

SIEMENS

SITRANS F

Ultrasonic Flowmeters

FS200 Utility
Programming Manual

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CAUTION
without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.
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Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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Introduction

1.1 Basic Requirements

This manual is designed to assist you with the installation and operation of the Siemens FS200 Utility software. This utility software package allows you to interface with any Siemens FST030 / 020 flowmeter to assess the condition of your flowmeter installation and to collect data for comparison with prior baseline data. Along with FS200 utility software installation and operation, this manual will also cover system requirements as they pertain to personal computers (PC's) when used with the SITRANS F series ultrasonic transit-time flowmeters.

The FS200 utility is designed to work with Microsoft Windows-7 through current Windows 10 operating systems and was developed specifically to interface with Siemens equipment. It allows you to connect your PC to your flowmeter simply and directly. You will find that the utility is very intuitive and simple to use, making it a useful tool for managing your Siemens ultrasonic flowmeters.

PC Requirements

1. Operating Systems; Windows-7 through 10 operating systems.
2. 30 MB of free hard drive space.
3. The utility is only suitable for communication via a standard USB port
4. An appropriate USB cable: Type A (PC end) to Type A mini (Transmitter end)

Siemens Flowmeter Requirements

- Must be a SITRANS FST030 / 020 family flowmeter
- Flowmeter must be installed and actively measuring flow (or zero flow) for use of diagnostic screens. An uninstalled flowmeter will provide no diagnostic information for the utility to work with.
- Utility screens can be accessed and utilized without the need to connect to a flowmeter

1.2 Error Messages

The FS200 utility program is complex and all possible error messages cannot be listed here. If an error message occurs and seems unsolvable, contact the Siemens technical support hotline (In North America) at: 1-800-333-7421 or report an issue via the SIOS portal; <http://support.industry.siemens.com/>

2.1 FS200 Utility Download and Installation

The FS200 utility package (FS200_sizing_software.zip) can be accessed and downloaded from the Siemens (SIOS) website at this location:

<https://support.industry.siemens.com/cs/document/109762612/fs200-clamp-on-utility-software-for-sitrans-fs230-fs220-flowmeters?dti=0&lc=en-US>

Installation and use of the utility is quite simple. Please perform the following steps to install your Siemens FS200 software:

1. Create a suitable folder ("FS200_Utility" or desired name) on your PC hard drive.
2. Download the file "FS200_sizing_software.zip" from the above location.
3. Extract the file to your created folder
4. Open the folder and double-click the file "FS200.exe" to launch the program

Note:

The FS200 program supports the following languages: English, French, German and Spanish

5. If desired, create a shortcut and icon for the FS200.exe file and place it on the PC desktop.

3.1 FS200 Communications Setup

1. Connect the appropriate USB cable between the flowmeter and any available USB port on the PC.
2. Turn on power to the flowmeter if it is not already powered up
3. Make sure to note what port number your PC assigns to this connection. If necessary, access the Control panel / System / Device manager of your PC to verify the port assignment
4. Verify the communication configuration settings of the FS200 utility by accessing the Setup tab on the FS200 menu bar, then click communications (See Figure 3-1 Below). Set as follows, then click OK;
 - **Device address:** Typically 1
 - **Connect Using:** Select appropriate port as assigned by your PC
 - **Baud Rate:** Select either 9600 or 19200
 - **Stop Bits:** Typically 1
 - **Parity:** None



Figure3-1 Communication settings

Connecting

3.2 FS200 to Flowmeter Communications Setup

1. Launch the FS200 Utility program (if not already running).
2. On the FS200 Menu bar, use your mouse to click on the [Connection] function, then again to select [Connect]. this will open the dialogue box illustrated below.

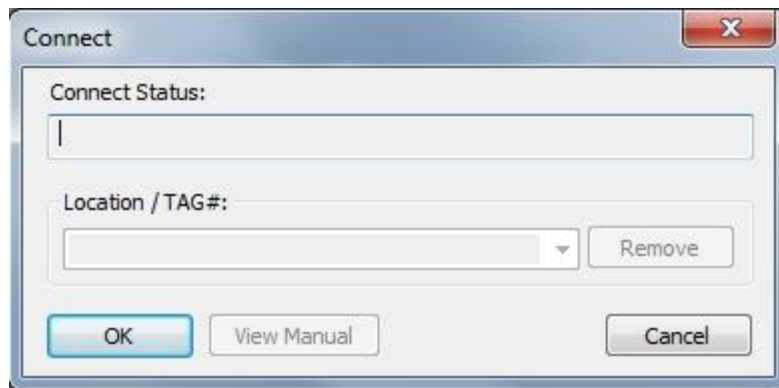


Figure 3-2 Connection Status

3. Click the [OK] button. [Connecting to Meter, Please Wait.../] will appear in the [Connect Status] box as the FS200 utility establishes communication with the flowmeter. This should only take a few seconds. Note that the [Location / Tag#] data box is not a programmable entry
4. When the connection is established “connected” will appear at the bottom left of the FS200 screen and the connect dialogue box will close automatically

Note

If communication cannot be established with the flowmeter, a pop-up error message will appear stating [No Response from Meter] or if the meter responds incorrectly an [Expected Data Not Received] error message will appear. If either of these messages appear you should verify proper communication settings (EG Port selection) in the FS200 program. You should also verify the security of the USB cable connections at the flowmeter and your PC.



Figure 3-3 Error Message

Note

The SITRANS FS230 flowmeter must have at least one active measurement path that is operating, otherwise the FS200 program will not provide any useful diagnostic or operational data beyond simply establishing communication with the flowmeter.

Setup Screens

This section provides a detailed description of each FS200 configuration menus and their function. The screens can be accessed by clicking on the appropriate Menu Tab at the top of the FS200 main page.

If you are not familiar with certain terminology and their definitions refer to the glossary for clarification. If a hard copy of a screen is desired, certain screens can be printed by clicking the [Print] button located near the bottom of the screen. Note that only those screens with active [Print] buttons can be printed.

Print requests will be routed to the default printer assignment as selected in the File menu. If no print button is present a copy of the subject screen can be implemented by using the [Print Screen] command on your PC to capture the desired window into the Windows clipboard, you can then paste it into a suitable document.

4.1 File Menu

The [File] menu consists of two sub-menus:

- Print Setup
- Exit

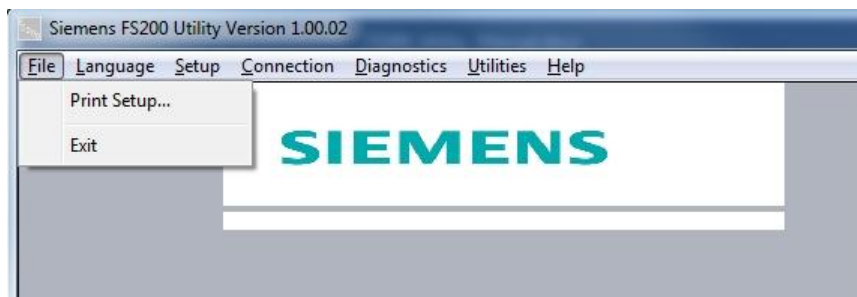


Figure 4-1 File menu

Print Setup Menu

The [Print Setup] menu is used to select a printer to print out FS200 menu-screen data. When selected, the [Print Setup] menu appears and allows the user to select a desired default printer and configure the printer properties.

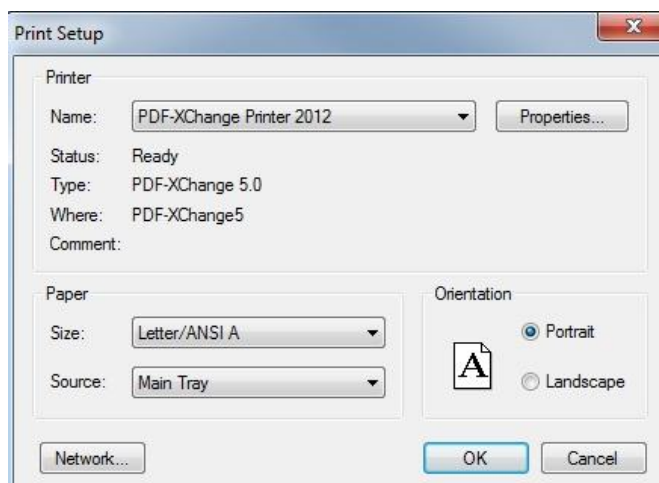


Figure 4-2 Print Setup

Exit

Selecting the [Exit] button will close the FS200 utility program.

4.2 Language Menu

The language menu enables selection of one of four languages; English, German, French, or Spanish for ease of use by personnel whose native language differs from English.

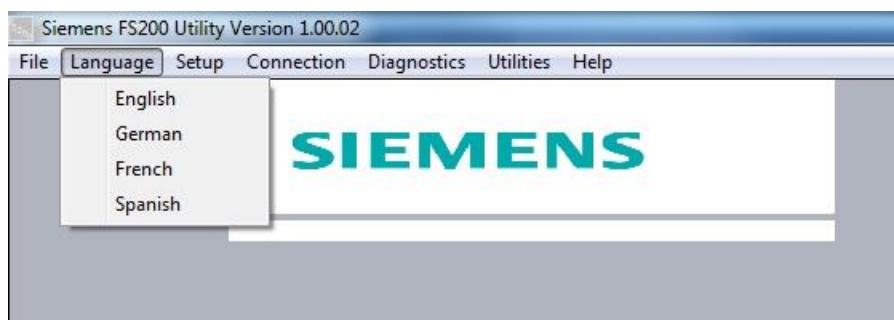


Figure 4-3 Language menu

4.3 Setup Menu

The [Setup] menu consists of two sub-menus:

- Communications
- Pass/Fail Limits

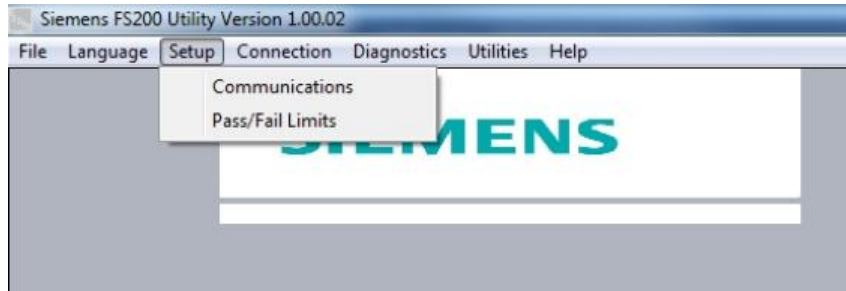


Figure 4-4 Setup Selection

Note

The [Pass/Fail Limits] menu appears only after a connection to the flowmeter has been established via the [Connection] and [Connect] menus.

Communications Setup Screen

The [Communications Setup] screen is used to configure the FS200 utility communication protocol data for connection to the flowmeter. It was covered in detail in section 3

Pass/Fail Limits Setup Screen

This screen enables the user the ability to modify the FS200 default numerical Warning and Fail limits pertaining to proper flowmeter operation. These limits will be expressed as Yellow (warning) or Red (Fail) indications when observing the Diagnostic data screen of the FS200 utility. This screen displays the last saved input data settings.

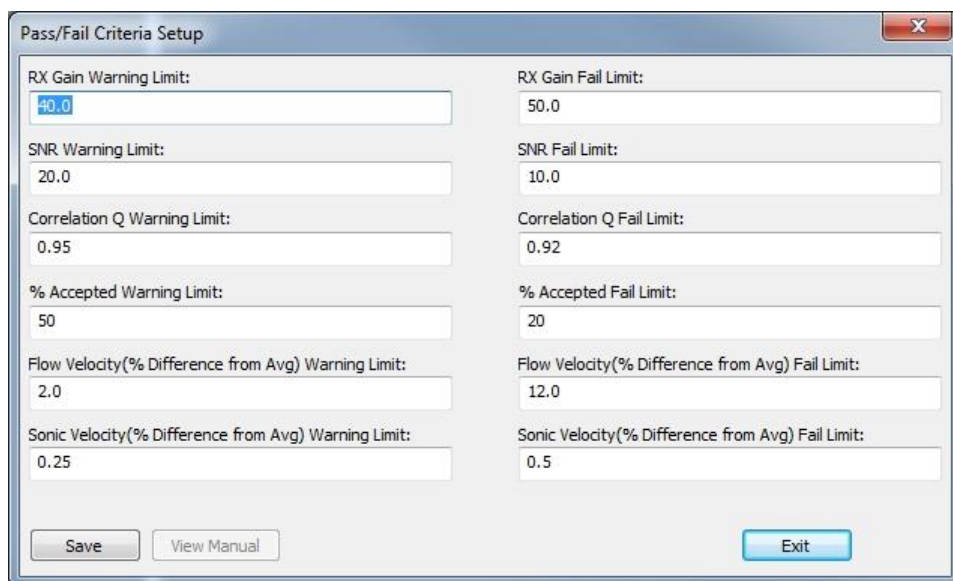


Figure 4-5 Pass / Fail Limit Settings

4.4 Connection Screen

The [Connection] screen where a communication link can be established between the FS200 program and the flowmeter and will indicate when the FS200 utility and the flowmeter are successfully connected and communicating. When a communication connection is completed "Connected" will appear at the bottom left of the Si-Ware screen and the [Connect] screen will close automatically.

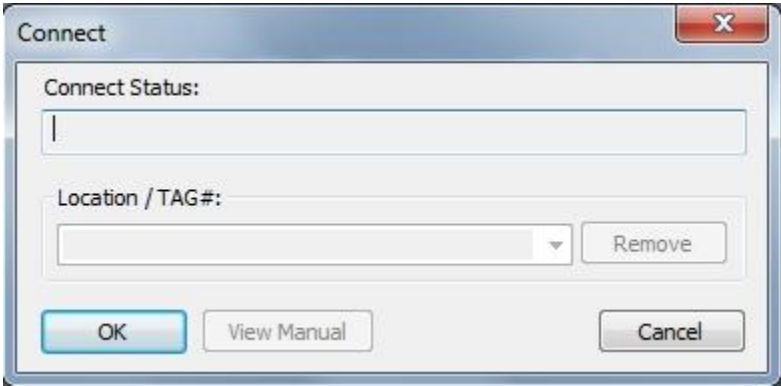


Figure 4-6 Connection Status

Diagnostic Screens

Diagnostics Menu

Access to the diagnostic screens is only available after a connection to the flowmeter has been established as described in section 3.2

The FS200 utility has two Diagnostic screens: Signal Graph and Meter Diagnostic, they are selected by clicking on [Diagnostics] in the FS200 menu bar.

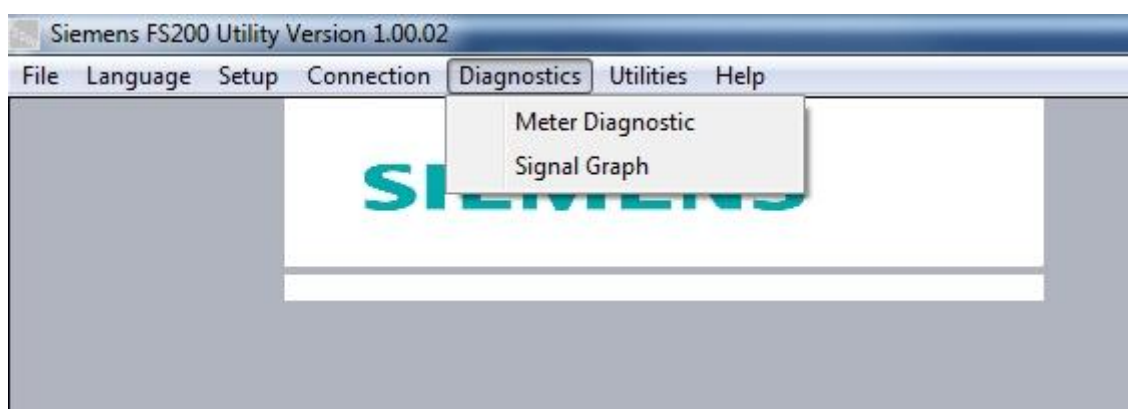


Figure 5-1 Diagnostics Menu

5.1 Signal Graph

The Signal Graph screen allows you to view real-time digitized transducer receive signals for any operational flowmeter path. This feature is useful for diagnosing waveform problems such as those caused by liquid aeration, noise interference, or poor transducer match to pipe.

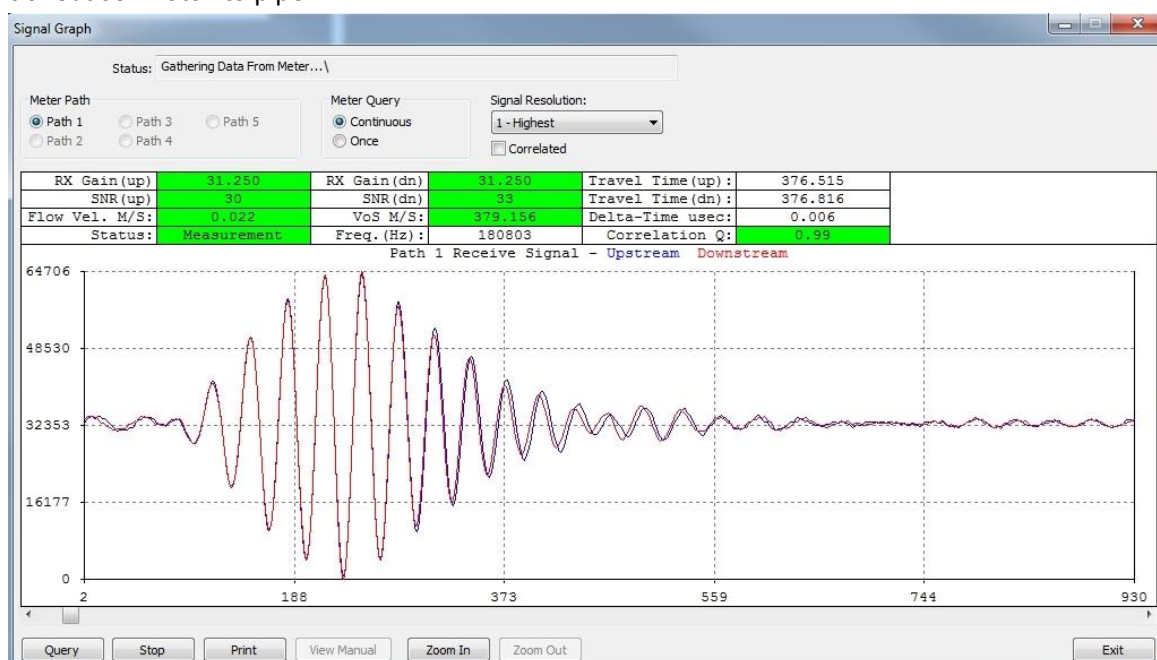


Figure 5-2 Signal Graph Screen

Diagnostic Screens

To select the Signal Graph:

Note

To view a Signal Graph, first establish a flowmeter connection using the [Connection] and [Connect] menus, ensure the path to be viewed is actively operating and measuring flow rate or zero flow condition.

1. On the FS200 menu bar, click on [Diagnostics] then on [Signal graph] in the drop down menu
2. The Signal Graph screen will appear and begin gathering data automatically. Any active flowmeter paths will be shown as available for selection with bold font. Inactive paths will be grayed-out to prevent selection.
3. Using your mouse, select the desired path to graph its signal. The menu selection choices are defined in the table below:

Menu Choices	Description
Meter Path	Allows you to select any one of the active measurement Paths.
Meter Query	Select "Continuous" for continuous (live) updating) of the signal graph. Select "Once" for a single snapshot of the graph. If "Once" is selected the view can be refreshed by clicking the [Query] button at the bottom left of the FS200 screen
Signal Resolution	By Default, the FS200 displays the signal at its highest resolution. Selecting a lower resolution allows the FS200 to update the graph more frequently when "Continuous" mode is selected, however this may degrade the quality of the signal waveshape.
Correlated	Correlated mode removes any flow induced phase shifting of the Upstream vs Downstream transducer signals realigning them as if flow were at zero. This can be helpful to obtain a clearer view of the signal shape when higher flows are present. Select [Correlated] to view the signal graph in correlated mode, uncheck for delta-time mode.

Table 4-1 Signal Graph Selections

4. If the [Stop] button is pressed or if a single query has completed, press the [Query] button to start a new query. This will cause Si-Ware to gather signal data and display it in the manner selected.
5. Use the [Zoom In] or [Zoom Out] buttons as needed to expand or decrease the zoom factor of the signal display. Use the slider to move the signal shape right or left.
6. Click the [Exit] button to leave the Signal Graph screen.

5.2 Meter Diagnostic Menu

The FS200 Utility [Meter Diagnostics] screen displays real-time flowmeter diagnostic data and provides a Pass/Fail indication alerting the user of marginal or poor installation conditions. This screen also provides a useful [data capture] facility, which allows diagnostic data to be collected to a file on your PC (in ".csv" format) for later analysis.

To select the Meter Diagnostic Screen:

1. Click on [Diagnostics] in the FS200 menu bar then click [Meter Diagnostic] from the drop-down list.
2. The [Meter Diagnostic] screen will open and begin gathering flowmeter data automatically.
3. The FS200 will display the flowmeter diagnostics as shown in Figure 5-3 below, it will continuously update these values.
4. The screen example shown below is for a dual-path flowmeter configuration. Note that for flowmeters configured for single path operation the [Path Flow Deviation] and [Path VoS deviation] bar graphs seen on the right side of the screen will not appear. These bar graphs are only applicable to multi-path flowmeters.
5. Diagnostics shown in green are within acceptable limits for proper flowmeter operation. If a value is Marginal, it will be shown in yellow. Any value below acceptable minimums will be presented in red. The Pass/Fail threshold limits can be adjusted in the Setup menu described in section 4.2

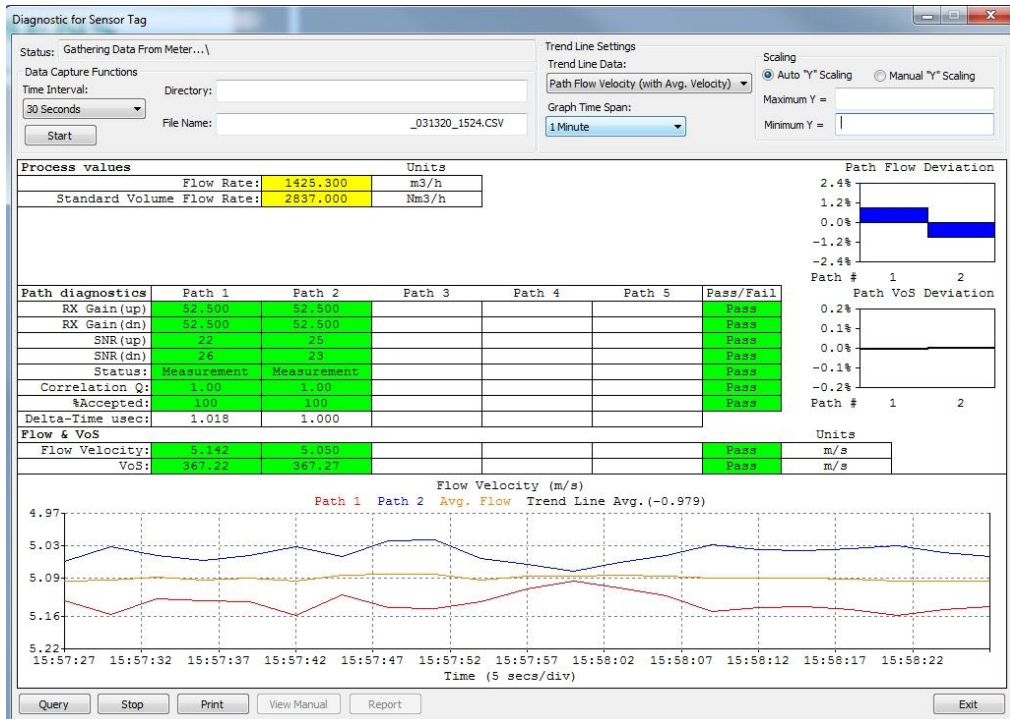


Figure 5-3 Meter Diagnostics Screen

Diagnostic Screens

Evaluating and Controlling the Diagnostics Screen

The diagnostic data screen presents a significant amount of valuable data for the purpose of both monitoring and evaluating system performance. The data presented, their descriptions and their expected values are outlined below.

Process Values

Flow Rate: Presents the actual (Gross) volumetric flow rate in the measurement units selected in the Flowmeter program

Standard Volume Flow Rate: Presents the volumetric flow rate compensated for pressure, temperature and where applicable; compressibility factor. Only certain versions of the FS230 flowmeter can produce Standard volume flow data. The volumetric units are as selected in the Flowmeter program.

Path Diagnostics

RX Gain (Up – Dn): These values indicate the signal strength of the flow sensor (transducer) signal and differentiate between the upstream traveling and downstream traveling signals. The data is presented in Db with lower values being better. The default warning limit is any value above 40 while the fail limit is a value above 50.

SNR (Up – Dn): These values indicate the signal to noise ratio of the flow sensor (transducer) signal and differentiate between the upstream traveling and downstream traveling signals. The data is presented in Db with higher values being better. The default warning limit is any value below 20 while the fail limit is a value below 10.

Status: Indicates the operating condition of the flowmeter. When application conditions are acceptable; and all diagnostic parameters are meeting minimum requirements, the status will indicate “Measurement”. If conditions cause an operating parameter to be unsuitable; interruption of flow measurement may occur. In such cases the status will change to indicate the underlying issue

Correlation Q: This value is derived from a signal (phase) analysis by comparing the phase differential of the initial receive signal frequency cycle to that of a later occurring cycle of the same signal. When the two match perfectly the “Cor-Q” is 1.0. The default value at which a warning is generated is below 0.95, a Fail is declared if the value is below 0.92. In gas systems where very large signal phase shifts can occur, the Cor-Q can be improved by performing an “HF” adjustment in the flowmeter “Maintenance and Diagnostics” menu

% Accepted: This parameter indicates the percentage of acoustic signal transmissions/receives that are used for flow measurement with the ideal value being 100%. If application conditions such as high aeration or noise interference are present, some of the receive signals will be unacceptable and rejected by the flowmeter. In these cases, the [% accepted] will decrease. The default warning limit is less than 50% accepted while the Fail limit is less than 20%.

Delta-Time usec: Indicates the displacement (Phase shift) between the upstream vs downstream flow signal and is indicated in microseconds. This differential is caused by the flow velocity acting upon the flow sensor signal propagation through the flow stream.

Flow & Vos

Flow Velocity: Indicates the speed of flow through the pipe in the velocity units selected in the Flowmeter program

VoS: Indicates the velocity of sound propagation through the flow medium. The units are in the sound velocity units selected in the flowmeter program

5.3 Data Capture Utility

1. The meter diagnostics screen continuously updates the presented data for all diagnostic parameters. This can be evidenced by the indication in the status bar “Gathering Data From Meter”
2. In addition to the above, the FS200 utility can “Capture” data in “.csv” files. The saved .csv files can be easily imported for later review and analysis in programs such as MS-Excel. At the bottom of the capture report is a useful summary statement providing Min, Max, Average, Alarm Limits and # of Alarms, for each of the applicable data columns.
3. The upper left section of the FS200 diagnostics screen provides the [Data Capture] controls where you can designate a location for the file and the time period for data collection (see Figure 5-4 below).
4. The format of the Data Capture file name will default to: [Date Time.CSV]. It can be edited or changed by simply typing an alternate name in the [File Name] bar as desired. The default location of the file will be in the FS200 Utility folder; however, if desired an alternative folder location (path) can be entered in the [Directory] bar.

Note: Special Characters

If you perform a Data Capture function you cannot use “special characters” in the file name. The special characters not allowed to be used in file names are \ / : * ? " < > |

5. Data collection periods can be selected in the [Time Interval] drop down menu and range from a minimum of 30 seconds up to 1 Hour plus unlimited.

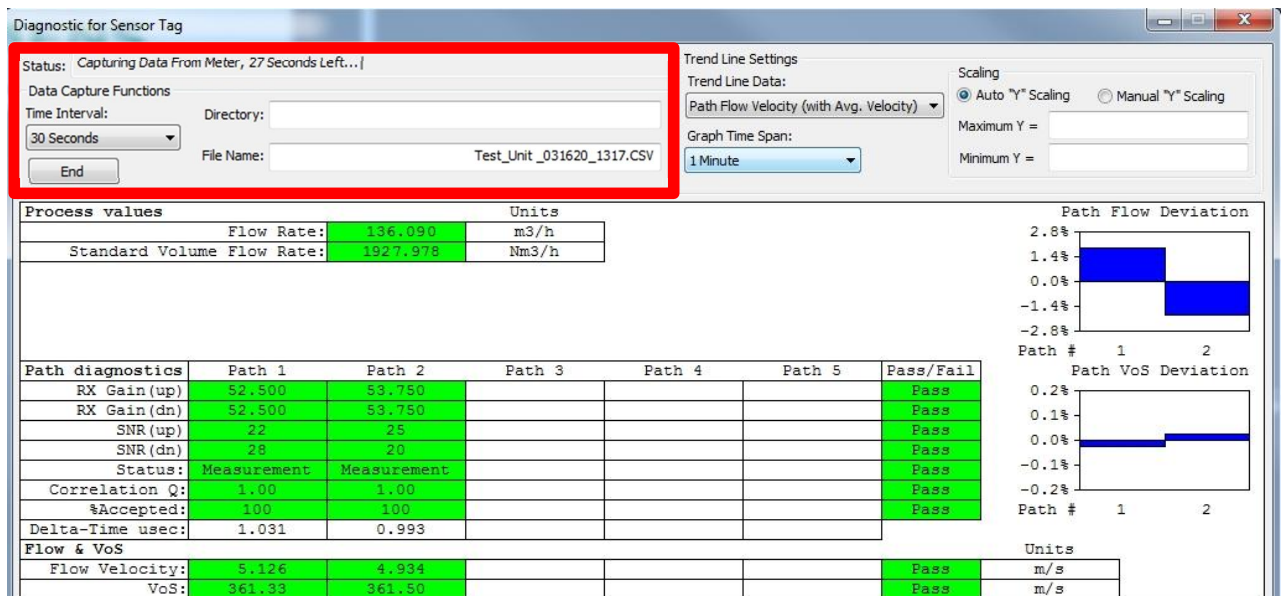


Figure 5-4 Data Capture Entry Field

Diagnostic Screens

To capture and record diagnostic data:

1. In the [Directory] field, type in the desired drive directory folder. The FS200 utility will create the selected folder if it does not exist. If no directory path is entered in this location, the capture file will be saved into the same directory where the FS200 program resides.
2. The capture function automatically assigns a unique file name to the data, which by default is the current Date and Time. If a different name is preferred, then simply overwrite the [File Name] field with the desired name.
3. Under the [Time Interval] choice box, select one of the preset time periods over which the data is to be collected, or select [Unlimited] if long periods are desired. The [Unlimited] function continues to run until stopped.
4. Click the [Start] button to initiate the data capture. The FS200 utility will begin capturing the diagnostic data and store it within the assigned directory using the selected file name. The indication in the [Status] bar will change to "Capturing Data From Meter" and the remaining time will count down to zero at which time the indication will revert to "Gathering Data From Meter" and the data file will be closed.

Note

Clicking the [End] or [Stop] button at any time will terminate the data capture process and close the ".csv" file with the data previously collected.

5. After the data capture process is complete, the ".csv" file generated by the FS200 utility will be stored either in the FS200 utility folder, or in the folder you designated as illustrated below. In this example the file name is "Test_Unit_031620_1317.CSV"

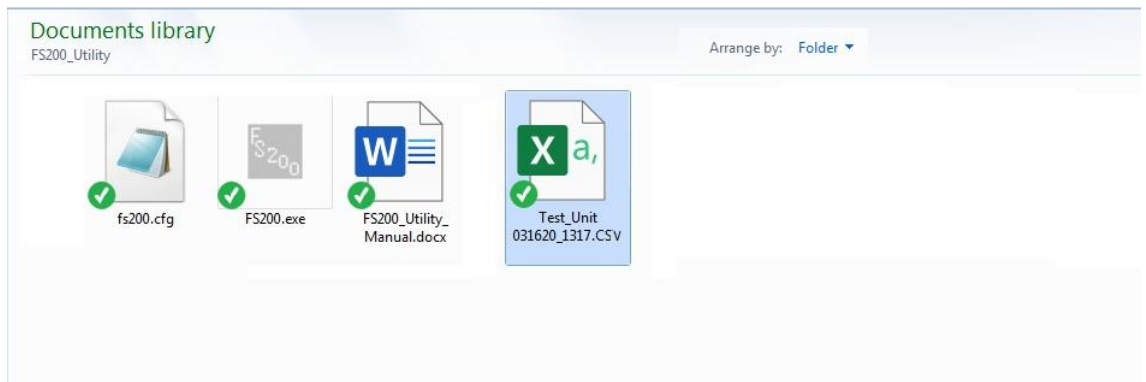


Figure 5-5 Data Capture Location

6. The file can now be viewed in MS Excel, as shown in Figure 5-6 below.

Note

The FS200 utility will continue to display and update the trend line and diagnostic data even after the data capture process is terminated.

Diagnostic Screens

Siemens Data Capture Log
 FS200 Utility Version 1.00.02
 Long Tag
 Product S/N N1J4118000027
 COMS Settings Baud:19200 Parity:None Data Bits:8
 Location Identifier
 Meter Bore id 3.937 inches

System Setup Parameters

Parameter	Value	Units
Pipe Diameter	4.537	inches
Pipe Wall Thickness	0.3	inches
Pipe Inside Diameter	3.937	inches
Transducer Size	D4H	

Path Setup Parameters

Parameter	Path 1	Path 2	Units
Mounting Mode	Direct	Direct	
Sensor Spacing LTN	0.4204	0.4204	inches
Sensor Frequency	187500	187500	Hz
Vsmin	197.2924	197.2924	mps
Vsmax	402.7076	402.7076	mps

Column#	Label	Description
1	Date	Query Date
2	Time	Query Time
3	Flow Rate(m3/h)	Meter Flow Rate(m3/h)
4	Status FR	Status Flow Rate
7	VF1(m/s)	Flow Velocity path 1(m/s)
9	Avg VF(m/s)	Avg. Flow Velocity(m/s)
10	VoS1(m/s)	VoS path 1(m/s)
12	Avg VoS(m/s)	Avg. VoS(m/s)
13	Status 1	Status path 1
14	Status 2	Status path 2
15	RX Gain(up) 1	Upstream Xmit RX Gain(up) path 1
17	RX Gain(dn) 1	Downstream Xmit RX Gain(dn) path 1
19	DT 1(uS)	Transit-time Delta path 1(uS)
21	SNR(up) 1	Upstream Xmit SNR(up) path 1
23	SNR(dn) 1	Downstream Xmit SNR(dn) path 1
25	CorQ 1	Correlation Factor path 1
27	%ACP 1	Accepted Burst Percentage path 1
29	Temp(F)	Temperature(F)
30	Press(PSIA)	Pressure(PSIA)
31	Density(lbm/ft3)	Density(lbm/ft3)
32	Viscosity(cS)	Viscosity(cS)

Date	Time	Flow Rate(m3/h)	Status FR	Standard Volume Flow Rate(Nm3/h)	Status SVFR	VF1(m/s)	VF2(m/s)	VoS1(m/s)
3/16/2020	13:19:22	136.1288	Pass	1928.6162	Pass	5.096	4.953	361.49
3/16/2020	13:19:25	136.0898	Pass	1927.9778	Pass	5.126	4.934	361.33
3/16/2020	13:19:28	136.1612	Pass	1928.4122	Pass	5.112	4.948	361.48
3/16/2020	13:19:31	136.0763	Pass	1927.1472	Pass	5.096	4.955	361.52
3/16/2020	13:19:34	135.934	Pass	1924.6659	Pass	5.08	4.976	361.59
3/16/2020	13:19:37	136.0927	Pass	1927.6021	Pass	5.045	4.999	361.49
3/16/2020	13:19:40	136.0052	Pass	1925.5692	Pass	5.03	5.014	361.5
3/16/2020	13:19:43	135.755	Pass	1922.4499	Pass	5.029	4.996	361.45
3/16/2020	13:19:46	135.6573	Pass	1920.7065	Pass	5.058	4.971	361.55
3/16/2020	13:19:49	136.0195	Pass	1927.0039	Pass	5.06	4.984	361.63
3/16/2020	13:19:52	136.1911	Pass	1928.8372	Pass	5.07	4.984	361.61
Average Value		136.0101		1926.2717		5.073	4.974	361.51
Minimum		136.1911		1928.8372		5.126	5.014	361.33
Maximum		135.6573		1920.7065		5.029	4.934	361.63
Warning Limit		Simulation Mode	Simulation Mode	Simulation Mode	Simulation Mode	> 2%	> 2%	> 0.25%

Failure Limit	Pass	Pass	Pass	Pass	Measurement	Measurement	> 0.50% Or not Measurement
# of Warnings	0	0	0	0	0	0	0
# of Failures	0	0	0	0	0	0	0
# of Samples	11						

Figure 5-6 Capture Log Example

Special Notes for the Data Capture file:

1. The FS200 utility capture file will only contain fields pertinent to the installation. For example, a Dual Path system with only Path-1 enabled will not present any data columns

Diagnostic Screens

for Path-2.

2. Refer to the Data Capture file heading list that provides the variable name and a short description of each column within the report. For convenience, the short variable name is provided above the first row of data.
3. The "summary" rows found at the bottom of the file include the following information for applicable data items:

Summary Item	Description
Average Value	Average of all data within column.
Minimum	Minimum value within column.
Maximum	Maximum value within column.
Warning Limit	Warning limit used for Diagnostics Screen "Warning" display.
Failure Limit	Failure limit used for Diagnostics Screen "Fail" display.
Number of Warnings	Number of Warnings occurring within the capture period for each data item.
Number of Failures	Number of failures occurring within the capture period for each data item.
Number of Samples	the number of Data reports collected in the Data Capture file

Table 5-1 Data Capture Summary Parameters

Utility Menu Screens

Utilities Menu

The Utilities menu has three sub-menus:

- AGA8 Calculations
- Clamp-On Gas Tool
- Clamp-On Liquid Tool

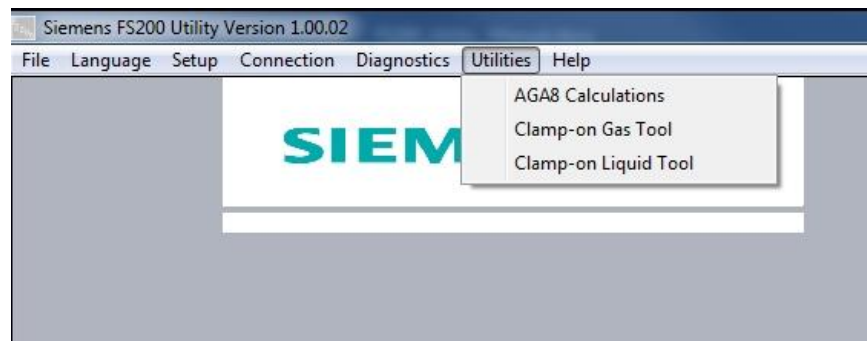


Figure 6.1 Utility Menu Options

6.1 AGA8 Calculations

Note

AGA8 tables are used with gas flowmeters only.

The [AGA8 Calculations] screen is used to generate AGA8 data values. It will enable the entry of gas composition mole fractions, along with base and actual temperature and pressure, to determine fundamental gas values such as theoretical speed of sound (VoS), Mass, and Enthalpy.

Additionally, the AGA-8 Utility can be used to compute an AGA-8 table for fixed composition gasses that can be uploaded to the flowmeter directly. This table will enable the meter to perform standard volume correction based on measured temperature and pressure of your gas application.

Entering Fundamental Gas fractions

1. Click the AGA8 calculation parameter in the Utilities drop-down menu.
2. Refer to Figure 6-2 below. Input your default units of measurement in the row at the top of the screen.
3. Enter your gas composition mole fractions taken from a recent Gas Chromatograph report into the appropriate screen fields.
4. Click the [Normalize] button to ensure the total percental equal 100%.
5. Enter your base pressure, actual pressure, base temperature and actual temperature.
6. Click [Calculate] to generate the screen.

Utility Screens

- The FS200 Utility will compute and display a variety of pertinent gas characteristics

Status: Calculation Completed Successfully Create AGA8 Table

Units
 Pressure: PSIA Temperature: Fahrenheit Velocity: feet/second Density: lbm/ft³ Enthalpy: Btu/lbm

Gas Composition and Mole Fraction %

Helium:	CO ₂ :	Ethane:	n-Butane:	n-Hexane:	n-Nonane:	Water:
0.0	0.0	2.5028	0.099	0.7583	0.0	0.0
Hydrogen:	H ₂ S:	Propane:	i-Pentane:	n-Heptane:	n-Decane:	CO:
0.0	0.0	0.4557	0.0585	0.0	0.0	0.7756
Nitrogen:	Methane:	i-Butane:	n-Pentane:	n-Octane:	Argon:	O ₂ :
0.578	94.5104	0.0922	0.1695	0.0	0.0	0.0

Buttons: Normalize, Clear, Open, Save, Save As, Total: 100.0

Gas Pressure and Temperature
 Base Pressure: 14.7 Pressure: 385.0 Base Temperature: 60.0 Temperature: 68.0

Field	Value	Units	Field	Value	Units
Speed of Sound:	1358.6701	FT/SEC	Zb:	0.9977	
C*:	0.6878		Zf:	0.9426	
Isentropic Exponent:	1.3006		Fpv:	1.0298	
Specific Enthalpy:	235.9146	Btu/lbm	Molar Mass:	17.4241	
Specific Entropy:	2.2405	Btu/lbm-F	Cp (ideal gas):	2.1304	kJ/kg-K
Molar Density:	1.1553	moles/dm ³	Cp (real gas):	2.3284	kJ/kg-K
Mass Density:	1.2567	lbm/ft ³	Cv (real gas):	1.6892	kJ/kg-K
RD (ideal gas):	0.6016		Cp/Cv:	1.3785	
RD (real gas):	0.6028		Enthalpy (real gas):	577.9984	kJ/kg

Buttons: Calculate, Send Table, Erase Flash, Stop, Print, View Manual, Exit

Figure 6-2 Gas Characteristics screen

6.2 Creating an AGA-8 Table

An AGA8 compensation table can be created in the FS200 Utility. When uploaded to the FS230 Gas Flowmeter, table data will facilitate standard volume correction based upon measured temperature and pressure over the complete range of your application.

Note that this table is most accurate for fixed gas compositions. If gas properties vary considerably, compressibility compensation factors will change resulting in a decrease of meter accuracy.

Table data can be sent to the FS230 gas flowmeter by selecting the [Send Table] button. If the flowmeter is not a gas meter the [Send Table] button will be grayed out.

To Create an AGA8 Table

- Using the same data you entered in the AGA8 screen earlier (see example in Figure 6-2), check the [Create AGA8 Table] box at the top right corner of the screen. This action will remove the Enthalpy data but keep your gas composition entries intact.
- Enter your application's Minimum / Maximum and Base pressure and the Minimum / Maximum / Base temperature in the appropriate fields
- Click the [Calculate] button to generate the AGA8 table as illustrated in Figure 6-3 below
- Since the FS230 gas meter operates from a default AGA8 gas table you must first erase the default table before uploading your custom table. Therefore, to upload the table to the meter, first click the [Erase Flash] button then click the [Send Table] button

Utility Screens

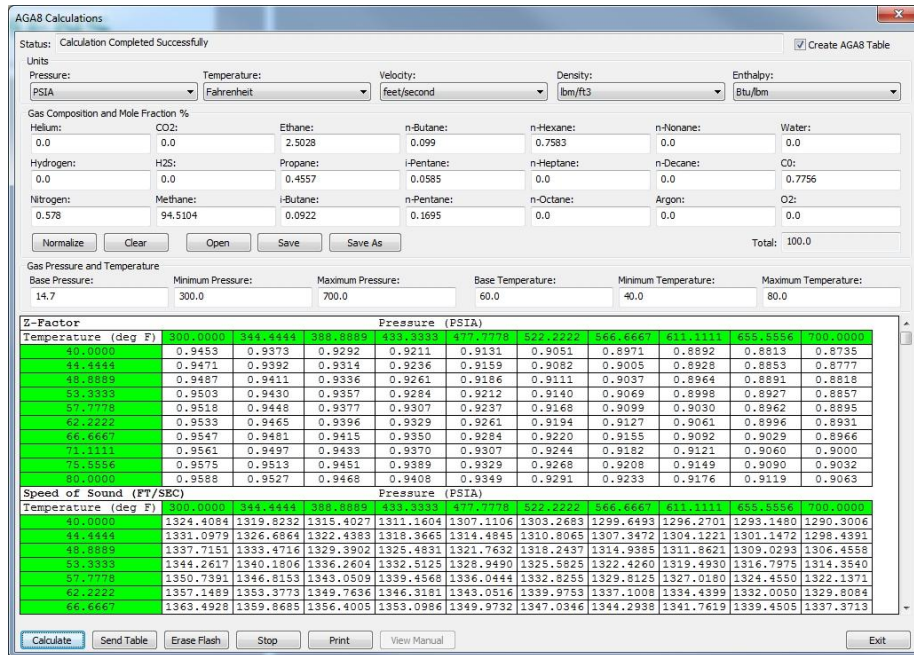


Figure 6-3 AGA8 Table Data

The AGA8 table is comprised of two sections. The top section is a matrix of compressibility factors relative to temperature (vertical axis) versus pressure (Horizontal axis) across your specified application range.

The lower section is a matrix of theoretical sound velocity relative to the same range of temperature and pressure.

6.3 Clamp-On Gas Tool

The [Gas Sensor Selection and Sizing Tool] screen allows the user to specify units of measure, pipe dimensional data, and gas type, along with nominal values for flow range, temperature range and pressure range. These values are used by the sizing tool to calculate the recommended sensor selection along with the recommended sensor installation methods.

The tool also provides application calculations for minimum pressure requirements, flow velocity, Reynolds number, compressibility factor, Std Volume compensation factor, expected repeatability and will point out if an application conflict exists.

Gas Sensor Selection and Sizing Tool Screen

To display the [Gas Sensor Selection and Sizing Tool] screen:

1. In the [Utilities] drop down menu select [Clamp-On Gas Tool].
2. Input your default units of measurement in the row at the top of the screen
3. Select your pipe material from the drop-down menu, then enter your pipe's Outside diameter and Wall thickness as accurately as possible.
4. Select a gas type from the [Gas Properties] drop down menu. Enter the Min / Max flow range for your application (be careful to use the units of measure and multiplier shown), Lastly enter the Min / Max temperature and pressure

- Click the [Calculate] button. The FS200 Clamp-On gas tool will compute the recommended sensor type and size for your specified pipe. Typically, only High Precision sensors are suitable for gas applications and will be the primary selection. The tool will also provide sensor mounting mode and spacing information. An example appears in Figure 6-4 below.

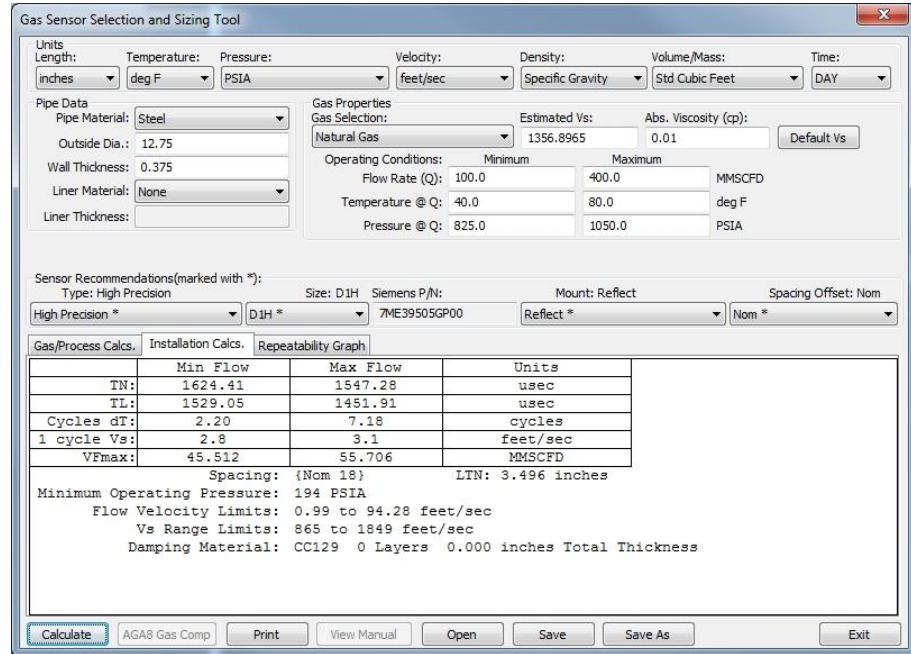


Figure 6-4 Clamp-On Gas Sizing Tool screen

- The Clamp-On Gas Tool screen presents data in 3 available views; [Gas Process Calcs], [Installation Calcs] and [Repeatability Graph]. You may click on the appropriate tab for specific details related to the application you programmed. The data shown under each tab is relative to the application parameters you entered for pipe dimensions, gas type, flow, temperature and pressure in the Gas tool. Should an application conflict exist it will alert you with an “Application Problem” message.

Gas/Process Calcs. Tab

Click on the [gas process calc] tab for application information on the theoretical values for compressibility factor, Sg, Speed of sound, Volume compensation, flow velocity, Viscosity, and Reynolds number over your specified application range.

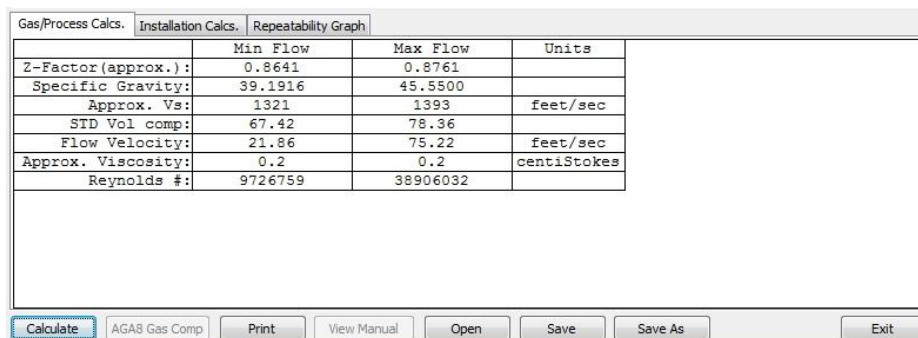


Figure 6-5 Gas/Process Calculations

Utility Screens

Installation Calcs. Tab

Click on the [Installation Calcs] tab for application specific information pertinent to the installation of your flow sensors, including spacing recommendation and spacing offset (LTN) along with minimum pressure requirements.

Additionally, fundamental data relative to transit-time values, signal phase shift cycles (useful for beam-blowing evaluation), and flow range limits are also presented in this view

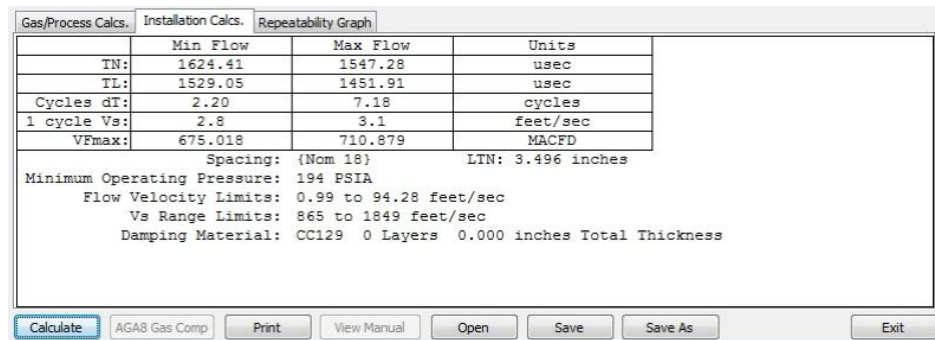


Figure 6-6 Gas Installation Calculations

Repeatability Graph Tab

The [Repeatability Graph] provides performance data relative to the estimated repeatability of your flowmeter over your specified flow range. Additionally, it provides Reynolds number transitional-flow start / end specifications based on pipe dimensions, viscosity and flow range

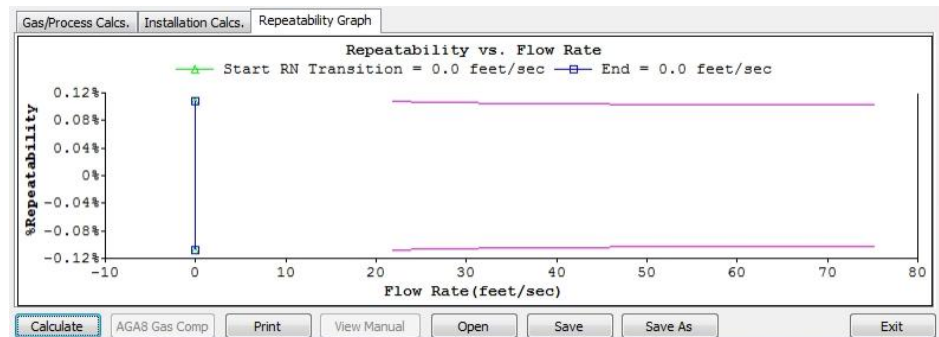


Figure 6-7 Gas Repeatability Data

Utility Screens

Application Problems Tab

1. If any of your entered application parameters conflict with performance capabilities of the FS230 flowmeter an “Application Problem” message will appear at the bottom of the sizing screen; this will cause an additional tab to open [Application Problems] (See Figure 6-8 below). Click on the tab to view a description of the conflict(s). If no conflicts are present the tab will not appear.

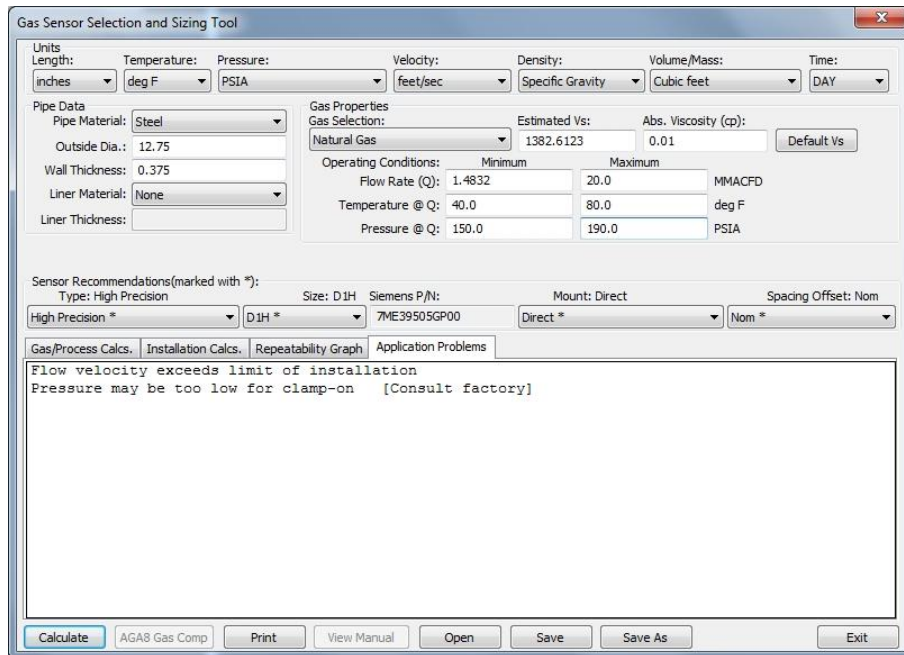


Figure 6-8 Gas Application Problems Screen

2. A list of possible application conflicts and corrective actions appear in Table 4.1 below.

Application Warning	Corrective Action
Pipe diameter too small for selected sensor.	Allow FS200 to specify sensor
Flow velocity exceeds limit of installation.	Programmed (Max) Flow too high verify entered value
Accuracy limitation at minimum velocity.	Programmed Min Flow below 1 FPS
Temperature above sensor limits.	Specified temperature exceeds 250F / 121C
Temperature below sensor limits.	Specified temperature below -40F/C
Poor sensor match to pipe wall.	Incorrect sensor selection, allow FS200 to select
Poor diameter-to-wall thickness ratio.	Pipe OD to wall ratio <10 to 1, may reduce performance
Excessive wall thickness.	Wall Thickness >1.25" Require Universal sensor
Pipe diameter must be greater than 1 inch / 25.4mm	Pipe OD must be greater than 1" / 25.4mm for gas
Pressure may be too low for clamp-on.	Specified pressure below minimum, increase pressure
Carbon dioxide mole % too high.	CO2 mole % must be <10%
H2S mole % to high.	H2S mole% must be <20%

Table 6-1 Typical Gas Application Problems

Utility Screens

Gas Composition and Mole % Sizing Screen

If desired, your actual gas composition can be utilized for sensor sizing instead of one of the default gasses in the drop-down menu. The following steps describe how to display a [Gas Composition and Mole Fraction %] entry screen in the sizing tool.

1. Select [Use AGA8 Gas(es)] from the [Gas Selection] drop down menu. This will activate the [AGA Gas Comp] button at the bottom of the screen; see Figure 6-9 Below

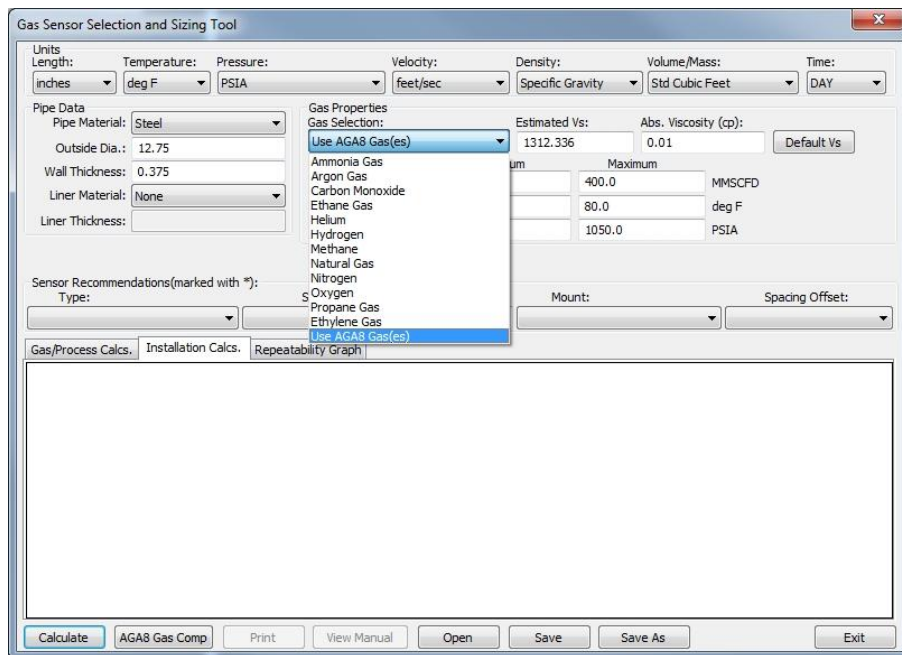


Figure 6-9 AGA8 Selection

2. Click the [AGA8 Gas Comp] button. This will open a gas composition screen for you to enter your gas mole fractions

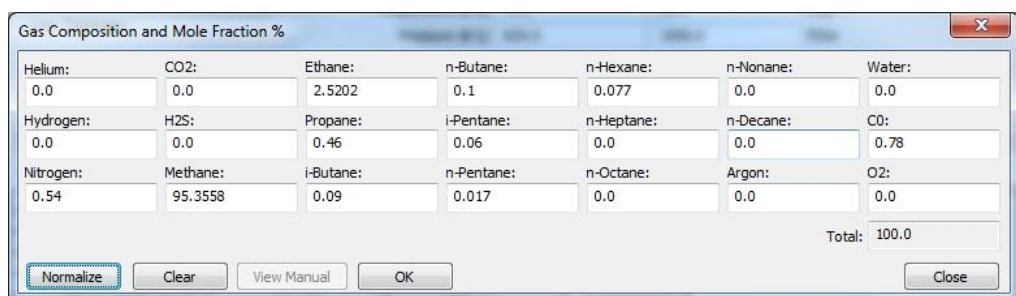


Figure 6-10 Gas Fractions Entry Selection

3. Select the gases that comprise your product and input the percentage of each gas. If the total is not 100% click the [Normalize] button to force the total to equal 100%.
4. You can use the [Clear] button to clear all data and input new gas data as needed.
5. Click [OK] to verify data and close the screen. The estimated sound velocity will be computed to produce a proper sensor spacing when the [Calculate] button is clicked

6.4 Clamp-On Liquid Tool

The [Liquid Sensor Selection and Sizing Tool] screen allows the user to specify units of measure, pipe dimensional data, liquid type, along with nominal values for flow range, and temperature range. These values are used by the sizing tool to calculate the recommended sensor selection (type and size) along with the recommended sensor installation methods.

The tool also provides application calculations for flow velocity, Reynolds number, Std Volume compensation factor, expected repeatability and will point out if an application conflict exists.

Liquid Sensor Selection and Sizing Tool Screen

To display the [Liquid Sensor Selection and Sizing Tool] screen:

1. In the [Utilities] drop down menu select [Clamp-On Liquid Tool].
2. Input your default units of measurement in the row at the top of the screen
3. Select your pipe material from the drop-down menu, then enter your pipe's Outside diameter and Wall thickness as accurately as possible.
4. Select a liquid type from the [liquid Properties] drop down menu. Enter the Min / Max flow range for your application (be careful to use the units of measure and multiplier shown), lastly enter the Min / Max temperature.
5. Click the [Calculate] button. The FS200 Clamp-On liquid tool will compute the recommended sensor type and size for your specified pipe. It will also provide sensor mounting mode and spacing information. An example appears below in Figure 6-11

Figure 6-11 Clamp-On Liquid Sizing Screen

Utility Screens

Sensor Selection

- Liquid applications can be serviced by any of 3 sensor types as follows;
 - High Precision: The primary choice for steel pipes
 - Universal: For all non-steel and plastic pipes
 - High Temperature: For all pipes with temperatures between 250 – 450F
- The FS200 Liquid Tool will recommend the best suited sensor type and size based on your programmed application data parameters. In many cases more than one type sensor is acceptable. The FS200 tool will identify these sensors with the indication “Recommended” or with an asterisk (*). Alternate types can be selected so long as you choose recommended types and sizes, be aware if an “Application Problem” alert appears
- The FS200 utility will also provide the recommended sensor part number and the recommended mounting method

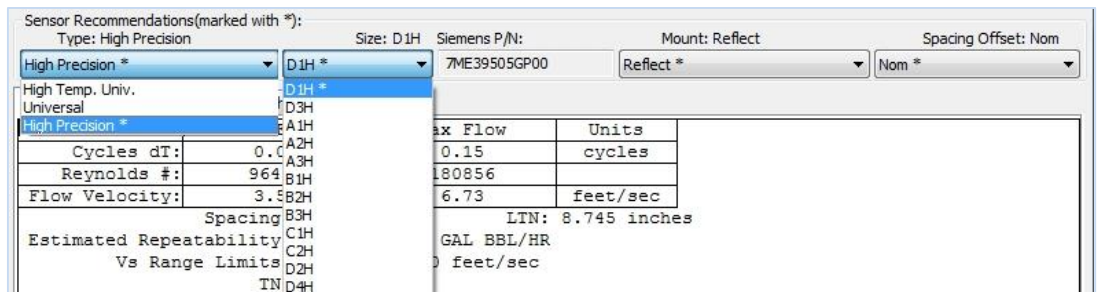


Figure 6-12 Liquid Sensor Type / Size Selection

Clamp-On Liquid Tool screen

The Clamp-On Liquid Tool screen presents data in 2 available views; [Application Calcs] and [Repeatability Graph]. You may click on the appropriate tab for specific details related to the specified application. The data shown under each tab is relative to the application parameters you entered for pipe dimensions, liquid type, flow, and temperature in the liquid tool using the units of measure you selected. Should an application conflict exist it will alert you with an “Application Problem” message.

Application Calcs. Tab

Click on the [Application Calcs] tab for application specific information pertinent to the installation of your flow sensors, including spacing recommendation and offset (LTN).

Additionally, fundamental data relative to transit-time values, signal phase shift, Reynolds number, flow velocity range and repeatability are also presented in this view

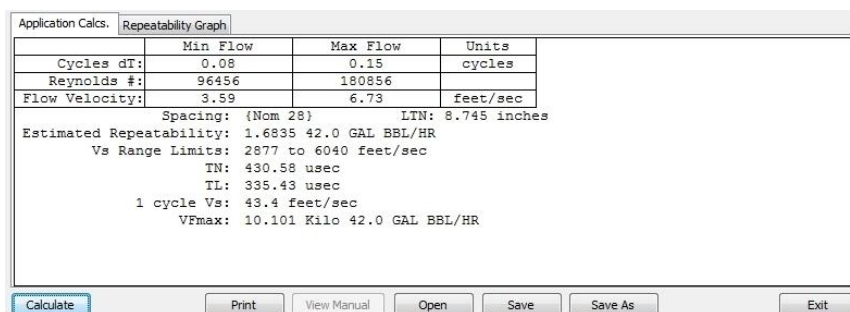


Figure 6-13 Liquid Application Calculations

Repeatability Graph Tab

The [Repeatability Graph] tab provides performance data relative to the estimated repeatability of your flowmeter over your specified flow range. Additionally, it provides specifications for Reynolds number (Nr) transitional-flow start / end based on pipe dimensions, viscosity and flow range. Nr data is useful in evaluating the potential for measuring flow in transitional conditions.

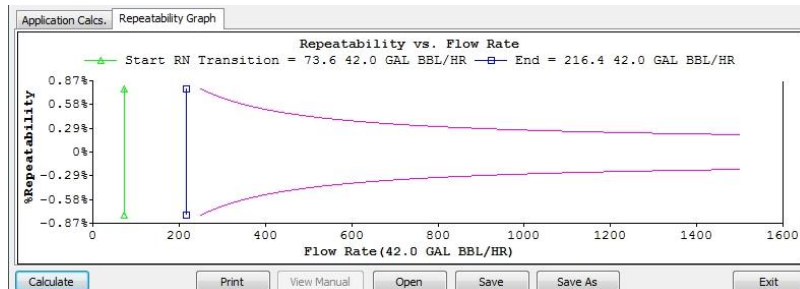


Figure 6-14 Liquid Repeatability Data

Application Problems Tab

If any of your entered application parameters conflict with performance capabilities of the FS230 flowmeter an “Application Problem” message will appear at the bottom of the screen; this will cause an additional tab to open [Application Problems] (See Figure 6-15 below). Click on the [Application problem] tab to view a description of the conflict(s). If no conflicts are present the tab will not appear.

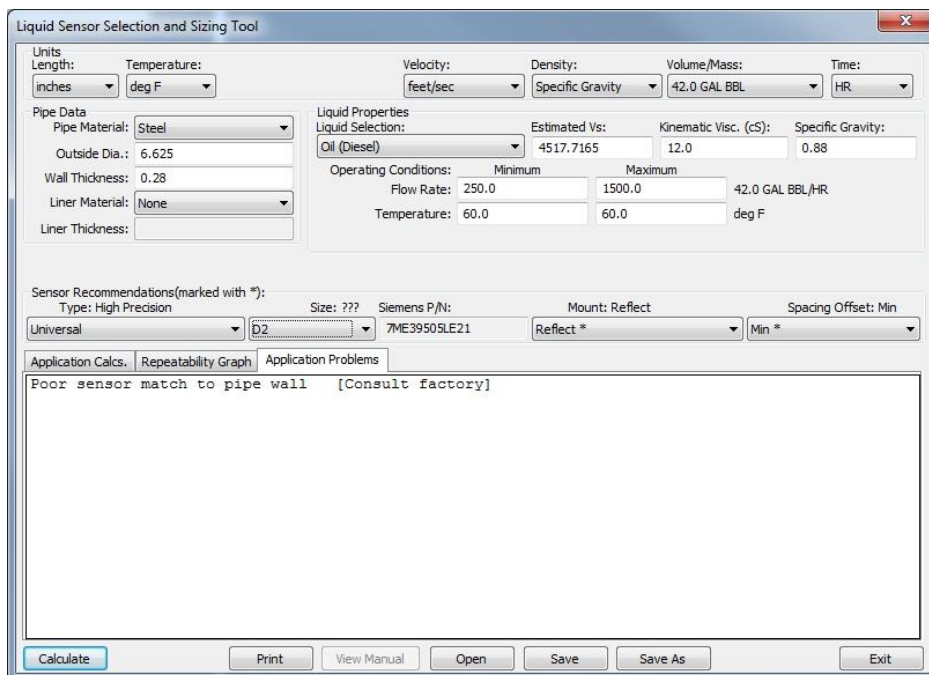


Figure 6-15 Liquid Application Problems Screen

Utility Screens

A list of possible application conflicts and corrective actions appear in Table 6-2 below.

Application Warning	Corrective Action
Maximum Pipe Diameter Exceeded	Select larger (Universal) sensor
Pipe diameter too small for selected sensor.	Allow FS200 to specify sensor
Flow velocity exceeds limit of installation.	Programmed (Max) Flow too high verify entered value
Accuracy limitation at minimum velocity.	Programmed Min Flow below 1 FPS
Temperature above sensor limits.	Specified temperature exceeds 250F / 121C
Temperature below sensor limits.	Specified temperature below -40F/C
Poor sensor match to pipe wall.	Incorrect sensor selection, allow FS200 to select
Poor diameter-to-wall thickness ratio.	Pipe OD to wall ratio <10 to 1, may reduce performance
Excessive wall thickness.	Wall Thickness >1.25" Require Universal sensor
Operation in or near Reynolds transition	Flows in transition region will impact accuracy

Table 6-2 Liquid Application Problems

Glossary

% Accepted

Percentage of all acoustic transmit/receive signals used for flow measurement analysis. 100% is perfect. If application conditions such as aeration or noise interference are present this number may decrease.

AGA-8

The AGA8 function is used to calculate the compressibility factor of natural gas and related hydrocarbon gases. The internal AGA8 lookup table provides for the actual gas density and compressibility factor (Z Actual) for the indicated pressure and temperature. These values are then used to compute either mass flow rate or standard volume corrected flow rate.

Channel

An assignable input / output terminal for the purpose of connecting communication cabling, I/O signal wiring or RTDs to an FS230 Flowmeter.

Correlation Q

Quality of correlation (phase coherency) between the upstream and downstream receive signals. Cor-Q ranges from 0.9 to 1.0, where 1.0 indicates perfect correlation and 0.9 indicates ambiguous or poor correlation. Poor correlation is generally a result of acoustic "beam blowing" due to high flow velocities in gas applications. Cor-Q can be improved through an "HF" adjustment in the flowmeter.

Delta-time (uSec)

Transit-time difference between upstream and downstream receive signals caused by flow velocity. It is measured in microseconds.

Estimated Repeatability

The estimation of the maximum deviation in agreement between the results of successive flow measurements carried out under the same conditions.

Path (N)

One of at least two (or four) physical flow measurement channels that comprise a multi-path (or multi-beam) flow meter.

RxGain

Amplifier Gain setting that responds to varying receive signal amplitude. Lower is better. Values undue 40 are acceptable for flow measurement.

Signal

The digitized acoustic (Receiver) signal.

Glossary

SNR

[Signal to Noise Ratio]. Represents a measure of SNR of the digitized acoustic receive signal. Higher is better, typically values above 20 are desirable.

Status

Error code that is triggered by instantaneous acoustic signal problems. A "Measurement" Status indicates that the meter is satisfied with the acoustic receive signal and producing proper flow measurement readings.

Up and Dn

Indicates the upstream or downstream direction of acoustic signal transmission. Also represents placement of flow sensors relative to flow direction for the purpose of identifying "Forward" and "Reverse" flow directions.

VFmax

The flow rate that would create exactly 1-cycle (360°) of phase shift between the Upstream and Downstream receive signals. This value is useful for the setting of the "HF" parameter in gas applications, as it is necessary to do so at a flow rate that is higher than VFmax.

VoS

Velocity of Sound in the fluid medium. Shown in meter-selected measurement units of either Feet/second (FPS) or Meters/second (M/S).

Get more information

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