# Replacing Sensus Turbine Meters with TrueShot USM

Written by John Lansing

## Introduction


Turbine meters have been used for custody transfer applications in the gas transmission and distribution market since before the 1980's. Traditionally line sizes from 4-inch through 12-inch were the most common. For lower volume applications, where rotary meters are generally preferred, 2-inch and 3-inch turbine meters were occasionally used as the rotary meters may not be available for the given metering pressure application. Thus, turbine meters were the primary choice for applications above 16,000 ACFH (16M) due to cost benefits and capacities.

Today's 12-inch turbine meters have a capacity of 230,000 ACFH which is way beyond what any rotary meter can handle. As turbine meters have a much higher capacity than rotary meters, their popularity significantly increased in the mid-1980's.

The widespread use of turbine meters all began to change in the 1990's with the introduction of multipath gas ultrasonic meters (USMs). Gas ultrasonic meters were initially only available in line sizes from 6-inch and larger. For larger volume applications, they quickly became the defacto standard replacing multiple turbine or orifice meters. The USM's higher flow rate, and greater rangeability for a given line size, contributed to their quick acceptance. This Application Note discusses the difference in lengths for the Sensus (formally Rockwell and Equimeter) turbine meters when replacing with the TMCO TrueShot USM.

## Turbine Performance Discussion

Turbine meters generally have less rangeability than today's ultrasonic meter. Their rangeability is very dependent upon line size and metering pressure. The gas USM's rangeability is independent of pressure, and with today's technology, the rangeability is essentially independent of line size. Turbine meters generally require more maintenance than ultrasonic meters. Their bearings require regular oiling to provide accurate performance at lower flow rates. Clients often remove the metering module annually to test the condition of the bearings using a procedure called a "spin test". This requires depressurizing and removing the meter module from the meter body. Additional piping would have been included at the time of construction to allow gas to continue flowing during this period.

Turbine meters are not suitable for client applications where the flow rate can increase from very low to very high quickly (snap-acting loads like boilers). This puts a lot of stress on the bearings and can also damage the blades. If a turbine meter is significantly over-ranged, the blades will be damaged requiring replacement of the module. Snap-acting loads or significant over-ranging will not damage the TrueShot.

Even though traditional turbine meter applications typically have clean dry gas, this is not always the case. Most clients place a filter upstream to minimize or eliminate any particulate matter from entering the turbine meter. This adds CapEx cost while also leading to higher ongoing operational expenses. Small debris will contaminate the bearings, shortening their life and causing the meter to under-register at lower flow rates. Over time any debris will damage the blades and affect accuracy. The USM will not be damaged by particulate contamination, and the meter's accuracy is also unaffected.

## TrueShot Performance Discussion

When gas ultrasonic metering first gained popularity in the 1990's, they were traditionally used for high-pressure transmission applications. This is partly due to their higher cost and lack of ability to operate at lower pressures often seen in the Distribution applications (60 PSIG and less). The TMCO TrueShot gas USM has overcome both cost and pressure limitations while providing all the traditional diagnostic, performance and reliability benefits USMs are known for. Thus, for new applications, the TrueShot meter is a much better choice, not only for the performance benefits, but also from a financial perspective.

## TrueShot Replacement Discussion

Clients realize that having to replace their module periodically significantly increases their costs and are looking for an alternative solution. Replacing older turbine meters with the TMCO TrueShot USM is a cost-

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effective solution. Since turbine meter and USM body lengths are generally not the same, some piping changes may be required. Following is a summary of the overall length (OAL) for the various Sensus Turbine Meters, and the OAL for a replacement TrueShot USM with the same line size and ANSI Flange rating. The column on the right (Downstream Adapter Length in Inches) summarizes the difference between the TrueShot and the Sensus meter and includes 0.125" for an additional gasket, if needed.

| Meter Overall Length -- Aluminum 175 PSIG | | | | | | |
|---|---|---|---|---|---|---|
| Line Size | TMCO OAL | TMCO | Sensus | Sensus | Gasket | Downstream Adapter |
| Inches | Millimeters | OAL Inches | MM (L) | Inches (L) | Inches | Length in Inches |
| 4 | 350 | 13.780 | 356 | 14.000 | 0.125 | 0.095 |
| 6 | 400 | 15.748 | 406 | 16.000 | 0.125 | 0.127 |
| 8 | 500 | 19.685 | 533 | 21.000 | 0.125 | 1.190 |
| 12 | 600 | 23.622 | 762 | 30.000 | 0.125 | 6.253 |

| Meter Overall Length -- Steel ANSI 150/300/600 | | | | | | |
|---|---|---|---|---|---|---|
| Line Size | TMCO OAL | TMCO | Sensus | Sensus | Gasket | Downstream Adapter |
| Inches | Millimeters | OAL Inches | MM (L) | Inches (L) | Inches | Length in Inches |
| 4 | 350 | 13.780 | 394 | 15.500 | 0.125 | 1.596 |
| 6 | 400 | 15.748 | 572 | 22.500 | 0.125 | 6.627 |
| 8 | 500 | 19.685 | 692 | 27.250 | 0.125 | 7.440 |
| 12 | 600 | 23.622 | 826 | 32.500 | 0.125 | 8.753 |

The 4-inch and 6-inch Sensus aluminum turbine meter (175 PSIG) the adapter dimensions are very small as both meters are almost the same length. Thus, an adapter may not be needed. Once the turbine meter is removed, this small distance can be made up by tightening the studs and pulling the meter assembly together. For line sizes where the adapter is less than 2 inches, a spacer is likely the best choice, although the outlet piping section can be modified or replaced to make up the difference.

For adapter lengths that are 6-inches and larger, a special flange-by-flange adapter is more practical. TMCO can provide these adapters if needed. Modifying, or replacing the downstream (or upstream) pipe spool, is generally required to compensate for the difference in lengths if an adapter is not used.

### Flow Conditioning Discussion

Traditionally turbine meters have been installed using 19-tube bundles. More recently, after significant testing, clients began replacing the 19-tube bundle flow conditioner with a "high performance flow conditioner" like the CPA 50E (or the CPA 55E). The issue with the 19-tube bundle is it doesn't remove asymmetrical flow profiles, but rather freezes them, which can cause the turbine to over-register.

Testing done in the 1990's [Ref 1] at Southwest Research Institute (SwRI) showed gas USM performance was also affected by the 19-tube bundle. All USMs that were tested performed better by removing the 19-tube bundle and using only straight pipe. When installing a TrueShot USM to replace a turbine meter (with an existing pinned 19-tube bundle), it is recommended to remove the tube bundle and use only straight piping. If a flanged 19-tube bundle was used, it is recommended to replace it with a CPA 50E (CPA 55E).

### Summary

Replacing the Sensus turbine meter with the TMCO TrueShot USM will significantly reduce costs by minimizing site visits, delivering improved accuracy (especially at low flow rates), will not be damaged by over-ranging or snap-acting loads, and provides multiple meter diagnostics for remote health monitoring.

### References

1. *The Influence of Velocity Profile on Ultrasonic Flow Meter Performance,* Terrance A Grimley, Senior Research Engineer, Southwest Research Institute, 1998 AGA Operations Conference, Orlando, Fl.