Differential Testing of Dresser Series B3 Meters

The oldest and most efficient method of field testing Dresser Natural Gas Solutions (NGS) Meters is by measuring the pressure drop from the inlet to the outlet of the meter. This process is known as differential testing.

Variables Affecting Meter Accuracy

History shows us that rotary meter accuracy remains relatively constant. In fact, the U.S. National Bureau of Standards (now NIST) reported in 1946 in its Research Paper No. 1741 entitled "Testing Large Capacity Gas Meters" that the accuracy of a rotary meter is non-adjustable. There are no linkages, cams, valves or parts which can be used to adjust or change the meter accuracy. The meter has fixed, non-wearing and non-contacting internal parts in the measuring chamber, and the static volumetric displacement is constant. Therefore, only three possible conditions exist which will affect meter accuracy:

1) change in static displacement

2) enlarging meter clearances

3) increase in the meter's internal resistance

Research Paper No. 1741 states on page 187: "The static displacement of a rotary gas meter appears to be almost unaffected by deposits, even those resulting from unpurified gas. Hence, having once been determined, it will seldom be necessary to redetermine."

It is also known that clearances do not change between the impellers and cylinder. There is no wearing of parts or changes in clearances. However, the third variable, change in the meter's internal resistance can affect rotary meter accuracy. Any significant increase in the meter's internal resistance to flow will increase the pressure drop across the meter, or differential. Principal causes of internal resistance are: binding of impellers, dirt, worn bearings and too heavy or too much oil. Therefore, the meter differential pressure appears as a prime indicator of meter condition.

Features

- High accuracy at a low price
- Accuracy of ±0.05% of F.S.
- Intrinsically Safe for Class 1, Groups A, B, C & D
- No temperature effect from 23°F to 122°F
- Pulsation damping (pressure averaging)
- Integral valve and piping assembly
- Full 5 digit display
- Resolution to 0.01" w.c.
- Portable, battery powered
- Backlit display

Differential Testing

A differential test consists of a series of different pressure readings taken across the meter at several gas flow rates within the meter's range of capacity. It should be performed when the meter is initially installed, under actual conditions of gas flow rate, line pressure, and specific gravity that will exist during service (somewhere between 25% to 100% of meter rating). This is particularly important when line pressure will be higher than 15 PSIG, so that direct comparison with later tests can be made.

To perform a differential test, pressurize the meter by slowly opening the inlet and discharge line valves. Adjust the bypass and inlet valves until the meter is operating at some selected flow rate in the lower range of its capacity.

With flow stabilized, time the passage of a predetermined volume of gas as registered on the counter or instrument, and record the differential pressure reading. Repeat the test to obtain an accurate average reading. Also record the line pressure.

It is advisable to construct a graph and plot a point for each differential at each level of capacity tested. Three points are typical within the 25% to 100% range to establish an accurate curve. From the registered volumes and times, calculate the gas flow in displaced CFH and plot a curve matching the differential versus flow rate. (See Figure 1.) Below 15 PSIG, the field tests on gas, for all practical purposes, can be compared directly with Factory test results on air. These test results can be obtained from either an individual Prover Test Curve or Characteristic Accuracy and Differential Curves, available from the factory. This latter differential data from Dresser Meters has been established from a comprehensive study of meter data. **Although accuracy cannot be directly determined by a differential test, test results have shown that an increase of up to 50% in differential pressure can be tolerated without affecting meter accuracy at the higher flow rates (25% and above) by more than 1%.**

Figure 1, for example, shows the possible results of a differential test performed five years later on the same meter at the same line of pressure at similar capacities. In the comparison, notice that differential pressure has increased slightly, but is still within the acceptable range of a 50% increase. This slight differential pressure increase is due to a small amount of internal resistance. Figure 1 also shows the hypothetical results of a differential test performed on the same meter under the same condition of pressure in its 10th year of operation. The differential increased by more than 50% of the initial test results derived at the time of installation. These results would be unacceptable.

If the differential is found to be more than 50% higher than the initial test, the first step is to flush the metering chamber with an approved solvent. Dust and material tend to collect on impeller and cylinder surfaces, which generally causes a higher differential pressure. A simple flushing may easily remove the material and bring the meter back into specification. Figure 1 also shows the results of flushing the meter and a reduction of differential pressure to an acceptable level.

Differential Testing Equipment

A differential test requires only a pressure gauge, a manometer or equivalent differential pressure indicator and a stop-watch for timing the dial rate of the meter. The manometer should be suitable for the maximum operating line pressure and it should be readable to 0.1 inches water column.

The range of the manometer or gauge is important since the values of the differentials are often relatively small. NOTE: The range of the manometer will require several inches for high pressure testing.

Permanent valves or appropriate fittings are often mounted on the meters to reduce connection and test time. Meter forms or graphs (Figure 1) for logging the readings are used by some companies to provide simple data comparison.

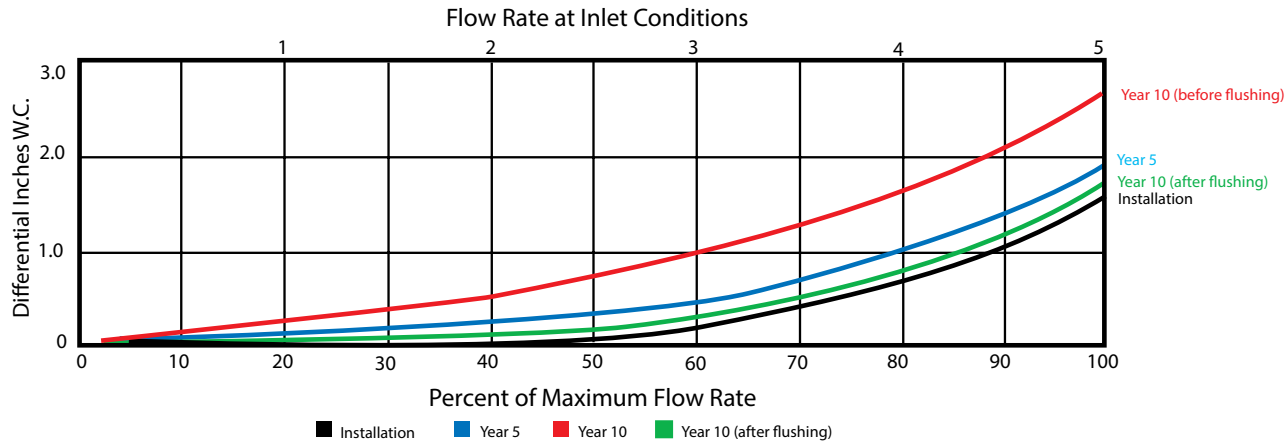


Figure 1

Frequency of Differential Testing

It is recommended that the meter be checked periodically for change in differential. There are no set time requirements for frequency of differential testing meters, but current information suggests that a five-year interval is usually more than adequate, providing that the gas stream is clean.

Conclusion

It has been found over decades of experience that differential testing is an effective method of detecting changes in meter condition. At present, the most effective differential comparison appears to be directly with the initial field data, although factory supplied characteristic data may also be used. Other progress in differential testing is expected as better testing standards are developed and the benefits of experience realized.

Figure 2 - The Meriam Smart Manometer Handheld, All-Electronic d/p Tester

Differential - Rate Test Data

Meter Model 5M175 Dresser Serial Number 8500794 Utility Serial No. _____

Location _____ Date Installed 3/1/85 Registered Reading 00000

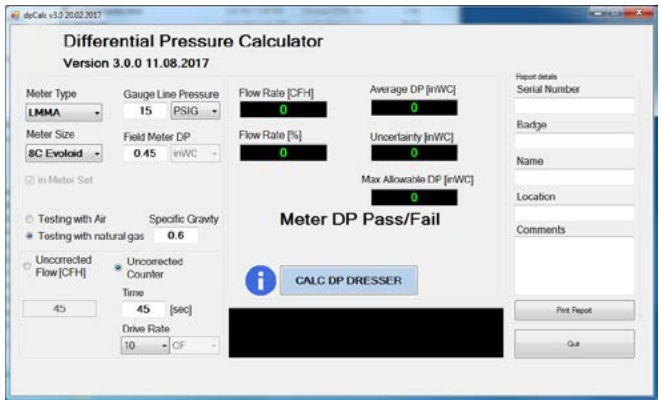
Line Press	Gas Temp	So. Grav	Volume Meas	Run Time Sec	Rate CFH m^3/h	Differential Pressure		Date	Transfer
						Inches W.C. (mm W.C.	% Change		
Initial Tests									
2 psig	60° F	.6	10cf	28.8	1250	.1	—	3/1/85	J.Doe
2 psig	60° F	.6	10cf	14.4	2500	.3	—	3/1/85	J.Doe
2 psig	60° F	.6	10cf	7.6	4750	1.3	—	3/1/85	J.Doe
Periodic Check Tests									
2 psig	60° F	.6	10cf	28.8	1250	.14	40	4/1/90	J.Doe
2 psig	60° F	.6	10cf	14.4	2500	.4	33	4/1/90	J.Doe
2 psig	60° F	.6	10cf	7.6	4750	1.5	15	4/1/90	J.Doe
2 psig	60° F	.6	10cf	28.8	1250	.2	100	3/1/95	J.Doe
2 psig	60° F	.6	10cf	14.4	2500	.7	133	3/1/95	J.Doe
2 psig	60° F	.6	10cf	7.6	4750	2.3	69	3/1/95	J.Doe
2 psig	60° F	.6	10cf	28.8	1250	.12	20	3/2/95	J.Doe
2 psig	60° F	.6	10cf	14.4	2500	.35	17	3/2/95	J.Doe
2 psig	60° F	.6	10cf	7.6	4750	1.4	8	3/2/95	J. Doe

Differential Test Acceptance Calculator

Dresser's new Differential Test Acceptance Calculator takes all the manual calculations out of meter acceptance determinations. Just "clock" your meter, take your differential pressure reading, plug in your value, and the software does the rest. No need to carry around differential curves for the various meter sizes for both series.

No need to calculate elevated pressure factors or flow rates. No need to do ANY math. Remove the chance for human calculation error.

The unique ability to perform a low cost differential test on Dresser rotary meters equates to reduced testing time. And that testing time just got shorter. Reducing field service cost improves the bottom line. With our new DTA Calculator, you can quickly verify the operational condition of your Dresser meter. Print or Save data for future comparisons.



Specifications

Pressure Range	**Differential Non-Isolated 200" w.c.**
Accuracy	**M201 Test Gauge; ±0.05% of full scale (includes the combined effects of temperature, linearity, repeatability, hysteresis and resolution. NIST Traceability Certification supplied with each manometer.)**
Temperature	**Storage: -40°F to 140°F (-40°C to +60°C) Operating: -4°F to 122°F (-20°C to +50°C)**
Media Compatibility	**Non-isolated sensors for use with clean, dry non-corrosive gases only. Isolated sensors for all fluids compatible with 316SS**
Pressure Limits	**2x range on DN units when pressurized on high side only; 150 psi (10.5 Kg/cm^2) static when applied to both sides of sensor simultaneously.**
Connection	**1/8" female NPT, 316SS. DN models have two pressure ports. P_1 is the high pressure connection, P_2 the low pressure connection.**
Power	**4 each AA alkaline batteries, field replaceable**
Display	**5 significant digit LCD w/h backlight**
Enclosure	**14 oz. ABS plastic measuring 6.5" x 3.6" x 2.25"**
CSA Units	**Intrinsically safe for Class 1, Groups A, B, C, and D**

Dresser Smart Manometer Kit, p/n 059663-000, includes:

- **Smart manometer (0-200" w.c.)**
- **ABS plastic case**
- **Push-to-read valve**
- **Hose kit with Pete's needles & quick-connects**

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