



# VN2000 Flow Meters

## Hot Tap Insertion Meter

### DESCRIPTION

The VN2000 Hot Tap Insertion Vortex Flow Meter measures the volumetric flow, mass flow rate or BTU/energy of steam, gas or liquids over a large flow range. The meter is a heavy duty design engineered to stand up to the most abusive environments inside and outside the pipe.

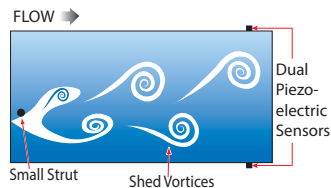
The vortex sensing element is CNC machined out of one piece of solid stainless steel. The dual ceramic piezoelectric sensors are bonded inside the vortex element, which is press-fit to the stainless steel insertion bar and completely welded together. There are no internal O-rings or seals of any kind and absolutely no leak paths into the sensors or electronics. Our sensors do not touch the process fluid, which gives them an almost unlimited life span.

### BENEFITS

- Measure volumetric or mass flow rate of steam, gas or liquids
- Standardize on an insertion bar that can measure line sizes 2...36 in.
- Reduced noise interference with dual piezoelectric sensors and filtering
- Machined safety stop provides constant seal, will not leak
- Standard model handles process temperatures up to 400° F (204° C)
- Reduced maintenance due to:
  - ◊ No moving parts
  - ◊ Heavy duty welded stainless steel construction
  - ◊ Piezoelectric and temperature sensors never touch process fluid
  - ◊ No recalibration necessary
  - ◊ No pins or screws to corrode and rust

### 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 tiny 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.



### APPLICATIONS

The unique design of the VN2000 meter can be used in steam, gas or liquid lines. The same design can measure water as low as 1.32 feet per second and saturated steam in excess of 250 feet per second.

### INSTALLATION

Each meter has a seal assembly that rides along the shaft of the insertion bar. This stainless steel seal assembly has a 1-1/2 in. NPT or flange connection for easy connect and disconnect with any valve or Threadolet®.

The VN2000 meter can be installed or removed during high pressure applications using our optional insertion tool. Once the meter is installed into the flow, simply point the machined arrow at the top of the insertion bar downstream for an accurate and repeatable flow reading.

### SIZING SOFTWARE

The VN2000 Meter Sizing Application software determines the precise scaling factor for your application based on:

- Fluid type
- Minimum and maximum operating flow rate
- Operating temperature
- Operating pressure



## SPECIFICATIONS

	<b>Uncertainty</b>	
	<b>Volumetric Flow</b>	<b>Repeatability</b>
<b>Liquids</b>	±1.0% of reading	±0.25% of reading
<b>Steam</b>	±1.0% of reading	±0.25% of reading
<b>Gas</b>	±1.0% of reading	±0.25% of reading
	<b>Mass or Heat Flow</b>	<b>Repeatability</b>
<b>Liquids</b>	±1.0% of reading	±0.25% of reading
<b>Steam</b>	±1.0% of reading	±0.25% of reading
<b>Gas</b>	±1.0% of reading	±0.25% of reading
<b>Velocity – Liquid</b>	1.32...32 ft/s (0.402...9 m/s)	
<b>Velocity – Gas</b>	cube root (140/p) ft/s... 300 ft/sec (91 m/sec)	
<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>	2...36 in. (50...900 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 304L	
<b>Hot Tap Connections</b>	1-1/2 in: NPT, ASME/ANSI 150, 300 flanges Sealing assembly: Two ethylene propylene O-rings Optional removable extractor	

<b>Measurement Options</b>	<b>Sensors</b>			
Volumetric flow rate	Dual piezo vortex sensors			
Mass flow rate based on velocity and temperature	Dual piezo vortex sensors RTD embedded in sensor: 100 Ohm, 3 wire			
BTU/Energy	Dual piezo vortex sensors RTD embedded in sensor: 100 Ohm, 3 wire External 100 Ohm RTD input			
Units of measure	<b>Steam</b>	<b>Gases</b>	<b>Liquids</b>	<b>Energy (Any Fluid)</b>
	Pounds	Cubic Feet	Gallons	BTU
	Kilograms	Cubic Meter	Liters	
	Tons	Liters	Cubic Feet	
	Tonns (metric)		Cubic Liters	
Units of measure are used for flow rate, mass flow rate, heat/energy flow rate; volume total, mass total, heat/energy total				
Measurement interval	Second, minute, hour, day			

### Transmitter

<b>Display</b>	2×16 characters reflective display Rotatable display Flow rate: 6 digits with decimal Totalizer
<b>Keypad</b>	4 membrane buttons
<b>Power</b>	14...36 V DC; loop powered with 4...20 mA option
<b>Operating Temperature</b>	32...140° F (0... 60° C) 5...100% relative humidity non-condensing
<b>Output</b>	One 4...20 mA, 10...36V max load, 24-bit resolution 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 Max output frequency = 12.5 Hz Opto isolator 5...24V DC
<b>Communication</b>	EIA-485, 9600 baud with Modbus RTU
<b>Enclosure</b>	General purpose
<b>Mounting</b>	Integral meter or remote pipe and wall; Up to 30 ft (10 m) from pipe (custom lengths available)
<b>Cable</b>	Cable jacket material: polyurethane (gray) Operating temperature -13...185° F (-25...85° C)

## FLOW RATE TABLES

## Saturated Steam Minimum...Maximum Flow Rates in lb/hr

Pipe Line Size in.	Pressure (psig); Density (lb/ft <sup>3</sup> )						
	5 psig 0.0486 lb/ft <sup>3</sup>	50 psig 0.1503 lb/ft <sup>3</sup>	100 psig 0.2577 lb/ft <sup>3</sup>	150 psig 0.3614 lb/ft <sup>3</sup>	200 psig 0.4688 lb/ft <sup>3</sup>	300 psig 0.6481 lb/ft <sup>3</sup>	400 psig 0.8613 lb/ft <sup>3</sup>
2	58.38...1019	124.0...3152	177.7...5404	222.7...7580	264.9...9832	328.7...13592	397.4...18064
3	128.6...2244	273.2...6945	391...11905	490.5...16698	583.5...21662	724.2...29944	875.5...39797
4	221.5...3865	470.5...11959	674.0...20501	844.7...28755	1005...37302	1247...51565	1508...68531
5	348.1...6074	739.4...18794	1057...32218	1327...45188	1579...58620	1960...81035	2369...107697
6	502.6...8771	1068...27140	1530...46525	1917...65256	2280...84653	2830...117021	3421...155525
8	870.4...15188	1849...46997	2649...80564	3319...112999	3949...146586	4900...202637	5924...269310
10	1372...23939	2914...74078	4175...126988	5232...178113	6224...231055	7724...319403	9338...424496
12	1947...33981	4137...105152	5927...180256	7427...252827	8835...327976	10964...453385	13255...602561
14	2354...41075	5000...127102	7164...217884	8977...305604	10679...396440	13253...548028	16022...728344
16	3075...53649	6531...166010	9357...284583	11725...399157	13948...517799	17310...715791	20927...951306
18	3892...67907	8267...210132	11843...360218	14842...505242	17655...655418	21911...906031	26489...1204139
20	4836...84381	10273...261109	14717...447606	18442...627814	21938...814421	27227...1125833	32915...1496262
22	6170...107670	13108...333173	18778...571142	23532...801085	27993...1039195	34741...1436554	41999...1909218
24	6994...122044	14858...377651	21285...647389	26674...908029	31730...1177925	39379...1628331	47606...2164096
26	8712...152020	18507...470408	26513...806397	33225...1131054	39523...1467242	49051...2028274	59299...2695631
28	10147...177056	21555...547880	30880...939203	38697...1317327	46032...1708882	57129...2362310	69064...3139574
30	11691...203999	24835...631254	35579...1082126	44586...1517793	53037...1968932	65823...2721797	79574...3617341
32	12815...223615	27223...691952	39000...1186179	48873...1663737	58137...2158256	72152...2983512	87226...3965167
36	16264...286802	34550...878194	49497...1505443	62027...2111538	73785...2739159	91572...3786537	110703...5032408

## Saturated Steam Minimum...Maximum Flow Rates in kg/hr

Pipe Line Size mm	Pressure (bar); Density (kg/m <sup>3</sup> )						
	0.4 bar 0.7779 kg/m <sup>3</sup>	3.4 bar 2.372 kg/m <sup>3</sup>	6.9 bar 4.127 kg/m <sup>3</sup>	11 bar 6.125 kg/m <sup>3</sup>	13.8 bar 7.508 kg/m <sup>3</sup>	20.7 bar 10.38 kg/m <sup>3</sup>	27 bar 13.79 kg/m <sup>3</sup>
50	26.48...462.0	55.70...1409	80.58...2451	104.9...3637	120.1...4459	149.1...6164	180.2...8192
75	58.33...1018	122.7...3104	177.5...5399	231.0...8013	264.8...9824	328.4...13580	397.0...18048
100	100.4...1753	211.3...5345	305.7...9297	397.8...13799	455.7...16917	565.5...23385	683.7...31080
125	157.9...2754	332.1...8400	480.4...14611	625.1...21685	716.1...26585	888.8...36750	1074...48842
150	228.0...3978	479.5...12130	693.7...21100	902.7...31315	1034...38391	1283...53071	1552...70533
200	394.7...6888	830.4...21004	1201...36537	1563...54226	1791...66479	2222...91899	2687...122136
250	622.2...10857	1309...33108	1894...57591	2464...85472	2823...104787	3503...144854	4235...192515
300	883.2...15411	1858...46996	2688...81749	3498...121326	4007...148742	4973...205617	6011...273270
350	1068...18628	2246...56806	3249...98813	4228...146652	4843...179791	6011...248539	7266...330315
400	1394...24330	2933...74195	4243...129063	5522...191546	6326...234830	7851...324622	9491...431431
450	1765...30797	3713...93914	5371...163364	6989...242454	8007...297242	9937...410898	12013...546095
500	2193...38268	4614...116698	6674...202996	8685...301273	9949...369352	12348...510582	14927...678577
550	2798...48830	5887...148906	8516...259021	11082...384421	12695...471290	15756...651498	19047...865859
600	3172...55349	6673...168784	9653...293600	12561...435741	14390...534207	17859...738472	21590...981449
650	3951...68943	8312...210240	12024...365713	15647...542766	17924...665416	22245...919852	26893...1222508
700	4602...80297	9681...244865	14004...425942	18224...632154	20876...775003	25909...1071343	31322...1423943
750	5302...92517	11154...282127	16135...490760	20997...728352	24053...892940	29852...1234375	36088...1640517
800	5812...101413	12226...309255	17687...537949	23016...798387	26366...978801	32722...1353067	39558...1798262
900	7376...128708	15517...392493	22448...682741	29211...1013276	33462...1242249	41529...1717250	50205...2282271

**Air Minimum...Maximum Flow Rates in ft<sup>3</sup>/min (SCFM <sup>1</sup>)**

Pipe Line Size in.	Pressure (psig); Density (lb/ft <sup>3</sup> )								
	0 psig 0.075 lb/ft <sup>3</sup>	50 psig 0.3312 lb/ft <sup>3</sup>	100 psig 0.5871 lb/ft <sup>3</sup>	150 psig 0.843 lb/ft <sup>3</sup>	200 psig 1.0998 lb/ft <sup>3</sup>	300 psig 1.611 lb/ft <sup>3</sup>	400 psig 2.123 lb/ft <sup>3</sup>	500 psig 2.635 lb/ft <sup>3</sup>	1000 psig 5.194 lb/ft <sup>3</sup>
2	17.05...344.2	45.82...1515	67.13...2686	85.45...3857	102.0...5028	131.6...7370	158.2...9711	182.7...12053	287.4...237062
3	37.57...758.4	100.9...3338	147.9...5918	188.3...8497	224.7...11077	290.0...16236	348.5...21395	402.6...26554	633.1...52350
4	64.69...1306	173.8...5748	254.7...10190	324.2...14632	386.9...19074	499.3...27959	600.2...36843	693.2...45727	1090...90148
5	101.7...2052	273.2...9033	400.2...16014	509.5...22995	608.0...29976	7841.7...43937	943.2...57899	1089...71861	1713...141669
6	146.8...2964	394.5...13045	578.0...23126	735.7...33207	878.0...43288	1133...63450	1362...83612	1573...103774	2474...204583
8	254.2...5132	683.1...22589	1001...40045	1274...57501	1520...74958	1962...109871	2359...144784	2724...179696	4284...354261
10	400.7...8090	1077...35605	1578...63120	2008...90636	2397...118151	3093...173182	3718...228213	4294...283244	6753...558398
12	568.8...11483	1528...50540	2239...89598	2850...128655	3402...167713	4390...245828	5277...323942	6095...402057	9585...792632
14	687.6...13880	1848...61090	2707...108301	3446...155512	4112...202722	5307...297143	6379...391565	7368...485986	11586...958092
16	898.1...18129	2413...79792	3535...141454	4500...203117	5371...264780	6931...388106	8332...511431	9623...634757	15133...1251385
18	1137...22947	3054...100998	4475...179050	5696...257101	6798...335152	8773...491254	10546...647357	12181...803459	19155...1583972
20	1413...28514	3795...125500	5561...222487	7078...319473	8447...416459	10902...610432	13104...804405	15135...998378	23802...1968241
22	1802...36384	4843...160137	7095...283891	9032...407645	10779...531399	13910...778907	16721...1026414	19313...1273922	30371...2511460
24	2043...41241	5489...181516	8042...321790	10237...462065	12218...602340	15767...882889	18953...1163439	21891...1443988	34426...2846736
26	2545...51370	6838...226099	10018...400827	12752...575555	15219...750284	19640...1099741	23609...1449197	27268...1798654	42882...3545938
28	2964...59830	7964...263335	11668...466839	14852...670343	17725...873848	22874...1282857	27497...1687865	31758...2094874	49944...4129918
30	3415...68935	9176...303408	13443...537881	17112...772353	20422...1006826	26355...1475772	31681...1944717	36591...2413663	57544...4758391
32	3743...75563	10058...332582	14736...589601	18758...846619	22386...1103638	28890...1617675	34727...2131712	40110...2645750	63077...5215936
36	4751...95902	12765...422098	18702...748294	23806...1074490	28411...1400687	36665...2053079	44074...2705471	50906...3357864	80054...6619826

<sup>1</sup> Standard conditions of 68° F (20° C) in schedule 40 pipe

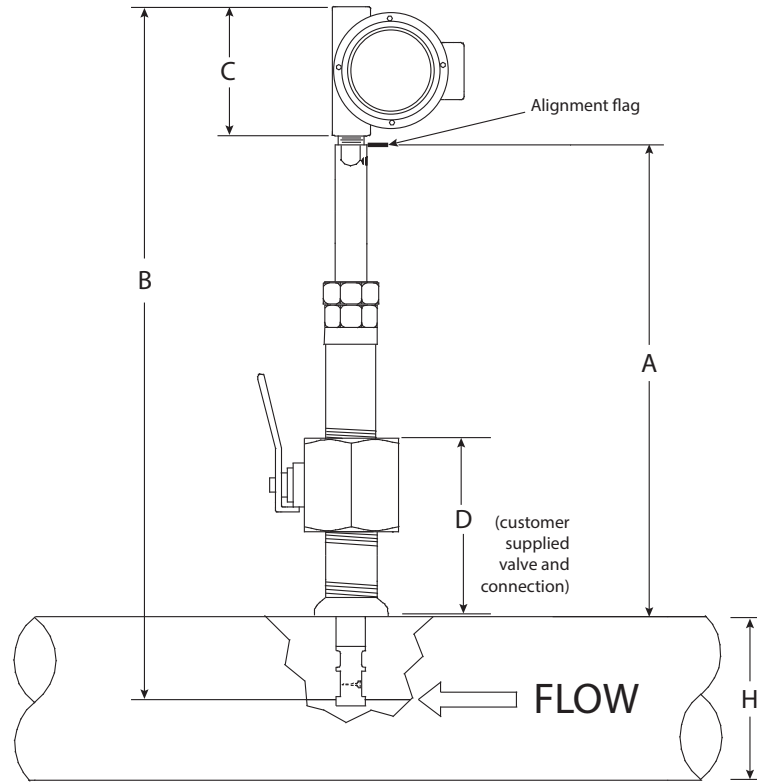
**Air Minimum...Maximum Flow Rates in m<sup>3</sup>/min (SCMM <sup>2</sup>)**

Pipe Line Size mm	Pressure (bar); Density (kg/m <sup>3</sup> )								
	0 bar 1.205 kg/m <sup>3</sup>	3.4 bar 5.248 kg/m <sup>3</sup>	6.9 bar 9.409 kg/m <sup>3</sup>	11 bar 14.28 kg/m <sup>3</sup>	13.8 bar 17.61 kg/m <sup>3</sup>	20.7 bar 25.82 kg/m <sup>3</sup>	27.6 bar 34.02 kg/m <sup>3</sup>	34.5 bar 42.22 kg/m <sup>3</sup>	69 bar 83.24 kg/m <sup>3</sup>
50	0.4829...9.748	1.288...42.45	1.902...76.11	2.512...115.5	2.889...142.5	3.729...208.8	4.482...275.2	5.177...341.6	8.141...673.4
75	1.064...21.48	2.838...93.52	4.190...167.7	5.535...254.6	6.365...313.9	8.215...460.1	9.875...606.3	11.41...752.5	17.94...1484
100	1.832...36.98	4.888...161.0	7.215...288.7	9.531...438.3	10.96...540.5	14.15...792.3	17.00...1044	19.64...1296	30.89...2555
125	2.879...58.12	7.681...253.1	11.34...453.8	14.98...688.9	17.23...849.4	22.23...1245	26.72...1641	30.86...2036	48.54...4015
150	4.157...83.93	11.09...365.5	16.37...655.3	21.63...994.8	24.88...1227	32.10...1798	38.59...2369	44.57...2941	70.09...5798
200	7.199...145.3	19.21...632.8	28.35...1135	37.46...1723	43.07...2124	55.59...3113	66.82...4103	77.18...5092	121.4...10039
250	11.35...229.1	30.27...997.5	44.69...1789	59.04...2715	67.90...3348	87.62...4908	105.3...6467	121.7...8027	191.3...15824
300	16.11...325.2	42.97...1416	63.44...2539	83.81...3854	96.38...4752	124.4...6966	149.5...9180	172.7...11393	271.6...22462
350	19.47...393.0	51.95...1712	76.68...3069	101.3...4659	115.3...5659	150.3...8420	180.7...11096	208.7...13772	328.3...27151
400	25.43...513.4	67.85...2235	100.2...4008	132.3...6085	152.2...7503	196.4...10998	236.0...14493	272.6...17988	428.7...35462
450	32.19...649.8	85.88...2830	126.8...5073	167.5...7702	192.6...9497	248.5...13921	298.8...18345	345.1...22768	542.7...44887
500	40.00...807.4	106.7...3516	157.5...6304	208.1...9571	239.3...11801	308.8...17298	371.3...22795	428.8...28292	674.3...55776
550	51.04...1030	136.2...4486	201.0...8044	265.5...12212	305.4...15058	394.1...22072	473.7...29086	547.1...36100	860.5...71170
600	57.85...1168	154.3...5085	227.8...9118	301.0...13842	346.1...17068	446.7...25019	537.0...32969	620.2...10919	975.3...80671
650	72.06...1455	192.3...6334	283.8...11358	374.9...17242	431.1...21261	556.4...31164	668.9...41067	772.5...50970	1215...100485
700	83.93...1694	223.9...7378	330.5...13228	436.7...20082	502.2...24762	648.0...36296	779.0...47830	899.7...59364	1415...117034
750	96.70...1952	258.0...8500	380.8...15241	503.1...23138	578.6...28530	746.7...41820	897.5...55109	1037...68398	1630...134844
800	106.0...2140	282.8...9318	417.5...16707	551.5...25362	634.2...31274	818.5...45841	983.9...60408	1136...74975	1787...147810
900	134.5...2716	358.9...118.26	529.8...21203	699.9...32189	804.9...39691	1039...58179	1249...76667	1442...95154	2268...187593

<sup>2</sup> Standard conditions of 68° F (20° C) in schedule 40 pipe

**DIMENSIONS**

**VN2000 Hot Tap Insertion Meter, Integral Mount**



H		A		B		C		(should not exceed) D	
in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
2	51	27.75	705	36	914	7	178	10	254
4	102	26.75	679	36	914	7	178	10	254
6	152	25.75	654	36	914	7	178	10	254
8	203	24.75	629	36	914	7	178	10	254
10	254	23.75	603	36	914	7	178	10	254
12	305	22.75	578	36	914	7	178	10	254
14	356	21.75	552	36	914	7	178	10	254
16	406	20.75	527	36	914	7	178	10	254
18	457	19.75	502	36	914	7	178	10	254
20	508	18.75	476	36	914	7	178	10	254
22	559	18.75	476	36	914	7	178	10	254
24	610	18.75	476	36	914	7	178	10	254
26	660	18.75	476	36	914	7	178	10	254
28	711	18.75	476	36	914	7	178	10	254
30	762	18.75	476	36	914	7	178	10	254
32	813	18.75	476	36	914	7	178	10	254
34	864	18.75	476	36	914	7	178	10	254
36	914	18.75	476	36	914	7	178	10	254

### Power Plug

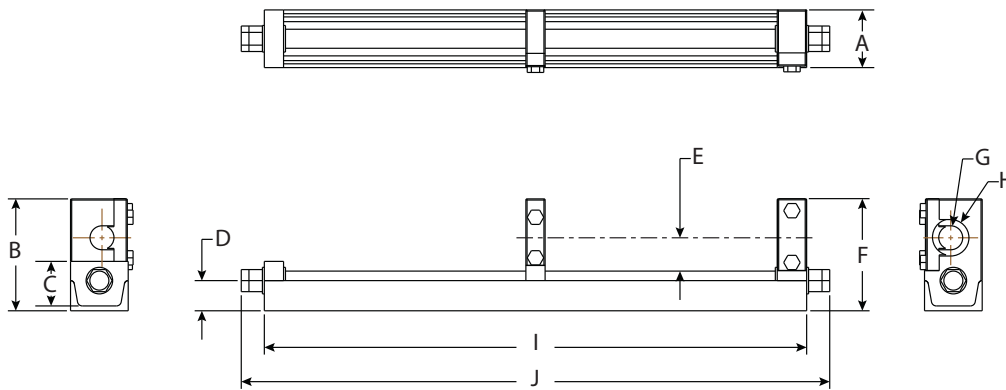
The multi-pole connector virtually eliminates wiring errors in the field. Simply plug the connector into the top of the enclosure and screw it down. This design saves time and money because the electronics package never comes out of the enclosure. No internal wiring is required and no connecting of hard-to-reach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

Simply plug and play!



### Optional Insertion/Extraction Tool Dimensions

The insertion/extraction tool can be used for installation under extreme pressures and makes it easy for the installer to adjust and fine tune their flow instrumentation. The tool eliminates the weight, bulkiness and equipment malfunction that occurs when insertion tools are permanently connected to the instrument and exposed to harsh elements. Once the installation is complete, the installer can quickly remove the tool and store it in a location away from harsh environments.



A		B		C		D		E		F		G		H		I		J	
in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
3	76	5.8	147	2.3	58	1.6	41	1.7	43	5.8	147	1.2	30	1.9	48	28.2	717	30.6	778

### Optional External RTD for BTU/Energy Measurement

An insertion 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.



## Control. Manage. Optimize.

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