

Situation:

The rough pumps (first-stage vacuum pumps) of mass-spectrometers provide primary vacuum to the MS chambers; the turbo pump inside the instrument provides the second-stage, ultra-low vacuum.

The rough pumps used with most LC-MS systems: are large and heavy generate a lot of noise get very hot

Manufacturers recommend regular oil changes to prevent damage to the rough pump, and to prolong pump life. This warning is often neglected because changing the oil is difficult. As a result, rough pump lifetime is often shortened.

Why isn't the oil changed regularly? Oil finds its way to the outside of the pump, the pump feet, and the pump tray or floor, making a real mess. Leaking oil also makes the pump very slippery, which, along with the weight of the pump, makes it very difficult to pick up or move the pump for routine maintenance.

Multiple access covers allow reading of the pump oil level and oil drainage, as well as ballast adjustment. A step-on tilting apparatus and full-size oil pan allow oil to be effectively changed without moving the vacuum pump

Agilent has designed the Quiet Cover II for superior access to the pump, and allow simplified oil changes. It also reduces pump noise in the lab during use.



Benefits and user needs

Performance need	Advantage	Benefits
Foam-insulated cabinet and Stand-out Baffles	Reduced noise from vacuum pump	Improved working environment
Shock-absorbing design	Reduced noise and reduced vibration	Benefits as above; reduces vibration-bleed to other instruments
Twin cooling fans	Maintains pump operating temp.	Maintains pump life
Over-temp. alarm	Warns user of undesirable operating conditions	Longer pump/instrument life and more-reliable data
User need	Advantage	Benefits
Expanded-open-access cover	Fits E2M28 and E2M18 vacuum pumps	Versatility Can quiet all pumps in lab
Floating oil/drip pan	Contains oil leaks without pump sitting in oil	No oil on pump feet or enclosure
Deep-basin oil pan with double spouts	Holds full pump-change of oil; Allow ergonomic pouring without extra containers	Oil change occurs in enclosure; less strain on operator
Step-on-tilt bar	Easy tilt of pump for improved oil drainage	Makes oil change easy
Open-access cover	Multiple access options (door, access panels, full cover)	No need to remove or disconnect pump for reading oil level, changing oil, or setting ballast

Performance tests

Performance tests on the Quiet Cover II include determinations of noise reduction and temperature control.

Readings were taken in a quiet room with the use of a Sound Level Meter #452 from Scott Instrument Labs. Decibels were taken Readings were taken at fixed distances from the pump, at five different locations, as shown in the table. dB readings with background noise subtracted is also shown (background for this experiment was 47 dB_A). The mean reduction in dB increased consistently from a minimum of 6.6 to a maximum of 9.6 dB_A as location of the readings was increased from 1 ft to 1.5 m.

NOTE: The dB Scale is logarithmic; a change of 2 dB is readily noticeable; a change of 10 dB is perceived as half-as-loud!

Location (ft)	dB reading (A-weighted)		dB minus Room Noise		dB reduction by Cover	Room Noise
	No Cover	Cover with Foam	No Cover	Cover with Foam		
Supervisor	67	65	20	21	2.1	43
Site Supervisor	70	66	23	19	4	43
Op Switch	70	67	23	20	3	43
Sw	68	65	21	19	2	43
Top	68	61	21	14	7	43
Mean					3.3	

Location (ft)	dB reading (A-weighted)		dB minus Room Noise		dB reduction by Cover	Room Noise
	No Cover	Cover with Foam	No Cover	Cover with Foam		
Supervisor	65	64	21	20	1	43
Site Supervisor	67	65	20	19	1	43
Op Switch	67	65	20	19	1	43
Sw	67	65	20	19	1	43
Top	67	61	20	14	6	43
Mean					2	

Location (ft)	dB reading (A-weighted)		dB minus Room Noise		dB reduction by Cover	Room Noise
	No Cover	Cover with Foam	No Cover	Cover with Foam		
Supervisor	67	66	20	20	0	43
Site Supervisor	67	66	20	19	1	43
Op Switch	67	66	20	19	1	43
Sw	67	66	20	19	1	43
Top	68	65	21	14	7	43
Mean					3.3	

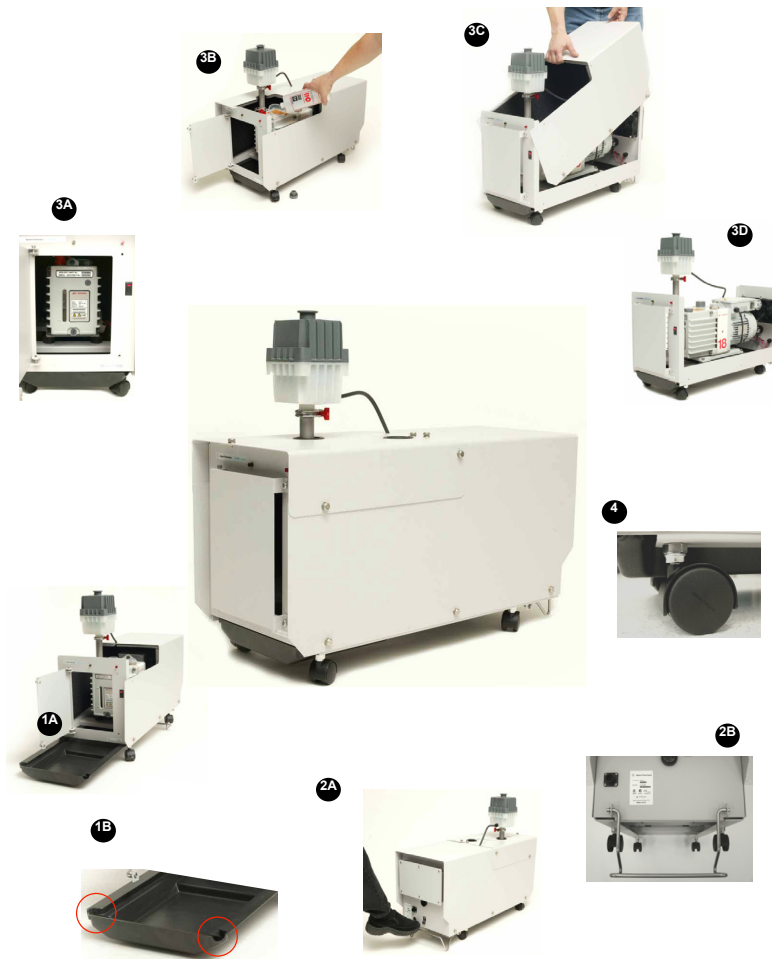
Performance testing on the temperature effects

The Quiet Cover II reduces noise in the lab, yet the temperature of the vacuum pump is kept at an acceptable level. The table below shows temperature readings taken at various locations in and around the pump while in a controlled-environment chamber.

The pump was installed in the Quiet Cover II. The chamber temperature was set to 30, 32, and 34°C, and temperature readings were taken at the same locations in two experiments. In general, temperatures track the chamber set temperature in 2°C increments. The thermostat area tracks about 7°C above the chamber, and the area over the pump at about 4°C above the chamber.

The most critical temperature is that of the pump oil itself (highlighted in yellow) since this indicates the temperature inside the pump. The data show oil temperature tracking approximately 30°C above the chamber temperature. In each of these elevated-temperature experiments, the pump oil temperature is kept safely below the 66.7°C reached by the pump oil in the reference experiment.

Ref.	Pump Conditions Uncooled chamber at 40°C	Temperature-Reading Location (Temp °C)			
		At Thermostat	Center over Pump	In Oil	Ambient
		40.6	43.9	66.7	40.8
Expt. 1	In enclosure, chamber at 30°C	36.2	34.7	60.1	31.0
	In enclosure, chamber at 32°C	39.6	36.1	61.4	33.1
	In enclosure, chamber at 34°C	41.4	38.0	63.7	35.1
Expt. 2	In enclosure, chamber at 30°C	37.2	33.8	58.5	31.2
	In enclosure, chamber at 32°C	39.1	35.7	60.7	32.9
	In enclosure, chamber at 34°C	41.0	38.1	63.5	34.9



Quiet Cover II Design Features

1. Floating oil/drip pan, deep basin, double spouts

The oil pan/drip pan was designed to reduce the mess from any dripped or splattered pump oil. The pan forms the bottom of the cover to catch all oil drips. The pan floats below the pump (without touching it, Fig. 1A) so that oil is kept away from the pump.

Oil changes can be performed in the Quiet Cover II without an additional container. The pan contains a large basin to hold the full contents of the pump. The pan may be easily slid out and either a left-handed or right-handed pouring spout (Fig. 1a, red circles) used to pour oil directly into a disposal container.

2. Lift-n-Tilt kickstand

The kickstand of the acoustic enclosure was designed from user input that the vacuum pumps are difficult to lift and drain of all oil. The kickstand was ergonomically designed to effortlessly lift the motor-end of the pump (Fig. 2A, 2a) so that oil is effectively drained from it.

OPTIMIZATION:

- Arm length and fulcrum angles of kickstand changed.
- Pivot-point moved from under enclosure to the back.

3. Open-access cover

The acoustic cover was designed to provide extremely good access to the pump for optimal maintenance. The Quiet Cover II has a flexible cover design that allows access to the pump from the door and from one or both of the access panels.

Oil levels are quickly checked using the door (Fig. 3A). Access panels allow adjustment of the ballast and addition of oil (Fig. 3a), as well as access to the vacuum tubing and filter. With full cover removed (Fig. 3c), the pump inside is fully exposed on three sides (Fig. 3b) for maintenance, installation, or removal. Because of the design, all this can be achieved without unplugging the power or breaking vacuum.

4. Rolling Castors

The Quiet Cover II is built on locking castors. Once the rough pump is installed in the Quiet Cover II, you can easily roll it out of your way, and easily bring it back for maintenance.

G3199B Quiet Cover II Compatibility

New G3199B Quiet Cover II Design accommodates:

- BOC Edwards E1M18 Used with Agilent Single Quad, Ion Traps
- BOC Edwards E2M28 Used with Agilent QQQ, Q-TOF, TOF
- BOC Edwards E1M28 Used with Agilent ICP-MS