

Selection of pumps

Selection of pumps should be based on

- The duty point of the pump (see section 1)
- Sizing data such as pressure loss as a result of height differences, friction loss in the pipework, pump efficiency etc. (see section 2)
- Pump materials (see section 3)
- Pump connections (see section 4)
- Shaft seal (see section 5).

1. Duty point of the pump

From a duty point it is possible to select a pump on the basis of the curve charts shown in section *Performance curves / Technical data* from pages 16 to 23.

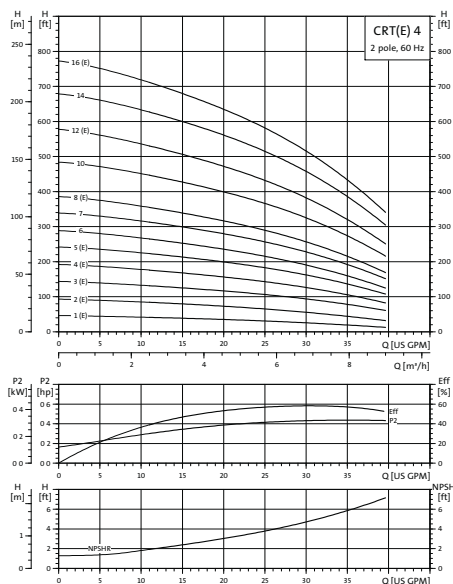


Fig. 4 Example of a curve chart

2. Sizing data

When sizing a pump the following must be taken into account (see Fig. 7).

- Required flow and pressure at the point of use.
- Pressure loss as a result of height differences (H_{geo}).
- Friction loss in the pipework (H_f). It may be necessary to account for pressure loss in connection with long pipes, bends or valves, etc.
- Best efficiency at the estimated duty point.
- NPSH value. For calculation of the NPSH value, see "Minimum inlet pressure - NPSH" page 14.

Efficiency

Before determining the point of best efficiency, the operation pattern of the pump needs to be identified. If the pump is expected to operate at the same duty point, then select a CRT(E) pump which is operating at a duty point corresponding with the best efficiency of the pump.

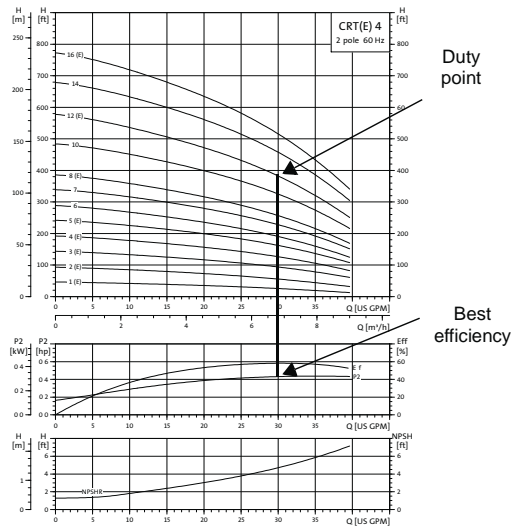


Fig. 5 Example of a CRT(E) pump's duty point

As the pump is sized on the basis of the highest possible flow, it is important to always have the duty flow to the right of the optimum efficiency point (see fig. Fig. 6, range with check mark). This must be considered in order to keep efficiency high when the flow drops.

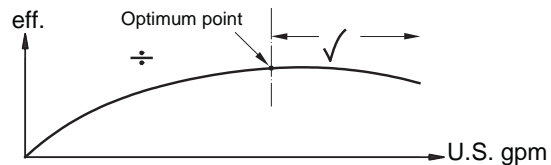


Fig. 6 Best efficiency

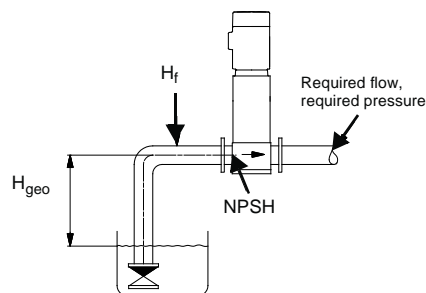


Fig. 7 Sizing data

Normally, E-pumps are used in applications characterized by a variable flow. Consequently, it is not possible to select a pump that is constantly operating at optimum efficiency.

In order to achieve optimum operating economy, the pump should be selected on the basis of the following criteria:

- The max. required duty point should be as close as possible to the QH curve of the pump.
- The required duty point should be positioned so that P_2 is close to the max. point of the 100% curve.

Between the min. and max. performance curve E-pumps have an infinite number of performance curves each representing a specific speed. Therefore it may not be possible to select a duty point close to the 100% curve.

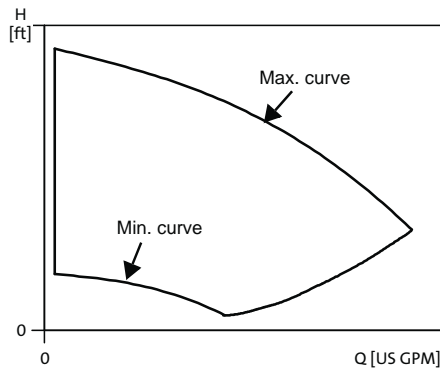


Fig. 8 Min. and max. performance curves

In situations where it is not possible to select a duty point close to the 100% curve the affinity equations to the right can be used. The head (H), the flow (Q) and the input power (P) are all the appropriate variables for the motor speed (n).

Note:

The approximated formulas apply on condition that the system characteristic remains unchanged for n_n and n_x and that it is based on the formula $H = k \times Q^2$, where k is a constant.

The power equation implies that the pump efficiency is unchanged at the two speeds. In practice this is not quite correct.

Finally, it is worth noting that the efficiencies of the frequency converter and the motor must be taken into account if a precise calculation of the power saving resulting from a reduction of the pump speed is wanted.

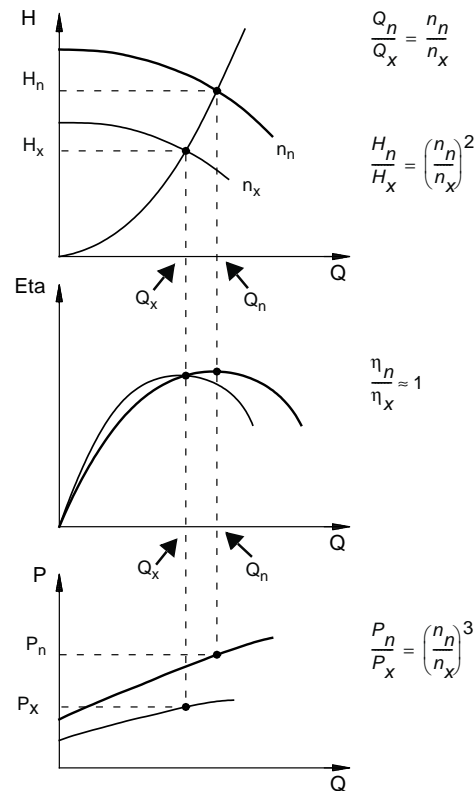


Fig. 9 Affinity equations

Legend

- H_n Rated head in feet
- H_x Current head in feet
- Q_n Rated flow in US gpm
- Q_x Current flow in US gpm
- n_n Rated motor speed in min^{-1} ($n_n = 3500 \text{ min}^{-1}$)
- n_x Current motor speed in min^{-1}
- η_n Rated efficiency in %
- η_x Current efficiency in %

WinCAPS® and WebCAPS®

WinCAPS and WebCAPS are both selection programs offered by Grundfos.

The two programs make it possible to calculate an E-pump's specific duty point and energy consumption.

By entering the sizing data of the pump, WinCAPS and WebCAPS can calculate the exact duty point and energy consumption. For more information about WinCAPS or WebCAPS see *Further documentation* on page 33.

3. Material

The material variant should be selected based on the liquid to be pumped.

4. Pump connection

Selection of pump connection depends on the rated pressure and pipework. To meet any requirement the CRT(E) pumps offer the following connections:

- PJE coupling - see Fig. 11
- ANSI adapter (CRT 8 and CRT 16 only - sold separately)

5. Shaft seal

As standard, the CRT(E) range is fitted with a Grundfos type A shaft seal suitable for the most common applications, see Fig. 12.

In service situations Grundfos type A shaft seals can be replaced without dismantling the pump head.

The following three key parameters must be taken into account, when selecting the shaft seal:

- Type of pumped liquid
- liquid temperature
- maximum pressure.

Inlet pressure and operating pressure

The limit values stated on page 10 must not be exceeded as regards ...

- maximum inlet pressure and
- maximum operating pressure.

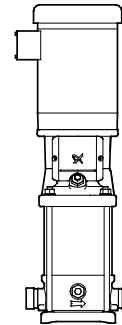


Fig. 10 CRT pump

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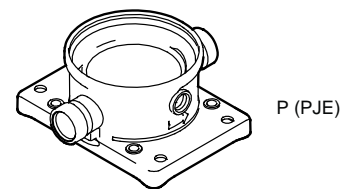


Fig. 11 Pump connections

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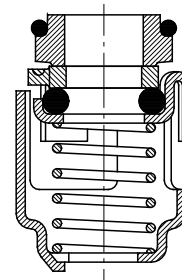


Fig. 12 Shaft seal

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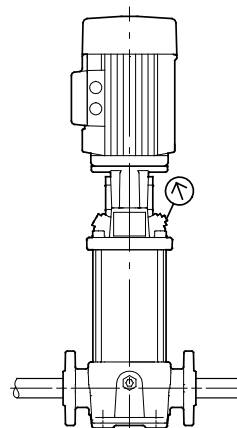


Fig. 13 Inlet and operating pressure

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Minimum inlet pressure - NPSH

Calculation of the inlet pressure "H" is recommended when

- the liquid temperature is high
- the flow is significantly higher than the rated flow
- water is drawn from depths
- water is drawn through long pipes
- inlet conditions are poor.

To avoid cavitation, make sure that there is a minimum pressure on the suction side of the pump. The maximum suction lift "H" in feet can be calculated as follows:

$$H = p_b - \text{NPSH} - H_f - H_v - H_s$$

p_b = Barometric pressure in feet absolute.
(Barometric pressure can be set to 33.9 ft at sea level).
In closed systems, p_b indicates the system pressure in feet.

NPSH= Net Positive Suction Head in feet.
(To be read from the NPSH curve at the highest flow the pump will be delivering).

H_f = Friction loss in suction pipe in feet.
(At the highest flow the pump will be delivering.)

H_v = Vapor pressure in feet.
(To be read from the vapor pressure scale. " H_v " depends on the liquid temperature " T_m ").

H_s = Safety margin = minimum 2.0 feet.

If the "H" calculated is positive, the pump can operate at a suction lift of maximum "H" feet of head.

If the "H" calculated is negative, an inlet pressure of minimum "H" feet is required.

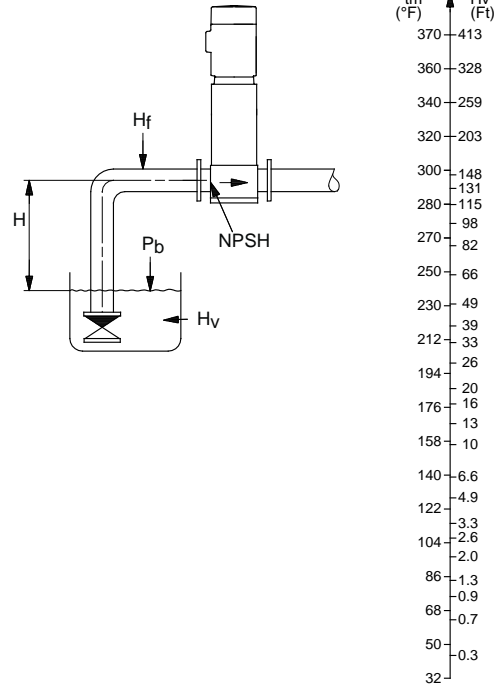


Fig. 14 Minimum inlet pressure - NPSH

Note: In order to avoid cavitation, never select a pump whose duty point lies too far to the right on the NPSH curve.

Always check the NPSH value of the pump at the highest possible flow.

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How to read the curve charts

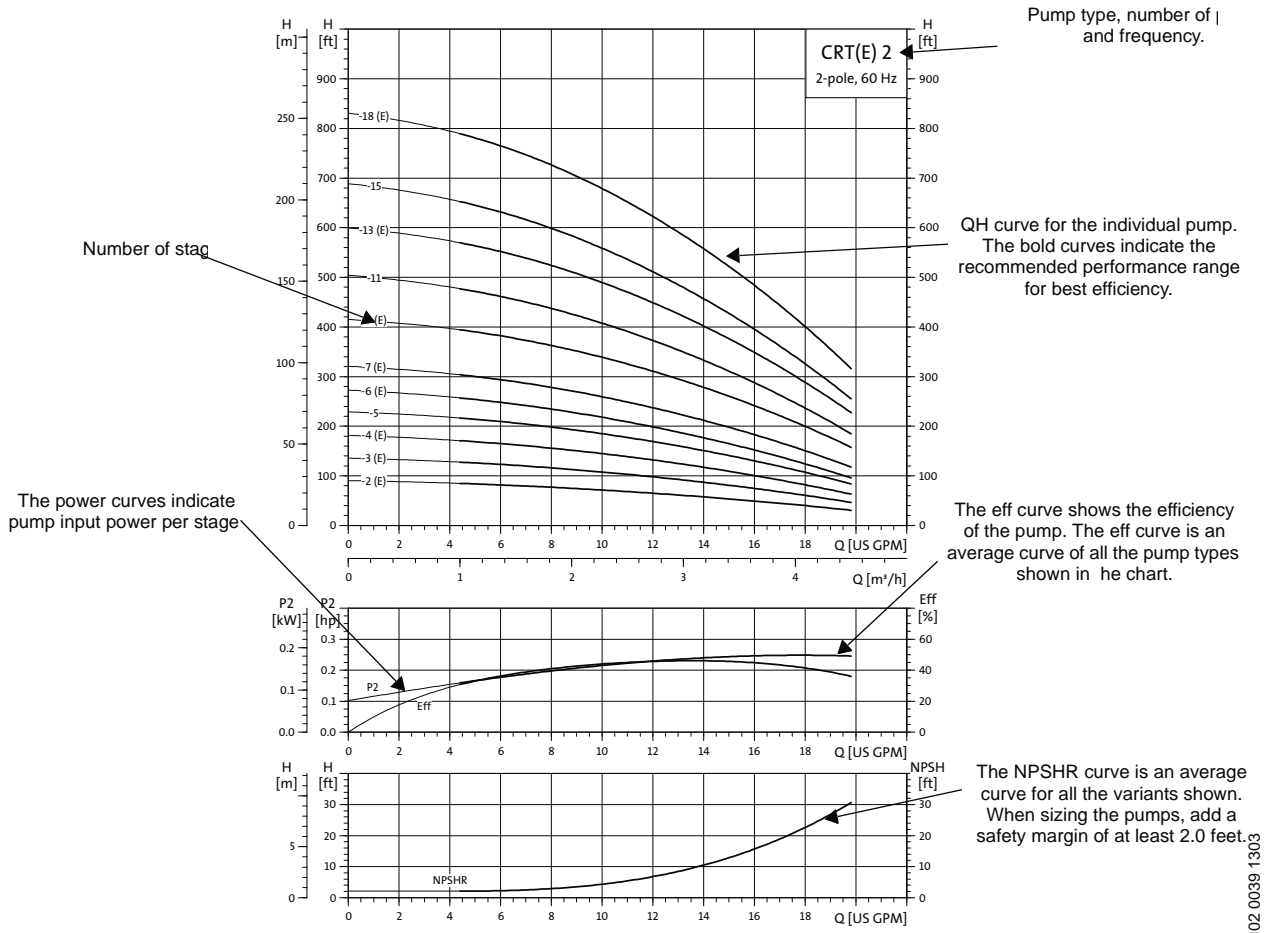


Fig. 15 How to read the curve charts

Guidelines to performance curves

The guidelines below apply to the curves shown on the following pages:

1. The motors used for the measurements are standard motors (TEFC or MLE).
2. Measurements have been made with airless water at a temperature of 68 °F (20 °C).
3. The curves apply to a kinematic viscosity of $\nu = 1 \text{ mm}^2/\text{s}$ (1 cSt).
4. Due to the risk of overheating, the pumps should not be used at a flow below the minimum flow rate.
5. The QH curves apply to actual speed with the motor types mentioned at 60 Hz.