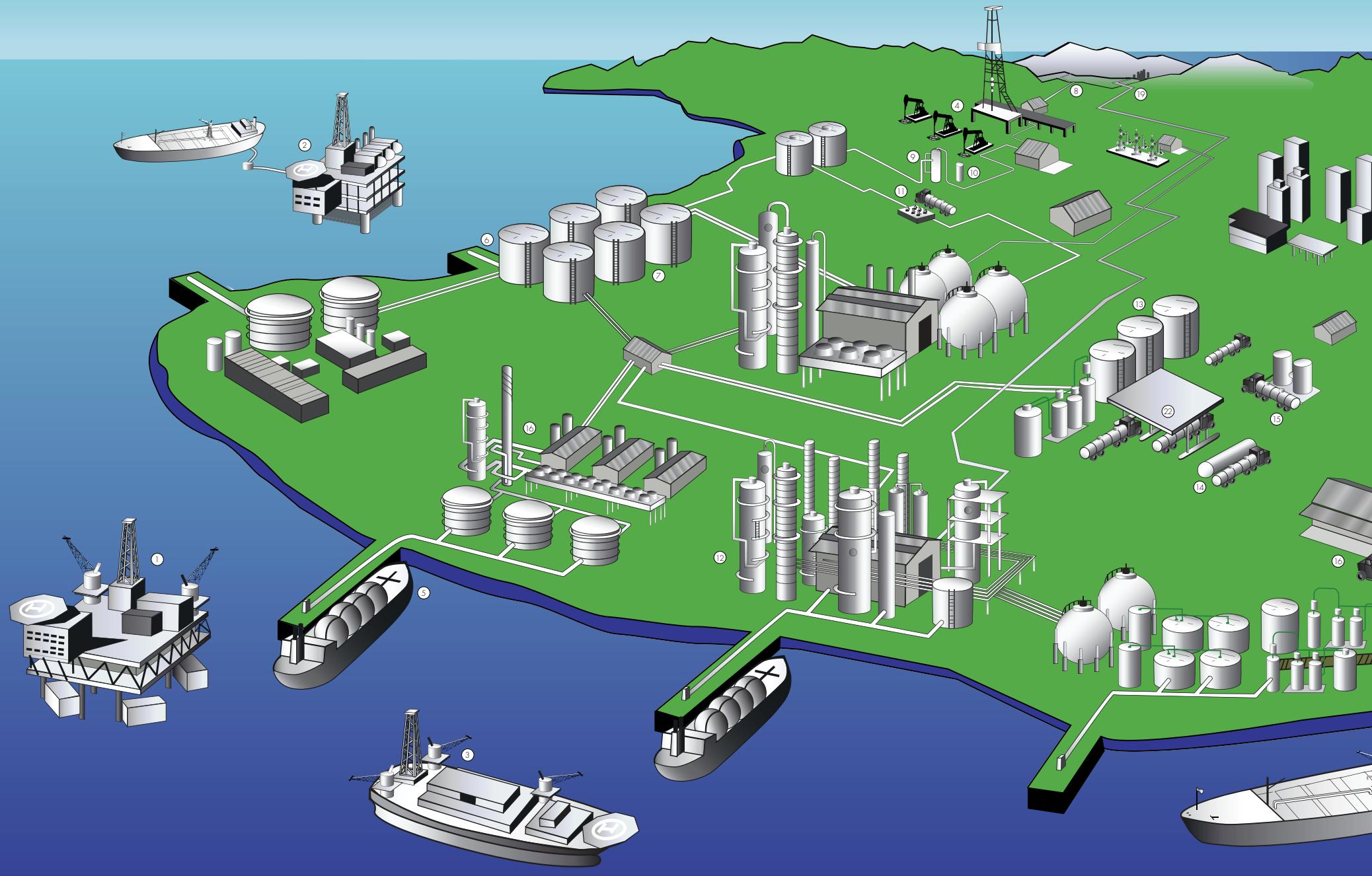


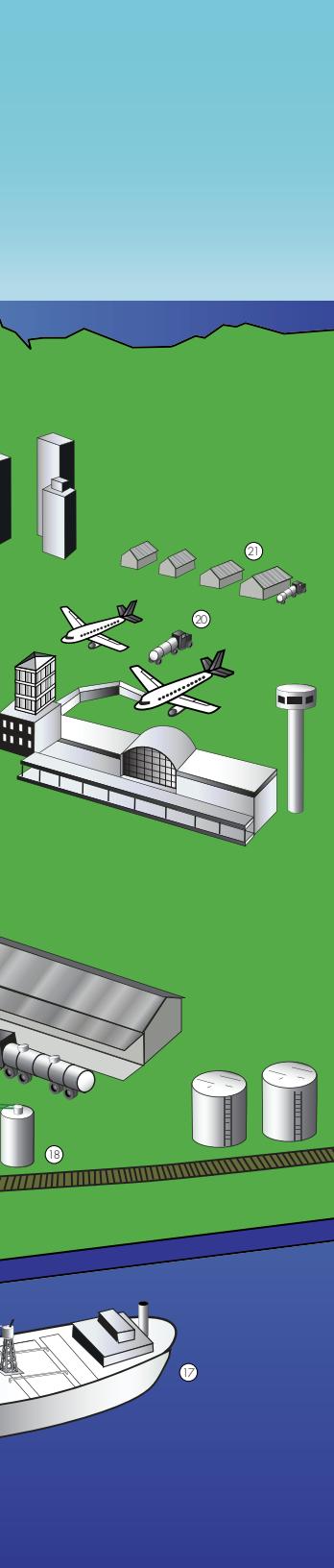
*engineering the future*



**BRODIE**  
International

product catalog





## SERVED MARKETS industry applications

### Upstream

- ① Offshore Production Platform
- ② Litering Platform
- ③ FPSO—Floating Production Storage Offshore
- ④ Crude Oil Production

### Midstream

- ⑤ LNG Loading/Unloading Terminal
- ⑥ Tanker Loading Terminal
- ⑦ Hub Terminal
- ⑧ Long Distance Crude Transportation Pipeline
- ⑨ Bulk Test Separation Unit
- ⑩ Test Separator

### Downstream

- ⑪ LACT—Lease Automatic Custody Transfer
- ⑫ Liquid Crude Refinery
- ⑬ Bulk Plant
- ⑭ LPG Loading
- ⑮ Biodiesel/Ethanol Fuel
- ⑯ Lube Oil Packaging
- ⑰ Barge/Tanker Fueling/Offloading Terminal
- ⑱ Rail Refueling & Terminal
- ⑲ Long Distance Refined Products Pipeline
- ⑳ Aviation
- ㉑ Tank Truck Home Delivery
- ㉒ Marketing Terminal

- Brodie's products are proven to be highly consistent and accurate for critical applications across a broad petroleum customer base.

# Setting the Direction of the Future

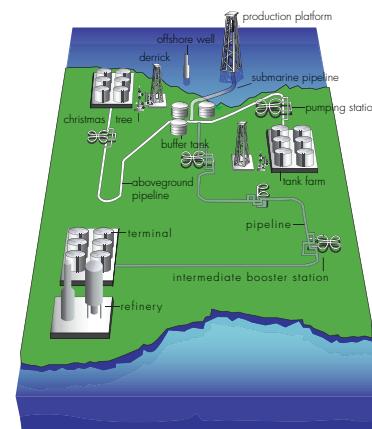
Whether it's new biofuels for the automotive industry, tracking crude oil through miles of pipeline, or accurately and efficiently distributing gasoline from marketing terminals, operators continue to face more stringent regulatory requirements and cost pressures.

Brodie International continues to build on its strong foundation of high precision measurement and control equipment, adding a vigorous commitment to engineering excellence in an expanded global environment.

Ralph Brodie founded his company in 1929, and in 1948, developed the BiRotor Meter, which set a new Industry Standard for accuracy and reliability in Positive Displacement Meter technology.

In 1965, Rockwell Manufacturing purchased the Brodie Meter Co., improved the technology, and moved manufacturing to Statesboro, Georgia, USA, today's world headquarters.

1970 ushered in an era of additional technical improvements, under the ownership of Brooks Instrument, a division of Emerson Electric. While the product

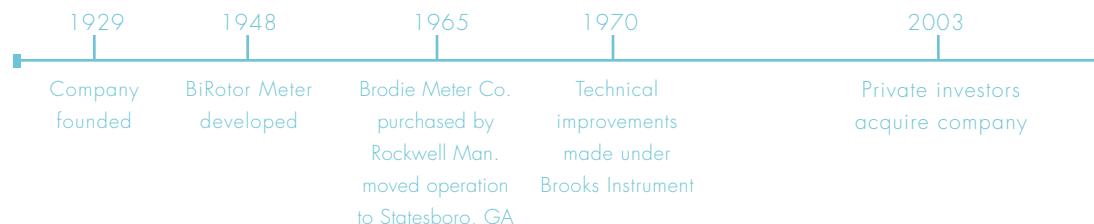


range continued to expand and improve, the company name changed frequently—from Fisher-Rosemount Petroleum to Daniel Measurement & Control.

In 2003, a group of private investors acquired the Statesboro manufacturing facility and all its assets. |

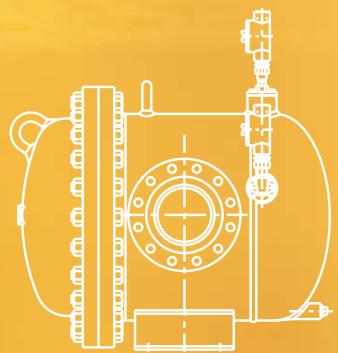
Today, Brodie International is an Industry leader in the design, manufacture and distribution of high precision liquid flow meters and valves as used in the custody transfer of petroleum products.

## BRODIE INTERNATIONAL development milestones



## key product

'P' Series Electronic Pulse Output Meter



The Brodie 'P' Series BiRotor is a PD meter designed to provide an electrical output pulse signal.





## Crude Oil & NGL Production

- There is a wide variety in the composition of Petroleum as produced at the wellhead. Product gravities can range widely, from very heavy Crudes through to the very light Natural Gas Liquids/Condensates produced from gas-loaded fields. Large amounts of wax, sand and water may be present in the produced Petroleum product, especially from fields that are operating secondary recovery. Oil bearing shales are particularly difficult applications.

While onshore fields can have local treatment units, such as Gas-Oil Separation plants, Water separation units, etc., the remote location of many of the world Petroleum production fields, especially when

offshore, mean that there is often a severe restriction on the amount of field processing that can be undertaken. This means that there is an increasing requirement to move large quantities of Petroleum product, such as unstabilized Crude, etc., to a location where further processing can take place.

This places a very high demand on Metering equipment, which has to handle all types of Liquid Hydrocarbon product, with varying degrees of contamination. |

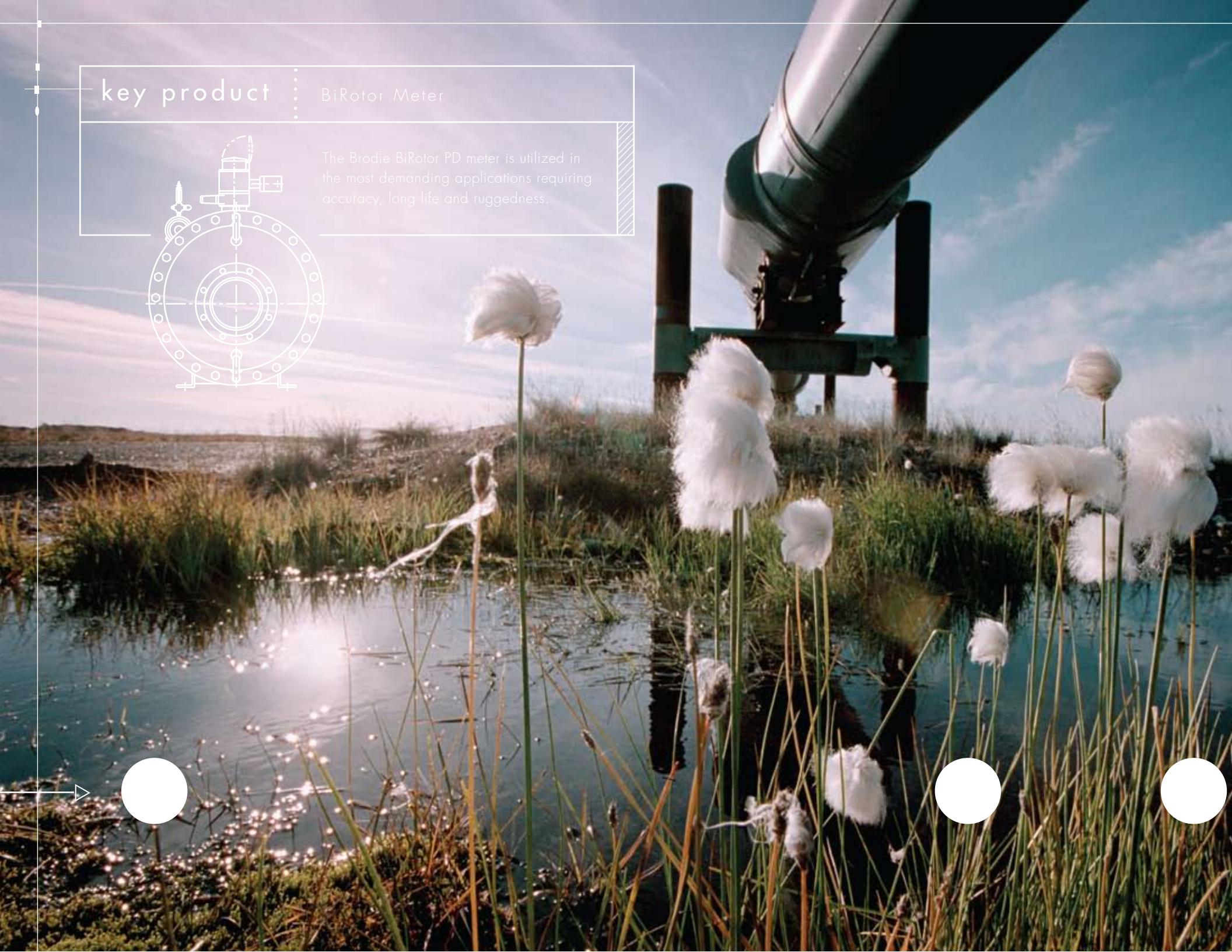
Such equipment has to be rugged to withstand use in harsh conditions and reliable as on-site maintenance may be impractical.

## key product

### BiRotor Meter



The Brodie BiRotor PD meter is utilized in the most demanding applications requiring accuracy, long life and ruggedness.





## Crude Oil & Refined Product Pipelines

- Whether transporting Crude Oil or Refined Products,
- Pipeline Operators are facing new challenges as the
- Industry moves into the 21<sup>st</sup> Century. Oil production locations are becoming more remote and there is greater demand for more capacity and for new outlets and Refined Product networks. Above all, there is mounting legislation worldwide of the Environmental and Health & Safety aspects of operation—leaks can be both damaging and extremely dangerous. The remote location of many of these lines requires a very high level of reliability from all the equipment used, as maintenance can be difficult and expensive to perform.

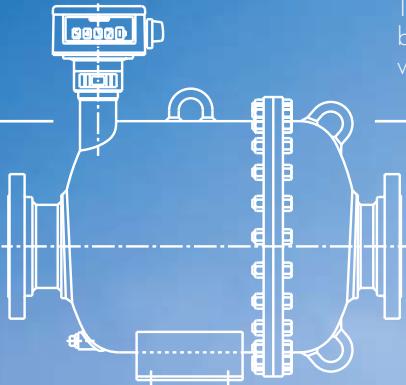
High accuracy metering is a key factor in controlling product movement, especially on a pipeline network with multiple input or take-off points. Some of the factors that need to be taken into account when selecting pipeline equipment, such as Flow Meters and Valves, include: High Sulphur, High Sand and High Wax contents in Crude Oil, prevention of product flash-off in some Natural Gas Liquid/Condensate Lines, and handling of differing gravity products in Multiple Operator or Multi-Product Refined product lines.

Tank stripping can inadvertently introduce large quantities of air into the product, in the form of air slugs — this can be quite damaging to some types of flowmetering equipment, but the BiRotor design is impervious to most air slug passage.



## key products

BiRotor Meter • Control Valve



The Brodie BiRotor design features two finely balanced rotors in a double case design which protects the meter from adverse effects.

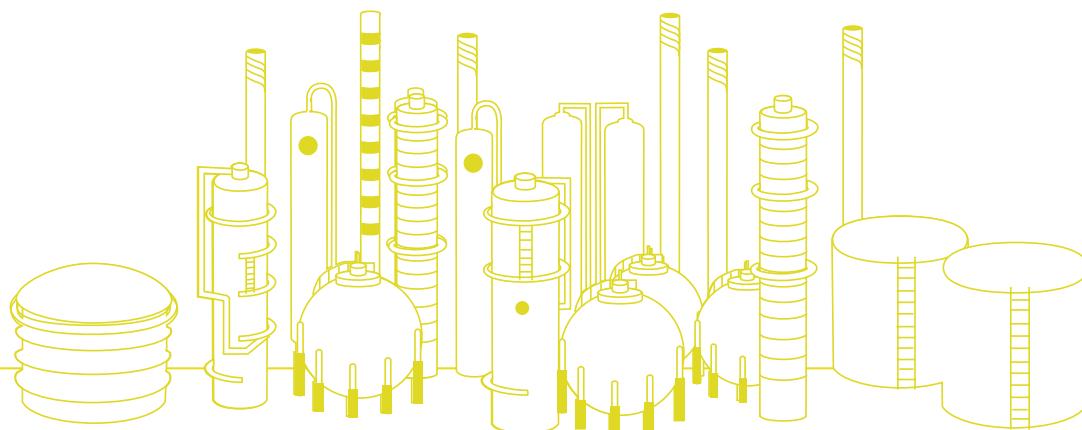




## Oil Refining

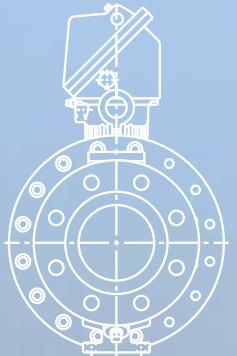
- As with Hydrocarbon production, refining is a continuous process, and thus equipment reliability is a key element for efficient operation. The main Fiscal
- Metering points within a refinery are on Feedstock Import and Refined Product Export, but there are many transfer metering applications within the refinery tank farm areas that require high accuracy metering, especially on Finished Product blending—reworking of "off-spec" product is both time consuming and expensive.

The cost of Crude Oil will inevitably increase over time, and this has an obvious knock-on effect with all refined products—not only the fuels, but with feedstock for other Petrochemical industries. The highest possible accuracy of metering is needed to avoid to minimize product giveaway. |



## key products

BiRotor Plus Meter • BiRotor Meter  
Digital Control Valve



The Brodie BiRotor Plus is a double case meter which combines the rugged durability and long service life of the traditional BiRotor with the improved accuracy and pulse output associated with today's most sophisticated devices.





## Marketing & Distribution

Over the last 30 years, there have been very significant developments in Truck and Rail Car loading. Back then, the typical Marketing Terminal would be loading products such as gasoline, diesels and kerosene, with no additives other than those put in at the refinery. Bottom loading had not come into use, so manually operated top loading systems were the order of the day. Most of the presetting was manual, batching with all-mechanical meters and using paper tickets for transaction receipts. Very little electronic equipment was in evidence.

First, top loading was superseded by bottom loading, allowing multi-compartment trucks to be filled simultaneously, thus dramatically increasing Terminal throughputs.

Secondly, the fuel products themselves have changed, due to additive injection (and more recently, blending) all at the point of loading. Beginning with additives, such as detergents, thru to blending Biofuels, the nature of the products has become more complex.

One of the additives, such as Ethanol as a blend component in Biofuels at the loading rack, has created problems with the pipeline equipment (wetted parts) coming into contact with these additives and blends. Some of the pipeline equipment has begun to suffer badly, due to the increased wear and tear on the meters and valves and in the breakdown of elastomers, such as 'O' ring seals, which are vital for safe and accurate loading.

It has been a constant challenge to keep abreast of all these changes in fuel formulation, and Brodie has pioneered with new products, such as the BiRotor Plus, the "AP" (Aggressive products) and the Low Cv Valve, in order to meet these challenges.



# Positive Displacement Meters

## 1 BiRotor Plus Electronic Output

Available in 2", 3", 4", 6"

The BiRotor Plus is the industry leading positive displacement meter in accuracy (+/- .075%) and repeatability (+/- .01%). Applied in custody transfer of biofuels and refined products, the BiRotor Plus provides amazing results in any of its variations from 2" to 6", saving operators in their total cost of ownership.

## 2 BiRotor Plus for Aviation Electronic Output

Available in 4", 6"

The BiRotor Plus is the industry leading positive displacement meter in accuracy (+/- .075%) and repeatability (+/- .01%). Applied in custody transfer of aviation fuels, the non ferrous BiRotor Plus provides amazing results in either of its variations of a 4" or 6", providing operators with a compact, lightweight design capable of vertical or horizontal mounting & extremely low pressure drop.



## 3 BiRotor Mechanical Output

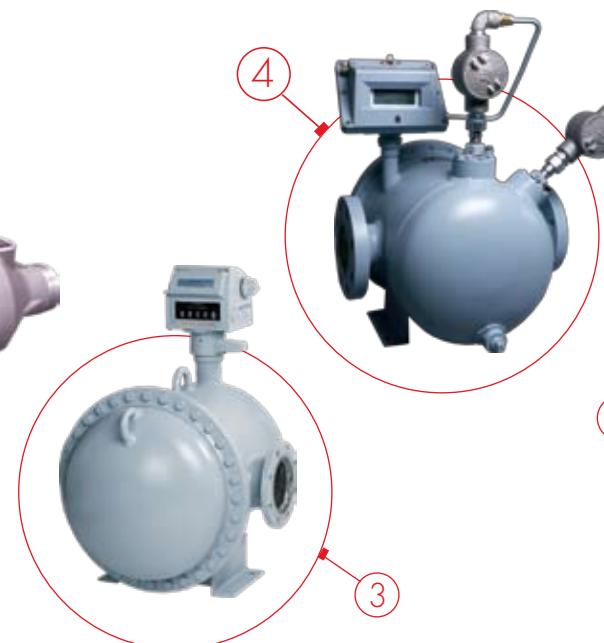
Available in 1½", 2", 3", 4", 6", 8", 10", 12", or 16"

The BiRotor PD Meter is the unit to use when there are dirty applications like crude pipelines, Offshore platforms or non powered applications. It is available from 1½" to 16" sizes and in 150#, 300#, and 600# RF ANSI Pressure Classes.

## 4 BiRotor P-Style Electronic Output

Available in 3", 4", 6", 8", 10", 12", 16"

The BiRotor PD Meter is the unit to use when a pulse only output is required like on crude pipelines, offshore platforms and other similar situations. It is available from 3" to 16" sizes in 150#, 300#, and 600# RF ANSI Pressure Classes, with Dual Pulse Transmitter 90°electrically out of Phase.



## 5 Oval Gear Flowmeter Electronic & Mechanical Output

Available in 1½" - 3"

The Brodie Oval Gear Flowmeters are positive displacement meters predominately used in the industrial, pharmaceutical, and petrochemical industries. These highly accurate meters are virtually unaffected by changes in viscosity and maintain precision accuracy even when handling low viscosity products at low flow rates or high viscosities up to 1,000,000 cP. The Oval Gear Meter's 3 piece design allows for easy service and maintenance. The all stainless steel construction lends itself toward aggressive products. The Brodie Oval Gear Flowmeter is available in both Electronic and Mechanical output, and 150# and 300# ANSI.

## 6 Cyclone Meter Mechanical Output

Available in 2"

The Cyclone Meter is a 2", single case, positive displacement meter designed for the high speed measurement of petroleum products. Its simple design utilizes the rotating crescent principle of operation which allows for high accuracy performance that exceeds requirements found in aircraft refueling, bulk plants, tank truck, and general petroleum applications.



## Control Valves

The Brodie Control Valve is a piston actuated, hydraulically operated valve featuring a two-piece, 'AP' (Aggressive Products) cylinder, characterized ports, and an optional position indicator. Pilots and other optional accessories enable the valve to perform a variety of control functions such as:

**BV02 Check Valve**

**BV03 Bare Valve**

**BV10 & BV11 On/Off**

**BV50 Pressure Reducing**

**BV60 Back Pressure**

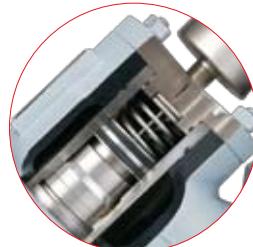
**BV54 Flow Limiting**

**BV70 Differential Control**

**BV86 2-Stage Hydraulic**

**BV88 Digital Control**

**BV89 2-Stage Set Stop**



## Packaged Systems

- Brodie offers a variety of engineered, fabricated, packaged systems, combining meters and valves with various electronics.
- Typical of these are:
  - Truck Unloading Skids
  - Master Meter Carts
  - Blending Skids for Biofuels

## Meter Accessories

Brodie International offers state of the art electronic and mechanical accessories complementary to their lines of positive displacement BiRotors Meters, Oval Gear Meters, and Control Valves.

The mechanical accessories range from totalizing registers, ticket printers, batch controllers, frequency to analog converters, flow rate indicators, temperature compensators, strainers and air eliminators. The electronic accessories include totalizing registers, presets, pulsers, and batch controllers. These accessories provide an interface between the measuring units and receiving equipment that is necessary for control, monitoring and documentation. If the output required is mechanical Brodie has the ability to provide reliable and accurate equipment the industry can rely on to perform exceptionally.

Brodie can also fabricate small packages of equipment, combining one or two meters and valves, plus various electronics.

Typical of these are:

- Truck unloading skids
- Master Meter trolleys
- Blending skids



## Crude Oil & NGL Production

- There are a number of places within the Petroleum Production area in which PD metering is widely used, including:
  - Crude gathering stations
  - The liquid leg of Gas/Oil separation units (GOSPs)
  - Automated Custody Transfer points (ACTs and LACTs)
  - Offshore Production/Storage platforms (export metering)

## Ship Bunkering

- Although Diesel is in widespread use for Marine applications, much of the world's high tonnage bulk cargo fleet is still powered by various grades of fuel oil—some of it extremely heavy (and therefore very viscous until heated). Brodie BiRotor PD meters provide an excellent solution for ship bunkering—whether from shore line or barge.

The rugged double-case construction of the BiRotor meter, together with its immunity from damage when passing air slugs (due to entrapped air in the line) gives it a distinct operational advantage over other types of PD Meters, which can easily be damaged by air slugs. The meter can either be supplied with electronic or mechanical readout, according to application. The wide operating viscosity of the BiRotor meter lends its to use on a variety of fuel types.

## Bulk Storage Depots

- Bulk storage Depots act as a 'halfway house' in the Fuel Distribution sector, receiving refined hydrocarbon products in bulk quantities (usually by Pipeline, Ship or Railcar), storing and then re-exporting these products to Marketing terminals (usually by Pipeline, Railcar, and in some cases, by Truck). The size and number of Bulk Storage terminals in a region is a function of the geographical area and number of Marketing Terminals served. Occasionally, some Bulk Storage Depots have associated truck loading facilities, within or just outside their fence.

As well as the Import and Export metering, there is often product movement around the Storage Depot—freeing up tankage for other products which may be about to be imported etc. Although this doesn't normally entail change of ownership of the product, the measurement accuracy really needs to parallel that of the import and export metering, otherwise overall product inventory won't balance.

Because refined products are being moved around, and high accuracy is needed for Inventory Balance, the BiRotor plus is especially recommended for this application.

## Blending

- Whether blending within the Refinery, within the Bulk Storage Terminal, or at point of loading into Truck or Railcars, the final blend quality is dependant on the accuracy of metering of the individual components of the blend. Having a tank full of 'off-spec' product is expensive and time consuming, as the tank has to be emptied and the product reworked, which can then take up more tankage for the rework process. All of this adds unnecessary cost to the operation.

The Brodie BiRotor range covers many blending operations, such as Ethanol in Gasoline, Vegetable Oils in Diesel, Kerosene in Bitumen Cutback blending etc.

Lubricating Oils are becoming more and more sophisticated in order to cope with higher performance rotating machinery. Even the base oils are very expensive, so accurate blends avoid wasting expensive feedstock. There are still BiRotor meters in the field, operating within Lube Oil blending plants, that have been working daily for the last 35 years without any detectable wear.



## Meter Calibration

- A flow meter that is badly out of calibration and is no longer repeatable, is no longer a flow meter—it is merely a flow indicator.

In all areas where Custody Transfer standards apply, the various Weights & Measures authorities around the world will require these meters to be periodically checked. For very small meters (such as a Tank Truck offload metering or the metering pump within a gasoline dispenser) this is most easily achieved with a certified volumetric container of the appropriate volume.

For larger size meters (3" and upwards) it is more practical to prove with a master meter pipe or compact prover, which is connected in series with the meter under test. Regular meter proving can highlight potential problems, such as long-term drift in meter 'k' factor (which could indicate the onset of wear) or sudden shift in meter 'k' factor (e.g. due to a recently damaged or missing turbine meter blade).

Large calibration tanks upwards of, 500 gallons or 2500 liters, become very cumbersome to move around marketing terminals and then take time and effort in disposing of contents for a new calibration run. A portable Master Meter or compact provers are ideal solutions for proving in-situ (and therefore under normal operation conditions).

Brodie supplies loose Master Meters (with traceable factory calibration certificates), or master meter complete carts/trailer mounted comprising a Master Meter, readout, couplings, hoses and flow control valve. This is a small and light enough to be moved around a Marketing Terminal, even by hand.



## Aviation Fueling

- Aviation Fuel requires very careful handling, in order to ensure cleanliness of product (no particulate matter) and the complete absence of water, which could lead to corrosion of line equipment, as well as the possibility of water contamination within the aircraft fuel tanks. These requirements apply equally to Aviation Turbine Kerosene and High Octane Aviation Gasoline.

Brodie manufactures a range of Aviation refuelling meters, which are fabricated from non-ferrous metals (primarily aluminum) to ensure that there is no chance of any corrosion taking place inside the meter body. Meters can be supplied either with standard flanges or Victaulic couplings. Mechanical or electronic readouts can be provided, electronic now being favored, although mechanical meters are still in use on a global basis.



## Bitumen Metering

- Bitumen (Asphalt) needs to be handled at elevated temperatures to prevent solidification, but when molten, is easily handled by a BiRotor meter equipped for high temperature operation.

## Liquid Sulphur Metering

- High sulfur crude oil and natural gas normally needs to be treated (sweetened) prior to shipment, and certainly before selling. This results in large quantities of Sulphur being produced at desulfurizing plants. Sulphur is a valuable product on the world market, being used in the vulcanisation of rubber, the production of sulfuric acid, etc. The BiRotor meter is the ideal solution for metering of liquid sulphur, at elevated temperatures, at the point of onward shipment.



Brodie International

19267 Highway 301 North • Statesboro, GA 30461 USA • P 001.912.489.0200 • [www.brodieintl.com](http://www.brodieintl.com)

Corporate Offices • USA Statesboro, Tulsa, Houston, Phoenix, New York • United Kingdom • Australia, China

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