

## **Turbine Flow Meters Frequently Asked Questions**

### **General Information and Specifications**

#### **1. What is a turbine flow meter? How and when is it used?**

A turbine flow meter is a liquid/gas velocity measurement device. The turbine flow meter contains a free-spinning turbine rotor that turns at a speed that is proportional to the flow velocity. See *Turbine Meters – Theory of Operation* for more information.

#### **2. Why should I buy a Cameron NUFLO™ flow meter?**

- Low cost
- High quality
- Local service/parts availability

#### **3. What is the delivery time of the flow meters and MC-II™s?**

Delivery usually can be made in one or two weeks for in-stock equipment, using FedEx or UPS. If the equipment is not in stock, check with Cameron for delivery time.

#### **4. What is the material of construction?**

- Body and vanes – 316L SS
- Bearings and Shaft – tungsten carbide (alternates are available for special applications)
- Rotor – Alloy CD4MCu (See the Flow Meter Rotor Alloy CD4MCu data sheet for chemical composition information.)

#### **5. What are the different types of liquid meters and what are their benefits?**

- Standard grade
- Industrial grade (for improved linearity)

#### **6. What is the linearity of these meters?**

- Liquid: 1% for standard grade, 0.5% for industrial grade
- Gas: 2%

#### **7. Can liquid meters measure gas and vice versa?**

No – gas in a liquid meter will cause the meter to read high and can cause catastrophic failures. Liquid going through a gas meter will cause erroneous indications of the gas flow rate and can cause meter damage.

## 8. What sizes are available?

- Liquid: 3/8" through 8"
- Gas: 2" – low, standard and high ranges

## 9. How do you size gas turbines?

With gas turbines, flowing pressure and temperature are taken into account, as well as the flow rate. See the gas meter flow rate graph in the *Gas Turbine Flow Meter* data sheet and select the range that fits the application, or use Cameron's SizeGas Program located on our web site under the Gas meter section. If in doubt, call Cameron for assistance.

## 10. What size meter is needed when using snap-acting dump?

A meter should be sized to the instantaneous flow rate of dump regardless of the daily total volume.

## 11. What are the physical dimensions of the various meters?

See the *Liquid Turbine Meters* brochure for face-to-face dimensions.

## 12. What end connections are available?

Threaded, grooved, flanged, and EZ-IN® (wafer style)

(Special end connections, such as WECO Union, Gray-Loc, and others are available upon request.)

## 13. What is the maximum working pressure?

The maximum working pressure of NUFLO meters is determined by the end connections. See the *Liquid Turbine Meters* brochure for maximum working pressures.

## 14. What size meter will I need for a certain size pipe?

Meter size depends on the flow rate being metered, not pipe size. Most oilfield applications oversize the pipe so the meter flow rate size may be smaller than the pipe size.

If the fluid being measured is a non-lubricating liquid, such as solvent, gasoline, acetone, alcohol, etc., the meter must be run in the upper 60% of the operating range. See the *Turbine Meter Normal and 60% Flow Ranges* chart on the following page.

## 15. What happens when flow goes in the reverse direction in the meter?

The meter is not damaged as the meters are designed to be Bi-Directional, but the counter will read the total of the forward flow and the reverse flow. For example, if five barrels flow through the meter in the forward direction, and then four barrels flow back through the meter in the reverse direction, the counter will show nine barrels even though the net transfer through the meter is only one barrel. Consult Cameron for Bi-Directional operation assistance.

## 16. What are the flow ranges?

See the *Liquid Turbine Meters* brochure for flow ranges. In most cases, the ratio of maximum flow rate to minimum flow rate is 10 to 1. This is called the turndown ratio.

## 17. How do you size meters for certain applications?

Injection wells – flow rates, working pressure and end connections.

Separators – recommend snap dumps. (You need the instantaneous flow rate when it is dumping, not the total amount dumped per day.)

Oil meters – consider viscosity of oil and gas in the fluid. Install a backpressure device downstream of the meter that will keep the gas entrained in the fluid.

Meters in general – try to mid-range if possible.

Meters for CO<sub>2</sub> service – recommend upper 60% range. Measure it in the liquid state only

### Turbine Meter Normal and Upper 60% Flow Ranges

Normal Range				
Meter Size	GPM	b/d	m <sup>3</sup> /hr	m <sup>3</sup> /day
3/8"	0.3 to 3	10 to 100	0.068 to 0.68	1.63 to 16.3
1/2"	0.75 to 7.5	25 to 250	0.17 to 1.7	4.08 to 40.8
3/4"	2 to 15	68 to 515	0.45 to 3.41	10.8 to 81.84
7/8"	3 to 30	100 to 1000	0.68 to 6.81	16.3 to 163
1"	5 to 50	170 to 1700	1.14 to 11.36	27.3 to 273
1-1/2"	15 to 180	515 to 6000	3.41 to 88	81.8 to 981
2"	40 to 400	1300 to 13,000	9.09 to 90.85	218 to 2180
3"	80 to 800	2743 to 27,423	18.18 to 181.7	436 to 4361
4"	100 to 1200	3400 to 41,000	22.71 to 272.55	545 to 6541
6"	250 to 2500	8600 to 86,000	56.78 to 567.82	1362 to
8"	350 to 3500	12,000 to 120,000	79.49 to 794.94	1907 to
Upper 60%				
Meter Size	GPM	b/d	m <sup>3</sup> /hr	m <sup>3</sup> /day
3/8"	1.38 to 3.0	46 to 100	0.31 to 0.68	7.52 to 16.3
1/2"	3.45 to 7.5	115 to 250	0.78 to 1.7	18.8 to 40.8
3/4"	7.2 to 15	246 to 515	1.63 to 3.41	39.24 to 81.84
7/8"	13.8 to 30	473 to 1000	3.13 to 6.81	75.22 to 163
1"	23 to 50	788 to 1700	5.22 to 11.36	125 to 272
1-1/2"	81 to 180	2777 to 6000	18.39 to 40.88	441 to 981
2"	184 to 400	6308 to 13,000	41.79 to 90.85	1002 to 2180
3"	368 to 800	12,617 to 27,423	83.58 to 181.7	2006 to 4361
4"	540 to 1200	18,514 to 41,000	122.6 to 272.55	2943 to 6541
6"	1120 to 2500	38,400 to 86,000	254.5 to 568.82	6105 to
8"	1610 to 3500	55,200 to 120,000	365 to 794.94	8776 to

1 liter = 0.264 gallons

1 gallon = 3.785 liters

1 gallon = 0.00379 m<sup>3</sup>

1 gallon = 0.0238 barrels

1 barrel = 42 gallons

1 x m<sup>3</sup> = 6.289 barrels

**18. How does the liquid meter work in viscous fluids?**

A liquid meters performance with viscous fluids is predictable and repeatable. Knowledge of the behavior (i.e., empirical data) is required to determine the performance. Contact Cameron for assistance in these applications.

**19. Will the meter stand up to high corrosiveness?**

The metallurgy of the meter determines its corrosion resistance. The effect of the fluid on these materials establishes service life. All NUFLO meters comply with the recommendations of NACE MR01-75 for sour gas/liquid applications.

**20. Where do you buy strainers?**

Strainers are recommended for use upstream of meters if debris is present or a possibility in the flow stream. These can be locally purchased at various supply stores.

**21. What happens to accuracy when you are above or below range of the meter?**

The bottom end of the flow range is the critical point. Below this minimum, the factor changes with flow rate change. Each meter performs differently, so it is not possible to predict the performance. The top end of the flow range is based more on bearing wear than accuracy. The meter will still be accurate above the top end of the range, but the kit will not last long if continuously run above the top end of the flow range. Over range use should be limited to 10% of the maximum flow rate, and not more than 10% of the time.

**22. What is the difference between dump rate and production rate?**

Production rate: how much the well makes in a day Dump rate: the instantaneous flow rate.

**23. What is the life expectancy of the meter?**

Many factors can affect this, but, normally, if debris is kept out of the meter and fine particles such as sand are kept to a minimum, the meter can last for many years. Life expectancy depends entirely on the application and meter size.

**24. Is the turbine meter easy to work on and maintain?**

Yes – minimal tools are required.

**25. Are the meter and MC-II field repairable onsite or do they have to be sent off?**

They are both field repairable. By keeping a few spare parts on hand, an operator can make most repairs in approximately 30 minutes. If you cannot figure out the problem, contact a Cameron service representative and they usually can propose a solution over the phone. Field service also is available as well as product training classes from your local Cameron Representative.

## **26. How long will the rotor and vane kit last?**

The longevity of the rotor and vane kit depends strictly on the application. A meter that is measuring a clean lubricating fluid will last longer than one that is measuring a dirty, sandy, non-lubricating product. The life of the meter depends on the application and meter size.

## **27. Can the meter be used with propane, butane, CO<sub>2</sub>, etc.?**

Yes – the product must be liquid, and because it is less lubricating, it is best used in the upper 60% range of the meter. Precautions must be exercised to prevent gas flashing, which can cause catastrophic failures and/or high readings.

## **28. Can meters be used with piston type pumps?**

The turbine meter works well in this application compared to other measurement devices. However, due to the constant pulsation of the fluid, the EZ-IN<sup>®</sup> meter may be the best choice because of its design. Depending on the backpressure and the proximity of the installed meter to the pump, the snap rings can wear, and loss of one vane and the rotor can occur. If the turbine meter is some distance away from the triplex pump, the standard meter will most likely give adequate performance.

## **Calibration**

### **1. What is a calibration factor and how is a meter calibrated? What happens if the calibration factor tag is lost?**

The calibration factor is the number of pulses per gallon a meter will produce. Every meter is individually calibrated by flowing a known volume of water through the meter at five different flow rates – one at the maximum rate, one at the minimum rate, and three at rates equidistantly spaced between. This calibration factor is put on a plastic tag and attached to the 1" MNPT conduit pickup adapter of a meter.

If the calibration tag is lost and the kit has not been changed from the original kit that was sold in the meter, the calibration number can be obtained by contacting Cameron's Duncan Technology Center in Duncan, Okla. (1 580 470 9600) and providing the meter serial number.

Since kits are also calibrated individually and come with their own calibration factor, if the original kit has been changed and the new calibration factor tag is lost, the only way to get the actual factor is to send the meter to the Duncan Technology Center for recalibration or a third party proving facility. Sometimes a nominal factor will be close enough for the application.

If a meter requires repairs, it is critical to change the entire kit. Never replace or interchange parts.

## **2. What method is used to calibrate NUFLO turbine flow meters and replacement rotor and vane kits?**

The volumetric tank method is used. The volume of the calibration tanks is determined by filling them with water that is measured by Seraphim tanks that are calibrated and certified by the National Institute of Standards and Technology. These calibration tank volumes are checked periodically. Each flow meter and kit is placed in a flowline, and the calibration tank is filled at five different flow rates over the range of the meter. One run is performed at the maximum rate, one at the minimum rate, and three runs are performed at rates equidistantly spaced between the maximum and minimum rates. The total number of pulses generated by the flow meter at each flow rate is recorded. The total pulses are divided by the total volume at each flow rate to determine the calibration factor. The mean factor is determined as halfway between the high and low factors. The flow meter is tagged with the mean factor. The maximum deviation between the mean factor and high or low factor cannot exceed  $\pm 0.5\%$  for industrial grade meters or  $\pm 1.0\%$  for standard grade meters.

### **Installation**

#### **1. How do I install a liquid turbine meter?**

See the installation drawing in the NUFLO Liquid Turbine Flow Meter installation guide. Make sure there are at least 10 pipe diameters of straight pipe upstream of the meter and five pipe diameters of straight pipe downstream of the meter. The pipe must be the size of the end connection of the meter. Never install a throttling valve or any other flow restricting device upstream of the meter.

#### **2. How do I install a gas turbine meter?**

See the installation drawing in the NUFLO Gas Flow Meter data sheet. It is critical that the meter be centered in the flow line. Also notice that the minimum pipe length for the gas turbine meter is much greater than that for the liquid meters.

#### **3. I have a 3" line flowing 100 b/d water. Can I install a 3" meter?**

No – not at this flow rate. You have to stay within the flow range for a particular meter size. In this example, the flow rate will be below the minimum flow rate required for a 3" meter.

#### **4. Can a meter be installed in vertical run?**

Yes – meters can be installed in both horizontal and vertical applications. Always observe the flow direction arrow.

#### **5. What is the proper way to install a magnetic pickup?**

Hand-tighten the connection, then back up 1/4 of a turn and install a lock nut with a 3/4" deep well thin wall deep socket wrench (NUFLO Part No. 9A- 100013146).

## 6. How far from the turbine meter can I install an MC-II?

The MC-II can be installed up to 2000 ft (610 m) from the turbine meter without a pre-amp, depending on the meter size, flow rate and amount of electrical noise in the area. Electrically induced noise may give stray counts on the readout if the installation is in an area with high electrical noise. In such cases, a pre-amp is recommended.

## 7. How much accuracy do you lose if the meter is not installed properly?

There is no way to determine this. It depends on the application and the nature of the installation problem.

## Troubleshooting

### 1. What is the most common problem with the meters?

Debris getting in the meter can cause readings to be high, low or non-existent. This problem can be solved with the use of a strainer or filters ahead of the meter. These are recommended in all meter installations where debris or particles may be present in the flow stream.

### 2. What if the meter is not reading?

Check for debris that prevents the turbine from turning, or a bad pickup. See the *Troubleshooting* data sheet for details.

### 3. The meter reads low, and there is no debris in it.

Check for debris binding the turbine. Remove the meter internals to thoroughly observe, because some debris, such as Teflon tape, cannot be seen by just looking through the meter. Check for damage to the rotor or shaft, bearing wear, external factors actually reducing flow such as a valve, a well pressuring up due to a blockage, an incorrect divisor, malfunctioning totalizer, or shaft broken on one side of rotor.

Debris can cause one of three problems:

- No reading at all (turbine is not turning)
- Low reading (debris is binding the turbine)
- High reading (debris is jetting fluid through the turbine)

### 4. The rate seems to be increasing, but the pressure does not change. Check

for a buildup in the meter and upstream piping, such as scale, paraffin, etc.

## **5. What causes turbine flow meters to read high, more than actual flow?**

- Debris blocking part of the inlet to the meter
- A partially closed valve or other restriction upstream of the meter
- An elbow, tee or some other flow diverter too close to the upstream end of the meter  
viscosity of fluid being measured
- Misalignment of the meter or gaskets in the flow line
- Wax or scale buildup in the pipe or meter
- An incorrect divisor
- A malfunctioning totalizer.
- A malfunctioning/faulty magnetic pickup.
- Noise from vibration or nearby energy source emitting noise.

## **6. The meter has suddenly started reading very high.**

Check for debris lodged on the upstream end of the turbine, or a change of fluid conditions that could cause gas breakout.

Gas or air in the fluid can cause also high reading.

A valve used for rate control must be mounted on the downstream side of the meter. Backflow is measured and added to the regular flow volume, causing the totalizer to yield excessively high values. A leaking check valve, therefore, can cause a high totalizer reading.

## **7. What problems will make a liquid meter read inaccurately?**

Debris in the meter, a broken shaft, viscous fluids, gas in flow line and/or improper sizing or installation can cause inaccurate readings.

## **8. When should a rotor and vane kit be replaced due to bearing wear?**

Bearing wear on a shaft will appear as a dimple in the end of the shaft or a groove cut around the shaft ends. When a groove is observed, the kit should be replaced. As a rule of thumb, if a dimple covers 66% of the surface area of the end of the shaft, the kit should be replaced. If the groove on the side of the shaft can be felt, it should be replaced.

## **9. How do you check pickups?**

The pickup can be checked with an ohmmeter, or it can be connected to a properly working readout device. When a wire brush or screwdriver is passed across the pickup tip, the readout should show a rate or update of the total if the pickup is functioning properly.