

PRODUCT RANGE.

Horizontal pumps

with hydrodynamic shaft seal
up to the dry-running magnetic drive

Vertical pumps

- for dry installations, short design
- for wet installations,
without bearing in the liquid
- for wet installations,
with rolling bearing independent of product
- with feeder propeller
for space-saving installation

Tank pumps

with intake from above

Horizontal- and Vertical pumps

- with semi-open impellers
- with closed impellers
- with torque flow impellers

Downstream seals

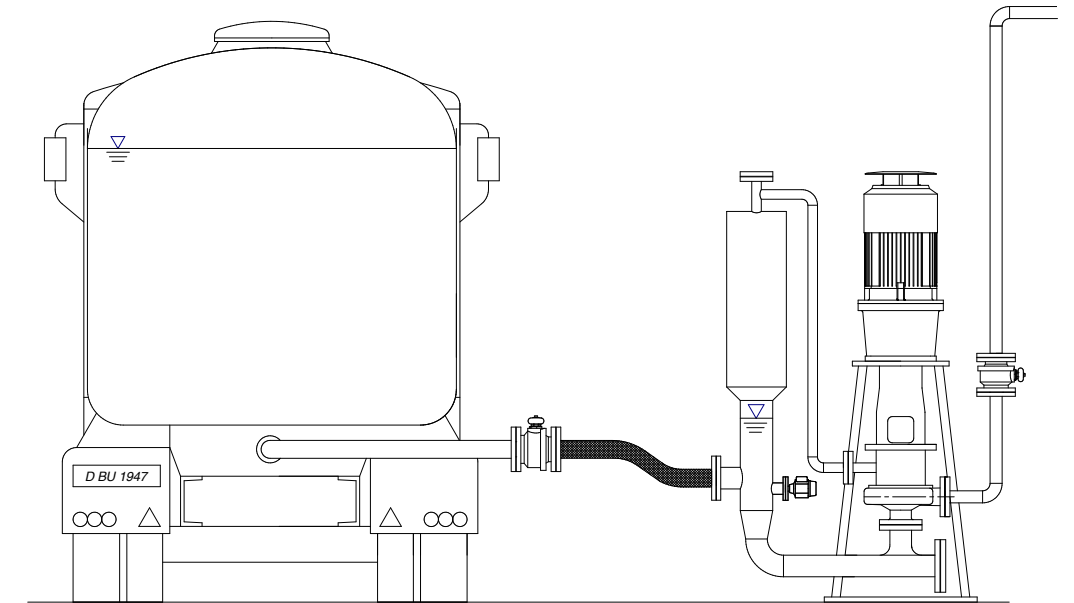
for pumps with hydrodynamic relief of the shaft gap

- gland packing
- mechanical seal
- magnetic drive
- particular solution for problem cases

**Comprehensive information about
each type of pumps is featured
in individual product brochures.**

MATERIALS.

- all castable and weldable stainless steel qualities
- castable and weldable special alloys
- grey cast iron, rubber lined
- special materials such as titanium, zirconium, etc.



BUNGARTZ
CENTRIFUGAL PUMPS
UNLOADING SYSTEMS

PAUL BUNGARTZ GMBH & CO. KG

Düsseldorfer Straße 79
40545 Düsseldorf, Germany
T +49 211 57 79 05-0
F +49 211 57 79 05-12
www.bungartz.de
pumpen@bungartz.de

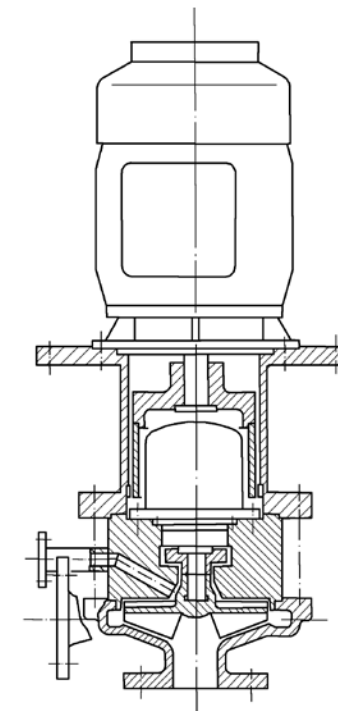


Pars Marine Industry Co. official representative of Bungartz in IRAN

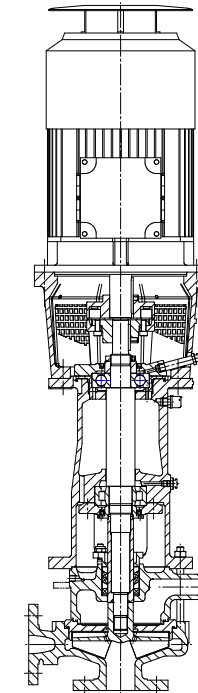
NO EMPTY PROMISES. THE SELF-REGULATING PUMP V-AN.

One of a pump's most ambitious challenges is the complete unloading of tanker trucks and tanker wagons. Highest requirements must be fulfilled in terms of explosion protection and Germany's Technical Instructions on Air Quality Control (TA-Luft). Here, the intrinsically safe V-AN pump has proved to be absolutely perfect even under boiling conditions if, for instance, liquefied gases are involved. Due to its hydraulic control and a sealing concept adjusted to the specific applications, its operation needs only minimal monitoring.

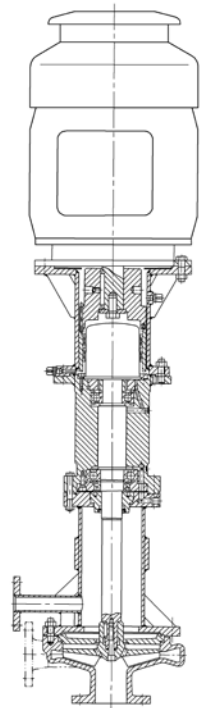
The principle is quite simple to explain. It is based on pressure balance between the pump impeller and the feed vessel. This means: The V-AN delivers the product depending on the inlet flow rate and automatically reduces the feed rate. This is important when, for instance, the tanker truck is almost empty. And that's not all: A pressure drop at the impeller is prevented at any time. Thus, the NPSH value of the pump is almost zero.



MPVAN



VK-AN



MPCVAN

The V-AN is also suited for unloading from above, e.g. of heavy liquids, such as oleum and zinc tetrachloride. In the suction vessel to be provided to this end, the pressure may be reduced down to boiling conditions.

If the V-AN is used together with separators, such as vacuum belt and rotary filters, centrifuges and decanters, it even works without suction container and dry-running protection. Then, the pressure balance makes it possible to directly extract the product from the vacuum without any barometric tail pipe being required even at low suction heads of mostly less than one metre.

PROPERTIES.

- safe to run dry
- intrinsically safe in terms of sealing and ATEX requirements
- NPSH close to zero: complete unloading is possible even under boiling conditions
- automatic reduction of the feed rate when the tanker truck is almost empty
- complete unloading of the systems without the risk of dry running or cavitation

DESIGNS.

MPVAN with magnetic drive and liquid-lubricated slide bearings

VK-AN with hydrodynamic shaft sealing and downstream gland packing, double mechanical seal or gas-sealed lip seal

MPCVAN with dry-running magnetic drive

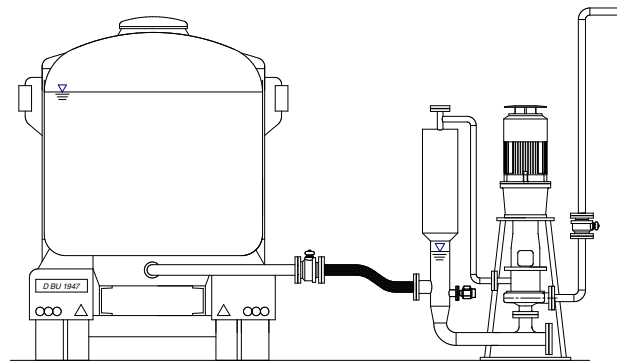
UNDER SEAL.
THE DRY-RUNNING
SHAFT CLEARANCE
SEAL.

The quality of a pump crucially stands and falls with its seal. The V-AN series is equipped with a powerful shaft seal. This seal consists of individual components which, in their interaction, guarantee highest safety.

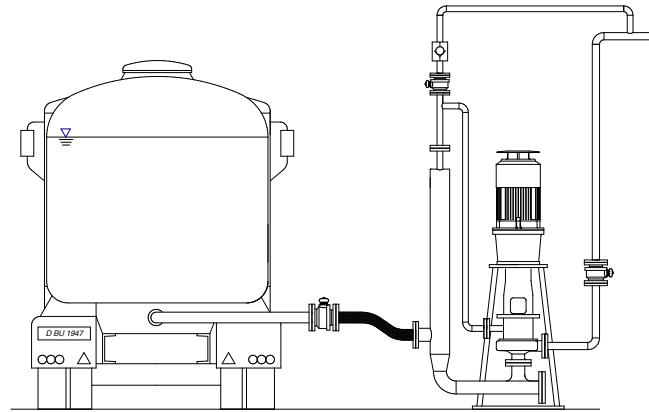
Back vanes are arranged at the impeller. They reduce the pressure to be sealed until the pumping pressure is reached. This principle is called hydrodynamic shaft sealing which is provided as primary sealing. However, it is only active during operation. As a secondary sealing for the idle state, conventional seals are provided (refer to the table). A gas space is generated beneath the respective sealing chamber of the secondary sealing. It prevents the pumping liquid from getting into contact with the shaft seal. In case of non-toxic media a simple gland packing may be used as secondary seal. For media requiring a higher degree of sealing tightness, a locked lip seal unit or a gas-lubricated or liquid-lubricated double mechanical seal is used. If the requirements are even more stringent, a magnetic drive is the method of choice – either of the classical liquid-flushed or a completely dry-running design.

A design feature of all sealing systems from Bungartz: Neither the pump nor the seal or bearing are impaired at zero delivery. If, for instance, the tanker truck has already been completely emptied or the suction valve has accidentally been closed, there is absolutely no risk for the pump and the shaft seal.

TYPE OF SEAL	GRAPHITE GLAND PACKING	DOUBLE MECHANICAL SEAL, GAS	LIP SEAL, GAS	DOUBLE MECHANICAL SEAL, LIQUID	MAGNETIC DRIVE, LIQUID	MAGNETIC DRIVE, GAS
PUMP TYPE	VKS-AN	VKA-AN	VKC-AN	VKG-AN	MPVAN	MPCVAN
Meets requirements of TA-Luft	No	Yes	Yes	Yes	Yes	Yes
Sealing / flushing medium	Not required	Nitrogen, 2 – 3 bar above pumping pressure	Nitrogen, 2 – 3 bar above pumping pressure	Liquid in TS system, 2 – 3 bar above pumping pressure	Pumping medium from pressure port, minimum differential pressure 1	Nitrogen, 2 – 3 bar above pumping pressure
Additional measures / requirements	Discharge leakage in idle state	Provide venting pipe at feed pipe	Provide venting pipe at feed pipe	Provide TS system with cooling coil or stand-alone system with air cooler	Clean pumping medium Minimum head at zero delivery 1 bar Minimum level sensor for activation	Provide venting pipe at feed pipe
Typical pumping media	Non-toxic liquids under atmospheric pressure; solids permitted	Liquefied gases and other TA-Luft media; solids permitted	This type of seal is an extremely robust alternative to the gas-lubricated double mechanical seal	Liquefied gases and other TA-Luft media; solids permitted	e.g. sulphuric acid, oleum, zinc tetra-chloride; generally solid-free media	Liquefied gases and other TA-Luft media; solids permitted
Measure for sealing pressure / sealing gas failure	Not required	Activation of alarm and shutdown Immediate damage to seal is possible	Activation of alarm Seal is not immediately damaged Check of sealing pressure situation after tanker truck unloading	Activation of alarm and shutdown Immediate damage to seal is possible in case of dry running	Any flushing liquid shortage is detected by a temperature sensor at the containment cup Switch off immediately	Activation of alarm Seal is not immediately damaged Check of sealing pressure situation after tanker truck unloading
Choosing the right secondary seal						



1



2

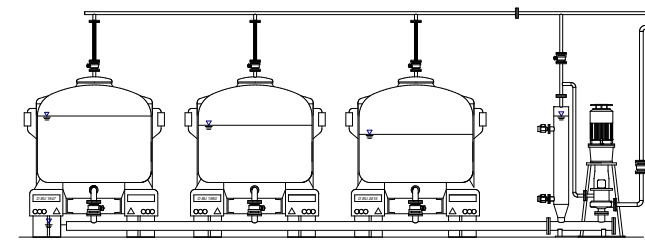
THE GROUND OF HARD FACTS. TANKER TRUCK UNLOADING FROM BELOW.

Complete, cavitation-free unloading – this is the perfect challenge for the self-regulating pump V-AN. It can be installed on ground level and is optimally suited for all types of liquids. Media, such as liquefied gases, tar, phenol, sulphuric acid and zinc tetrachloride, are no problem for it – just as media at the boiling point or media containing both gases and solids.

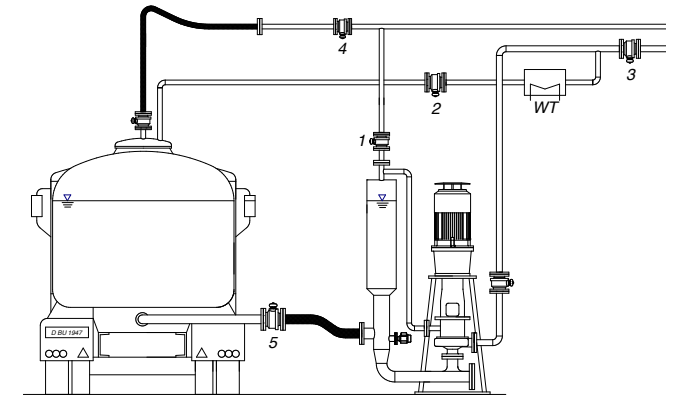
ADVANTAGES.

- Complete unloading down to smallest residual quantities
- Concurrent unloading of several tanker trucks
- Ground level installation even for boiling liquids
- Hermetically sealed pumps safe to run dry
- Intrinsically safe, fault-tolerant pumps
- User-friendly, low-monitoring

Not all unloading processes from below can be performed in the same way. It is first of all the media properties, such as boiling point and toxicity, but also existing structures that decide about installation. Basically, there are four different arrangements which require a specific design of the unloading system.



3



4

1 NON-BOILING LIQUIDS WITHOUT VENTING OF THE PUMP AND PIPE FEEDING.

- with or without vapour return
- > typical pump designs:
MPVAN,
VKG-AN,
VKS-AN

2 NON-BOILING LIQUIDS WITH VENTING OF PUMP.

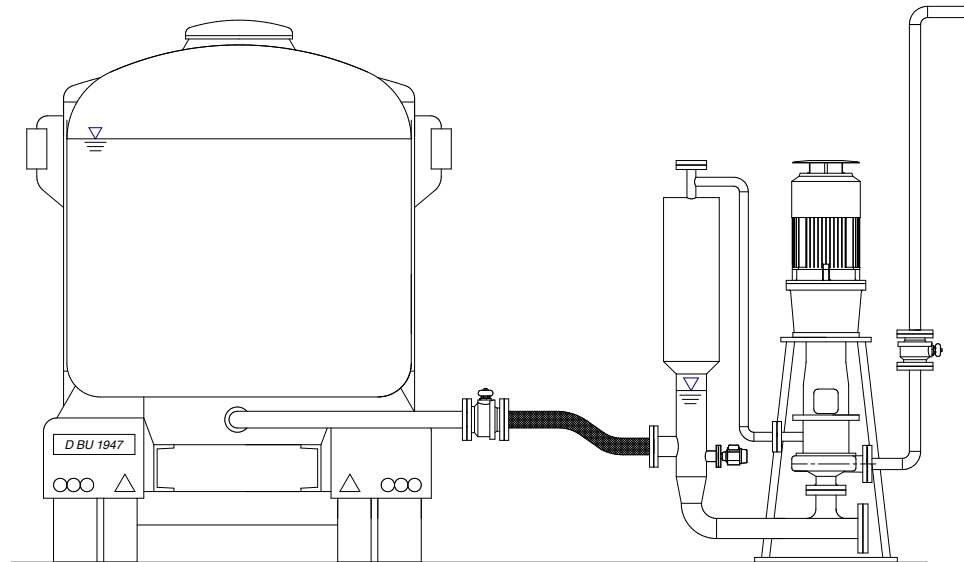
- with or without vapour return
- also suited for long suction lines
- > typical pump designs:
MPVAN,
MPCVAN,
VKA-AN,
VKG-AN,
VKS-AN,
VKC-AN

3 BOILING LIQUIDS, SUCH AS LIQUEFIED GASES, WITHOUT PRESSURE SUPERPOSITION OR CONCURRENT UNLOADING OF SEVERAL TANKER TRUCKS.

- without pressure boosting systems on the suction side with vapour return
- optimisation of unloading time
- > typical pump designs:
VKA-AN,
VKG-AN,
MPVAN,
MPCVAN

4 BOILING LIQUIDS, SUCH AS LIQUEFIED GASES, AND SHORT UNLOADING TIMES.

- with pressure boosting systems on the suction side with vapour return
- unloading of liquefied gases with pressure superposition
- > typical pump designs:
VKA-AN,
VKG-AN,
MPCVAN



NON-BOILING LIQUIDS. WITHOUT VENTING OF PUMP, WITH OR WITHOUT VAPOUR RETURN.

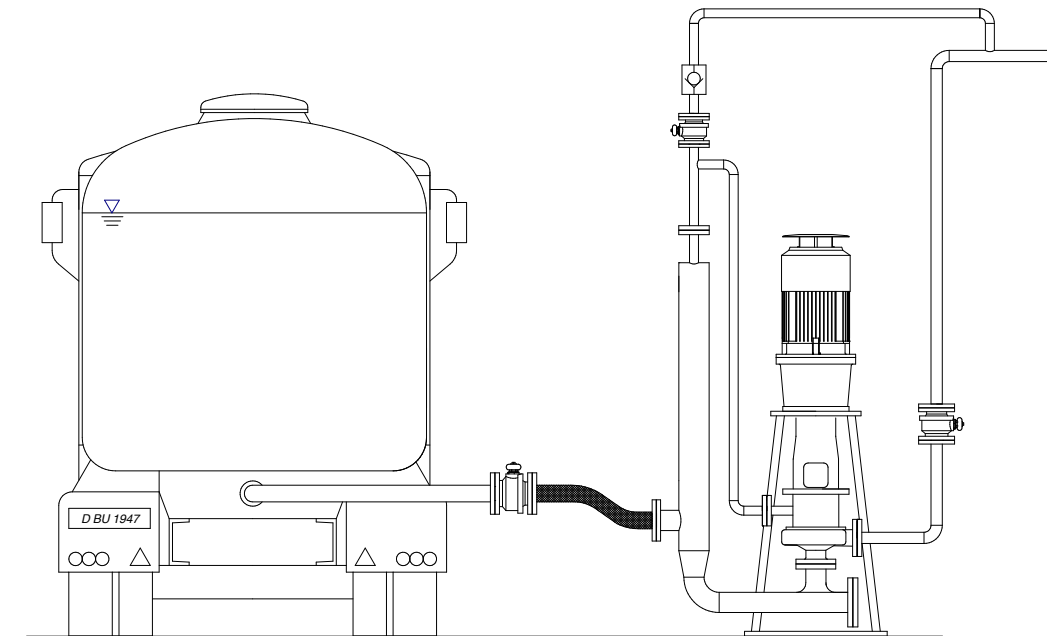
> Example: sulphuric acid

- selected shaft seal:
liquid-lubricated magnetic drive
of the MPVAN type
- possible pump designs:
MPVAN,
VKG-AN,
VKS-AN

If the pumping medium is a clean product, such as sulphuric acid, the magnet-coupled MPVAN type makes most sense. Since its installation is comfortably easy. Venting of the conveying system on the suction side is not necessary. The gas contained in the suction line and in the feeding system is compressed until the level required for starting the pump is reached. The magnet-coupled pump is thus flooded and can start its service. Its liquid-lubricated bearings are sufficiently supplied with flushing liquid by the pressure at the pressure port.

In the feed pipe the pump generates a negative pressure. It may reach up to the boiling point and this ensures an ideal unloading time. The pump delivers at full power until the first gas bubbles occur. Then, it automatically switches to the residual liquid emptying mode – purely hydraulically. That is to say: It empties the tanker truck almost completely.

The time control should be selected by setting the minimum level sensor such that the pump is switched off after a delay time of two minutes. In the meantime, the magnetic drive is supplied with sufficient flushing liquid by means of the static pressure of the pressure line. And this means: Also the magnetic drive pump lubricated by the product can empty the tanker truck completely and continue to run for a while in the zero flow mode.



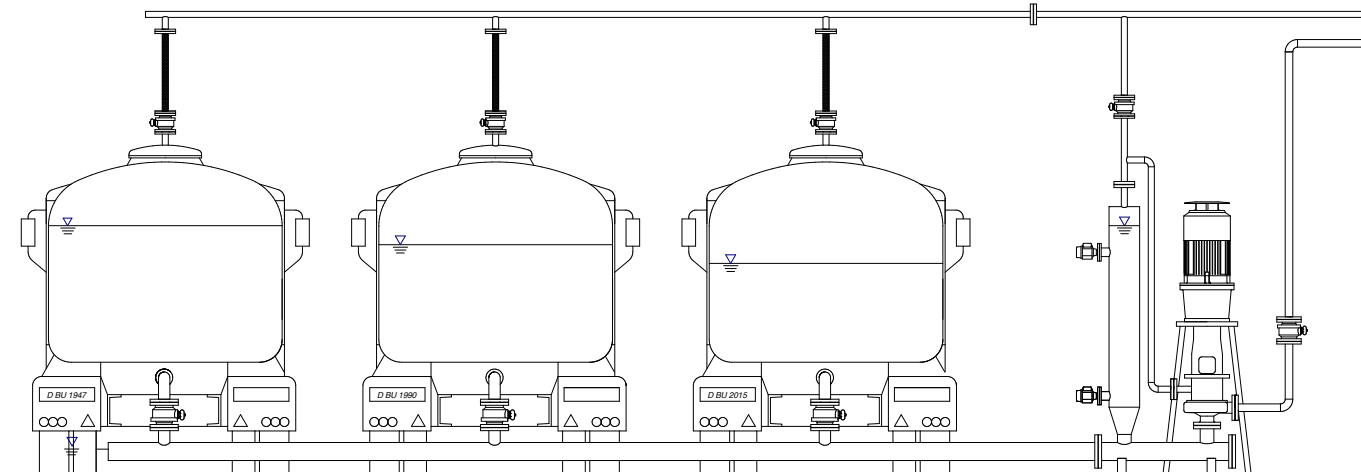
NON-BOILING LIQUIDS. WITH VENTING OF PUMP, WITH OR WITHOUT VAPOUR RETURN.

> Example: nitric acid

- selected shaft seal:
gas-sealed magnetic drive
of the MPCVAN type
- installation basis:
long suction line between
tanker truck and pump
- possible pump designs:
MPVAN,
MPCVAN,
VKA-AN,
VKG-AN,
VKC-AN,
VKS-AN

Even a larger distance between the fuelling area and the pump is no real obstacle. The pressure line remains filled with the product. As a result, this line either cannot ensure sufficient venting. Therefore, an installation with a pipe feeding to be vented is used. An intrinsically safe shaft seal safe to run dry is chosen since this seal performs its tasks in a sophisticated manner without any monitoring.

In this case an MPCVAN dry-running magnetic drive is used. This design ensures that not only the bearing area but also the magnetic drive itself is completely independent from the product. The operator of the fuelling station switches the pump manually on and off. Hence, the system is completely intrinsically safe and does not need any monitoring. The trapped air from the last unloading process as well as the sealing air superposition is discharged here via the compensation line into an external system or the pressure line. A non-return valve is provided to ensure automatic venting. It is important that the gases can flow out under no pressure. During the unloading process a negative pressure is generated in the pipe feeding, which corresponds to the losses on the suction side. The non-return valve is closed. The pump delivers at full power. As soon as a vortex is formed at the tanker truck outlet and gas flows to the feed pipe, the pump automatically changes into the residual liquid emptying mode. Almost complete unloading is ensured.

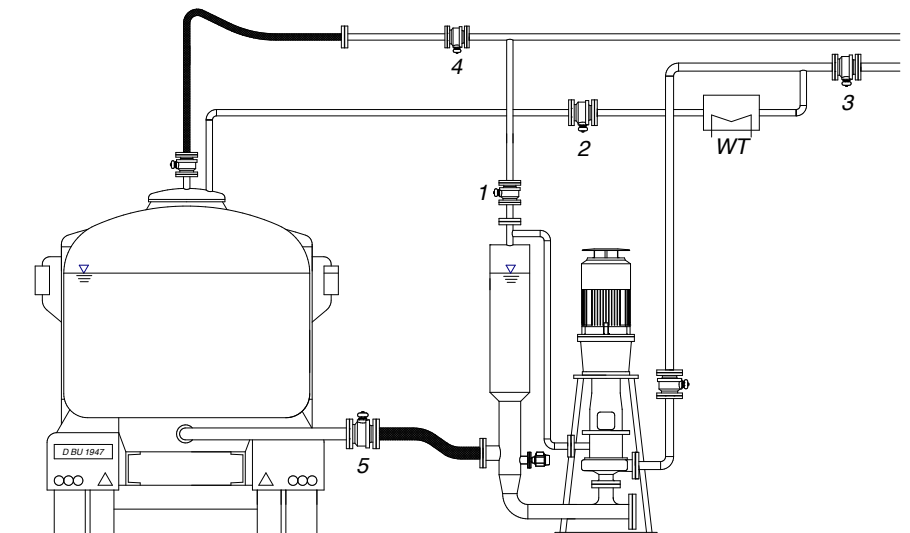


BOILING LIQUIDS. FOR LOWER FEED RATES OR THE CONCURRENT UNLOADING OF SEVERAL TANKER TRUCKS.

- without pressure boosting systems on the suction side
- with vapour return
- possible pump designs:
MPVAN,
MPCVAN,
VKA-AN,
VKG-AN

Liquids at the boiling point, such as liquefied gases, are a particular challenge. Since here, the pressure in the tanker truck and in the pump pipe feeding always corresponds to the vapour pressure at the temperature of the respective medium. The problem: No negative pressure can be generated in the pipe feeding to overcome the pressure drops on the inlet side.

If there is enough time for unloading or several tanker trucks are emptied at the same time, the system can nevertheless be employed without system pressure superposition. In such case only that liquid volume is unloaded, which flows out of the tanker truck into the feed pipe simply as a result of the suction head h_s . Usually, this volume amounts to an average of 25 to 30 m³/h, also due to the limited outlet-branches of the tanker truck. If a higher volume is required, unloading of several tanker trucks at a time is recommended. Then, the pump increases its performance significantly: It may be designed, for instance, for 90 m³/h (3 x 30 m³/h). In such application, the collecting main between the tanker trucks should be generously dimensioned, if possible ($c \leq 1$ m/s). The flow rate out of each tanker truck is then about 30 m³/h. The pump must be kept in operation until the minimum level in the pipe feeding has been reached.



BOILING LIQUIDS. FOR HIGH FEED RATES.

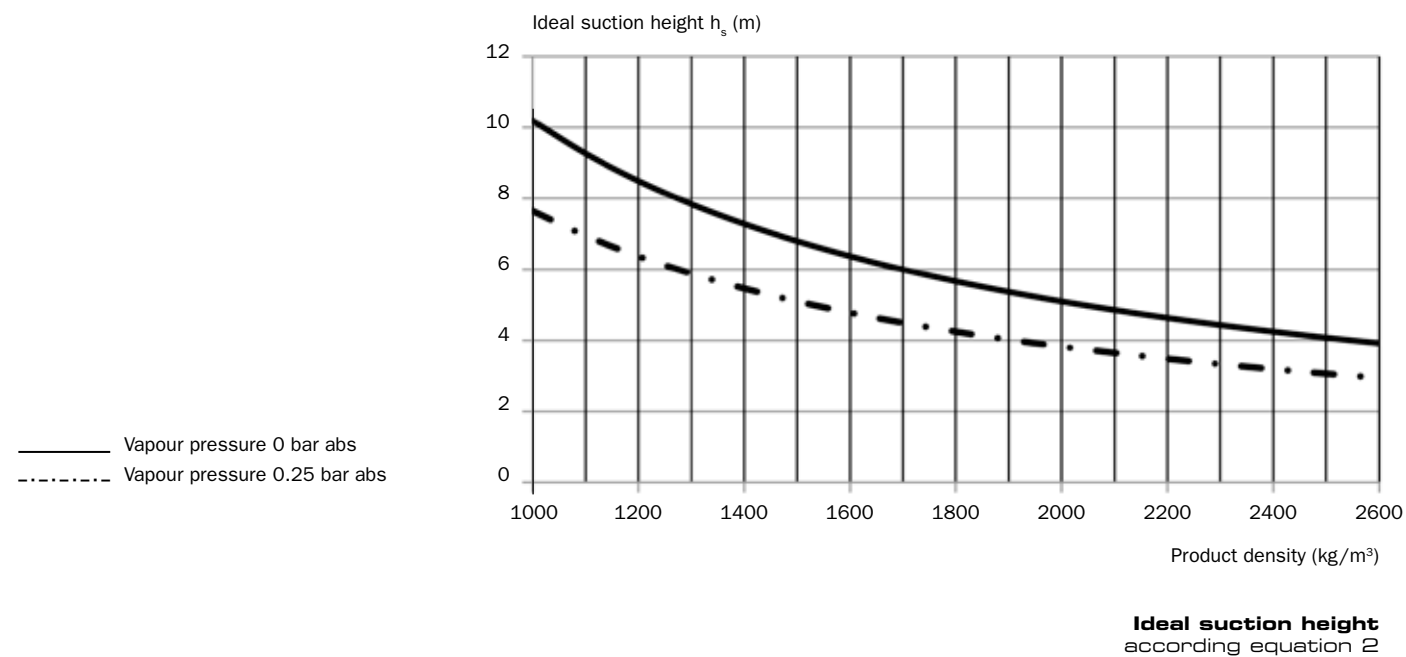
- with pressure boosting systems on the suction side
- with vapour return
- possible pump designs:
MPCVAN,
VKA-AN,
VKG-AN

The higher the flow rate, the more marked are the advantages of the type V-AN pumps. A liquefied gas unloading system with a design flow rate of 120 m³/h, for instance, may be a possible alternative to the variant described above where several tanker trucks are unloaded at the same time.

Due to its design, there is normally a rather high flow speed at the tanker truck outlet. Hence, the pressure drop can no longer be compensated for by the suction head in the tanker truck alone. Thus, part of the pumping medium flow is branched from the pressure line. The pressure in the tanker wagon is increased then by means of an evaporator.

UNLOADING PROCESS.

The unloading process starts with the filling of the pipe feeding and the establishment of a pressure balance between the systems by opening the valves 1, 4 and 5. Before the pump is started, valve 1 to the pipe feeding is closed and valve 2 of the evaporator line is opened in a defined manner. After the pump has been started, the system initially works automatically. A time control is provided to close the evaporator valve 2 at the end of the unloading process and open the compensating valve 1 to the pipe feeding. This allows for self-regulating residual liquid emptying. A minimum sensor with delay time finally stops the unloading process.



GREAT SUPERIORITY.

TANKER TRUCK UNLOADING FROM ABOVE.

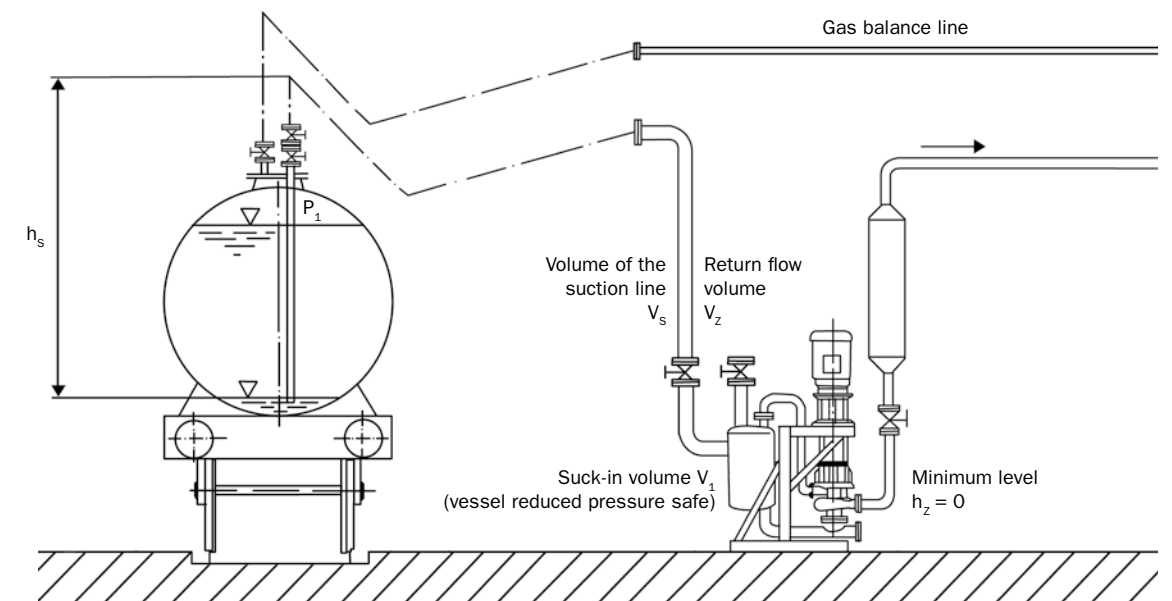
When tanker trucks or tanker wagons were emptied from above in the past, the liquid drained off as a result of the application of an externally applied overpressure. Today, the legislator permits this method only to a limited extent. Since there is the risk that the systems on the pressure side are damaged by incorrect operation and liquids escape into the environment. Moreover, it is extremely expensive and elaborate to dispose in an environmentally friendly manner of the contaminated gases contained in the tanker truck under overpressure.

Such problems can be avoided by using a special unloading system with a self-regulating pump (NPSH almost zero). This system is able to drain off from the truck even heavy liquids from above. Here, a small suction vessel is provided upstream of the self-regulating pump. When the pump is started, the liquid level is reduced and the pump extracts the liquid through the suction lance in the tanker truck. The system still works under almost boiling conditions at the highest point of the loading arm.

$$h_{s, \max} = \frac{(p_1 - p_0) \cdot 10^5}{\delta_{\text{Fl}} \cdot 9,81} - \text{NPSH}_{\text{Pump}}$$

$$h_v = \frac{c^2}{2 \cdot 9,81} \quad \text{EQUATION 1}$$

$$h_{s, \text{ideal}} = \frac{(p_1 - p_0) \cdot 10^5}{\delta_{\text{Fl}} \cdot 9,81} \quad \text{EQUATION 2}$$



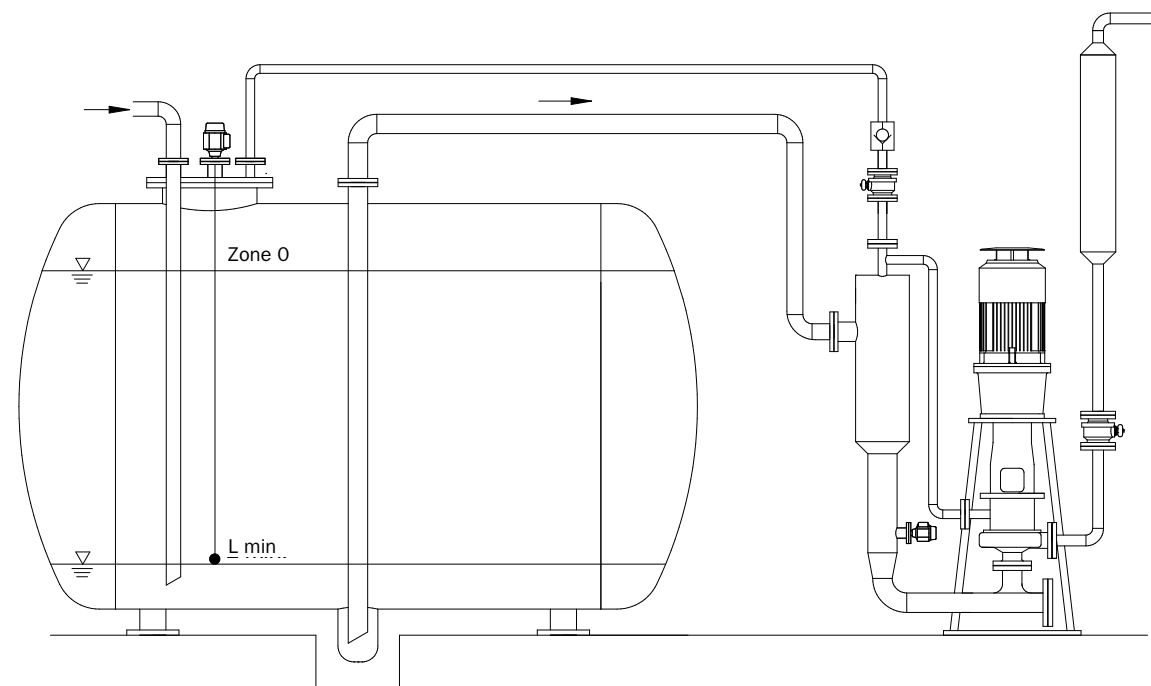
Tanker truck unloading from above

The maximum physical suction head h_s is mainly determined by the difference between the pressure in the tanker truck (p_1) and the vapour pressure of the liquid (p_0) as well as its specific weight (δ_{Fl}). Without considering the other variables (h_v = pressure drop, c = flow speed, NPSH value of the priming pump), the maximum suction head physically achievable can be calculated (in diagram 1 shown as a function of the product density). The table shows examples of the limit suction heads for various products that are almost reached when the selfregulating pump V-AN is employed. There is no suction principle to exceed this limit suction head.

Where the self-regulating pump V-AN is employed, the gas contained in the suction line is not evacuated. This applies, for instance, to side channel pumps. However, there the gas is expanded into the suction vessel. In other words: Upon completion of the priming process the gas from the suction line is in the suction vessel. During the delivery process it is continuously extracted by the V-AN.

PUMPING MEDIUM	DENSITY (kg/m^3)	VAPOUR PRESSURE (20 °C) bar	SUCTION HEAD h_s (liquid column)
Mixed acid (88% NH_3 , 11% H_2SO_4)	1590	0,064	6,0
Sulphuric acid 96%	1830	< 0,02	5,46
Oleum 28% SO_3	1935	< 0,02	5,16
Tin tetrachloride	2230	< 0,0125	4,46

Analysis of several heavy liquids



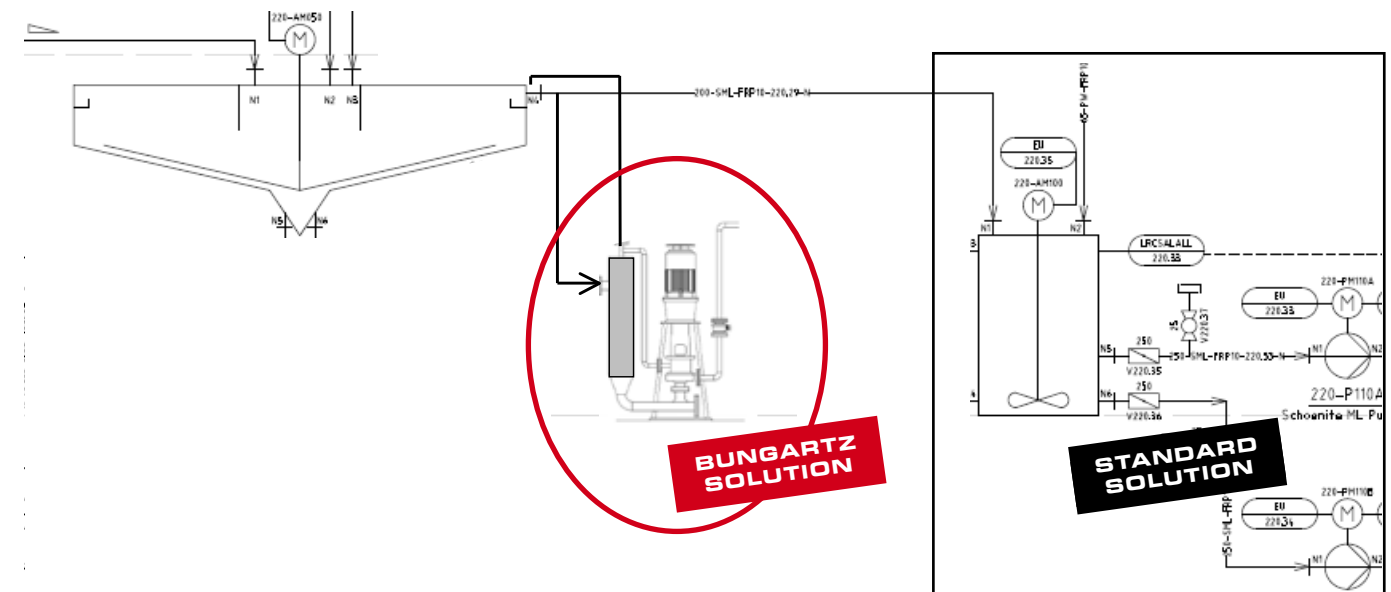
EXTRACTING FROM ABOVE.

FROM VESSELS WITH ZONE 0 ATMOSPHERE.

Discharging a product from a vessel with zone 0 atmosphere is challenging. This condition means that there is a potentially explosive mixture of medium gases in the gas space – and this permanently. If pumps are used in this application, they require a type approval. Such designs are submerged pumps of the MPCTAN type.

The elaborate zone 0 installation with submerged pumps can be effectively avoided. Namely, by means of a particular unloading system consisting of a self-regulating pump and a suction system. The pump with the suction vessel is simply arranged outside zone 0 – similar to the tanker truck unloading process from above. Now, the vessel falls under zone 1 or 2. A level sensor (L_{min}) ensures that the suction lance in the zone 0 vessel will not move out. This means: The gas from the vessel will not get into the unloading system. Therefore, the explosive mixture cannot enter the suction vessel. This vessel is now zone 2.

Here, we recommend a pump with a dry-running magnetic drive: type MPCVAN with nitrogen sealing. The sealing gas provides additional safety and guarantees that the suction vessel always remains inert.



Bungartz solution vs. standard solution

EXTRACTION FROM SEPARATORS.

OTHER APPLICATIONS.

Apart from tanker truck unloading, there are many more applications for which the type V-AN self-regulating pumps can be used. In general, the delivery principle is ideal for the complete unloading of systems and vessels. But it is also the first choice for extracting fluids from thickeners, decanters, centrifuges and vacuum filters. It even works perfectly when it comes to vacuum under boiling conditions.

The self-regulating pump can considerably simplify the systems for separating liquids and solids. Whereas conventional pumps need an additional reservoir with agitator and pump control unit (refer to example “Pumping from the overflow of a thickener”), the V-AN can completely do without. This saves space and considerably reduces the investment and life cycle costs.

In terms of space the pump can be installed economically next to a small feed pipe. The pump itself performs the control function in a purely hydraulic manner. Dry-running protection and level sensors are not required either.

Further applications are described in the brochure of the V-AN series.