

# WHAT MAKES OVAL GEAR FLOWMETERS OFTEN THE CHOICE FOR MEASUREMENT OF VISCOUS FLUIDS

Titan Enterprises was founded on the belief that the market required a high quality reasonably price mini-turbine flowmeter. This proved to be correct but we quickly ran into problems with attempting to meter more viscous fluids as these turbine flowmeters are Reynolds number dependant and were therefore forced into looking at alternative low cost, high viscosity flow technologies, but which one? As this was before the advent of our low-flow Atrato ultrasonic flowmeter technology it had to be a mechanical meter.

Below are some of the flow technologies we considered and why we ended up developing an oval gear flowmeter which offered low pressure drop, ease of high volume manufacture, good chemical resistance and a range of detector options.

## Nutating Disc



This technique is often used in domestic water meters. Nutating disc flowmeters use a flying saucer or Saturn shaped measuring element, with a slot in the disc and a divider to prevent rotation, wobbling around a circular path. The motion of the nutating disc is up and down but because the spindle is constrained to a small orbit the cyclical movement is circular. It is not a true positive displacement device as there is always clearance around the disc and between the divider plate. In this type of flowmeter there are a lot of rubbing/bearing surfaces which have to maintain their low friction characteristics. The low flow capability is limited, therefore not the type of meter we wanted.

## Oscillating Piston

Oscillating piston flowmeters are in some ways similar to nutating disc meters but the piston is constrained in one plane and it is therefore more efficient. Oscillating piston meters also rely on a lot of sliding surfaces and have a fairly large constant leak path. This technique can be used for some low flow viscous fluid applications.



## Sliding Vane



This technique uses a rotating hub in an offset orbit in a round chamber. In the hub are a number of spring loaded vanes. These slide in and out as the hub rotates so trapping a volume of liquid and transferring it from the inlet to the outlet. Sliding vane flowmeters can be very accurate but have even more sliding elements, and hence drawbacks, than the previous meters.

## Radial Piston

This flow technology typically uses four pistons on a central camshaft fluidically connected with suitable valve arrangements. You can view a radial piston flowmeter as a circular four cylinder two-stroke aero engine without the spark and running with an incompressible liquid instead of a gas mixture. Radial piston flowmeters are very accurate devices but incorporate complex assemblies and are therefore not possible for a lower cost solution.

## Helical Gear

Helical gear flowmeters use two inter-meshing helixes to pass a fixed volume of fluid along the length of the helix which are geared together. They are very efficient, but are unfortunately very expensive to produce.

## Gear Meters

Gear flowmeters operate using two meshed gears in a single close-fitting chamber. The volume of a single gear tooth is passed through as they rotate. As a result, they offer high resolution but require a fairly high pressure drop before they start working. Gear flowmeters also do not lend themselves to a moulded solution which would reduce the cost of manufacture to an acceptable level.

## Oval Gear



On investigation, we found that oval gear flowmeter technology combined the benefits of some of the others without compromising the performance. The rubbing/bearing areas are small and controlled. The clearances can be easily maintained in manufacture. The gears themselves can be moulded in chemically resistant materials with excellent bearing properties and precision machined afterwards to ensure closer tolerances if required. The pressure drop is relatively small and the start-up flow very low.

## Comparison of Flow Techniques for Viscous Fluids

Technology	Volumetric efficiency	Bearing surfaces	Chemical resistance	Moulding capability	Sale price
Nutating disc	Red	Red	Orange	Green	Green
Oscillating piston	Orange	Red	Green	Orange	Orange
Sliding vane	Green	Red	Orange	Green	Orange
Radial piston	Green	Orange	Red	Red	Red
Helical gear	Green	Green	Red	Red	Red
Gear meter	Green	Green	Red	Orange	Orange
Oval gear	Green	Green	Green	Green	Green

Our decision was to develop an oval gear flowmeter as this technology not only enabled us to handle viscous fluids but also low viscosity and aggressive fluids. Oval gear meters also beneficially offered the option of low cost manufacture for OEM applications.

## Author Details

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His experience in fluid handling dates back to the mid 1960's when he started working on rotating seals and flowmeter design for third party clients. Trevor draws upon over 40 years of using innovative design and production techniques to produce elegant flow metering solutions for organisations around the globe.

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