

Reliable vacuum pump supports remote atmospheric monitoring

In line with the **Global Atmosphere Watch (GAW) Program**, new equipment has been installed in a lighthouse on Gozo, part of the Maltese Islands in the central Mediterranean Sea. These new measuring and monitoring devices will be used for meteorological monitoring as well as to upgrade the detection of different components of the atmosphere, from trace gas to radioactivity. As one of the 300 regional stations around the world, Ta' Gordan Lighthouse is a remote site with very limited vehicular access, so the reliability of the equipment is of the utmost importance.



The **Global Atmosphere Watch (GAW)** programme of WMO is a partnership involving 80 countries with the intention to observe the global atmosphere. It consists of a world-wide monitoring network with 300 regional and 26 global measuring stations. These stations provide reliable scientific data and information on the chemical composition of the atmosphere, its natural and anthropogenic change, and help to improve the understanding of interactions between the atmosphere, the oceans and the biosphere. The scientific assessment allows early warnings of changes in the chemical composition and related physical characteristics of the atmosphere that may have adverse effects upon our environment.

The intention of the Global Atmosphere Watch is to understand and control the increasing influence of human activity on the global atmosphere.

Among the grand challenges are:

- The ozone depletion in the stratosphere and the resulting increase of ultraviolet (UV) radiation;
- Climatic and weather changes related to human influence on atmospheric composition, especially greenhouse gases, ozone and aerosols;
- Risk reduction of air pollution on human health and issues related to long-range transport and deposition of air pollution.

On the Northwest tip of the island of Gozo, part of the Maltese islands, there is a remote background atmospheric monitoring station, known as Ta' Gordan lighthouse, that is part of the GAW. It is only 800 metres from the northern shore of the island, 170 metres above sea level, and exposed to prevailing winds from the Northwest. The equipment of this station has recently been upgraded. The parameters being monitored are SO₂, NO_x, O₃, Radon 2-22, particulate matter and nano-particles. Gordan Lighthouse is the only station that is able to monitor long-range transport of pollution into the area from as far away as the US and Southeast Asia.

Two companies have been awarded the order for the supply of the new monitoring devices as a turnkey project: Joseph Cachia & Son Ltd (JCS), a Maltese company that is mainly a contractor for infrastructural projects in the fields of energy, environment and security; and Air Monitors, a UK company specialising in air quality monitoring. Together, these companies were able to provide all the required instrumentation, and integrate all the data with one comprehensive data management package.

As all the instruments are running 24 hours per day and 365 days per year, reliability is a concern, especially for moving parts that are subjected to normal mechanical wear and tear. The vacuum pump needed for the CO analyser has been identified as one component that is potentially critical to system reliability for this measuring device. The task of the vacuum pump is to draw down the vacuum below 10 Torr, and safely hold it there while pumping the required process gases (35ml/min of an argon gas mixture, 35ml/min nitrogen and the required continuous air flow of 2.5l/min of environmental air) that need to be measured. Furthermore, the pump should run very quietly and with low vibration levels so as not to affect the other instruments. Most importantly, the pump needs to run virtually free of maintenance, while keeping the pumping parameters constant. The air flow is kept constant by means of a critical jet nozzle at the appropriate pressure difference.



Based on these specifications, Air Monitors was looking for a diaphragm pump that was oil-free and clean-running, with much lower service demands than rotary vane pumps. An advantage of diaphragm pumps over scroll and piston pumps was that diaphragm pumps don't have sliding seals that are exposed to abrasion and can release particulates. Conventional diaphragm pumps with constant motor speed often have specified maintenance intervals of less than 5,000 hours. In many cases, their flow rate decreases from specification after some months of run-time and the ultimate vacuum capability also becomes worse. Variations in the pump performance may result in the need to recalibrate the measuring instrument more often, or lead to false results.

Air Monitors settled on the VACUUBRAND MD 1 VARIO® pump for this application. VACUUBRAND uses a specific diaphragm design to minimize performance deviations for prolonged periods. Actual long term test results of VACUUBRAND MD 1 diaphragm pumps document a service-free lifetime of more than 40,000 hours, which leads to fully maintenance-free operation in many applications. As shown in diagram 1, the VACUUBRAND test with six diaphragm pumps shows outstanding lifetime, with pumping performance of all six pumps remaining better than the specification limit over the whole 5-year test period. Even the small deviations of the ultimate vacuum of some 0.1 mbar visible in the diagram are more likely caused by the measuring devices than from the pumps.



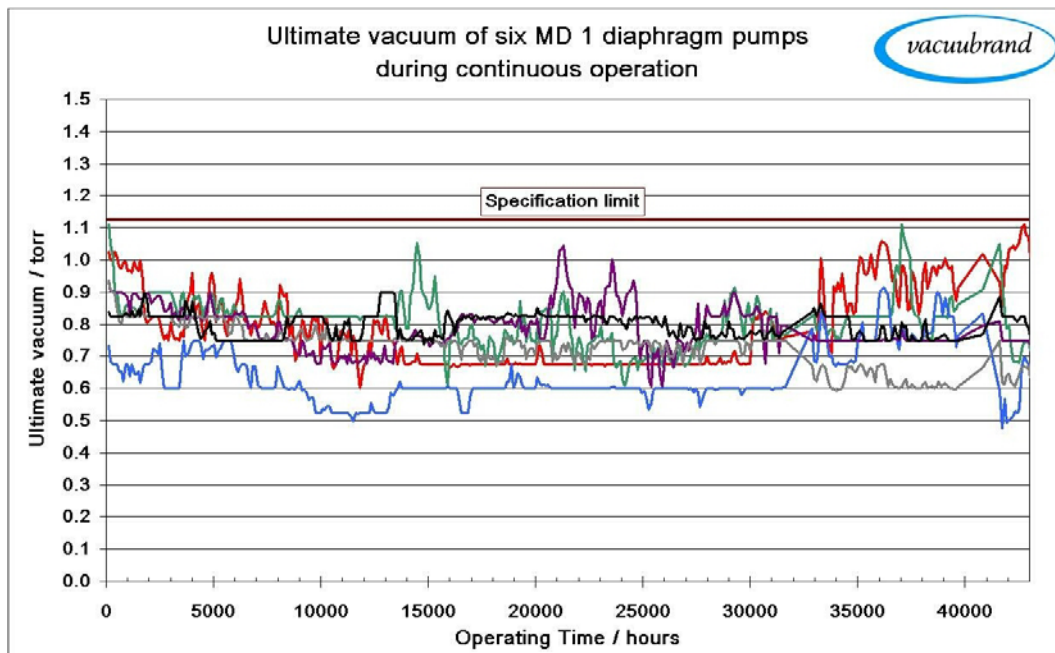


Diagram 1: Ultimate vacuum of six Vacuubrand MD 1 diaphragm pumps during five years continuous operation

For the CO monitoring instrument, the vacuum pump MD 1 VARIO® model has huge performance reserves. The VARIO® model of the pump includes speed control that permits a significant reduction of the motor speed when not needed to maintain vacuum levels. As a result, fewer strokes per unit time are needed, and the durability of the diaphragm is increased drastically, even beyond that of the MD 1 pumps tested at constant motor speed. Service intervals will be extended proportionally. By decreasing the motor speed, the already low vibration and noise levels are reduced further and the energy consumption declines, as well. Heat emission to the measuring room is consequently reduced to a minimum.

Conclusion

In applications like air monitoring in a remote measuring station with limited vehicular access, the reliability of the devices is of utmost importance. In this GAW application, modern diaphragm pumps with variable motor speed and proven constant performance over an extremely long period of time supported these reliability objectives. Low noise and vibration levels from the pumps contributed to the compatibility of these instruments with others at the station. Excellent energy efficiency is an additional benefit.