



**Cox**  
Turbine Flow Meters

## Turbine Flow Meters

Exact Dual Rotor

### DESCRIPTION

The Cox Exact Dual Rotor Turbine Flow Meter is the pinnacle of turbine meter technology that delivers results not attainable with single rotor designs. The Exact meter's hydraulically coupled helical dual rotor design provides exceptional performance and many unparalleled benefits. The dual rotor design extends the flow measurement range, due to the high incidence angle on the second rotor, resulting in turndowns of 120:1 on the smallest meter to 500:1 on larger meters. This exceptional flow range allows universal viscosity curves to blend over a 60:1 turndown range. This wide flow range often eliminates the need for more costly manifold systems.

Swirl effects on the leading rotor will have an opposite effect on the trailing rotor. Therefore, by summing (or averaging) both rotors, it will virtually cancel out rotor acceleration, eliminating the need for flow straighteners. With flow straighteners, the ratio of the two rotors can be monitored to determine bearing health. Reduced friction ceramic ball bearings, combined with a unique embedded pickoff system, impervious to vibration, makes the Exact Dual Rotor design ideal for onboard vehicle, flight and critical applications.

Features	Benefits
Dual Rotors	Superior absolute accuracy and wider turndown ratios are achieved. They also cancel out swirl effects.
Helical Rotor Design	Exceptional speed-of-response, with reduced pressure drop
High-Performance Ceramic Ball Bearings	Provide less friction and can be used in water and hydrocarbons
Extended UVC Range	Greater turndown flow range, while reducing the need for manifold systems
High Shock Design	Internals are rigidly clamped against a step in the bore, with rod and nut torqued design.
Facility with NIST traceable standards	Third party audits to ensure calibration uncertainty. Laboratory correlation to verify that all calibrators produce the same result.



Model CDL

### CALIBRATIONS

Calibrations are accomplished by utilizing various blends of solvent and oil to simulate actual fluid conditions. For varying process temperature conditions, multiple viscosity calibrations are used to develop a universal viscosity curve. UVC calibrations enable a flow computer to track temperature and compensate for fluid viscosity. Flow Dynamics tailors calibrations to replicate process conditions, so the meter is characterized to provide the best possible accuracy.

Calibrations are performed by our Flow Dynamics NVLAP (Lab Code 200668-0) accredited calibration facility located in Racine WI, which uses primary standard calibrators, offering uncertainties of  $\pm 0.05$  percent of reading with  $\pm 0.02$  percent repeatability. Users can be assured that Cox Precision 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

### APPLICATIONS

- OEM flight and hydraulic component testing
- Precision industrial blending processes
- Engine test cells and test stands
- Precision flow monitoring
- On-board aerospace and automotive testing
- Custody transfer
- Correlation standards
- Flow Transfer Standard Master Meter
- Custom flight or industrial OEM packaging



**Badger Meter**

CXX-DS-00172-EN-08 (May 2019)

**Product Data Sheet**

## OPERATION AND PERFORMANCE

The fluid being measured passes through the rotors, which rotate proportionally to the velocity. The rotor blades travel through a field created by the radio frequency (RF) pickoffs, which generate pulses proportional to flow. Each pulse is transmitted to the meter electronics, where it amplifies the pulse output.

The Cox Exact dual rotor design extends the lower flow range far below traditional single rotor designs by overcoming the drag and torsional forces exerted upon the rotor during normal operation. The dual rotors become hydraulically coupled, resulting from their counter-rotational direction. The near perpendicular flow path on the downstream rotor blades greatly extends the flow measurement range.

### Performance Specifications

- Linearity:  $\pm 0.1\%$  of reading, with a flow processor
- Absolute Accuracy:  $\pm 0.10\%$  of reading
- Calibrator Uncertainty:  $\pm 0.05\%$  of reading
- Repeatability:  $\pm 0.02\%$  of reading
- Pressure Rating: 3000 psig standard (other pressures available, depending on end fitting)
- Pressure Drop: 14 psid at max. flow rate (at 1.2 cSt)
- Process Temperature:  $-150 \dots 330^\circ \text{F}$  ( $-101 \dots 165^\circ \text{C}$ ) standard

## CONSTRUCTION MATERIALS

Cox Exact Meters feature 316 stainless steel housings as a standard. Wetted materials include two axial helical rotors made of 17-4 stainless steel that rotate around dual robust ceramic ball bearings. The supports, shaft, and all other materials are made from 300 series stainless steel. The Cox Exact Meter is offered in two models—the CDX and the CDL. The CDX model is used for the direct (integral) mounting of electronic enclosures. The CDL model features an MS connector for remote mounted electronics.

The exceptional repeatability of  $\pm 0.02\%$  is achieved by rigidly mounting the rotor supports. A single rod-through design allows all the internal parts to be clamped in place by means of a step in the bore of the body. This rigid assembly only allows for the movement of the rotors, while providing a high shock bidirectional design.

The Cox Exact Meter housing has many different material options. The Exact Meter pickoffs have the ability to see through uncommon materials, such as lightweight anodized aluminum and titanium. The ability to have a range of materials available accommodates custom applications in the aerospace, industrial and automotive industries, where meter weight is of concern.

### Materials of Construction

<b>Body</b>	316 stainless steel
<b>Shafts</b>	316 stainless steel
<b>Rotors</b>	17-4 PH stainless steel
<b>Bearing</b>	Ceramic ball, with hybrid corrosion resistant raceways
<b>Nuts</b>	ASTM A286
<b>Spacers</b>	303 stainless steel
<b>Supports</b>	303 stainless steel
<b>Transitions</b>	302 stainless steel

## METER INSTALLATION

Cox Turbine Flow Meters mount directly in the piping and can be installed in any position, without affecting performance. To obtain maximum precision, the meter should be calibrated in the same orientation as installed in the piping. Flow straightener sections are not required, but allows for additional features. Use of the upstream and downstream flow straighteners facilitates bearing diagnostics by monitoring the ratio of the rotors, which reveals contamination or wear. For best performance and longevity, upstream filtration (10 micron) is recommended to prevent bearing contamination and to avoid rotor blade damage.

## FLOW RANGE SPECIFICATIONS

### Sizing and Range

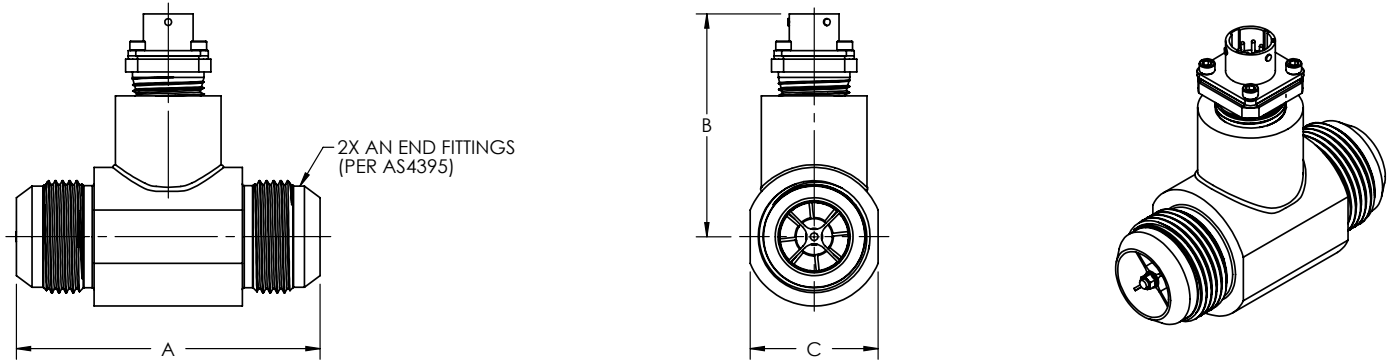
Size	Flow Ranges at 1 cSt S.G. – 1				Repeatable Range 1 cSt Ratio	UVC Down Range Ratio	Typical K-Factor (pulses/gallon)	
	gpm	lb/hr	lpm	kg/hr			Rotor "A"	Rotor "B"
8-4	0.025...3.00	9.53...1143	0.095...11.40	4.32...518.46	120:1	30:1	30,000	33,000
8-6	0.035...6.00	13.34...2286	0.132...22.71	6.05...1036.91	171:1	35:1	15,000	16,500
8	0.040...10.0	15.24...3810	0.151...37.85	6.91...1728.19	250:1	40:1	9480	10,440
10	0.045...16.0	17.15...6096	0.170...60.56	7.78...2765.10	355:1	45:1	6000	6375
12	0.080...30.0	30.48...11,430	0.303...113.5	13.82...5184.56	375:1	50:1	3640	4000
16	0.150...65.0	57.15...24,765	0.568...246.0	25.92...11,233.21	433:1	60:1	1680	1846
20	0.250...95.0	95.25...36,195	0.946...359.6	43.20...16,417.78	380:1	60:1	1149	1263
24	0.350...155	133.35...59,055	1.324...586.7	60.49...26,786.90	443:1	60:1	705	774
32	0.600...310	228.60...118,110	2.27...1173.5	103.69...53,573.79	517:1	60:1	242	266
40	1.000...500	381.00...190,500	3.78...1892.7	172.82...86,409.35	500:1	60:1	132	145
48	2.000...800	762.00...304,800	7.57...3028	345.64...138,254	400:1	60:1	45	50
64	5.000...1500	1905.00...571,500	18.90...5678	864.09...259,228	300:1	60:1	20	22

### Dual Frequency Outputs

See EC80 Flow Processor specifications for output selections.

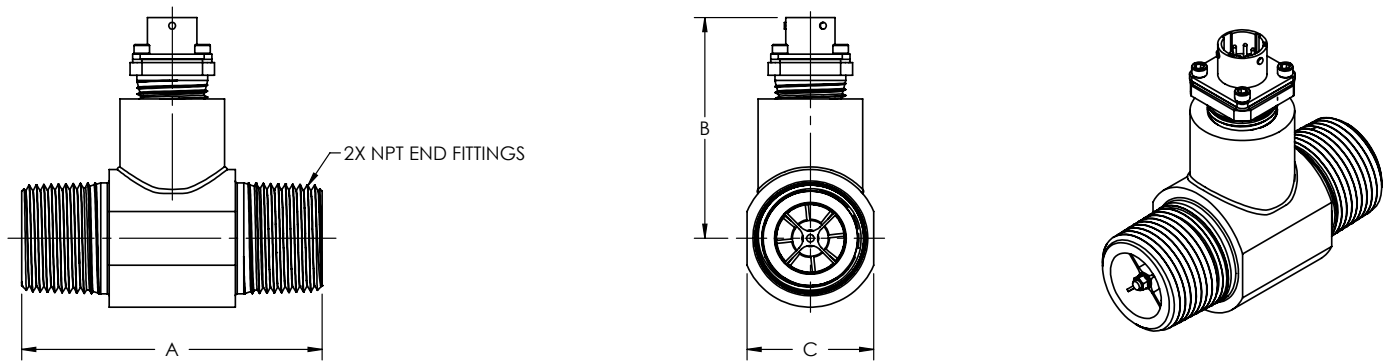
## DIMENSIONS

### AN End Fittings



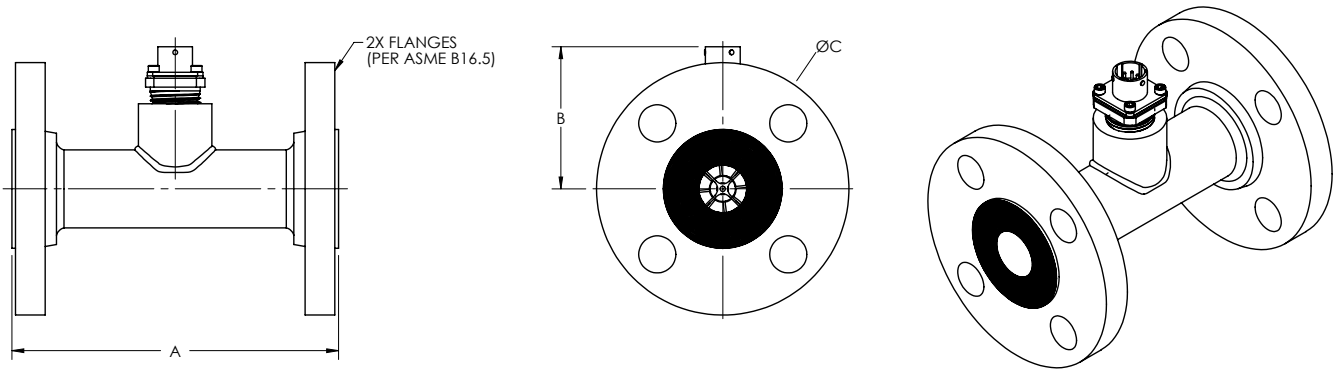
Size	End Fitting in. (mm)	A in. (mm)	B (DL Model) in. (mm) ± 0.13 (3.30)	C in. (mm)
8-4	0.50 (12.70)	2.75 (69.85)	2.42 (61.47)	0.87 (22.10)
8-6	0.50 (12.70)	2.75 (69.85)	2.42 (61.47)	0.87 (22.10)
8	0.50 (12.70)	2.75 (69.85)	2.42 (61.47)	0.87 (22.10)
10	0.625 (15.88)	2.92 (74.17)	2.42 (61.47)	1.00 (25.40)
12	0.75 (19.05)	3.25 (82.55)	2.53 (64.26)	1.37 (34.80)
16	1.00 (25.40)	3.56 (90.42)	2.61 (66.29)	1.50 (38.10)
20	1.25 (31.75)	4.06 (103.1)	2.80 (71.12)	1.72 (43.69)
24	1.50 (38.10)	4.59 (116.6)	2.93 (74.42)	2.00 (50.80)
32	2.00 (50.80)	6.06 (153.9)	4.26 (108.2)	2.63 (66.80)

**NPT End Fittings**



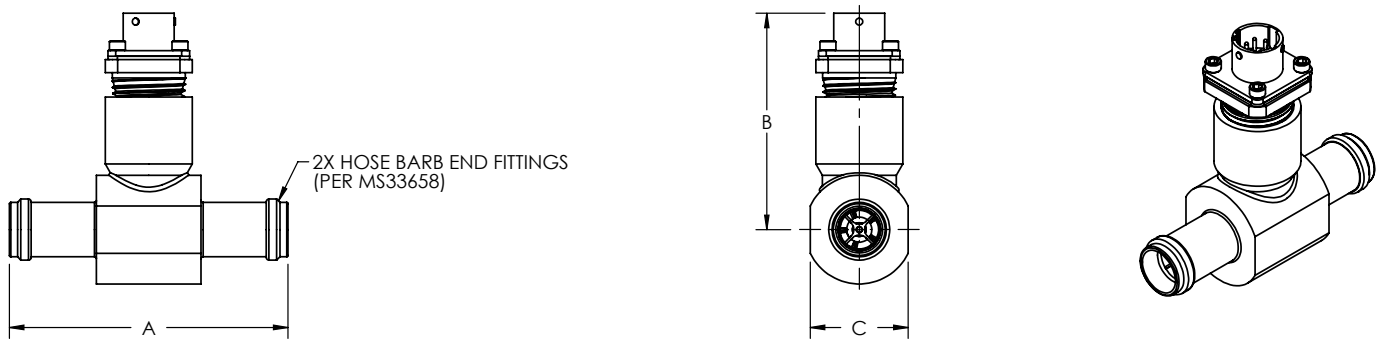
Size	End Fitting in. (mm)	A in. (mm)	B (DL Model) in. (mm) ± 0.13 (3.30)	C in. (mm)
8-4	0.25 (6.35)	2.75 (69.85)	2.42 (61.47)	0.87 (22.10)
8-6	0.375 (9.53)	2.75 (69.85)	2.42 (61.47)	0.87 (22.10)
8	0.50 (12.70)	2.75 (69.85)	2.42 (61.47)	0.87 (22.10)
10	0.75 (19.05)	2.92 (74.17)	2.42 (61.47)	1.00 (25.40)
12	0.75 (19.05)	3.25 (82.55)	2.53 (64.26)	1.37 (34.80)
16	1.00 (25.40)	3.56 (90.42)	2.61 (66.29)	1.50 (38.10)
20	1.25 (31.75)	4.06 (103.1)	2.80 (71.12)	1.72 (43.69)
24	1.50 (38.10)	4.59 (116.6)	2.93 (74.42)	2.00 (50.80)
32	2.00 (50.80)	6.06 (153.9)	4.26 (108.2)	2.63 (66.80)

**Flange End Fitting**



Size	End Fitting in. (mm)	A in. (mm)	B (DL Model) in. (mm)	C – 150# Flange in. (mm)	C – 300# Flange in. (mm)	C – 600# Flange in. (mm)
8-4	Consult Factory					
8-6						
8						
10						
12						
16	1.00 (25.40)	5.50 (139.7)	2.40 (60.96)	4.25 (107.9)	4.88 (123.9)	4.88 (123.9)
20	1.25 (31.75)	6.00 (152.4)	2.70 (68.58)	4.625 (117.5)	5.25 (133.3)	5.25 (133.3)
24	1.50 (38.10)	6.00 (152.4)	2.80 (71.12)	5.00 (127.0)	6.12 (155.4)	6.12 (155.4)
32	2.00 (50.80)	6.50 (165.1)	4.30 (109.2)	6.00 (152.4)	6.50 (165.1)	6.50 (165.1)
40	2.50 (63.50)	7.00 (177.8)	4.30 (109.2)	7.00 (177.8)	7.50 (190.5)	7.50 (190.5)
48	3.00 (76.20)	10.0 (254.0)	4.60 (116.8)	7.50 (190.5)	8.25 (209.5)	8.25 (209.5)
64	4.00 (101.6)	12.0 (304.8)	5.10 (129.5)	9.00 (228.6)	10.0 (254.0)	10.75 (273.1)

**HB End Fitting**



**NOTE:** Hose Barb fittings available for all ranges. Special end fittings are developed to meet your application requirements.

**METER MODEL NUMBER**

Cox Exact Turbine Flow Meters



<b>Model</b>					
Dual Rotor, MS Connector; for use with remote mount electronics	CDL				
Dual Rotor; for use with integral mount electronics	CDX				
<b>Meter Size</b>					
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				
40 (2-1/2") Available for flanges only.	40				
48 (3") Available for flanges only.	48				
64 (4") Available for flanges only.	64				
<b>End Fitting Type</b>					
37° MS Flare				AN	
National Pipe Thread				NP	
Hose Barb				HB	
150# ANSI Raised Face Flange				F1	
300# ANSI Raised Face Flange				F2	
600# ANSI Raised Face Flange				F3	
<b>Bearing</b>					
Hybrid Ceramic Ball Bearing, Water/Hydrocarbon Service				C	
<b>Pickoff</b>					
RF Carrier					A
RF Carrier with Thermistor					B
RF Carrier with RTD					R
<b>Specials</b>					
3-Digit Special Code (Leave blank for non-custom orders.)					XXX

**NOTE:** Higher flange ratings and other end fitting types can be provided. Consult the factory for pricing and delivery estimates.

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## Control. Manage. Optimize.

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