

Development of Software for the Design of Differential Pressure Flowmeters in Accordance with the Updated ISO 5167:2022

<https://doi.org/10.31713/MCIT.2025.019>

Oleh Masniak

Institute of Energy and Systems Management (IESM)
Lviv Polytechnic National University

Lviv, Ukraine

oleh.y.masniak@lpnu.ua

Solomiia-Anna Vyshnevskia

Institute of Computer Science and Information
Technologies (ICSIT)

Lviv Polytechnic National University
Lviv, Ukraine

solomiia-anna.vyshnevskia.mpzip.2024@lpnu.ua

Abstract – This paper presents a study on the relevance of developing new software that implements the updated ISO 5167:2022 standard. The market for automating the design of variable pressure differential flowmeters was studied, and it was determined that with the successful launch of the software as a web application, there could be approximately 5,000-7,000 users worldwide. The main competitors of the future application were studied, namely FLOWCALC32, CAHP «BHTPATOMIP» and AFT FATHOM. Based on the functionality of analogues, a competitive matrix was constructed indicating the advantages of the new DiffFlow product.

Keywords – software; web application; flowmeter; differential pressure method

I. INTRODUCTION

In the modern world, the efficient use of energy resources, particularly natural gas, is a key factor in ensuring the sustainable development of the industry and the energy sector. Accurate measurement of gas flow is critically important for maintaining energy security, optimising technological processes, commercial accounting, and environmental monitoring. To ensure these aspects, international standards have been implemented that regulate methods for measuring gas flow. One such document is ISO 5167:2022 [1], which defines a method for calculating gas flow using standard flow-restricting devices (such as orifice plates, Venturi tubes, and nozzles). This method is known as the differential pressure method.

When designing differential pressure flowmeters for natural gas, it is essential to ensure not only compliance with regulatory requirements but also the convenience of the interface for engineers, operators, and other users. At the same time, existing software tools are often outdated, difficult to maintain, or lack proper support for the latest versions of standards. This context highlights that developing a web application to automate the design of differential pressure flowmeters in accordance with ISO 5167:2022 is both relevant and practically significant.

The development of the new system will provide an innovative web application for the automated calculation and design of flowmeters in accordance with ISO 5167:2022. The application enables fast and accurate computations based on the updated international standard, while also providing users with convenient and quick access to its functionality.

The flowmeter industry is undergoing digital transformation, creating significant opportunities for innovation but also increasing competition within the field. Creating a web application that automates calculations and adapts the standard's requirements for practical use will allow enterprises to optimise their processes. The DiffFlow project aims to solve a practical problem: developing a universal tool that enables companies to effectively apply the latest ISO 5167:2022 standard, automate complex calculations, and ensure compliance with the accuracy and reliability requirements of differential pressure flowmeters.

II. MARKET RESEARCH ON AUTOMATION OF FLOWMETER DESIGN

Natural gas and oil remain among the leading sources of energy, while the pharmaceutical and chemical industries are experiencing moderate growth driven by technological progress. Consequently, the demand for flowmeters – the design of which is the focus of the developed product – continues to increase.

According to technical documents [2], [3] describing the main changes in the new edition of ISO 5167:2022, the updated version provides clarified recommendations for flow measurement and extends the applications of differential pressure flowmeters.

As of 2019, over 200 major companies [4] worldwide engaged in the extraction, transportation, and/or storage of natural gas and oil. The adoption of ISO 5167:2022 is crucial in countries with stringent industrial regulations, such as the United States, the European Union, and certain parts of Asia. However, not all companies in these sectors will immediately adopt automated solutions. Assuming an initial conservative implementation rate of 3-5% of the total

number of companies in these industries worldwide, the lower bound of potential users may be around 5,000-7,000 clients globally.

The flowmeter and process automation market in industries that must comply with standards such as ISO 5167:2022 is significant, encompassing hundreds of thousands of medium and large enterprises worldwide. Considering the growing trend of digital transformation in industrial sectors – not only in oil and gas but also in pharmaceutical and chemical industries – the upper estimate may rise to 10,000-20,000 companies worldwide within the next 5-10 years, as more companies seek to optimise operations and ensure compliance with international standards such as ISO 5167:2022.

The flowmeter market in 2023 was valued at USD 7 billion [5], with projections suggesting it could reach USD 13 billion by 2033. Moreover, the implementation and adoption of new standards increases measurement accuracy and expands the overall market volume.

The growing demand for renewable energy sources, such as natural gas, continues to drive market expansion. Alongside this growth, the need for automated solutions for the design of differential pressure flowmeters is also increasing. Such solutions must ensure high accuracy and compliance with the latest standards.

III. COMPETITOR ANALYSIS

The main competitors of the web application for automated calculation and design of differential pressure flowmeters include FLOWCALC32 (Gothenburg, Sweden) [6], CAIP «БИТРАТОМИП» (eng. CAD “Flowmeter”) (Lviv, Ukraine) [7], and AFT FATHOM (Colorado, USA) [8].

FLOWCALC32 CE is a Windows-based program for calculating various devices used for measuring flow with the differential pressure method. It can be applied to the calculation of orifice plates, Venturi tubes, and nozzles, as well as to the assessment of the effects of changing operating conditions, pipe diameters, and orifice dimensions of the primary device.

Compared to the developed web application, FLOWCALC32 has an outdated interface and is based on an older version of the standard (1991).

CAIP «БИТРАТОМИП» (until February 27, 2025, known as CAIP «ПАХОД-ПВ») is a program designed for the calculation and design of differential pressure flowmeters with standard flow-restricting devices in accordance with the set of intergovernmental standards DSTU GOST 8.586.(1-5):2009 (ISO 5167-(1-4):2003). This is a desktop application that operates according to a modified Ukrainian standard, rather than the international one.

In comparison, the developed application targets the international ISO 5167:2022 standard, whereas CAIP «БИТРАТОМИП» is primarily aimed at post-Soviet markets and relies on an outdated version of the standard.

AFT FATHOM is a fluid dynamics modelling software used to calculate pressure drops and flow

distribution in liquid and gas pipelines with low flow velocities.

Compared to the developed application, AFT FATHOM holds a strong position in the international market, offering broader functionality for simulating fluid flow and component interactions.

Among indirect competitors, there are programs with extensive engineering functionality where the design and calculation of differential pressure flowmeters are not the primary focus but are included as part of the feature set. For instance, Honeywell’s UniSim Design Suite is a process simulation software that helps engineers create steady-state and dynamic models. Meanwhile, OpenFOAM offers a wide range of tools for solving problems, including complex fluid flows (with chemical reactions, turbulence, and heat transfer), as well as acoustics, solid mechanics, and electromagnetics.

A comparison of the key features of DifFlow with its three main competitors – FLOWCALC32, CAIP «БИТРАТОМИП», and AFT FATHOM – is presented in Table I.

TABLE I. COMPETITOR MATRIX

Feature	DifFlow	FLOWCALC32	CAIP «БИТРАТОМИП»	AFT FATHOM
ISO 5167:2022	+	-	-	-
Payment model	Subscription	Freemium	Software package purchase	Per-seat
Application type	Web	Desktop, only for Windows	Desktop	Desktop or web, with limited functionality
Report generator	+	+	+	Customize templates
Ease of Use	+	+	+	+

IV. OVERVIEW OF THE DEVELOPED SOFTWARE

The developed DifFlow software, implemented as a web application, performs parameter calculations for the mathematical model of differential pressure flowmeters for gases and liquids in accordance with ISO 5167:2022, depending on the technical and design characteristics of their application.

The web application enables users to input the necessary parameters for the working fluid, primary measuring devices, and structural characteristics of the measurement pipeline. After performing the calculations, the application outputs the complete mathematical model of the differential pressure flowmeter based on the input data provided by the user.

The complete mathematical model is presented as a calculation report, which includes the dimensional parameters of the primary device displayed in a

schematic drawing. The report is available in two formats: full and abbreviated. Additionally, the web application provides the calculated components of measurement uncertainty for the flow meter.

Furthermore, users can access reference information, including protocol formats and types of flow-restricting devices, and verify whether the medium parameters and calculation results comply with the requirements of the international standard.

CONCLUSION

The software's advantages include its innovative functionality, particularly the implementation of calculations in accordance with the 2022 edition of the international standard ISO 5167. The application is developed as a web-based platform, providing users with the flexibility to access it from any location with an internet connection.

The product features a user-friendly interface and ensures accurate calculations. Business clients can utilise the software for automated calculation and design of differential pressure flowmeters, significantly improving both the quality and speed of their operations.

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