Vortex
Flow Meters

VN2000 Flow Meters

Transmitter

Badger Meter

VRX-UM-02233-EN-03 (January 2021)

User Manual

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PURPOSE OF THIS DOCUMENT

The purpose of this document is to provide instructions the installation, wiring and operation of the VN2000 Transmitter.

IMPORTANT
Read this manual carefully before attempting any installation or operation.
Keep the manual in an accessible location for future reference.

UNPACKING AND INSPECTION

Upon opening the shipping container, visually inspect the product and applicable accessories for any physical damage such as scratches, loose or broken parts, or any other sign of damage that may have occurred during shipment.

NOTE: If damage is found, request an inspection by the carrier's agent within 48 hours of delivery and file a claim with the carrier. A claim for equipment damage in transit is the sole responsibility of the purchaser.

Storage

If the meter is not scheduled for installation soon after delivery and must be stored:

- After inspection, re-pack the meter into its original packing.
- If the meter being stored has been previously installed, remove all process fluids and corrosives.
- Store in a clean, dry site free of mechanical vibration, shock and chemical corrosives.

INTRODUCTION

The VN2000 Transmitter is supplied with all vortex flow meters. It is designed to be located on the head of the meter or remotely mounted from the meter, for easy viewing and access. Three configurations are available:

- The VN2000 Volumetric Flow Transmitter has a large, easy-to-read LCD indicator that displays flow rate and accumulated total flow.
- The VN2000 Mass Flow Transmitter also displays temperature compensated flow rate.
- The VN2000 Energy Flow Transmitter also displays compensated flow rate (BTU/hr or kBTU/hr), total flow (total BTU), operating temperature, and outgoing and returning temperature.

The control panel keys used to program parameters including engineering units, line sizes (insertion only), 4…20 mA span adjustments and to recalibrate for new flow conditions.

All internal parameters of the flow meter can be read via the VN2000 Transmitter.

The transmitter has a built-in non-volatile memory for setup and calibration data with the ability to field-calibrate. All transmitters are factory-tested and programmed.

PRODUCT LABEL

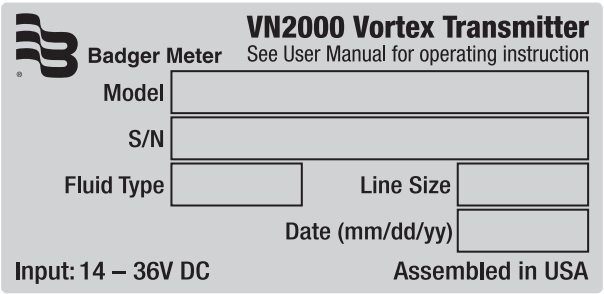


Figure 1: VN2000 transmitter label

INSTALLING THE TRANSMITTER

The remote transmitter enclosure has a mounting bracket for wall mounting. Locate the enclosure within 30 feet of the pipeline sensor and at eye level for easy viewing and access to the control panel keys for programming.

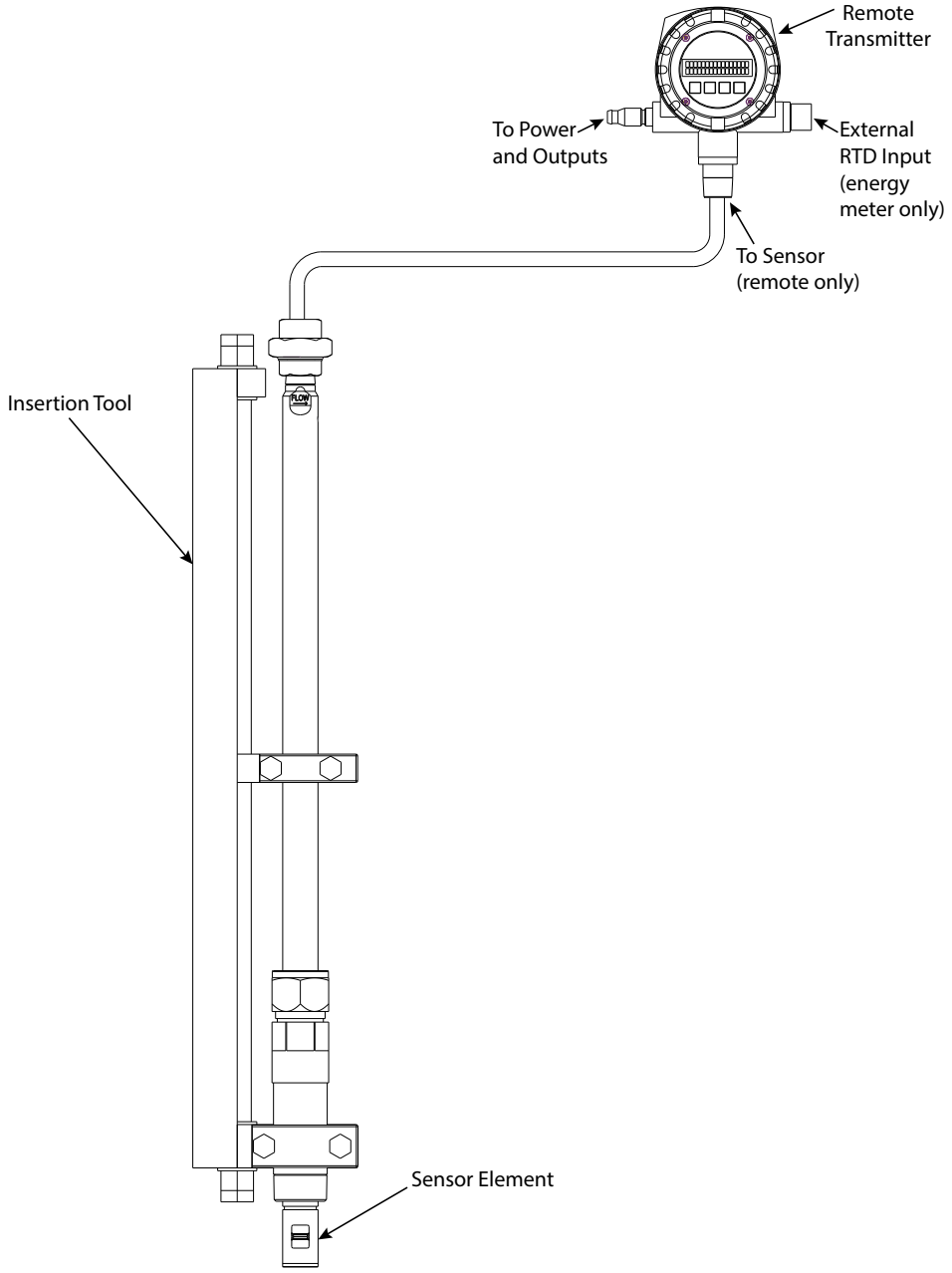


Figure 2: Remote installation

Rotating the Display

To adjust the orientation of the display for easier viewing:

1. Unscrew and remove the faceplate cover.
2. Gently lift and turn the faceplate to the desired orientation.
3. Return the faceplate into the enclosure.
4. Replace the faceplate cover.

WIRING

The transmitter ships with a cable that has a connector on one end and flying leads with 4 or 5 wires on the other end. Use this cable to wire the power and outputs. The transmitter is available with two output options:

- 4…20 mA/pulse output; uses a 4-wire cable
- Modbus RTU or BACnet MS/TP; uses a 5-wire output

Display Only (No Output)	Black wire	24 VDC
	Blue wire	Ground
Pulse Output	Black wire	24 VDC
	Blue wire	Ground
	Brown wire	Pulse DC power
	White wire	Pulse output
Modbus RTU or BACnet MS/TP Output	Black wire	24 VDC
	Blue wire	Ground
	Gray wire	Data +
	Pink wire	Data -
	White wire	Signal Ground (only connect if needed)
4…20 mA Output, Loop Powered	Black wire	10…36 VDC
	Blue wire	4…20 mA signal

Table 1: Wiring

Grounding

Ground the power supply to DC ground or good earth ground. DO NOT connect to AC ground.

Analog Version, 4…20 mA

To wire for power, use 24 gauge with multi-pin power connector supplied with meter. Do not run the wire over transformers, motors, or any other magnetic field generating devices. Connect the end of wire to 24V DC for loop powering the device.

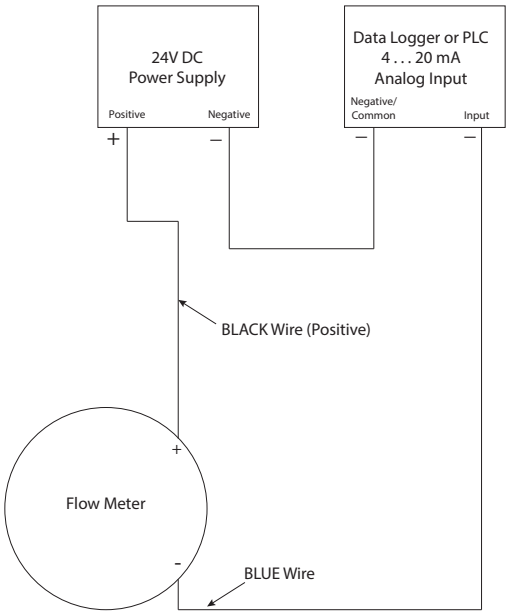


Figure 3: Analog version wiring diagram

CONNECTING CABLES

Connecting to the flow meter is easy using our plug-and-play design. No internal wiring is required. All cables are included with the meter.

Cable Description	Replacement Part Number
Transmitter power, 4…20 mA 4-pin cable, 9 ft (3 m)	68513-001
Transmitter power, Modbus RTU or BACnet MS/TP 5-pin cable, 9 ft (3 m)	68513-011
Transmitter-sensor or external RTD cable, 9 ft (3 m)	68513-007
Transmitter-sensor or external RTD cable, 30 ft (9 m)	68513-006

Table 2: Transmitter cables

1. Connect the wired end of the cordset to the power supply and outputs.

NOTE: DO NOT USE 110…220V AC without using an optional AC-to-DC power supply, available as an accessory.

2. Connect the other end of the cordset into the remote transmitter. Find the matching keyway between the plug and the connector in the enclosure. When the key finds the grooved slot, push the plug into the connector.
3. Slowly tighten the threaded connection. Make sure the plug is tightened all the way down into the plug socket.
4. If the transmitter is mounted remotely, use the cordset with connectors on both ends to connect to the sensor.
5. If the meter is an energy meter with an external RTD, use the cordset with connectors on both ends to connect to the external RTD. The external RTD and remote sensor cable are identical.
6. Apply power to the power supply.
7. The screen displays the version of the operating software.
8. After approximately 5 seconds, the rate and total display (if flow is present).

OPERATING THE VN2000 TRANSMITTER

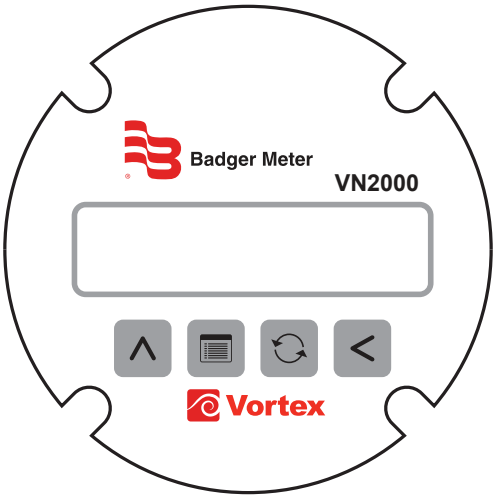


Figure 4: VN2000 transmitter

Control Panel Keys

To access the control panel keys, unscrew and remove the faceplate cover.

In *Password* or *Program* mode, press the **Up Arrow** key to increment the selected digit by one. In an idle state with the temperature adjustment enabled, press to toggle the display between *Totalizer* and *Temperature*.

Press the **Menu** key to move the control panel keys from an idle state to the *Password* mode.

Press the **Reset** key to reset the totalizer.

In *Password* or *Program* mode, press the **Left Arrow** key to move the cursor one digit to the left. If the cursor is already in the left-most position, press to move the cursor to the right-most position.

Display Modes

The VN2000 Transmitter has a 32-character display that is organized as two rows of 16 characters each.

The display software is designed to operate in one of three modes.

NOTE: The options available in the *Programming* mode will vary, depending on the media (steam, gas or liquid) for which the transmitter was configured:

- *Startup*
- *Operational*
- *Programming* (Three Levels)

Startup Mode

The *Startup* mode begins when the system is first powered on or when the system transitions from the programming mode. The initial screen displays for about 10 seconds. The top line of the display shows the company name. The bottom line shows the product name and the hardware revision number. The display cannot be changed during this mode.

```
 BADGER METER
 VN2000 REV 1
```

Operational Mode

The *Operational* mode is the main mode of the transmitter. The top line of the display shows the *Flow Rate*. The bottom line of the display shows the *Totalizer* value.

```
  0.0000  LB/HR
0000000000    LB
```

The bottom line of the display can also have alternate uses in this mode. For example, if the transmitter detects an event, it displays an alarm message alternating with the *Totalizer* value. See *"Alarm Messages" on page 22* for a list of possible alarms and how to clear them.

```
  0.0000  LB/HR
BAD TEMPERATURE
```

In the *Operational* mode, the transmitter displays the *Temperature* and *Pressure* values alternating with the *Totalizer* value. The *Temperature* and *Pressure* values are available only if they have been configured to be read and they are not being overridden with manual values. This portion of the display shows either *Temperature*, *Pressure* or both. The table below shows what displays.

Temperature		Pressure		Displayed
Enabled	Manual Override	Enabled	Manual Override	
yes	no	yes	no	Temperature and Pressure
yes	no	yes	yes	Temperature
yes	no	no	—	Temperature
yes	yes	yes	no	Pressure
no	—	yes	no	Pressure

Table 3: Temperature and pressure values

In all other cases, the option to display *Temperature* or *Pressure* is not available.

To activate the option to display *Temperature* or *Pressure*, press **Up Arrow** to scroll through three display patterns:

- *Totalizer* value only
- *Temperature* and *Pressure* only
- Alternating the display between the *Totalizer* and the *Temperature*/*Pressure* display

NOTE: Independent of the active display pattern, any event alert message automatically alternates with the display or is included in the alternating pattern.

NOTE: When the system is powered ON, the warning messages, display pattern, remote message suppression and any remote messages are cleared.

Reset Total

Press **Reset** to reset total.

Programming Mode

The transmitter automatically exits the programming mode after 20 seconds with no key presses.

The three levels of the *Programming Mode* are detailed in the following sections.

Programming Mode Level 1

NOTE: Currently, the word "Pressure" displays on the screen, but the *Pressure* feature is not yet supported.

NOTE: The options available in the *Programming* mode will vary, depending on the fluid type (steam, gas or liquid) and function (Mass, Volumetric or Energy) for which the transmitter is configured:

With power ON and *Flow Rate* and *Flow Total* displayed, press **Menu** to cycle through the Level 1 programming options:

- *Pipe Size* (Insertion meters only)
- *Units of Measure*
- *Flow Measurement Time Interval*
- *K-Factor* (Inline meters only)
- *Low Flow Cutoff (4 mA)*
- *Max Flow (20 mA)*
- *Pulse Rate*
- *Pulse Width*

Pipe (Line) Size (Insertion Only)

The transmitter automatically calculates the flow rate from the pipe dimensions and fluid velocity. The K-Factor Source option in Programming Mode Level 3 determines which type of pipe dimension entry appears.

Line Size	DN	Pipe ID
Select pipe size in inches for ASME pipe. To set the pipe schedule, select the *Schedule* in *Programming Mode Level 3*	Select pipe size in millimeters nominal diameter (DN) pipe	Enter the pipe size in inches for the inner diameter (ID)
Press **Up Arrow** to increase the size. The list will wrap around and start with the smallest pipe size	Press **Up Arrow** to increase the size. The list will wrap around and start with the smallest pipe size	Press **Left Arrow** to select the digit to change. Press **Up Arrow** to increase the number

Table 4: Pipe size settings

```
LINE SIZE
  6 in
```

Units of Measure (Engineering Units)

Press **Up Arrow** to scroll through the engineering units. Stop pressing when the proper unit is displayed. That unit is now the unit of measure. When the units are changed, the *Flow Total* and *Flow Rate* are automatically adjusted.

```
ENGINEERING UNIT
GAL
```

Units Base	Steam	Liquids	Gases	Energy Meter
English	Pounds (LB) Tons (TON) Cubic Feet (FT^3) Gallons (GAL)	Pounds (LB) Tons (TON) Cubic Feet (FT^3) Gallons (GAL) Oil Barrels (BBL)	Pounds (LB) Tons (TON) Cubic Feet (FT^3) U.S. Gallons (GAL)	British Thermal Units (BTU) Tons (TON)
Metric	Kilograms (KG) Tonnes (TNN) Cubic Meters (M^3) Liters (LTR)	Kilograms (KG) Tonnes (TNN) Cubic Meters (M^3) Liters (LTR)	Kilograms (KG) Metric Tonnes (TNN) Natural Cubic Meters (Nm^3) Natural Liters (Nlt)	—
Actual English	—	—	Pounds (LB) Tons (TON) Actual Cubic Feet (Acf) U.S. Gallons (GAL)	—
Natural Metric	—	—	Kilograms (KG) Metric Tonnes (TNN) Actual Cubic Meters (Am^3) Actual Liters (Alt)	—

Table 5: Units of measure

Units of Measure (Time Base)

Press **Up Arrow** to scroll through the *Time Base* options. Stop pressing when the proper time is displayed. The options are SEC (seconds), MIN (minutes), HR (hour) and DAY.

```
TIME BASE
HR
```

K-Factor (Inline Meters Only)

The *K-Factor* is used for VN2000 inline vortex flow meters. The transmitter automatically generates the *K-Factor* based on the flow meter model type and bore size.

NOTE: DO NOT change the K-factor that has come with your device without first consulting the factory.

To change the *K-Factor*, press **Left Arrow** to move the cursor under the digit to be changed. Press **Up Arrow** to change the digit. If the *K-Factor* does not match the "VN2000 SF" found on the bottom right of your sizing sheet, contact the manufacturer.

Low Flow Cutoff

The *Low Flow Cutoff* is factory-set to the minimum flow rate of the meter. Below this number, the meter gives 4 mA output and displays zero flow reading.

```
LOW FLOW CUTOFF
000000   GAL/HR
```

The meter reading drops to zero when the flow drops below the minimum setting. To measure flow below the minimum range of measurement, lower the setting. Press **Up Arrow** to increment each digit. Press **Left Arrow** to move the cursor to the next digit.

Max Flow (20 mA)

Use *Max Flow* to span and adjust the 4 mA and 20 mA range based on your flow range. The number must represent the 20 mA setting on the receiving PLC or other analog input device. Once this number matches what 20 mA represents on the receiving device, the 4…20 mA span will be correct and the meter's output from *Max Flow* to zero reading will match what is showing on the display. For example, if Max Flow is set to 500, then 250 will output 12 mA (12 mA is in the middle of 4…20 and 250 is the middle of 500).

```
MAX FLOW (20 MA)
0057000  GAL/HR
```

Pulse Rate

The *Pulse Rate* option adjusts the number of pulses for a flow unit and the number of units that are represented by a pulse.

Press **Up Arrow** to scroll through the pulse rate options:

- OFF = Turns off pulser
- 1 unit per pulse
- 0.1 unit per pulse
- 0.01 unit per pulse
- 0.001 unit per pulse
- 10 units per pulse
- 100 units per pulse
- 1000 units per pulse

Pulse Width

The pulse width is predefined with 5 widths and directions of pulse.

- 10, 20, 50, 100 or 150 ms negative
- 10, 20, 50, 100 or 150 ms positive

Programming Mode Level 2 (*****-**-C)

With the power ON and *Flow Rate* and *Flow Total* displayed, press **Left Arrow**. When a text string with -C at the end is displayed, press **Menu** to scroll through the second programming level options.

Level 2 programming options:

- *Mass Flow Mode*
- *Flow Adjust (In-Field Calibration)*
- *Vortex Threshold*
- *Change Password*

Mass Flow Temperature/Pressure Input (Gas and BTU/Energy Meters Only)

The *Mass Flow Mode* turns on the other RTD and/or pressure sensors (if present) in the flow meter. It also allows the entry of a mean pressure and/or temperature for fixed Mas Flow calculations

Press **Up Arrow** to scroll through the *Mass Flow Mode* options.

Temperature Input	Auto	Uses the internal RTD reading in the *Mass Flow* calculations
	Manual	Uses a fixed temperature in the mass flow calculations. Enter mean temperature when prompted. For BTU/Energy meters, enter source and return temperature
Pressure Input	Auto	(Future)
	Manual-Pressure	Uses a fixed pressure in the mass flow calculations. Enter mean pressure when prompted

Table 6: Mass flow mode options

Flow Adjust

The *Flow Adjust* option allows for field calibration of each vortex flow meter without changing core application data, such as the K-factor.

```
ADJUST FLOW?
OFF
```

Use *Flow Adjust* only as a last resort if there can be no change to the location of the installation or overall flow profile due to:

- Inadequate upstream and downstream piping
- Large piping
- Obstructions
- Overall flow turbulence

The *Flow Adjust* option only operates—and should only be used—for in-field calibration while the meter is reading steady flow.

Press **Up Arrow** to scroll through the in-field calibration options:

Set Flow	Calibrates based on flow rate
Set Ratio	Calibrates based on total accumulated flow
Reset	Removes any calibration previously done and returns the factory settings to the meter
ON	Displays when the meter has been calibrated and the calibration option is ON
OFF	Displays when no calibration has been done

Table 7: Flow adjust options

Set Flow

1. Press **P**. The "New Flow Rate" message displays. This is a snapshot of the current flow rate.

```
NEW FLOW RATE
000000  GAL/HR
```

2. Press **Left Arrow** to move the cursor and **Up Arrow** to change the digits to the desired flow rate.
3. Press **Menu** and let the meter come back to *Flow Rate* and *Flow Total*.

The VN2000 Transmitter adjusts the internal calibration curve, allowing the new flow rate to appear.

Set Ratio

1. When the *Set Ratio* menu displays, press **P**. The "Ratio – 1.00" message displays.
2. Press **Left Arrow** to move the cursor and **Up Arrow** to change the digits to the desired ratio.
3. Press **Menu** and let the meter come back to *Flow Rate* and *Flow Total*.

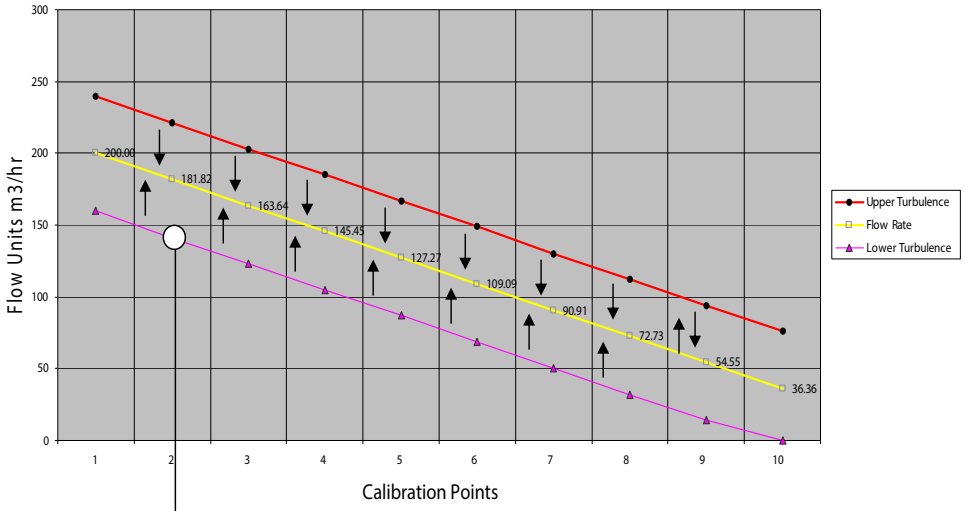
The VN2000 Transmitter adjusts the internal calibration curve, allowing the new ratio to appear.

The ratio of one (1) equals the current total in the VN2000 Transmitter totalizer.

Example 1: If the total accumulated flow is 25% higher than it should, change the ratio to 0.75% to lower the internal curve and all accumulated flow readings by 25%.

Example 2: If the total accumulated flow is 25% lower than it should, change the ratio to 1.25% to raise the internal curve and all accumulated flow readings by 25% .

NOTE: Brownouts and blackouts do not affect the in-field calibrated settings. Select *RESET* to completely remove all in-field calibrated settings.



Current Flow Rate is being affected by poor flow profile, driving the flow rate lower. This entire curve can be adjusted upward to the correct Flow Rate by entering the correct Flow Rate in Flow Adjust mode: ***181 m3/hr***. The new curve will have repeatability of ± 0.25%.

Figure 5: In-field calibration points

Vortex Threshold

The *Vortex Threshold* feature:

- Is designed to the get the most out of low flow conditions.
- Is meant to be used in high density fluids like liquids where signals are large.
- Is set at the factory and should not be changed unless consulting the factory first.
- Has settings range from 0…7, with 0 being the most sensitive and 7 being the least sensitive.

The typical *Vortex Threshold* setting for liquid, gases and steam is 3. If the setting is not at 3, consult the factory.

When to use the *Vortex Threshold* settings:

- The flow meter has been installed and the operating condition is very close or below the meter's minimum.
- There is zero flow rate at normal operating conditions, or the flow rate is bouncing to zero, or the flow rate is much lower than expected. In this case, increase the sensitivity of the dual sensors by lowering the *Vortex Threshold* settings.
  - ◊ To increase the sensitivity of the dual sensors, lower the threshold to 2, 1, or 0.
  - ◊ Zero (0) is the most sensitive settings.
  - ◊ Do not raise the threshold setting above 3, unless the factory recommends it.

Change Password

The *Password Security* feature lets you create a password to stop any unauthorized user from tampering with settings or parameters within the VN2000 Transmitter electronics.

Every VN2000 Transmitter does not come with a password. The security password can be created in this program mode. Any user will be required to enter this password before entering into the *Program Mode*. If the correct password is not entered, NO flow meter settings or parameters can be changed.

How to set your password:

1. Press **Menu** until the *Enter Password Setting* option appears. The default Password is 000000.
2. Press **Left Arrow** to position the cursor under each number.
3. Press **Up Arrow** to select each digit.
4. Confirm the password by repeating steps 2 and 3.
5. Let the program mode sit for 10 seconds until *Flow Rate* and *Flow Total* displays.

If any user wants to change flow meter settings, they have to first enter the correct password.

NOTE: If an incorrect password is entered, the VN2000 Transmitter immediately reverts back to the *Flow Rate* and *Flow Total* display.

Programming Mode Level 3 (*****-**-S)

With the power ON and *Flow Rate* and *Flow Total* displayed, press **Left Arrow**, then **Up Arrow**. When a text string with -S at the end is displayed, press **Menu** to scroll through the Level 3 programming options:

- *4 mA Field Calibration*
- *20 mA Field Calibration*
- *Units Base* (English or Metric)
- *Dampening*
- *Meter Type*
- *K-Factor Source* (Insertion meters only)
- *K-Factor* (Insertion meters only)
- *Schedule* (Insertion meters only)
- *Gas Constant* (if Fluid is set to Gas)
- *Temperature Calibration*
- *Application*
- *Settings*
- *Vibration Control*

Units Base (Flow or Mass Meters)

The *Units Base* option is used at the factory to set up all internal units to English or Metric.

Dampening

The *Dampening* option allows adjustment of the *Flow Rate Averaging* or *Dampening*. The most common use for this feature is to eliminate high flow variation or to lessen the flow rate change on the display that is due to the flow dynamics in the pipe. This option allows for stabilization of the flow reading when erratic flow is present in the pipe.

Press **Up Arrow** to scroll through the *Dampening* options:

- The Auto Setting is used for steam and gases:
  - ◊ The *Auto Setting* uses mathematical calculations to determine the correct dampening setting.
  - ◊ When the flow rate is steady (not changing more than 15% from one reading to the next), the dampening is set to the highest setting to provide stable and reliable flow readings.
  - ◊ When the flow rate is fluctuating (changing more than 15% from one reading to the next), dampening is decreased to provide a quick response time to flow rate changes.
- The *1-5 Setting* sets faster response times.
- The *6-9 Setting* sets slower response times for steadier instantaneous flow readings.

IMPORTANT

All liquid applications should be set to a dampening of 8. All steam and gas applications should be set to a dampening of Auto.

NOTE: All totalized flow rate is counted, regardless of the dampening setting. The totalizer NEVER misses any reading based on the dampening selected.

Meter Type

The *Meter Type* option adjusts the electronics to work with all meter types in the VN2000 Flow Meter Series (large or small, inversion or insertion).

Verify that the *Meter Type* is **Large Insertion**.

IMPORTANT

DO NOT change this setting. Contact the factory if you suspect this setting has been changed.

K-Factor Source (Insertion Meter Only)

Use the K-Factor Source option to indicate the type of pipe used for flow calculations.

Line Size	Use for ASME pipe along with *Schedule* option. Select the pipe size in *Programming Mode Level 1*
DN	Use for DN pipe. Select the pipe size in *Programming Mode Level 1*
Pipe ID	Use for non-standard pipes or when the pipe inner diameter (ID) can be measured directly. Enter the pipe size in *Programming Mode Level 1*
K-Factor Entry	Use K-Factor only and not pipe dimensions in calculations. When *K-Factor Entry* is selected, the pipe size option does not appear in *Programming Mode Level 1*

Table 8: K-factor source options

K-Factor (Insertion Meter Only)

The *K-Factor* is used for VN2000 insertion vortex flow meters. The transmitter automatically generates the K-Factor based on the flow meter model type and bore size.

NOTE: DO NOT change the *K-Factor* that came with your device without first consulting the factory.

To change the *K-Factor*, press **Left Arrow** to move the cursor under the digit to be changed. Press **Up Arrow** to change the digit. If the *K-Factor* does not match the "VN2000 SF" found on the bottom right of your sizing sheet, contact the manufacturer.

Schedule (Insertion Meter Only)

When the *K-Factor Source* is *Line Size*, use the *Schedule* option to select the pipe schedule.

Density (Volumetric Liquid meters)

For liquid meters without temperature compensation, the meter uses *Density* to calculate the mass flow when pounds (LB), tons (TON), Kilograms (KG) or Tonnes (TNN) is selected for the units. Enter density in kilogram/cubic meter or pounds/cubic feet.

Gas Constant (Gas Only)

Use the *Gas Constant* option only when the gas has characteristics that require calculations other then the standard formula for calculating the effects of temperature and pressure on the gas flow rate.

Specific Gravity (Volumetric Gas meters)

For gas meters without temperature compensation, the meter uses Specific Gravity to calculate the mass flow when pounds (LB), tons (TON), Kilograms (KG) or Tonns (TNN) is selected for the units. Enter the specific gravity of the gas at typical temperature and pressure.

Temperature (Supply/Return) Calibration

The *Temp Calibration* option calibrates the internal RTD located in the flow meter body and is used only with mass meters that have the Mass Flow Transmitter. For BTU meters with an external RTD and internal RTD located in the flow meter body, the transmitter has both the Supply and Return temperature calibration information. The calibration is done at the factory and these settings should NOT be changed unless for reasons below:

Press **Up Arrow** to scroll through the options:

- *Temp Offset* is factory-set and should NOT be changed
- *Temp Gain* is factory-set and should NOT be changed except to calibrate the operating pressure and temperature in the steam flow meter.
  - ◊ If the operating internal pressure and temperature of the flow meter must be in-field calibrated, do the following:
    - To calibrate to a higher setting, increase the *Temp Gain* by 10 units at a time until the desired operating pressure and temperature display on the transmitter
    - To calibrate to a lower setting, decrease the *Temp Gain* by 10 units at a time until the desired operating pressure and temperature display on the transmitter.

Application

The *Application* option sets up the flow meter for the desired fluid type and application. The *Application* is factory-set. The setting is based on the application fluid type and should NOT be changed. If the incorrect fluid type is selected, please contact the factory immediately.

Modbus Address (Modbus RTU Transmitter Only)

Enter the Modbus RTU address. See the "VN2000 Flow Meters Modbus User Manual."

BACnet Address (BACnet MS/TP Transmitter Only)

Enter the BACnet address 0…127 for the meter. See the "VN2000 Flow Meters BACnet User Manual."

BACnet ID (BACnet MS/TP Transmitter Only)

Enter the BACnet network ID 0...4194302 for the meter, if used. See the "VN2000 Flow Meters BACnet User Manual."

Baud Rate (Modbus RTU or BACnet MS/TP Transmitter Only)

Enter the baud rate: 9600, 19200, 38400, 57600, 76800, 115200

Settings

Initially, the meter shows field settings that have been factory-set for your particular application parameters.

This option lets you reset all program settings to factory settings, if required. DO NOT change to factory settings unless advised to do so by the manufacturer.

Vibration Control

The *Vibration Control* settings block out unwanted vibration or other frequencies that may affect the flow meter accuracy or repeatability.

High	The highest vibration control setting helps with no-flow condition and active flow condition. Use in locations where vibration is present.
Medium	Good vibration control helps with no-flow condition and active flow. Use this setting for steam and gases.
Low	Basic vibration control during no-flow condition and active flow. Use this setting for liquids.
Off	No vibration control activated.

Table 9: Vibration control settings

Language

Select the language for the readings, menus and messages: ENGLISH, FRANÇAIS, DEUTSCH, ESPAÑOL

SPECIFICATIONS

Display	2×16 characters reflective display Rotatable display Flow rate: 6 digits with decimal Totalizer
Keypad	4 membrane buttons
Power	14…36 V DC; loop powered with 4…20 mA option, 28V DC max
Operating Temperature	32…140° F (0… 60° C) 5…95% relative humidity non-condensing
Output	One 4…20 mA, 10…36V max load, 24-bit resolution; Available Communication and I/O Standard option "S"
Digital Output	One min. input resistance 1000 Ohm Max output frequency = 12.5 Hz Opto isolator 5…24V DC Available Communication and I/O Standard option "S"
Communication	EIA-485 with Modbus RTU (9600, 14400, 19200 baud) available Communication and I/O Standard option "M" or BACnet MS/TP (9600, 19200, 38400, 76800 baud) available Communication and I/O Standard option "B"
Enclosure	General purpose
Mounting	Integral meter or remote pipe and wall; Up to 30 ft (10 m) from pipe
Cable	Cable jacket material: polyurethane (gray) Operating temperature –13…185° F (–25…85° C)

ALARM MESSAGES

The following alarm messages may appear during operation:

Message	Meaning	Solution
BAD START MEMORY	The flash memory for the system did not load and a default configuration was assumed.	Replace the transmitter.
BAD TEMPERATURE	Temperature was out of range.	Check the process for very low or very high temperatures. Check cable connectors for loose connectors or corrosion
BELOW LOW FLOW	This message indicates that the meter is operating properly but the flow conditions may be out of range for your desired operation.	Check the process system for pump or valve operation if this condition is not expected. Change the LOW FLOW CUTOFF value, if needed.
CHECK MAN. PRESS.	The manual pressure entry is out of range for the application.	Program the manual pressure entry to the correct value and units.
CHECK MAN. TEMP.	The manual temperature entry is out of range for the application.	Program the manual temperature entry to the correct value and units.
CHECK TEMP.	This message will display for saturated steam meters when the temperature in the pipe is below 212° F (100° C). When the temperature inside the pipe reaches 212° F (100° C) and greater, this message disappears and flow rate shows compensated flow rate and total accumulated flow.	Check the steam system for proper temperature and operation. If the steam is at 212° F (100° C) or greater, check the RTD in the meter.
OVER MAX FLOW	This message displays when the actual flow rate has exceeded the max flow (20 mA) setting in the VN2000 Transmitter representing the 20 mA output. The flow meter continues to display an unlimited maximum flow rate. However, the output stays at 20 mA.	Check the process system for pump or valve operation, if this condition is not expected. Change the max flow (20 mA) setting, if needed.
HIGH PULSE RATE	The pulse rate is too fast for the hardware.	Check PULSE RATE entry and flow rate displayed. Lower PULSE RATE to a slower setting.
LOW PULSE RATE	The pulse rate is too slow for the hardware.	Check PULSE RATE entry and flow rate displayed. Raise PULSE RATE to a faster setting.
NO PRESSURE	If the Pressure Sensor is enabled, then the system was unable to read the sensor.	Check that a pressure sensor was included in the vortex sensor.
NO TEMPERATURE	If the Temperature Sensor is enabled, then the system was unable to read the sensor.	Disconnect power. Check that the sensor included an RTD. Check cable connectors for loose connectors or corrosion. Remove power from the transmitter and open the transmitter. With an Ohm meter, measure the resistance between the gray, white and pink wires. Gray and white, 0…3 Ohms Gray and pink, approximately 100 Ohms White and pink, approximately 100 Ohms

Table 10: Alarm messages

TROUBLESHOOTING

Screen is blank (No display)	Verify that you have 24V DC.
	Verify that power polarity is correct (Black +24V DC & Blue -24V DC).
Screen shows no flow rate during flow	Check arrow and alignment hole on the top of the probe. They must be pointing down the pipe in the direction of flow.
	Take a measurement from the top of the stainless steel probe to the top hole in the center of the pipe. The overall length of the meter from the shedder bar to the hole is XX. The length of XX minus the length measured is the distance the meter is in the pipe. Make sure the meter is in the center of the pipe and not sitting inside the valve assembly or close to the inside wall of the pipe.
Flow rate is erratic	Check to see what is installed upstream of the flow meter. Other instruments or devices before the flow meter can shed vortices of their own causing a disruption in flow reading.
	Check to see if there are any valve, tees or elbows upstream of flow meter. If these items are too close to the flow meter then they can cause disruption in flow reading.
	Check to see what size hole is drilled into the pipe for insertion. If an existing hole larger than 1.5 inch was used, the larger hole can create turbulence directly above the flow sensor.
Flow rate seems incorrect	Review the program settings and make sure the correct line size is chosen for your application. If this is a multi-variable MASS unit, make sure the correct pressure and temperature is being displayed on the screen. If this is a fixed MASS unit, make sure the correct operating pressure is entered into the electronics for calculations.

Table 11: Troubleshooting

Transmitters and replacement electronics are available. Please contact the factory for proper selection.

REMOVING VN2000 TRANSMITTER ELECTRONICS

1. Turn OFF power to the transmitter.
2. Remove the enclosure lid.
3. Remove the transmitter electronics:
   a. Insert a standard screwdriver under one of the slits along the sides of the case.
   b. Carefully put your thumb or finger under the end of the screwdriver
   c. Using the end of the screwdriver as a lever, press down on the handle to move the transmitter slowly out of the case.
   d. Repeat steps 3a, 3b and 3c for each slit until the case can be pulled out with the fingers.
   e. Press down on the connector tab and pull straight out.

⚠CAUTION

DO NOT TO BEND THE CONNECTOR. PULL IT STRAIGHT OUT. DO NOT PUT EXCESSIVE PRESSURE ON THE PLUG BECAUSE DAMAGE TO THE PLUG OR CONNECTOR ON THE BOARD MAY OCCUR.

NORTH AMERICAN PIPE SCHEDULES

Steel, Stainless Steel, PVC Pipe, Standard Classes

NPS in.	OD in.	SCH 60		X STG.		SCH 80		SCH 100		SCH 120/140		SCH 180	
		ID in.	Wall in.	ID in.	Wall in.	ID in.	Wall in.	ID in.	Wall in.	ID in.	Wall in.	ID in.	Wall in.
1	1.315	—		0.957	0.179	0.957	0.179	—		—		0.815	0.250
1.25	1.660			1.278	0.191	1.278	0.191					1.160	0.250
1.5	1.900			1.500	0.200	1.500	0.200					1.338	0.281
2	2.375			1.939	0.218	1.939	0.218					1.687	0.344
2.5	2.875			2.323	0.276	2.323	0.276					2.125	0.375
3	3.500			2.900	0.300	2.900	0.300					2.624	0.438
3.5	4.000	—		3.364	0.318	3.364	0.318	—		—		—	
4	4.500			3.826	0.337	3.826	0.337			3.624	0.438	3.438	0.531
5	5.563			4.813	0.375	4.813	0.375			4.563	0.500	4.313	0.625
6	6.625			5.761	0.432	5.761	0.432			5.501	0.562	5.187	0.719
8	8.625	7.813	0.406	7.625	0.500	7.625	0.500	7.437	0.594	7.178	0.719	6.183	1.221
10	10.75	9.750	0.500	9.75	0.500	9.562	0.594	9.312	0.719	9.062	0.844	8.500	1.125
12	12.75	11.626	0.562	11.75	0.500	11.37	0.690	11.06	0.845	10.75	1.000	10.12	1.315
14	14.00	12.814	0.593	13.00	0.500	12.50	0.750	12.31	0.845	11.81	1.095	11.18	1.410
16	16.00	14.688	0.656	15.00	0.500	14.31	0.845	13.93	1.035	13.56	1.220	12.81	1.595
18	18.00	16.564	0.718	17.00	0.500	16.12	0.940	15.68	1.160	15.25	1.375	14.43	1.785
20	20.00	18.376	0.812	19.00	0.500	17.93	1.035	17.43	1.285	17.00	1.500	16.06	1.970
24	24.00	22.126	0.937	23.00	0.500	21.56	1.220	20.93	1.535	20.93	1.535	19.31	2.345
30	30.00	—		29.00	0.500	—		—		—		—	
36	36.00			35.00	0.500								
42	42.00			41.00	0.500								
48	48.00			47.00	0.500								

Steel, Stainless Steel, PVC Pipe, Standard Classes (continued)

NPS in.	OD in.	SCH 5		SCH 10 (Lt Wall)		SCH 20		SCH 30		STD		SCH 40	
		ID in.	Wall in.	ID in.	Wall in.	ID in.	Wall in.	ID in.	Wall in.	ID in.	Wall in.	ID in.	Wall in.
1	1.315	1.185	0.065	1.097	0.109	—		—		1.049	—	1.049	0.133
1.25	1.660	1.53	0.065	1.442	0.109					1.380		1.380	0.140
1.5	1.900	1.77	0.065	1.682	0.109					1.610		1.610	0.145
2	2.375	2.245	0.065	2.157	0.109					2.067		2.067	0.154
2.5	2.875	2.709	0.083	2.635	0.120					2.469		2.469	0.203
3	3.500	3.334	0.083	3.260	0.120					3.068		3.068	0.216
3.5	4.000	3.834	0.083	3.760	0.120	—		—		3.548	—	3.548	0.226
4	4.500	4.334	0.083	4.260	0.120					4.026	0.237	4.026	0.237
5	5.563	5.345	0.109	5.295	0.134					5.047	0.258	5.047	0.258
6	6.625	6.407	0.109	6.357	0.134					6.065	0.280	6.065	0.280
8	8.625	8.407	0.109	8.329	0.148	8.125	0.250	8.071	0.277	7.981	0.322	7.981	0.322
10	10.75	10.482	0.134	10.42	0.165	10.25	0.250	10.13	0.310	10.02	0.365	10.02	0.365
12	12.75	12.42	0.165	12.39	0.180	12.25	0.250	12.09	0.330	12.00	0.375	11.938	0.406
14	14.00	—		13.50	0.250	13.37	0.315	13.25	0.375	13.25	0.375	13.124	0.438
16	16.00			15.50	0.250	15.37	0.315	15.25	0.375	15.25	0.375	15.000	0.500
18	18.00			17.50	0.250	17.37	0.315	17.12	0.440	17.25	0.375	16.876	0.562
20	20.00			19.50	0.250	19.25	0.375	19.25	0.375	19.25	0.375	18.814	0.593
24	24.00			23.50	0.250	23.25	0.375	23.25	0.375	23.25	0.375	22.626	0.687
30	30.00	—		29.37	0.315	29.00	0.500	29.00	0.500	29.25	0.375	29.25	0.375
36	36.00			35.37	0.315	35.00	0.500	35.00	0.500	35.25	0.375	35.25	0.375
42	42.00			—		—		—		41.25	0.375	41.25	0.375
48	48.00									47.25	0.375	47.25	0.375

Copper Tubing, Copper and Brass Pipe, Aluminum

Nominal Diameter in.		Copper Tubing in. Type K	Copper Tubing in. Type L	Copper Tubing in. Type M	Copper & Brass Pipe in.	Alum. in.	Nominal Diameter in.		Copper Tubing in. Type K	Copper Tubing in. Type L	Copper Tubing in. Type M	Copper & Brass Pipe in.	Alum. in.
0.5	OD	0.625	0.625	0.625	0.840	—	3.5	OD	3.625	3.625	3.625	4.000	—
	Wall	0.049	0.040	0.028	0.108			Wall	0.120	0.100	0.083	0.250	
	ID	0.527	0.545	0.569	0.625			ID	3.385	3.425	3.459	3.500	
0.6250	OD	0.750	0.750	0.750	—	—	4	OD	4.125	4.125	4.125	4.500	4.000
	Wall	0.049	0.042	0.030				Wall	0.134	0.110	0.095	0.095	0.250
	ID	0.652	0.666	0.690				ID	3 857	3.905	3.935	3.935	4.000
0.75	OD	0.875	0.875	0.875	1.050	—	4.5	OD	—	—	—	—	5.000
	Wall	0.065	0.045	0.032	0.114			Wall					0.250
	ID	0.745	0.785	0.811	0.822			ID					4.500
1	OD	1.125	1.125	1.125	1.315	—	5	OD	5.125	5.125	5.125	5.563	5.000
	Wall	0.065	0.050	0.035	0.127			Wall	0.160	0.125	0.109	0.250	0.063
	ID	0.995	1.025	1.055	1.062			ID	4.805	4.875	4.907	5.063	4.874
1.25	OD	1.375	1.375	1.375	1.660	—	6	OD	6.125	6.125	6.125	6.625	6.000
	Wall	0.065	0.055	0.042	0.146			Wall	0.192	0.140	0.122	0.250	0.063
	ID	1.245	1.265	1.291	1.368			ID	5.741	5.845	5.881	6.125	5.874
1.5.	OD	1.625	1.625	1.625	1.900	—	7	OD	—	—	—	7.625	7.000
	Wall	0.072	0.060	0.049	0.150			Wall				0.282	0.078
	ID	1.481	1.505	1.527	1.600			ID				7.062	6.844
2	OD	2.125	2.125	2.125	2.375	—	8	OD	8.125	8.125	8.125	8.625	8 000
	Wall	0.083	0.070	0.058	0.157			Wall	0,271	0.200	0.170	0.313	0.094
	ID	1.959	1.985	2.009	2.062			ID	7.583	7.725	7.785	8.000	7.812
2.5	OD	2.625	2.625	2.625	2.875	2.500	10	OD	10.125	10.125	10.125	10 000	—
	Wall	0.095	0.080	0.065	0.188	0.050		Wall	0.338	0.250	0.212	0.094	—
	ID	2.435	2.465	2.495	2.500	2.400		ID	9.449	9.625	9.701	9.812	—
3	OD	3.125	3.125	3.125	3.500	3.000	12	OD	12.125	12.125	12.125	—	—
	Wall	0.109	0.090	0.072	0.219	0.050		Wall	0.405	0.280	0.254	—	—
	ID	2.907	2.945	2.981	3.062	2.900		ID	11.315	11.565	11.617	—	—

Cast Iron Pipe, Standard Classes, 3…20 inch

Size in.		Class in.							
		A	B	C	D	E	F	G	H
3	OD	3.80	3.96	3.96	3.96	—	—	—	—
	Wall	0.39	0.42	0.45	0.48				
	ID	3.02	3.12	3.06	3.00				
4	OD	4.80	5.00	5.00	5.00	—	—	—	—
	Wall	0.42	0.45	0.48	0.52				
	ID	3.96	4.10	4.04	3.96				
6	OD	6.90	7.10	7.10	7.10	7.22	7.22	7.38	7.38
	Wall	0.44	0.48	0.51	0.55	0.58	0.61	0.65	0.69
	ID	6.02	6.14	6.08	6.00	6.06	6.00	6.08	6.00
8	OD	9.05	9.05	9.30	9.30	9.42	9.42	9.60	9.60
	Wall	0.46	0.51	0.56	0.60	0.66	0.66	0.75	0.80
	ID	8.13	8.03	8.18	8.10	8.10	8.10	8.10	8.00
10	OD	11.10	11.10	11.40	11.40	11.60	11.60	11.84	11.84
	Wail	0.50	0.57	0.62	0.68	0.74	0.80	0.86	0.92
	ID	10.10	9.96	10.16	10.04	10.12	10.00	10.12	10.00
12	OD	13.20	13.20	13.50	13.50	13.78	13.78	14.08	14.08
	Wall	0.54	0.62	0.68	0.75	0.82	0.89	0.97	1.04
	ID	12.12	11.96	12.14	12.00	12.14	12.00	12.14	12.00
14	OD	15.30	15.30	15.65	15.65	15.98	15.98	16.32	16.32
	Wall	0.57	0.66	0.74	0.82	0.90	0.99	1.07	1.16
	ID	14.16	13.98	14.17	14.01	14.18	14.00	14.18	14.00
16	OD	17.40	17.40	17.80	17.80	18.16	18.16	18.54	18.54
	Wall	0.60	0.70	0.80	0.89	0.98	1.08	1.18	1.27
	ID	16.20	16.00	16.20	16.02	16.20	16.00	16.18	16.00
18	OD	19.50	19.50	19.92	19.92	20.34	20.34	20.78	20.78
	Wall	0.64	0.75	0.87	0.96	1.07	1.17	1.28	1.39
	ID	18.22	18.00	18.18	18.00	18.20	18.00	18.22	18.00
20	OD	21.60	21.60	22.06	22.06	22.54	22.54	23.02	23.02
	Wall	0.67	0.80	0.92	1.03	1.15	1.27	1.39	1.51
	ID	20.26	20.00	20.22	20.00	20.24	20.00	20.24	20.00

Cast Iron Pipe, Standard Classes, 24…84 inch

Size in.		Class in.							
		A	B	C	D	E	F	G	H
24	OD	25.80	25.80	26.32	26.32	26.90	26.90	27.76	27.76
	Wall	0.76	0.98	1.05	1.16	1.31	1.45	1.75	1.88
	ID	24.28	24.02	24.22	24.00	24.28	24.00	24.26	24.00
30	O D	31.74	32.00	32.40	32.74	33.10	33.46	—	
	Wall	0.88	1.03	1.20	1.37	1.55	1.73		
	ID	29.98	29.94	30.00	30.00	30.00	30.00		
36	OD	37.96	38.30	38.70	39.16	39.60	40.04	—	
	Wall	0.99	1.15	1.36	1.58	1.80	2.02		
	ID	35.98	36.00	35.98	36.00	36.00	36.00		
42	OD	44.20	44.50	45.10	45.58	—			
	Wall	1.10	1.28	1.54	1.78				
	ID	42.00	41.94	42.02	42.02				
48	OD	50.55	50.80	51.40	51.98	—			
	Wall	1.26	1.42	1.71	1.99				
	ID	47.98	47.96	47.98	48.00				
54	OD	56.66	57.10	57.80	58.40	—			
	Wall	1.35	1.55	1.90	2.23				
	ID	53.96	54.00	54.00	53.94				
60	OD	62.80	63.40	64.20	64.28	—			
	Wall	1.39	1.67	2.00	2.38				
	ID	60.02	60.06	60.20	60.06				
72	OD	75.34	76.00	76.88	—				
	Wall	1.62	1.95	2.39					
	ID	72.10	72.10	72.10					
84	OD	87.54	88.54	—					
	Wall	1.72	2.22						
	ID	84.10	84.10						

Control. Manage. Optimize.

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