Ultrasonic Flowmeters

SITRANS FUP1010 IP67 Portable

Quick Start - January 2013

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Ultrasonic Flowmeters FUP1010 IP67 Portable Quick Start

Operating Instructions

01/2013

CQO:QSG003 Revision 05

Legal information

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This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠ DANGER

indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠ WARNING

indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠ CAUTION

indicates that minor personal injury can result if proper precautions are not taken.

NOTICE

indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

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1.1 Introduction

Introduction

This Quick Start is for the Siemens FUP1010 Weatherproof IP67 Portable flow meters. It includes procedures to form and charge the battery pack and use the AC Power Adapter. It also illustrates a typical set using D-Series transducers in the Reflect operating mode (for Direct mode see Operation Instructions manual). These procedures can also be applied to single and multi-channel models as well.

To use the Siemens Si-Ware program to assist in flow meter installation download the program at [http://s13.me/ns/cv].

Note

Important Safety Note: For complete Important Safety considerations and Ratings, refer to the Operation Instructions manual included with the unit.

Note

This Quick Start Guide applies to the following FUP1010 IP67 (weather proof) operating systems: Version 3.02.02 and later and version 4.03.00 and later.

1.2 Items supplied

- SITRANS FUS1010 IP65 NEMA 4X & IP66 NEMA 7 Transmitter
- SITRANS F Literature CD
- Quick Start Guide

Note

For additional items refer to your packing slip.

Installation 2

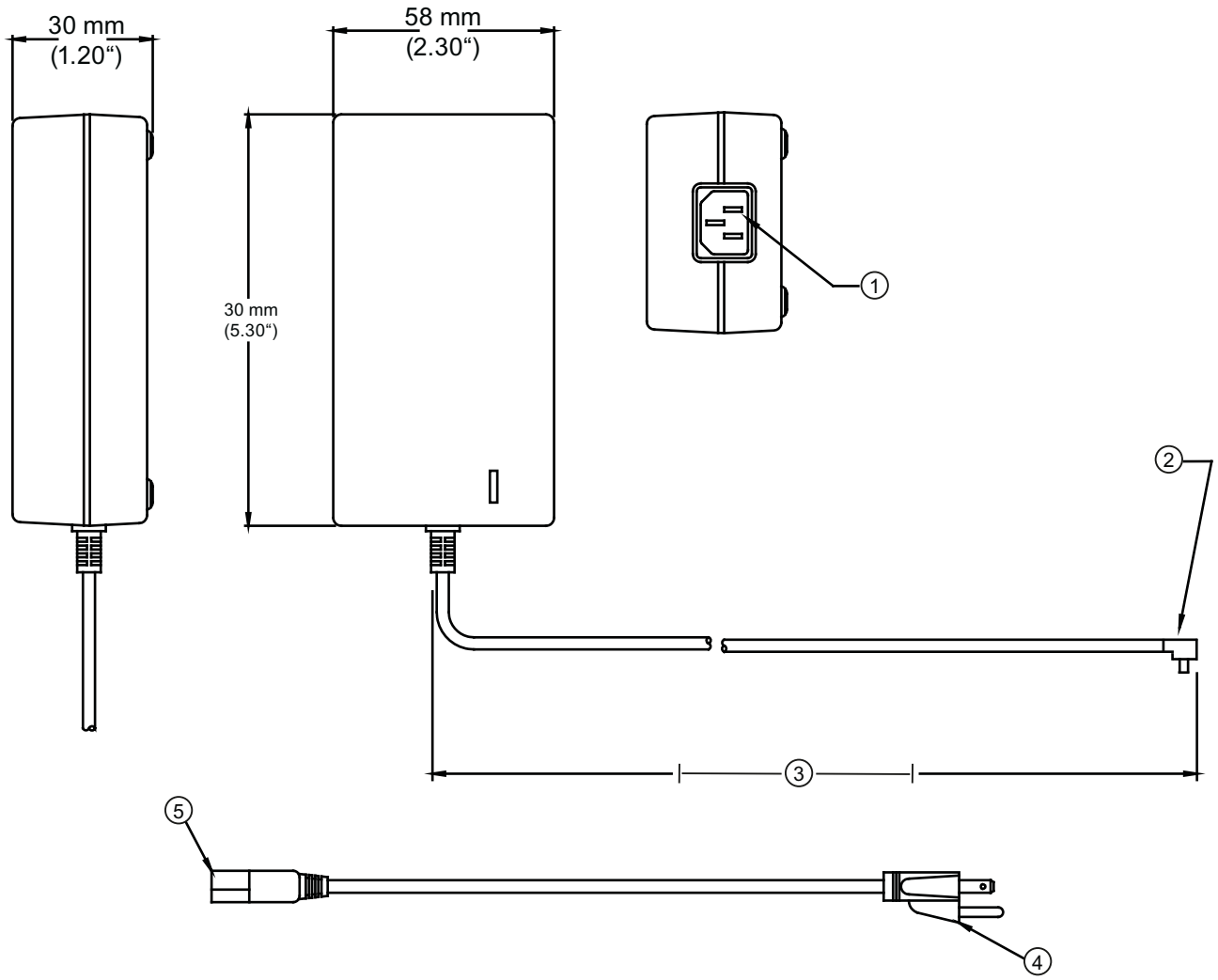
2.1 Application Guidelines

Basic Requirements

- Determine pipe material and dimensions.
- Avoid vertical pipes flowing in a downward direction.
- Avoid installation of sensors on the top and bottom of horizontal pipes, if possible.
- Select a location with the longest straight run of pipe.
- Identify upstream piping configuration (elbow, reducer, etc.).
- Pipe surface should be smooth and, if necessary, free of paint.
- Avoid pressure reduction components upstream.
- Avoid mounting on or near weld seams.
- Pipe must be full to achieve proper operation.

The flow meter has an optional battery charger that operates from a 100, 110 or 220 VAC (50 Hz or 60 Hz) power source. It has a universal power input that requires no user switching. *Optional cords can be provided for connection to AC outlets in most countries.*

⚠ CAUTION
The 1015BCK-1 Power Adapter/Battery charger is NOT waterproof or water resistant.
Exposure to a wet or submerged environment will result in damage to the unit that cannot be repaired and could expose the user to the risk of electric shock.
Do not allow it to become wet, or attempt to use it when wet.



① IEC 320 Power Inlet
②. Connector
③ 0,9 meters minimum (3 ft)
④ NEMA 5 - 15P (see Power Cord table)
⑤ IEC 320 Plug (see Power Cord table)

Figure 2-1 Power Adapter/Battery Charger

Table 2- 1 Power Cord Codes

Assembly P/N	POWER CORD	
	Plug Std.	Rating
1015BCA-1	CEE 7/7	10A / 230VAC
1015BCC-1	A5 3112	10A / 250VAC
1015BCD-1	BS 1363	5A / 240VAC
1015BCJ-1	JIS 8303	12A / 125VAC
1015BCK-1	NEM 5-15P	10A / 120VAC
1015BCL-1	SEV 1011	10A / 250VAC

2.2 Forming the Internal Battery

Battery Operation

All portable systems include battery chargers that operate from an AC voltage source. We strongly recommend that you "form" and charge the battery before operating the system for the first time.

The Charge Indicator LED

A battery status indicator shows the status of its internal battery and charging circuits. The indicator LED color switches between red or green based upon the flow meter operation.

LED	Battery Condition
Green	Trickle charge in progress
Red	Rapid Charge in progress (flow meter must be off)

Forming the Internal Battery

The flow meter uses an internal, rechargeable battery pack designed for a rapid charge cycle (NiMH, 12 VDC, 3200mAH). The batteries have to be "formed" to deliver their optimum operating time, which is approximately 7 hours. This is accomplished by performing a minimum of two complete discharge/charge cycles.

Note

To remove, replace or dispose of the internal battery pack refer to Maintenance and Service section in the instruction manual.

To Produce a Charge/Discharge Cycle:

1. Press the ON keypad to turn the flow meter ON without connecting an external power source. Leave it ON until an automatic shutdown occurs.
2. Connect the AC charger (Page 11) and charge the internal battery with the meter power shut OFF. The charge indicator LED will turn RED (Rapid Charge) for approximately 1 to 2 hours, then turn GREEN (Trickle Charge). Charge the battery for an additional 8 hours or more.
3. Repeat the charge/discharge cycle again. The battery should now be "formed" to provide its maximum operating time.

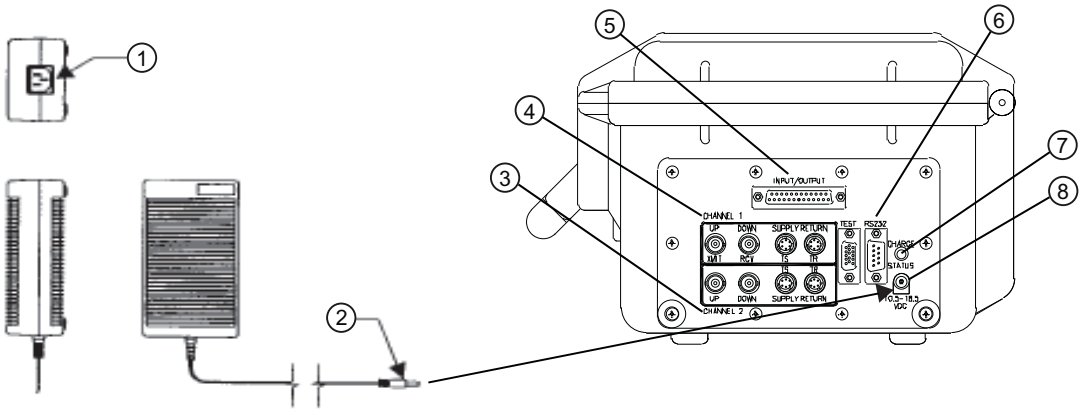
To maintain the battery "forming," whenever possible, discharge the battery completely before recharging. If the operating time during battery use appears to be unusually short, then a discharge/charge cycle should lengthen the operating time. If this does not correct a short operating time, then the internal battery should be replaced.

Status	Indication	Action
Battery Warning Beeper	Normal operation, periodic audible alarm	Connect a Battery Charger for continued operation.
Battery Discharge	Unit will not turn on (no display screen)	Connect to Battery Charger for at least 1.5 hours before attempting to operate.

2.3 Connecting AC Power Adapter/Charger

Connecting the 1015BCK-1 (7ME39404PG00) Power Adapter/Charger

1. Connect the AC power cord to the AC cord input of the Power Adapter/Charger.
2. Plug the Power Adapter/Charger connector into the rear panel Auxiliary Power/Battery Charger input connector.
3. Plug the Power Adapter/Charger AC plug into an AC power outlet.



①	AC Cord Input	⑤	Input/Output Connector
②	Connect to Rear Panel Power Input Connector	⑥	RS-232 Port
③	Flow Sensor Channel 2	⑦	Battery Status Indicator
④	Flow Sensor Channel 1	⑧	Auxiliary Power/Battery Charger Input

Figure 2-2 Power Adapter/AC-Charger for Dual Channel Flow Meter

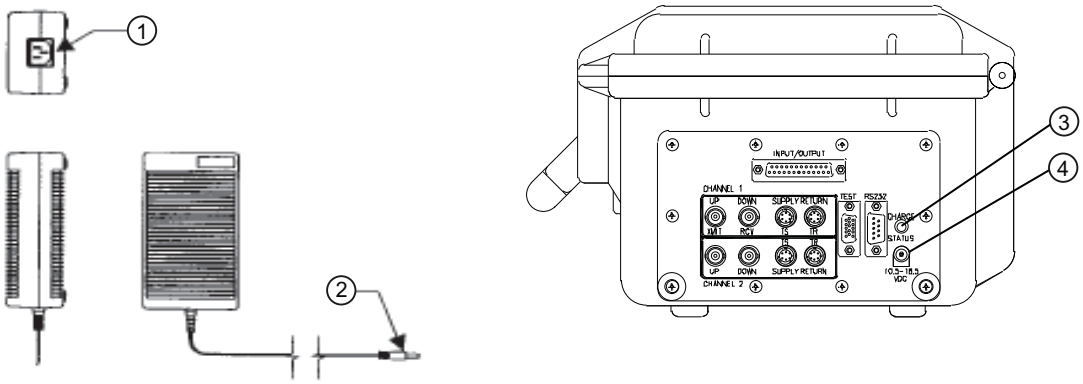
Commissioning

3

3.1 Connecting AC Power

Connecting the 1015BCK-1 (7ME39404PG00) Power Adapter/Charger

1. Connect the AC power cord to the AC Cord input of the Power Adapter/Charger.
2. Plug the Power adapter connector into the rear panel Power input connector.



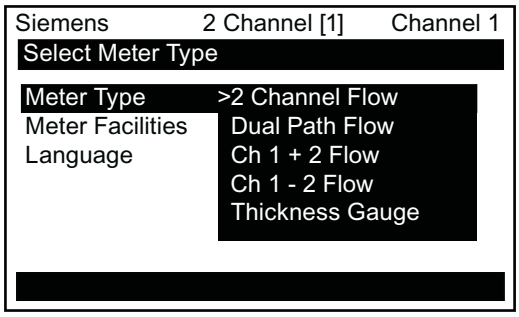
① AC Cord Input
② Connect to Rear Panel Power Input Connector
③ Battery Status Indicator
④ Auxiliary Power/Battery Charger Input

Figure 3-1 Power Adapter/AC Charger for single and Dual Channel Flow Meters

3. Plug charger into an AC outlet. Within 10 seconds of power-up the flow meter main display will become active and a typical Siemens graphic will briefly appear. The screen also identifies the software version of the unit.

① Software Version (x.xx.xx)

4. Press the <MENU> key and the Main Menu will appear.



3.2 Navigating the Menu

Installation Menu Navigation

The Installation Menu Chart is a multi-level structure divided into three columns from left to right		
Level A - lists the major menu categories.		
Level B - list the menu cells associated with Level A. You can enter data into Level B menu cells that are display parameters in a column at the right of the screen.		
Level C - lists the Level B data		
Level A	**Level B**	**Level C**
	Recall Site Setup	**Pump 1** **Pump 2**
	Channel Enable	
	Create/Name Site	
	Site Security	
	Delete Site Setup	
	Save/Rename Site	

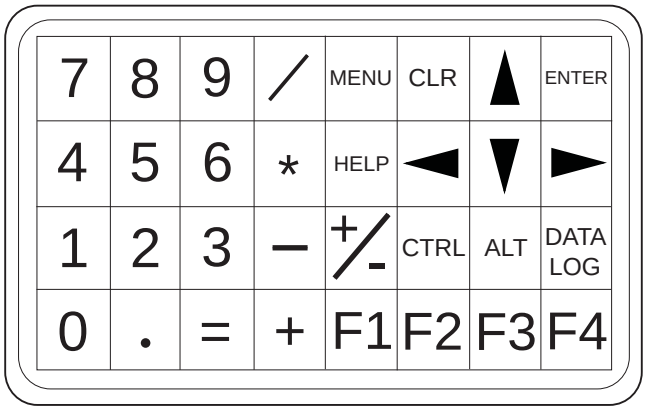


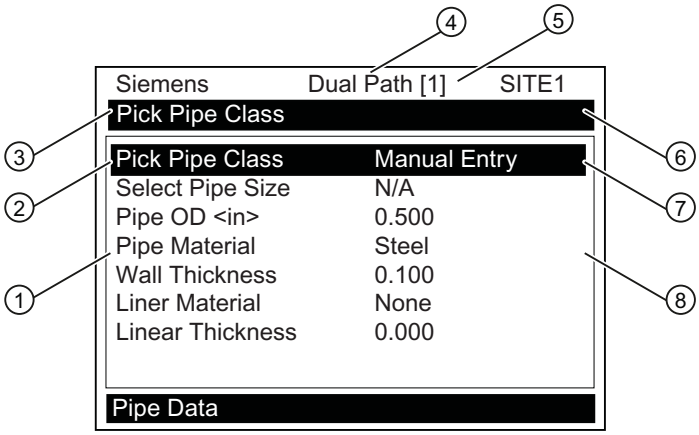
Figure 3-2 KeyPad

Note

Use <Left Arrow> key to return to previous menus.

Table 3- 1 Keypad Function Chart

Keys	Description
MENU	Press to activate the Installation Menu.
ENTER	Store numeric data, select from option lists, etc.
Left / Right Arrows	Menu navigation keys move cursor.
Up / Down Arrows	Same as <Left> and <Right> arrows. Scrolls option lists and graphic display screen.
CLR	Erases data or selects list options.
Numbers 0 - 9	Use to type numeric data.
Decimal Point	Use for decimal points in numeric data.
Math Operators	4-function math operations in numeric entry cells.
"F" Keys 1, 2, and 3	Used to start/stop/reset Totalizer.
F4	Caution: used during power up for system reset.
CTRL and ALT	Used as shift keys for alternative key functions.
DATALOG	Triggers immediate Datalogger report.
Plus and Minus [+ / -]	Changes the sign of numeric data.



① Menu Cell Data (left-hand column)
② Highlighted Menu Cell
③ Menu Prompt Line (Reverse Video)
④ Current Selected Meter Type
⑤ Current Selected Measurement Channel
⑥ Site Name Identified
⑦ Highlighted Data
⑧ Menu Cell Data (right-hand column)

Figure 3-3 Typical Installation Menu Screen

3.3 Setting the Parameters

Select Language and Units

Note

Before creating a site select a language and then English or Metric units from the Meter Facilities menu.

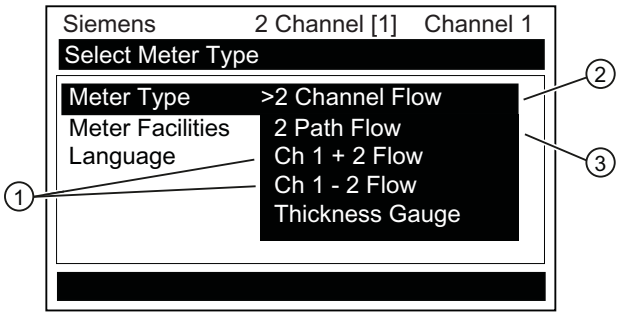
Select a Meter Type

1. Press the <MENU> key and select the Meter Type.
2. Press the Right Arrow> and scroll to [2 Channel Flow]

Note

Select [2 Channel Flow] if measuring two different pipes and [2 Path Flow] if sensors are mounted on the same pipe.

3. Press <ENTER> to select. Press <Right Arrow> to select meter function. Press <ENTER>.



① Select for measuring two different pipes. (Not available for all models.)
② Select if two sensors are mounted on the same pipe.
③ Select for summing or subtracting flow from two different pipes.

Create a Site

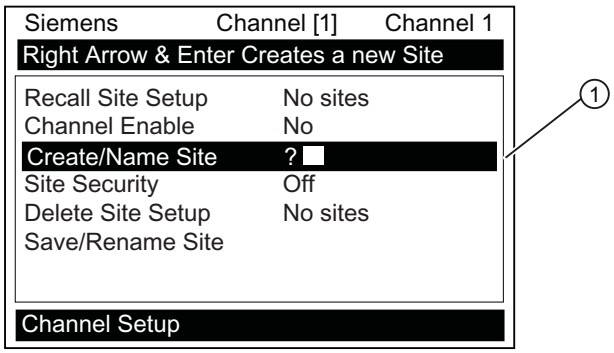
1. **Before proceeding make sure that English or Metric units have been selected.**
2. At the [Channel Setup] Menu press <Right Arrow> and enter a Site name.
3. Press <ENTER> to create Site name (e.g., ABC). (See figure below.)

Note

To set English or Metric units: In the Meter Type menu, scroll to Meter Facilities Menu. Press <Right Arrow> and select desired units. Press <ENTER> to select. Press <Left Arrow> and <Up Arrow> to return to Meter Type menu.

Note

To select letters: Press <Right Arrow> to cursor and then press <Up/Down Arrow> to select letters and numbers. Press <ENTER> when done.

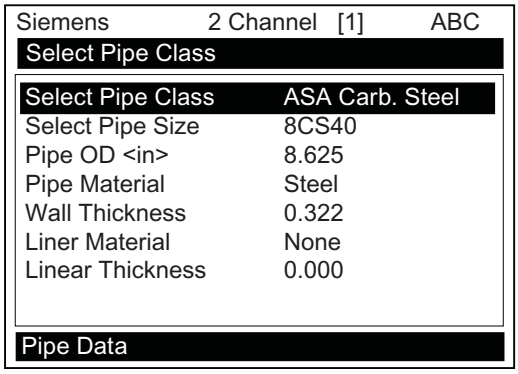


① Insert desired name (8 characters max.)

4. Scroll to [Save/Rename Site]. Press <Right Arrow> then press <ENTER> to save site.
5. Press the <Left Arrow> and return to the main menu.

Select Pipe Class

1. Press the <Right Arrow> to select Pipe Class. Press <Right Arrow> again and scroll to desired Pipe Class.
2. Press <ENTER> to select.



3. Pre-programmed Pipe Size and relevant pipe parameters will appear in menu cells. Press <Right Arrow> and scroll to desired pipe size.

4. Press <ENTER>. Enter dimensions manually if pre-programmed dimensions do not match application.

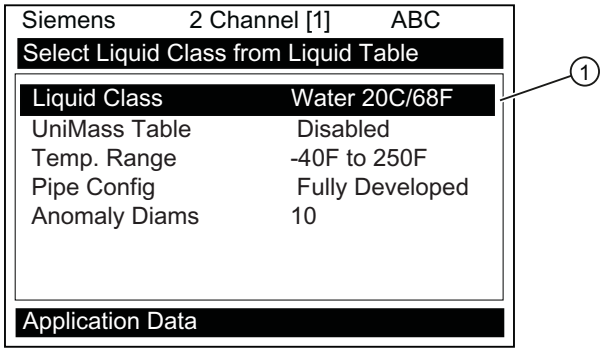
Note

The DN sizes listed in the [Select Pipe Size] menu option list are referenced to DIN Table 2448. After selecting pipe size, check pipe OD and wall thickness for correct dimensions.

5. Press the <Left Arrow> and return to the main menu.

Select Liquid Class

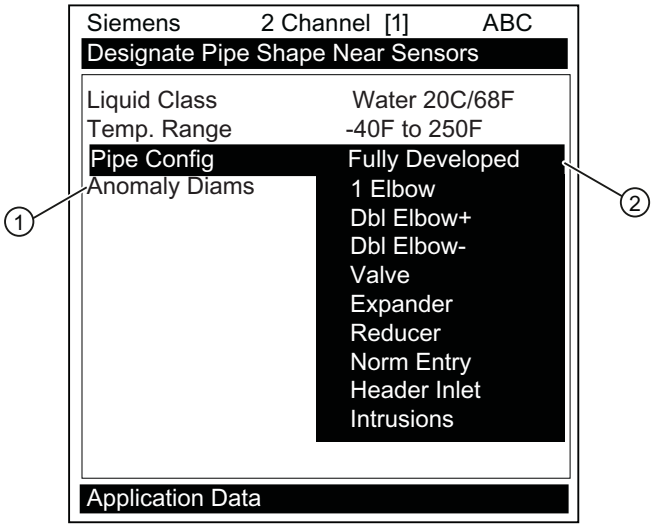
1. Press the <Down Arrow> and scroll to [Application Data].
2. Press the <Right Arrow> to select [Liquid Class].
3. Press the <Right Arrow> again and scroll to desired liquid.
4. Press <ENTER> to save selection.



① Select from list.

Select Pipe Configuration

1. Scroll down to [Pipe Config] and press the <Right Arrow>.
2. Select a configuration that approximates the conditions upstream of your Sensor mounting location. (Refer to the definitions below.)
3. Press <ENTER> to save selection.



① Use this menu cell to enter the number of pipe diameters between the upstream configuration and the Sensor installation.

② Use this menu cell to select the pipe configuration that most accurately represents the upstream pipe condition.

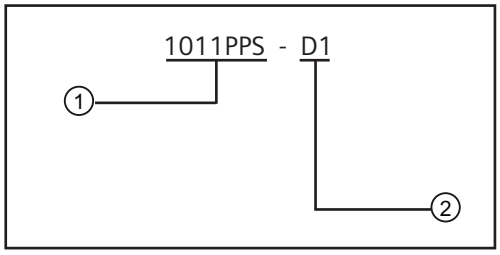
4. Press the <Left Arrow> and return to the main menu.

Table 3- 2 Pipe Configuration Option List Definitions

Options	Definitions
Fully Developed	Fully developed flow, as would be expected for very long straight pipe runs or installation downstream of a flow condition.
1 Elbow	Single 90 degree Elbow upstream of Sensor installation.
Dble Elbow+	Double out-of-plane Elbows upstream of Sensor installation.
Dble Elbow-	Double in-plane Elbows upstream of Sensor installation.
Valve	Not available at this time.
Expander	Pipe expansion upstream of Sensor installation.
Reducer	Pipe reduction upstream of Sensor installation.
Norm Entry	Not available at this time.
Header Inlet	Header or pipe manifold upstream of Sensor installation.
Intrusions	Not available at this time.

Sensor Identification

The Sensor part number located on the front face provides a detailed identification. For example, the *Part Number: 1011PPS-D1* means:



① Model
② Size

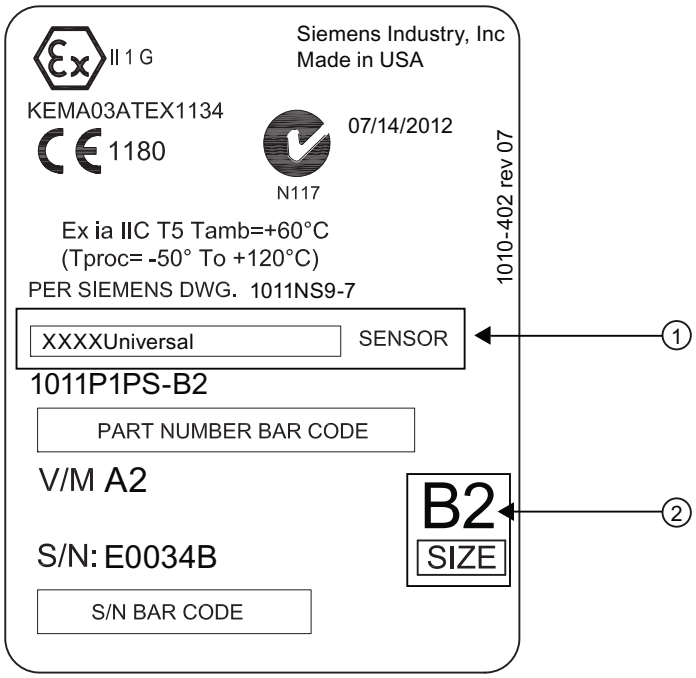
Note

Check to make sure that the Sensors are a matched set with the same serial numbers and marked with an "A" and "B" (e.g., 19256A and 19256B).

Note

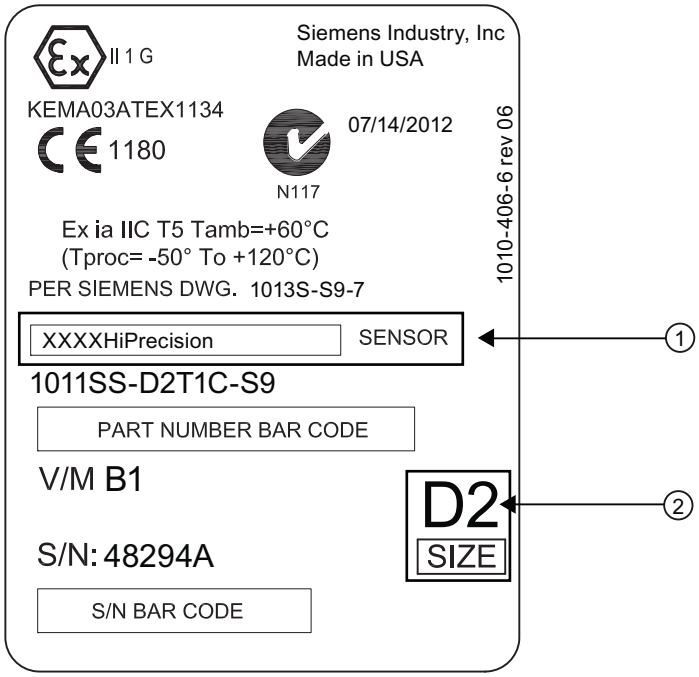
Sensor Model names for Version 3 op systems are as follows: 1011H Hi Precision, 1011 Universal and 991 Universal.

Typical Sensor Labels



① Universal sensor model number
② Sensor size

Figure 3-4 Universal Sensor Label



① Hi Precision sensor model number
② Sensor size

Figure 3-5 Hi-Precision Sensor Label

Sensor Selection

The following is a typical sensor installation procedure.

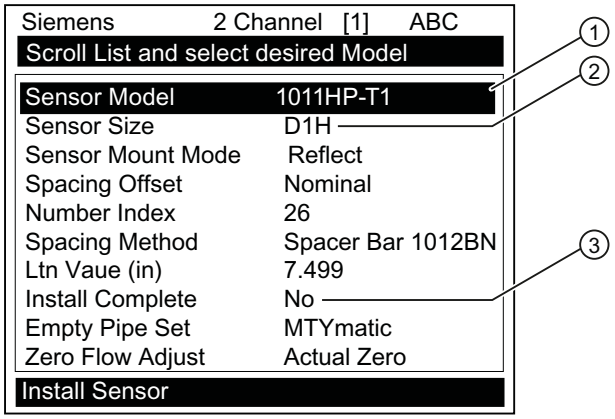
1. Press <Left Arrow> to return to Main Menu. At [Meter Type], press the <Right Arrow> and then <ENTER>.
2. The [Channel Setup] menu will appear.
3. Press the <Down Arrow> to select [Install Sensor].
4. Press the <Right Arrow> to [Sensor Model]. Press <Right Arrow> and scroll to select the sensor model number on the sensor label.

5. The drop down menu lists the following sensor selections:
   - 1011 Universal
   - 1011HP-T1 - Usable -40 to 120°C, recommended for Ø Temperature <40°C; Standard.
   - 1011HP-T2 - Usable -40 to 120°C, recommended for Ø Temperature >40°C - <80°C; Named as high temperature.
   - 1011HP-T3 - Usable -40 to 120°C, recommended for Ø Temperature >80°C <120°C; special request.
   - 991 Universal

   Note

   The meter will automatically recommend a sensor depending on the application data that has been entered.

6. For this example, select the sensor model that appears on the sensor label then press <ENTER>.



① Select based on type.

② Select based on size.

③ **After Sensor is mounted select [Install].**

7. To select Sensor Size, press <Right Arrow>. Scroll to select the sensor size that matches the size indicated on the sensor label. Press <ENTER>.
8. At [Sensor Mount Mode], press the <Right Arrow>. Scroll to select [Reflect] or [Direct] mount and then press <ENTER>.
9. **IMPORTANT: Record Spacing Method and Number Index. This data will be used to mount the sensors.**
10. Sensors can now be mounted. Refer to Sensor Installation (Page 25) mounting procedures and select the mounting mode desired.
11. **After sensors are mounted scroll to [Install Complete] and select [Install].**

3.4 Sensor Installation

3.4.1 General information

Reflect and Direct Mounting Modes

Reflect and Direct mounting modes are supported for clamp-on sensors. The transmitter recommends a mounting mode after analyzing your pipe and liquid data entries. This Quick Start illustrates a typical sensor setup using the Reflect Mode.

Note

For Direct Mount refer to the Operating Instructions manual.

Mounting Supplies

The following items will be needed to mount the sensors (most are supplied):

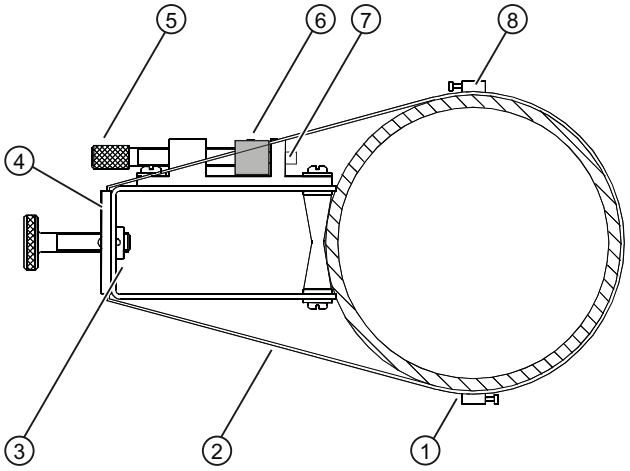
- Flat blade screwdriver
- Mounting Frames or Mounting tracks
- Tape, chalk and a ruler or measuring tape
- Mounting Straps
- Spacer Bar
- Mounting Guide (for Direct Mount)
- Ultrasonic coupling compound
- Sensors (matched set)

3.4.2 Installing the Sensors.

Reflect Mount using Mounting Frames and Spacer Bar

1. After receiving the spacing index from the Installation Menu, prepare the pipe surface area where the sensors will be mounted.
2. Degrease the surface and remove any grit, corrosion, rust, loose paint, etc.

Before beginning refer to the Reflect Mount Installation diagram example below.



① Optional: On larger pipes, multiple lengths of straps can be linked together to surround pipe.
② Mounting Strap positioned around Mounting Frame
③ Sensor shown in the 9 o'clock position on pipe
④ Mounting Frame
⑤ Space Bar Platform & Clamping Screw
⑥ Space Bar (Front View)
⑦ Metal Post
⑧ Mounting Strap Adjusting Screw

Figure 3-6 Reflect Mount with Mounting Frames and Spacer Bar (Front View)

Note

Minimum Ltn 18mm (0.75 in)

Ltn Menu Cell

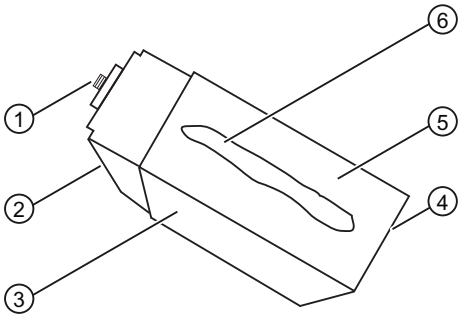
This view only menu cell shows the distance in inches or millimeters between the front faces of the sensors along the axis of the pipe. If you are mounting the sensors without a track or spacer bar, you have to space them according to this value. Note that Ltn may be a negative number for direct mount on very small pipes where the sensor spacing overlaps.

Installation Procedure (See figure for reference)

1. On a flat surface, attach the Spacer Bar to a Mounting Frame so that the Reference Hole on the Spacer Bar fits over the metal post on the platform of the frame. Tighten the clamping screw.
2. Slide the second Mounting Frame onto the other end of the Spacer Bar and align the Number Index Hole with the metal post on the platform. Then tighten the clamping screw. *Ensure that the angled sides of both frames face away from each other.*
3. Wrap a Mounting Strap around the pipe. Make sure to position it so there is easy access to the Mounting Strap Adjusting Screw.
4. At the mounting location, place the Mounting Frame/Spacer Bar Assembly on the pipe so that it rests on the top of the pipe.

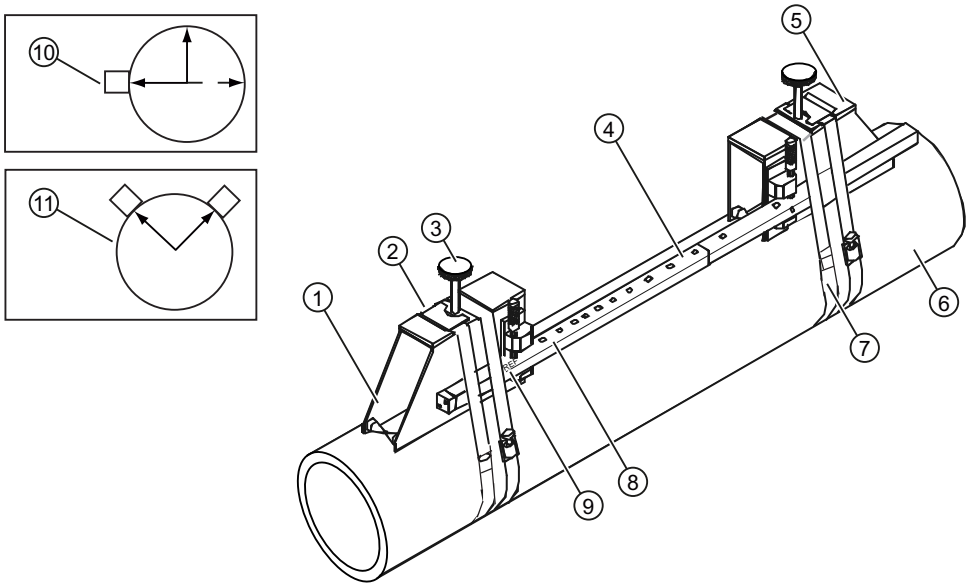
5. Engage the end of the Mounting Strap with the Mounting Strap Adjusting Screw.
6. Slide strap under the spring clip of one of the Mounting Frames.
7. Tighten the Mounting Strap Screw enough to take up all of the slack, but not enough to prevent rotation of the assembly. *Repeat procedure for the other Mounting Frame*.
8. Rotate the assembly on the pipe to the final conditioned location, ensuring that it is straight along the pipe axis. (Refer to the sensor orientation diagram.)
9. Tighten the mounting straps to seat the assembly firmly on the pipe. Do not over tighten.

10. Take either sensor and apply a continuous lengthwise 3mm (1/8-inch) bead of coupling compound across the center of the sensor emitting surface.



①	F-Connector	④	Front Face
②	Angled Edge	⑤	Emitting Surface
③	Sensor	⑥	Coupling Compound

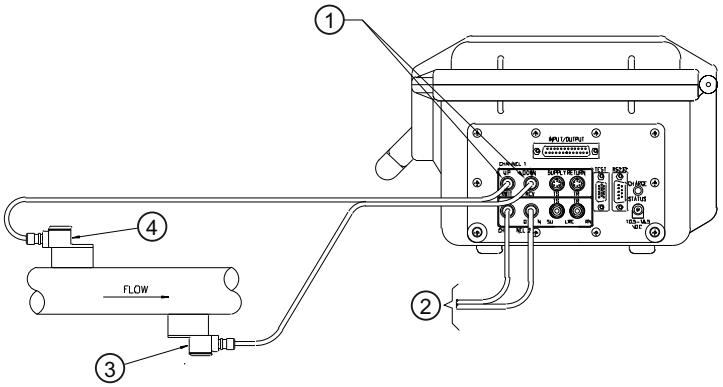
Figure 3-7 Sensor



①	Front View	⑥	Mounting Strap
②	Spring Clip (Not present on some models)	⑦	Note: Operational 2nd Mounting Strap shown. Larger pipes over 76cm (30 inches) may need an additional support.
③	Sensor Clamping Screw	⑧	Spacer Bar Platform and Clamping Screw
④	Spacer Bar	⑨	Spacer Bar Reference Hole
⑤	1012 Series Mounting Frame	⑩	Orientation for Single Beam Sensor at 9 o'clock position
		⑪	Orientation for Dual Beam Sensor at 10 & 2 o'clock positions

Figure 3-8 Sensor Installation

11. Slide sensor into a mounting frame back end first aligning the angled edge of the sensor with the angled edge of the mounting frame. Keep sensor from making contact with the pipe until it butts up against the mounting frame stop. Push sensor down to mate with pipe.
12. Tighten the sensor clamping screws to hold the sensor firmly in place. *Repeat procedure for the other sensor*
13. Observing the upstream and downstream orientation, attach the UP and DN cables to the sensors and make snug. Attach the other ends to the UP and DN terminals of the (see figure below).



① Flow Sensor Cable Connectors
② To Channel 2 Flow Sensor Set
③ Channel 1 - Upstream Sensor
④ Channel 1 - Downstream Sensor

Figure 3-9 Connecting Sensors to Flow Meter

3.4.3 Final Setup

1. At [Install Sensor] menu, scroll down to [Install Complete]. Press the <Right Arrow> and select [Install]. Press <ENTER>. Flow meter will go through drives.
2. Observe the Measured Vs window and verify a correct sound velocity measurement (if known).
3. Press the <Down Arrow> to accept sound velocity value.
4. **The meter is now ready to report flow. Press the <MENU> key twice to display flow.**

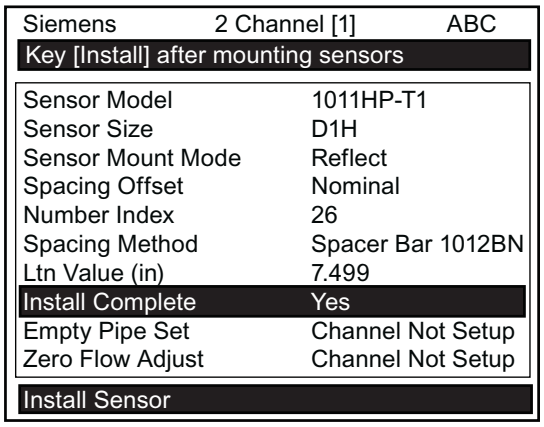


Figure 3-10 Final Setup

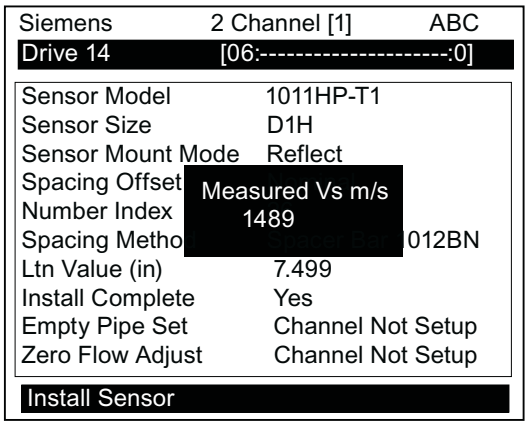


Figure 3-11 Measuring Flow

See also

Refer to I/O Connection tables (Page 35) for input/output wiring and flow meter manual for data spanning procedures.

Troubleshooting

4

4.1 Troubleshooting

The following is list of troubleshooting tips and messages that you may encounter. They include explanations and, in some cases, a recommended action. If a problem seems unsolvable, contact your local Siemens office or regional Ultrasonic Flow Representative for expert help at: http://www.automation.siemens.com/partner (http://www.automation.siemens.com/partner).

Table 4- 1 Troubleshooting Tips

Error or Message	Probable Cause	Solution
Memory Full!	Response to an attempt to save site data, when data memory is full.	Delete an obsolete site or clear Datalogger memory to make room for the new data.
Memory Corrupted!	Memory read error occurred while accessing the active site data.	Refer to F4 reset procedure in the Operation Instructions manual.
Chan Not Setup	Response to an attempt to invoke an operation that requires a channel to be enabled.	Enable the channel [Channel Setup - Channel Enable - Yes]. Note that a channel cannot be enabled until an "Install" operation is completed.
Clr Active Memory?	Response to pressing and holding the F4 key during power-up.	Use the F4 key function to restore operation if a severe event (e.g., a violent power surge) disrupts system operation.
Clr Saved Data?	[Clr Saved Data?] only appears after pressing the <Down Arrow> in response to [Clr Active Memory?].	Answering Yes to [Clr Saved Data?] will erase **ALL** saved data. To invoke in RS-232 serial mode, type @@@ and then press <ENTER> key.
<EOT>	Response to a request to output Datalogger data to the printer or the Graphics screen when no Datalogger data exists or at the end of a transmitted file..	Set up the Datalogger.
No Sites - Press <ENTER>	Response while trying to recall/delete a site setup when no sites are stored.	Create a site.
Security	Response upon changing previously entered data when security switch is in [Disable] position or security code has been entered.	• Change switch position to [Enable]. • Enter previously set security code.
RTC Error	Component level problem.	• Meter requires service. Request RMA.
- - -F- - - Fault Alarm	• Loss of signal strength (ALC) • Change of Rx signal location (Beam Blowing)	• Recouple sensors with fresh couplant. • Install sensors in Direct mount mode • Note: If problem persists call Tech support.

Error or Message	Probable Cause	Solution
Re-space Index	The measured liquid sonic velocity (Vs) is more than +/- 25% of the average Vs range.	• Ensure proper pipe dimensions and/or Liquid data entries are correct. • Properly enter correct Sensor Size into the meter [Install Sensor] menu. • Confirm sensor spacing is correct by checking [Install Sensor] menu spacing parameters.
Invalid Setup (use Direct Mode)	During the Initial Makeup the system detects invalid Sensor spacing, erroneous liquid or pipe parameters, or some other factor that prevents it from completing the Initial Makeup.	This may be due to one of the following: • An out-of-range data entry. • An invalid condition (e.g., overlapping Sensors in Reflect Mode). If selecting Direct Mode does not resolve, review all site setup and Sensor installation choices; particularly data entered for pipe and liquid. • In Reflect Mode the flow meter detects that the pipe wall signal may impinge upon the liquid signal. Use Direct Mode instead. • Press <ENTER>, <Up Arrow>, <Down Arrow>, or <Left Arrow> to abort install routine. Continue programming other site data in anticipation of resolving the difficulty later. Call technical support for help if necessary.
Low Signal - Press <ENTER>	During the Initial Makeup the flow meter decides that the level of the receive signal is insufficient for proper operation.	Some reasons for low signal are: • Invoking [Install Complete?] on an empty pipe. • Coupling compound insufficient; not applied or evaporated. Reapply couplant. • A disconnected or broken Sensor cable. • The pipe needs to be conditioned at the mounting location. • Flush out large air bubbles. • The Sensor cables are defective or not connected to the correct channel. • The Set Empty routine performed when pipe was NOT actually empty. If you locate and correct the improper condition immediately, press <ENTER> to resume the installation procedure. Otherwise, press the <Left Arrow> to abort the installation and conduct a thorough investigation.
Detection Fault	If it appears that the flow meter cannot complete an Initial Makeup it means that the pipe and/or liquid conditions do not permit a receive signal that meets the flow detection standards. The system will not operate.	Attempt to improve operating conditions by reinstalling the Sensors at a different spacing offset, or even at a different location on the pipe. Switching from Reflect to Direct Mount may solve the problem. However, operation may not be possible if there is poor liquid or pipe wall sonic conductivity.

Note

If you receive a Detection Fault message, it is strongly recommended that the Technical Service Department (http://www.automation.siemens.com/partner) be contacted.

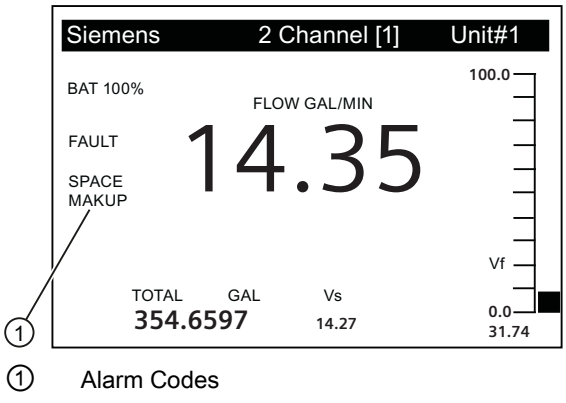
4.2 Alarm Codes

Alarm Codes and Descriptions

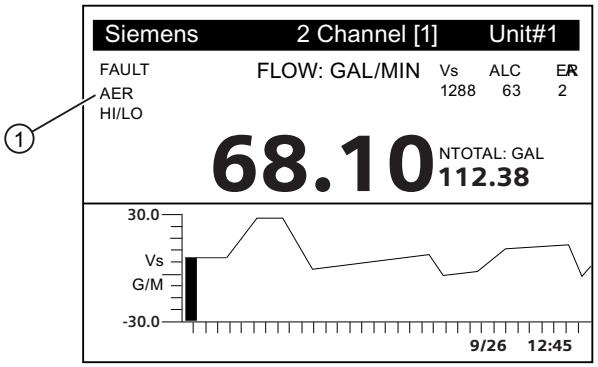
The following alarm codes appear on the main display of the flow meter.

Letter Codes	Alarm Code	Description
SPACE	Spacing	Sensor spacing may need adjustment
EMPTY	Empty	Pipe is empty
HI/LO	Rate	Flow above High setting or below Low setting
FAULT	Fault	Three continuous seconds without new data update
AER	Aeration	Current aeration percentage exceeds the alarm set point
MEMRY	Memory	Last valid reading for a selected interval during Fault condition
MAKUP	Makeup	In-Process Makeup occurred
The following alarm codes appear in the Datalogger status messages:		
I	Interface	Liquid Vs exceeds interface alarm set point
P	Pig	Pig passage detected (optional)
Z	ZeroMatic	ZeroMatic signal occurred

The displays shown below indicate where the Alarm Codes appear on the screen. Press <UP> or <DOWN> Arrows to change screen views.



① Alarm Codes



① Alarm Codes

Appendix A

A.1 I/O Connections and Wiring

Terminal Block Wiring - FUP1010 IP67 Battery Powered 2 Channel/2 Path Weatherproof Flow Meter Wiring

(Refer to manual drawing 1010WDP-7 sheet 2 of 2)

Note

Single Channel flow meters have the same terminal pin numbers and signals.

The terminal block wiring table applies to the part numbers listed below.

Table A- 1 Part Numbers and Connection Data

1010WDP-7 (Sheet 2 of 2) Drawing	
FUP1010	7ME3510

Table A- 2 2 Channel/2 Path Input/Output Terminal Block Wiring

Pin#	Signal	Function	Description
A	GND	Signal Ground	Return For Signals
B	N/C	N/C	No Connection
C	R1B	Logic Out 1	Logic Level State (HIGH=5 to 3 VDC; LOW= 1 to 0 VDC)
D	N/C	N/C	No Connection
E	R2B	Logic Out 2	Logic Level State (HIGH=5 to 3 VDC; LOW= 1 to 0 VDC)
F	N/C	N/C	No Connection
G	R3B	Logic Out 3	Logic Level State (HIGH=5 to 3 VDC; LOW= 1 to 0 VDC)
H	N/C	N/C	No Connection
J	R4B	Logic Out 4	Logic Level State (HIGH=5 to 3 VDC; LOW= 1 to 0 VDC)
K	PGEN1	Frequency Output 1	Assignable Logic Level Pulse Train (5V TTL CMOS Logic)
L	PGEN2	Frequency Output 2	Assignable Logic Level Pulse Train (5V TTL CMOS Logic)
M	Vo1	Voltage Output 1	Assignable (0 to 10 VDC) [Min. load=5k ohms]
N	Vo2	Voltage Output 2	Assignable (0 to 10 VDC) [Min. load=5k ohms]
P	Io1	Current Output 1	Assignable 4 to 20mA output 4-20mA outputs also provide a fault indication by dropping to 2mA if assigned to flow rate and under fault conditions.
R	Io2	Current Output 2	Assignable 4 to 20mA output 4-20mA outputs also provide a fault indication by dropping to 2mA if assigned to flow rate and under fault conditions.
S	Io PWR	External Current Loop	User supplied 18 to 30 VDC @ 25mA min.
T	GND	Signal Ground	Return For Signals
U	CNTRL1	Logic In 1	TTL Level State [HIGH=5 to 3 VDC; LOW=1 to 0 VDC]
V	CNTRL2	Logic In 2	TTL Level State [HIGH=5 to 3 VDC; LOW=1 to 0 VDC]
W	CNTRL3	Logic In 3	TTL Level State [HIGH=5 to 3 VDC; LOW=1 to 0 VDC]
X	CNTRL4	Logic In 4	TTL Level State [HIGH=5 to 3 VDC; LOW=1 to 0 VDC]
Y	Iin1	Current Input 1	External sensor input (4-20mA) [Load = 250 ohms]
Z	Iin2	Current Input 2	External sensor input (4-20mA) [Load = 250 ohms]
a	Vin1	Voltage Input 1	External sensor input (0 to 10 VDC) [Load = 100k ohms]
b	Vin2	Voltage Input 2	External sensor input (0 to 10 VDC) [Load = 100k ohms]
c	GND	Signal Ground	Return For Signals

Temperature Range	Degree of Protection
Operating: -18°C to 60°C (0°F to 140°F) Storage: -20°C to 60°C (-4°F to 140°F)	IP67 (weather proof))

Performance

The following specifications apply under standard conditions (i.e., measurements taken on a straight run of 15 diameters upstream and 5 diameters downstream; flow rate above 1 fps; non-aerated Newtonian liquids flowing at Reynolds numbers <2000 or >10000).

Table A- 3 Performance Specifications

Transit-Time Accuracy	At least 1% to 2 % of indicated flow (better than 0.5 % possible with calibration.)
Flow Sensitivity	0.0003 m/s (0.001 fps) - even at zero flow.
Zero Drift Stability	Less than 0.005 m/s (0.015 fps)
Repeatability (small volume)	Better than 0.5 %
Response Rate (Damping)	SmartSlew effective from 0.2 seconds to 5 minutes.
Flow Velocity Range	Min. ±12 m/s (±40 ft/s), inc. zero flow
Linearity	0.0001 m/s (0.003 ft/s)
Flow Profile Compensation	Automatic Reynolds number correction of reported flow rate.

FUP1010 IP67 Installation Menu Chart

LEVEL A	LEVEL B	LEVEL C	LEVEL D	LEVEL E	LEVEL F	LEVEL G	LEVEL H
Meter Type	**2 Channel Flow**	**Channel 1/2**	**Clamp-on**	**FastStart Setup**	**Pick Pipe Class**	**Enter From List**	
	Dual Path Flow		**Reflexor**		**Select Pipe**	**N/A**	
	Ch 1+2 Flow				**Install Xdcr**	**Transducer Model**	**Enter From List**
	Ch 1-2 Flow					**Transducer Size**	**Enter From List**
	Thickness Gauge					Xdcr Mount Mode	Enter From List
						Spacing Offset	Enter From List
						Number Index	View only
						Spacing Method	View only
						Ltn Value <in>	View Only
						Install Complete	**No/Install**
						Empty Pipe Set	Enter From List
						Zero FlowAdjust	Enter From List
			① **Full Site Setup**	**Channel Setup**		Recall Site	Enter From List
						Channel Enable	No/Yes
					② **Create/Name Site**	**Enter Site Name**	
						Site Security	On/Off
						Delete Site	Enter From List
						Save/Rename Site	Enter/Clear Site Name
				③ **Pipe Data**	**Pick Pipe Class**	**Enter From List**	
					Select Pipe Size	**Enter From List**	
					Pipe OD (in)	**Numeric Entry**	
					Pipe Material	**Enter From List**	
					Wall Thickness	**Numeric Entry**	
					Liner Material	Enter From List	
					Liner Thickness	Numeric Entry	
				④ **Application Data**	**Liquid Class**	**Select Liquid**	**Enter from List**
						Estimated Vs M/S	Numeric Entry
						Viscosity (cS)	Numeric Entry
						Density S.G.	Numeric Entry
					Temp. Range	Enter From List	
					Pipe Config	Enter From List	
					Anomaly Diams	Numeric Entry	
				⑤ **Install Sensor**	**Sensor Model**	**Enter From List**	
					Sensor Size	**Enter From List**	
					Sensor Mount Mode	**Enter From List**	
					Spacing Offset	**Enter From List**	
					Number Index	**View Only**	
					Spacing Method	**View Only**	
					Ltn Value (in)	**View Only**	
					Install Complete	**No/Install**	**Select Install**
					Empty Pipe Set	Enter From List	
					Zero Flow Adjust	Enter From List	
				Operation Adjust	Damping Control	Time Average / SmartSlew	
					Deadband Control	Numeric Entry	
					Memory/Fault Set	Fault/Memory	
					Memory Delay (s)	N/A	
				Flow/Total Units	Flow Vol. Units	Enter From List	
					Flow Time Units	Enter From List	
					Flow Disp. Range	Autorange/High	
					Flow Disp. Scale	Enter From List	
					Total Vol. Units	Enter From List	
					Totalizer Scale	Enter From List	
					Total Resolution	Enter From List	
					Totalizer Mode	Enter From List	
					Batch/Sample Tot	Numeric Entry	
				Span/Set/Cal	Span Data	Enter From List	
					Set Alarm Levels	Enter From List	
					Calib. Flowrate	Intrinsic	
						Kc	
						MultiPoint	
				Display Setup	Select Data	Enter From List	
					Data Display	Enter From List	
					Time Base	Enter From List	
					Stripchart Clear	Yes/No	
				Logger Setup	Logger Mode	Enter From List	
					Logger Data	Enter From List	
					Logger Interval	Enter From List	
					Logger Events	Enter From List	
					Display Logger	Enter From List	
				I/O Data Control	Analog Out Setup	Enter From List	
					Relay Setup	Relay 1,2	
					Analog Inp Setup	Enter From List	
				Diagnostic Data	Flow Data	Enter From List	
					Application Info	Enter From List	
					Liquid Data	Enter From List	
					Site Setup Data	Enter From List	
					Test Facilities	Enter From List	
					Print Site Setup	No/Yes	
					Site Created:	View Only	mm.dd.yy hh.mm.ss

This Menu Chart applies to:
MLFB - 7ME3510
7ME3511

SIEMENS
Siemens Industry, Inc.
Industry Automation Division
CoC Ultrasonic Flow
Hauppauge, New York
USA
Web: www.siemens.com/flow

FUP1010 IP67 Installation Menu Chart

LEVEL A	LEVEL B	LEVEL C	LEVEL D	LEVEL E	LEVEL F
Meter Facilities	Preferred Units	English/Metric			
	Table Setups	Pipe Table	Create/Edit Pipe	Enter From List	
			Delete Pipe	Enter From List	
		Sensor Type	Enter From List		
	Logger Control	Display Logger	Enter From list		
		Output Logger	Yes/No		
		Circular Memory	Yes/No		
		Est LogTime Left	View Only		
		Clear Logger	Yes/No		
	Memory Control	Log Memory Left	View Only		
		Memory Map	Yes/No		
		Defragment	Yes/No		
	Analog Out Trim	Trim Io1 / Io2	Operate / Trim @ 4mA		
		Trim Vo1 / Vo2	Operate / Trim @ 2V		
		Trim Pgen1 / Pgen2	Operate / Trim @ 1 kHz		
	RTD Calibrate	RTD 1 / RTD 2	Factory / User Cal		
	Clock Set	Date (MM.DD.YY)	Edit Date		
		Time ((HH.MM)	Edit Time		
	RS-232 Setup	Baud Rate	Enter From List		
		Parity	Enter From List		
		Data Bits	7/8		
		Line Feed	Yes/No		
		Network ID	Numeric Entry		
		RTS Key Time	Enter From List		
	Backlight	Enter from List			
	System Info	Version	View Only		
		Battery Capacity	View Only		
		Reset Data/Time	View Only	mm.dd.yy hh.mm.ss	
		Op System P/N	View Only		
		Checksum	View Only		
		Code	View Only		
		System Time	View Only	mm.dd.yy hh.mm.ss	
Language	Enter From list				

SIEMENS

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Tel. +1 (631) 231-3600 Fax. +1 (631) 231-3334
Web: www.siemens.com

DUCTILE IRON PIPE

Nominal Diameter	Actual O.D.	CLASS 50		CLASS 51		CLASS 52		CLASS 53		CLASS 54		CLASS 55		CLASS 56		Liner (Cement)	
		Wall	I.D.	Wall	I.D.	Wall	I.D.	Wall	I.D.	Wall	I.D.	Wall	I.D.	Wall	I.D.	Single	Double
3	3.96	N/A	N/A	0.25	3.46	0.28	3.40	0.31	3.34	0.34	3.28	0.37	3.22	0.40	3.16	0.125	0.250
4	4.80	N/A	N/A	0.26	4.28	0.29	4.22	0.32	4.16	0.35	4.10	0.38	4.04	0.41	3.98	0.125	0.250
6	6.90	0.25	6.40	0.28	6.34	0.31	6.28	0.34	6.22	0.37	6.16	0.40	6.10	0.43	6.04	0.125	0.250
8	9.05	0.27	8.51	0.30	8.45	0.33	8.39	0.36	8.33	0.39	8.27	0.42	8.21	0.45	8.15	0.125	0.250
10	11.10	0.29	10.52	0.32	10.46	0.35	10.40	0.38	10.34	0.41	10.28	0.44	10.22	0.47	10.16	0.125	0.250
12	13.20	0.31	12.58	0.34	12.52	0.37	12.46	0.40	12.40	0.43	12.34	0.46	12.28	0.49	12.22	0.125	0.250
14	15.30	0.33	14.64	0.36	14.58	0.39	14.52	0.42	14.46	0.45	14.40	0.48	14.34	0.51	14.28	0.1875	0.375
16	17.40	0.34	16.72	0.37	16.66	0.40	16.60	0.43	16.54	0.46	16.48	0.49	16.42	0.52	16.36	0.1875	0.375
18	19.50	0.35	18.80	0.38	18.74	0.41	18.68	0.44	18.62	0.47	18.56	0.50	18.50	0.53	18.44	0.1875	0.375
20	21.60	0.36	20.88	0.39	20.82	0.42	20.76	0.45	20.70	0.48	20.64	0.51	20.58	0.54	20.52	0.1875	0.375
24	25.80	0.38	25.04	0.41	24.98	0.44	24.92	0.47	24.86	0.50	24.80	0.53	24.74	0.56	24.68	0.1875	0.375
30	32.00	0.39	31.22	0.43	31.14	0.47	31.06	0.51	30.99	0.55	30.90	0.59	30.82	0.63	30.74	0.250	0.500
36	38.30	0.43	37.44	0.48	37.34	0.53	37.24	0.58	37.14	0.63	37.04	0.68	36.94	0.73	36.84	0.250	0.500
42	44.50	0.47	43.56	0.53	43.44	0.59	43.32	0.65	43.20	0.71	43.08	0.77	42.96	0.83	42.84	0.250	0.500
48	50.80	0.51	49.78	0.58	49.64	0.65	49.50	0.72	49.36	0.79	49.22	0.86	49.08	0.93	48.94	0.250	0.500
54	57.56	0.57	56.42	0.65	56.26	0.73	56.10	0.81	55.94	0.89	55.78	0.97	55.62	1.05	55.46	0.250	0.500

CAST IRON PIPE - AWWA STANDARD

Pipe Size	CLASS A			CLASS B			CLASS C			CLASS D			CLASS E			CLASS F			CLASS G			CLASS H		
	O.D	Wall	I.D.	O.D	Wall	I.D.	O.D	Wall	I.D.	O.D	Wall	I.D.	O.D	Wall	I.D.	O.D	Wall	I.D.	O.D	Wall	I.D.	O.D	Wall	I.D.
3	3.80	0.39	3.02	3.96	0.42	3.12	3.96	0.45	3.06	3.96	0.48	3.00												
4	4.80	0.42	3.96	5.00	0.45	4.10	5.00	0.48	4.04	5.00	0.52	3.96												
6	6.90	0.44	6.02	7.10	0.48	6.14	7.10	0.51	6.08	7.10	0.55	6.00	7.22	0.58	6.06	7.22	0.61	6.00	7.38	0.65	6.08	7.38	0.69	6.00
8	9.05	0.46	8.13	9.05	0.51	8.03	9.30	0.56	8.18	9.30	0.60	8.10	9.42	0.66	8.10	9.42	0.71	8.00	9.60	0.75	8.10	9.60	0.80	8.00
10	11.10	0.50	10.10	11.10	0.57	9.96	11.40	0.62	10.16	11.40	0.68	10.04	11.60	0.74	10.12	11.60	0.80	10.00	11.84	0.86	10.12	11.84	0.92	10.00
12	13.20	0.54	12.12	13.20	0.62	11.96	13.50	0.68	12.14	13.50	0.75	12.00	13.78	0.82	12.14	13.78	0.89	12.00	14.08	0.97	12.14	14.08	1.04	12.00
14	15.30	0.57	14.16	15.30	0.66	13.96	15.65	0.74	14.17	15.65	0.82	14.01	15.98	0.90	14.18	15.98	0.99	14.00	16.32	1.07	14.18	16.32	1.16	14.00
16	17.40	0.60	16.20	17.40	0.70	16.00	17.80	0.80	16.20	17.80	0.89	16.02	18.16	0.98	16.20	18.16	1.08	16.00	18.54	1.18	16.18	18.54	1.27	16.00
18	19.50	0.64	18.22	19.50	0.75	18.00	19.92	0.87	18.18	19.92	0.96	18.00	20.34	1.07	18.20	20.34	1.17	18.00	20.78	1.28	18.22	20.78	1.39	18.00
20	21.60	0.67	20.26	21.60	0.80	20.00	22.06	0.92	20.22	22.06	1.03	20.00	22.54	1.15	20.24	22.54	1.27	20.00	23.02	1.39	20.24	23.02	1.51	20.00
24	25.80	0.76	24.28	25.80	0.89	24.02	26.32	1.04	24.22	26.32	1.16	24.00	26.90	1.31	24.28	26.90	1.45	24.00	27.76	1.75	24.26	27.76	1.88	24.00
30	31.74	0.88	29.98	32.00	1.03	29.94	32.40	1.20	30.00	32.74	1.37	30.00	33.10	1.55	30.00	33.46	1.73	30.00						
36	37.96	0.99	35.98	38.30	1.15	36.00	38.70	1.36	39.98	39.16	1.58	36.00	39.60	1.80	36.00	40.04	2.02	36.00						
42	44.20	1.10	42.00	44.50	1.28	41.94	45.10	1.54	42.02	45.58	1.78	42.02												
48	50.50	1.26	47.98	50.80	1.42	47.96	51.40	1.71	47.98	51.98	1.96	48.06												
54	56.66	1.35	53.96	57.10	1.55	54.00	57.80	1.90	54.00	58.40	2.23	53.94												
60	62.80	1.39	60.02	64.40	1.67	60.06	64.20	2.00	60.20	64.82	2.38	60.06												
72	75.34	1.62	72.10	76.00	1.95	72.10	76.88	2.39	72.10															
84	87.54	1.72	84.10	88.54	2.22	84.10																		

STAINLESS STEEL, HASTELLOY "C" & TITANIUM△ PIPE

Sched.	Size	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10	12	14	16	18	20	22	24
5S◇	O.D.	0.840	1.050	1.315	1.660	1.900	2.375	2.875	3.500	4.000	4.500	5.563	6.625	8.625	10.750	12.750	14.000	16.000	18.000	20.000	22.000	24.000
	I.D.	0.710	0.920	1.185	1.530	1.770	2.245	2.709	3.334	3.834	4.334	5.345	6.407	8.407	10.482	12.438	13.688	15.670	17.670	19.634	21.624	23.563
	Wall	0.065	0.065	0.065	0.065	0.065	0.065	0.083	0.083	0.083	0.083	0.109	0.109	0.109	0.134	0.156	0.156	0.165	0.165	0.188	0.188	0.218
10S◇	I.D.	0.674	0.884	1.097	1.442	1.682	2.157	2.635	3.260	3.760	4.260	5.295	6.357	8.329	10.420	12.390	13.624	15.624	17.624	19.564	21.564	23.500
	Wall	0.083	0.083	0.109	0.109	0.109	0.109	0.120	0.120	0.120	0.120	0.134	0.134	0.148	0.165	0.180	0.188	0.188	0.188	0.218	0.218	0.250
40S	I.D.	0.622	0.824	1.049	1.380	1.610	2.067	2.469	3.068	3.548	4.026	5.047	6.065	7.981	10.020	12.000						
	Wall	0.109⊗	0.113⊗	0.133⊗	0.140⊗	0.145⊗	0.154⊗	0.203⊗	0.216⊗	0.226⊗	0.237⊗	0.258⊗	0.280⊗	0.322⊗	0.365⊗	* .375						
80S	I.D.	0.546	0.742	0.957	1.278	1.500	1.939	2.323	2.900	3.364	3.826	4.813	5.761	7.625	9.750	11.750						
	Wall	^.147	^.154	^.179	^.191	^.200	^.218	^.276	^.300	^.318	^.337	^.375	^.432	^.500	^.500	* .500						

CARBON STEEL and PVC△ PIPE

Pipe	Size	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	42
	O.D.	0.840	1.050	1.315	1.660	1.900	2.375	2.875	3.500	4.000	4.500	5.563	6.625	8.625	10.750	12.750	14.000	16.000	18.000	20.000	22.000	24.000	26.000	28.000	30.000	32.000	34.000	36.000	42.000
Stand-ard	I.D.	0.622	0.824	1.049	1.380	1.610	2.067	2.469	3.068	3.548	4.026	5.047	6.065	7.981	10.020	12.000	13.250	15.250	17.250	19.250	21.250	23.250	25.250	27.250	29.250	31.250	33.250	35.250	41.250
	Wall	0.109	0.113	0.133	0.140	0.145	0.154	0.203	0.216	0.226	0.237	0.258	0.280	0.322	0.365	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	* .375
Extra Strong (XS)	I.D.	0.546	0.742	0.957	1.278	1.500	1.939	2.323	2.900	3.364	3.826	4.813	5.761	7.625	9.750	11.750	13.000	15.000	17.000	19.000	21.000	23.000	25.000	27.000	29.000	31.000	33.000	35.000	41.000
	Wall	0.147	0.154	0.179	0.191	0.200	0.218	0.276	0.300	0.318	0.337	0.375	0.432	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	* .500
Double Extra Strong (XXS)	I.D	0.252	0.434	0.599	0.896	1.100	1.503	1.771	2.300	2.728	3.152	4.063	4.897	6.875	8.750	10.750													
	Wall	0.294	0.308	0.358	0.382	0.400	0.436	0.552	0.600	0.636	0.674	0.750	0.864	0.875	1.000	1.000													
Sched. 10	I.D.																13.500	15.500	17.500	19.500	21.500	23.500	25.376	27.376	29.376	31.376	33.376	35.376	
	Wall																0.250	0.250	0.250	0.250	0.250	0.250	0.312	0.312	0.312	0.312	0.312	0.312	
Sched. 20	I.D.													8.125	10.250	12.250	13.376	15.376	17.376	19.250	21.250	23.250	25.000	27.000	29.000	31.000	33.000	35.000	41.000
	Wall													0.250	0.250	0.250	0.312	0.312	0.312	0.375⊗	0.375⊗	0.375⊗	^.500	^.500	^.500	^.500	^.500	^.500	^.500
Sched. 30	I.D.													8.071	10.136	12.090	13.250	15.250	17.124	19.000	21.000	22.876		26.750	28.750	30.750	32.750	34.750	40.750
	Wall													0.277	0.307	0.330	0.375⊗	0.375⊗	0.438	^.500	^.500	0.562		0.625	0.625	0.625	0.625	0.625	* .625
Sched. 40	I.D.	0.622	0.824	1.049	1.380	1.610	2.067	2.469	3.068	3.548	4.026	5.047	6.065	7.981	10.020	11.938	13.124	15.000	16.876	18.184		22.626							
	Wall	0.109⊗	0.113⊗	0.133⊗	0.140⊗	0.145⊗	0.154⊗	0.203⊗	0.216⊗	0.226⊗	0.237⊗	0.258⊗	0.280⊗	0.322⊗	0.365⊗	0.406	0.438	^.500	0.562	0.593		0.687							
Sched. 60	I.D.													7.813	9.750	11.626	12.814	14.688	16.500	18.376	20.250	22.064							
	Wall													0.406	^.500	0.562	0.593	0.656	0.750	0.812	0.875	0.968							
Sched. 80	I.D.	0.546	0.742	0.957	1.278	1.500	1.939	2.323	2.900	3.364	3.826	4.813	5.761	7.625	9.564	11.376	12.500	14.314	16.126	17.938	19.750	21.564							
	Wall	^.147	^.154	^.179	^.191	^.200	^.218	^.276	^.300	^.318	^.337	^.375	^.432	^.500	0.593	0.687	0.750	0.843	0.937	1.031	1.125	1.218							
Sched. 100	I.D.													7.439	9.314	11.064	12.126	13.938	15.688	17.438	19.250	20.938							
	Wall													0.593	0.718	0.843	0.937	1.031	1.156	1.281	1.375	1.531							
Sched. 120	I.D.										3.624	4.563	5.501	7.189	9.064	10.750	11.814	13.564	15.250	17.000	18.750	20.376							
	Wall										0.438	0.500	0.562	0.718	0.843	1.000	1.093	1.218	1.375	1.500	1.625	1.812							
Sched. 140	I.D.													7.001	8.750	10.500	11.500	13.124	14.876	16.500	18.250	19.876							
	Wall													0.812	1.000	1.125	1.250	1.438	1.562	1.750	1.875	2.062							
Sched. 160	I.D.	0.466	0.614	0.815	1.160	1.338	1.689	2.125	2.624		3.438	4.313	5.189	6.813	8.500	10.126	11.188	12.814	14.438	16.064	17.750	19.314							
	Wall	0.187	0.218	0.250	0.250	0.281	0.343	0.375	0.438		0.531	0.625	0.718	0.906	1.125	1.312	1.406	1.593	1.781	1.968	2.125	2.343							

NON-STANDARD CARBON

Size	10	20	24	24
O.D.	10.750	20.000	24.000	24.000
I.D.	10.192	19.375	23.375	22.126
Wall	0.279	0.312	0.312	0.937

The above sizes are produced by pipe mills but dimensions do not conform to any regular standard or schedule.

△ These materials are generally available in Schedules 40 and 80 only.

◇ Wall Thickness of Schedule 5S & 10S does not permit threading in accordance with the American Standard for Pipe Threads (ASA No. B2.1)

⊗ Wall thickness identical with thickness of "Standard Weight" pipe.

^ Wall Thickness identical with thickness of "Extra-Heavy" pipe.

* These do not conform to American Standard B36. 10.

PIPE WEIGHT FORMULA FOR STEEL PIPE (lbs per foot)
10.68 (D-t) t, where D=Outside Diameter and t=Wall Thickness

SIEMENS

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SIEMENS

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Sonic Velocity Relative to Temperature of Pure Water

Temperature		Velocity	Temperature		Velocity	Temperature		Velocity
°F	°C	M/S	°F	°C	M/S	°F	°C	M/S
0.0	-17.8	1292.45	100.0	37.8	1525.03	200.0	93.3	1548.38
2.0	-16.67	1300.64	102.0	38.9	1526.99	202.0	94.4	1547.60
4.0	-15.55	1308.63	104.0	40.0	1528.86	204.0	95.6	1546.78
6.0	-14.44	1316.44	106.0	41.1	1530.67	206.0	96.7	1547.60
8.0	-13.33	1324.06	108.0	42.2	1532.4	208.0	97.8	1545.02
10.0	-12.22	1331.50	110.0	43.3	1534.06	210.0	98.9	1544.08
12.0	-11.00	1338.77	112.0	44.4	1535.64	212.0	100.0	1543.11
14.0	-10.0	1345.86	114.0	45.6	1537.16	214.0	101.1	1542.10
16.0	-8.89	1352.78	116.0	46.7	1538.61	216.0	102.2	1541.05
18.0	-7.78	1359.53	118.0	47.8	1539.99	218.0	103.3	1539.97
20.0	-6.67	1366.12	120.0	48.9	1541.30	220.0	104.4	1538.85
22.0	-5.56	1372.55	122.0	50.0	1542.55	222.0	105.6	1537.70
24.0	-4.44	1378.82	124.0	51.1	1543.74	224.0	106.7	1536.51
26.8	-3.33	1384.94	126.0	52.2	1544.86	226.0	107.8	1535.29
28.0	-2.22	1390.90	128.0	53.3	1545.91	228.0	108.9	1534.03
30.0	-1.11	1396.72	130.0	54.4	1546.91	230.0	110.0	1532.74
32.0	0.0	1402.39	132.0	55.6	1547.84	232.0	111.1	1531.42
34.0	1.11	1407.91	134.0	56.7	1548.72	234.0	112.2	1530.06
36.0	2.22	1413.30	136.0	57.8	1549.53	236.0	113.3	1528.67
38.0	3.33	1418.55	138.0	58.9	1550.29	238.0	114.4	1527.26
40.0	4.44	1423.66	140.0	60.0	1550.99	240.0	115.6	1525.81
42.0	5.56	1428.64	142.0	61.1	1551.63	242.0	116.7	1524.33
44.0	6.67	1433.48	144.0	62.2	1552.21	244.0	117.8	1522.83
46.0	7.78	1438.20	146.0	63.3	1552.74	246.0	118.9	1521.29
48.0	8.89	1442.80	148.0	64.4	1553.22	248.0	120.0	1519.73
50.0	10.0	1447.27	150.0	65.6	1553.64	250.0	121.1	1518.14
52.0	11.11	1451.62	152.0	66.7	1554.01	260.0	126.7	1507.00
54.0	12.22	1455.85	154.0	67.8	1554.32	270.0	132.2	1497.00
56.0	13.33	1459.97	156.0	68.9	1554.59	280.0	137.8	1487.00
58.0	14.44	1463.97	158.0	70.0	1554.80	290.0	143.3	1476.00
60.0	.15.56	1467.86	160.0	71.1	1554.98	300.0	148.9	1465.00
62.0	16.67	1471.64	162.0	72.2	1555.07	310.0	154.4	1453.00
64.0	17.89	1475.31	164.0	73.3	1555.13	320.0	160.0	1440.00
66.0	18.89	1478.88	166.0	74.4	1555.15	330.0	165.6	1426.00
68.0	20.0	1482.34	168.0	75.6	1555.11	340.0	171.1	1412.00
70.0	21.1	1485.70	170.0	76.7	1555.03	350.0	176.7	1398.00
72.0	22.2	1488.96	172.0	77.8	1554.90	360.0	182.2	1383.00
74.0	23.3	1492.13	174.0	78.9	1554.72	370.0	187.8	1368.00
76.0	24.4	1495.19	176.0	80.0	1554.49	380.0	193.3	1353.00
78.0	25.6	1498.16	178.0	81.1	1554.22	390.0	198.9	1337.00
80.0	26.7	1501.04	180.0	82.2	1553.91	400.0	204.4	1320.00
82.0	27.8	1503.82	182.0	83.3	1553.55	410.0	210.0	1302.00
84.0	28.9	1506.52	184.0	84.4	1553.14	420.0	215.6	1283.00
86.0	30.0	1509.13	186.0	85.6	1552.70	430.0	221.1	1264.00
88.0	31.1	1511.65	188.0	86.7	1552.21	440.0	226.7	1244.00
90.0	32.2	1514.08	190.0	87.8	1551.67	450.0	232.2	1220.00
92.0	33.3	1516.44	192.0	88.9	1551.10	460.0	237.8	1200.00
94.0	34.4	1518.70	194.0	90.0	1550.48	470.0	243.3	1180.00
96.0	35.6	1520.89	196.0	91.1	1549.82	480.0	248.9	1160.00
98.0	36.7	1523.00	198.0	92.2	1549.12	490.0	254.4	1140.00

Ethylene Glycol