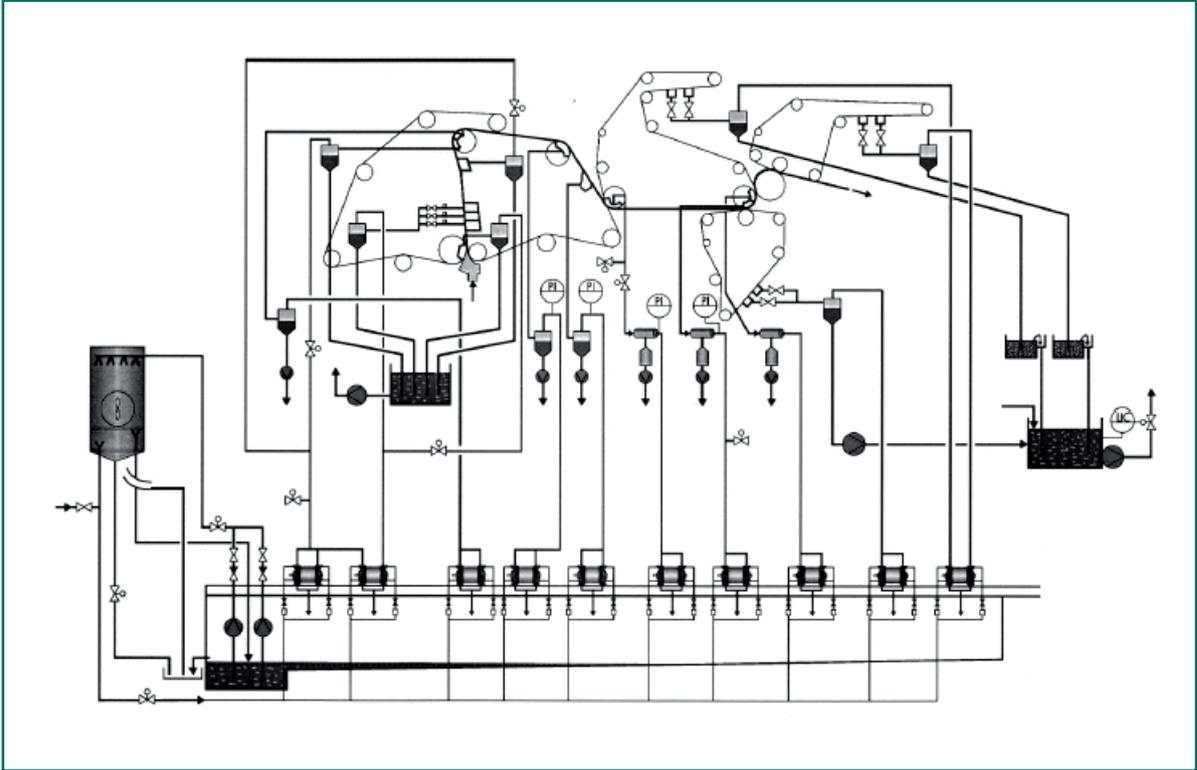


# VACUUM VALVE SIZING



*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.

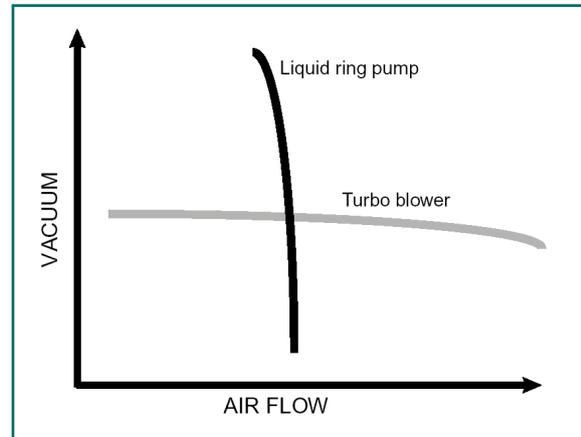


Figure 1. Performance curves of liquid ring pump and turbo blower.

## 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 ( $[Nm^3/h]$  or  $[scfh]$ ), then:

$$q[Nm^3/hr] = q_{act}[m^3/hr] \frac{p_1 \cdot T_N}{p_N \cdot T_1}$$

where:

- $p_1$  = upstream pressure (SI units: [barA]; US units: [psiA])
- $T_1$  = upstream temperature (SI units: [K]; US units: [ $^{\circ}R$ ])
- $p_N$  = standard pressure (1.013 barA or 14.73 psiA)
- $T_N$  = standard temperature (288.75 K or 519.75  $^{\circ}R$ )

## Check list for vacuum sizing

- Flow unit in NORMAL CONDITIONS
- Vacuum pump or blower side of the valve is usually DOWN STREAM ( $p_2$ ) side
- Sizing vacuum valves with Nelprof be careful with which pressure ( $p_1$  or  $p_2$ ) stay unchanged when differential pressure changed

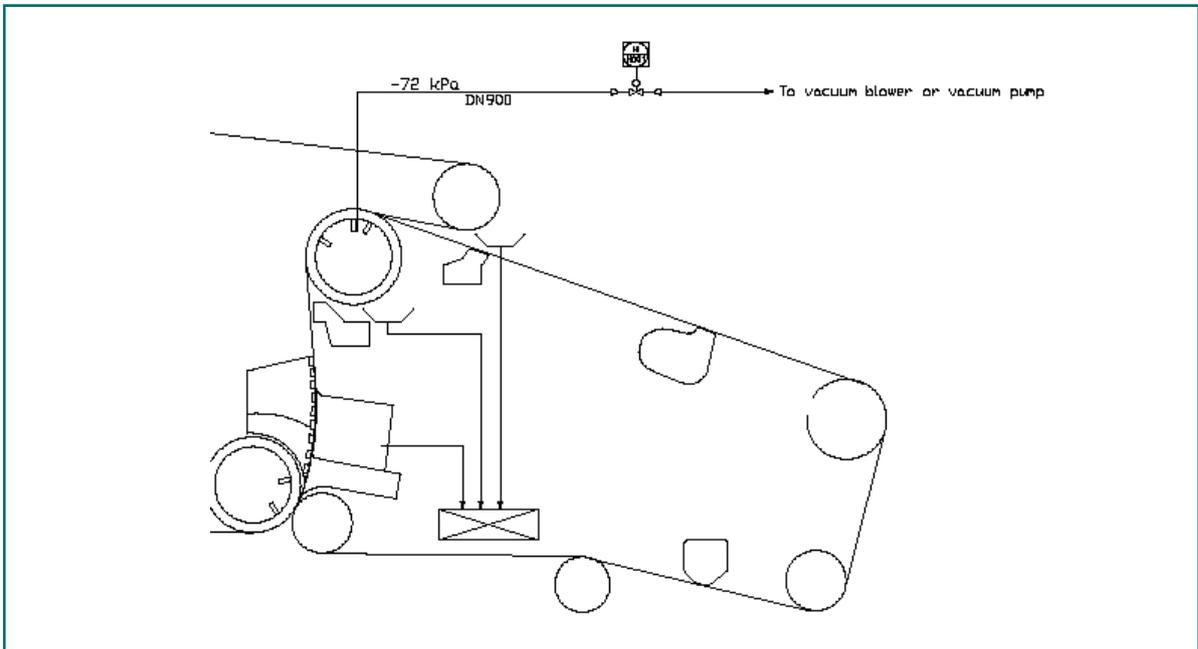


Figure 2 Suction roll vacuum control

For example flow conditions in Figure 2.

Typically temperature in such condition is 40 deg.C. In this case flow is 12m<sup>3</sup> / s

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

Metal seated butterfly valves are commonly used as control valves.

Software interface for valve sizing. The interface includes tabs for 'Notes and warnings', 'Characteristics Curves', and 'Comparison'. It features a 'Pipeline' table, 'Flow data' table, 'Valve...' table, and 'Results' table. A 'Calculate' button is present, and the result is displayed as 'L12 600'.

Pipeline	Unit	Inlet dia	Outlet dia	Thickness	Schedule
	mm	900	900		40

Flow data	Unit	Case 1	Case 2	Case 3	Case 4
Gas flow	Nm <sup>3</sup> /h	28312.44	28312.44		
Inlet temp	degC	40	40		
Inlet press	kPaG	-72	-65		
Press diff	kPa	3	10		
Outlet press	kPaG	-75	-75		
Compress		1	1		

Valve...	Unit	Type	Press rating	Code	Size
	mm	ALL	ALL ANSI	L12	AUTOM

Results	Unit	Case 1	Case 2	Case 3	Case 4
Max capacity	FpCv	19529.64			
Req capacity	FpCv	14396.16	8054.56		
Travel	%	79.8	56.8		
Opening	deg	72.4	52.4		
Noise	dba [VDMA]	75	82		
Flow velocity	Mach	0.32	0.32		
Xt coeff.		0.25	0.42		

Result:  
L12 600

The information provided in this bulletin is advisory in nature, and is intended as a guideline only.  
For specific circumstances and more detailed information, please consult with your local automation expert at Metso.

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