



Neptune C&I MACH[®] 10 Ultrasonic Meter Testing

The C&I MACH 10[®] can be set up like the typical test set up of a mechanical meter, however there are certain critical variables to consider when testing an ultrasonic meter. The following are step-by-step instructions and best practice tips to ensure conditions are adequate for a successful ultrasonic meter test:

Installation:

1. Place and secure the meter(s) in test bench like any mechanical meter.
2. Close the outlet valve(s) and **slowly** open the bench fill valve to its fully open position.

Purge Air from Line:

IMPORTANT: The presence of air in the line will impact accuracy when testing ultrasonic meters. Pre-programmed "Purge" buttons do not adequately purge the line when testing ultrasonic meters. If there is a "Purge" setting pre-programmed into your test bench's software, Neptune recommends first performing steps 2 through 7, (50% flow purge) **AND THEN** running the pre-programmed "PURGE" at least 5 times. This will ensure all pumps and lines used during testing are cleared of air.

3. Open the bleed screw located near the register with a Phillips head screwdriver. *Note: Turn the screw until you can feel water pushing it up and out from the meter maincase. The screw is captured and will not eject from the meter. Do this for each MACH 10 being tested.*
4. Open tank discharge valve(s).
5. Slowly open test bench outlet valve(s) until 50% of the meter's max flow is reached. *(See Table 2 for Neptune MACH 10 Flow Rates by meter size.)*
6. Adjust the input pump's speed (output percentage) or use the test bench outlet valve(s) to throttle the flow until the pressure at the exit of the meter is at least **30 psig**. *Note: If there is not at least 30psi at the exit of the last meter being tested, your high (full) flow test results may not be representative of the actual accuracy of the meter.*
7. When the flow is at **50% of the meter's max flow** and there is at least 30psig of back pressure on the meter, run water through the meter for at least 30 seconds to purge air out of the meter. *Note: If air is still in the line, the flow rate will show as 0.0 and the empty pipe icon will appear; if the 50% of max flow is not achievable, consider running as high a flow rate as possible for several minutes.*
8. Once the meter(s) is purged of air, tighten the bleed screw(s) until no water can be seen exiting the meter(s).



Testing the Meter:

9. Adjust the outlet valve(s) to set the desired flow rate for testing. **Start with high (full) flow rate** (see Appendix: Table 1), then test intermediate flow rate (see Appendix: Table 2), and finish with low flow rate (see Appendix: Table 3). *Note: If you are using pre-programmed flow tests and do not have access to either the C&I MACH 10 test profile or AWWA C-715 Ultrasonic test profile, you may use the AWWA C-701 Turbine meter test profile.*
10. When the flow is set and the line is pressurized, shut off the flow using the test bench outlet valve. Verify that no leaks are present. Leaks will skew results. *Note: If possible, a separate valve at the test outlet should be used to start/stop flow, so the meter(s) starts and stops the test at line pressure.*
11. Check tank to ensure valve(s) are closed and the tank is either empty or the weight has been tared. *Note: If you tare the tank, ensure there is enough empty tank volume left to perform the test.*
12. Record initial register indication.
13. Open start/stop test bench outlet valve to begin test.
Note: Timing the test can help to determine the average flow rate over the test. This can help to highlight if any gross flow rate fluctuations happened during the test.
14. When test reaches the desired volume, close the outlet start/stop valve to end test.
Note: Close valve at a steady rate, slowly enough so there is no water hammer effect. This can have detrimental effects to the system and meter accuracy.

Note: Do not "bump" test to reach certain volume/weight. This may affect the test.

15. Record final register indication and tank volume/weight.
16. Calculate accuracy of the meter(s):

$$\text{Accuracy (\%)} = \frac{V_{\text{meter}}}{V_{\text{tank}}} * 100$$

17. Repeat steps 9 – 17 for additional flow rates (See Table 2 for Neptune MACH 10 Flow Rates.)

Removing Meter:

18. Make sure to relieve water pressure from bench before removing meter(s).

Table 1: AWWA Recommended Flow Rating Accuracy Testing for Ultrasonic Meters

AWWA recommendations come directly from the AWWA M6 Manual. To test the C&I MACH 10 to the values printed on the meter's test ticket, please use **Table 2**.

Size [in]	Flow	Reading Resolution			Test Volume					Test Time
		Gallons	Cu. Ft.	m ³	Rate [gpm]	Gallons	Cu. Ft.	m ³	Accuracy [%]	Gallons (min)
3	Full	0.1	0.01	0.001	200	500	50	-	100 +/- 1.5	2.5
	Intermediate	0.1	0.01	0.001	15	100	10	-	100 +/- 1.5	6.7
	Low	0.1	0.01	0.001	2.5	100	10	-	100 +/- 5.0	40
4	Full	0.1	0.01	0.001	400	1000	100	-	100 +/- 1.5	2.5
	Intermediate	0.1	0.01	0.001	20	500	50	-	100 +/- 1.5	25
	Low	0.1	0.01	0.001	3.5	300	40	-	100 +/- 5.0	85.7
6	Full	1	0.1	0.01	800	2000	200	-	100 +/- 1.5	2.5
	Intermediate	1	0.1	0.01	40	1000	100	-	100 +/- 1.5	25
	Low	1	0.1	0.01	9	300	30	-	100 +/- 5.0	33.3
8	Full	1	0.1	0.01	1000	5000	500	-	100 +/- 1.5	5
	Intermediate	1	0.1	0.01	80	3000	400	-	100 +/- 1.5	37.5
	Low	1	0.1	0.01	18	2000	300	-	100 +/- 5.0	111.1
10	Full	1	0.1	0.01	3000	7000	1000	-	100 +/- 1.5	2.3
	Intermediate	1	0.1	0.01	400	5000	500	-	100 +/- 1.5	12.5
	Low	1	0.1	0.01	50	3000	400	-	100 +/- 5.0	60
12	Full	1	0.1	0.01	4000	10000	1000	-	100 +/- 1.5	2.5
	Intermediate	1	0.1	0.01	400	5000	500	-	100 +/- 1.5	12.5
	Low	1	0.1	0.01	65	3000	400	-	100 +/- 5.0	46.2

Table 2: Neptune Flow Rating Accuracy Testing 3" MACH 10

Neptune recommended intermediate flow values are 10% of the full flow. All other Neptune values come directly from Neptune Literature. Test Time was calculated based on the 'Gallons' Test Volume and will vary if 'Cu. Ft.' or 'm³' Test Volumes are used.

Size [in]	Flow	Reading Resolution			Test Volume					Test Time
		Gallons	Cu. Ft.	m ³	Rate [gpm]	Gallons	Cu. Ft.	m ³	Accuracy [%]	Gallons (min)
3	Full	0.1	0.01	0.001	500	1500	150	5	100 +/- 1.5	3
	Intermediate	0.1	0.01	0.001	50	500	50	1.5	100 +/- 1.5	10
	Low	0.1	0.01	0.001	0.75	50	5	0.5	100 +/- 1.5	66.7
4	Full	0.1	0.01	0.001	1250	1500	150	5	100 +/- 1.5	1.2
	Intermediate	0.1	0.01	0.001	125	1000	100	2.5	100 +/- 1.5	8
	Low	0.1	0.01	0.001	1.5	50	5	0.5	100 +/- 1.5	33.3
6	Full	1	0.1	0.01	2000	2000	200	7.5	100 +/- 1.5	1
	Intermediate	1	0.1	0.01	200	1500	150	5	100 +/- 1.5	7.5
	Low	1	0.1	0.01	2	500	50	5	100 +/- 1.5	250
8	Full	1	0.1	0.01	4000	5000	500	20	100 +/- 1.5	1.3
	Intermediate	1	0.1	0.01	400	1500	150	15	100 +/- 1.5	3.8
	Low	1	0.1	0.01	6	1500	150	2.5	100 +/- 1.5	250
10	Full	1	0.1	0.01	6500	5000	500	15	100 +/- 1.5	0.8
	Intermediate	1	0.1	0.01	650	2000	200	20	100 +/- 1.5	3.1
	Low	1	0.1	0.01	10	1500	150	12	100 +/- 1.5	150
12	Full	1	0.1	0.01	8000	5000	500	15	100 +/- 1.5	0.6
	Intermediate	1	0.1	0.01	800	2000	200	20	100 +/- 1.5	2.5
	Low	1	0.1	0.01	12	1500	150	12	100 +/- 1.5	125

Best Practices for MACH 10 Ultrasonic Meter Testing

The following are tips and best practices related to bench-testing ultrasonic meters.

Be certain to purge all air from the line.

- Ultrasonic meter measurements are impacted by air more so than mechanical meters. Therefore, when testing ultrasonic meters, test conditions will vary from traditional mechanical configurations. Follow steps 3 through 8 to ensure adequate purging.

Avoid cavitation by ensuring there is plenty of upstream pressure especially when testing high flows.

- At a minimum, Neptune recommends 30 psi of back pressure on the meter to prevent cavitation.
- To increase back pressure, close the downstream outlet valve incrementally and if necessary, increase the pump's velocity.

Use the MACH 10 Register Indicators to monitor the state of the meter.

Flow Rate will read 0.0 if the following conditions exist:

- Too much air in the line.
- Cavitation
- Empty Pipe icon will appear if too much air is in the line.

Make use of available AWWA Ultrasonic or Neptune MACH 10 profiles through your test software.

- MARS benches make available AWWA and/or MACH 10 profiles for testing ultrasonic meters. While these profiles offer test parameters, it is still necessary to perform adequate bench set up and purging.