MAN Energy Solutions
Future in the making

Average Paper Mill

CEPI Case Study

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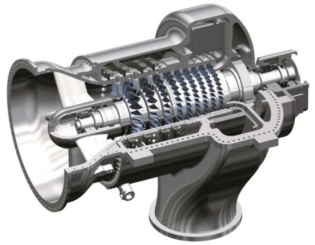
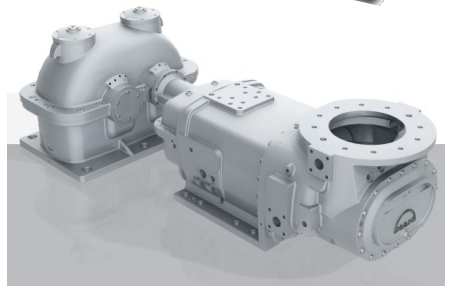
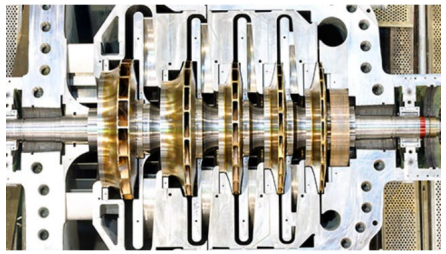
MAN ES Heat Pumps

Compressors

- **MAN Energy Solutions** owns a range of **compressor types suitable** for use in heat pumps
- **Referenced pressure and temperature levels** exceed by far those levels required by vapour or transcritical (based on CO2) compression cycle heat pumps
- **MAN ES Compressor casings up to ~ 60 MW** (for one casing) shaft power with electric drive have been installed and are operated throughout the world

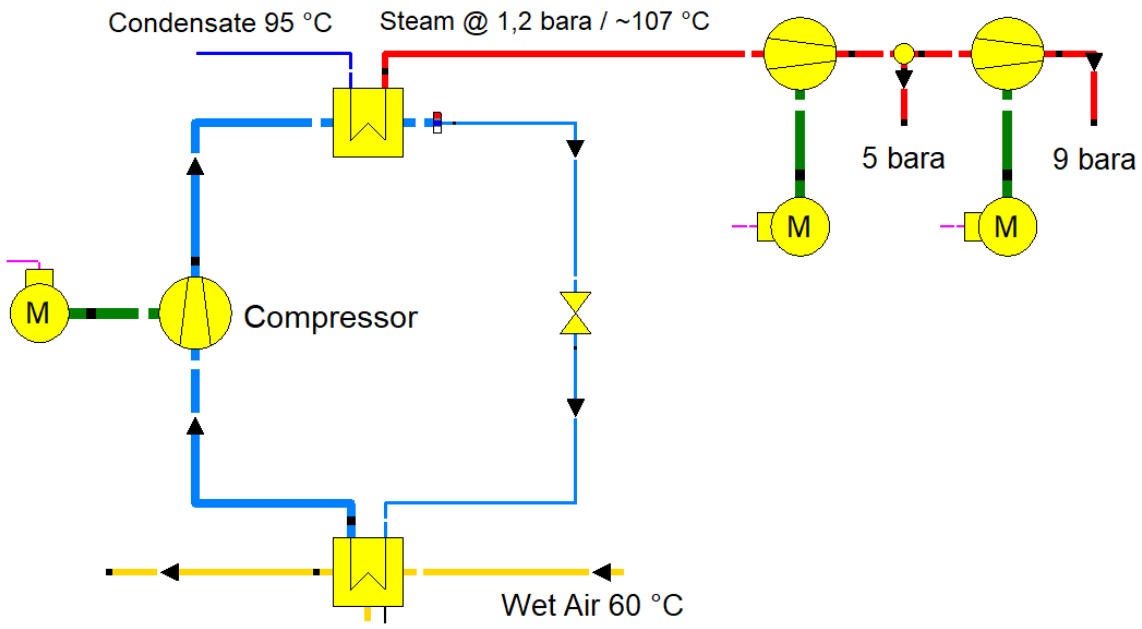






MAN ES approach to average paper mill

- Vapour compression cycle heat pump to generate low pressure ~1.2 bara steam from the moist air heat source
- Subsequent steam compression to 9 bara with an extraction at 5 bara
- Pressure let down from 5 bara or 9 bara line to required levels
- Refrigerants Butane or NH3 depending on the size of the heat pump. R1233zd on request.
- One geared compressor for heat pump sizes of about 30 MW for both heat pump and steam compression services
- COP highest for NH3. COP comparable for Butane and R1233zd
- Absolute COP depending on further boundary conditions, e.g. ratio of humid air flow over steam flow



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Thank you very much!

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