Pump Vacuum, Flow Rates and Extension Tubing

NEO and POLI Sampling Pumps Flow Rates

NEO and POLI sampling pumps typically draw in the gas sample at about 380-430 cc/min under normal operating conditions of high pump speed and a standard, clean 0.45-µm water trap filter attached (see Table 1). At low pump speed, flows are typically 200-250 cc/min. NEO flows tend to be slightly higher than POLI flow rates. Monitors should normally be operated using filters, but if necessary, flow rates can be increased to the 500 cc/min range by removing the filter. Cases that warrant removing the filter include measurement of certain highly-reactive or strongly-absorbing gases, or in laboratory settings known to be free of dust particles.

Table 1. Typical* NEO and POLI Pump Flow Rates

Flow Rates	With filter	Without Filter
High Speed	400 cc/min	500 cc/min
Low Speed	240 cc/min	310 cc/min

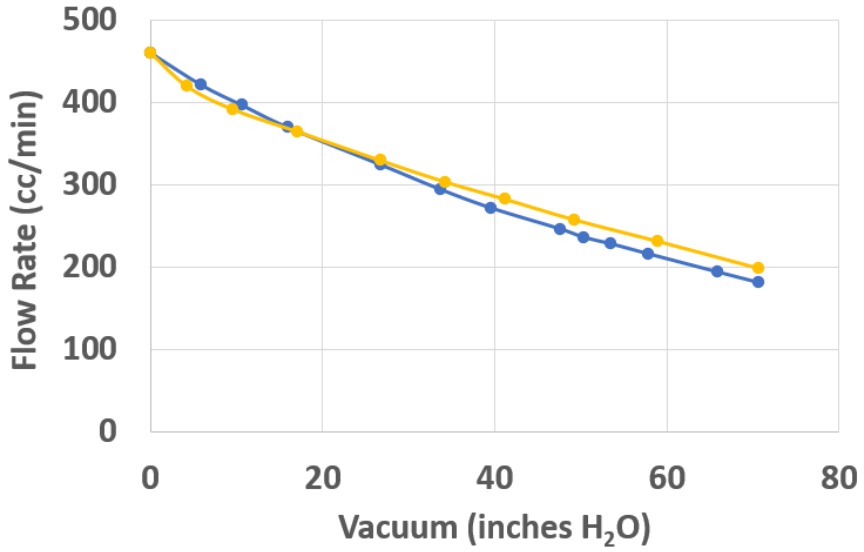
* Actual flow rates depend strongly on the cleanliness of the filter and wear and tear of the pump

Drawing Against Reduced Pressures

NEO and POLI sampling pumps are rated to a minimum vacuum of -300 mbar (-120 in H_2O) on high pump speed with a clean filter on the inlet. The table below lists 300 mbar equivalents in other pressure units.

Units	mbar	kPa	MPa	In. H_2O	mm Hg	psi	Atm
Vacuum Level	-300	-30	-0.03	-120	-225	-4.3	0.7

Although a pump in good condition can draw against such vacuums, the flow will be reduced, as shown in the figure below. We do not recommend drawing against vacuums of stronger than about



Typical Flow-Vacuum curves for POLI and NEO Monitors

(Flows at zero vacuum are without any filter attached)

-60 in. H_2O for extended periods of time, as this may cause excessive strain on the pump and shorten its operating life. Also, vacuums weaker than -60 in. H_2O have minimal (<5%) effect on readings, whereas stronger vacuums can reduce PID response and/or cause electrochemical (EC) sensors to

dry out. EC sensors are typically rated to vacuums within 20% of ambient pressure (±80 in. H_2O). Quick sampling at stronger vacuums should not affect pump life significantly.

On some new instruments the pump is able to draw as much as 450 mbar (180 in. H_2O) vacuum. If operation at such low pressures is necessary, it will affect the calibration, so the unit should be calibrated at the same pressure, if possible.

Pump Maintenance and Demand-Flow Regulators

Whenever drawing against a vacuum or demand-flow regulators, it is important to maintain pumps, in good condition, especially those that have been exposed to dusty environments (See POLI Manual). Most demand-flow regulators are rated to open at only about 8 mbar (3 in. H_2O) vacuum, and therefore should easily be opened by mPower monitor pumps. However, more vacuum is required when the gas cylinder is nearly empty. With a combination of low cylinder pressure and a poorly working pump, demand-flow regulators may not open, causing failed calibrations.

Extension Tubing

Up to about 150 feet (45 m) of 1/8-in. i.d. extension tubing can be used with a POLI or NEO that has a well-working pump and clean filter. With 100 feet of 1/8-in. i.d. tubing and high pump speed, flow is reduced by about 15% and the sample delayed by about 40 seconds. Table 2 lists tubing volume and sample delay times for other tubing diameters and lengths. Note that at 3/16" i.d. and above, it may take a few minutes for the gas sample to reach the monitor for 100 ft of tubing. Using 1/8" and larger i.d. tubing does not cause significant pressure drop and therefore will not significantly affect pump life even at 100-ft lengths, while 1/16" i.d. tubing may cause pump strain at longer lengths. In any case, the Pump Stall Threshold should be set with any inlet extension tubing attached, to avoid excessive pump stalls.

25-ft. Extension Tubing
PN M070-3004-000

Table 2. Extension tubing volume and sample delay times

Tubing Inner Diameter			Tubing Volume		Delay Time (sec) at Lo Flow (240 cc/min) for tubing length of				Delay Time (sec) at Hi Flow (400 cc/min) for tubing length of			
inches	inches	cm	cc/ft	cc/m	3 ft	10 ft	30 ft	100 ft	3 ft	10 ft	30 ft	100 ft
					1 m	3 m	9 m	30 m	1 m	3 m	9 m	30 m
1/16	0.063	0.159	0.6	2.0	0.5	2	5	18	0.3	1	3	11
1/8	0.125	0.318	2.4	7.9	2	6	18	70	1.1	4	11	42
3/16	0.188	0.478	5.5	17.9	4	14	41	136	2.5	8	25	82
1/4	0.250	0.635	9.7	31.7	7	24	72	241	4	14	43	145
5/16	0.313	0.795	15.1	49.6	11	38	113	378	7	23	68	227

Use Inert (Teflon FEP) Tubing for Reactive Gases and VOCs

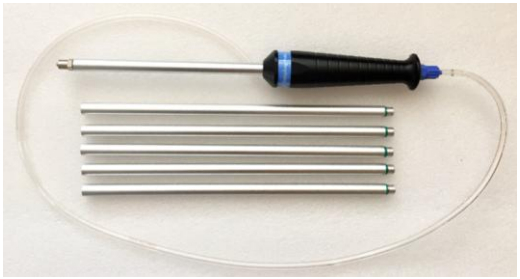
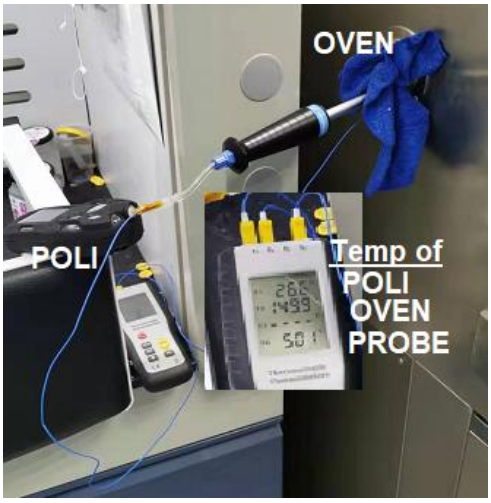
Tygon® tubing is suitable for POLI measurements of the standard 4 gases O_2/H_2S/CO/CH_4 LEL. However, inert tubing must be used for reactive gases such as Cl_2, ClO_2 and HCl and for adsorbable vapors like most VOCs. For example, 10 feet of Tygon® tubing will completely absorb diesel fuel, causing no PID response. mPower offers FEP-lined Tygon® tubing for this purpose because it combines the inertness of Teflon® with the handling flexibility of Tygon®. Where sharp bends must be made, Viton® tubing offers good inertness with high flexibility, albeit at higher cost. Glass or metal tubing can also often be used since they do not significantly absorb or react with VOCs or the standard 4 gases O_2/H_2S/CO/CH_4 LEL. In all cases of reactive or adsorbable gases, the shortest possible length of tubing should be employed, regardless of tubing type.

POLI Extension Probe

The POLI extension probe comes with 3 feet (1 m) of tubing for ease of handling, as shown in the image below. Up to five 1-foot (30-cm) sections can be attached for a maximum total length of 6 feet (2 m). There is no perceptible effect on sensor response time, even at the maximum length. For standard 4 gases O_2/H_2S*/CO/CH_4 LEL and PID measurements: there is no loss of sample because of FEP lining and aluminum surfaces do not absorb these gases. However, the probe cannot be used for acid gases like HF and HCl. When in doubt, check for sample loss by measuring with and without the probe attached.

* Note: longer lengths of aluminum tubing may affect H_2S concentrations.

POLI Extension Probe



The 1-ft hand probe can be used to cool hot sample gases such as stack gases up to at least 200°C (390°F). As shown below, a 150°C gas temperature is cooled to <27°C by the time it reaches the POLI, well below its operating maximum of 50°C. Adding extensions should allow even higher gas temperatures as long as the bulk of the probe is in a room temperature environment.