow Transmitter Suppliers	12-7
	ABB Ltd.....	12-8
	Emerson Process Management, Bristol	12-8
	Emerson Process Management, Rosemount Division	12-9
	Endress+Hauser	12-10
	FMC Technologies.....	12-10
	Fuji Electric.....	12-11

TABLE OF CONTENTS
(continued)

<u>Chapter</u>	<u>Description</u>	<u>Page Number</u>
	Honeywell	12-11
	Siemens	12-12
	Smar Equipamentos Industriais	12-12
	Thermo Fisher Scientific, Thermo Scientific brand	12-13
	Tokyo Keiso.....	12-13
	Yamatake	12-14
	Yokogawa	12-14
	Factors Promoting the Growth of the Pressure Transmitter	
	Market	12-15
	Plant Renovations and Upgrades	12-15
	The Need to Conserve Energy	12-15
	The Large Installed Base of Differential Pressure Flow	
	Transmitters	12-16
	Rapid growth in China and Other Developing Markets	12-16
	Advanced Features in Differential Pressure Flow Transmitters....	12-17
	Market Size and Growth Forecasts	12-18
	Average Selling Prices of Differential Pressure Flow	
	Transmitters by Region: Figure 12-6.....	12-20
Thirteen	Primary Elements	13-1
	Overview	13-1
	Orifice Plate Measuring Point.....	13-1
	Pitot Tube.....	13-3
	Venturi Tube	13-4
	Flow Nozzle	13-5
	Wedge Element.....	13-6
	Other Primary Elements.....	13-6
	Primary Element Suppliers	13-7
	Primary Element Suppliers	13-10
	ABB	13-10
	Bopp & Reuther	13-11
	Cameron, Measurement Systems division.....	13-12

TABLE OF CONTENTS
(continued)

<u>Chapter</u>	<u>Description</u>	<u>Page Number</u>
	Emerson Process Management, Daniel Measurement and Control.....	13-12
	Emerson Rosemount	13-13
	FMC Technologies.....	13-14
	Fuji Electric.....	13-14
	McCrometer, Inc.	13-15
	Racine Federated Inc.....	13-15
	Spirax Sarco	13-16
	Thermo Fisher Scientific.....	13-16
	Veris Inc.....	13-17
	Factors Promoting the Growth of the Primary Elements Market ..	13-18
	Growth in the Oil & Gas Industry.....	13-18
	The Large Installed Base of Differential Pressure Flow Transmitters	13-19
	Rapid Growth in China and Other Developing Markets	13-20
	Technology Improvements in Primary Elements	13-20
	Growth in the Use of Multivariable DP Flowmeters	13-21
	Growth in the Use of Integrated DP Flowmeters.....	13-22
	Expanded Distribution Channels, Including E-Business	13-22
	Market Size and Growth Forecasts	13-23
	Shipments of Primary Elements Worldwide:	
	Figures 13-1 to 13-5.....	13-23
	Average Selling Prices of Primary Elements by Region:	
	Figure 13-6.....	13-23
Fourteen	Positive Displacement Flowmeters	14-1
	PD Technologies	14-1
	Definitions.....	14-2
	Positive Displacement Flowmeter Suppliers	14-3
	Positive Displacement Flowmeter Suppliers	14-6
	Badger Meter	14-7
	Bopp & Reuther	14-7
	Brooks Instrument.....	14-8
	Cameron, Measurement Systems division.....	14-8
	Dresser, Inc.	14-9

TABLE OF CONTENTS
(continued)

<u>Chapter</u>	<u>Description</u>	<u>Page Number</u>
	Elster Instromet.....	14-10
	FMC Technologies.....	14-11
	IDEX, Liquid Controls Group	14-11
	Itron.....	14-12
	OVAL Corporation	14-14
	Racine Federated Inc., Blaneett Division	14-14
	FTI Flow Technology	14-15
	Sensus	14-15
	Siemens	14-16
	Applications for PD Meters	14-17
	Prospects for PD Meters	14-20
	Conclusion	14-21
	Market Size and Growth Forecasts	14-22
	Shipments of Positive Displacement Flowmeters by Region:	
	Figures 14-1 to 14-5.....	14-22
	Average Selling Prices of Positive Displacement Flowmeters by Region: Figure 14-6	14-22
Fifteen	Turbine Flowmeters	15-1
	Turbine Flowmeter Design	15-1
	Turbine Flowmeter Suppliers	15-2
	Turbine Flowmeter Suppliers	15-5
	Badger Meter	15-6
	Bopp & Reuther	15-7
	Cameron, Measurement Systems division.....	15-7
	Dresser, Inc.	15-8
	Elster Instromet.....	15-9
	Emerson Process Management, Daniel.....	15-10
	FTI Flow Technology Inc.	15-11
	FMC Technologies.....	15-11
	IDEX Corporateion, Liquid Controls Group	15-12
	Itron.....	15-13
	McCrometer, Inc., a subsidiary of Danaher.....	15-13

TABLE OF CONTENTS
(continued)

<u>Chapter</u>	<u>Description</u>	<u>Page Number</u>
	Neptune Technology Group, Roper Industries	15-14
	OVAL Corporation	15-15
	Racine Fecerated Inc., Blancett, Flo-tech, and Hedland divisions	15-16
	Sensus	15-16
	Spirax Sarco, EMCO Flow Systems division	15-18
	Thermo Fisher Scientific.....	15-18
	Tokyo Keiso.....	15-19
	Growth Factors for the Turbine Flowmeter Market	15-19
	Turbine Flowmeters Are Well-Established	15-19
	Installed Base of Turbine Flowmeters	15-20
	Approval Organizations Specify Turbine Flowmeters	15-20
	Turbine Flowmeters Remain a Viable Choice for Steady, Medium to High-Speed Flows	15-21
	Market Size and Growth Forecasts	15-22
	Shipments of Turbine Flowmeters by Region:	
	Figures 15-1 to 15-5.....	15-23
	Average Selling Prices of Turbine Flowmeters by Region:	
	Figure 15-6.....	15-23
Sixteen	Open Channel Flowmeters.....	16-1
	Methods Used to Measure Open Channel Flow	16-2
	A Look Ahead.....	16-7
	Advantages & Disadvantages of Different Open Channel Flow Methods	16-8
	Open Channel Flowmeter Suppliers	16-8
	Open Channel Flowmeter Suppliers	16-10
	Market Size and Growth Forecasts	16-12
	Shipments of Open Channel Flowmeters by Region:	
	Figures 16-1 to 16-5.....	16-12
	Average Selling Prices of Open Channel Flowmeters by Region: Figure 16-6	16-13

TABLE OF CONTENTS
(continued)

<u>Chapter</u>	<u>Description</u>	<u>Page Number</u>
Seventeen	Variable Area Flowmeters 17-1 Variable Area Flowmeter Suppliers..... 17-1 Growth Factors for the Variable Area Flowmeter Market..... 17-3 Variable Area Flowmeters Continue to Fill Multiple Needs for Users..... 17-3 Variable Area Flowmeters Are the Lowest Cost Solution Available 17-3 Variable Area Flowmeters will Continue to be Used for Laboratory, Research, and OEM Applications 17-4 Factors Limiting Growth..... 17-4 Market Size and Growth Forecasts 17-5 Shipments of Variable Area Flowmeters by Region: Figures 17-1 to 17-5..... 17-5 Average Selling Prices of Variable Area Flowmeters by Region: Figure 17-6..... 17-5	
Eighteen	Target Flowmeters 18-1 Target Flowmeter Suppliers..... 18-2 Target Flowmeters for Steam Flow Applications: Advantages and Limitations 18-2 Market Size and Growth Forecasts 18-3 Growth Factors for the Target Flowmeter Market..... 18-3 Target Flowmeters a Good Solution for Steam Flow Measurement..... 18-3 Target Flowmeters Have Attractive Features 18-3 Factors Limiting Growth..... 18-4 Shipments of Target Flowmeters by Region: Figures 18-1 to 18-5..... 18-4 Average Selling Prices of Target Flowmeters by Region Figure 18-6..... 18-5	

TABLE OF CONTENTS
(continued)

<u>Chapter</u>	<u>Description</u>	<u>Page Number</u>
Nineteen	Emerging Technology Flowmeters 19-1 Sonar 19-1 Sonar Flowmeter Suppliers 19-2 Optical 19-2 Optical Flowmeter Suppliers 19-4	
Twenty	Flowmeter Supplier Market Shares 20-1 Overview 20-1 Coriolis 20-1 Magnetic 20-1 Ultrasonic 20-1 Vortex 20-1 Thermal 20-2 Differential Pressure 20-2 Primary Elements 20-2 Positive Displacement 20-2 Turbine 20-2 Open Channel 20-3 Variable Area 20-3 Target 20-3	
Twenty One	Supplier Profiles 21-1 ABB, Ltd 21-3 Badger Meter, Inc. 21-9 Bopp & Reuther Messtechnik GmbH 21-16 Brooks Instrument 21-19 Cameron, Measurement Systems (division) 21-24 Danaher Corporation 21-29 McCrometer, Inc. (a subsidiary of Danaher) 21-30 Hach Flow, Marsh-McBirney & Sigma Flow 21-32 Dresser, Inc. 21-35	

TABLE OF CONTENTS
(continued)

<u>Chapter</u>	<u>Description</u>	<u>Page Number</u>
	Elster-Instromet.....	21-38
	Emerson Process Management	21-43
	Bristol Measurement and Control Products.....	21-44
	Daniel Measurement and Control	21-47
	Micro Motion Inc.	21-51
	Rosemount Division.....	21-55
	Endress+Hauser Holding AG	21-62
	Fluid Components International LLC.....	21-66
	FMC Technologies.....	21-69
	Foxboro (Invensys Process Systems).....	21-75
	Fuji Electric Group	21-79
	GE Measurement and Control Solutions	21-82
	Honeywell International / Honeywell Process Solutions.....	21-87
	IDEX (Accusonic, Liquid Controls, Liquid Controls	
	Sponsler, Faure Herman, S.A.M.P.I.,	21-91
	Itron.....	21-98
	KROHNE Messtechnik GmbH.....	21-102
	OVAL Corporation	21-106
	Racine Federated Inc.....	21-112
	Roper Industries, Inc. / Neptune Technology Group Inc.	21-117
	FTI Flow Technology, Inc.	21-120
	Sensus	21-123
	SICK AG.....	21-126
	Siemens	21-128
	Sierra Instruments	21-136
	Smar Equipamentos Industrials Ltds	21-141
	Spirax Sarco Engineering	21-144
	EMCO Flow Systems	21-145
	Thermo Fisher Scientific.....	21-148
	Tokyo Keiki Inc.	21-153
	Tokyo Keiso Company, Ltd.....	21-156
	Toshiba Corporation	21-159
	Veris	21-163
	Yamatake Corporation (azbil).....	21-165
	Yokogawa Electric Corporation	21-169

Appendix: Study Overview **A-1**

LIST OF FIGURES

<i>Figure Number</i>	<i>Description</i>	<i>Page Number</i>
1-1	Total Shipments of All Flowmeters Worldwide (Dollars)	1-7
1-2	Total Shipments of All Flowmeters Worldwide (Units)	1-8
1-3	Shipments of All Flowmeters by Region.....	1-9
1-4	Shipments of All Flowmeters Worldwide by Flowmeter Type.....	1-10
1-5	Shipments of All Flowmeters Worldwide by Flowmeter Type (Dollars)	1-11
1-6	Shipments of All Flowmeters Worldwide by Flowmeter Type (Units)	1-12
1-7	Shipments of New-Technology Flowmeters Worldwide by Type	1-13
1-8	Shipments of Traditional Technology Flowmeters Worldwide by Type	1-14
2-1	New-Technology and Traditional Technology Flowmeters	2-31
2-2	New-Technology Flowmeters Approved by the Fieldbus Foundation.....	2-32
4-1	Total Shipments of All Flowmeters Worldwide	4-5
4-2	Total Shipments of All Flowmeters Worldwide	4-6
4-3	Shipments of All Flowmeters Worldwide by Technology	4-7
4-4	Shipments of All Flowmeters Worldwide by Technology	4-8
4-5	Shipments of All Flowmeters Worldwide by Technology	4-9
4-6	Shipments of All Flowmeters Worldwide by Technology	4-10
5-1	Shipments of New-Technology Flowmeters Worldwide	5-7
5-2	Shipments of New-Technology Flowmeters Worldwide	5-8
5-3	Shipments of New-Technology Flowmeters by Type.....	5-9
5-4	Shipments of New-Technology Flowmeters by Type	5-10
5-5	Shipments of New-Technology Flowmeters by Type.....	5-11

LIST OF FIGURES*(continued)*

<u>Figure Number</u>	<u>Description</u>	<u>Page Number</u>
6-1	Total Shipments of Coriolis Flowmeters Worldwide	6-23
6-2	Total Shipments of Coriolis Flowmeters Worldwide	6-24
6-3	Shipments of Coriolis Flowmeters by Region	6-25
6-4	Shipments of Coriolis Flowmeters by Region	6-26
6-5	Shipments of Coriolis Flowmeters by Region	6-27
6-6	Average Selling Price of Coriolis Flowmeters by Region.....	6-28
7-1	Total Shipments of Magnetic Flowmeters Worldwide	7-23
7-2	Total Shipments of Magnetic Flowmeters Worldwide	7-24
7-3	Shipments of Magnetic Flowmeters by Region	7-25
7-4	Shipments of Magnetic Flowmeters by Region	7-26
7-5	Shipments of Magnetic Flowmeters by Region	7-27
7-6	Average Selling Price of Magnetic Flowmeters by Region.....	7-28
8-1	Total Shipments of Ultrasonic Flowmeters Worldwide	8-33
8-2	Total Shipments of Ultrasonic Flowmeters Worldwide	8-34
8-3	Shipments of Ultrasonic Flowmeters by Region	8-35
8-4	Shipments of Ultrasonic Flowmeters by Region	8-36
8-5	Shipments of Ultrasonic Flowmeters by Region	8-37
8-6	Average Selling Price of Ultrasonic Flowmeters by Region	8-38
9-1	Total Shipments of Vortex Flowmeters Worldwide	9-25
9-2	Total Shipments of Vortex Flowmeters Worldwide	9-26
9-3	Shipments of Vortex Flowmeters by Region	9-27
9-4	Shipments of Vortex Flowmeters by Region	9-28
9-5	Shipments of Vortex Flowmeters by Region	9-29
9-6	Average Selling Price of Vortex Flowmeters by Region.....	9-30

LIST OF FIGURES*(continued)*

<u>Figure</u>	<u>Description</u>	<u>Page Number</u>
<u>Number</u>		
10-1	Total Shipments of Thermal Flowmeters Worldwide.....	10-13
10-2	Total Shipments of Thermal Flowmeters Worldwide.....	10-14
10-3	Shipments of Thermal Flowmeters by Region.....	10-15
10-4	Shipments of Thermal Flowmeters by Region.....	10-16
10-5	Shipments of Thermal Flowmeters by Region.....	10-17
10-6	Average Selling Price of Thermal Flowmeters by Region	10-18
11-1	Total Shipments of Traditional Technology Flowmeters Worldwide	11-19
11-2	Total Shipments of Traditional Technology Flowmeters Worldwide	11-20
11-3	Shipments of Traditional Technology Flowmeters by Type	11-21
11-4	Shipments of Traditional Technology Flowmeters by Type	11-22
11-5	Shipments of Traditional Technology Flowmeters by Type	11-23
12-1	Total Shipments of Differential Pressure Flowmeters Worldwide	12-21
12-2	Total Shipments of Differential Pressure Flowmeters Worldwide	12-22
12-3	Shipments of Differential Pressure Flowmeters by Region.....	12-23
12-4	Shipments of Differential Pressure Flowmeters by Region.....	12-24
12-5	Shipments of Differential Pressure Flowmeters by Region.....	12-25
12-6	Average Selling Price of Differential Pressure Flowmeters by Region.....	12-26
13-1	Total Shipments of Primary Elements Worldwide	13-25
13-2	Total Shipments of Primary Elements Worldwide	13-26
13-3	Shipments of Primary Elements by Region.....	13-27
13-4	Shipments of Primary Elements by Region.....	13-28
13-5	Shipments of Primary Elements by Region.....	13-29
13-6	Average selling Price of Primary Elements by Region	13-30
14-1	Total Shipments of Positive Displacement Flowmeters Worldwide	14-23
14-2	Total Shipments of Positive Displacement Flowmeters Worldwide	14-24
14-3	Shipments of Positive Displacement Flowmeters by Region.....	14-25
14-4	Shipments of Positive Displacement Flowmeters by Region.....	14-26
14-5	Shipments of Positive Displacement Flowmeters by Region	14-27
14-6	Average Selling Price of Positive Displacement Flowmeters by Region....	14-28

LIST OF FIGURES
(continued)

<i>Figure Number</i>	<i>Description</i>	<i>Page Number</i>
15-1	Total Shipments of Turbine Flowmeters Worldwide	15-25
15-2	Total Shipments of Turbine Flowmeters Worldwide	15-26
15-3	Shipments of Turbine Flowmeters by Region	15-27
15-4	Shipments of Turbine Flowmeters by Region	15-28
15-5	Shipments of Turbine Flowmeters by Region	15-29
15-6	Average Selling Price of Turbine Flowmeters by Region	15-30
16-1	Total Shipments of Open Channel Flowmeters Worldwide	16-15
16-2	Total Shipments of Open Channel Flowmeters Worldwide	16-16
16-3	Shipments of Open Channel Flowmeters by Region	16-17
16-4	Shipments of Open Channel Flowmeters by Region	16-18
16-5	Shipments of Open Channel Flowmeters by Region	16-19
16-6	Average Selling Prices of Open Channel Flowmeters by Region	16-20
17-1	Total Shipments of Variable Area Flowmeters Worldwide	17-7
17-2	Total Shipments of Variable Area Flowmeters Worldwide	17-8
17-3	Shipments of Variable Area Flowmeters by Region	17-9
17-4	Shipments of Variable Area Flowmeters by Region	17-10
17-5	Shipments of Variable Area Flowmeters by Region	17-11
17-6	Average Selling Price of Variable Area Flowmeters by Region	17-12
18-1	Total Shipments of Target Flowmeters Worldwide	18-7
18-2	Total Shipments of Target Flowmeters Worldwide	18-8
18-3	Shipments of Target Flowmeters by Region	18-9
18-4	Shipments of Target Flowmeters by Region	18-10
18-5	Shipments of Target Flowmeters by Region	18-11
18-6	Average Selling Price of Target Flowmeters by Region	18-12

LIST OF FIGURES
(continued)

<i>Figure Number</i>	<i>Description</i>	<i>Page Number</i>
20-1	Market Shares for the Leading Suppliers of Coriolis Flowmeters Worldwide	20-5
20-2	Market Shares for the Leading Suppliers of Magnetic Flowmeters Worldwide	20-6
20-3	Market Shares for the Leading Suppliers of Ultrasonic Flowmeters Worldwide	20-7
20-4	Market Shares for the Leading Suppliers of Vortex Flowmeters Worldwide	20-8
20-5	Market Shares for the Leading Suppliers of Thermal Flowmeters Worldwide	20-9
20-6	Market Shares for the Leading Suppliers of Differential Pressure Flow Transmitters Worldwide	20-10
20-7	Market Shares for the Leading Suppliers of Primary Elements Worldwide	20-11
20-8	Market Shares for the Leading Suppliers of Positive Displacement Flowmeters Worldwide	20-12
20-9	Market Shares for the Leading Suppliers of Turbine Flowmeters Worldwide	20-13
20-10	Market Shares for the Leading Suppliers of Open Channel Flowmeters Worldwide	20-14
20-11	Market Shares for the Leading Suppliers of Variable Area Flowmeters Worldwide	20-15
20-12	Market Shares for the Leading Suppliers of Target Flowmeters Worldwide	20-16

LIST OF TABLES

<u>Table Number</u>	<u>Description</u>	<u>Page Number</u>
3-1	Advantages and Disadvantages of DP and New Technology Flowmeters	3-10
3-2	New Technology and DP Flowmeter Principles of Operation.....	3-12
3-3	Paradigm Case Conditions for New-Technology Flowmeters.....	3-14
4-1	Advantages and Disadvantages of DP and New-Technology Flowmeters	4-9
4-2	New-Technology and DP Flowmeter Principles of Operation	4-11
4-3	Paradigm Case Conditions for New-Technology Flowmeters.....	4-13
6-1	Models and Types of Coriolis Flowmeters by Supplier.....	6-3
7-1	Models and Types of Magnetic Flowmeters by Supplier	7-3
8-1	Models and Types of Ultrasonic Flowmeters by Supplier	8-6
9-1	Models and Types of Vortex Flowmeter Suppliers.....	9-2
9-2	Worldwide Average Selling Prices for Flowmeters	9-17
10-2	Suppliers of Thermal Flowmeters	9-3
11-1	Mergers and Acquisitions in Traditional Technology Flowmeter Suppliers	11-14
11-2	Where Traditional Technology Flowmeters Excel.....	11-16
12-1	DP Flow Transmitter Suppliers	11-6
13-1	Suppliers of Primary Elements for Flow Measurement	12-8
14-1	Positive Displacement Flowmeter Suppliers by Fluid Type	14-4
15-1	Turbine Flowmeter Suppliers by Fluid Type	15-3
16-1	Advantages and Disadvantages of Different Open Channel Flow Methods	16-9

16-2	Open Channel Suppliers	16-11
17-1	Variable Area Flowmeter Suppliers by Flowtube Material Type	17-2
18-1	Target Flowmeter Suppliers	18-2
19-1	Sonar Flowmeter Suppliers	19-2
19-2	Optical Flowmeter Suppliers	19-4

LIST OF MAPS

<i>Map Number</i>	<i>Description</i>	<i>Page Number</i>
2-1	World	2-11
2-2	World by Region.....	2-12
2-3	Asia	2-12
2-4	Europe and Russia.....	2-13
2-5	The Russian Federation.....	2-13
2-6	China.....	2-14
2-7	Japan	2-14
2-8	India	2-15
2-9	Indonesia	2-15
2-10	Europe, Middle East, and Africa (EMEA).....	2-16
2-11	The Middle East.....	2-17
2-12	Commonwealth of Independent States and Asia	2-17
2-13	South America	2-18
2-14	Central America	2-18
2-15	The United States.....	2-19
2-16	Canada.....	2-19

LIST OF PHOTOS

<u>Photo Number</u>	<u>Description</u>	<u>Page Number</u>
12-1	An Orifice Plate	12-2
12-2	Orifice Flange Assemblies.....	12-3
12-3	Verabar Multiport Averaging Pitot Tube	12-4
12-4	Venturi Tubes	12-5
12-5	A Flow Nozzle.....	12-6
12-6	COIN Wedge Meter.....	12-7

