

VACUU·PURE 10C

A Business Case for Vacuum in Chemistry Laboratories

Technology

- + maintenance free for life
- + corrosion resistant
- + significant operational cost saving
- + high vapor tolerance
- + replaces cold traps
- + no environmental impact through waste oil
- + 5×10^{-3} mbar ultimate vacuum
- + 9 m³/h pumping speed

Vacuubrand has developed the 'once-considered-impossible' fine vacuum pump suitable for chemistry use. A twin screw, 100% hydrocarbon free, non-compression, maintenance free, high vapor load tolerant design in a durable and robust package.



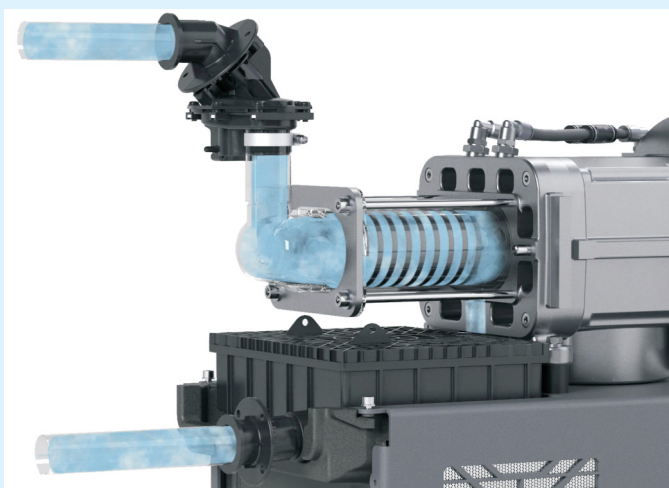
VACUU·PURE 10C is suited for processes in the vacuum range down to 10^{-3} mbar. Unlike other fine vacuum pumps, such as rotary vane and scroll pumps, VACUU·PURE 10C can be used from atmospheric pressure to its ultimate vacuum. Aggressive gases and vapours can be pumped in most cases, thanks to all media-wetted parts being made from high chemical resistance PEEK material. The use of a cold trap is no longer necessary in the vast majority of applications.

Vapour Compatibility

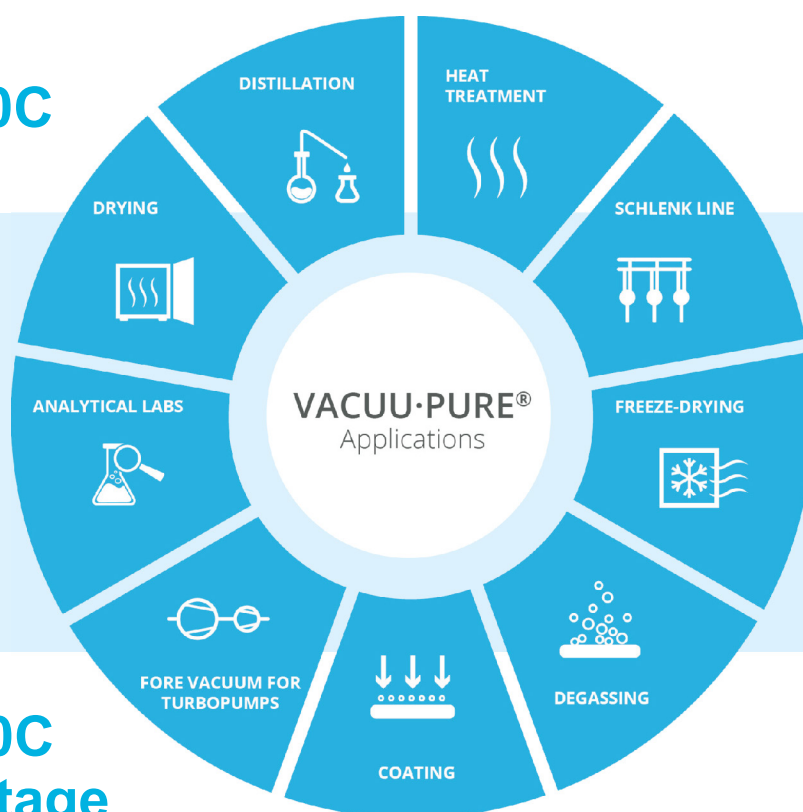
VACUU·PURE easily handles high vapour loads through its extraordinary condensate compatibility.

A gas ballast is entirely unnecessary, thus avoiding associated disadvantages, such as the reduction in pumping speed and an increase in noise levels. The integrated regeneration mode enables rapid drying of the sample throughput at the end of the process.

This allows sample throughput to be increased significantly as compared to other pump technologies.



VACUU·PURE 10C Applications:

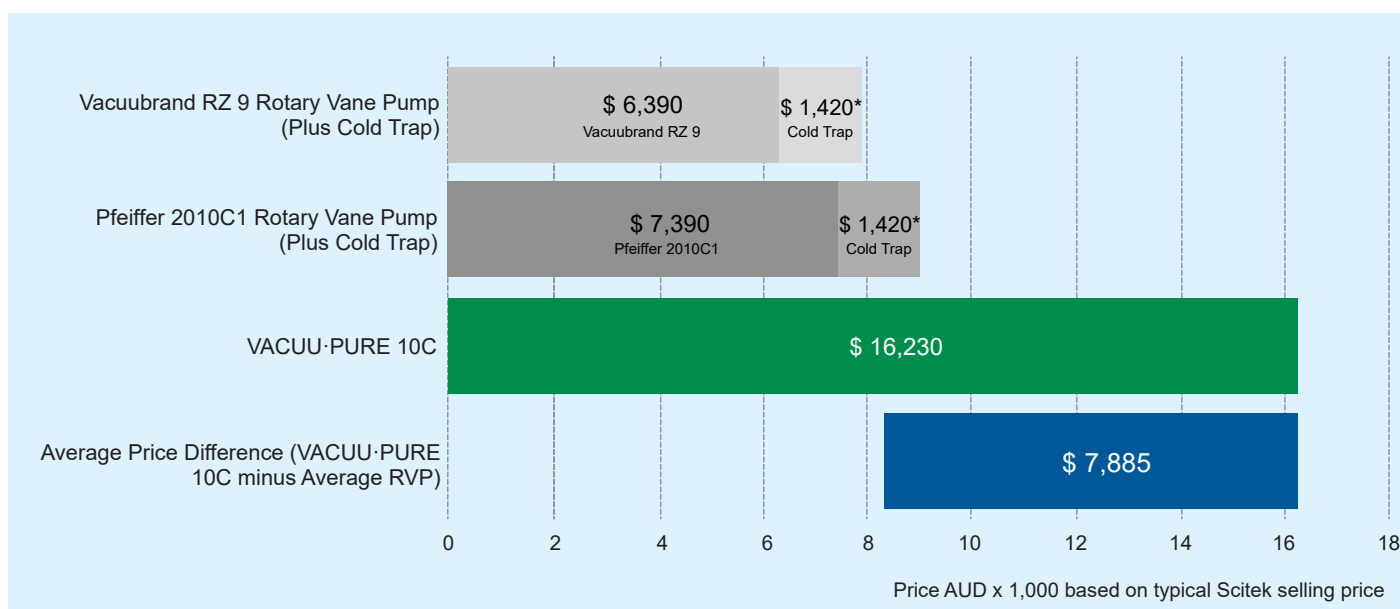


VACUU·PURE 10C Financial Advantage

VACUU·PURE has been designed to be maintenance free and consumable free for life. It can operate without cold traps offering you and your organisation substantial long-term saving potential on both service and pump protection. VACUU·PURE has sufficient pumping speed to often replace two pumps by servicing two applications at once.

Capital Investment (Purchase Price)

Here are some examples of popular “chemistry use optimised” rotary vane pump setups, inclusive of oil mist filters and cold traps, compared with VACUU·PURE 10C. For existing laboratory setups, the cost of liquid nitrogen cold traps may not apply.



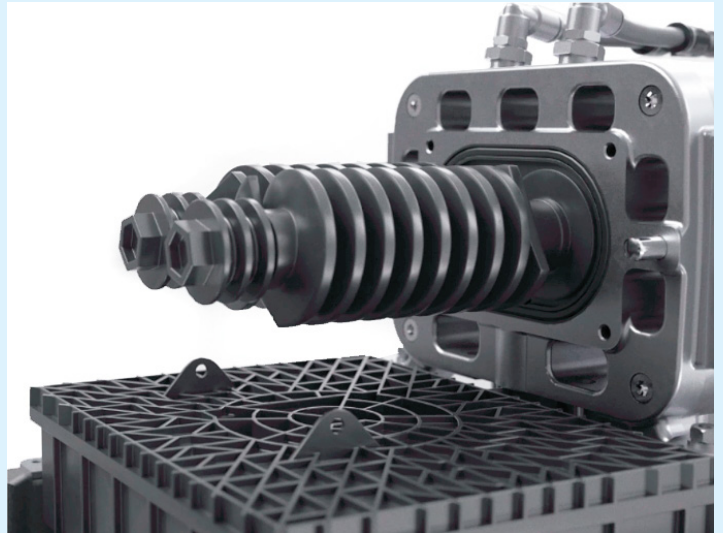
Operational Investment (Lifetime Cost)

Pump Service

What makes VACUU·PURE 10C so different from a rotary vane pump?

Rotary Vane Pumps are oil sealed pumps generally made from materials with poor chemical resistance, such as cast iron, mild steel, aluminum and basic elastomers. In general, oils used are standard hydrocarbon-based, which have low water and even lower chemical resistance. Contaminated and chemically degraded oil no longer lubricates or seals properly, causing poor performance and shortened pump life. When the pump is shut down, chemicals collected in pump oil and pump housing will corrode internal materials.

'Special version' pumps are available, which are made from stainless steel and use PFPE (Fomblin) oils, however these have a much higher investment cost and only offer marginal improvement against pump corrosion, especially when acids and strong corrosives are used by operators.



For rotary vane pumps, lifetime costs are calculated by adding the cost of oil changes and pump maintenance costs. Manufacturer guidelines recommend oil changes every 3 months in heavy chemistry use or whenever the oil is discoloured. In addition, the oil mist filter cartridge needs to be replaced once per year or whenever no longer efficient at collecting oil mist. A common service interval for rotary vane pumps is once every two years of life.

	Rotary Vane Pump Service Frequency per calendar year	Cost**	Annual Cost
Oil Changes	4	\$ 70	\$ 280
Maintenance Kit	0.5 (1 once every 2 years)	\$ 560	\$ 280
Oil Mist Filter Element	1	\$ 110	\$ 110
Service Labour	3 (6 hours every 2 years)	\$ 170	\$ 510
Annual Service Total			\$ 1,180

A typical rotary vane pump has a life expectancy of five years in a chemistry application.

Pump Protection

Liquid nitrogen is the most common coolant used in cold traps for vacuum pump protection. The cold trap is designed to collect corrosive gas and vapours, which become trapped as they freeze on the cold finger surface. Cold trap coolant gets used up over time through heat load from the process gas and vapours as well as natural ambient evaporation. In typical laboratory use, liquid nitrogen coolant lasts anywhere from a few hours to half a day.

Commonly a cold trap holds between 500 mL and 2L of coolant. For simplicity in our calculation we are using 1L filling volume.

Prices for liquid nitrogen vary hugely based on your annual purchase volumes. The official web shop price of BOC is \$5,46 per litre as of 9. November 2020. However, some of our customers have shared with us prices as low as \$1 per litre***.

Assuming 3 cold trap fills per working day at \$1 per litre, we end up with annual cost of

$$3 \times \$1 = \$3 \text{ per working day} \times 250 \text{ working days} = \$750$$



Combined Annual Rotary Vane Pump Operating Cost

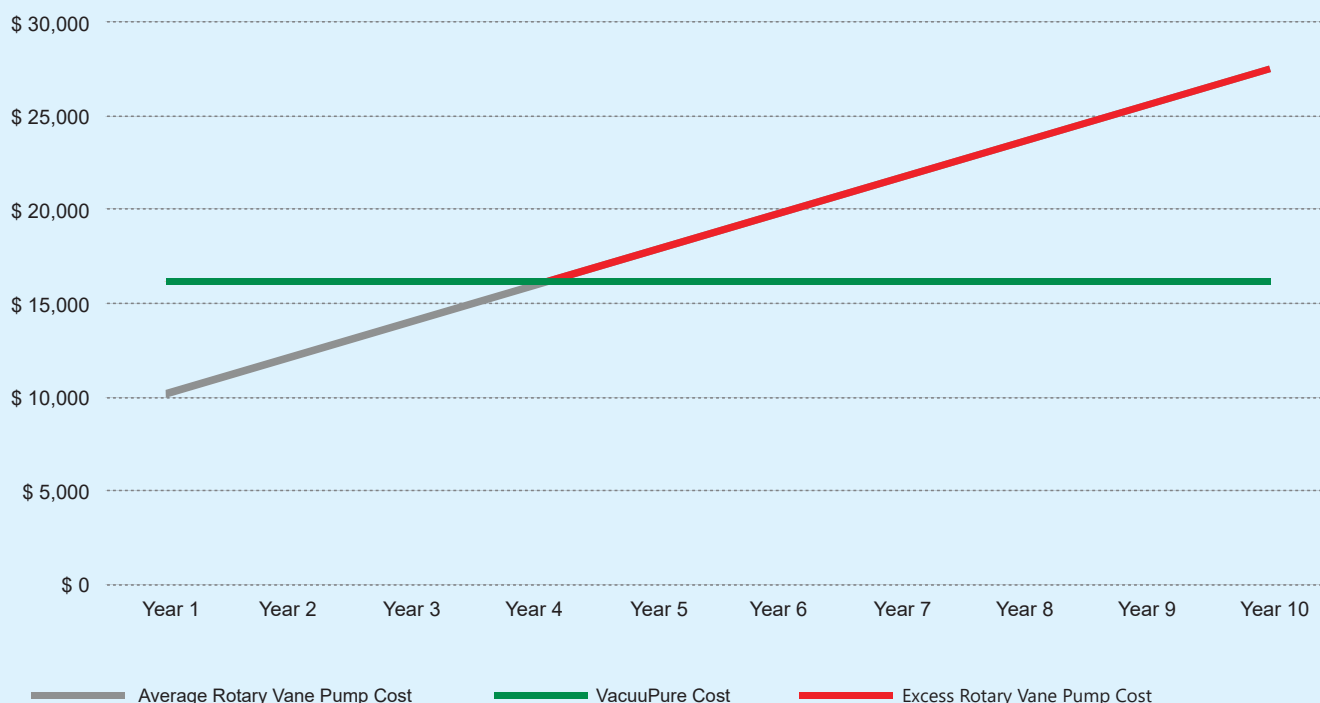
Oil Changes & Service	\$ 1,180
Pump Protection	\$ 750
Annual Operating Cost	\$ 1,930

VACUU·PURE 10C Break Even Period Calculation

To calculate the investment break even period we need to consider the buy price difference as well as the operation cost.

Buy Price Difference \$ 7,885 / Annual Operating Cost \$ 1,930 = 4 years.

Break Even Illustration



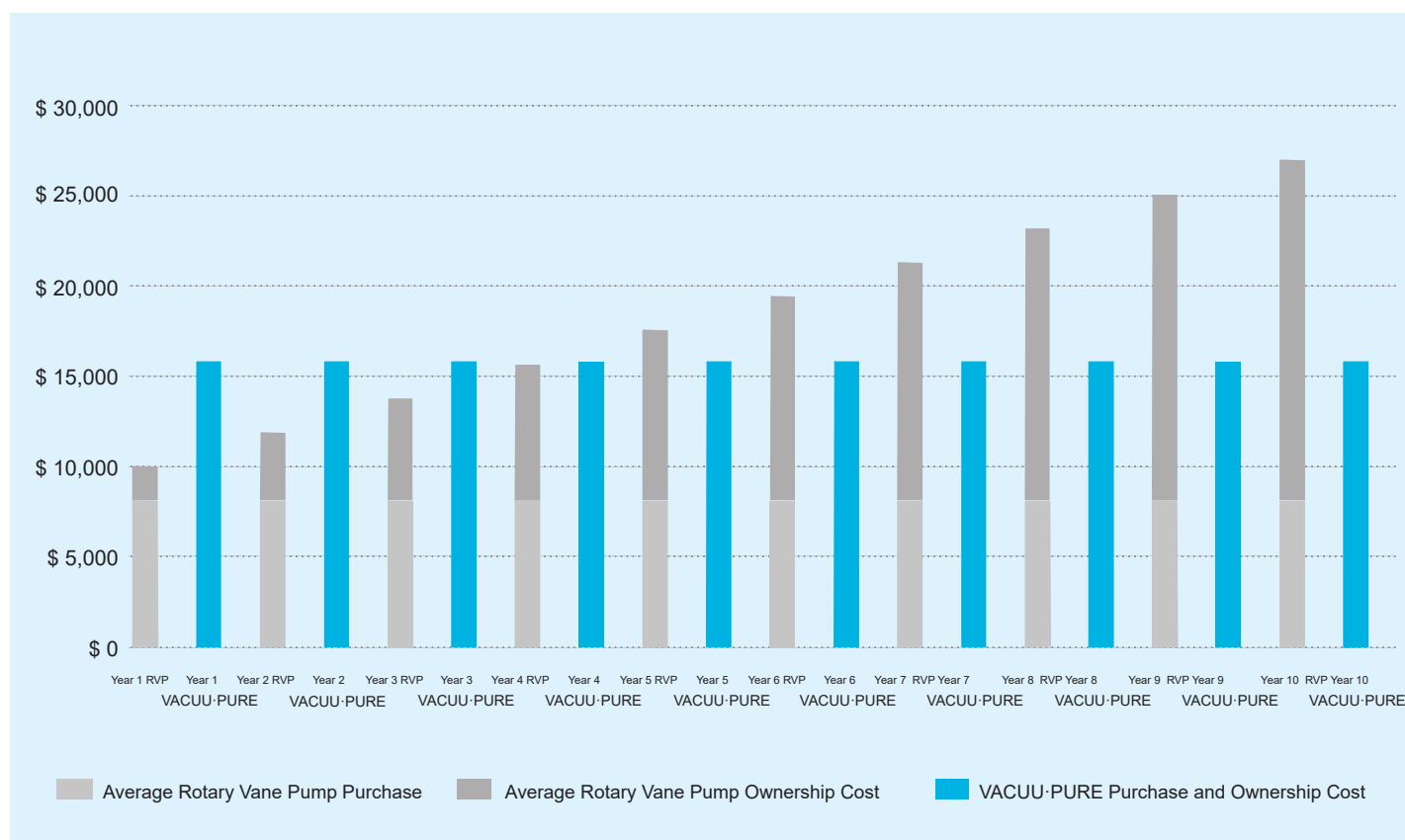
The additional upfront investment into VACUU·PURE 10C saves significant money from year 5 onwards.

How much can you save over the lifetime of your VACUU·PURE 10C?

At this time, Vacuubrand expect for VACUU·PURE 10C to operate in excess of 10 years typical chemistry laboratory use, with long term testing already beyond 40,000h continuous operation.

If your VACUU·PURE 10C was to work for 10 years, then it would save you a total of Annual Operating Cost \$ 1,930 x (Additional Years Expected Pump Life) 6 years = \$ 11,580 over its life.

Keep in mind that within this timeframe, you are most likely going to have to replace your rotary vane pump at least once, so the total saving potential here is close to \$20,000 over the life of your pump.



Fast-Track your Break Even Period

VACUU·PURE 10C has 9 m³/h pumping speed, which is approximately 2x – 4x more than your typical rotary vane pump used on Schlenk lines and similar applications. With the assistance of a vacuum connection splitter you can easily connect 2 applications to your VACUU·PURE 10C. **This would effectively half your investment cost, half your break-even period and double your overall savings!**

Intangible Cost

In addition to the tangible payback period calculation, take a moment to think on these 'hidden costs' and "inconveniences" in your environment.

Time lost for frequent cold trap refills, say 5 min each time
(including preparing yourself with PPE) 5 min x 3 per day x 250
days = 3,750 min or 225 hours per year

Time lost to refill your lab storage dewar from the central LN2
tank
20 min x 2 per week = 50 weeks = 33 hours per year

Significant WHS risk for handling of LN2

Experimental progress lost in shutting down experiments, that
you can't run overnight or over the weekend

Inconvenience if your pump ceases to operate mid-experiment

Environmental impact and cost of waste oil disposal



Data Sources *Sigma Aldrich Australia online shop November 2020, ** Scitek service price guide, *** Information provided by University of Queensland.

