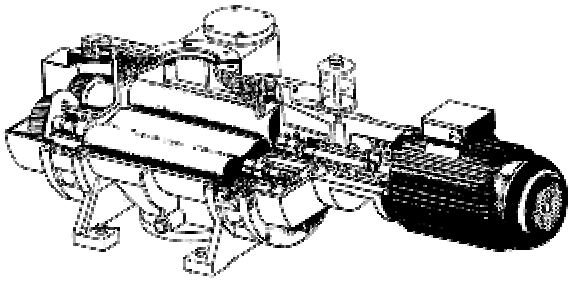
"Investigating various vacuum pumps in typical use on vacuum web coating machines, principles of operation and general maintenance considerations. Furthermore, special practical considerations will be discussed with regard to vacuum pumping systems when coating paper."

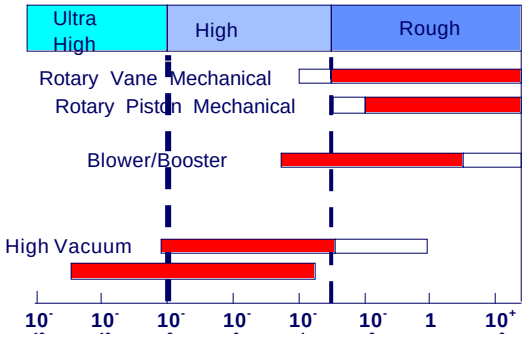
The paper will cover the component make-up and operation principles of the roughing pumps and high vacuum pumps which are typically in use on metallizing machines. Specifically, the following roughing pumps will be covered: rotary piston type, rotary vane type and booster (roots) pumps. The oil diffusion pump and cryogenic pump will also be covered as the main types of high vacuum pumps. Pictures showing cut away views of the insides of the pumps will be shown to aid the audience's understanding of the operating principles, for example:



ROOTS BLOWER

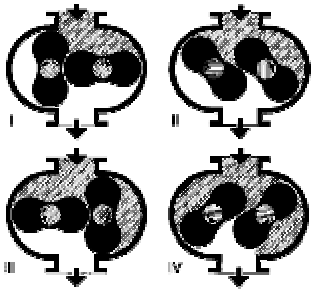
A description will be given of how the four types of pump are teamed up for pumping down vacuum web coating machines. There are many different types of pumps available but to enable pumping of a chamber of a metallising machine with a 'dirty process' in a fast pumpdown time, the collection of pumps above is one of the best options.

Pumping ranges for rough and high vacuum pumps will be talked about, for example:



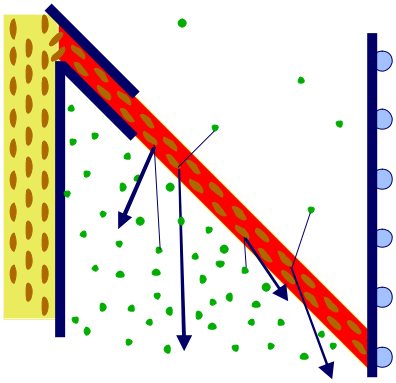
Furthermore, the properties of the vacuum levels that each pump deals with, will be elaborated on, for example: at rough vacuum, the gas inside the chamber has a transitional molecular flow whereby there are many molecules and therefore many collisions between the molecules in the chamber. The rotary vane/piston and booster pumps have to cope with this flowing type of load from atmosphere. However, as the number of molecules decreases (i.e. as the vacuum level improves) the number of molecules reduces and therefore, the number of molecular collisions reduces. Thus, the vacuum level improvement leads away from molecular flow to random molecular movement (and random collisions) hence, the pump construction and resultant pumping speed curves reflects this phenomenon. This is why the diffusion pumps have such a large input mouth to increase the statistical likelihood of randomly moving molecules entering the top of the pump and being trapped by the top oil vapour jet.

Some diagrams will be offered for the illustration of the respective pumping phase sequences for each pump, for example:



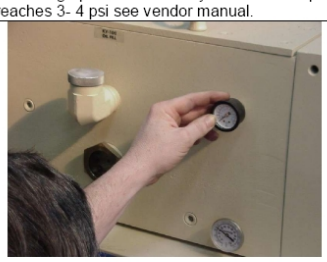
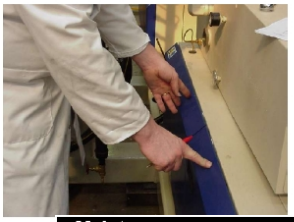
Pumping phase sequence for a booster (roots) type pump

Animated diagrams (shockwave flash files) detailing pump operation, will further add to the learning experience.



Excerpt Diagram from live animation of diffusion oil vapour jet pumping action

Maintenance aspects will be discussed for each of the above pump types, with step-by-step picture representation. Tasks will be broken down into daily, weekly, monthly, annually and biannually; for example:

Maintenance Requirement	Equipment And Task To Be Performed
Daily	Check the discharge pressure. Usually around atmosphere. If pressure reaches 3- 4 psi see vendor manual.
Figure 1.2 - 3 Check The Discharge Pressure	
Daily	Check the lubrication oil pressure is below 2 bar, if not consult the vendor manual.
Figure 1.2 - 4 Check The Oil Pressure	
Daily	Check that all guards are in place
Figure 1.2 - 5 Check Guards Are in Place	
Daily	Drain excess water fro
Weekly	Check the belt tension

Maintenance Requirement	Equipment And Task To Be Performed
Figure 1.2 - 6 Check Belt Tension	

Some particular aspects will be discussed with regard to machines that are produced to metallize papers or special fabric substrates. Additional pumping maintenance precautions (for example, checking and replacement of pump oils on a more frequent basis) and suitable paper types for metallization will be outlined: