PRESSEINFORMATION
PRESS INFORMATION

LEWA Condition Monitoring System (CMS) provides plant operators with a clear insight of pump operating parameters.

Process Diaphragm Pumps: Intelligent Condition Monitoring System offers early warning of deteriorating performance and reduces downtime by planned, condition oriented maintenance not pump failure.

All dynamic mechanical action is subject to wear – levels of wear depend on operating conditions, operating periods and, like any mechanical device, LEWA process diaphragm pumps require maintenance and repair work. The important question is raised: *When is the right time for these tasks?* The intelligent CMS from LEWA answers this question for pump operators and, most importantly, offers the answer before pump malfunction occurs.

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When critical fluids and suspensions have to be injected or metered in the high-pressure processes typical of the oil and gas industry, there are very few pumping alternatives. The state-of-the-art, hermetically sealed, process diaphragm pumps (Fig. 1) offers the best available option. These pumps achieve delivery pressures of up to 1200 bar and pump up to 200 m^3/h. Typical oil and gas industry applications are methanol injection or the re-injection of carbon dioxide.

The functionality of piston and diaphragm pumps is basically the same. The diaphragm pump, however offers increased safety as a result of the use of zero leak, hermetically sealed diaphragms. Hydraulic liquid is used to transfer the oscillating movement of the piston to the diaphragm, and thus to the fluid being pumped. The diaphragm separates the pumped fluid and the hydraulic liquid, seals the fluid chamber and prevents leakage. PTFE or metal is commonly used as the diaphragm material.

The design and construction of these pumps makes them extremely safe and reliable. If the plant process and the diaphragm pump are accurately matched and there are no critical deviations from the reference data during operation, this type of unit will function reliably over a long period of time.

Rapid recognition of error conditions

With the increase of plant automation, a current trend in the process industry and maintenance personnel reductions plant engineers will increasingly rely on automated equipment condition monitoring, especially when handling hazardous fluids. International occupational and environmental protection regulations are becoming more stringent and will be mandatory in the near future.

Financial considerations are always an important factor in the selection and evaluation process. It is estimated that 70% of the pump operating costs are a result of expenses incurred during unplanned downtimes. The initial cost of a pump can be insignificant when compared to the cost of lost production due to pump failure. The output of an oil and gas industry plant is often valued at millions per day making availability of central components, such as pumps highly critical. This is one of the reasons why operators are recognising that pumps equipped with a condition monitoring system are a possible key to preventing unplanned plant shutdown.

No question about it: Pump maintenance is required at some point – but if plant operators (with the aid of continuous monitoring) are able to recognise maintenance requirements at an early stage and, if necessary, delay the maintenance process, they can continue production for longer and reduce the down-time by having only required parts available and not having to inspect all parts for wear or damage and significantly increase the plant's cost effectiveness.

Cost effectiveness: In general, all the providers of monitoring and early error detection systems have a similar problem when marketing their product: They always mention the qualitative higher equipment availability and short period to amortize the monitoring equipment cost, but fail to provide quantitative evidence. No pump manufacturer could relate the exact downtime costs to a customer. Plant operators are required to consider their own financial situation and can estimate, depending on the process, what loss of production can cost. From this estimate a plant operator can approximate that a system, designed to prevent unplanned downtimes, will pay for itself in a short space of time.

For example, in Norway the malfunctioning of a CO_2 process pump, used to pump more than 90t of liquid carbon dioxide per hour back into deeper rock layers during liquid gas production, resulted in downtime costs of $6,000 /hour, just in taxes. This occurred because Norway, which has ratified the Kyoto Protocol, raises a penalty tax if CO_2 is emitted into the atmosphere. This example shows that in certain critical situations the amortization on high-cost monitoring solutions takes less than a few hours.

Condition Monitoring System: The eyes and ears of the operator

Intelligent CMS enables operators to monitor current operating conditions. These operating conditions are then compared to the initially programmed "prime" conditions, the prime conditions are those determined when the pump is new. If the two conditions indicate a deviation trend, it is possible to conclude the future operating condition of a machine or plant. Appropriate physical values are additionally recorded and interpreted taking the current operating conditions into consideration.

The most probable fault sources of process diaphragm pumps are the typical wear parts (Fig. 2): The fluid valves on the suction and pressure side, the dynamic seals (e.g. piston seal) in the hydraulic drive, and the diaphragm. These components are monitored continuously by the CMS.

Fluid valves

Depending on the fluid being pumped and the operating conditions, the fluid valves are subject to varying degrees of wear. In the course of time, backflow will occur, reducing pump efficiency. Further wear will result in basic fluid valve malfunction; for example, if a valve is unable to open and close correctly flow reduction or stoppage will result. Malfunction can also occur without wear if, for example, sediment suspension caused by insufficient flow rate restricts valve movement.

In order to ascertain the condition of the pump head, the impact sound of the fluid valves and the pressure in the hydraulic chamber is measured and evaluated. The pressure signal curve graphically displays the pump's hydraulic profile and provides an experienced engineer with valuable information on the condition of the pump head. If a fluid valves leak, the compression and decompression speed changes. However, a significant change in the pressure curve only occurs after a leakage of approximately 10%, i.e. when the amount of fluid backflow reduces pump efficiency by 10%. The impact sound signal is more sensitive: Measurement of the impact sound events in the pump head can be compared to the work carried out by an experienced pump engineer who is able to detect noise at the pump head via a stethoscope. Leakage rates as low as 1% can significantly change the impact sound signals, which are evaluated with the aid of a computer (Fig. 4). At higher the pressure, the signal sensitivity is greater and consequently the detectable leakage rate is smaller. The concept of the LEWA CMS is based on a single, centrally mounted impact sound sensor. The central location of the impact sound sensor enables identification of suction and discharge valve sound events assisting in prompt identification of potential problems.

Hydraulic leakage
Hydraulic leakage between the pressurised hydraulic chamber and the hydraulic reservoir is continuously checked, e.g. via the piston seal. If hydraulic leakage occurs, the diaphragm reaches its rear contact surface earlier than in the prime condition. Therefore, the time for the leakage as well as the duration of the characteristic pressure loss at the end of the suction stroke is extended. The length of this time window can be evaluated with the aid of a computer.

Diaphragm
The diaphragm is also a wear part and has to be replaced at regular intervals. Modern diaphragm pumps are equipped with a sandwich diaphragm with two diaphragm layers. If one of the diaphragms is worn and damaged, the pump remains hermetically sealed and can continue to be operated for a limited period. Possible damage to a diaphragm layer is displayed by increased pressure in the diaphragm intermediate space. This increased pressure is sensed by a pressure switch or pressure transmitter and signalled to the LEWA CMS

Prime condition is programmed on site
The Condition Monitoring System LEWA CMS (Fig. 5) monitors the operating parameters with the following sensors:

- An impact sound sensor, mounted to the front of the pump head
- A pressure sensor which records the pressure in the hydraulic chamber.
- An inductive position sensor as the trigger signal at the crank mechanism
- A pressure switch for diaphragm monitoring.

The numerous possible operating conditions of process diaphragm pumps (varying fluids, delivery pressures and flow rates) result in various physical phenomena during operation.

Therefore, the system concept stipulates that during initial start-up of the new or overhauled pump a "prime condition" has to be programmed and saved. During subsequent operation, the current condition is compared with this "prime condition". The operator sets system sensitivity, i.e. which level of deviation results in a warning or error message. The system recognises three operating conditions "Operation OK", "Warning" and "Error".

Communication: LEWA CMS PC Connection
The newly developed PC connection makes it possible to communicate the monitoring system parameters to a central process or maintenance control system. An explosion-proof version is also available for application in hazardous areas. Data transfer via Intranet or Internet of up to 32 LEWA CMS devices can be connected to a central PC via an RS485 or Ethernet interface. In addition wireless remote data can be transferred via GPRS, GSM or UMTS standards (Fig. 6).

Communication between the PC and the LEWA CMS occurs via an XML-based bus protocol. Control of the CMS device is carried out at the PC by the CMS control program. Remote control occurs via an easy-to-operate interface which provides all the functions of the LEWA CMS membrane keypad. The remote control allows you to view, online, any error messages as well as the current measured pressure and impact sound.

The XML-compatible data format makes it possible to open downloaded measuring data files directly with MS Excel at a PC. No additional, special software for measured value analysis is required (Fig. 7).

An Excel macro is provided to ensure user-friendly operation. The macro displays the measured data files in a concise manner on various sheets enabling the operator to assess the condition of a machine at a glance.

A user who requires more details can view the pump's indicator diagram on further excel sheets. The indicator diagram is effectively the pump's Electro Cardio Gram (ECG). Just as a doctor uses an ECG to determine the condition of and possible risks to a patient's heart, an experienced engineer can, by means of the indicator diagram, judge the condition of the pumps.

The measured data records can be emailed and enabling remote diagnosis at the LEWA factory or any other experienced facility. If changes occur at a pump, a LEWA specialist can be contacted at any time via Internet to provide a qualified analysis.

Summary
The LEWA Condition Monitoring System (CMS) for process diaphragm pumps enables the monitoring of potential pump faults. By progressing from a “preventive” (fixed service intervals) to a “condition-oriented” maintenance procedure it is possible to cut maintenance costs without increasing the risk of unplanned downtimes. This results in important advantages for the operator:

- Production losses are reduced, since downtimes can be scheduled and replacement parts made available.
- Potential failures are recognised at an early stage, allowing planned action instead of unplanned reaction
- Parts only have to be replaced when their condition demands it
- Oriented maintenance due to clear and accurate condition diagnoses
- Cooperation with the pump supplier’s service department is optimised

The Condition Monitoring System LEWA CMS is a measuring and diagnosis tool which enables the acquisition of data relating to the operational quality of the plant. Data and evaluations can be transferred directly to a PC and subsequently made available to a global audience via Intranet or Internet.

A major difference to other monitoring systems: LEWA CMS does not report ***after*** a damaging event, but uses error messages to warn operators **in advance** of potential wear. This proven field technology considerably reduces production downtimes.

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Figure proposals press information pump monitoring CMS

Figure 1: LEWA process diaphragm pump.

Process_diaphragm_pump_LEWA.eps
Process_diaphragm_pump_LEWA.jpg

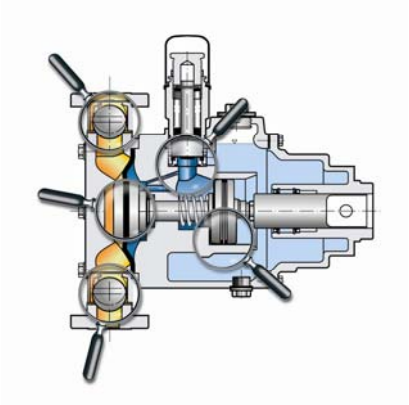

Figure 2: LEWA CMS: Monitoring and diagnosis tool for all function- relevant components.

Pump_head_LEWA.eps
Pump_head_LEWA.jpg

Figure 3: LEWA CMS: Accurate early error detection

CMS_device.eps
CMS_device.jpg

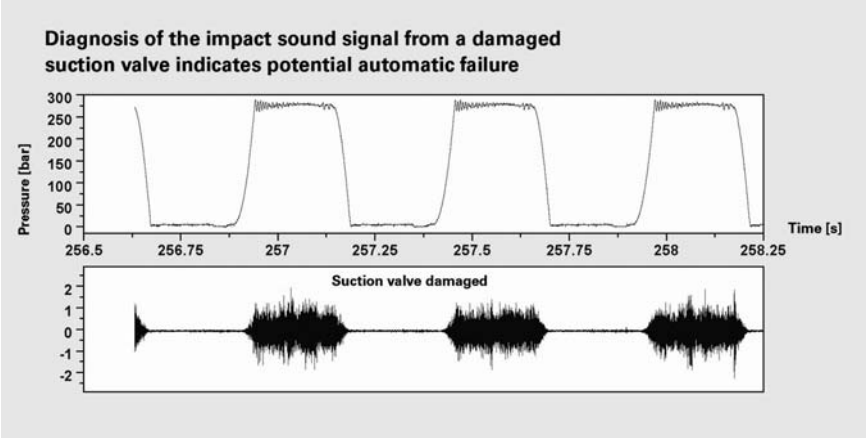

Figure 4: Fluid valve leakage can be detected via impact sound.

Diagnosis.eps
Diagnosis.jpg

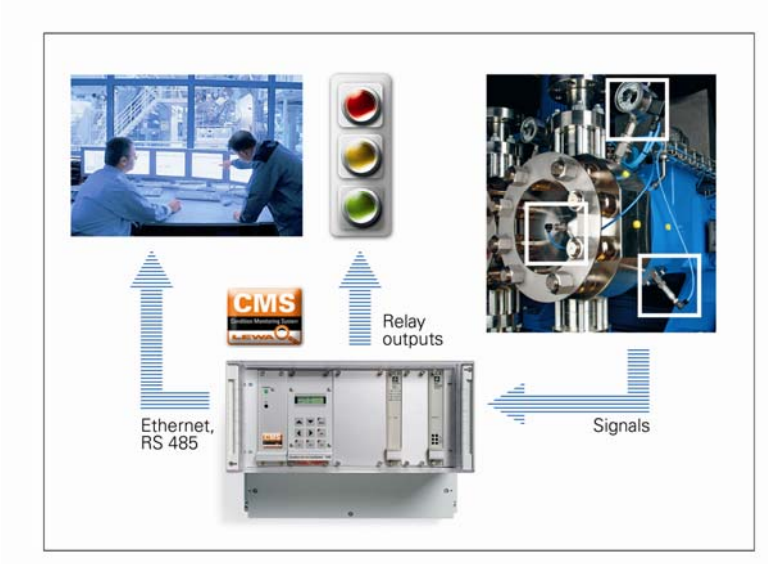

Figure 5: LEWA CMS detects deviations from the reference, prime condition and thus reduces production downtimes. Moreover, this type of system reduces the cost of routine maintenance associated with extended service life and raises safety levels.

CMS_action.eps
CMS_action.jpg

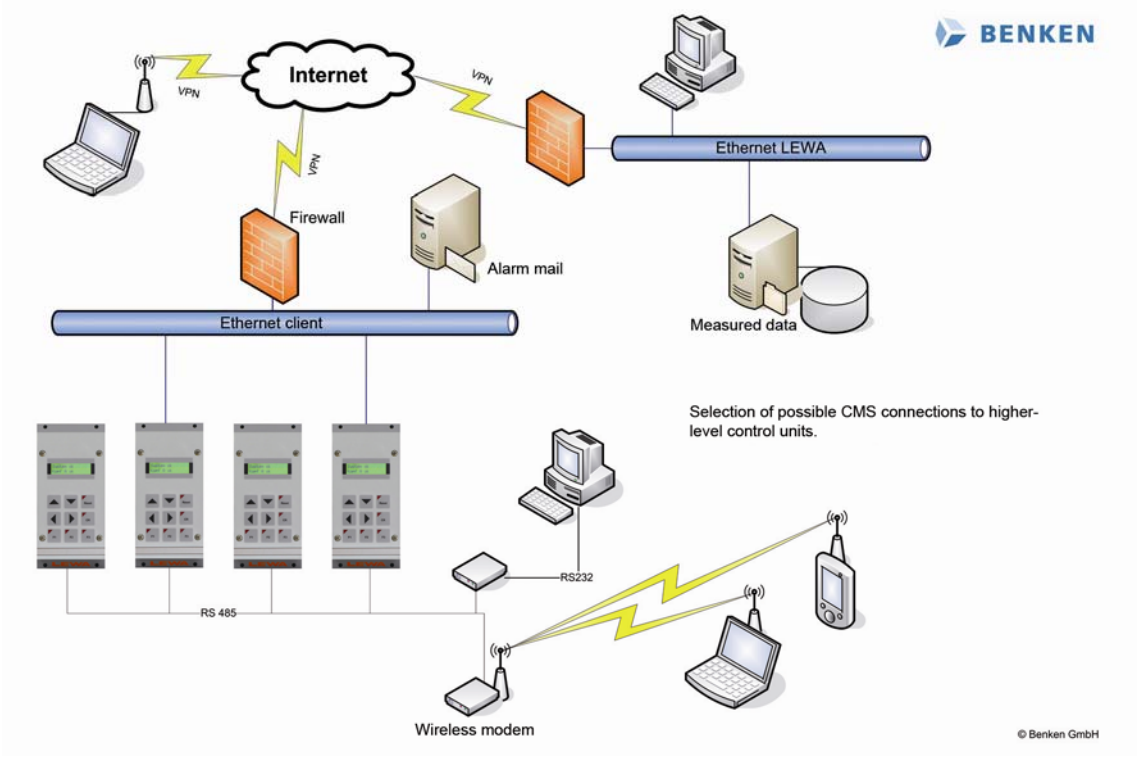

Figure 6: Possible Condition Monitoring System connections

Possible_CMS_connections.eps
Possible_CMS_connections.jpg

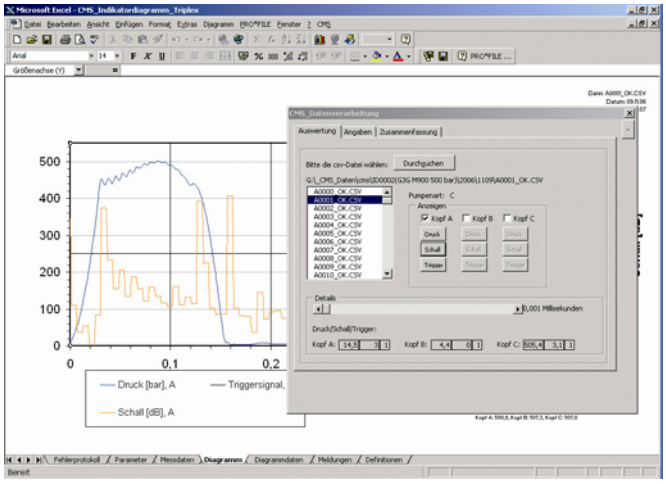

Figure 7: The XML-compatible data format makes it possible to open measuring data files that have been downloaded from CMS directly with MS Excel at a PC. No additional or special software for measured value analysis is required.

XML_compatible.eps
XML_compatible.jpg

Image data / File names / Files:

Process_diaphragm_pump_LEWA.eps
Process_diaphragm_pump_LEWA.jpg

Pump_head_LEWA.eps
Pump_head_LEWA.jpg

CMS_device.eps
CMS_device.jpg

Diagnosis.eps
Diagnosis.jpg

CMS_action.eps
CMS_action.jpg

Possible_CMS_connections.eps
Possible_CMS_connections.jpg

XML_compatible.eps
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