

North America Thermal Mass Flow Controller Market Size and Forecast (2021 - 2031)

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Abstracts

The North America Thermal Mass Flow Controller (TMFC) Market is projected to grow significantly, reaching an estimated US\$ 225.9 million by 2031, up from US\$ 155.7 million in 2024, reflecting a compound annual growth rate (CAGR) of 5.7% from 2025 to 2031. This growth is primarily fueled by the region's advanced industrial and technological landscape, which is marked by innovation, automation, and high-precision manufacturing.

The United States, in particular, boasts a robust semiconductor manufacturing base, a burgeoning biotechnology sector, and numerous research and development facilities. These industries depend heavily on precise control of gas and liquid flows for various processes, including wafer fabrication, chemical vapor deposition, and bioreactor gas regulation. The increasing trend towards process automation and digitalization further amplifies the demand for accurate and reliable instrumentation, which is essential for modern industrial control systems.

Federal initiatives aimed at bolstering domestic semiconductor and electronics manufacturing, such as substantial investments in new chip fabrication plants, have also heightened the need for thermal mass flow controllers, which are critical components in gas delivery systems. Additionally, environmental regulations and energy efficiency mandates are driving industries to focus on reducing emissions and optimizing energy usage, necessitating precise flow control. The growing emphasis on renewable energy technologies, hydrogen production, and fuel cell applications further supports the adoption of TMFCs, as they play a vital role in gas mixing and monitoring.

The North American market benefits from a mature industrial infrastructure, a strong culture of research and development, and high-quality standards, all of which contribute

to sustained demand for thermal mass flow controllers. The concentration of semiconductor, biotechnology, and pharmaceutical companies in the US and Canada, which require ultra-precise flow control for cleanroom and laboratory processes, is a significant driver of market growth. Government incentives for chip manufacturing and funding for renewable energy and advanced materials research are also contributing to the demand for high-performance mass flow controllers.

The market segmentation reveals that, by flow rate, the TMFC market is divided into Low, Medium, and High flow rates, with the Low segment leading in 2024. In terms of application, the market is segmented into Semiconductors, Food and Beverage, Chemicals, Pharmaceutical and Healthcare, Oil and Gas, and Others, with the Semiconductors segment dominating in 2024.

A transformative trend in the market is the development of low-cost sensor technologies, which are set to accelerate the growth of thermal mass flow controllers. Traditional TMFCs, while accurate and reliable, often rely on expensive materials and complex manufacturing processes, making them less accessible for small-scale users. Recent advancements in Micro-Electro-Mechanical Systems (MEMS) and Complementary Metal-Oxide-Semiconductor (CMOS) fabrication have enabled the production of compact, high-performance flow sensors at significantly lower costs. These miniaturized sensors offer comparable accuracy and sensitivity to traditional models while being smaller, more energy-efficient, and easier to integrate into portable and analytical instruments.

The democratization of high-precision flow control is driving growth in emerging application areas such as biotechnology, environmental testing, medical diagnostics, and microfluidics, where cost-effective instrumentation is crucial. The availability of low-cost sensors allows manufacturers to produce TMFCs with faster response times and greater calibration stability, enhancing performance in dynamic or low-flow environments and broadening the market's appeal across various industries.

The integration of new sensor technologies is fostering innovation in TMFC design and functionality, leading to smarter, more efficient, and integrated flow control systems. Low-cost sensors are increasingly combined with digital signal processing (DSP) and AI-based calibration algorithms, enabling TMFCs to self-adjust for varying gas properties, pressure fluctuations, and temperature changes, thereby enhancing long-term accuracy and reliability. This convergence of affordability and intelligence supports broader industrial digitalization trends, as low-cost sensors make it economically viable to deploy TMFCs at multiple monitoring points within a process for real-time data collection and

control.

In terms of geographical insights, the North America TMFC market is segmented into the United States, Canada, and Mexico, with the US holding the largest market share in 2024. The US market is characterized by strong high-technology industries, a robust research infrastructure, and aggressive industrial automation trends. The ongoing investment in semiconductor manufacturing, driven by initiatives like the CHIPS and Science Act, is leading to the construction of new fabrication facilities, each requiring numerous precision gas control instruments, making TMFCs indispensable.

Key players in the North America TMFC market include Parker Hannifin Corporation, Avantor Inc, Dwyer Instruments, Sensirion Holding AG, Teledyne Technologies Inc, Horiba Ltd, Azbil Corp, Axetris AG, MKS Instruments Inc, and Brooks Instrument. These companies are employing various strategies such as expansion, product innovation, and mergers and acquisitions to enhance their market presence and offer innovative products to consumers.

Contents

1. INTRODUCTION

- 1.1 Report Guidance
- 1.2 Market Segmentation

2. EXECUTIVE SUMMARY

- 2.1 Key Insights
- 2.2 Market Attractiveness

3. RESEARCH METHODOLOGY

- 3.1 Secondary Research
- 3.2 Primary Research
 - 3.2.1 Hypothesis formulation:
 - 3.2.2 Macroeconomic factor analysis:
 - 3.2.3 Developing base number:
 - 3.2.4 Data Triangulation:
 - 3.2.5 Country-level data:

4. THERMAL MASS FLOW CONTROLLER MARKET LANDSCAPE

- 4.1 Market Overview
- 4.2 PEST Analysis
- 4.3 Ecosystem Analysis
 - 4.3.1 List of Vendors in the Value Chain

5. NORTH AMERICA THERMAL MASS FLOW CONTROLLER MARKET - KEY MARKET DYNAMICS

- 5.1 Market Drivers
- 5.2 Market Restraints
- 5.3 Market Opportunities
- 5.4 Future Trends
- 5.5 Impact of Drivers and Restraints:

6. THERMAL MASS FLOW CONTROLLER MARKET - NORTH AMERICA MARKET

ANALYSIS

6.1 North America Thermal Mass Flow Controller Market Revenue (US\$ Million), 2024 - 2031

6.2 North America Thermal Mass Flow Controller Market Forecast and Analysis

7. NORTH AMERICA THERMAL MASS FLOW CONTROLLER MARKET REVENUE ANALYSIS - BY FLOW RATE

7.1 Low

7.1.1 Overview

7.1.2 Low: North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million)

7.2 Medium

7.2.1 Overview

7.2.2 Medium: North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million)

7.3 High

7.3.1 Overview

7.3.2 High: North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million)

8. NORTH AMERICA THERMAL MASS FLOW CONTROLLER MARKET REVENUE ANALYSIS - BY APPLICATION

8.1 Semiconductors

8.1.1 Overview

8.1.2 Semiconductors: North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million)

8.2 Food and Beverage Industry

8.2.1 Overview

8.2.2 Food and Beverage Industry: North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million)

8.3 Chemicals

8.3.1 Overview

8.3.2 Chemicals: North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million)

8.4 Pharmaceutical and Healthcare Industry

8.4.1 Overview

8.4.2 Pharmaceutical and Healthcare Industry: North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million)

8.5 Oil and Gas

8.5.1 Overview

8.5.2 Oil and Gas: North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million)

8.6 Others

8.6.1 Overview

8.6.2 Others: North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million)

9. NORTH AMERICA THERMAL MASS FLOW CONTROLLER MARKET - COUNTRY ANALYSIS

9.1 North America

9.1.1 North America Thermal Mass Flow Controller Market Revenue and Forecast and Analysis - by Country

9.1.1.1 North America Thermal Mass Flow Controller Market Revenue and Forecast and Analysis - by Country

9.1.2.2 United States: North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million)

9.1.2.2.1 United States: North America Thermal Mass Flow Controller Market Share - by Flow Rate

9.1.2.2.2 United States: North America Thermal Mass Flow Controller Market Share - by Application

9.2.3.3 Canada: North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million)

9.2.3.3.1 Canada: North America Thermal Mass Flow Controller Market Share - by Flow Rate

9.2.3.3.2 Canada: North America Thermal Mass Flow Controller Market Share - by Application

9.3.4.4 Mexico: North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million)

9.3.4.4.1 Mexico: North America Thermal Mass Flow Controller Market Share - by Flow Rate

9.3.4.4.2 Mexico: North America Thermal Mass Flow Controller Market Share - by Application

10 COMPETITIVE LANDSCAPE

- 10.1 Heat Map Analysis by Key Players
- 10.2 Company Positioning & Concentration

11 INDUSTRY LANDSCAPE

- 11.1 Overview
- 11.2 New Product Development
- 11.3 Merger and Acquisition
- 11.4 Other Strategic Developments

12 COMPANY PROFILES

12.1 Parker Hannifin Corporation

- 12.1.1 Key Facts
- 12.1.2 Business Description
- 12.1.3 Products and Services
- 12.1.4 Financial Overview
- 12.1.5 SWOT Analysis
- 12.1.6 Key Developments

12.2 Avantor Inc

- 12.2.1 Key Facts
- 12.2.2 Business Description
- 12.2.3 Products and Services
- 12.2.4 Financial Overview
- 12.2.5 SWOT Analysis
- 12.2.6 Key Developments

12.3 Dwyer Instruments, Inc.

- 12.3.1 Key Facts
- 12.3.2 Business Description
- 12.3.3 Products and Services
- 12.3.4 Financial Overview
- 12.3.5 SWOT Analysis
- 12.3.6 Key Developments

12.4 Sensirion Holding AG

- 12.4.1 Key Facts
- 12.4.2 Business Description
- 12.4.3 Products and Services
- 12.4.4 Financial Overview

- 12.4.5 SWOT Analysis
- 12.4.6 Key Developments
- 12.5 Teledyne Technologies Inc
 - 12.5.1 Key Facts
 - 12.5.2 Business Description
 - 12.5.3 Products and Services
 - 12.5.4 Financial Overview
 - 12.5.5 SWOT Analysis
 - 12.5.6 Key Developments
- 12.6 Horiba Ltd
 - 12.6.1 Key Facts
 - 12.6.2 Business Description
 - 12.6.3 Products and Services
 - 12.6.4 Financial Overview
 - 12.6.5 SWOT Analysis
 - 12.6.6 Key Developments
- 12.7 Azbil Corp
 - 12.7.1 Key Facts
 - 12.7.2 Business Description
 - 12.7.3 Products and Services
 - 12.7.4 Financial Overview
 - 12.7.5 SWOT Analysis
 - 12.7.6 Key Developments
- 12.8 Axetris AG
 - 12.8.1 Key Facts
 - 12.8.2 Business Description
 - 12.8.3 Products and Services
 - 12.8.4 Financial Overview
 - 12.8.5 SWOT Analysis
 - 12.8.6 Key Developments
- 12.9 MKS Instruments Inc
 - 12.9.1 Key Facts
 - 12.9.2 Business Description
 - 12.9.3 Products and Services
 - 12.9.4 Financial Overview
 - 12.9.5 SWOT Analysis
 - 12.9.6 Key Developments
- 12.10 Brooks Instrument
 - 12.10.1 Key Facts

- 12.10.2 Business Description
- 12.10.3 Products and Services
- 12.10.4 Financial Overview
- 12.10.5 SWOT Analysis
- 12.10.6 Key Developments

13. APPENDIX

13.1 About The Insight Partners

List Of Tables

LIST OF TABLES

- Table 1. North America Thermal Mass Flow Controller Market Segmentation
- Table 2. List of Vendors
- Table 3. North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million)
- Table 4. North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million) - by Flow Rate
- Table 5. North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million) - by Application
- Table 6. North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million) - by Country
- Table 7. United States: North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million) - by Flow Rate
- Table 8. United States: North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million) - by Application
- Table 9. Canada: North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million) - by Flow Rate
- Table 10. Canada: North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million) - by Application
- Table 11. Mexico: North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million) - by Flow Rate
- Table 12. Mexico: North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million) - by Application
- Table 13. Heat Map Analysis by Key Players

List Of Figures

LIST OF FIGURES

- Figure 1. North America Thermal Mass Flow Controller Market Segmentation - Country
- Figure 2. PEST Analysis
- Figure 3. Ecosystem: Thermal Mass Flow Controller Market
- Figure 4. North America Thermal Mass Flow Controller Market - Key Market Dynamics
- Figure 5. Impact Analysis of Drivers and Restraints
- Figure 6. North America Thermal Mass Flow Controller Market Revenue (US\$ Million), 2024 - 2031
- Figure 7. North America Thermal Mass Flow Controller Market Share (%) - by Flow Rate, 2024 and 2031
- Figure 8. Low: North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million)
- Figure 9. Medium: North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million)
- Figure 10. High: North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million)
- Figure 11. North America Thermal Mass Flow Controller Market Share (%) - by Application, 2024 and 2031
- Figure 12. Semiconductors: North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million)
- Figure 13. Food and Beverage Industry: North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million)
- Figure 14. Chemicals: North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million)
- Figure 15. Pharmaceutical and Healthcare Industry: North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million)
- Figure 16. Oil and Gas: North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million)
- Figure 17. Others: North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million)
- Figure 18. North America Thermal Mass Flow Controller Market Breakdown by Key Countries, 2024 and 2031 (%)
- Figure 19. United States: North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million)
- Figure 20. Canada: North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million)

Figure 21. Mexico: North America Thermal Mass Flow Controller Market - Revenue and Forecast, 2021 - 2031 (US\$ Million)

Figure 22. Company Positioning & Concentration

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