

### DESCRIPTION

The VN2000 Wafer Plate Inline Flow Meter measures the volumetric or mass flow rate or BTU/energy of steam, gas or liquids over a large flow range. The meter is available as a slim wafer meter.

The vortex wafer is CNC machined out of one piece of solid stainless steel and engineered to stand up to abusive environments inside and outside the pipe. The dual sensors are bonded inside the vortex element to better detect and eliminate process fluid noise or vibration from affecting the reading.

### BENEFITS

- Measure volumetric, mass flow rate or BTU/energy of steam, gas or liquids
- Inline meters for pipes 3/4...6 inch
- Reduced noise interference with dual piezoelectric sensors and filtering
- Standard model handles process temperatures up to 400° F (204° C)
- Reduced maintenance due to:
  - ◊ Heavy duty welded stainless steel construction
  - ◊ O-ring-free element
  - ◊ No moving parts
  - ◊ Piezoelectric and temperature sensors never touch process fluid

### APPLICATIONS

The unique design of the VN2000 meter can be used in steam, gas or liquid lines. The narrow wafer design allows the meter to be installed tight fitting locations.

- Saturated steam for heating
- Deionized water
- Compressed air
- Wet or dirty gas

### SIZING SOFTWARE

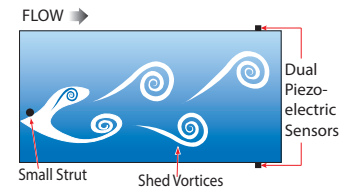
The Vortex Sizing Application software determines the best meter for your application based on:

- Fluid type
- Min. and max. operating flow rate
- Operating temperature
- Operating pressure



### OPERATION

An everyday example of a vortex shedding phenomenon is a flag waving in the breeze: the flag waves due to the vortices shed by air moving across the flagpole. Within the flow meter, as flowing fluid moves across the strut or “shedder bar”, vortices are shed on a smaller scale. The frequency of the vortices shedding is proportional to the fluid velocity.



Through the use of an internal RTD, the flow meter software compensates for changes in temperature to achieve an accurate mass flow measurement.

With the addition of a second external RTD, the meter can measure the energy transfer across a heat exchanger.

## SPECIFICATIONS

|                          | <b>Uncertainty</b>                                                                | <b>Repeatability</b> |
|--------------------------|-----------------------------------------------------------------------------------|----------------------|
| <b>Liquids</b>           | ±0.7% of reading                                                                  | ±0.25% of reading    |
| <b>Steam</b>             | ±0.7% of reading                                                                  | ±0.25% of reading    |
| <b>Gas</b>               | ±0.7% of reading                                                                  | ±0.25% of reading    |
|                          | <b>Mass or Heat Flow</b>                                                          | <b>Repeatability</b> |
| <b>Liquids</b>           | ±0.7% of reading                                                                  | ±0.25% of reading    |
| <b>Steam</b>             | ±0.7% of reading                                                                  | ±0.25% of reading    |
| <b>Gas</b>               | ±0.7% of reading                                                                  | ±0.25% of reading    |
| <b>Velocity – Liquid</b> | 32 ft/s (9.75 m/s) maximum                                                        |                      |
| <b>Velocity – Gas</b>    | 300 ft/sec (91.44 m/sec) maximum                                                  |                      |
| <b>Reynolds Range</b>    | 10,000...7,000,000 depending on fluid density                                     |                      |
| <b>Straight Run Pipe</b> | Upstream 10 diameters; downstream 5 diameters with one 90° elbow before the meter |                      |
| <b>Pipe sizes</b>        | 3/4...6 in. (19.05...152.40 mm)                                                   |                      |
| <b>Fluid temperature</b> | –250...400° F (–120...204°C)                                                      |                      |
| <b>Maximum Pressure</b>  | 1000 psi (68.9 bar)                                                               |                      |
| <b>Wetted Materials</b>  | Stainless steel 303                                                               |                      |
| <b>Connections</b>       | Wafer                                                                             |                      |

| Measurement Options                              | Sensors                                                                                                                |                                                                     |                                                                     |                                                                                           |
|--------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|---------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| Volumetric flow rate                             | Dual piezo vortex sensors                                                                                              |                                                                     |                                                                     |                                                                                           |
| Mass flow rate based on velocity and temperature | Dual piezo vortex sensors<br>RTD embedded in sensor: 100 Ohm, 3 wire (± 0.3 + 0.005t)°C                                |                                                                     |                                                                     |                                                                                           |
| BTU/Energy                                       | Dual piezo vortex sensors<br>RTD embedded in sensor: 100 Ohm, 3 wire<br>External 100 Ohm RTD input, (± 0.3 + 0.005t)°C |                                                                     |                                                                     |                                                                                           |
| Units of measure                                 | Units Base                                                                                                             | Steam                                                               | Liquids                                                             | Gases                                                                                     |
|                                                  | English                                                                                                                | Pounds (LB)<br>Tons (TON)<br>Cubic Feet (CFT)<br>Gallons (GAL)      | Pounds (LB)<br>Tons (TON)<br>Cubic Feet (CFT)<br>Gallons (GAL)      | Pounds (LB)<br>Tons (TON)<br>Cubic Feet (CFT)<br>U.S. Gallons (GAL)                       |
|                                                  | Metric                                                                                                                 | Kilograms (KG)<br>Tonns (TNN)<br>Cubic Meters (CUM)<br>Liters (LTR) | Kilograms (KG)<br>Tonns (TNN)<br>Cubic Meters (CUM)<br>Liters (LTR) | Kilograms (KG)<br>Metric Tons (TNN)<br>Natural Cubic Meters (Nm3)<br>Natural Liters (Nlt) |
|                                                  | Actual English                                                                                                         | —                                                                   | —                                                                   | Pounds (LB)<br>Tons (TON)<br>Actual Cubic Feet (Acf)<br>U.S. Gallons (GAL)                |
|                                                  | Natural Metric                                                                                                         | —                                                                   | —                                                                   | Kilograms (KG)<br>Metric Tons (TNN)<br>Actual Cubic Meters (Am3)<br>Actual Liters (Alt)   |
| Measurement interval                             | Second, minute, hour, day                                                                                              |                                                                     |                                                                     |                                                                                           |

## Transmitter

|                              |                                                                                                                                                                                      |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Display</b>               | 2×16 characters reflective display<br>Rotatable display<br>Flow rate: 6 digits with decimal<br>Totalizer                                                                             |
| <b>Keypad</b>                | 4 membrane buttons                                                                                                                                                                   |
| <b>Power</b>                 | 14...36V DC, loop powered with 4...20 mA option                                                                                                                                      |
| <b>Operating Temperature</b> | 32...140° F (0... 60° C)<br>5...95% relative humidity non-condensing                                                                                                                 |
| <b>Current Output</b>        | One 4...20 mA, 10...36V max load, 24-bit resolution<br>Adjust the 4 mA and 20 mA signal from the keypad and zero out any anomalies found between the meter and the monitoring device |
| <b>Digital Output</b>        | One min. input resistance 1000 Ohm<br>Max output frequency = 12.5 Hz<br>Opto isolator 5...24V DC                                                                                     |
| <b>Communication</b>         | EIA-485 with Modbus RTU (9600, 14400, 19200 baud) or BACnet MS/TP (9600, 19200, 38400, 76800 baud)                                                                                   |
| <b>Enclosure</b>             | General purpose                                                                                                                                                                      |
| <b>Mounting</b>              | Integral meter or remote mount; Up to 30 ft (10 m) from pipe (custom lengths available)                                                                                              |
| <b>Cable</b>                 | Cable jacket material: polyurethane (gray)<br>Operating temperature –13...185° F (–25...85° C)                                                                                       |

## FLOW RATE TABLES

## Saturated Steam

| Saturated Steam Minimum and Maximum Flow Rates (lb/hr) |             |              |               |               |                |                 |                  |
|--------------------------------------------------------|-------------|--------------|---------------|---------------|----------------|-----------------|------------------|
| Pressure <sup>2</sup><br>(Density) <sup>3</sup>        | 3/4 in.     | 1 in.        | 1.5 in.       | 2 in.         | 3 in.          | 4 in.           | 6 in.            |
| 5<br>(0.0486)                                          | 7.4<br>132  | 12.4<br>220  | 30.6<br>537   | 51.25<br>901  | 110<br>2005    | 200<br>3500     | 450<br>7920      |
| 50<br>(0.1503)                                         | 15.8<br>410 | 26.4<br>676  | 65.25<br>1616 | 105<br>2775   | 240<br>6210    | 420<br>11,000   | 960<br>24,500    |
| 100<br>(0.2577)                                        | 22.8<br>702 | 38<br>1158   | 92<br>2850    | 150<br>4760   | 340<br>10,650  | 598<br>18,550   | 1,375<br>42,000  |
| 150<br>(0.3614)                                        | 28.5<br>980 | 47.5<br>1630 | 110<br>4000   | 190<br>6670   | 425<br>15,000  | 760<br>26,000   | 1710<br>58,900   |
| 200<br>(0.4688)                                        | 34<br>1270  | 55<br>2110   | 135<br>5190   | 230<br>8660   | 519<br>19,360  | 898<br>33,700   | 1998<br>76,380   |
| 300<br>(0.6481)                                        | 42<br>1760  | 70<br>3000   | 170<br>7200   | 280<br>12000  | 640<br>26,800  | 1,100<br>46,600 | 2,540<br>106,000 |
| 400<br>(0.8613)                                        | 50<br>2330  | 85<br>3880   | 198<br>9530   | 340<br>15,900 | 775<br>35,600  | 1355<br>61,900  | 3010<br>140,500  |
| 500<br>(1.122)                                         | 61<br>3023  | 99<br>4906   | 250<br>12,390 | 418<br>20,710 | 996<br>49,361  | 1627<br>80,634  | 3688<br>182,777  |
| 1000<br>(2.279)                                        | 98<br>6151  | 158<br>9917  | 400<br>25,108 | 670<br>42,055 | 1499<br>94,092 | 2609<br>163,766 | 5914<br>371,221  |

<sup>2</sup> psig<sup>3</sup> lb/ft<sup>3</sup>

| Saturated Steam Minimum and Maximum Flow Rates (kg/hr) |               |               |               |               |               |                |                 |
|--------------------------------------------------------|---------------|---------------|---------------|---------------|---------------|----------------|-----------------|
| Pressure <sup>4</sup><br>(Density) <sup>5</sup>        | 18.75 mm      | 25 mm         | 40 mm         | 50 mm         | 75 mm         | 100 mm         | 150 mm          |
| 0.4<br>(0.7779)                                        | 3.4<br>59.6   | 5.6<br>99.5   | 13.9<br>244   | 23.3<br>407   | 52<br>910     | 90.5<br>1,585  | 203<br>3,590    |
| 3.4<br>(2.372)                                         | 7.1<br>182    | 11.9<br>302   | 29.3<br>742   | 49<br>1,240   | 109<br>2,775  | 190<br>4,830   | 430<br>10,980   |
| 6.9<br>(4.127)                                         | 10.3<br>316   | 17.2<br>526   | 42.4<br>1290  | 70.8<br>2160  | 158<br>4830   | 276<br>8400    | 625<br>19,040   |
| 11<br>(6.125)                                          | 13.5<br>470   | 22.4<br>780   | 55.2<br>1915  | 92.2<br>3201  | 206<br>7160   | 359<br>12,465  | 814<br>28,255   |
| 13.8<br>(7.508)                                        | 15.45<br>575  | 25.75<br>1002 | 63.2<br>2350  | 105<br>3925   | 236<br>8777   | 411<br>15,280  | 933<br>34,640   |
| 20.7<br>(10.38)                                        | 19.2<br>795   | 31.9<br>1321  | 78.5<br>3246  | 131<br>5425   | 293<br>12,135 | 510<br>21,120  | 1150<br>47,885  |
| 27<br>(13.79)                                          | 23.2<br>1056  | 38.6<br>1756  | 94.9<br>4320  | 158<br>7210   | 354<br>16,130 | 617<br>28,070  | 1,400<br>63,640 |
| 34.5<br>(17.969)                                       | 27.66<br>1370 | 44.89<br>2224 | 113<br>5619   | 189<br>9392   | 451<br>22,385 | 737<br>36,568  | 1672<br>82,892  |
| 69<br>(36.5)                                           | 44<br>2789    | 71.65<br>4497 | 181<br>11,386 | 303<br>19,072 | 679<br>42,672 | 1183<br>74,270 | 2682<br>168,354 |

<sup>4</sup> bar<sup>5</sup> kg/m<sup>3</sup>

## Air

| Air Minimum and Maximum Flow Rates (SCFM) <sup>1</sup> |               |                |               |               |               |                 |                 |
|--------------------------------------------------------|---------------|----------------|---------------|---------------|---------------|-----------------|-----------------|
| Pressure <sup>2</sup><br>(Density) <sup>3</sup>        | 3/4 in.       | 1 in.          | 1.5 in.       | 2 in.         | 3 in.         | 4 in.           | 6 in.           |
| 0<br>(0.0752)                                          | 2.19<br>44.36 | 3.65<br>73.8   | 8.98<br>181.3 | 15.01<br>303  | 33.57<br>678  | 58.43<br>1180   | 132.5<br>2675   |
| 50<br>(0.3312)                                         | 5.9<br>195    | 9.82<br>325    | 24.13<br>798  | 40.32<br>1333 | 90.2<br>2982  | 157<br>5191     | 356<br>11,770   |
| 100<br>(0.5871)                                        | 8.6<br>346.1  | 14.3<br>576    | 35.35<br>1415 | 59.08<br>2365 | 132<br>5287   | 230<br>9203     | 521<br>20,866   |
| 150<br>(0.843)                                         | 11.01<br>497  | 18.32<br>826.8 | 45<br>2031    | 75.2<br>3395  | 168.2<br>7592 | 292.8<br>13,215 | 663<br>29,965   |
| 200<br>(1.0998)                                        | 13.14<br>5050 | 21.86<br>1078  | 53.7<br>2650  | 89.75<br>4425 | 200<br>9897   | 349<br>17,226   | 790<br>39,060   |
| 300<br>(1.611)                                         | 16.96<br>950  | 28.2<br>1580   | 69.3<br>3881  | 115<br>6485   | 259<br>14,507 | 450<br>25,250   | 1022<br>57,248  |
| 400<br>(2.123)                                         | 20.39<br>1251 | 33.9<br>2082   | 83.32<br>5115 | 139<br>8546   | 311<br>19,116 | 542<br>33,275   | 1229<br>75,440  |
| 500<br>(2.635)                                         | 23.55<br>1553 | 39.15<br>2585  | 96.23<br>6348 | 160<br>10,607 | 359<br>23,726 | 626<br>41,300   | 1415<br>93,635  |
| 1000<br>(5.194)                                        | 37.03<br>3065 | 61.6<br>5095   | 150<br>12,520 | 252<br>20,910 | 565<br>46,775 | 984<br>81,420   | 2232<br>184,588 |

<sup>1</sup> Standard conditions of 68° F (20° C) in schedule 40 pipe<sup>2</sup> psig<sup>3</sup> lb/ft<sup>3</sup>

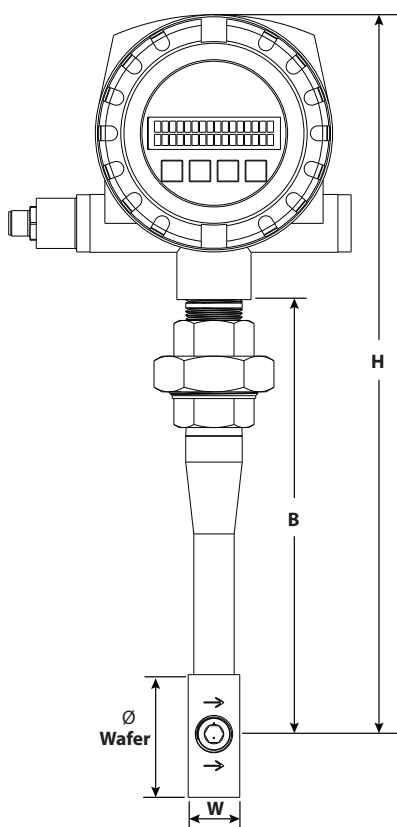
| Air Minimum and Maximum Flow Rates (SCMM) <sup>4</sup> |                |                |                |               |                |                |                |               |
|--------------------------------------------------------|----------------|----------------|----------------|---------------|----------------|----------------|----------------|---------------|
| Pressure <sup>5</sup><br>(Density) <sup>6</sup>        | 18.75 mm       | 25 mm          | 40 mm          | 50 mm         | 75 mm          | 100 mm         | 150 mm         | 200 mm        |
| 0<br>(1.205)                                           | 0.062<br>1.25  | 0.1035<br>2.09 | 0.254<br>5.134 | 0.425<br>8.57 | 0.95<br>19.19  | 1.65<br>33.4   | 3.75<br>75.72  | 7.2<br>168    |
| 3.4<br>(5.248)                                         | 0.742<br>5.47  | 0.276<br>9.1   | 0.678<br>22.35 | 1.13<br>37.35 | 2.53<br>83.56  | 4.41<br>145.4  | 10<br>329.7    | 22.3<br>675   |
| 6.9<br>(9.409)                                         | 0.742<br>9.8   | 0.407<br>16.32 | 1.002<br>40.08 | 1.67<br>66.98 | 3.74<br>149.8  | 6.51<br>260.8  | 14.77<br>591.2 | 32.5<br>1210  |
| 11<br>(14.28)                                          | 0.323<br>14.89 | 0.538<br>24.77 | 1.32<br>60.85  | 2.21<br>101.7 | 4.94<br>227.4  | 8.6<br>396     | 19.5<br>197.6  | 43.6<br>412   |
| 13.8<br>(17.61)                                        | 0.372<br>18.36 | 0.619<br>30.54 | 1.52<br>75.03  | 2.52<br>125.4 | 5.68<br>280.4  | 9.8<br>488.1   | 22.44<br>1,107 | 49.6<br>2450  |
| 20.7<br>(25.82)                                        | 0.48<br>26.95  | 0.79<br>44.77  | 1.96<br>110    | 3.28<br>184   | 7.34<br>412    | 12.78<br>715.5 | 28.96<br>1622  | 62<br>3580    |
| 27.6<br>(34.02)                                        | 0.577<br>35.46 | 0.96<br>59     | 2.36<br>145    | 3.94<br>242.2 | 8.82<br>541.7  | 15.35<br>943   | 34.8<br>2138   | 74<br>4460    |
| 34.5<br>(42.22)                                        | 0.667<br>44.05 | 1.11<br>73.22  | 2.72<br>180    | 4.55<br>300.6 | 10.19<br>672.3 | 17.7<br>1170   | 40.2<br>2654   | 86.6<br>3650  |
| 69<br>(83.24)                                          | 1.04<br>86.77  | 1.74<br>144.3  | 4.28<br>354.6  | 7.16<br>593   | 16.03<br>1325  | 27.89<br>2307  | 63.24<br>5231  | 132<br>13,200 |

<sup>4</sup> Standard conditions of 68° F (20° C) in schedule 40 pipe<sup>4</sup> bar<sup>5</sup> kg/m<sup>3</sup>

## Water

| Water at 62.43 lb/ft <sup>3</sup> Minimum and Maximum Flow Rates (gal/min) |              |              |             |             |             |              |             |
|----------------------------------------------------------------------------|--------------|--------------|-------------|-------------|-------------|--------------|-------------|
| Bore Size                                                                  | 3/4 in.      | 1 in.        | 1.5 in.     | 2 in.       | 3 in.       | 4 in.        | 6 in.       |
|                                                                            | 1.78<br>40.4 | 2.96<br>67.3 | 7.27<br>165 | 12.2<br>276 | 27.2<br>618 | 47.3<br>1075 | 107<br>2440 |

## DIMENSIONS



| Model | Connection Size | H      |          | W     |         | A     |         | B      |          | Ø     |         |
|-------|-----------------|--------|----------|-------|---------|-------|---------|--------|----------|-------|---------|
|       |                 | in.    | mm       | in.   | mm      | in.   | mm      | in.    | mm       | in.   | mm      |
| W07N  | 3/4 in.         | 13.369 | 339.5726 | 0.958 | 24.3332 | 0.479 | 12.1666 | 6.747  | 171.3738 | 2.35  | 59.69   |
| W10N  | 1 in.           | 13.566 | 344.5764 | 0.958 | 24.3332 | 0.479 | 12.1666 | 6.944  | 176.3776 | 2.725 | 69.215  |
| W15N  | 1-1/2 in.       | 14.002 | 355.6508 | 1.25  | 31.75   | 0.625 | 15.875  | 7.38   | 187.452  | 3.475 | 88.265  |
| W20N  | 2 in.           | 14.374 | 365.0996 | 1.25  | 31.75   | 0.625 | 15.875  | 7.752  | 196.9008 | 4.22  | 107.188 |
| W30N  | 3 in.           | 14.999 | 380.9746 | 1.37  | 34.798  | 0.685 | 17.399  | 8.377  | 212.7758 | 5.47  | 138.938 |
| W40N  | 4 in.           | 15.749 | 400.0246 | 1.62  | 41.148  | 0.81  | 20.574  | 9.127  | 231.8258 | 6.97  | 177.038 |
| W60N  | 6 in.           | 16.687 | 423.8498 | 2.37  | 60.198  | 1.185 | 30.099  | 10.065 | 255.651  | 8.845 | 224.663 |

### Power Plug

The multi-pole connector virtually eliminates wiring errors in the field. Simply plug the connector into the top of the enclosure and screw it down. This design saves time and money because the electronics package never comes out of the enclosure. No internal wiring is required and no connecting of hard-to-reach terminal blocks. This design also allows for a conduit connection to be attached over the power plug.

Simply plug and play.



### Optional External RTD for BTU/Energy Measurement

An insertion RTD (part number VNA-RTD) is used in conjunction with an RTD internal to the probe to measure the temperature difference across a heat exchanger. The energy transfer can be calculated by multiplying the temperature difference with the mass flow rate.



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**Control. Manage. Optimize.**

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