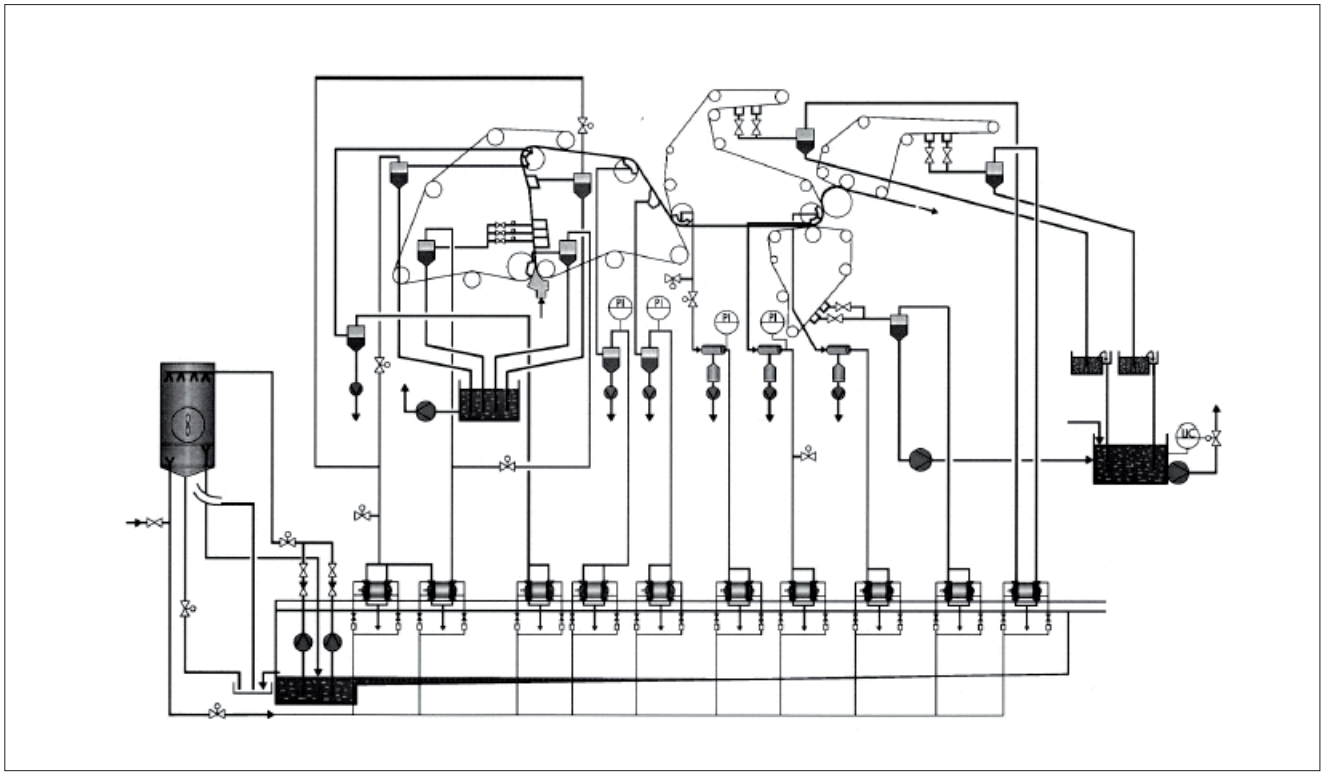
Vacuum valve sizing



A typical vacuum system with liquid ring pumps

Vacuum system is an essential part of a paper machine. It is used on a wire section, press section, and dryer section. On the wire section, vacuum contributes to the forming process affecting the quality of the end product. The other task of the vacuum system on the wire section is to remove water from the wet web before it enters into the press section. In the press section as well as on the dryer section, the vacuum system is used to help in runnability and to deal with water removed from the web.

Pump or blower

There are two types of vacuum pumps used in the paper industry: the volumetric pump and the turbo blower. The most commonly used volumetric pumps in the paper industry are liquid ring pumps. The liquid ring pump operates as a constant air flow device, whereas the turbo blower operates with constant vacuum (Fig. 1). Changes in flow resistance of the suction point (e.g., changes in felt condition) have a radical effect on developing vacuum in liquid ring pumps, while the air flow remains almost the same. Turbo blowers operate with variable air flow, which depends on the flow resistance.

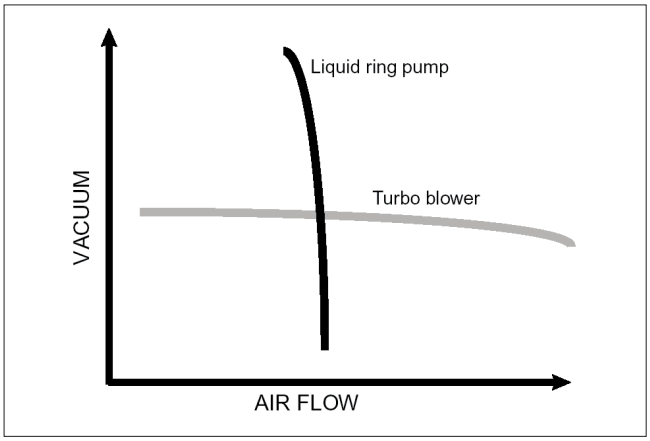


Fig. 1. Performance curves of liquid ring pump and turbo blower.

Sizing

It is recommended that flow rate is given by mass flow units, but if volumetric units are used they must be in NORMAL CONDITIONS.

Note: When converting actual flow to flow in normal conditions ([Nm3/h] or [scfh]), then:

$$q[Nm^3/hr] = q_{act}[m^3/hr]\frac{P_1 \bullet T_N}{P_N \bullet T_1}$$

where: *p1* = upstream pressure (SI units: [barA]; US units: [psiA]
T1 = upstream temperature (SI units: [K]; US units: [°R]
pN = standard pressure (1.013 barA or 14.73 psiA)
TN = standard temperature (288.75 K or 519.75 °R)

Check list for vacuum sizing

- Flow unit in NORMAL CONDITIONS
- Vacuum pump or blower side of the valve is usually DOWN STREAM (p2) side
- Sizing vacuum valves with Nelprof™ be careful with which pressure (p1 or p2) stay unchanged when differential pressure changed

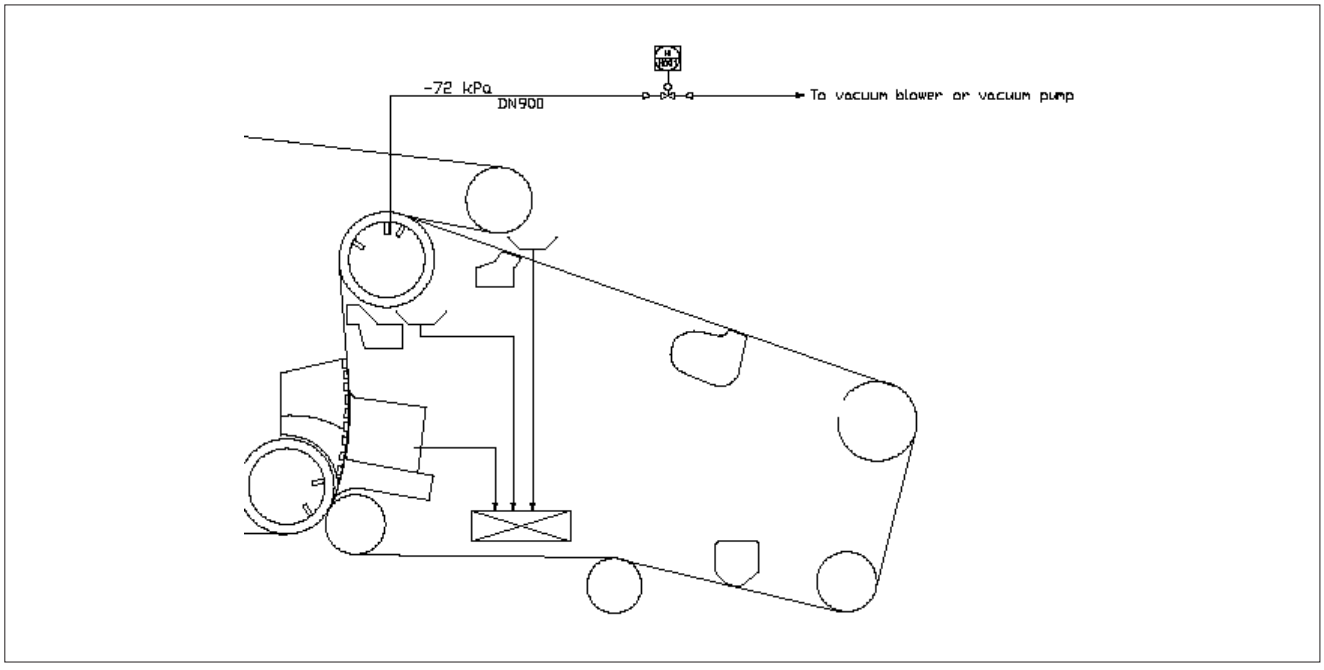


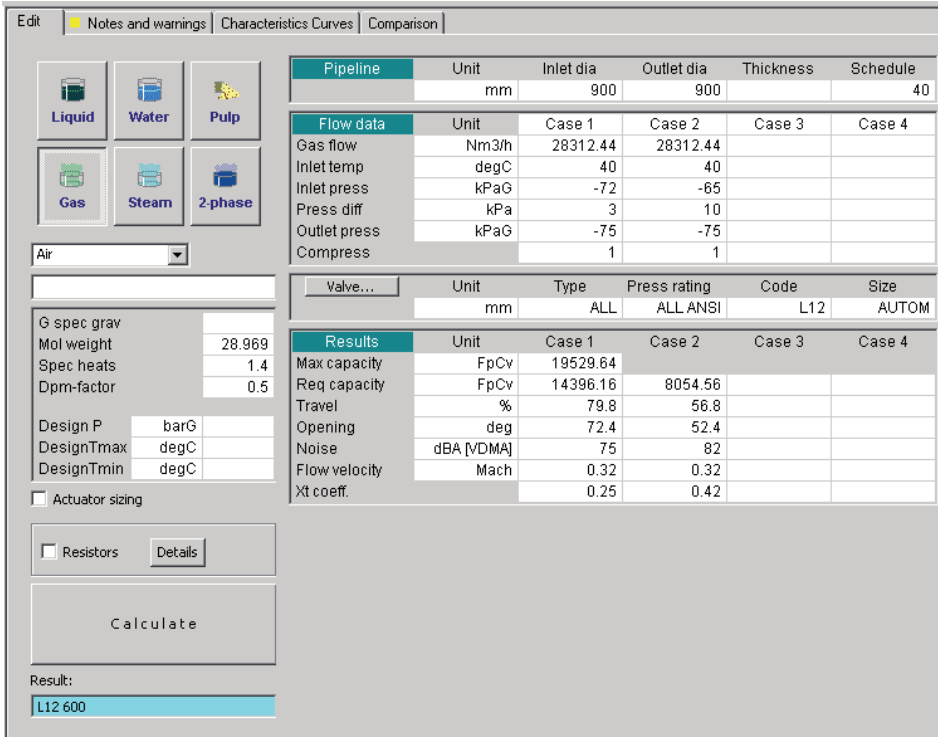
Fig. 2. Suction roll vacuum control

For example flow conditions in Figure 2.

Typically temperature in such condition is 40 deg.C. In this case flow is 12m³ / s

$q(Nm^3/hr) = 12 \times 3600 \times (0{,}72 \times 288.75) / (1{,}013 \times 313.15)$
$= 28312.44$

Metal seated butterfly valves are commonly used as control valves.



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