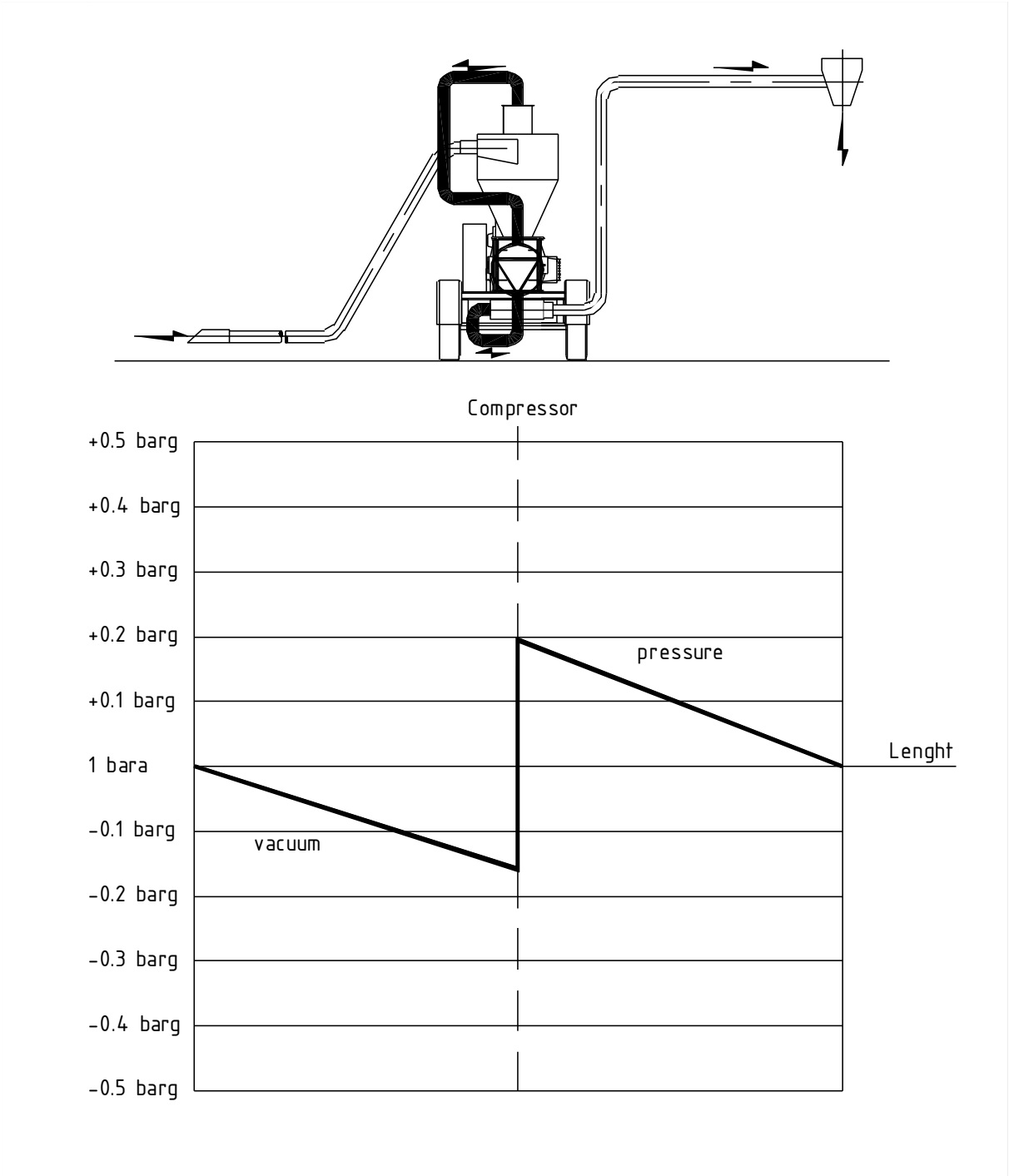
MOBILE VACUUM/PRESSURE UNIT

For conveying grain- and cereal crops, suction/pressure units are designed to load bulk trucks from a heap of crop.



Drawing 1: Continuous mobile vacuum-pressure unit, using one blower

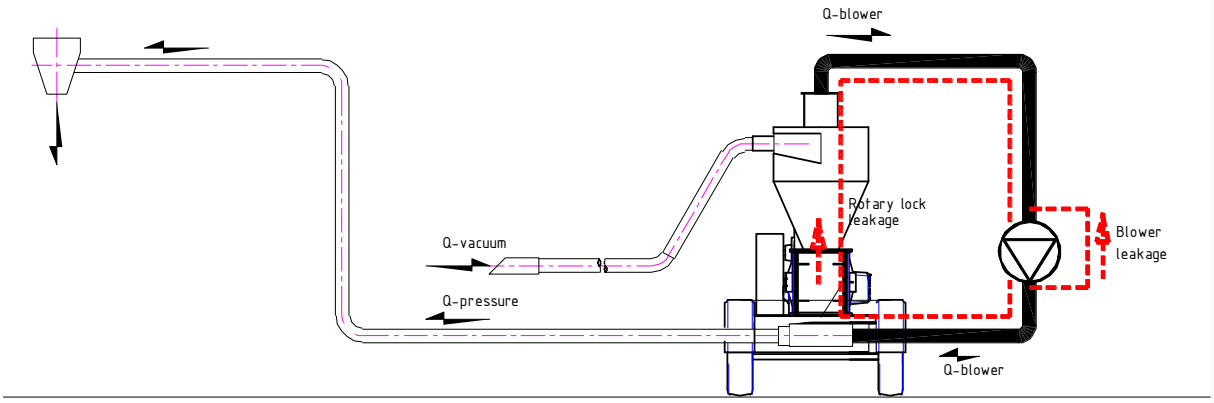
These units use one single blower as a vacuum source and as a pressure source at the same time.

Material separation is achieved by a cyclone in the suction side, whereby the grain is fed into the pressure conveying system through a rotary valve.
The pneumatic installation has the following properties:

1. Air mass flow suction system = Air mass flow pressure system
2. Material mass flow suction system = Material mass flow pressure system
3. From 1. and 2. follows that SLR-suction = SLR pressure
4. The mass flow leakage through the rotary valve is not part of the conveying air flow, but has to be displaced by the blower.

For a P(ositive) D(isplacement) blower, the displaced air mass is a function of the vacuum at the intake. As a consequence of this, the air mass flow in the pressure system varies with the vacuum.

As the compressor is experiencing a vacuum at the intake and a pressure at the outlet, the standard blower data sheets or curves cannot be used directly, as these datasheets assume either an atmospheric outlet pressure or an atmospheric intake pressure.



Drawing 2: Leakage flows in a contineous mobile vacuum-pressure unit, using one blower

The air mass flow for the vacuum system equals the air mass flow for the pressure system.
For the calculation of these air mass flows, the blower internal leakage and the rotary lock leakage have to be related to the calculated pressures.
This requires a calculation iteration process between the vacuum calculation and the pressure calculation.

In the calculation program, the calculated pressures from the vacuum system are entered in te appropriate cells in the pressure calculation and vice versa until the calculated pressures correspond in both, vacuum and pressure system calculation.

The design calculations for a vacuum-pressure installation are performed in 2 steps:

- Design calculation of the vacuum part for a fixed capacity, resulting in a calculated vacuum
- Design calculation of the pressure part with the derived air flow from the vacuum part for the fixed capacity, resulting in a calculated pressure.
- Check, whether the calculated pressure drop over the blower is within the operating limits of the blower
    - If the pressure drop over the blower is too high, repeat the calculation for a lower fixed capacity
    - If the pressure drop over the blower is too low, repeat the calculation for a higher fixed capacity
    - If the pressure drop over the blower is accepted, repeat the calculation for the same fixed capacity, whereby the pressure difference over the rotary valve is taken from the previous calculations.
- Repeat these calculations until (Iteration process):
    - Air mass flow suction system = Air mass flow pressure system
    - Material mass flow suction system = Material mass flow pressure system
    - SLR-suction = SLR pressure
    - The mass flow leakage through the rotary valve is equal in the vacuum calculation and in the pressure calculation.

For simplicity, normally is a cyclone used as material/air separator.
However, a cyclone has a separation efficiency below 100%, causing dust passing through the compressor.
If the compressor is a PD-blower, this dust can cause excessive wear on the rotor tips or even choking in case the blower is flooded with material.
A self-cleaning filter assembly is the a better solution.

In some cases, a centrifugal fan is used as compressor.
As a fan curve has a sharp dropping pressure at increasing volume flows, the iteration process for finding the equilibrium in air mass flow, material mass flow, sufficient air velocities to keep the material in suspension is more difficult.
A centrifugal fan can handle dust better without extensive wear on the blades than PD-blower.
Therefore, the combination centrifugal fan with a cyclone as material separator is usually used.