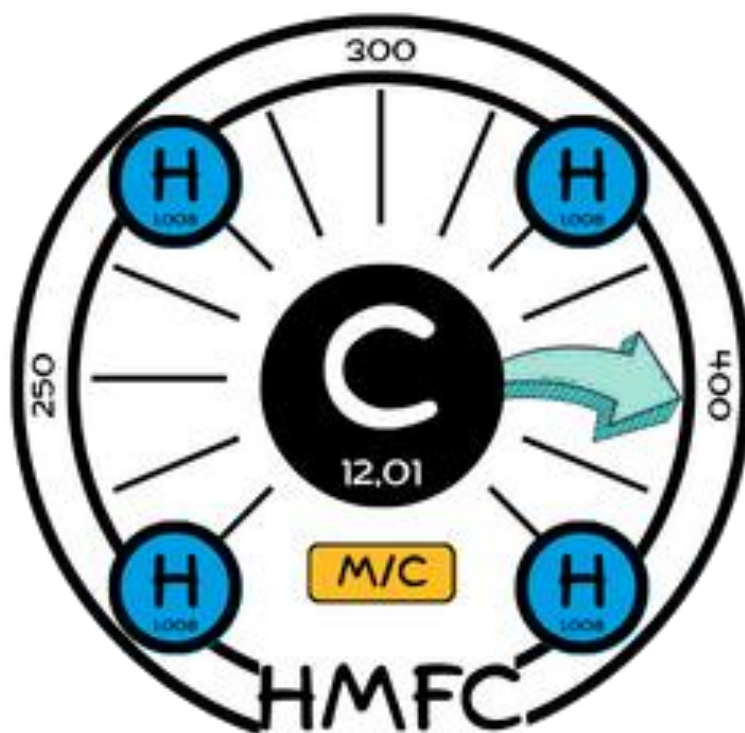**Scientific
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Software

«Hydrocarbon Mass Flow Calc»

User manual

2025

ABSTRACT

This user manual is intended for users working with the "Hydrocarbon Mass Flow Calc" software (hereinafter referred to as the Software).

The software includes a set of dynamic libraries for calculating the density of hydrocarbon-containing gases, assuming the gas is only in the gaseous phase, within a temperature range from -50 to 400 °C (223.15 to 673.15 K) and absolute pressures from 0.1 to 4 MPa, based on empirical dependencies.

The user interface of the software provides simplified data entry and presents the results as floating-point numbers with up to six decimal places..

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CONTENT

1. Introduction

Scope of Application

The software is designed to calculate the density of hydrocarbon gas (natural gas) (paraffinic hydrocarbons CnH2n+2 from C1 to C8, containing up to 10% molar fraction of organic and inert gas impurities), provided the gas remains in a single-phase state (the gas temperature at the specified pressure is at least 10 °C above the hydrocarbon condensation temperature), under the following parameter ranges:

-if the gas component concentrations correspond to values in Table 1:

Temperature: from −10.15 to 226.85 °C

Absolute pressure: from 0.1 to 4.0 MPa

Table 1 - Component content at temperatures from minus 10.15 to 226.85 ºC

№	Indicator name	Indicator value, mol.%	
		min	max
1	CH4 (methane)	0	100
2	C2H6 (ethane)	0	82
3	C3H8 (propane)	0	81
4	n-C4H10(n-butane)	0	84
5	i-C4H10(iso-butane)	0	54
6	n-C5H12 (n-pentane)	0	25
7	i-C5H12 (iso-pentane)	0	22
8	C6H14 (hexane)	0	17
9	C7H16 (heptane)	0	2
10	C8H18 (octane)	0	2
11	N2 (nitrogen)	0	16*
12	CO2 (carbon dioxide)	0	10*
13	O2 (oxygen)	0	5
14	CO (carbon monoxide)	0	2
15	H2S (hydrogen sulfide)	0	8
* the sum of the components of nitrogen and carbon dioxide in hydrocarbon gas should not exceed 20%.			

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-if the components correspond to Table 2:
   Temperature: from -50 to $400\,°C$
   Absolute pressure: from 0.1 to 4.0 MPa

Table 2 - Component content at temperatures from minus 50 to 400 ºC

№	Indicator name	Indicator value, mol.%	
		min	Максимальное
1	CH4 (methane)	30	100
2	C2H6 (ethane)	0	25
3	C3H8 (propane)	0	14
4	n-C4H10(n-butane)	0	6
5	i-C4H10(iso-butane)	0	
6	n-C5H12 (n-pentane)	0	0,5
7	i-C5H12 (iso-pentane)	0	
8	C6H14 (hexane)	0	0,2
9	C7H16 (heptane)	0	0,1
10	C8H18 (octane)	0	0,05
11	N2 (nitrogen)	0	16*
12	CO2 (carbon dioxide)	0	10*
13	O2 (oxygen)	0	2
14	CO (carbon monoxide)	0	2
15	H2S (hydrogen sulfide)	0	8
* the sum of the components of nitrogen and carbon dioxide in hydrocarbon gas should not exceed 20%.			

1.2 Brief Description of Features

The software outputs the calculated density value (kg/m³) of hydrocarbon gas based on available input parameters:
   1) Speed of sound, m/s
   2) Pressure, MPa
   3) Temperature, °C

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1.3 Metrological Characteristics

The software is divided into metrologically significant and non-significant parts.

The metrologically significant part is implemented as a DLL dynamic library with a digital identifier (MD5 checksum):

0db967d389f6a36ed42f7478c8810ca2.

Compliance with GOST R 8.654-2015 and GOST R 8.883-2015 requirements for measurement software is confirmed by Certificate of Conformity No. TP 316-24.

The metrologically significant part ensures the following characteristics:

- for absolute gas pressure from 0.1 to 3.5 MPa:

Conditions imposed	Error limits for calculating the gas density of the software under test, %
At molar mass of gas more than 25 g/mol and the number of hydrocarbons more than 0.78	±3
When the molar mass of the gas is less than or equal to 25 g/mol and/or number of hydrocarbons less than or equal to 0.78	±(13-10x)

- for absolute gas pressure from 3.5 to 4 MPa:

Conditions imposed	Error limits for calculating the gas density of the software under test, %
At molar mass of gas more than 25 g/mol and the number of hydrocarbons more than 0.78	±5
When the molar mass of the gas is less than or equal to 25 g/mol and/or number of hydrocarbons less than or equal to 0.78	±(13-10x)

where

x - number of hydrocarbons. Calculate using the formula

$$x = \frac{M_{hydrocarbons}}{M_{gas}},$$

where

$M_{hydrocarbons}$	-	total molar mass of hydrocarbon components of gas, g/mol;
M_{gas}	-	molar mass of gas, g/mol.

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2 System Requirements

The software is intended for use on personal computers that comply with IBM PC-compatible architectures. Minimum Hardware Requirements:

- RAM: at least 2 GB;
- Processor with a clock speed of 2.0 GHz;
- Monitor;
- Keyboard;
- Mouse.

Operating System Type and Version: Microsoft Windows 10 or higher

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3   Authorization

3.1 Launch the "Hydrocarbon Mass Flow Calc" Software

Double-click the Hydrocarbon.exe file to start the "Hydrocarbon Mass Flow Calc" application (Figure 1).
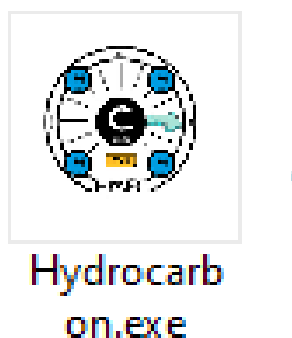
Figure 1 – Software Launch

If you attempt to open two instances of the software at the same time, a corresponding message will appear (Figure 2) and the second instance will close automatically.
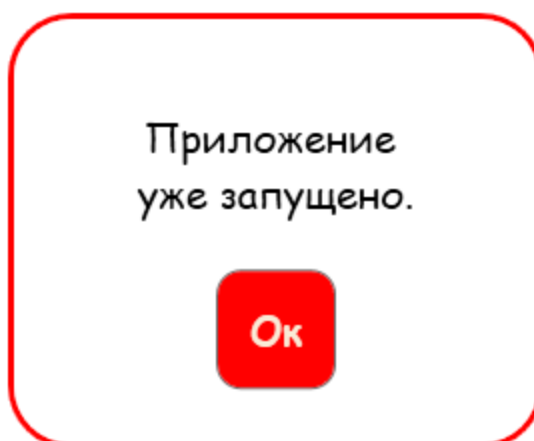
Figure 2 – Notification

3.2 In the opened "Authorization" window (Figure 3), fill in the "Login" and "Password" fields. If necessary, check or uncheck the "Remember me" box, then click the "Login" button (or press the Enter key).

Figure 3 – "Authorization" Window

If authorization is successful, a corresponding message will appear (Figure 4).

Figure 4 – Message

After clicking the "Ok" button (or pressing the Enter key), you will be taken to the "Main Window" (Figure 5).
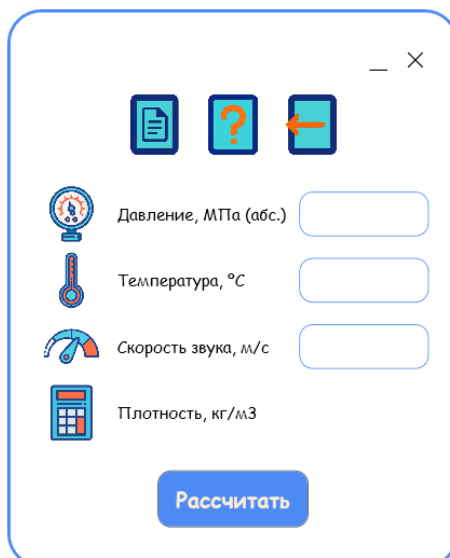
Figure 5 – "Main Window" after Authorization

If an incorrect login or password is entered, a window with an appropriate message will appear.

To allow users to review the program documentation, it is possible to close the "Authorization" window and access the "Main Window" without user authorization (Figure 6). In this case, the "Calculate" button will be inactive.
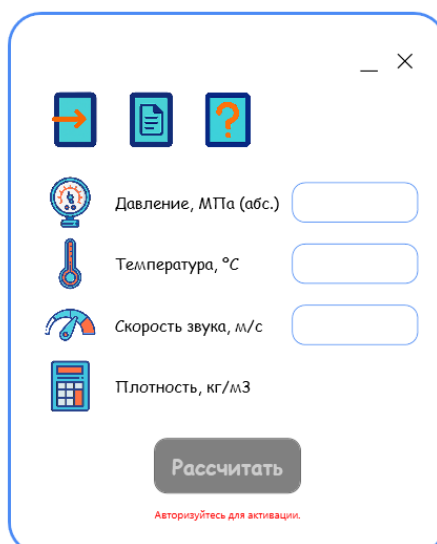
Figure 6 – "Main Window" without Authorization

4   Calculation

To perform a calculation, fill in the corresponding fields (Pressure (MPa), Temperature (ºC), and Sound Velocity (m/s)) in the "Main Window" and click the "Calculate" button located at the bottom (or press the Enter key).

The ranges for pressure and temperature are specified in Section 1 of this manual.

The limits of calculation error are provided in Section 2 of this manual.

5   Menu

The menu is located at the top horizontal part of the "Main Window" and contains four buttons: "Login," "Documentation," "About," and "Exit."

The "Login" button (Figure 7) opens the "Authorization" window and is available only if the user is not authorized.
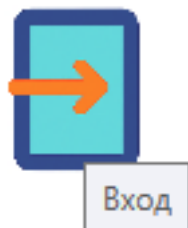
Figure 7 – "Login" Button

a)The "Documentation" button (Figure 8) opens the corresponding "Documentation" window.
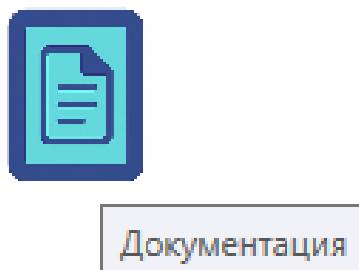

Figure 8 – "Documentation" Button

When you click the buttons in the "Documentation" window (Figure 9), the documentation for this software will open in PDF format.

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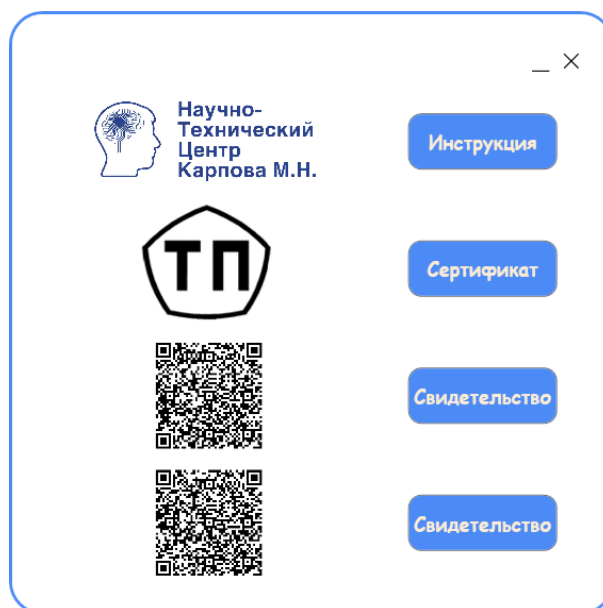Scientific
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Figure 9 – "Documentation" Window

b) The "About" button (Figure 10) opens the corresponding "About" window.
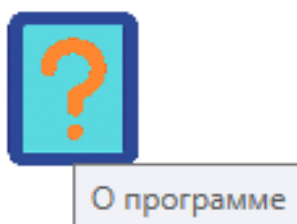

Figure 10 – "About" Button

The "About" window (Figure 11) contains information about the software version and a link to technical support.
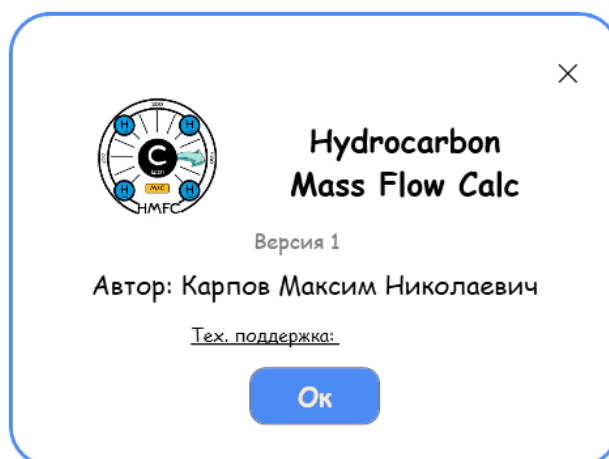

Figure 11 – "About" Window

The "Exit" button (Figure 12) logs out the authorized user, thereby disabling the calculation function. It is available only if the user is authorized.
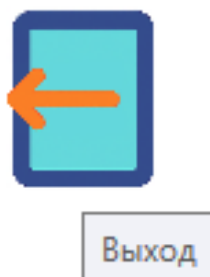

Figure 12 – "Exit" Button

6 Window Control Buttons

Window control buttons (Figure 13) are located at the top right corner of each window and include:

a. The "Minimize" button – minimizes all open software windows;

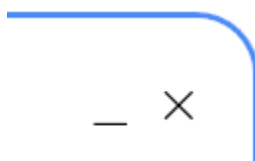b. The "Close" button – closes the window or program.

Figure 13 – Window Control Buttons

When you attempt to close the program, a confirmation prompt will appear (Figure 14).

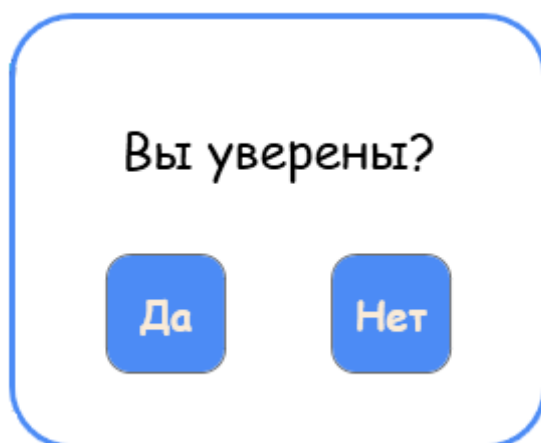To confirm, press the "Yes" button (Enter key); to cancel, press the "No" button (Esc key).

Figure 14 – Software Close Confirmation

When the software is closed, the authorized user is forcibly logged out.