BiRotor Plus
Positive Displacement Flow Meter

B27X [3"]
B28X [4"]
B29X [6"]

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1 Read Me First

Notice

Brodie International, a Brodie Meter Co., LLC Company (“Brodie”) shall not be liable for technical or editorial errors in this manual or omissions from this manual.

Brodie makes no warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose with respect to this manual and, in no event, shall Brodie be liable for any special or consequential damages including, but not limited to, loss of production, loss of profits, etc.

Product names used herein are for manufacturer or supplier identification only and may be trademarks/registered trademarks of these companies. The contents of this publication are presented for informational purposes only, and while every effort has been made to ensure their accuracy, they are not to be construed as warranties or guarantees, expressed or implied, regarding the products or services described herein or their use or applicability. We reserve the right to modify or improve the designs or specifications of such products at any time.

Brodie does not assume responsibility for the selection, use or maintenance of any product. Responsibility for proper selection, use and maintenance of any Brodie product remains solely with the purchaser and end-user.

2 Essential Instructions

General

Brodie International designs, manufactures and tests its products to meet many international standards. As the instruments are sophisticated technical products they must be installed, used and maintained properly to ensure they continue to operate within their normal specifications. The following instructions must be adhered to and incorporated into onsite safety programs where possible.

Read all instructions prior to installing, operating, and servicing the product. If this instruction manual is not the correct manual, telephone +1 912 489 0200 and the requested manual will be provided.

Save this instruction manual for future reference. If you do not understand any of the instructions, contact your Brodie representative for clarification.

Follow all warnings, cautions, and instructions marked on and supplied with the product. Inform and educate your personnel in the proper installation, operation, and maintenance of the product. Install your equipment as specified in the installation instructions of the appropriate instruction manual and per applicable local and national codes. Connect all products to the proper electrical and pressure sources.

To ensure proper performance, use qualified personnel to install, operate, update, program, and maintain the product. When replacement parts are required, ensure that qualified personnel use replacement parts specified by the manufacturer.

Unauthorized parts and procedures can affect the product's performance and place the safe operation of your process at risk. Look-alike substitutions may result in fire, electrical hazards, or improper operation.

Ensure that all equipment doors are closed and protective covers are in place, except when maintenance is being performed by qualified personnel, to prevent electrical shock and personal injury.

When installing this equipment, bolting must conform to the requirements of ASME B16.5 paragraph 5.3 and to the material requirements of ASME B16.5 Table 1B. Gaskets must conform to the requirements of ASME B16.20.

It is the customer's responsibility to ensure that piping or other attachments connected to the valve do not place adverse stresses on the valve. The design of the valve has not been assessed for the effects of traffic, wind, or earthquake loading.

It is the customer's responsibility to provide fire prevention measures and equipment per local regulations.

The valve has been designed without allowance for corrosion. The customer should implement a periodic inspection and maintenance program to ensure that no part of the valve's pressure retaining components has been subjected to corrosion.

Use of this equipment for any purpose other than its intended purpose may result in property damage and/or serious personal injury or death.

Essential Instructions for Measuring Equipment, Including the European Union (Directive 2004/22/EC MID)

Although measurement transducers are not specifically included in the MID regulations as they do not form a complete measuring instrument system, in accordance with Article 1 and 4, Annex I and Annex MI-005, Brodie Meter Co., LLC implements the same stringent regulations for all products and tests to the same standards which are used for complete measuring instrument systems.

The complete system must contain all the necessary components to meet the requirements of the local regulations. These components may include pumps, air eliminators, strainers, valves, flow computers, etc. The unit must be sealed in accordance with the local regulations; it is the end user's responsibility to ensure this happens.

Flow measuring devices are provided with two labels which specify flow ranges. The name plate label, which includes the factory serial number, details the operating flow range. This is the flow range the device will operate within without causing damage. The custody transfer label details the working flow range associated with a particular weights and measures approval.

It should be noted that these may not be the same; therefore, in trade applications, the flow ranges specified on the custody transfer label should be followed.

Essential Instructions for Electrical Equipment, Including the European Union (Directive 2004/108/EC and 2004/22/EC)

This unit contains Electrostatic sensitive circuit boards. Electrostatic safety precautions should be taken to prevent damage.

When connecting wiring it is good practice to use shielded cable. The shield should be connected to earth at the read out or control systems end of the cable; the other end of the shield should not be connected.

This wiring practice is mandatory in order to comply with the requirements for electromagnetic compatibility as per the EMC directive 2004/108/EC and MID 2004/22/EC of the council of the European Union.

It is the end user's responsibility to ensure that all protective covers are in place to prevent electrical shock and/or personnel injury.

Essential Instructions for Pressure Containing Equipment, Including the European Union (Directive 97/23/EC)

When installing the equipment the bolting must conform to the requirements of ASME B16.5, paragraph 5.3, and to the material requirements of ASME B16.5, Table 1B. Gaskets must conform to the requirements of ASME B16.20.

Although it is not expected for the device to be used in a service where it would come in to contact with unstable fluids, it is the end user's responsibility to assess any risks and take any precautions necessary.

It is the end user's responsibility to ensure that piping and other attachments connected to the Brodie instrument do not place adverse stresses upon it, the design of the instrument has not been assessed for the effects of traffic, wind or earthquake loadings.

It is the end user's responsibility to ensure that the instrument is mounted when required on suitable supporting foundations.

It is the end user's responsibility to install the device in a well-designed system to avoid potential hazards such as water hammer, vacuum collapse or uncontrolled chemical reactions.

It is the end user's responsibility to provide fire protection measures and equipment in accordance with the local regulations.

It is the end user's responsibility to install suitable straining and air/gas elimination systems.

The instrument has been designed without allowance for corrosion or other chemical attack. The end user should implement a periodic inspection and maintenance program to ensure that none of the instruments pressure containing components have been subject to any corrosion. It is possible to examine the instrument for evidence of corrosion through the inlet and the outlet.

When the ambient temperature is below the minimum operating temperature specified on the device it is the end user's responsibility to ensure that the device is warmed to an appropriated temperature before being pressurized.

Do not exceed the operating pressure and temperature limits of the instrument as stamped on the nameplates.

It is the customer's responsibility to install this equipment in a system that provides adequate over-pressure protection and that limit pressure surges to 10% of the maximum allowable working pressure of the instrument.

It is the end user's responsibility to provide fire protection measures and equipment in accordance with the local regulations.

Essential Instructions for Equipment to be Used in Hazardous Locations, Including the European Union (Directive 94/9/EC)

Any Hazardous area approval applies to equipment without cable glands. When mounting the flame-proof enclosure in a hazardous area only cable glands/conduit seals certified to meet or exceed the rating of the equipment should be used, refer to the type approval documentation for further details. Cable glands and cable must be suitable for the operating temperature of the device under its rated conditions, this is especially important if the device has an operating temperature above 1580F (700C). It is the end user's responsibility to ensure this happens.

The meter has been provided with an approved sealing device in one of the cable entries, the other entry has been closed with a plastic cap plug. It is the end user's responsibility to remove the cap plug and replace it with a suitable cable gland or conduit seal before the equipment is put into service.

It is the end user's responsibility to ensure, when the instrument is located in a hazardous area, that all cable glands and conduit seals are installed in accordance with all local codes and regulations.

It is the end user's responsibility to ensure that before opening an electronic enclosure in a flammable atmosphere that all the electrical circuits have been interrupted.

If replacement of the screws which secure the sensor housing, the UMB cover of the electronic register and its cover, are required, they must be replaced with either factory direct parts or M6-1x16 (6g) mm hex head socket screws of equal length. The screws must be made from stainless steel grade A1-70 or A2-70 and be torqued to a value of 55 inch lbs. upon installation. It is the end user's responsibility to ensure this happens.

It is the end user's responsibility to assess the maximum surface temperature of the device and the equipment the device is attached to and located next to as this may exceed the temperature ratings of the device itself. If this happens, additional safety precautions will need to be implemented by the end user.

Flame proof housings contain Aluminum; although the composition of these enclosures is carefully maintained to prevent any risk of an ignition source it is the end users responsibility to ensure that the housing is not struck by rusty tools or objects.

If the equipment is to be installed in an area where dust deposits and build up are to be expected, a maintenance plan should be arranged to include regular removal of the dust build up. This will prevent the dust from forming a possible source of ignition.

The power supply requirements for this product are specified within the operating and maintenance manual, it is the end user's responsibility to operate the product within these specified limits.

The instrument may contain surfaces that constitute flames paths, these surfaces should not contain any mars or scratches. If any are present the factory or the local representative should be contacted immediately to obtain a new housing as the safety of the enclosure may be impaired. It is the end user's responsibility to inspect these surfaces every time the enclosure is opened.

When flanged flame paths are reassembled the gap between them should be less than 0.0015" (0.038 mm) such that a 1/2" (12.5mm) wide 0.0015" (0.038 mm) feeler gauge will not enter the gap more than 1/8" (3mm). It is the end user's responsibility to ensure this happens each time the enclosure is reassembled.

3 Warranty Claim Procedures

3.1 - Limited Warranty

Subject to the limitations contained in Section 2 herein and except as otherwise expressly provided herein, Brodie International, a Brodie Meter Co., LLC Company ("Brodie") warrants that the firmware will execute the programming instructions provided by Brodie, and that the Goods manufactured, or Services provided, by "Brodie" will be free from defects in materials or workmanship under normal use and care until the expiration of the applicable warranty period.

Goods are warranted for twelve (12) months from the date of initial installation or eighteen (18) months from the date of shipment by "Brodie", whichever period expires first. Consumables and Services are warranted for a period of 90 days from the date of shipment or completion of the Services.

Products purchased by "Brodie" from a third party for resale to Buyer ("Resale Products") shall carry only the warranty extended by the original manufacturer.

Buyer agrees that "Brodie" has no liability for Resale Products beyond making a reasonable commercial effort to arrange for procurement and shipping of the Resale Products.

If The Buyer discovers any warranty defects The Buyer must notify "Brodie" thereof in writing during the applicable warranty period. "Brodie" shall, at its option, promptly correct any errors that are found by "Brodie" in the firmware or Services, or repair or replace F.O.B. point of manufacture that portion of the Goods or firmware found by "Brodie" to be defective, or refund the purchase price of the defective portion of the Goods/Services.

All replacements or repairs necessitated by inadequate maintenance, normal wear and usage, unsuitable power sources, unsuitable environmental conditions, accident, misuse, improper installation, modification, repair, storage or handling, or any other cause not the fault of "Brodie" are not covered by this limited warranty, and shall be at Buyer's expense.

"Brodie" shall not be obligated to pay any costs or charges incurred by Buyer or any other party except as may be agreed upon in writing in advance by an authorized "Brodie" representative.

All costs for dismantling, reinstallation, freight and the time and expenses of "Brodie's" personnel for site travel and diagnosis under this warranty clause shall be borne by Buyer unless accepted in writing by "Brodie".

Goods repaired and parts replaced during the warranty period shall be in warranty for the remainder of the original warranty period or ninety (90) days, whichever is longer. This limited warranty is the only warranty made by Brodie and can be amended only in a writing signed by an authorized representative of "Brodie".

Except as otherwise expressly provided in the Agreement, THERE ARE NO REPRESENTATIONS OR WARRANTIES OF ANY KIND, EXPRESSED OR IMPLIED, AS TO MERCHANTABILITY, FITNESS FOR PARTICULAR PURPOSE, OR ANY OTHER MATTER WITH RESPECT TO ANY OF THE GOODS OR SERVICES.

It is understood that corrosion, or erosion, of materials is not covered by our guarantee.

3.2 - Limitation of Remedy and Liability

Brodie International, a Brodie Meter Co., LLC Company (“Brodie”) shall not be liable for damages caused by delay in performance.

The sole and exclusive remedy for breach of warranty hereunder shall be limited to repair, correction, replacement or refund of purchase price under the limited warranty clause in Section 1 herein.

In no event, regardless of the form of the claim or cause of action (whether based in contract, infringement, negligence, strict liability, other tort or otherwise), shall “Brodie’s” liability to buyer and/or its customers exceed the price to buyer of the specific goods manufactured or services provided by Brodie giving rise to the claim or cause of action.

Buyer agrees that in no event shall Brodie’s liability to buyer and/or its customers extend to include incidental, consequential or punitive damages.

The term “consequential damages” shall include, but not be limited to, loss of anticipated profits, loss of use, loss of revenue and cost of capital.

Brodie International
P.O. Box 450 (30459-0450)
19267 Highway 301 North
Statesboro, GA 30461, USA

www.brodieintl.com
Phone: +1 (912) 489-0200

4 Receipt of Shipment

When you receive your equipment inspect the outside of the packing case for damage which may have incurred during shipping. Damage incurred during shipment is the responsibility of the carrier and is not part of the factory warranty. If the packing case is damaged, notify the local carrier immediately.

If the package is in good condition remove the envelope containing the packing list and carefully remove the equipment and all components included in the shipment from the packing case. Inspect for damaged or missing parts, referring to the packing list, and prior to discarding the packing material.

If Items are missing from your shipment, contact your sales representative. Your sales order number will be required.

5 Return of Equipment

If the equipment must be returned to the factory for repair or replacement, a Returned Materials Authorization (RMA) must be included with the components.

RMA forms may be obtained from your sales representative or from the Product Service Department. In addition to the RMA, a Material Safety Data Sheet and a Decontamination Statement must be included with Items being returned to the factory. A Decontamination Statement is included in the back of this manual.

If the equipment is removed from service it must be thoroughly drained and neutralized before it is packed for shipment. Care must be taken to ensure that product removed from the equipment is disposed of in accordance with all applicable local, state and federal regulations.

The flanges should be sealed to keep residual fluid from leaking out of the meter during transport. The type of flange seal required will vary with the form of transportation used. Contact the carrier for specific instructions.

The equipment should be securely mounted on a wooden skid for shipment. The original container or a solid wooden box should be used to protect the exterior of the components.

When packing the components for return to the factory, place the RMA and a copy of the packing list that was delivered with the equipment inside an envelope. Place the envelope inside the shipping container with the Item being returned and reference the RMA number on the outside of the shipping container.

Equipment returned to the factory without the proper documentation will be returned to sender at their expense.

Ship the container to:
Brodie Meter Co., LLC
Product Service Department
19267 Highway 301 North
Statesboro, GA 30461, USA

Phone: +1 (912) 489-0200
Fax: +1 (912) 489-0294
service@brodieintl.com

6 Storage

Brodie International instruments are precision devices and should be handled and stored with care. They should not be subjected to rough or improper handling or stored in an environment where moisture, extreme temperatures, or foreign material can damage the meter.

The inlet and outlet flange covers should remain on the instrument until the unit is ready for installation.

If extended storage is required it is recommended that the instrument be placed in an environmentally controlled warehouse. If this is not possible the instrument should be stored in a waterproof lined wooden box. Desiccant packs should be taped to the inside of the instrument end connections before they are sealed to reduce the effect of humidity on the equipment and accessories. Caution must be used to ensure desiccant packs are removed prior to installation.

Depending on the storage time it may also be preferable to use a compatible corrosion inhibitor.

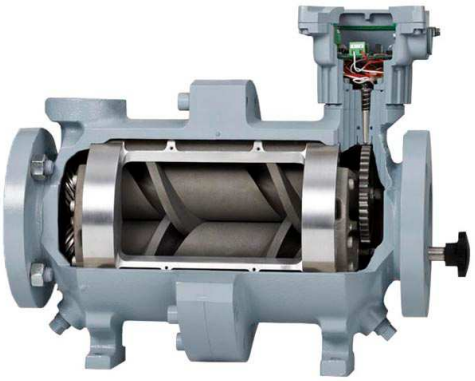
If the valve is removed from service for an extended period of time it should be flushed with a light oil before being placed into storage.

7 Description

General

The BiRotor Plus is an extremely accurate, dual-cased, flow measuring device. It produces a high resolution signal, via the use of non-wetted pick offs, which is directly proportional to the rate of liquid flow through the meter. These signals can be shaped by a simple pre-amplifier for transmission to ancillary equipment.

The BiRotor Plus meter utilizes the exclusive Bi-Rotor principle. There are no sliding, oscillating, or reciprocating parts.



8 Specifications

Materials of Construction

Item	Material	
	High Temperature (-29°F to 230°F)	Low Temperature (-40°F to 230°F)
Meter Housing, 3" and 4"	ASTM A 216 WCB Carbon Steel	ASTM A 352 LCB Carbon Steel
Meter Housing, 6"	ASTM A 216 WCB and ASTM A 516 GR 70 Carbon Steel	ASTM A 352 LCB and ASTM A 516 GR 70 Carbon Steel
Connection Flanges	ASTM A 105 Carbon Steel	ASTM A 350 LF2 Carbon Steel
Sensor Housing	ASTM A 479, 304 Stainless Steel	
Endplates and Body	A 356 Cast Aluminum, Anodized Hard Coat	
Rotors	ALCO 319 Cast Aluminum	
Rotor Shafts	17-4 Ph Stainless Steel	
Timing Gears	416 Stainless Steel	
Bearings	Stainless Steel (Ceramic Optional)	
UMB Housing*	A356 T6 Cast Aluminum	
Elastomers** (Standard)	Viton A	
	Viton F	
	Low Swell Nitrile	
	FluoroSilicon	

*: This part is non-wetted
**: Must have Flurosilicon seals or Viton 1289 for Low Temperature

NOTE:
Other elastomer options are available.

Performance

B27X Linearity, Standard Rotors

+/- 0.1% Over Standard Flow Range
+/- 0.15% Over Extended Flow Range

B28X and B29X Linearity, Standard Rotors

+/- 0.075% Over Standard Flow Range
+/- 0.15% Over Extended Flow Range

Premium Accuracy is also available.

Repeatability (All Sizes): +/- 0.01%

Operating Temperature Limits

Meter Type	Seal Material	Minimum Operating Temperature		Maximum Operating Temperature	
		Degree F	Degree C	Degree F	Degree C
Low Temp	Viton 1289	-40	-40	167	75
	Flurosilicon	-40	-40	167	75
Standard	Viton A	-15	-25	167	75
	Low Swell Nitrile	-20	-29	167	75
	Viton F	-15	-25	167	75
	Flurosilicon	-20	-29	167	75
High Temp	Viton A	14	-10	230	110
	Low Swell Nitrile	14	-10	212	100
	Viton F	14	-10	230	110
	Flurosilicon	14	-10	230	110

Maximum Working Pressure at 100°F (38°C)

Flange Ratings	PSI	Bar
ANSI 150#	285	19.5
ANSI 300#	740	51
DIN PN 16	232	16
DIN PN 40	580	40

Shipping Weights and Volume

Model	Size	Wieght	
		Lb.	Kg
B27X	3" ANSI 150#	193	88
	DN80 PN 16	193	88
	3" ANSI 300#	200	91
	DN80 PN 40	200	91
B28X	4" ANSI 150#	293	133
	DN100 PN 16	293	133
	4" ANSI 300#	300	136
	DN100 PN 40	300	136
B29X	6" ANSI 150#	350	159
	DN150 PN 16	350	159

Flow Ranges

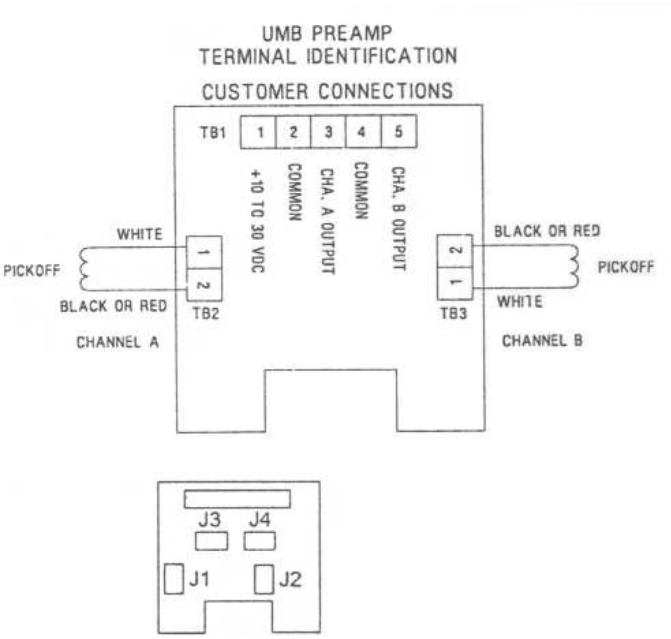
Meter Size	Flow Rate				Nominal K-Factor
	US GPM	BPH	M3/HR	L/MIN	
DN80 and 3"	550	786	125	2082	160 PUL/ US GAL +/- 10%
	425	607	97	1609	
	213	304	48	806	
	83	119	19	314	
	43	61	10	163	
	30	43	7	114	
DN100 and 4"	1000	1429	227	3785	96 PUL/ US GAL +/- 10%
	700	1000	159	2650	
	350	500	79	1325	
	140	200	32	530	
	70	100	16	265	
	33	47	7	125	
DN150 and 6"	1200	1714	273	4542	96 PUL/ US GAL +/- 10%
	1000	1429	227	3785	
	500	714	114	1893	
	250	357	57	946	
	100	143	23	379	
	40	57	9	151	

Electrical Details

Pick Off:
Non-Wetted Reluctance Type
Sine Wave Amplitude: 40 mV P-P, min.

Preamplifier:
Supply Voltage: 9 - 28 VDC
Outputs (jumper selectable): 0 - 5 KHz
5 V Power Pulse: 0 - 5 VDC, 20 mA max
Variable Voltage Pulses: 0 - Supply Voltage
Less 5%, 70 mA max

Open Collector:
Max Voltage: 30 VDC
Max Current: 125 mA
Max Power: 0.5 W



Preamp Jumper Configurations

JUMPER	A	B	OUT
J1 - Chan. A Input	N/A	40 mV min.Signal	N/A
J2 - Chan. B Input	N/A	40 mV min. Signal	N/A
J3 - Chan. A Output	5V Pulse	Sup. Volt Pulse (10-30 Vdc)	O.C.
J4 - Chan. B Output	5V Pulse	Sup. Volt Pulse (10-30 Vdc)	O.C.
J3 - Chan. A Output	5V Pulse	Sup. Volt Pulse (10-30 Vdc)	O.C.
J4 - Chan. B Output	5V Pulse	Sup. Volt Pulse (10-30 Vdc)	O.C.

Figure 8-1 Electrical Connections

Pressure Drop Values

To convert pressure drop value to actual process fluid, use the following equation:

$$\Delta P_A = (cP_A)^{0.25} \cdot (SG_A)^{0.75} \cdot \Delta P_m$$

ΔP_A = Pressure Drop on Actual Fluid in PSI
cP_A = Viscosity of Actual Fluid in cP
SG_A = Density of Actual Fluid in SG
ΔP_m = Pressure Drop on Mineral Spirits

Reference Figures 8-2 and 8-3 for P_m values.

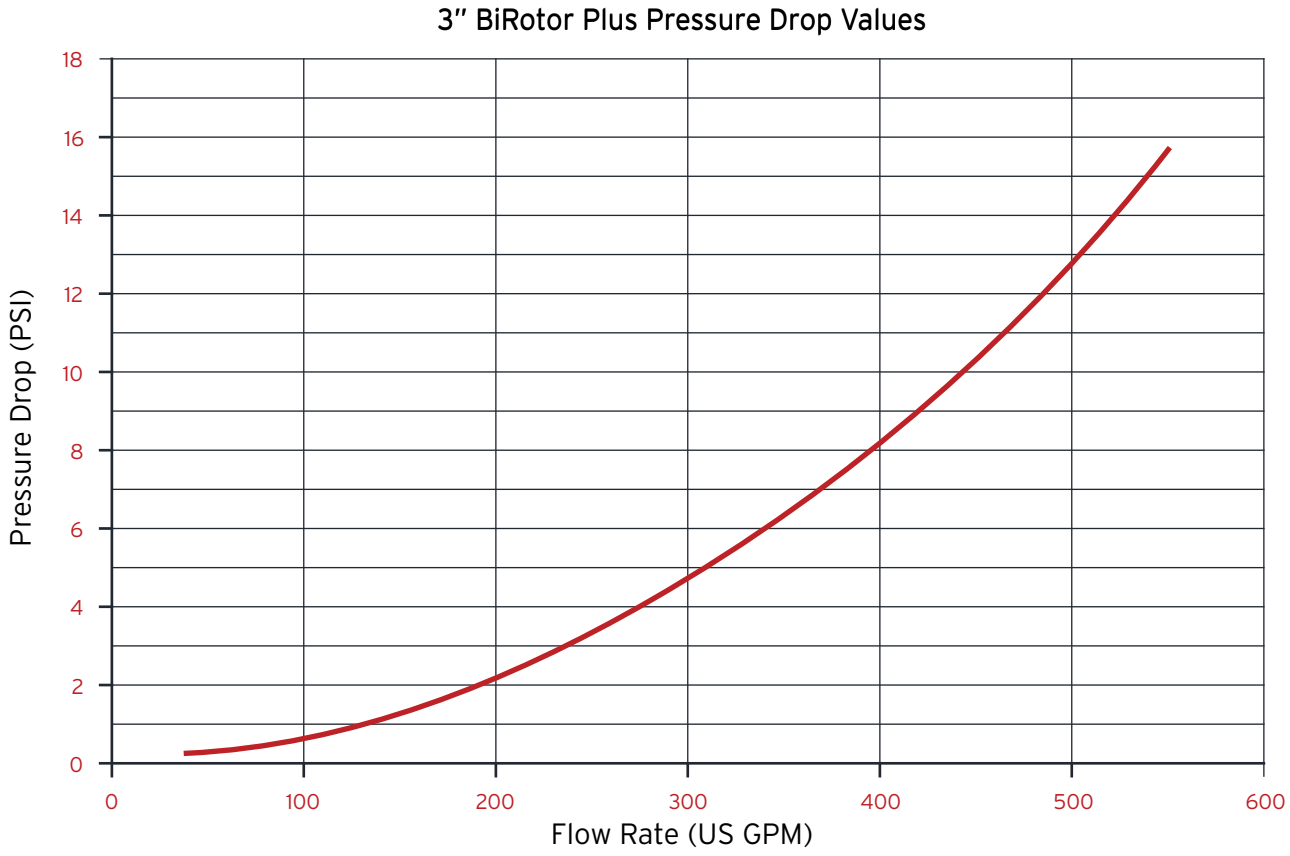


Figure 8-2 3" Pressure Drop

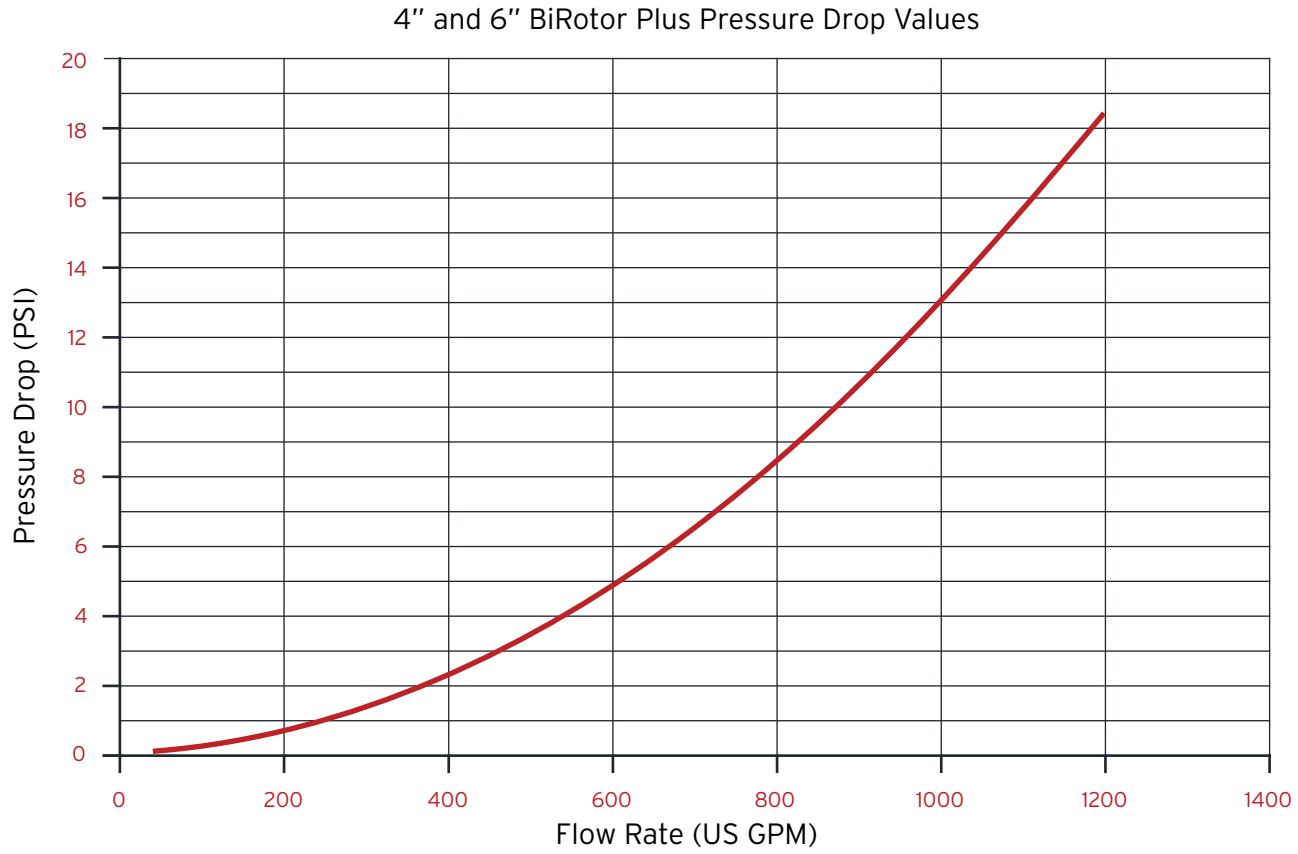


Figure 8-3 4" and 6" Pressure Drop

International Approvals

Environmental:

NEMA 4X (USA)
Type 4X (UL and CSA)
IP 65 (EU)
OIML R117-1 Class H3 (EU)

Electromagnetic Emissions & Immunity:

CE European Union (EN 61326) (EU)
OIML R117-1 Class E2 (EU)
MID Class E2 (EU)
FCC 47 CFR Part 15 (USA)
ICES-003 Issue 4 (CANADA)

Hazardous Area Approvals:

Temp Ambient. -40 to 60°C, -40 to 140°F

CSA (USA and CANADA)
Class 1, Division 1, Group C, and D Certificate:
2142875 221162
Standard Pickoff:
-4°F - 167°F, -20°C - 75°C
High-Temp Pickoff:
14°F - 230°F, -10°C - 110°C
ATEX (EU)
CE 0359 Ⓔx II 2 G Ex d IIB T6 - T4 Gb
Certificate: ITS 08 ATEX 15842X
Standard Pickoff:
-20°F - 167°F, -29°C - 75°C
High-Temp Pickoff:
-20°F - 230°F, -29°C - 110°C
IEC Ex (International)
Ex d IIB T6 – T4 Gb
Certificate: IEC Ex ITS 08.0021X
Standard Pickoff:
-20°F - 140°F, -29°C - 60°C
High-Temp Pickoff:
-20°F - 230°F, -29°C - 110°C
GOST (RU)
-20°F - 167°F, -29°C - 75°C

Weights and Measure:

NTEP*
OIML R117-1*
The Peoples Republic of China**
Netherlands Weight and Measures*
Measurement Canada
PTB Germany*
MID Certified as a component for use with in a measuring system as agreed within WELMEC
GOST*

Pressure Equipment:

Under the EU Pressure Equipment Directive:
97/23/EC*
Rated as SEP for ANSI 150# and PN 16 versions*
Rated as CAT 2 for 300# and PN40 versions,
Canadian Registration: All Provinces*

NOTE:
***Not Applicable for Low Temp BiRotor Plus**
****Pending for Low Temp BiRotor Plus**

Hazardous Area Temperature Classification

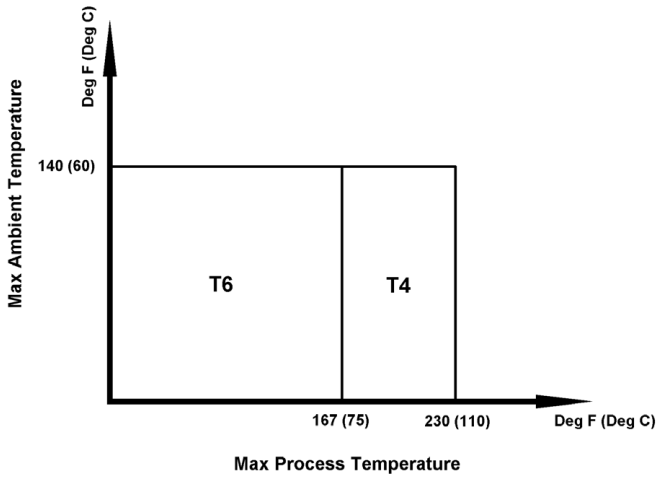
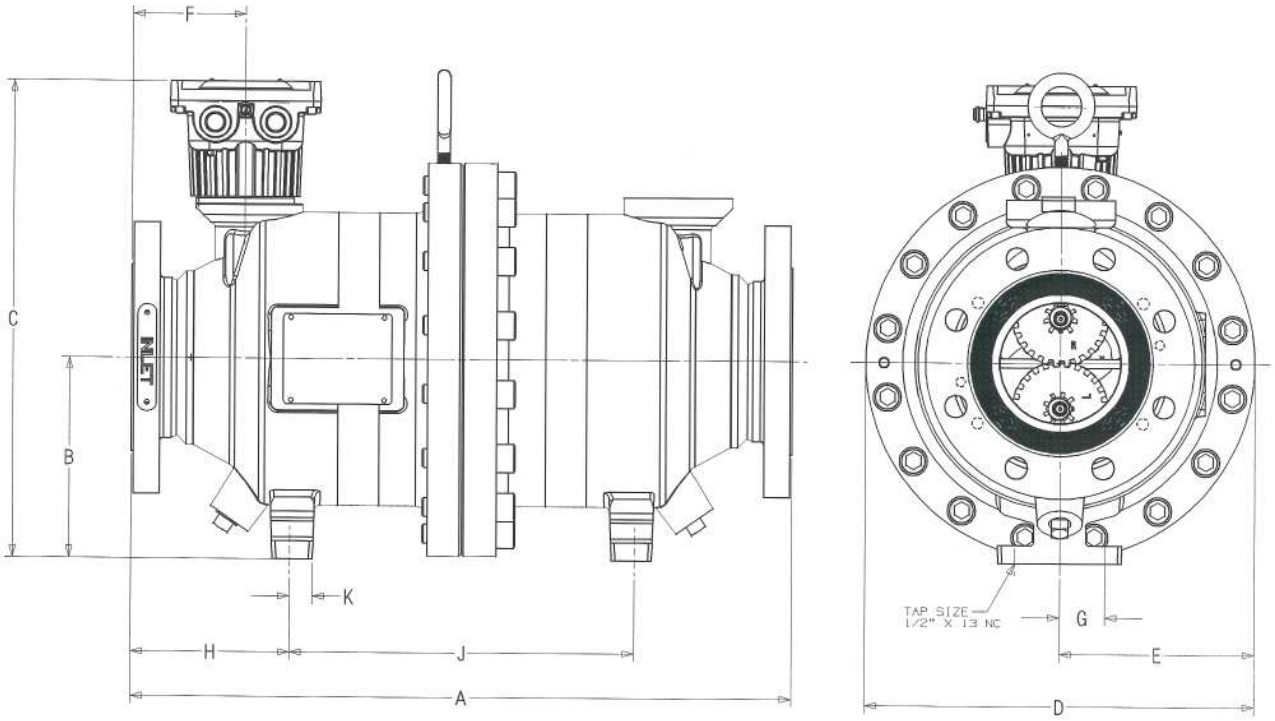


Figure 8-3 T Rating Chart

Dimensions (Contact Factory for Certified Dimensional Prints)



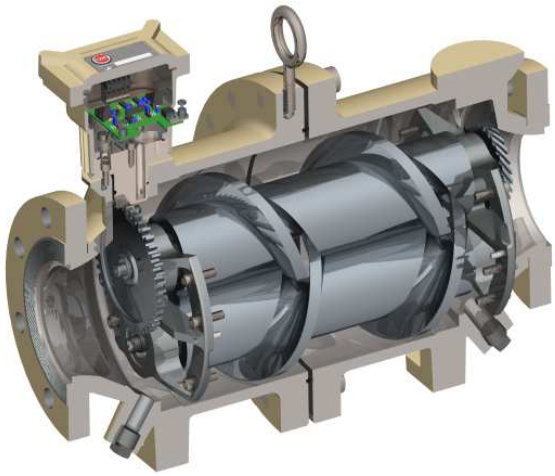
Model	Size	Unit	A	B	C	D	E	G	H	J
B27X	3" ANSI 150#	inch	18	6 1/6	14 13/16	11 1/2	5 3/4	1 3/8	4 3/16	9 5/8
		mm	457	154	376	292	146	35	107	244
	DN80 PN 16	inch	18	6 1/6	14 13/16	11 1/2	5 3/4	1 3/8	4 3/16	9 5/8
		mm	457	154	376	292	146	35	107	244
	3" ANSI 300#	inch	19	6 1/6	14 13/16	11 1/2	5 3/4	1 3/8	4 3/16	9 5/8
		mm	483	154	376	292	146	35	107	244
	DN80 PN 40	inch	19	6 1/6	14 13/16	11 1/2	5 3/4	1 3/8	4 3/16	9 5/8
		mm	483	154	376	292	146	35	107	244
B28X	4" ANSI 150#	inch	22	6 5/8	16	13	6 1/2	1 1/2	5 1/4	11 1/2
		mm	559	168	406	330	165	38	133	292
	DN100 PN 16	inch	22	6 5/8	16	13	6 1/2	1 1/2	5 1/4	11 1/2
		mm	559	168	406	330	165	38	133	292
	4" ANSI 300#	inch	23 1/8	6 5/8	16	13	6 1/2	1 1/2	5 15/16	11 1/2
		mm	587	168	406	330	165	38	150	292
	DN100 PN 40	inch	23 1/8	6 5/8	16	13	6 1/2	1 1/2	5 15/16	11 1/2
		mm	587	168	406	330	165	38	150	292
B29X	6" ANSI 150#	inch	24	6 5/8	16	13	6 1/2	1 1/2	6 1/4	11 1/2
		mm	610	168	406	330	165	38	159	292
	DN150 PN 16	inch	24	6 5/8	16	13	6 1/2	1 1/2	6 1/4	11 1/2
		mm	610	168	406	330	165	38	159	292

9 Installation and Operation

General

The operation of the meter is embodied in the function of the measuring rotors; they are always dynamically balanced but hydraulically unbalanced during operation. The rotors have no metal to metal contact with each other or the housing in which they rotate. Clearances between moving components are maintained with the use of timing gears.

The BiRotor Plus is a positive displacement (PD) meter. A PD meter uses a mechanical principle that measures flow by continuously dividing the flowing stream into known volumetric segments, isolating those segments momentarily, and then returning them to the flowing stream while counting the number of displacements. This is a direct volume measurement, there is no inferred, or software generated, measurement.



9.1 - Installation Requirements

1. The instrument should be mounted on a secure foundation. Provisions should be made for vertically mounting the meter to ensure stability.

2. The process piping should not place any undue strain on the instrument.

3. Precautions should be taken to ensure that thermal fluid explansion does not raise the line pressure above the maximum working pressure of the instrument.

4. Process piping must be clean and free of any foreign matter.

5. A strainer should be installed upstream of the instrument.

6. An air eliminator should be installed upstream of the instrument if the process fluid is expected to contain entrained air.

7. A flow limiting valve should be installed downstream of the instrument, this will maintain a back pressure on the instrument and prevent excessive flow rates.

8. Isolation valves should be located at either ends of the instrument run and a bypass section installed. This will facilitate ease of component removal, when required, and reduce loss of product.

9.2 - Installing the Instrument

1. Remove the inlet and outlet protection covers.

2. Install the instrument into the pipe work using suitable hardware as specified in the local codes and regulations. Ensure that the connections are made tight and torqued to the correct values.

3. Connect the instrument wiring, refer to Figures 9-1 and 9-2. Cable entry into the electrical enclosure is by two 3/4-14 NPT female threads.

4. Use wiring appropriate for the location and operating conditions. Wiring glands and/or conduits must conform to local electrical codes and regulations if wiring is to be installed in a hazardous area.

NOTE:
For additional requirements on installation please refer to Chapter 2, Essential Instructions, at the beginning of this manual.

If the instrument is being installed with additonal accessories, the instructions for those accessories should be read and understood before continuing with the installation. The output signal from the preamplifier, if one is fitted, can be altered to interface with most electronic accessories. This is accomplished by the use of jumpers on the circuit board. Refer to Figure 9-1 for their configurations.

The UMB housing may be rotated in 90° increments to accomodate the mounting of accessories. If the UMB housing is removed for any reason, care must be taken to disconnect the sensor wires to prevent sensor damage. It is essential that the four retaining screws used to secure the UMB housing to the meter body be torqued to 55 in/lbs. (Item 18, Figure 12-1)

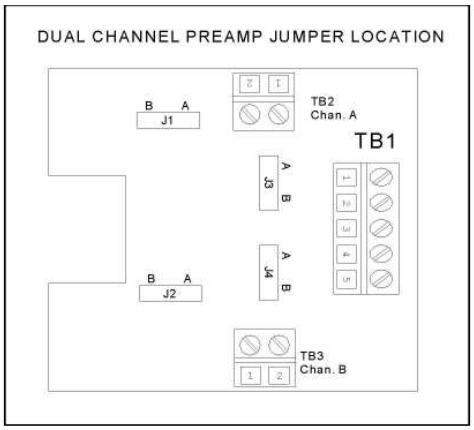


Figure 9-1 Wiring Connections

TB1	Function
1	9-28 VDC Supply
2	V Comm
3	Channel A Signal
4	Channel A and B Common
5	Channel B Signal

Jumper	Position
J1 (Channel A)	B
J2 (Channel B)	B

Jumper	Open Collector	5 VDC Pulse	V Supply Pulse
J3 (Channel A)	OUT	A	B
J4 (Channel B)	OUT	A	B

The instrument should not be located in a location where excessive vibration is to be expected.

Care should be taken not to locate the instrument near any source of electromagnetic interference, such as those produced by electric motors, transformers, solenoids, etc.

Either of these factors could induce a signal into the flow sensing pickoff and interfere with the accuracy of line product measurement.

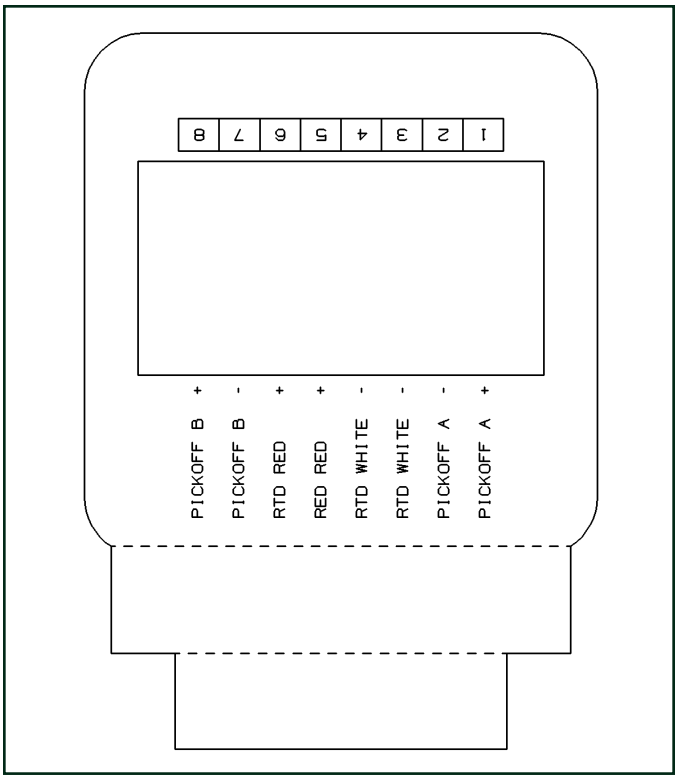


Figure 9-2 Wiring Connections

Integral Brodie Electronic Rate Totalizer (BERT-E)

If the instrument has been supplied with an integral electronic register, the internal wiring connections will already be in place. For additional functions and wiring possibilities please refer to the BERT-E's instruction manual.

9.3 - Meter Start Up and Operation

Review the system installation to ensure all the components are in proper sequence, all isolation valves must be closed, all electrical connections are complete, and all covers are in place.

1. To pressurize the system, slowly open the inlet valve so as to prevent system shock. Slowly allow product to enter the system whilst keeping the downstream isolation valve closed.

2. Open the downstream valve (10%) to allow any air to be flushed from the system. Do not overspeed the instrument.

3. Once the air has been flushed from the system, close the downstream isolation valve and check for any leaks. If leaks are found, check all seals and retighten connections.

4. Fully open the upstream isolation valve to pressurize the system.

Flow start up can commence once the sytem has been pressurized.

1. Turn on all electronic circuits and check for proper function.

2. Open flow control valves and allow the instrument to run at 20% of its rated flow for 5 minutes.

3. During this initial run, check all other components in the system for functionality.

4. Once this run is complete, set the flow control valve to the required flow and ensure that the maximum flow for the instrument is not exceeded.

9.4 - Higher Temperature Start Up

On higher temperature start up above 212°F (100°C), based on an ambient temperature of 70°F (21°C), special start up procedures are required to prevent damage to the flow meter components. A similar procedure should be followed on any thermal shock in excess of 176°F (80°C). The following equation may be used to determine the approximate flow meter warm up time.

$t_h = [(C_{nom}) \cdot (OT_{°f} - 212)]/100$

t_h = Warm Up Time in Hours
C_{nom} = Nominal Connection Size
$OT_{°f}$ = Operating Temperature in °F

During this warm up time the meter should be operated at approximately 5% of maximum flow to allow the temperature to stabilize.

9.5 - Custody Transfer

A meter factor will need to be established under actual operating conditions if the instrument is to be used in custody transfer applications. This inital proving run should be carried out following the completion of the meter start up procedure, and in accordance with local regulations.

NOTE:
There are no user adjustable parts in these instruments, however, the instrument housing is provided with two cross-drilled bolts and drain plugs to facilitate sealing if required by the local weights and measurements regulations.

Typical Horizontal Installation with Associated Accessories

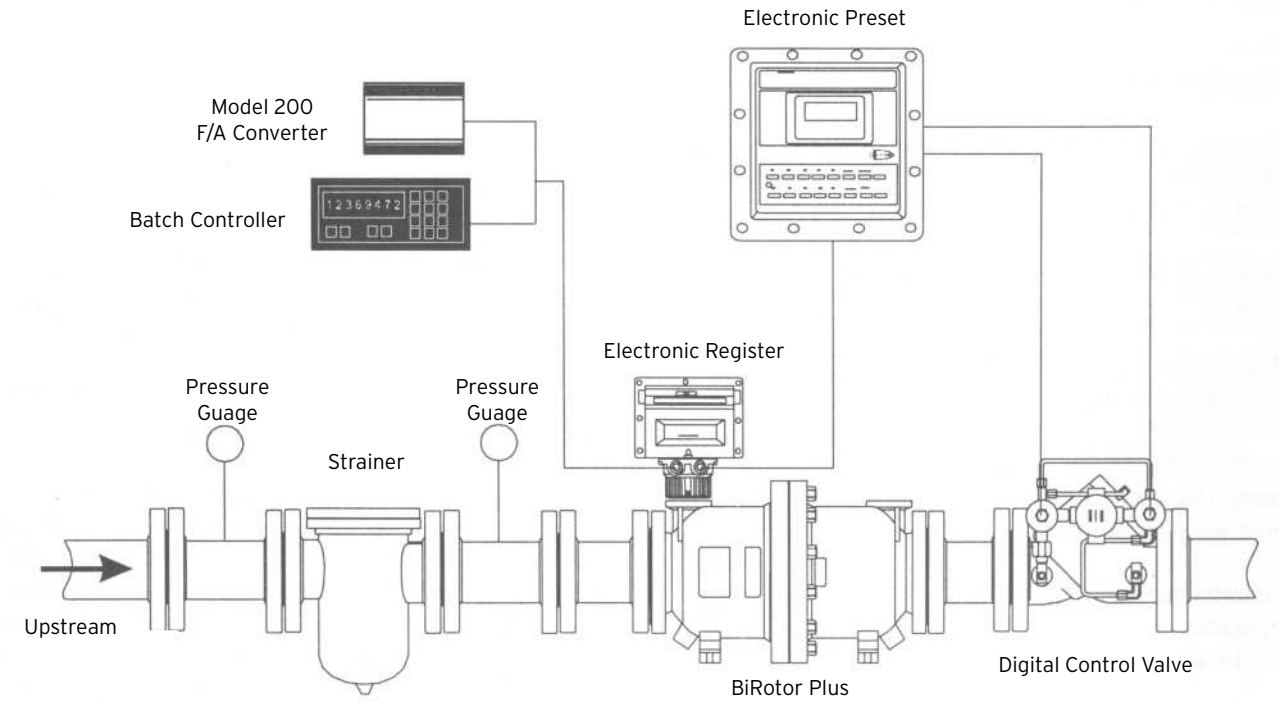


Figure 9-3 Horizontal Installation

Truck Loading - Vertical Installation for Marketing Terminal Applications

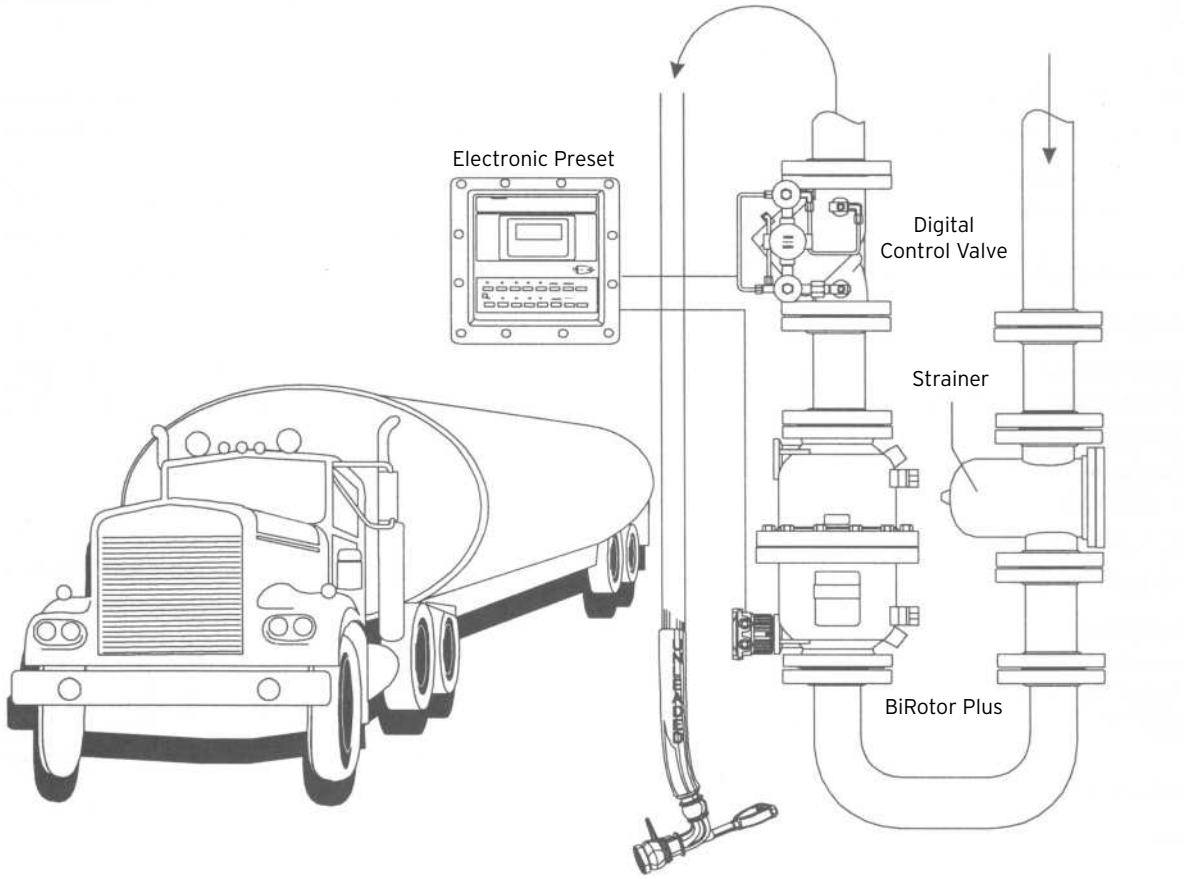


Figure 9-4 Vertical Installation

10 Maintenance

General

The Brodie BiRotor Plus will give many years of consistent performance with little need for maintenance or service. There are, however, several recommendations which, if followed, will further extend the instrument's service life.

The instrument should be kept filled with the process fluid it is measuring. This prevents the exposure to any product vapor which, in the case of petroleum products, are more corrosive than their liquids. In addition, this also prevents the formation and build up of deposits or gums, which would cause increased mechanical friction. The instrument should always be kept free of water, keeping it full of process fluid will accomplish this, but if this is not possible a regular inspection program should be set up and any water drained from the measuring unit.

Filter and strainer baskets should be cleaned frequently. Debris and foreign matter are the biggest cause of meter wear and damage.

All other associated equipment within the system should be regularly maintained and checked for functionality.

NOTE:
If the instrument is being used in hazardous areas, all instructions on the labels and in this manual must be followed before the start of any maintenance.

If the instrument is removed from the process line, the line should be sealed with suitable blanking flanges to prevent any possible leakage of product.

WARNING:
The internal measuring element contains closely meshed moving parts, care should be taken not to insert figures into the rotors or timing gears as this will cause injury.

NOTE:
All Item Numbers referenced in this section can be found on Figure 12-1 in Chapter 12, Parts Lists.

Performance Considerations

The amount of maintenance necessary for efficient instrument performance is dependant on many factors; some of these are listed below.

Continuity of Operation: An instrument that operates continuously will require more attention than one used intermittently.

Working Flow Rate: The life of the instrument is proportional to the speed of its operation. If the instrument is operating at or near the maximum flow rate it will have a shorter life expectancy than if it were operating at its minimum flow rate.

Lubricity: The lower the lubricration properties of the process fluid being measured then the lower the life expectancy should be.

Cleanliness: A product contaminated with abrasive particulate will accelerate the wear of the instrument.

Electronics

This instrument can be provided with up to two inductive pick off sensors and an optional preamplifier. Maintenance of the electronics does not require the system line pressure to be drained or the instrument to be removed from the system.

ESD precautions must be followed.

10.1 - Removal/Replacement of Circuit Board

1. Disconnect all power to the instrument.

2. Remove the electronics lid (Item 36), or electronics register, if one is fitted, by removing four Allen screws (Item 25).

3. Disconnect terminals and wiring to the circuit board.

4. Remove circuit board by removing the screws that attach it to the housing.

To reinstall, reverse the removal instructions and torque the four Allen screws (Item 25) to 55 in/lbs.

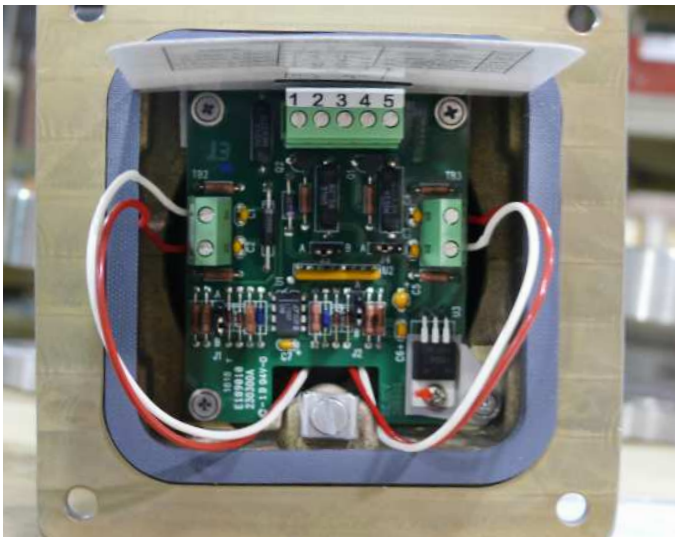


Figure 10-1 Circuit Board and Housing

10.2 - Removal/Replacement of Pick Off Sensors

1. Remove the circuit board as detailed above (Section 10.1).

2. Remove the center screw (Item 25) from the sensor housing (Item 23) and lift off the hold down washer (Item 29).

3. Lift out the inductive sensor(s) (Item 27) and spring (Item 28).

The pick off sensor should have a resistance of 1000 Ohms (+/- 15%) between the leads, and 10 Ohms between the leads and the sensor housing when installed.

If this is not the case the pick off sensor should be replaced. To reassemble, replace the pick off sensor in the sensor housing. If only one pick off sensor is present it should be inserted in the hole labelled 'A'. Secure with the hold down washer (Item 29) and Allen screws (Item 25) and replace the circuit board (Item 38).

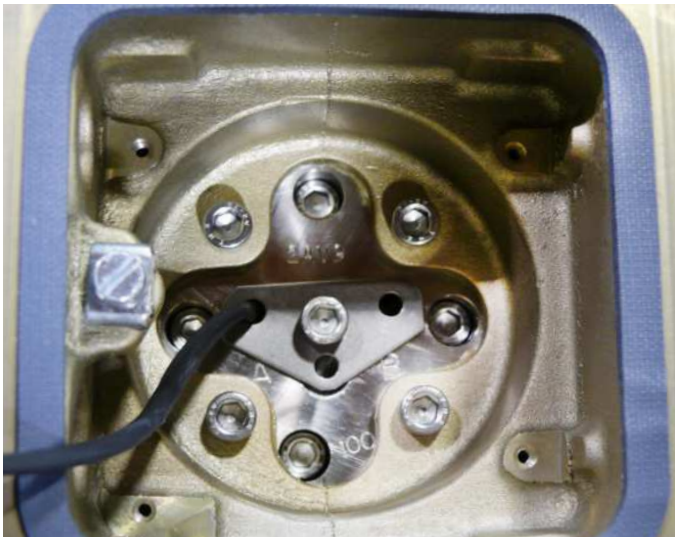


Figure 10-2 Pick Off Sensor Installation

10.3 - Removal of the Measuring Unit from the Process Line

1. Disconnect all power to the instrument.
2. Relieve all system pressure and drain the meter.
3. Disconnect all external wiring from the electronics unit.
4. Unbolt the instrument from the process piping and remove to a workshop for further disassembly.

NOTE:
Care should be exercised to prevent the intrusion of foreign material into the instrument end connections.

10.4 - Removal of the Measuring Unit from the Instrument Body

1. Turn the meter on end so that it stands on its inlet flange, this will also facilitate in fully draining the instrument of process fluid.
2. Remove screws (Items 1 and 2) and lift off the oulet housing (Item 50).
3. Remove O-ring (Item 16).
4. Holding the measuring unit assembly by the ribs, carefully lift straight up until the assembly clears the inlet housing.
5. Place the measuring unit in the horizontal position.

At this stage the assembly can be inspected for wear or damage. If the assembly had jammed it may be possible to unblock the rotors by flushing it with a cleaning solvent or kerosene without the need for further disassembly.

Further disassembly of the measuring unit for cleaning or inspection can be achieved while maintaining clearance settings. This procedure is covered in the next section (Section 10.5). To fully disassemble the measuring unit proceed to Section 10.6.

10.5 - Measuring Unit Disassembly While Maintaining Clearance Settings

1. Place a folded rag between the timing gears (Items 6 and 49) to prevent the rotors from turning during disassembly.

2. Remove the pulse wheel (Item 14) by removing the screw (Item 44), washer (Item 45), and retaining washer (Item 46).

3. Remove the screw (Item 7) from the end plate (Item 8) at the timing gear end of the measuring unit assembly.

NOTE:
A flat head screwdriver may be used in conjunction with the slots on the end plate to aid in its removal. Excessive force is not required.

4. Use a plastic or rubber mallet and strike the rotor shafts at the pulse wheel end of the housing to aid in the removal of the rotor assembly.

5. Once the rotor assembly has been removed from the housing any blockage or foreign material can be cleaned away.

At this stage the meter can be reassembled by reversing the disassembly procedures without the need to reset any clearances.

NOTE:
Any elastomers that have been removed should be replaced with new parts during reassembly.

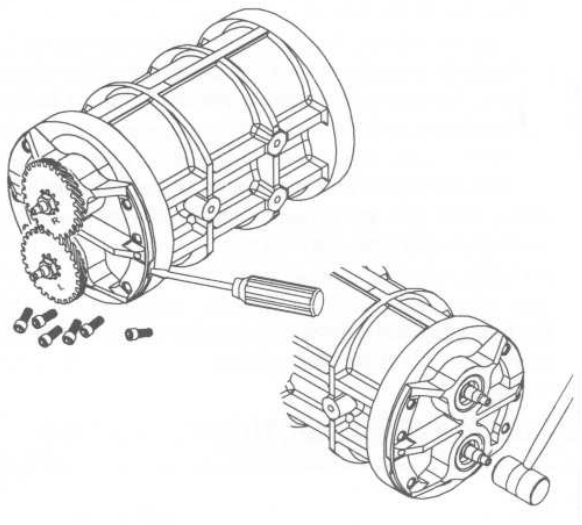


Figure 10-3 Measuring Unit Disassembly

10.6 - Complete Disassembly of the Measuring Unit

1. Place a folded rag between the timing gears (Items 6 and 49) to prevent the rotors from turning during disassembly.

2. Remove the pulse wheel (Item 14) by removing the screw (Item 44), washer (Item 45), and retaining washer (Item 46).

3. Remove the screw (Item 7) from the end plate (Item 8) at the timing gear end of the measuring unit assembly.

NOTE:
A flat head screwdriver may be used in conjunction with the slots on the end plate to aid in its removal. Excessive force is not required.

4. Use a plastic or rubber mallet and strike the rotor shafts at the pulse wheel end of the housing to aid in the removal of the rotor assembly.

5. Fold down the lack washer (Item 5) tabs to enable the nuts (Item 4) to be undone and remove them from the rotor shafts. The timing gears can be released from the shaft by striking them with a plastic or rubber mallet.

6. Remove the rotors (Items 11 and 48) from the end plate by gently tapping the rotor shafts with a plastic or rubber mallet.

7. Remove the O-rings (Item 10) from the rotor shafts.

8. The bearings (Item 9) can be removed from the end plates by pressing on the inner race of the bearings from the outside of the plate. If the bearings are removed from the endplates then they must be replaced.

9. Remove the other end plate from the measuring element housing and remove the bearings.

10. Remove the sensor housing (Item 23) from the inlet housing (Item 21) by removing four Allen screws (Item 25) located in the counter sunk holes under the circuit board (Item 35).

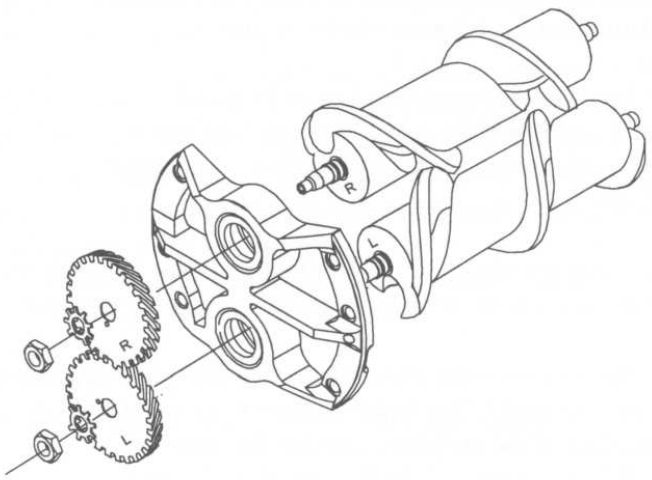


Figure 10-4 Rotor and Gear Orientation

10.7 - Complete Reassembly

1. Ensure all parts are clean and free of debris.

2. Lubricate all bearings and internal O-rings with a light oil.

NOTE:
All O-rings should be replaced with new ones during reassembly.

3. Press bearings (Item 9) in to the end plates (Item 8). Use a hand press and ensure that the bearing is pressed on the outer race to avoid damage. The bearing races should be flush with the bottom of the end plate once the bearings have been pressed in correctly. The outer race of an old bearing can be used to assist in proper seating.

4. Attach one end plate (Item 8) to the measuring unit body (Item 13) at the end with two dowel pins (Item 12). Align the dowel pins and gently tap into place with a plastic or rubber mallet. Once fully seated secure the end plate with screws (Item 7).

5. Each rotor (Items 11 and 48) and timing gear (Items 6 and 49) is marked with an 'R' or an 'L'. During assembly the inscriptions need to be matched. To orientate the rotors during assembly the measuring element body (Item 13) has three holes machined into it for manufacturing purposes. These holes should be positioned so that they face upwards. With these holes facing upwards turn the housing so that the end with the two dowel pins faces away from you. With the housing in this position the rotor marked with an 'R' (Item 48) goes in the right hand cavity and the rotor marked with an 'L' (Item 11) goes in the left hand cavity.

6. Lubricate O-rings (Item 10) and install on the rotor shafts. Mesh the two rotors together ensuring that the tapered shafts are at the same ends. The rotors should be held together with the tapered end of the shaft facing the end plate which is attached to the measuring element housing. While keeping the rotors meshed and even, insert them into the measuring chamber. Use a plastic or rubber mallet to gently seat the rotor shafts into the bearings.

7. Install the other end plate (Item 8) and screws (Item 7) on to the other end of measuring element body ensuring that the rotor shafts seat within the bearings.

8. Place the timing gears (Items 6 and 49) onto the respective tapered rotor shaft. The timing gears have a small hole for the location of the lock washer tab; this should be facing outward from the measuring element.

9. Install the lock washer (Item 5) ensuring the 90° tab locates in the hole of the timing gears (Items 6 and 49) and nuts (Item 4) to the rotor shafts. Tighten these only finger tight until the clearances have been correctly set (Refer to Section 10.8).

10. Replace the pulse wheel (Item 14) on the right hand rotor. Use thread locking compound on the threads and secure with the retaining washer (Item 46), washer (Item 45) and screw (Item 43).

11. Lower the complete measuring unit assembly into the inlet housing (Item 21) by aligning on to the dowel pins (Item 12).

12. Position the main housing O-ring (Item 16) in the groove on the inlet housing and position O-ring (Item 47) on timing gear end of the measuring element body.

13. Lower the outlet housing (Item 50) into the inlet housing (Item 21), aligning the dowel pins to ensure correct installation. Avoid damage to the O-rings.

14. Complete the assembly by securing all screws (Items 1 and 2) and tightening them to their required torque value.

NOTE:
150# and PN 16 - 80 ft/lbs
300# and PN40 - 150 ft/lbs

15. Install the O-ring (Item 22) on the sensor housing (Item 23) and insert the assembly into the inlet housing (Item 21). Secure with four Allen screws (Item 24) and torque to 55 in/lbs.

10.7 - Setting Clearances

With gear movement restricted:

1. Torque the nut (Item 4) on the right hand timing gear (Item 49) to 15-20 ft/lbs.

2. Loosen the nut (Item 4) on the left hand timing gear (Item 6).

3. Place a 0.005" shim in front of, and behind, the tooth of the left hand rotor (Item 11). Once the shims are in place, and with the rotor movement still restricted, torque the nut on the left hand timing gear to 15-20 ft/lbs.

4. Remove the shims and folded rag and check for correct clearance by slowly rotating the rotors. Listen for sound of binding, rotors should turn freely and not make contact at any point.

5. If the rotors bind, or make noise, repeat this procedure. This time loosening the right hand rotor instead of the left.

6. Once clearances are set use a small flat head screw driver to bend up one tab on each of the timing gear lock washers (Item 5) to secure the location of the nut.

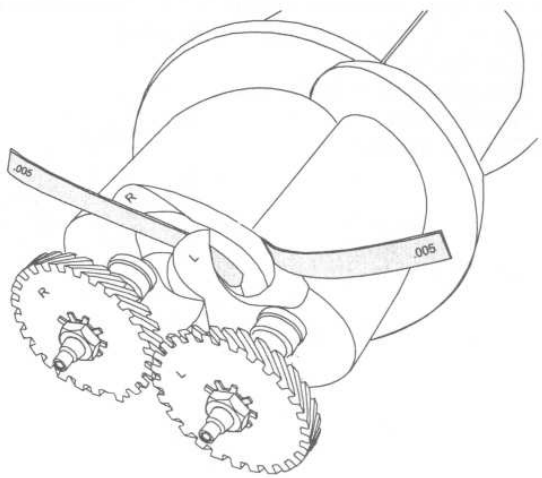


Figure 10-5 Shim Placement for Setting Rotor Clearance

11 Troubleshooting

General

The information in this section has been provided as an aid for basic troubleshooting. Disassembly procedures have been outlined in Chapter 10, Maintenance. If the BiRotor Plus has been found to be in need of repair it is recommended the user contact the nearest Brodie Service Office or Representative. It is important that servicing is performed by trained and qualified personnel.

Condition	Probable Cause	Corrective Actions
No Pulse Output is present	No flow through meter.	Ensure the pipeline has flow.
	Improper electrical connection.	Ensure proper wiring connections have been made.
	Insufficient voltage to preamplifier (if fitted).	Supply sufficient voltage to the pre-amplifier board (reference Section 8, Specifications).
	Power failure.	Ensure power is connected to the device and all associated accessories.
	Meter rotors jammed with debris.	Remove debris from rotors, and check for damage to rotors, timing gears, and bearings (reference Section 10.4).
	Damaged pick off/amplifier board.	Replace pick offs/preamplifier board (reference Sections 10.1 and 10.2).
Erratic or Nonuniform Pulse Signal	Improper electrical connection.	Ensure proper wiring connections have been made.
	Insufficient or fluctuating voltage to the preamplifier board (if fitted).	Supply sufficient voltage to the pre-amplifier board (reference Section 8, Specifications).
	Improper grounding or shielding of connection cable.	Replace wiring and/or grounds and shielding.
	Power failure/damaged pick offs or pre-amplifier board.	Ensure power supply and/or pick offs and preamplifier board are functioning as required (reference Sections 10.1 and 10.2).
	Damaged/worn bearings or timing gears.	Replace bearings and/or timing gears (reference Sections 10.6 and 10.7).

12 Parts Lists

General

This chapter contains the necessary parts required for routine maintenance and service of the Brodie BiRotor Plus. Each parts list contains recommended spare and replacement parts denoted by an asterisk. For items not listed, or additional information, consult the factory. When ordering, the following information must be furnished:

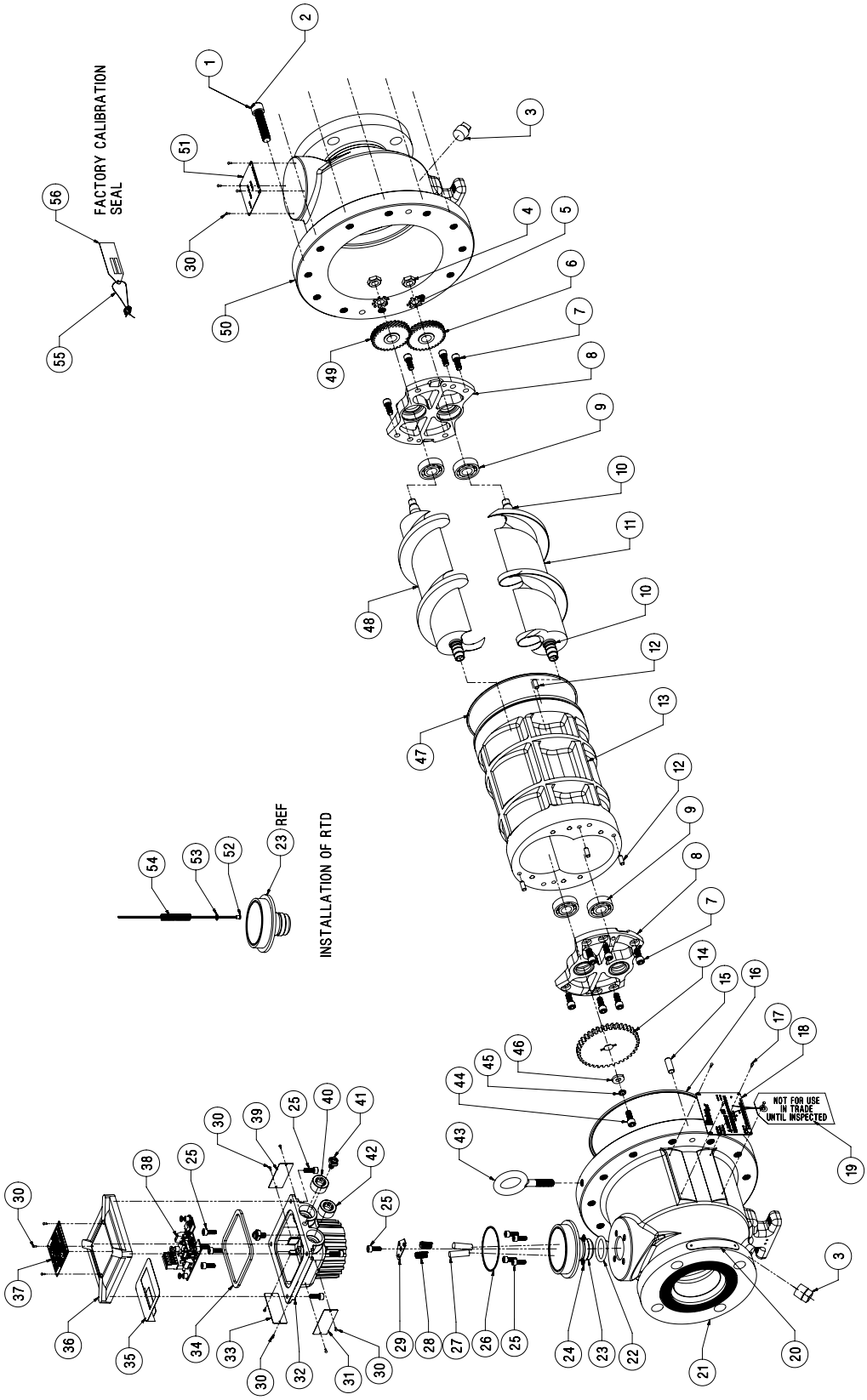
- Model Number
- Serial Number
- Part Number
- Quantity

NOTES:

LH and RH Rotors are only available as a matched set.

O-ring Suffix	O-ring Material
-022	Viton A
-023	Low Temp Viton 1289
-120	Low Swell Nitrile
-026	Viton F
-016	FluoroSilicon

12.1.1 - BiRotor Plus Illustrated Parts List



Item #	Description	Model			Qty
		B271	LB271	B274	
1*	Bolt with Seal Hole	151070-024M	1500985-024M	151080-024M	2
2*	Main Body Bolt	151070M (QTY 10)	1500985 (QTY 10)	151080M (QTY 14)	
3	Pipe Plug, MTRs	154704-024M			C/F
	Pipe Plug, MTRs and NACE	154704-024N			C/F
4	Locknut	60592			2
5	Gear Retaining Washer	51593			2
6	LH Rotor Gear	76291			NOTE
7	Endplate Screws	151042			12
8	Endplate	76825-100			2
9*	Bearings, Stainless Steel	155204			4
	Bearings, Ceramic	155204-001CER			4
10*	O-ring	157063-XXX			4
11	LH Rotor	76276-000			1
12	Element Dowel Pin	1559983			6
13	Element Body	76211-100			1
14	Pulse Wheel	76031-043			1
15	Body Dowel Pin	154097			2
16*	O-ring	152057			1
17	Drive Screw	153966			4
21	ANSI Inlet Housing, MTRs	76828-100M	76838-100M	76828-300P	C/F
	ANSI Inlet Housing, MTRs and NACE	76828-100N	N/A	76828-300R	C/F
	DIN Inlet Housing, MTRs	76828-016M	76838-016M	76828-040P	C/F
	DIN Inlet Housing, MTRs and NACE	76828-016N	N/A	76828-040R	C/F
22*	O-ring	157360-XXX			1
23	Sensor Housing, MTRs	86820-500M		86820-500P	C/F
	Sensor Housing, MTRs and NACE	86820-500N		86820-500R	C/F
24*	Weather Seal	152066-026			4
25*	UMB Screws	151496M			13
26*	Weather Seal	1500093-016			1
27*	Pick Off, Standard	899-00-201-00			1
	Pick Off, High Temp	899-00-201-01			1
28	Spring	1500418			1
29	Hold Down	86030-001			1
30	Drive Screw	153991			2
32	UMB Housing	899-00-100-00			C/F
34*	UMB Gasket	CA-375Z-259-XXA			1
36	UMB Cover	CC-219Z-633-EBG			C/F
38*	Pre Amp Board	230-00-300-00			1
	Terminal Board	230-10-300-50			1
40*	Approved Stopping Plug	1500909D			1
43	Lifting Hook	1500468			1
44	Pulse Wheel Screw	1500668			1
45	Lockwasher, Stainless Steel	1500667			1
46	Retainer Washer	86033			1
47*	O-ring	150810-XXX			1
48	RH Rotor	76286-000			1
49	RH Rotor Gear	76296			NOTE
50	ANSI Outlet Housing, MTRs	76829-100M	76839-100M	76829-300P	C/F
	ANSI Outlet Housing, MTRs and NACE	76829-100N	N/A	76829-300R	C/F
	DIN Outlet Housing, MTRs	76829-016M	76839-016M	76829-040P	C/F
	DIN Outlet Housing, MTRs and NACE	76829-016N	N/A	76829-040R	C/F
52	RTD Sensor	1500574			1
53	RTD Lockwasher	151845-019			1
54	Compression Spring	1500609			1

Item #	Description	Model			Qty
		B281	LB281	B284	
1*	Bolt with Seal Hole	151070-024M	1500985-024M	151080-024M	2
2*	Main Body Bolt	151070M (QTY 10)	1500985 (QTY 10)	151080M (QTY 14)	
3	Pipe Plug, MTRs	154704-024M			C/F
	Pipe Plug, MTRs and NACE	154704-024N			C/F
4	Locknut	60592			2
5	Gear Retaining Washer	51593			2
6	LH Rotor Gear	86291			NOTE
7	Endplate Screws	151042			12
8	Endplate	86825-100			2
9*	Bearings, Stainless Steel	155197			4
	Bearings, Ceramic	155197-001CER			4
10*	O-ring	152071-XXX			4
11	LH Rotor	86276-000			1
12	Element Dowel Pin	1559983			6
13	Element Body	86211-100			1
14	Pulse Wheel	86031-043			1
15	Body Dowel Pin	154097			2
16*	O-ring	152088-XXX			1
17	Drive Screw	153966			4
21	ANSI Inlet Housing, MTRs	86828-100M	86838-100M	86828-300P	C/F
	ANSI Inlet Housing, MTRs and NACE	86828-100N	N/A	86828-300R	C/F
	DIN Inlet Housing, MTRs	86828-016M	86838-016M	86828-040P	C/F
	DIN Inlet Housing, MTRs and NACE	86828-016N	N/A	86828-040R	C/F
22*	O-ring	157360-XXX			1
23	Sensor Housing, MTRs	86820-500M		86820-500P	C/F
	Sensor Housing, MTRs and NACE	86820-500N		86820-500R	C/F
24*	Weather Seal	152066-026			4
25*	UMB Screws	151496M			13
26*	Weather Seal	1500093-026			1
27*	Pick Off, Standard	899-00-201-00			1
	Pick Off, High Temp	899-00-201-01			1
28	Spring	1500418			1
29	Hold Down	86030-001			1
30	Drive Screw	153991			2
32	UMB Housing	899-00-100-00			C/F
34*	UMB Gasket	CA-375Z-259-XXA			1
36	UMB Cover	CC-219Z-633-EBG			C/F
38*	Pre Amp Board	230-00-300-00			1
	Terminal Board	230-10-300-50			1
40*	Approved Stopping Plug	1500909D			1
43	Lifting Hook	1500468			1
44	Pulse Wheel Screw	1500668			1
45	Lockwasher, Stainless Steel	1500667			1
46	Retainer Washer	86033			1
47*	O-ring	159678-XXX			1
48	RH Rotor	86286-000			1
49	RH Rotor Gear	86296			NOTE
50	ANSI Outlet Housing, MTRs	86829-100M	86839-100M	86829-300P	C/F
	ANSI Outlet Housing, MTRs and NACE	86829-100N	N/A	86829-300R	C/F
	DIN Outlet Housing, MTRs	86829-016M	86839-016M	86829-040P	C/F
	DIN Outlet Housing, MTRs and NACE	86829-016N	N/A	86829-040R	C/F
52	RTD Sensor	1500574			1
53	RTD Lockwasher	151845-019			1
54	Compression Spring	1500609			1

Item #	Description	Model B291	Qty
1*	Bolt with Seal Hole	151080-024M	2
2*	Main Body Bolt	151482M	14
3	Pipe Plug, MTRs	154704-024M	C/F
	Pipe Plug, MTRs and NACE	154704-024N	C/F
4	Locknut	60592	2
5	Gear Retaining Washer	51593	2
6	LH Rotor Gear	86291	NOTE
7	Endplate Screws	151042	12
8	Endplate	86825-100	2
9*	Bearings, Stainless Steel	155197	4
	Bearings, Ceramic	155197-001CER	4
10*	O-ring	152071-XXX	4
11	LH Rotor	86276-000	1
12	Element Dowel Pin	1559983	6
13	Element Body	86211-100	1
14	Pulse Wheel	86031-043	1
15	Body Dowel Pin	154097	2
16*	O-ring	152088-XXX	1
17	Drive Screw	153966	4
21	ANSI Inlet Housing, MTRs	86868-300P	C/F
	ANSI Inlet Housing, MTRs and NACE	86868-300R	C/F
	DIN Inlet Housing, MTRs	86868-040P	C/F
	DIN Inlet Housing, MTRs and NACE	86868-040R	C/F
22*	O-ring	157360-XXX	1
23	Sensor Housing, MTRs	86820-500M	C/F
	Sensor Housing, MTRs and NACE	86820-500N	C/F
24*	Weather Seal	152066-026	4
25*	UMB Screws	151496M	13
26*	Weather Seal	1500093-026	1
27*	Pick Off, Standard	899-00-201-00	1
	Pick Off, High Temp	899-00-201-01	1
28	Spring	1500418	1
29	Hold Down	86030-001	1
30	Drive Screw	153991	2
32	UMB Housing	899-00-100-00	C/F
34*	UMB Gasket	CA-375Z-259-XXA	1
36	UMB Cover	CC-219Z-633-EBG	C/F
38*	Pre Amp Board	230-00-300-00	1
	Terminal Board	230-10-300-50	1
40*	Approved Stopping Plug	1500909D	1
43	Lifting Hook	1500468	1
44	Pulse Wheel Screw	1500668	1
45	Lockwasher, Stainless Steel	1500667	1
46	Retainer Washer	86033	1
47*	O-ring	159678-XXX	1
48	RH Rotor	86286-000	1
49	RH Rotor Gear	86296	NOTE
50	ANSI Outlet Housing, MTRs	86869-100M	C/F
	ANSI Outlet Housing, MTRs and NACE	86869-100N	C/F
	DIN Outlet Housing, MTRs	86869-016M	C/F
	DIN Outlet Housing, MTRs and NACE	86869-016N	C/F
52	RTD Sensor	1500574	1
53	RTD Lockwasher	151845-019	1
54	Compression Spring	1500609	1

Appendix A

Decontamination Statement

RMA Number: _____

Item Being Returned: _____

List all chemicals, process fluids and gases that have come in contact with the equipment, including cleaning agents. Attach additional pages of information if necessary. A Material Safety Data Sheet (MSDS) is required if non-food grade products have been used with the item being returned.

Information Required	Product 1	Product 2
Chemical Name		
Health and Safety Hazards		
Precautions, First Aid		

I hereby certify the equipment being returned has been cleaned and decontaminated in accordance with good industrial practices and in compliance with OSHA and DOT regulations. This equipment poses no health or safety risks due to contamination.

Signature:_____

Name (Please Print):_____

Title:_____

Company Name:_____

Phone Number:_____

Fax:_____

E-mail:_____

Reason for Return:_____

REMINDER

All items being returned must be packaged separately. This decontamination statement and the MSDS sheet(s) must be placed on the outside of the shipping container.

Brodie International
A Brodie Meter Co. LLC Company
www.brodieintl.com

P.O. Box 450 (30459-0450)
19267 Highway 301 North
Statesboro, GA 30461, USA

Phone: +1 (912) 489-0200
Fax: +1 (912) 489-0294

Appendix B

Customer Problem Report

For faster service, complete this form and return it along with the affected equipment to customer service at the address indicated below. If you require technical assistance, please contact the Product Service Department at the phone number listed below.

Company Name: _____ Phone: _____

Technical Contact: _____

Repair PO#: _____

Invoice Address: _____

_____

_____

Shipping Address: _____

_____

_____

Return Shipping Method: _____ S/N:_____

Equipment Model #: _____ Failure Date:_____

Description of Problem:_____

_____

_____

What was happening at time of failure: _____

_____

Additional Comments: _____

_____

Report Prepared by: _____ Title: _____

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