

Data Sheet

DS-PD-BM-Ovals-eng

March, 2008

BM Oval Series

Brooks-Oval™ Models: BM04, BM07, BM10, BM40 & BM50

- Sizes for wide flow ranges, 0.26 to 92.5 GPM (1 to 350 LPM)
- Very low pressure drop
- Standard Viscosity to 1000 Cp (Centipoise)
- High Viscosity Rotors (Gears) to 1 million cP
- High Accuracy, 1/2% rate or better
- 0.03% repeatability
- Only two moving parts
- Reed or solid state Hall Effect Switch
- Screwed, Flanged or Tri-Clover® Connection options
- Body's available in Aluminum, PPS or 316 Stainless Steel
- Two Electronic Display options standard

DESCRIPTION

The Brooks® Models BM04, BM07, BM10, BM40 and BM50 are positive displacement oval gear flowmeters designed for applications requiring high accuracy measurement of clean liquids with viscosity's less than 1000 cP standard, or up to 1 million cP with rotors (gears) cut for high viscosity. All meters are available with a pulse output from a reed switch or solid state Hall effect switch for remote registration and/or totalization. Two optional LCD displays offer rate, resettable total, non-resettable total and the option for simple batch (Deluxe Display). Also offered on sizes BM10 and larger is an option for mechanical totalization. All six meters are available with PPS rotors (gears) as standard. Also available as an option are 316 SS rotors (gears). The Model BM07 is only available with a PPS body, rotors (gears) and optional Hastelloy C® rotor (gear) shafts. The BM07 is specially designed for corrosive liquid service when the optional Hastelloy C shafts are selected. The Model BM10 is available with optional 1 inch Tri-Clover connections in all 316 Stainless Steel construction.



BM-Oval Family - Typical Configurations

PRINCIPLE OF OPERATION

The oval meter is a positive displacement meter. As the fluid being measured passes through the meter, it rotates 2 oval gears in a measuring chamber to displace a precision volume of fluid. A sensor detects the gear rotation to determine displaced volume and flow rate.

Fluid pressure rotates the oval gears, Figure 1. In position 1, the fluid exerts a clockwise driving force on Gear A. There is no net driving force on Gear B. It is perpendicular to the flow so the fluid forces are balanced around the shaft. As the gears rotate to position 2, the fluid begins to exert a force on Gear B. At position 3, all the driving force is on Gear B. This alternating driving force provides a smooth rotation of almost constant torque.

The meter design minimizes the slippage between the gears and the measuring chamber wall. As a result, the oval meter is less affected than other designs by the liquid's viscosity and lubricity.

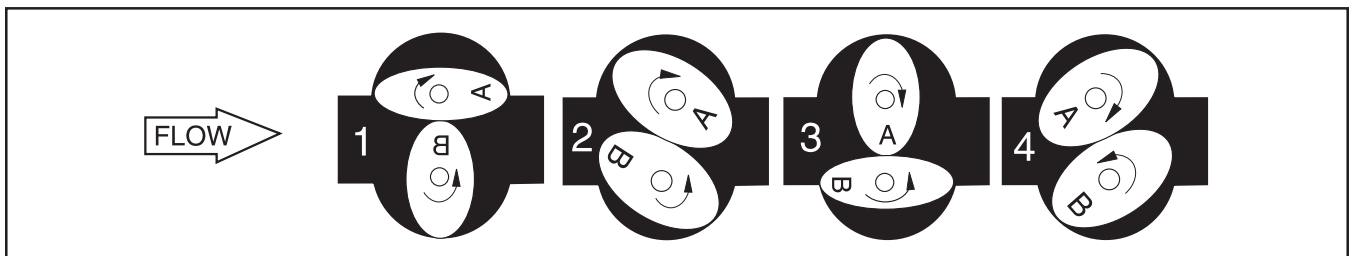


Figure 1 Principle of Operation Chart

BM Oval Series

SPECIFICATIONS

Capacities

See Table 1: Capacities

For capacities with higher viscosities: Refer to Table 5

Performance

Accuracy:

+/- 0.5% when viscosity is > 5 cP

+/- 1% when viscosity is < 5 cP

Pressure Drop:

< 3 PSI at full scale flow when viscosity is 1 cP or less and not more than 15 PSI at 1000 cP

Ratings

Maximum working pressure: See Table 2

Maximum working temperature: See Table 2

Ambient Temperature: -4° F to 104° F (-20° C to +40° C)

Meter sizes BM04, BM07, BM10 & BM50 have been subjected to a 4 times maximum working pressure test.

Meter size BM40 has been subjected to a 3 times maximum working pressure test.

Pressure Equipment Directive (97/23/EL)

Meter Classifications - PED

| Model | PED Category |
|---------|--------------|
| BM01/02 | SEP |
| BM04 | SEP |
| BM07 | SEP |
| BM10 | SEP |
| BM40 | Category 1 |
| BM50 | Category 1 |

Outputs

Reed Switch

Detection Method: Reed switch, two wire SPST N/O contact

Max. Voltage: 150 Vdc maximum

Contact Capacity: 0.25 AMPS

Rating 3 Watts

Hall Effect Switch

Detection Method: Hall effect switch

Response Frequency: 1,000 Hz maximum

Output Pulse: Unfactored voltage pulse

Input/Output = 4.5 to 24 Vdc (4.6 ~ 9 mA)

Open Collector 25 mA output NPN compatible with digital logic. Reverse power protection

Nominal K-factor for both reed and Hall effect switch,

| K-factors/Pulse Output Resolution | | | | |
|-----------------------------------|---------------|-------------|---------------|-------------|
| Model | Gallons | | Liters | |
| | Single Switch | Dual Switch | Single Switch | Dual Switch |
| BM04 | 424.3 | 848.6 | 112 | 224 |
| BM07 | 197 | 394 | 52 | 104 |
| BM10 | 136.3 | 272.6 | 36 | 72 |
| BM40 | 54.9 | 109.8 | 14.5 | 29 |
| BM50 | 25.29 | 50.58 | 6.68 | 13.36 |

Connections

| | |
|-------------|-----------------------------|
| BM04 | 1/2 inch NPT |
| BM07 | 1 inch NPT |
| BM10 | 1 inch NPT |
| | 1 inch 150 Lb RF Flange |
| | 1 inch TriClover |
| BM40 | 1 1/2 inch NPT |
| | 1 1/2 inch 150 Lb RF Flange |
| | 1 1/2 inch 300 Lb RF Flange |
| | 2 inch 150 Lb RF Flange |

Electronic and Mechanical Registers

Refer to page 4

Meter Materials of Construction

See Table 3

Electrical Connection

Pulsar Cap: 1/2 inch NPT

Dimensions

Refer to Figure 2

For certified dimensional prints, contact the factory.

ACCESSORIES AND OPTIONS

See Table 5

- Standard LCD Display
- Deluxe LCD Display
- Mechanical Register
- High Viscosity Rotors (Gears)
- High Temperature Rotors (Gears)

| Strainer Recommendations: | | |
|---------------------------|-------------------|---------------|
| Model | Max Partical Size | Strainer Size |
| BM04 | 0.011" (0.28mm) | 60 Mesh |
| BM07 | 0.011" (0.28mm) | 60 Mesh |
| BM10 | 0.011" (0.28mm) | 60 Mesh |
| BM40 | 0.015" (0.38mm) | 60 Mesh |
| BM50 | 0.018" (0.46mm) | 60 Mesh |

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Table 1 Capacities

| Viscosity | Model | | | | |
|-------------|----------------------------------|--------------------------------|----------------------------------|----------------------------------|--------------------------------------|
| | BM04 | BM07 | BM10 | BM40 | BM50 |
| < 5cp | .79 to 6.6 gpm (3 to 25 lpm) | 2 to 18.5 gpm (8 to 70 lpm) | 2.6 to 26 gpm (10 to 100 lpm) | 4 to 62 gpm (15 to 235 lpm) | 7.93 to 79.25 gpm (30 to 300 lpm) |
| 5 to 1000cp | .26 to 7.93 gpm (1 to 30 lpm) | .8 to 21 gpm (3 to 80 lpm) | 1.6 to 32 gpm (6 to 120 lpm) | 2.6 to 66 gpm (10 to 250 lpm) | 3.96 to 92.46 gpm (15 to 350 lpm) |

Table 2 Maximum Working Pressures and Temperatures

| Materials | | MODELS | | | | | |
|----------------------------|--------------------|----------------------------|-------------------|--------------------------|-------------------|--------------------------|-------------------|
| Body | Rotors(Gears) | BM04, BM10 | | BM40, BM50 | | BM07 | |
| | | Max. Press. PSIG(kPa) | Max Temp. F(C) | Max. Press. PSIG(kPa) | Max Temp. F(C) | Max. Press. PSIG(kPa) | Max Temp. F(C) |
| Aluminum, Screwed | PPS | 800(5500) | 176(80) | 260(1792) | 176(80) | N/A | N/A |
| Aluminum, Flanged, 150 lb | PPS | 275(1896) | 176(80) | 260(1792) | 176(80) | N/A | N/A |
| Aluminum, Screwed | 316 Stainless Stl. | 800(5500) | 248(120) | 260(1792) | 248(120) | N/A | N/A |
| Aluminum, Flanged, 150 lb. | 316 Stainless Stl. | 275(1896) | 248(120) | 260(1792) | 248(120) | N/A | N/A |
| 316SS, Screwed | PPS | 800(5500) | 176(80) | 260(1792) | 176(80) | N/A | N/A |
| 316SS, Flanged, 150 lb. | PPS | 275(1896) | 176(80) | 260(1792) | 176(80) | N/A | N/A |
| 316SS, Screwed | 316 Stainless Stl. | 800(5500) | 248(120) | 260(1792) | 248(120) | N/A | N/A |
| 316SS, Flanged, 150 lb. | 316 Stainless Stl. | 275(1896) | 248(120) | 260(1792) | 248(120) | N/A | N/A |
| 316 SS, Tri-Clover | 316 Stainless Stl. | See BM10 Tri-Clover below | | N/A | N/A | N/A | N/A |
| PPS, Screwed only | PPS | N/A | N/A | N/A | N/A | 150(1000) | 176(80) |
| Bronze, Screwed only | PPS | See BM10 Bronze Body Below | | N/A | N/A | N/A | N/A |

| Materials | | MODELS | | | |
|----------------------|--------------------|--------------------------|-------------------|--------------------------|-------------------|
| Body | Rotors(Gears) | BM10 Tri-Clover | | BM10, BRONZE BODY | |
| | | Max. Press. PSIG(kPa) | Max Temp. F(C) | Max. Press. PSIG(kPa) | Max Temp. F(C) |
| 316 SS, Tri-Clover | 316 Stainless Stl. | 150(1000) | 176(80) | N/A | N/A |
| Bronze, Screwed only | PPS | N/A | N/A | 800(5500) | 176(80) |

Notes:

The maximum pressure with mechanical display limits above applications to 500 psig (3450 kPa) or the lesser of the meter listed.

All pressures listed are at 100° F (38° C) For higher temperatures, pressure will be reduced per the standard flange specification ANSI B16.5.

ORDERING INFORMATION

To order please specify:

1. Model Number
2. Product (Process Fluid)
3. Viscosity
4. Maximum Operating Temperature
5. Maximum Operating Pressure
6. Operating Flow Ranges (Min., Max., & Normal)
7. Accessories Required
8. Output Pulse Type (Switch Type)

| Weights: | | Body Material | | |
|----------|------------|-----------------|---------------|------------------|
| Model | Connection | Alum | PPS | 316 SS |
| BM04 | Screwed | 3 lbs (1.4 kg) | N/A | 6 lbs (2.7 kg) |
| BM07 | Screwed | N/A | 3 lbs (1.4kg) | N/A |
| BM10 | Screwed | 6 lbs (2.7 kg) | N/A | 10 lbs (4.6 kg) |
| BM10 | Flanged | 10 lbs (4.6kg) | N/A | 14 lbs (6.3 kg) |
| BM40 | Screwed | 11 lbs (5 kg) | N/A | 19 lbs (8.6 kg) |
| BM40 | Flanged | 13 lbs (5.9 kg) | N/A | 21 lbs (9.6 kg) |
| BM50 | Screwed | 14 lbs (6.3 kg) | N/A | 38 lbs (17.3kg) |
| BM50 | Flanged | 16 lbs 7.3 kg) | N/A | 42 lbs (19.1 kg) |

BM Oval Series

Standard LC Display

The standard liquid crystal (LC) display is available on the BM04, BM07, BM10, BM40 and BM50 models.

Features:

- Seven (7) digit x 11/16 inch (17mm) Liquid Crystal Display.
- Rotatable in 90° increments.
- Selectable flow rate display in U.S. Gallons, Liters, Cubic Meters (M3), Milliliters and Barrels
- 2 total displays - resettable and non-resettable, up to 999999.99 units (gallons or liters)
- Programmable calibration constant (K-factor)
- Long life lithium battery Pulse output of ancillary equipment



Deluxe LC Display

The Deluxe liquid crystal (LC) display is available on the BM04, BM07, BM10, BM40 and BM50 models.

Features:

- Seven (7) digit x 1/2 inch (12.7mm) Liquid Crystal Display
- Rotatable in 90° increments
- Selectable flow rate display in U.S. Gallons or Liters (according to model selected)
- 2 total displays - resettable and non-resettable, up to 999,999.9 units (gallons or liters)
- Factory set calibration constant (K-factors)
- Additional nine (9) calibration constants (K-factors) available for "in the field" settings
- Long life lithium battery
- Extended life battery available as option
- Pulse output of ancillary equipment
- Approved for hazardous locations when used with standard battery for EExia IIC T6 (PTB nr. Ex-93.C 4033X)
- Pre-settable batch control function up to 9,999 units (99.99, 999.9 or 9,999 optional settings).
- Ten (10) preset batch quantity storage capacity.
- Single or dual valve actuation output to be used with add on trip amplifier



Mechanical Display

The mechanical display is available on the BM04, BM10, BM40 and BM50.

Features:

- U.S. Gallons or Liters
- Two total displays:
 - 1 to 9,999 liters or 1/10 to 999.9 U.S. Gallons (resettable)
 - 1 to 999;999 liters (X10) or 1 to 999,999 U.S. Gallons (Non-resettable)
- Push button reset
- Rotatable in 90° increments



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Table 3 Materials of Construction

| Item | Materials | Meter Model/Size | | | | |
|-----------------------------------|--------------------|------------------|----------|----------|----------|----------|
| | | BM04 | BM07 | BM10 | BM40 | BM50 |
| Body | PPS | N/A | Standard | N/A | N/A | N/A |
| | Aluminum | Standard | N/A | Standard | Standard | Standard |
| | 316 Stainless Stl. | Standard | N/A | Standard | Standard | Standard |
| | Bronze | N/A | N/A | Option | N/A | N/A |
| Rotor/Gear | PPS | Standard | Standard | Standard | Standard | Standard |
| | 316 Stainless Stl. | Option | N/A | Option | Option | Option |
| Shaft-Rotor/Gear | 316 Stainless Stl. | Standard | Standard | Standard | Standard | Standard |
| | Hastelloy C | N/A | Option | N/A | N/A | N/A |
| Cap-Pulse Meter | Aluminum | Standard | N/A | Standard | Standard | Standard |
| | 316 Stainless Stl. | Option | N/A | Option | Option | Option |
| | PPS | N/A | Standard | N/A | N/A | N/A |
| O-Ring-Body | Viton® | Standard | Standard | Standard | Standard | Standard |
| | Teflon® | Option | Option | Option | Option | Option |
| O-Ring/Seal Mech. Register | Viton | N/A | N/A | Option | Option | Option |

Table 4 Optional Accessories

| Optional Accessories | | | | | |
|----------------------|----------------------|--------------------|---------------------|-------------------------------|--------------------------|
| Available on Models | Standard LCD Display | Deluxe LCD Display | Mechanical Register | High Viscosity Rotors (Gears) | High Temp Rotors (Gears) |
| BM04 | Yes | Yes | Yes | PPS or 316 SS | PPS |
| BM07 | Yes | Yes | N/A | PPS Only | N/A |
| BM10 | Yes | Yes | Yes | PPS or 316 SS | PPS |
| BM40 | Yes | Yes | Yes | PPS or 316 SS | PPS |
| BM50 | Yes | Yes | Yes | PPS or 316 SS | PPS |

Table 5 Higher Viscosity Coefficient Factors

| Coefficient Factors | Viscosity | Models | | | | | | | | | |
|---------------------|--------------|--------|------|------|------|------|-------|------|-------|------|-------|
| | | BM04 | | BM07 | | BM10 | | BM40 | | BM50 | |
| | | GPM | LPM | GPM | LPM | GPM | LPM | GPM | LPM | GPM | LPM |
| 1 | < 2500 cP | 9.3 | 35.0 | 21.1 | 80.0 | 31.7 | 120.0 | 66.1 | 250.0 | 92.5 | 350.0 |
| 0.9 | < 3000 cP | 8.3 | 31.5 | 19.0 | 72.0 | 28.5 | 108.0 | 59.5 | 225.0 | 83.2 | 315.0 |
| 0.8 | < 4000 cP | 7.4 | 28.0 | 16.9 | 64.0 | 25.4 | 98.0 | 52.8 | 200.0 | 74.0 | 280.0 |
| 0.7 | < 5000 cP | 6.5 | 24.5 | 14.8 | 56.0 | 22.2 | 84.0 | 46.2 | 175.0 | 64.7 | 245.0 |
| 0.6 | < 8000 cP | 5.6 | 21.0 | 11.8 | 48.0 | 19.0 | 72.0 | 39.6 | 150.0 | 55.5 | 210.0 |
| 0.5 | < 12000 cP | 4.6 | 17.5 | 10.6 | 40.0 | 15.9 | 60.0 | 33.0 | 125.0 | 46.2 | 175.0 |
| 0.4 | < 25000 cP | 3.7 | 14.0 | 8.5 | 32.0 | 12.7 | 48.0 | 26.4 | 100.0 | 37.0 | 140.0 |
| 0.3 | < 40000 cP | 2.8 | 10.5 | 6.3 | 24.0 | 9.5 | 36.0 | 19.8 | 75.0 | 27.4 | 105.0 |
| 0.2 | < 95000 cP | 1.9 | 7.0 | 4.2 | 16.0 | 6.3 | 24.0 | 13.2 | 50.0 | 18.5 | 70.0 |
| 0.1 | < 450000 cP | 0.9 | 3.5 | 2.1 | 8.0 | 3.2 | 12.0 | 6.6 | 25.0 | 9.3 | 35.0 |
| 0.05 | < 1000000 cP | 0.5 | 1.8 | 1.1 | 4.0 | 1.6 | 6.0 | 3.3 | 12.5 | 4.6 | 17.5 |

BM Oval Series

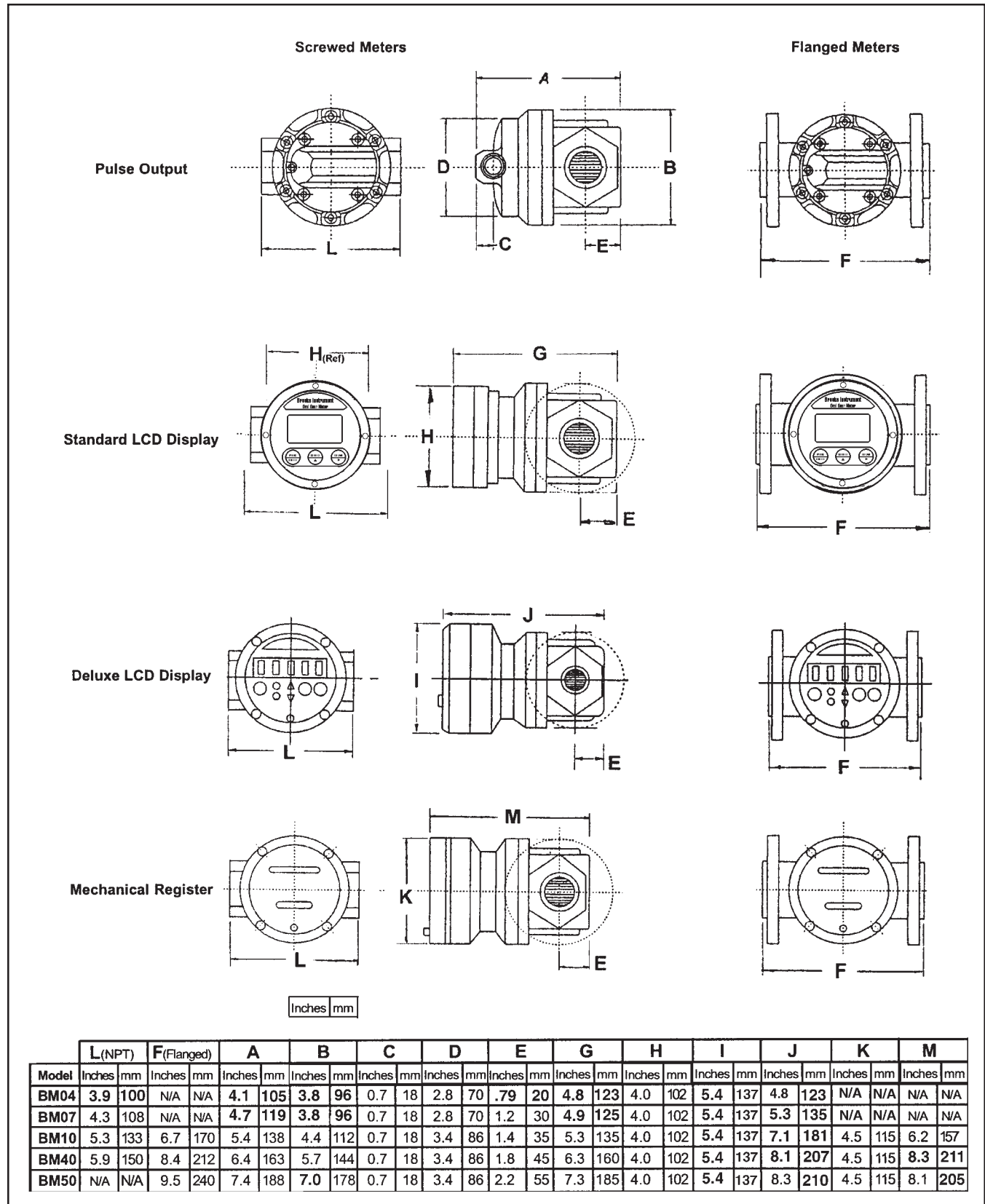


Figure 2 Dimensions

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Brooks BM - Series Oval Model Code

| | | | | | | | |
|-------|-------------|--|--------------------------------|------|------|------|------|
| MODEL | BASIC MODEL | | | | | | |
| BM | BROOKS-OVAL | | | | | | |
| | CODE | NOMINAL SIZE | | | | | |
| | 04 | 1/2 INCH | | | | | |
| | 07 | 1 INCH | | | | | |
| | 10 | 1 INCH | | | | | |
| | 40 | 1 1/2 INCH | | | | | |
| | 50 | 2 INCH | | | | | |
| | CODE | REVISION | | | | | |
| | A | CURRENT REVISION | | | | | |
| | CODE | BODY MATERIAL | | | | | |
| | A | ALUMINUM | | | | | |
| | B | BRONZE (BM10 METER ONLY) | | | | | |
| | R | PPS (BM7 METER ONLY) | | | | | |
| | S | 316 STAINLESS STEEL | | | | | |
| | CODE | ROTOR/GEAR MATERIAL | | | | | |
| | R | PPS ROTOR (GEAR) SET | | | | | |
| | S | 316 STAINLESS STEEL ROTOR (GEAR) SET | | | | | |
| | CODE | PULSER/DISPLAY | | | | | |
| | P | PULSE OUTPUT | | | | | |
| | E | DELUXE LCD DISPLAY (PROGRAMMABLE, GALLONS OR LITERS) | | | | | |
| | G | STANDARD LCD DISPLAY, GALLONS REGISTRATION | | | | | |
| | L | STANDARD LCD DISPLAY, LITERS REGISTRATION | | | | | |
| | M | MECHANICAL REGISTER, GALLONS REGISTRATION | | | | | |
| | N | MECHANICAL REGISTER, LITERS REGISTRATION | | | | | |
| | CODE | CONNECTION | AVAILABLE ON METER MODEL/SIZES | | | | |
| | | TYPE | BM04 | BM07 | BM10 | BM40 | BM50 |
| | 2 | NPT | YES | YES | YES | YES | YES |
| | 4 | 150 # RF | N/A | N/A | YES | YES | YES |
| | 5 | DIN 16 | N/A | N/A | N/A | YES | N/A |
| | 7 | TRICLOVER | N/A | N/A | YES | N/A | N/A |
| | 8 | 300 # RF | N/A | N/A | N/A | YES | N/A |
| | CODE | OUTPUT/ELECTRONIC | | | | | |
| | R | REED SWITCH (STANDARD) | | | | | |
| | H | HALL EFFECT (OPTIONAL) | | | | | |
| | N | NONE (MECHANICAL REGISTER OPTION) | | | | | |
| | CODE | VISCOSITY | | | | | |
| | 1 | STANDARD <1000 CP (ALL ROTOR (GEAR) MATERIALS) | | | | | |
| | 2 | HIGH > 1000 CP, PPS ROTORS (GEARS) | | | | | |
| | 3 | HIGH > 1000 CP, STAINLESS STEEL ROTOR (GEARS) | | | | | |
| | CODE | TEMPERATURE CLASS | | | | | |
| | A | STANDARD TEMP. PPS ROTORS (GEARS), 80C / 176F | | | | | |
| | B | HIGH TEMP. PPS ROTORS (GEARS), 120C / 248F | | | | | |
| | C | STANDARD TEMP. SS ROTORS (GEARS) 120C / 248F | | | | | |
| | CODE | SEALS/O-RINGS | | | | | |
| | V | VITON | | | | | |
| | K | TEFLON | | | | | |
| | CODE | OPTIONS | | | | | |
| | A | NONE (STANDARD METERS) | | | | | |
| | C | HASTALLOY C SHAFTS, BM07 METER ONLY. | | | | | |
| | S | SOLVENT KIT, ALUM MECH METERS | | | | | |
| | CODE | APPROVALS/CERTIFICATIONS | | | | | |
| | A | NONE | | | | | |

BM 10 A A R P 2 R 1 A V A A



BM10 SCREWED
PULSE OUTPUT
BM10AAP2R1AVAA



BM10 FLANGED
STANDARD LCD
DISPLAY
BM10AARF4R1AVAA



BM10 FLANGED
DELUXE LCD
DISPLAY
BM10AARE4R1AVAA



BM10 Tri-Clover
PULSE OUTPUT
BM10ASSP7R1CKAA

BM Oval Series

BROOKS LOCAL AND WORLDWIDE SUPPORT

Brooks Instrument provides sales and service facilities around the world, ensuring quick delivery from local stock, timely repairs and local based sales and service facilities.

Our dedicated flow experts provide consultation and support, assuring successful applications of the Brooks flow measurement and control products.

Calibration facilities are available in local sales and service offices. The primary standard calibration equipment to calibrate our flow products is certified by our local Weights and Measures Authorities and traceable to the relevant international standards.

START-UP SERVICE AND IN-SITU CALIBRATION

Brooks Instrument can provide start-up service prior to operation when required.

For some process applications, where ISO-9001 Quality Certification is important, it is mandatory to verify and/or (re)calibrate the products periodically. In many cases this service can be provided under in-situ conditions, and the results will be traceable to the relevant international quality standards.

CUSTOMER SEMINARS AND TRAINING

Brooks Instrument can provide customer seminars and dedicated training to engineers, end users and maintenance persons. Please contact your nearest sales representative for more details.

HELP DESK

In case you need technical assistance:

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Due to Brooks Instrument's commitment to continuous improvement of our products, all specifications are subject to change without notice.

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