Installation & Operation Manual

BRODIE INTERNATIONAL

BiRotor Plus
2″ Single Case

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Read Me First

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Brodie International
Statesboro, Georgia, USA

Essential Instructions

General

Brodie Meter Co., LLC 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 or servicing the product. If the instruction manual is not the correct one telephone +1 912 489 0200. Retain the instruction manual for future reference.

If you do not understand any of the instructions, contact your local Brodie representative for clarification.

Follow all warnings, cautions and instructions marked on or supplied with the product. It is the end users responsibility to operate the instrument with in the specifications as defined with in the instruction manual or marked on the instruments name plates.

Install the equipment as specified in the installation instructions of the appropriate manual and in accordance to local and national codes.

To ensure proper performance, use qualified personnel to install, operate, program and maintain the product.

Some types of equipment contain Carbon Steel, Cast Iron and/or Aluminum wetted parts, these instruments are not for use on water service.

It is the end users responsibility to assess the surface temperature of the device when it is in service, and if required take the necessary precautions to avoid personnel injury or damage to other equipment.

When replacement parts are required, ensure that qualified people use replacement parts specified by the manufacturer. Unauthorised parts and procedures can affect the products performance and place the safe operation of the process at risk. Look alike substitution may result in explosion, fire, electrical hazards, improper operation or personnel injury.

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

Essential Instructions for Measuring Equipment Including the European Union (Directive 2014/32/EU MID)

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

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 users 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, and the custody transfer label; this 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 2014/30/EU and 2014/32/EU)

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 2014/30/EU and MID 2014/32/EU of the council of the European Union.

It is the end users 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 2014/68/EU)

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 users responsibility to assess any risks and take any precautions necessary.

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

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

It is the end users 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 has 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 users responsibility to ensure that the devise 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 users responsibility to provide fire protection measures and equipment in accordance with the local regulations.

Essential Instructions for Equipments To Be Used In Hazardous Locations Including the European Union (Directive 2014/34/EU)

Any Hazardous area approval applies to equipment without cable glands. When mounting the flameproof 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. It is the end users responsibility to ensure this happens.

Cable glands and cable must be suitable for the operating temperature of the device under its rated conditions, this is especially important is the device has an operating temperature above 1580F (700C).

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 users 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 users responsibility to ensure when the instrument is located in a hazardous area that all cable glands and conduit seals must be installed in accordance with the local codes and regulations.

It is the end users responsibility to ensure that before opening an electronic enclosure in a flammable atmosphere; all the electrical circuits must be 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 M6-1 x 16 (6g) mm hex socket head 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 in lbs upon installation, its is the end users responsibility to ensure this happens.

It is the end users 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 Aluminium; 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 dusts forming a possible source of ignition.

The power supply requirements for this product are specified with in the operating and maintenance manual, it is the end users responsibility to operate the product with in these specified limits.

The instrument contains 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 users 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 +/- "(12.5mm) wide feeler 0.0015" (0.038mm) gauge will not enter the gap more than 1/8" (3mm). It is the end users responsibility to ensure this happens each time the enclosure is reassembled.

Receipt of Shipment

When the instrument is received, inspect the outside of the packing case for any damage that may have occurred during shipment. If the packing case is damaged notify the carrier immediately and follow their claim procedures. **Any damage incurred during shipment is the carrier's responsibility and is not part of the factory warranty**.

If the packaging is undamaged locate the envelope containing the packing list, this will generally be on the outside of the box. Carefully remove all the contents from the packaging checking for any damage. Make certain spare or replacement parts are not discarded with the packing material.

Check the items against the packing list for correct parts and quantities. If any items are incorrect or damage please contact your sales representative immediately, quoting the sales order reference number.

Storage

Brodie International instruments are precision devices and should be handled and stored with care. The inlet and outlet covers should remain on the instrument until the unit is ready for installation.

If extended storage is required it is recommend that the instrument be placed in an environmentally controlled warehouse, if it is not possible, the instrument should be stored in a water proof 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, depending on the storage time it may also be preferable to use a compatible corrosion inhibitor.

Care should be taken to remove any storage protection items before installing the instrument.

If an instrument is removed from service for an extended period of time it should be flushed with an appropriate corrosion inhibitor before being place in long term storage as mentioned above.

Return of Shipment

To be able to process returned goods quickly and efficiently, it is IMPORTANT that you provide essential information. Do not return any assembly or part without an "R.M.A." (Return Material Authorization). A letter describing the problem; corrective action (if any); and the work to be performed at the factory should be included with the shipment. "R.M.A." forms can be obtained from the local Sales Agent or Brodie International.

If an instrument has been exposed to process fluid, in addition to the RMA, a decontamination statement will be required.

A decontamination form is included in the back of this manual. **Note: When an instrument is removed from service it must be thoroughly drained and hazardous substances neutralized. Any material removed from the meter must be disposed of in accordance with local regulations.**

Placing the instrument upright on the inlet flange will aid drainage. Process connections must be sealed to prevent leakage of residual product during shipment. Contact the local carrier for information on requirements.

Any item must be securely packed and larger instruments mounted on wooden pallets or skids for shipment. The exterior of pallet mounted items should be protected by a suitable means such as a wooden crate.

Place a copy of the RMA inside the shipping container and attach it physically to the material being returned. A copy of your packing list should be placed inside an envelope and attached to the outside of the shipping container or placed inside the container.

Failure to follow the above procedures could possibly result in a considerable delay due to improperly or totally unidentified items.

Ship the container to:
Brodie Meter Co., LLC
Product Service Department
19267 Hwy. 301 North
Statesboro, GA 30461
Phone: 912-489-0200
Fax: 912-489-0294
service@brodiemeter.com

Introduction

6.1 General

The Single Case BiRotor Plus is an extremely accurate single cased flow measuring devicedesigned primarily for, but not limited to, ethanol blending. It produces a high resolution signal which is directly proportional to the rate of liquid flow through the meter utilizing non-wetted pick-offs. These signals can be shaped by a simple internal pre-amplifier for transmission to ancillary equipment.

The BiRotor Plus Meter utilizes the exclusive BiRotor principle. There are no sliding, oscillating, or reciprocating parts.

Principle of Operation
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 with the housing with in which they rotate. Clearances between moving components are maintained with 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.

Specifications

7.1 Materials of Construction

Housing: A 351 GR CF8M (316 Stainless Steel)

Measuring Unit

End Plates and Body: A 351 GR CF8M (316 Stainless Steel)
Rotors/Rotor Shafts: Aluminum Rotor, Anodizied 17-4 PH Stainless Steel Shaft
Timing Gears: 416 Stainless Steel
Bearings: Ceramic/Stainless Steel
Elastomers: Viton A®, Low swell Nitrile, Viton F®, or Fluoro Silicon are standard (other options available)

UMB Housing*: A356 T6 Cast Aluminium
* This part is not wetted.

Electrical Details
Pick off:
Non Wetted Reluctance Type
Sine Wave Amplitude: 40 mV P-P, min.
Preamplifier:
Supply Voltage:9 to 28 VDC
Outputs (Jumper selectable):
Square wave: 0 to 5 KHz

5 V Powered Pulse: 0 – 5 VDC, 20 mA Max

Variable Voltage Pulses:
0 to Supply Voltage Less 5%
70 mA max

Open Collector:
Max voltage: 30 VDC
Max current: 125 mA
Max power: 0.5 W

Performance
SB25X Linearity Standard Rotors
+/- 0.15% Over Standard Flow Range
+/- 0.25% Over Extended Flow Range

Repeatability: +/- 0.02%

Viscosity Range: 0.2 - 5 cP

Operating Temperatures Limits:
Dependant on pick off type and O-Ring seals used, see Table 1.

To convert pressure drop value to the actual process fluid, use the following equation:
$\Delta PA = (cPA)^{0.25} * (SGA)^{0.75} * \Delta Pm$
ΔPA = Pressure Drop on Actual Fluid in PSI
cPA = Viscosity of Actual Fluid in cP
SGA = Density of Actual Fluid in SG
ΔPm = Pressure Drop on Mineral Spirits (See Figure 3 on Page 6 for Reference.)

Table 1: Operating Temperature Limits

Pick Off Type	Seal Material	Minimum Operating Temp		Maximum Operating Temp	
		°F	°C	°F	°C
Standard	Viton A	-15	-25	167	75
Standard	Viton F	-15	-25	167	75
Standard	Fluoro Silicon	-40	-40	167	75
High Temp	Vitron A	14	-10	230	110
High Temp	Vitron F	14	-10	230	110
High Temp	Fluoro Silicon	14	-10	230	110

Installation

8.1 Installation

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.

8.2 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 8-1 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.

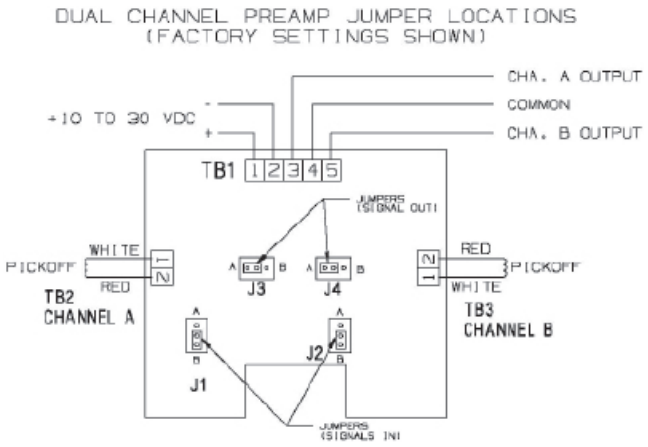

Figure 8.1 Wiring connections

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[1]	
J2 (Channel B)	B[1]	
	5 VDC Pulse	V Supply Pulse[2]
J3 (Channel A)	A	B
J4 (Channel B)	A	B

NOTE:

[1] **Do not Change without consulting factory.**

[2] **V Supply Pulse = Input V minus approximately 2 volts**

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.

Operation

9.1 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.

9.2 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.

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

t_h = Warm Up Time in Hours
C_{nom} = Nominal Connection Size
OT_{of} = 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.

9.3 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

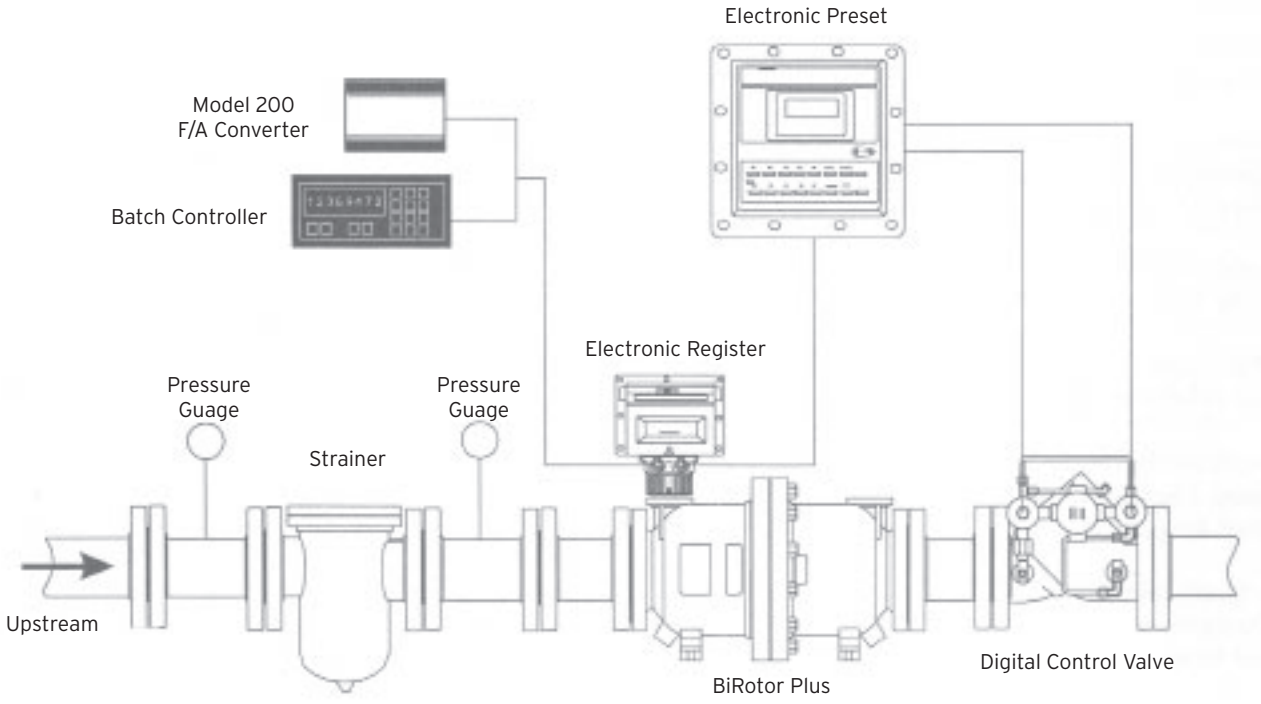

Figure 8-3 Horizontal Installation

Maintenance

10.1 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 11-1 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.

10.2 Removal/Replacement of Circuit Board

1. Disconnect all power to the instrument.
2. Remove the electronics lid , or electronics register, if one is fitted, by removing four Allen screws.
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 to 55 in/lbs.

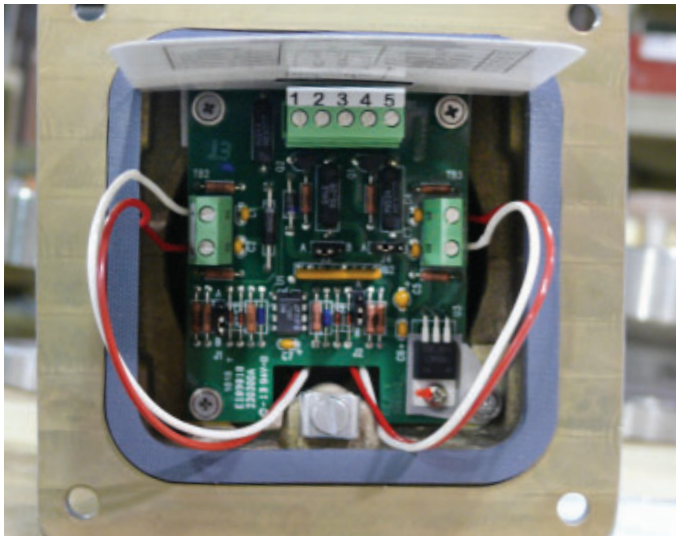

Figure 10-1 Circuit Board and Housing

10.3 - Removal/Replacement of Pick Off Sensors

1. Remove the circuit board as detailed above.
2. Remove the center screw from the sensor housing and lift off the hold down washer.
3. Lift out the inductive sensor(s) and spring.

Resistance between sensor leads:

For Sensor with ident marker on Sheath = 1000 Ohms +/-15%

For Sensor with ident marker on sensor = 750 Ohms +/-15%

Resistance between leads and housing when installed: 10 M Ohms

If any of this is not the case the pick off 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 and Allen screws and replace the circuit board

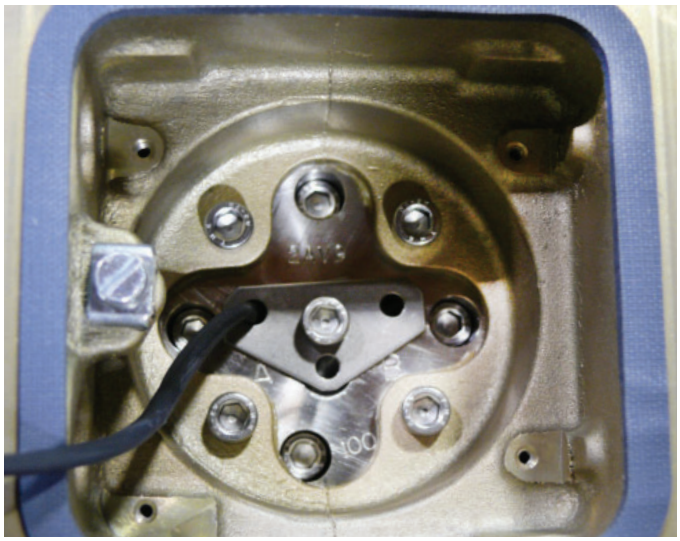

Figure 10-2 Pick Off Sensor Installation

10.4 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.

10.5 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 and lift off the oulet housing.

3. Remove O-ring.

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.

10.6 Measuring Unit Disassembly While Maintaining Clearance Settings

1. Place a folded rag between the timing gears to prevent the rotors from turning during disassembly.

2. Remove the pulse wheel by removing the screw , washer, and retaining washer.

3. Remove the screw from the end plate 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.

Figure 10-3 Measuring Unit DIsassembly

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.

10.7 Complete Disassembly

Continuing from step 3 above.

1. Restrict the rotor movement by placing a folded rag between the timing gears.

2. Undo nuts , then remove them from the rotor shafts. The timing gears can be released from the shaft by striking them on the flat surface with a plastic or rubber mallet.

3. Remove the rotors from the end plate by gently tapping the rotor shafts with a plastic or rubber mallet. Remove the o-rings from the rotor shafts.

4. The bearings 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, they must be replaced.

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

10.8 Complete Disassembly of the Measuring Unit

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

2. Lubricate all bearings with a light oil, Note all o-rings should be replace with new ones during reassembly, all o-rings should be lubricated with a compatible lubrication compound.

3. Press bearings in to the end plates, 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 to the measuring unit body outlet (the outlet end is the right hand side of the measuring unit housing when the nameplate lable is facing towards you). Align the dowel pin and gently tap into place with a plastic mallet. Once fully seated secure the end plate with screws.

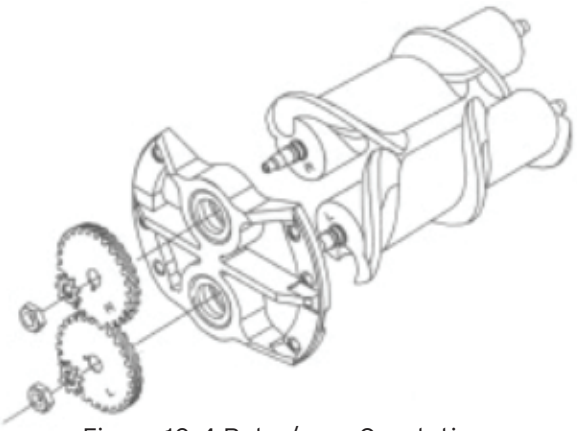

Figure 10-4 Rotor/gear Orentation

Each rotor and timing gear is marked with a R or an L, During assembly the inscriptions need to be matched. (To orientate the rotors during assembly lay the measuring unit housing on it's side so that the name plate label in on the bottom and the outlet end facing away from you. Then with the tapered ands of the rotors also facing away from you, the right hand rotor goes in the right hand cavity and the left hand rotor goes in the left hand cavity)

5. Lubricate O-rings 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.

6. Install the other end plate and screws on to the other end of measuring element body, ensure that the rotor shafts seat within the bearings.

7. Place the timing gears onto the respective tapered rotor shaft.

8. Install the lock nuts on to the rotor shafts, tighten these only finger tight until the clearances have been correctly set. Refer to the setting clearance section.

9. Replace the pulse wheel on the right hand rotor, Use thread locking compound on the threads and secure with the retaining washer, washer and screw.

10. Install the o-rings (12) onto the main housing.

11. Lower the complete measuring unit assembly into the inlet housing (21), align the dowel pin and ensure it is fully located.

12. Insert studs into the four holes in the measuring unit housing loosely attached four nuts to the studs at the inlet side.

13. Lower the outlet housing onto the main housing, the dowel pin is used to ensure correct location. Avoid damage to the O-rings.

14. Complete the assembly be securing all the nuts and tightening them to the required torque value. Torque (150#, 300#, PN16, PN40 - 43 ft-lbs.)

10.9 Setting Clearances

1. Restrict the gear movement by placing a folded rag between the timing gears.

2. Tighten the nut of the right hand timing gear to a torque setting of 35 in-lbs.

3. Loosen the nut of the left hand timing gear.

4. Place 0.003" shims in front and behind the tooth of the left hand rotor. Once the shims are in place and with the rotor movement still restricted tighten the nut on the left hand timing gear to a torque of 35 in-lbs ft-lbs.

5. Remove the shims and folded rag. Check to rotors for correct clearance by rotating them. The rotors should turn freely and not make contact at any point, listen for sounds of the rotors touching.

6. If the rotors bind or make noise repeat the procedure but this time loosen the right hand timing instead of the left.

Parts List

This section contains the necessary parts required to make up any standard unit that is covered in this bulletin. Each parts list also contains the recommended spare and replacement parts denoted by an asterisk. For items that are not listed or additional information, consult factory. Whenordering, the following information must be furnished.

1. Part number and description.
2. Model number of flow meter.
3. Serial number of flow meter.
4. Quantity required.

When ordering items of a material or special construction not indicated in the Parts List, furnish the following information so that the part number of the item can be determined.

1. Item number and description.
2. Specific material of item.
3. Model number of flow meter.
4. Serial number of flow meter.
5. Quantity required.

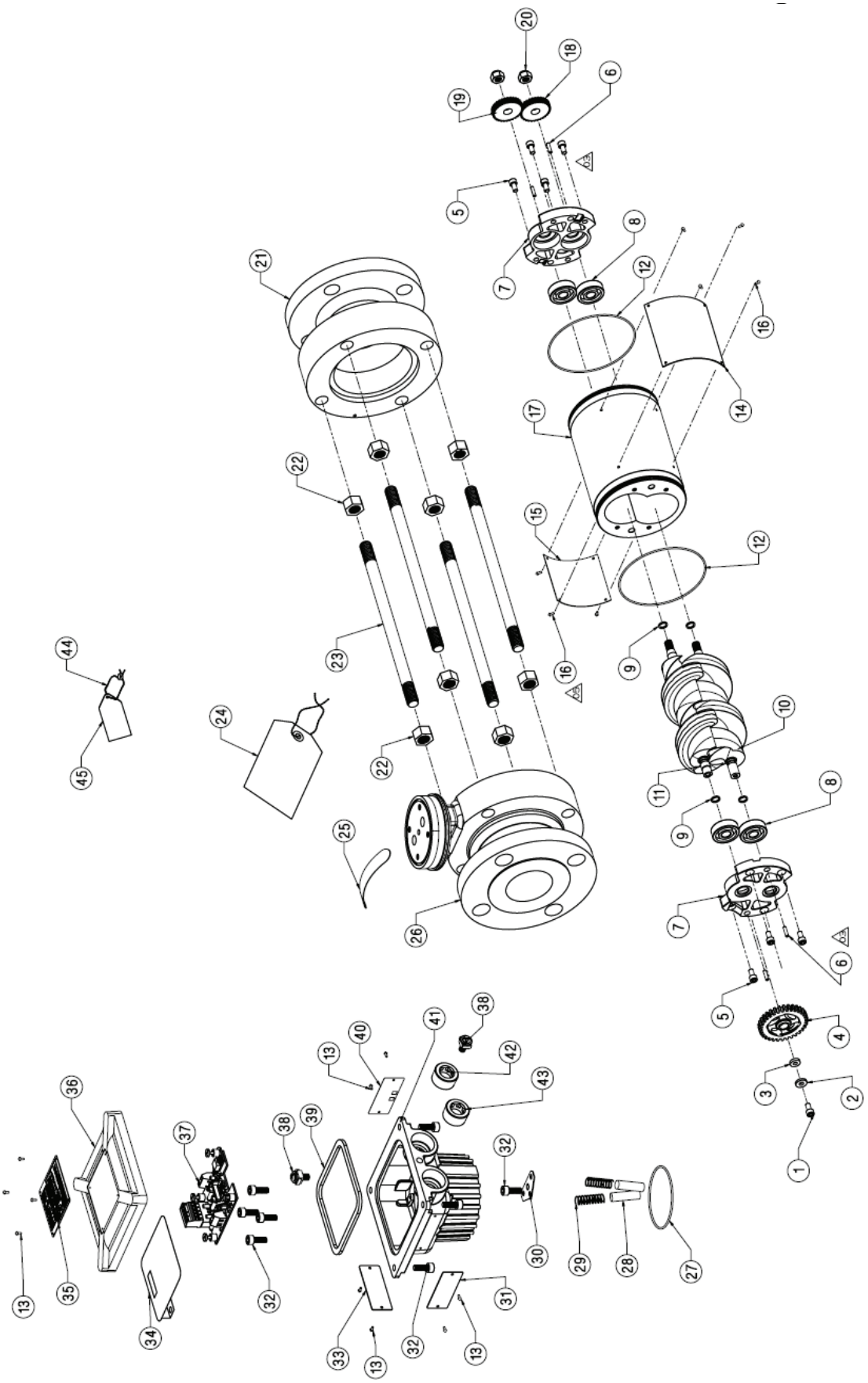

Figure 11-1 Complete Measuring Unit Assembly

Table 11-1 Parts List Single Case BiRotor Plus

Item	Model Number	Description	Quantity
1	151098-419	Screw	1
2	151881	Waher	1
3	56033	Lock Button	1
4	56031-043	Pulse Wheel	1
5	151098-419	Screw	8
6	154046	Dowel Pin	4
7	56825-050	End Plate	2
8*	1500937-001	Bearings, Stainless Steel	4
	1500937-001CER	Bearings, Ceramic	
9*	152066-( ) See note 2	O-Ring	4
10	56276-000	LH Rotor	1
11	56286-000	RH Rotor	1
12*	157361-( ) See note 2	O-Ring	2
17	56211-050M	Measuring Unit Housing, MTR's	1
	56211-050N	Measuring Unit Housing, MTR's and NACE	
18	56291	LH Timing Gear	See note 1
19	56296	RH Timing Gear	See note 1
20	1500942	Stop Nut	2
21	56819-100M	Outlet Housing, 150# ANSI, MTR's	1
	56819-100N	Outlet Housing, 150# ANSI, MTR's and NACE	
	56819-040M	Outlet Housing, DIN PN 16 and PN 40, MTR's	
	56819040N	Outlet Housing, DIN PN 16 and PN 40, MTR's and NACE	
	56819-300M	Outlet Housing, 300# ANSI, MTR's	
	56819-300N	Outlet Housing, 300# ANSI, MTR's and NACE	
22*	151555-419M	Hex Nut, MTR's	8
	151555-419N	Hex Nut, MTR's and NACE	
23*	1500941M	Stud, MTR's	4
	1500941N	Stud, MTR's and NACE	
26	56818-100M	Inlet Housing,150# ANSI, MTR's	1
	56818-100N	Inlet Housing,150# ANSI, MTR's and NACE	
	56818-040M	Inlet Housing, DIN PN 16 and PN 40, MTR's	
	56818-040N	Inlet Housing, DIN PN 16 and PN 40, MTR's and NACE	
	58818-300M	Inlet Housing,300# ANSI, MTR's	
	58818-300N	Inlet Housing,300# ANSI, MTR's and NACE	
27*	1500093-026	Weather Seal	1
28*	899-00-201-00	Pick Off, Standard	1
	899-00-201-01	Pick Off, High Temp	

Table 11-1 Parts List Single Case BiRotor Plus Continues

Item	Model Number	Description	Quantity
29	1500418	Spring	1
30	86030-001	Hold Down	1
32*	151496M	Umb Screws	9
36	CC-219Z-633-EBG	Umb Cover	1
37*	230-00-300-00	Pre Amp Board	1
	230-10-300-50	Terminal Board	
39	CA-375Z-259-XXA	Umb Gasket	1
41	899-00-100-00	Umb Housing	1
42*	1500909D	Approved Stopping Plug	1
43	SD442	Plastic Cap Plug	1

Notes:
*Items marked with a * are recommended spare parts.
1. These items are only available as a matched set, part number W56296.
2. O-ring material suffix is as follows:
-022 : Viton A
-026 : Viton F
-016 : FluoroSilicon
3. When ordering the following information must be provided: Part number, Model Number, Serial Number, and Quantity Required. This information is necessary for items marked C/F (Consult Factory).

Troubleshooting

Table 12.1 has been provided to aid in basic troubleshooting. Disassembly procedures are covered in Section 10 Maintenance. If the flowmeter is found to be in need of repair, it is important that servicing be performed by trained and qualified service personnel and it is recommended the user contact the Brodie Meter Co., LLC Repair Department.

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 7, 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.
	Damaged pick off/amplifier board.	Replace pick offs/preamplifier board.
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 7, Specifications).
	Improper grounding or shielding of connection cable.	Replace wiring and/or grounds and shielding.
	Power failure/damaged pick offs or preamplifier 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.

Warranty Claim Procedures

1. Limited Warranty

Subject to the limitations contained in Section 2 herein and except as otherwise expressly provided herein, Brodie Meter Co., LLC ("Brodie") warrants the Goods-manufactured 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 installation and 18 months from date of shipment, whichever occurs 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 Buyer discovers any warranty defects and notifies Brodie thereof in writing during the applicable warranty period, Brodie shall, at its option, repair or replace, that portion of the Goods 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 of dismantling, reinstallation and 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.

Brodie is not responsible for damages that incur during shipment to Buyer for shipments that are F.O.B. Brodie Factory, FCA Brodie Factory, or EX-WORKS Brodie Factory. Shipping charges for goods returned to Brodie under warranty will be at Buyer's expense.

Products found not to be warranted can be repaired and returned at Buyer's expense and return charges born by Brodie will be added to the cost of repair or returned to Buyer "as received" at Buyer's expense. Insurance for returned products will be at Buyer's expense.

For all returned products please package to prevent damage, or future damage during shipment.

Make sure the products are cleaned, free from grease oil, chemicals and other materials that may hamper defect detection and impede repair.

All returned items must be accompanied with a MSDS for the products that have been in contact with the equipment, including cleaning agents. A decontamination statement, RMA, and Customer Problem Report must also accompany equipment returned. Product received in an unsuitable condition will be returned at Buyer's expense without being examined.

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.

11.1 - Limited Warranty Continued

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 a 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 unless the Buyer has notified the Seller the product will be used in an environment conducive to corrosion and/or erosion and the product has been coated with Brodie's recommended method of protection against corrosion / erosion.

3. 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

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