



Cox[®]
Turbine Flow Meters

Turbine Flow Meters

Precision Series Gas Meters

DESCRIPTION

Cox Precision Gas Flow Meters are designed for precise and repeatable flow measurement of all compressible fluids, with the added benefit of minimal pressure loss. To accommodate the requirements of most gaseous flow applications, Cox Precision Gas Meters come in a variety of sizes, end fittings and options. The gas models feature three basic rotor designs to compensate for low, medium and high density gases.

Feature	Benefit
Comprehensive pickoff selection	Meets application requirements for temperature and electronic outputs.
High-Performance Ceramic Ball Bearings	Provides near-perfect roundness, higher Rockwell hardness and are lighter and more tolerant to temperature than 440C stainless steel bearings. They eliminate adhesive wear and perform well in non-lubricating fluids.
Three rotor designs	Rotor blade angle is matched to the density of the gas to optimize the flow range.
Facility with NIST traceable standards	Third party audits to ensure calibration uncertainty. Laboratory correlation to verify that all calibrators produce the same result.

CALIBRATIONS

Primary standard gas calibrations are accomplished by a bell prover, capable of flow rates up to 1000 SCFM (28,317 SLPM) air and pressures up to 400 psia (2758 kPa). There is a relationship between the flow rate and pressure, which determines the maximum flow capability, meaning the higher the line pressure, the lower the flow rate. Pressure is used to generate the gas density required to simulate your application. Gases, other than air, are available using sonic nozzles up to 400 SCFM (11,326 SLPM). Standard available gases are argon, helium and nitrogen. Flow Dynamics tailors calibrations to replicate process conditions, so the meter is characterized to provide the best attainable accuracy.



Calibrations are performed by our Flow Dynamics NVLAP (Lab Code 200668-0) accredited calibration facility located in Racine WI, which uses primary standard gas calibrators, offering uncertainties of ± 0.20 percent of reading with ± 0.10 percent repeatability. Users can be assured that Cox Precision Gas Meters come with a best-in-class calibration, traceable to NIST standards.



NVLAP accreditation applies only to the Badger Meter Flow Dynamics calibration Lab, located in Racine, WI

OPERATION

As a fluid media passes through the meter, the velocity of the fluid creates rotational energy on the rotor. The rotor blades, passing through a magnetic or radio frequency field, generate pulses proportional to flow. Each pulse is transmitted to the meter electronics, where it amplifies the pulse output. The output of the meter can be linearized, with the use of a flow processor.

APPLICATION

Virtually any type of clean gas can be measured. Examples of measurable gasses include argon, air, helium, oxygen, ammonia, methane and nitrogen.

- Argon shield gas to produce oxygen-free environment
- Compressed air
- Gas injection
- Steel manufacturing
- Nitrogen purge
- Gas refrigerants



Badger Meter

CXX-DS-00245-EN-07 (November 2021)

Product Data Sheet

SIZING GAS FLOW METERS

It is important to note when sizing gas flow meters, turbine flow meters measure volumetric flow of fluid passing through the meter. Therefore, it is necessary to convert all flow units to actual cubic feet per minute (ACFM) to determine the proper gas meter size. For ACFM, it is necessary to know the gas density at the operating pressure/temperature condition.

	Low Density	Medium Density	High Density
Density (lb/ft ³)	0.01...0.75	0.38...3.0	1.5...15
Atmosphere of Air (AoA)	0.125...10	5...40	20...200

For applications with a constant operating pressure/temperature:

1. Determine density of gas in pounds per cubic feet (lb/ft³). If operating at standard conditions (14.7 psia at 70° F), obtain the density value directly from the table below. If operating at other than standard conditions, calculate density using:

$$\text{Density}(\rho) = \frac{144P}{RT}$$

2. Determine maximum flow rate in actual cubic feet/minute (acfm) using:

$$\text{Density}(\rho) = \frac{144P}{RT}$$

$$\text{acfm} = \text{scfm} \left(\frac{14.7}{P} \times \frac{T}{530} \right)$$

or

$$\text{acfm} = \frac{\text{pph}}{\rho 60}$$

Where:

P = operating pressure in psia (psia = psig + 14.7)

T = operating temperature in Degrees Rankin (T = °F + 460)

R = Universal Gas Constant (see the table below)

ρ = density in lb/ft³

scfm = standard cubic feet per minute

pph = pounds/hour

3. Repeat Step 2 to determine minimum flow rate in ACFM.
4. Using the density value and minimum and maximum flow rates, select proper size gas flow meter using the flow ranges in *"Operating Ranges"* on page 3.

Gas	Symbol	Universal Gas Constant (R)	Standard Density Condition (lb/ft ³)
Acetylene	C ₂ H ₂	59.4	0.06724
Air	—	53.3	0.07493
Ammonia	NH ₃	90.8	0.04399
Argon	A	38.7	0.10320
Carbon Dioxide	CO ₂	35.1	0.11380
Carbon Monoxide	CO	55.2	0.07236
Ethylene	C ₂ H ₄	55.1	0.07249
Helium	HE	386.0	0.01035
Hydrogen	H ₂	767.0	0.00521
Methane	CH ₄	96.4	0.04143
Methyl Chloride	CH ₃ Cl	30.6	0.13052
Nitrogen	N ₂	55.2	0.07236
Nitric Oxide	NO	51.5	0.07755
Nitrous Oxide	N ₂ O	35.1	0.11379
Oxygen	O ₂	48.3	0.08269
Sulfur Dioxide	SO ₂	24.1	0.16573

SPECIFICATIONS

Performance	Repeatability	0.25% (of reading)
	Calibrator Uncertainty	± 0.20% (of reading)
	Frequency Output	1500...1800 Hz (Maximum)
	Pressure Rating	5000 psi (4 times less than burst)
	Response Time	20...30 milliseconds, or better
Materials	Body	316 stainless steel
	Shaft	316 stainless steel
	Rotors	17-4 PH stainless steel
	Bearing	Ceramic

Operating Ranges

COX Model Sizes	L Low Density Range	M Medium Density Range	H High Density Range
8-4	0.75...3.00 acfm	—	—
8-6	1.50...7.00 acfm	0.50...3.00 acfm	—
8	2.00...10.0 acfm	1.20...7.00 acfm	0.40...3.00 acfm
10	2.50...15.0 acfm	1.50...10.0 acfm	1.00...7.00 acfm
12	3.50...25.0 acfm	2.00...15.0 acfm	1.20...10.0 acfm
16	5.00...50.0 acfm	2.50...25.0 acfm	1.50...15.0 acfm
20	8.50...85.0 acfm	4.00...50.0 acfm	2.00...25.0 acfm
24	12.5...125.0 acfm	7.00...85.0 acfm	3.50...50.0 acfm
32	20.0...250.0 acfm	10.0...125 acfm	6.50...85.0 acfm

Density	Low	Medium	High
For gasses (psi)	8.0 x ρ	2.75 x ρ	1.0 x ρ
Atmosphere of Air (AoA)	0.6 x AoA	0.2 x AoA	0.08 x AoA

ρ = Density (lb/ft³)

Pressure Ratings for AN End Fittings

Size	Pipe Size	Meter Body: 316 Stainless Steel					
		100° F		300° F		500° F	
8-4	0.25 in. (6.35 mm)	367 bar	5330 psig	299 bar	4340 psig	231 bar	3350 psig
8-6	0.37 in. (9.52 mm)	317 bar	4600 psig	245 bar	3550 psig	172 bar	2500 psig
8	0.50 in. (12.7 mm)	483 bar	7000 psig	388 bar	5625 psig	293 bar	4250 psig
10	0.62 in. (15.87 mm)	390 bar	5660 psig	319 bar	4630 psig	248 bar	3600 psig
12	0.75 in. (19.05 mm)	317 bar	4600 psig	245 bar	3550 psig	172 bar	2500 psig
16	1.00 in. (25.4 mm)	248 bar	3600 psig	193 bar	2800 psig	138 bar	2000 psig
20	1.25 in. (31.75 mm)	190 bar	2760 psig	157 bar	2280 psig	124 bar	1800 psig
24	1.50 in. (38.1 mm)	168 bar	2430 psig	135 bar	1965 psig	103 bar	1500 psig
32	2.00 in. (50.8 mm)	121 bar	1760 psig	97 bar	1405 psig	72 bar	1050 psig

Pressure Ratings for NPT End Fittings

Size	ISO/NPT Pipe Size	Female (Mating Thread)	
8-4	0.25 in. (6.35 mm)	408 bar	5922 psig
8-6	0.37 in. (9.52 mm)	324 bar	4700 psig
8	0.50 in. (12.7 mm)	305 bar	4418 psig
10	0.75 in. (19.05 mm)	285 bar	4136 psig
12	0.75 in. (19.05 mm)	285 bar	4136 psig
16	1.00 in. (25.4 mm)	278 bar	4042 psig
20	1.25 in. (31.75 mm)	324 bar	4700 psig
24	1.50 in. (38.1 mm)	291 bar	4230 psig
32	2.00 in. (50.8 mm)	253 bar	3666 psig

Pressure Ratings for Flange End Fittings (in accordance with ASME B16.5 Standards)

ANSI Flange		
150#	19 bar	275 psig
300#	50 bar	720 psig
600#	99 bar	1440 psig

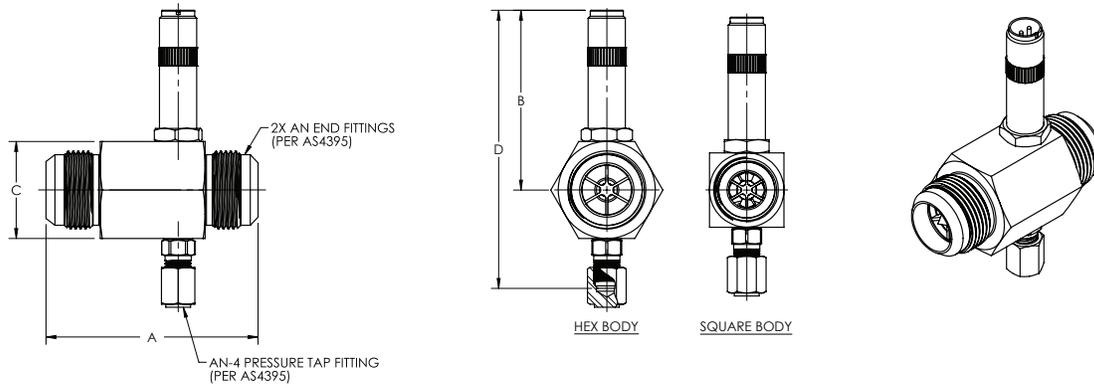
NOTE: Specifications from maximum non-shock allowable working pressure in psig at 100° F (37.8° C) or less.

NOTE: Stainless steel 316A-181 material.

DIMENSIONS

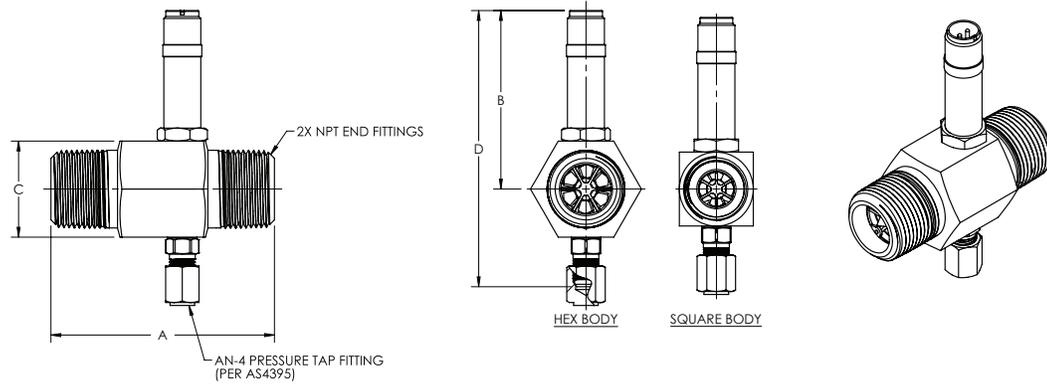
Dimension B represents most common pickoff type. Actual length may vary depending on pickoff selection. Consult factory for details.

AN End Fittings



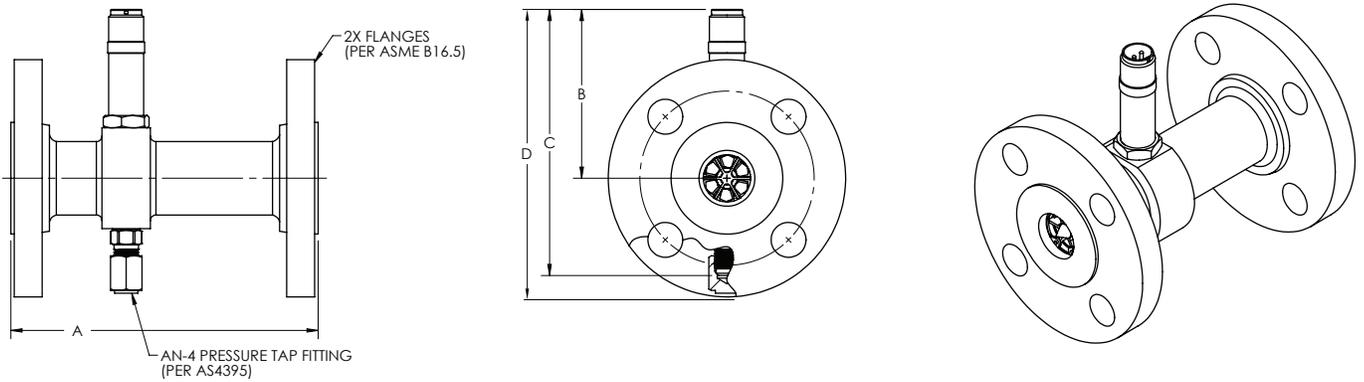
Size	End Fitting	A	B	C	D
8-4	0.50 in. (12.70 mm)	2.45 in. (62.23 mm)	2.80 in. (71.12 mm)	1.12 in. (28.44 mm) Square Body	4.20 in. (106.7 mm)
8-6	0.50 in. (12.70 mm)	2.45 in. (62.23 mm)	2.80 in. (71.12 mm)	1.12 in. (28.44 mm) Square Body	4.20 in. (106.7 mm)
8	0.50 in. (12.70 mm)	2.45 in. (62.23 mm)	2.80 in. (71.12 mm)	1.12 in. (28.44 mm) Square Body	4.20 in. (106.7 mm)
10	0.625 in. (15.88 mm)	2.72 in. (69.08 mm)	2.80 in. (72.12 mm)	1.25 in. (31.75 mm) Square Body	4.30 in. (109.2 mm)
12	0.75 in. (19.05 mm)	3.25 in. (82.55 mm)	2.90 in. (73.66 mm)	1.25 in. (31.75 mm) Square Body	4.40 in. (111.8 mm)
16	1.00 in. (25.40 mm)	3.56 in. (90.42 mm)	3.00 in. (76.20 mm)	1.63 in. (41.40 mm) Hex Body	4.70 in. (119.4 mm)
20	1.25 in. (31.75 mm)	4.06 in. (103.1 mm)	3.10 in. (78.74 mm)	1.88 in. (47.75 mm) Hex Body	4.90 in. (124.5 mm)
24	1.50 in. (38.10 mm)	4.59 in. (116.6 mm)	3.30 in. (83.82 mm)	2.25 in. (57.15 mm) Hex Body	5.20 in. (132.1 mm)
32	2.00 in. (50.80 mm)	6.06 in. (153.9 mm)	3.50 in. (88.90 mm)	2.75 in. (69.85 mm) Hex Body	5.70 in. (144.8 mm)

NPT End Fittings



Size	End Fitting	A	B	C	D
8-4	0.50 in. (12.70 mm)	2.70 in. (68.58 mm)	2.80 in. (71.82 mm)	1.12 in. (28.44 mm) Square Body	4.20 in. (106.7 mm)
8-6	0.50 in. (12.70 mm)	2.70 in. (68.58 mm)	2.80 in. (71.82 mm)	1.12 in. (28.44 mm) Square Body	4.20 in. (106.7 mm)
8	0.50 in. (12.70 mm)	2.70 in. (68.58 mm)	2.80 in. (71.82 mm)	1.12 in. (28.44 mm) Square Body	4.20 in. (106.7 mm)
10	0.75 in. (19.05 mm)	3.29 in. (83.57 mm)	2.80 in. (71.82 mm)	1.25 in. (31.75 mm) Square Body	4.30 in. (109.2 mm)
12	0.75 in. (19.05 mm)	3.29 in. (83.57 mm)	2.90 in. (73.66 mm)	1.25 in. (31.75 mm) Square Body	4.40 in. (111.8 mm)
16	1.00 in. (25.40 mm)	3.78 in. (96.01 mm)	3.00 in. (76.20 mm)	1.63 in. (41.40 mm) Hex Body	4.70 in. (119.4 mm)
20	1.25 in. (31.75 mm)	4.23 in. (107.4 mm)	3.10 in. (78.74 mm)	1.88 in. (47.75 mm) Hex Body	4.90 in. (124.5 mm)
24	1.50 in. (38.10 mm)	4.67 in. (118.6 mm)	3.30 in. (83.82 mm)	2.25 in. (57.15 mm) Hex Body	5.20 in. (132.1 mm)
32	2.00 in. (50.80 mm)	5.89 in. (149.6 mm)	3.50 in. (88.90 mm)	2.75 in. (69.85 mm) Hex Body	5.70 in. (144.8 mm)

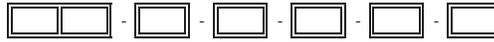
Flange End Fittings



Size	A	B#	C#	D 150# Flange	D 300# Flange	D 600# Flange
8-4	5.00 in. (127.0 mm)	2.80 in. (71.12 mm)	4.10 in. (104.1 mm)	3.50 in. (89 mm)	3.75 in. (95 mm)	3.75 in. (95 mm)
8-6	5.00 in. (127.0 mm)	2.80 in. (71.12 mm)	4.10 in. (104.1 mm)	3.50 in. (89 mm)	3.75 in. (95 mm)	3.75 in. (95 mm)
8	5.00 in. (127.0 mm)	2.80 in. (71.12 mm)	4.30 in. (109.2 mm)	3.50 in. (89 mm)	3.75 in. (95 mm)	3.75 in. (95 mm)
10	5.50 in. (139.7 mm)	2.80 in. (72.12 mm)	4.40 in. (111.8 mm)	3.50 in. (89 mm)	3.75 in. (95 mm)	3.75 in. (95 mm)
12	5.50 in. (139.7 mm)	2.90 in. (73.66 mm)	4.50 in. (114.3 mm)	3.88 in. (99 mm)	4.62 in. (117 mm)	4.62 in. (117 mm)
16	5.50 in. (139.7 mm)	3.00 in. (76.20 mm)	4.80 in. (121.9 mm)	4.25 in. (108 mm)	4.88 in. (124 mm)	4.88 in. (124 mm)
20	6.00 in. (152.4 mm)	3.10 in. (78.74 mm)	5.00 in. (127.0 mm)	4.62 in. (117 mm)	5.25 in. (133 mm)	5.25 in. (133 mm)
24	6.00 in. (152.4 mm)	3.30 in. (83.82 mm)	5.20 in. (132.1 mm)	5.00 in. (127 mm)	6.12 in. (155 mm)	6.12 in. (155 mm)
32	6.50 in. (165.1 mm)	3.50 in. (88.90 mm)	5.70 in. (144.8 mm)	6.00 in. (152 mm)	6.50 in. (165 mm)	6.50 in. (165 mm)

METER MODEL NUMBER

Cox Precision Gas Turbine Flow Meters



Model	CPG					
Precision Gas Turbine						
Meter Size						
8-4 (1/2" End Fitting, 1/4" Bore)	84					
8-6 (1/2" End Fitting, 3/8" Bore)	86					
8 (1/2" End Fitting, 1/2" Bore)	08					
10 (5/8" End Fitting)	10					
12 (3/4" End Fitting)	12					
16 (1" End Fitting)	16					
20 (1-1/4" End Fitting)	20					
24 (1-1/2" End Fitting)	24					
32 (2" End Fitting)	32					
End Fitting Type						
37° MS Flare		AN				
National Pipe Thread		NP				
150# ANSI Raised Face Flange		F1				
300# ANSI Raised Face Flange		F2				
600# ANSI Raised Face Flange		F3				
Bearing						
Hybrid Ceramic Ball Bearing, Water/Hydrocarbon Service			C			
Pickoff						
RF 2-Pin MS -250...400° F					C01	
RF 2-FL -250...400° F					C02	
RF FL -330...450° F RTD					C03	
RF 3-Pin MS -40...185° F Amp, ATEX, IS					C05	
RF 3-Pin MS -40...248° F Amp					C06	
RF 6-Pin MS -49...284° F Amp, RTD					C07	
RF 3-FL -40...248° F Amp					C09	
MAG 2-Pin MS -450...450° F 45...55 G Sizes 8-4 and 8-6					M01	
MAG 2-Pin MS -450...450° F Size 8...32 140...150 G					M02	
MAG NPT 2-Flying Lead -450...450° F Sizes 8...32 140...150 G					M25	
MAG NPT 2-Flying Lead -450...450° F Sizes 8-4 and 8-6 45...55 G					M36	
Density of Gas						
Low						L
Medium						M
High						H

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