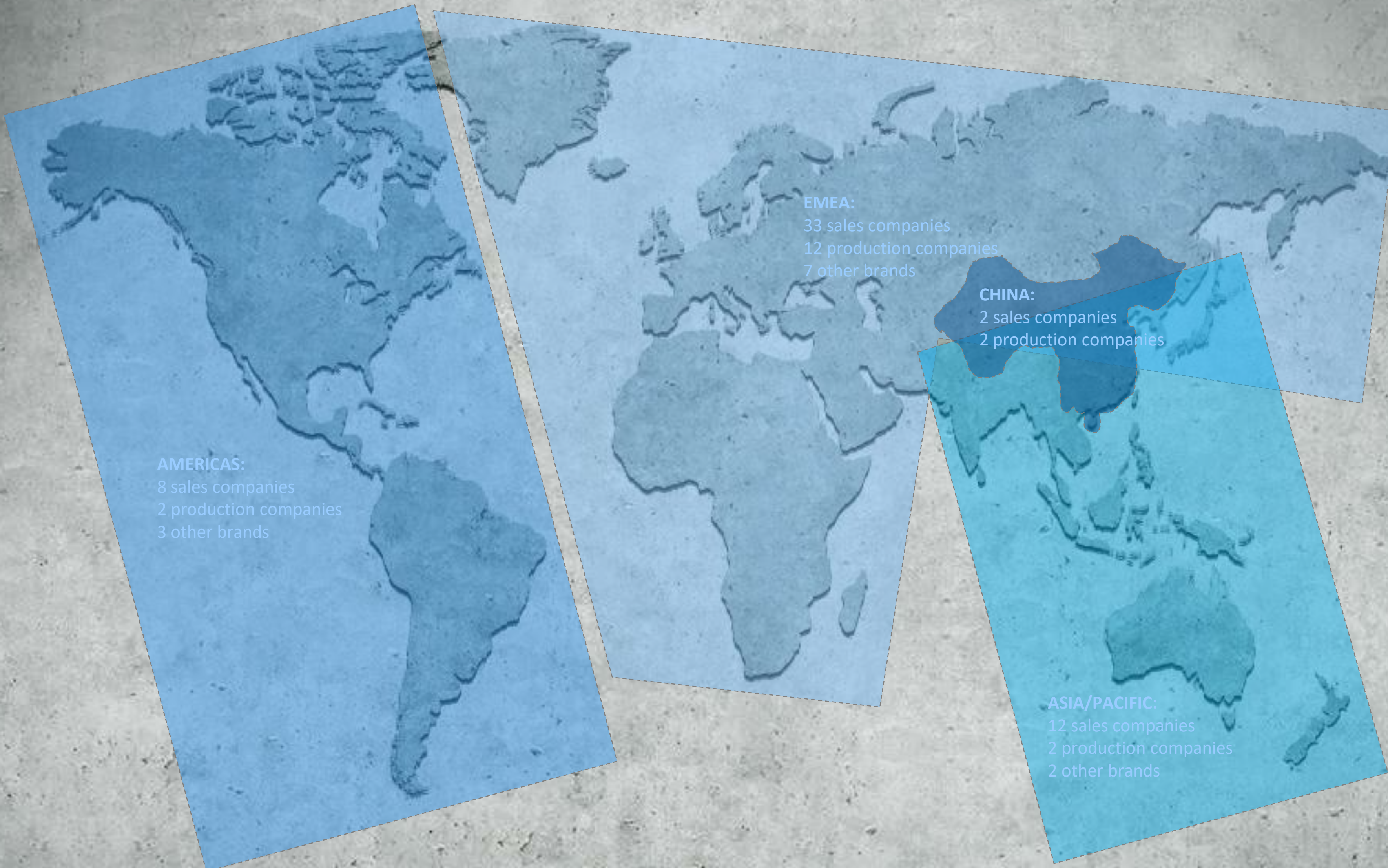
GRUNDFOS IN BRIEF

WHEN

- Grundfos was founded in 1945 by Poul Due Jensen
- We have an annual production of more than 16 million pump units
- In 2015 Grundfos’ turnover was 24.8 billion DKK
- Grundfos has more 17,000 employees in 56 countries

Grundfos in brief



be think innovate
is our promise to contribute to global sustainability

be think innovate
is our promise to add value to our costumers and partners

be think innovate
is our promise to ensure reliable operations

GRUNDFOS INDIA PURPOSE

Grundfos Pumps India will work towards helping its customers and the nation to conserve Water and Energy.

Grundfos will, through all its actions, focus on how it can co-create value with its stakeholders by being a responsible partner for a cleaner and greener planet

About Grundfos India

The Grundfos Company: **Grundfos Pumps India Pvt. Ltd.**

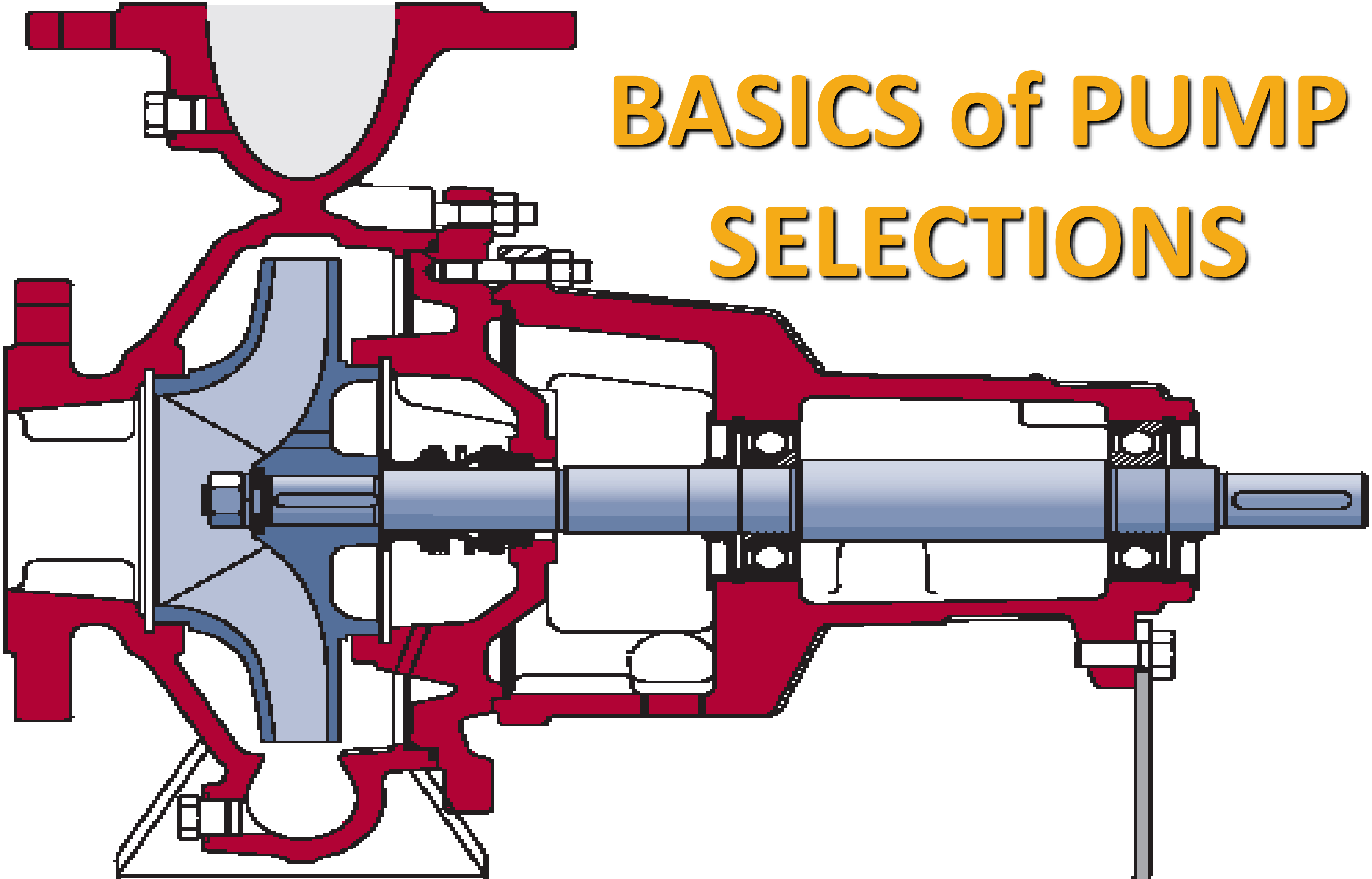
Grundfos employees**: 313 (including 43 SW)**

Sales Responsibility: **India, Bangladesh, Bhutan, Maldives and Nepal**

Sales Turnover (2017): **4750 Mio INR**

Local assembly:

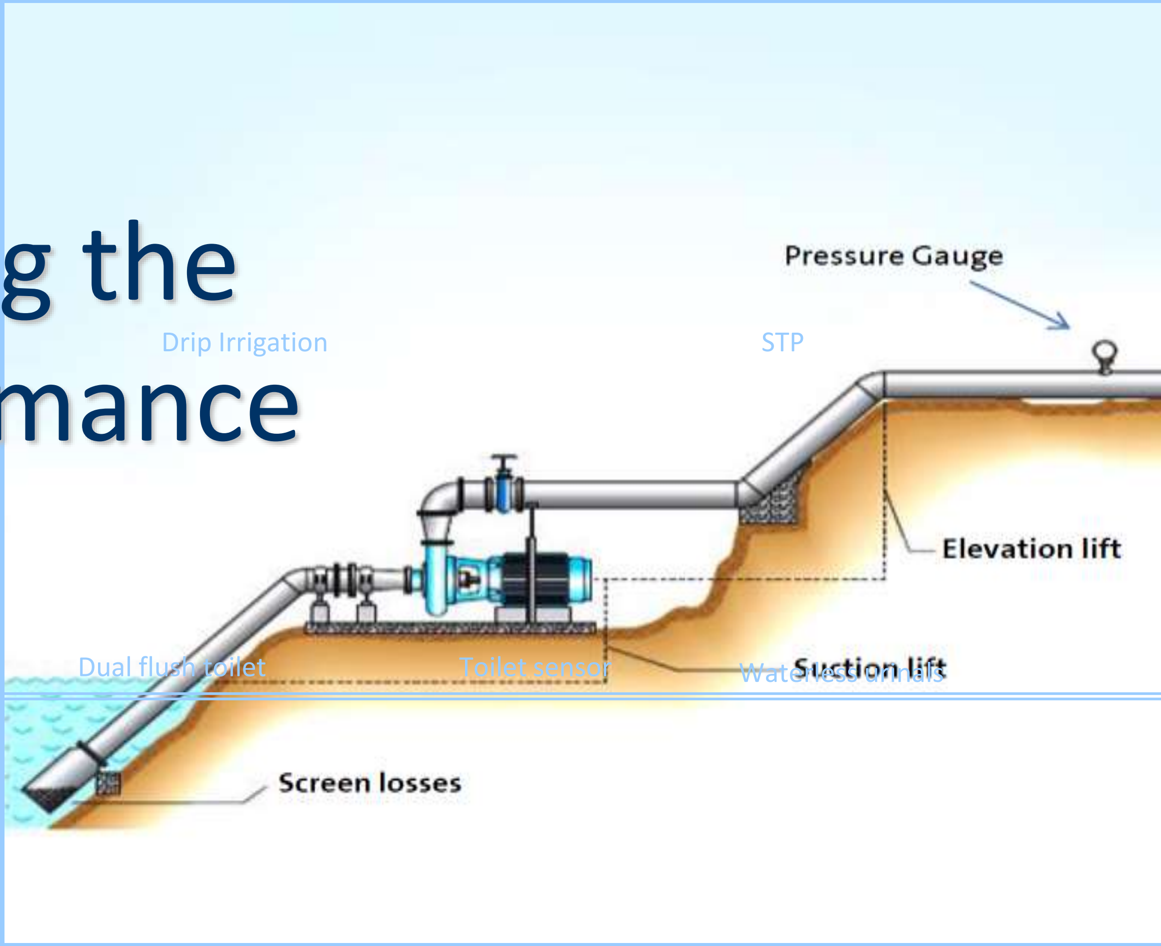
BASICS of PUMP SELECTIONS



TOPICS THAT WOULD BE COVERED

- PUMP /PUMP TYPES (Usage)
- PUMP PERFORMANCE (Various Applications)
- FACTORS AFFECTING PUMP PERFORMANCE
- DATA TO SEEK FOR PUMP SELECTION
- PUMP TYPES & USAGE
- USE OF VFDs
- SPLIT SYSTEMS
- CAUSES OF INEFFICIENCY

Understanding the Pump Performance



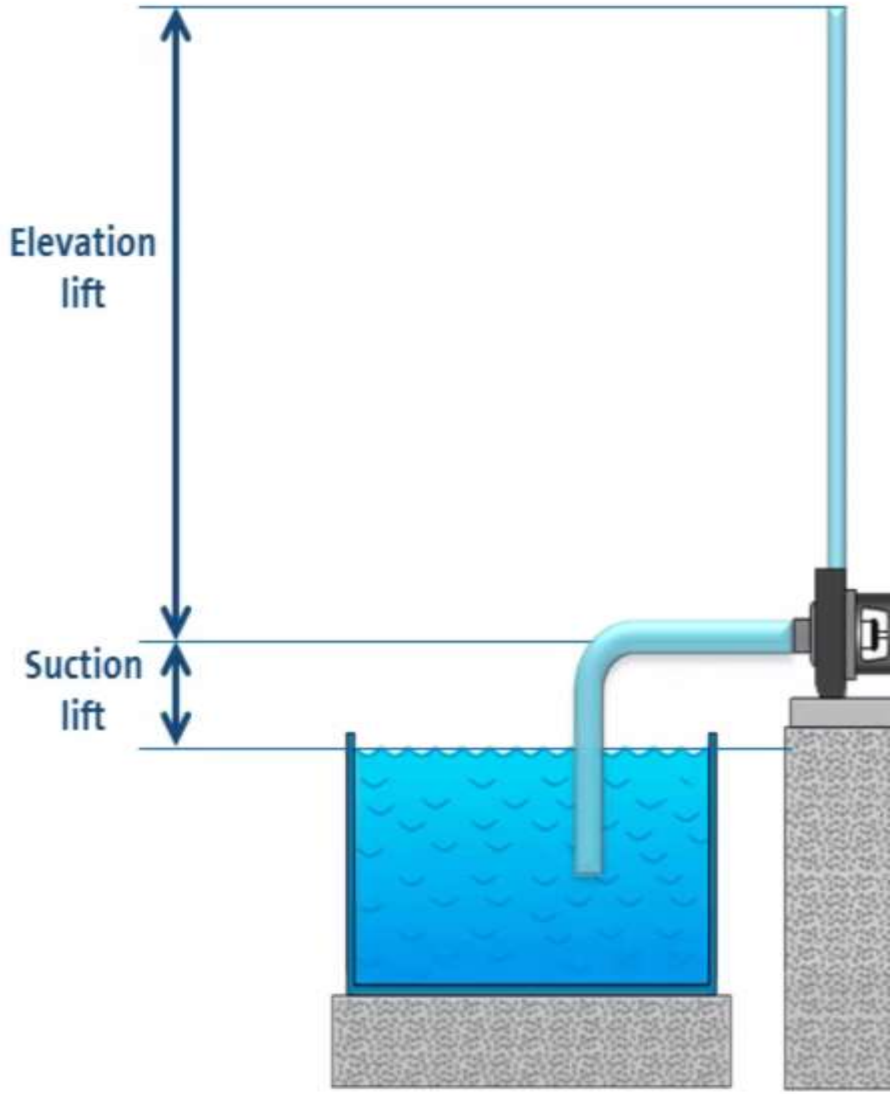
Flow

- Flow (Q) is the amount of water that a pump transports through the pipes in a given time.

- Flow (Q) is measured in cubic meters per hour (m^3/h).

Head

- The head of a pump is the pressure the pump is able to provide.
- It describes the height to which the pump is able to elevate water.
- Ex: a head of 40 m means that the pump is able to elevate water 40 meters.



POWER

- Power (P) in a water pumping system can be described as the force and speed by which the water is transported.
- Power (P) is directly dependent on both flow (Q) and head (H).
- Power is measured in kilowatt (kW).

What are the factors ?

The pump duty is dependant on two factors:

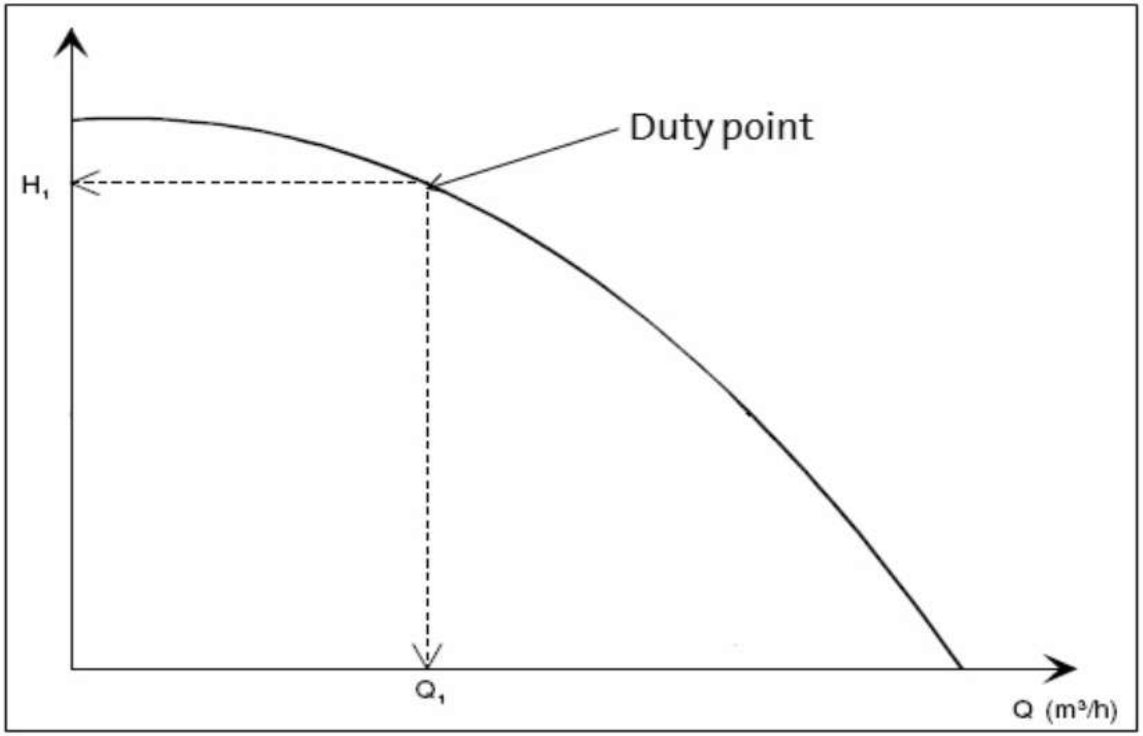
- The Flow Rate required = Q (establish first)
- The Total Head required = H (establish second)

Since H is dependent on Q we establish Q first

Pump selection

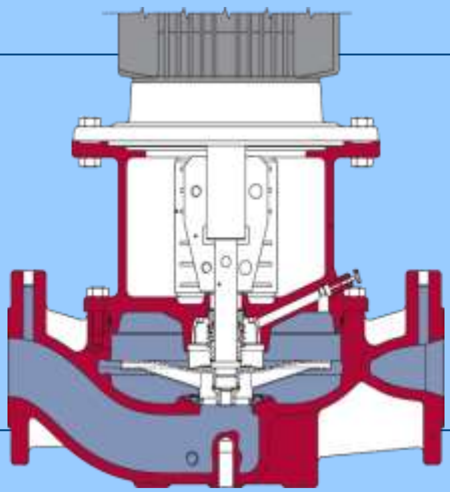
Based on the calculated Q (flow) & H (head) requirement a pump can now be selected

- When you have the Q & H this is called the duty point

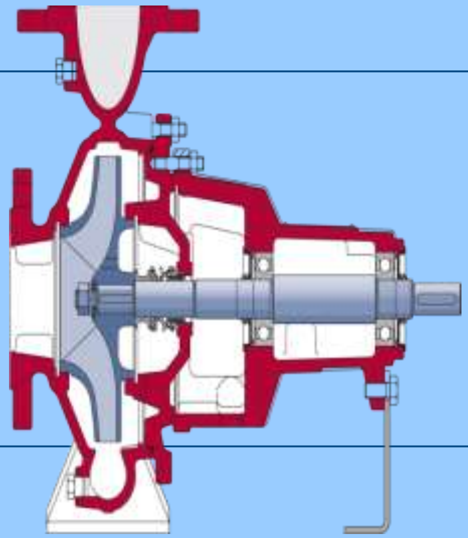


The intersection of the pump and system curve is the duty or operating point

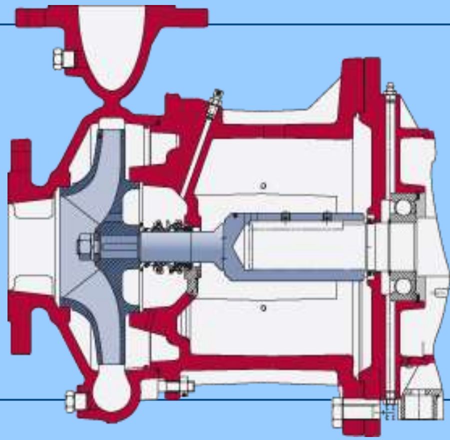
Different types of centrifugal pumps
Single-stage



Inline single-stage
TP range

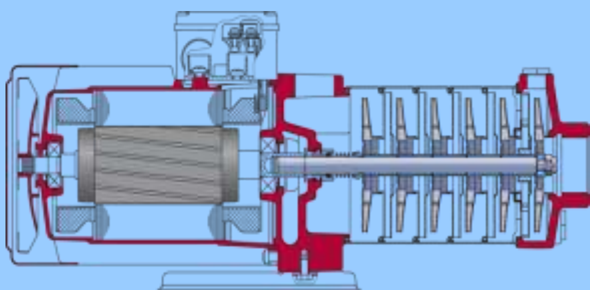


Horizontal norm pump
long-coupled
NK and NKG range

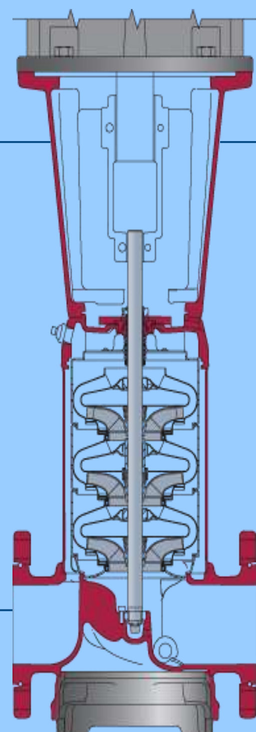


Horizontal norm pump
close-coupled
NB and NBG range

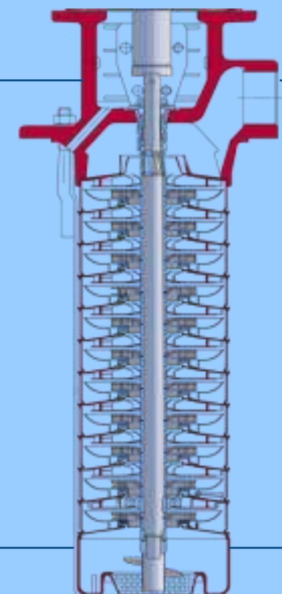
Different types of centrifugal pumps
Multistage



Horizontal multistage pump
CM range



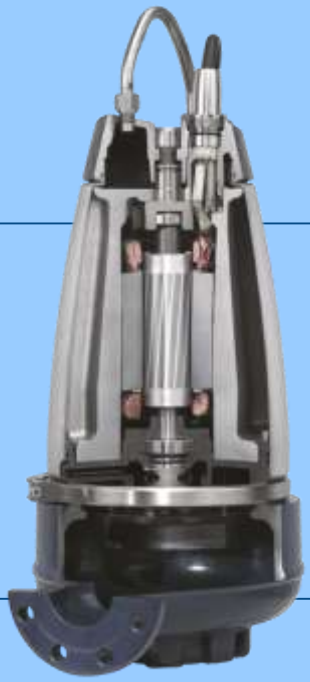
Vertical inline
multistage pump
CR range



Immersible
multistage pump
MTR range

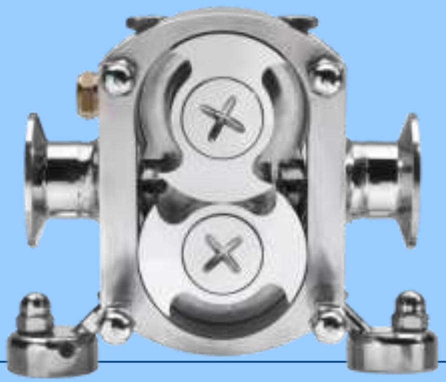
Submersible
multistage pump
SP range

Other pump designs



Centrifugal wastewater pump

SE range



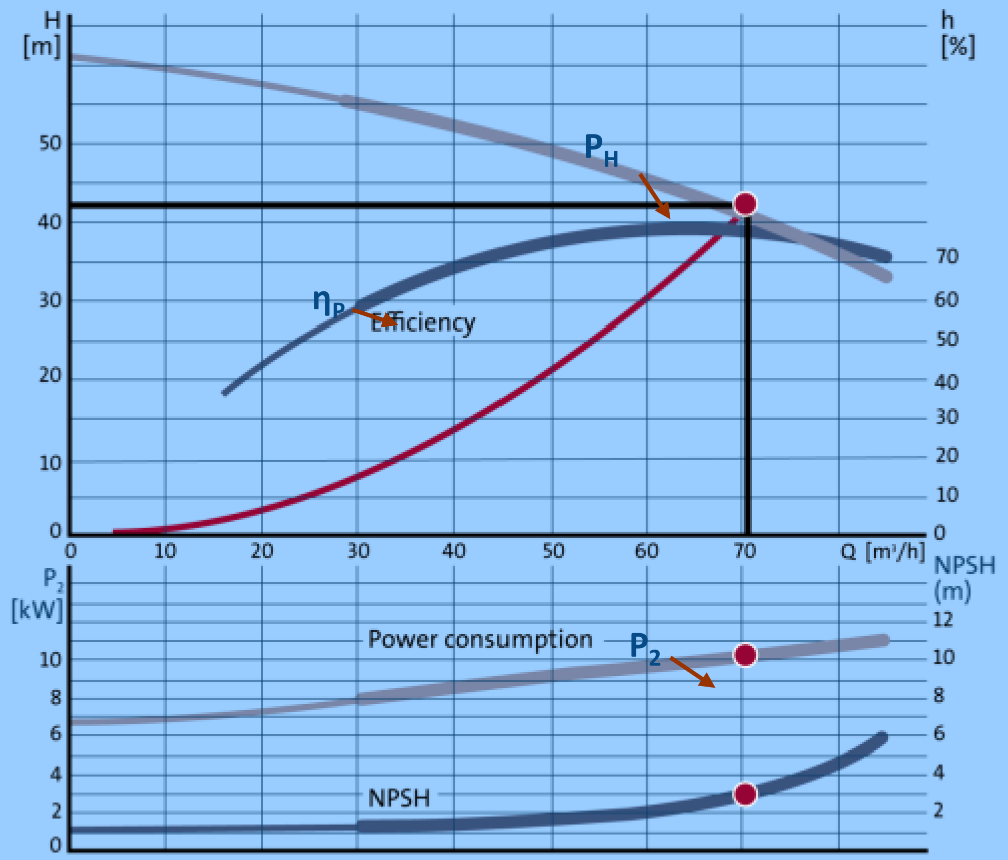
Positive displacement pump

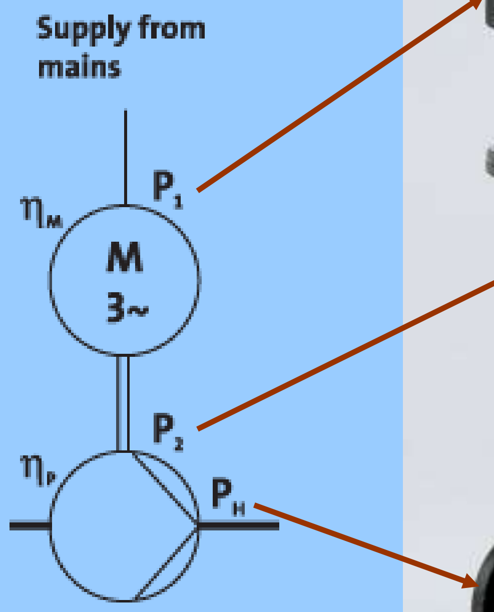
NOVAlobe range

Dosing pump

DME range

Pump curve


H
[m]
h
[%]
P_H
η_P
Efficiency
Q [m³/h]
P_2
[kW]
NPSH
(m)
Power consumption
P_2
NPSH


Supply from mains
P_1
η_M
M
3~
P_2
η_P
P_H

Power formula

$$P_H = Q \text{ x} H \text{ x} g \text{ x} \rho / 3600$$

$$P_2 = P_H / \eta_P$$

$$P_1 = P_2 / \eta_M$$

or

$$P_1 = U \text{ x} I \text{ x} \cos\varphi \text{ x} \sqrt{3}$$

Where ;

P_H is the hydraulic power in Watt

Q is the flow in m³/h

H is the head in meter

g is the acceleration of gravity 9.81 m/s

ρ is the density of the liquid in kg/m³

P_2 is the power input to the pump or the power output from the motor

η_P is the efficiency of the pump in the duty point

η_M is the efficiency of the motor

P_1 is the power input to the motor

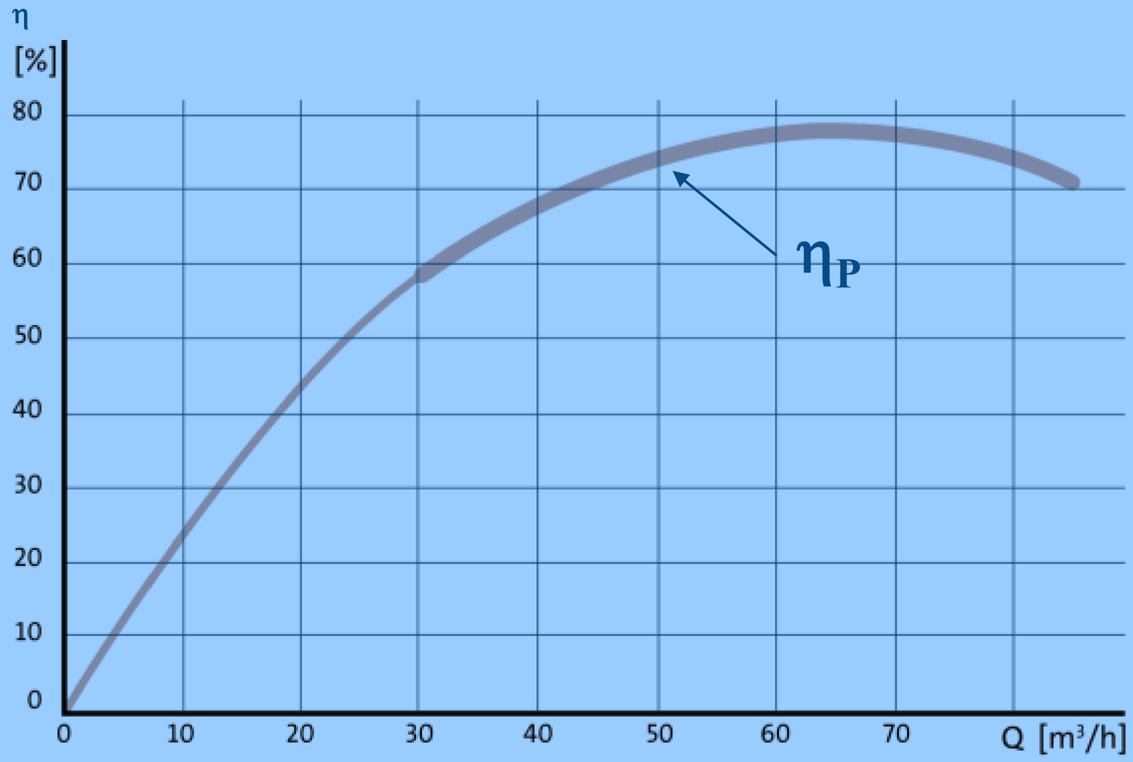
U is the voltage on the main grid in Volt

I is the current from the main grid in Amp.

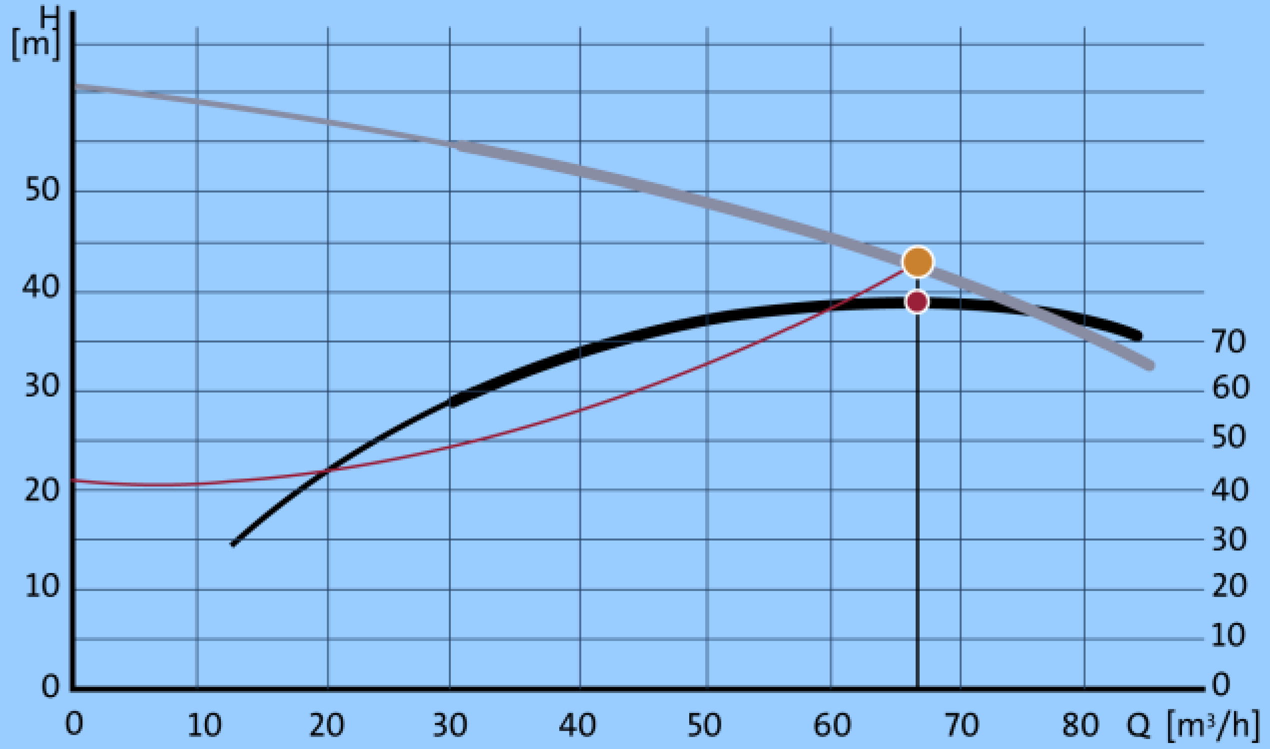
Cosϕ is the power factor

Efficiency curve

$\eta_P = P_H / P_2$



Efficiency curve



FACTORS AFFECTING PUMP PERFORMANCE

1. SPECIFIC GRAVITY

2. ALTITUDE

3. VISCOSITY

4. TEMPERATURE

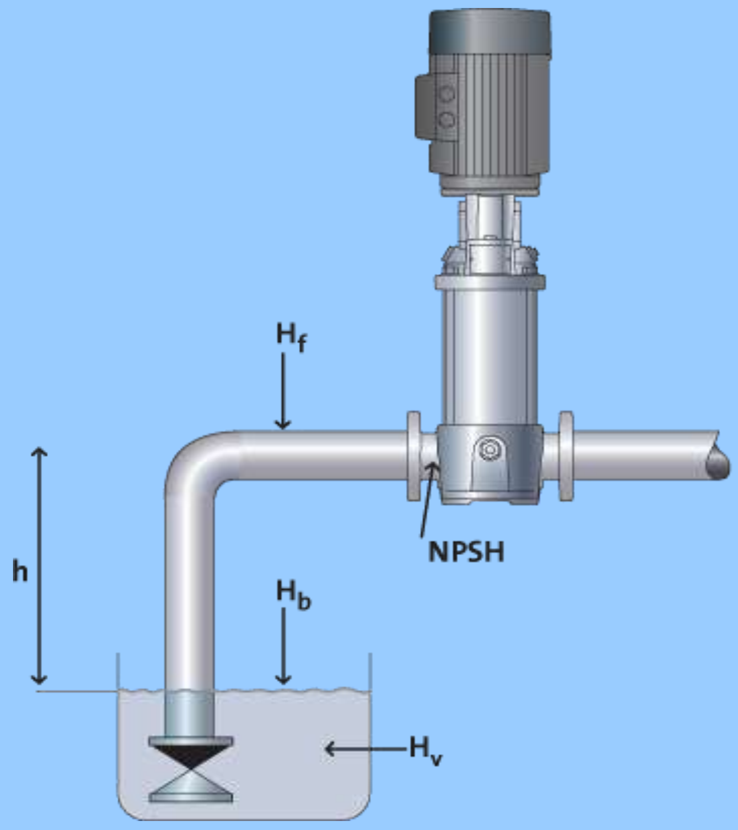
5. VAPOUR PRESSURE

6. PERCENTAGE OF SOLIDS

7.LIFE OF THE PUMP

Suction Conditions

Suction Conditions

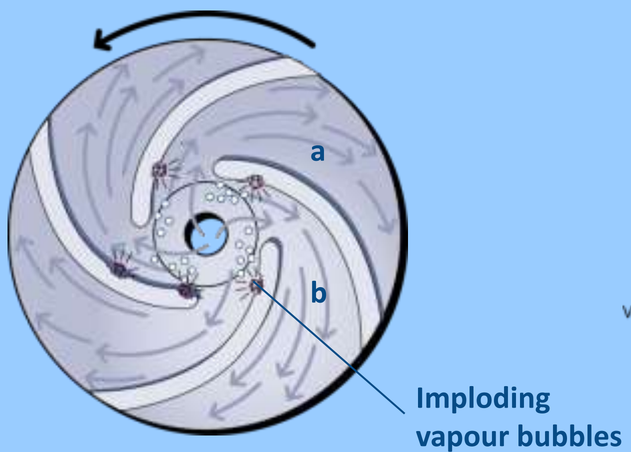


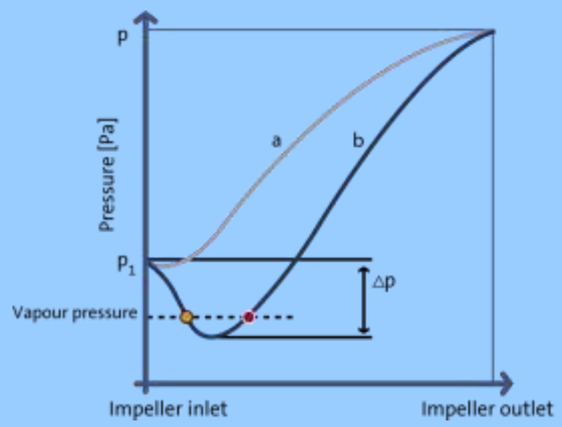
What is the maximum depth from which a pump can draw water?

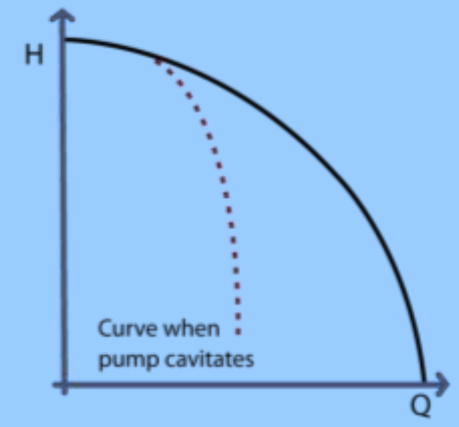
h; Max. suction lift
H_b ; 10.13m [barometric pressure]
H_f; Friction loss in pipes and foot valve
H_v; Vapour pressure
NPSH
H_s; Safety margin = minimum 0.5 meter

$$h = H_b - H_f - H_v - NPSH - H_s$$

Cavitation and NPSH







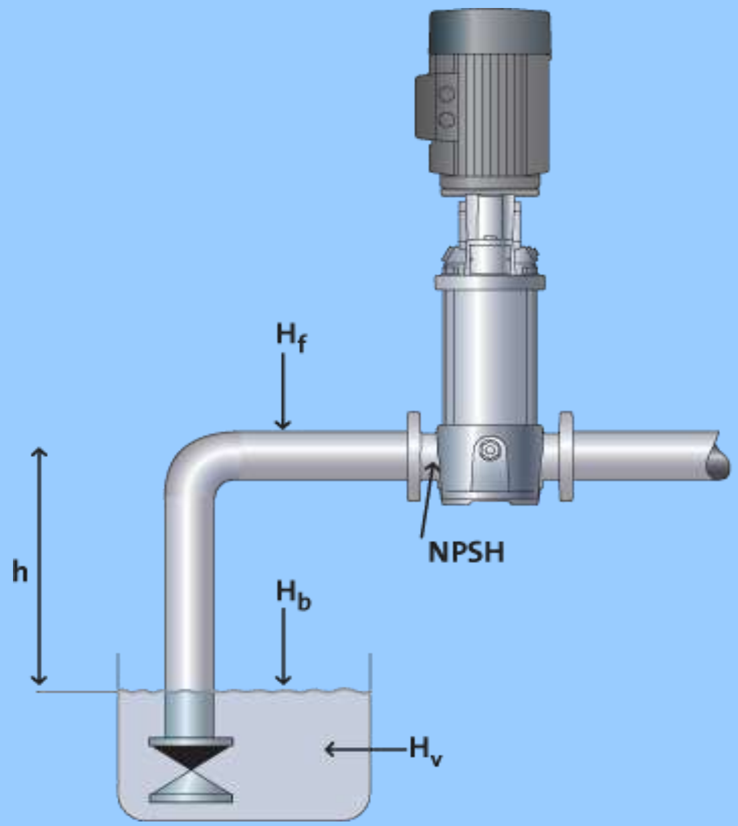
a = front of impeller vanes

b = back of impeller vanes

a = front of impeller vanes

b = back of impeller vanes

Calculation of risk of cavitation



h; Max suction lift
H_b ; 10.13m [barometric pressure]
H_f; Friction loss in pipes and foot valve
H_v; Vapour pressure
NPSH
H_s; Safety margin = minimum 0.5 meter

$$h = H_b – H_f – H_v – NPSH_R - H_s$$

AFFINITY LAWS

$$\frac{n_x}{n} = \left(\frac{Q_x}{Q}\right)$$

Speed **n** is proportional to flow **Q**

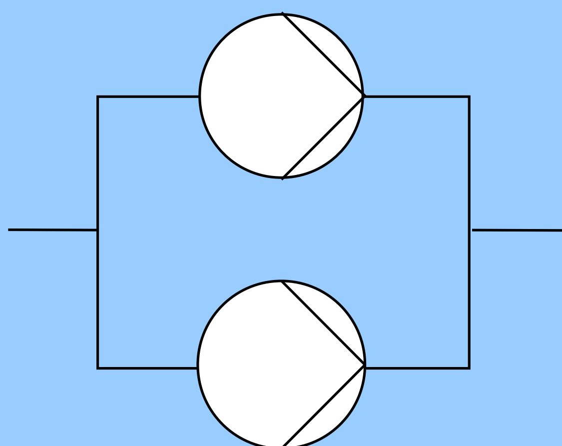
$$\frac{H_x}{H} = \left(\frac{Q_x}{Q}\right)^2$$

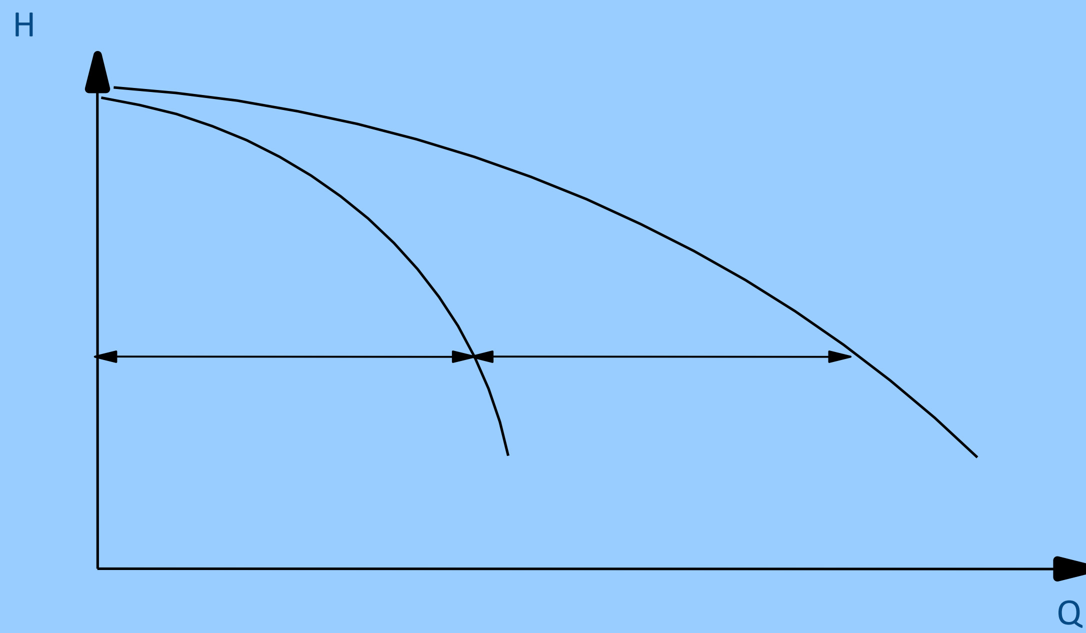
Head **H** is proportional to flow in second power.

$$\frac{P_x}{P} = \left(\frac{Q_x}{Q}\right)^3$$

Input power is proportional to flow **Q** in third power

Parallel Operation of Similar Pumps



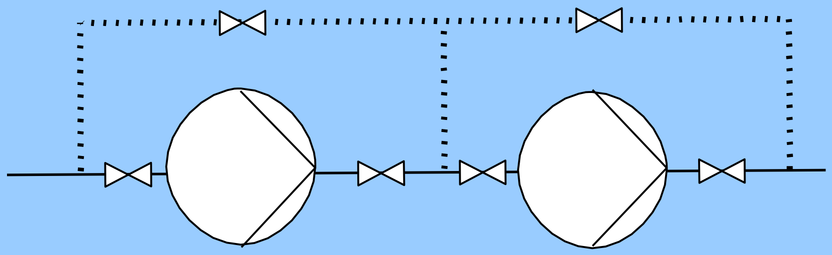


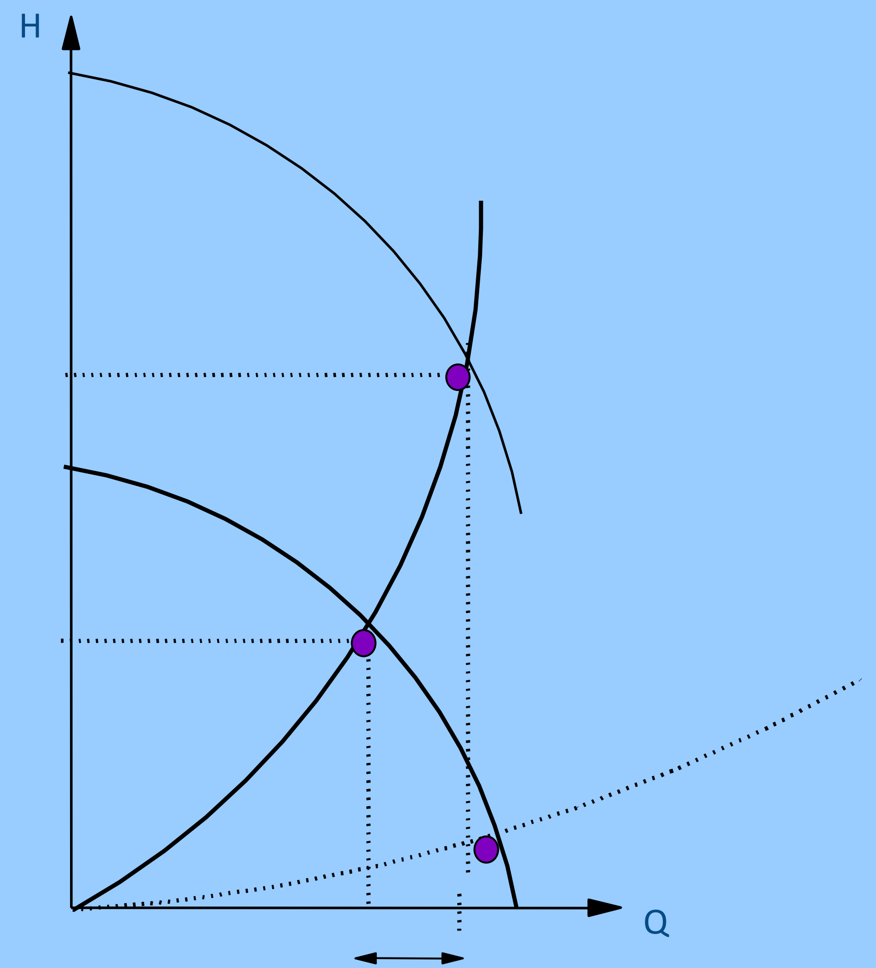
Theoretic:

Double flow [2 x Q]

Same head [1 x H]

Series Operation of Pumps





Theoretic:

Double head [2 x H]

Same flow [1 x Q]

DATA TO SEEK FOR PUMP SELECTION

- Media or Liquid to be pumped.
- Concentration of the liquid ,%(for ex acetic acid/HCL/H_2SO_4)
- Solid content ,if any.
- Particle size ,mm
- TDS
- Flow/Capacity of Pump ,m^3/hr or USGPM OR LPS
- Head, m or ft
- Suction pressure ,Discharge pressure ,Kg/cm^2
- Suction head or Suction lift condition
- Temperature of the Pumping liquid.Deg C.
- Specific gravity or Density of the liquid.
- Viscosity of the liquid, Cp/Cst.
- NPSHA, m or ft

Selection of Pumps

- Application
- Requirement at Site
- Process in Which Pump is to be used

End Suction Top Discharge Pump
In Line Pump (Closed Coupled)

- Low Flow and Low Head
- Low Negative Suction
- Lower kW
- Space Restriction
- Better Efficiency

End Suction Top Discharge Pump (Long Coupled)

- Medium Flow and Low Head
- Low Negative Suction
- High Temperature Applications
- High Pressure Intake to the Pump

Horizontal Split Case Pump (Long Coupled)

- High Flow and Medium Head
- Medium Negative Suction
- Low NPSH
- Higher Efficiency

Vertical Turbine Pump & Vertical Extended Shaft Pump

- High Flow, Very High Flow
- Medium Head, High Head
- High Negative Suction
- Problem of Flooding

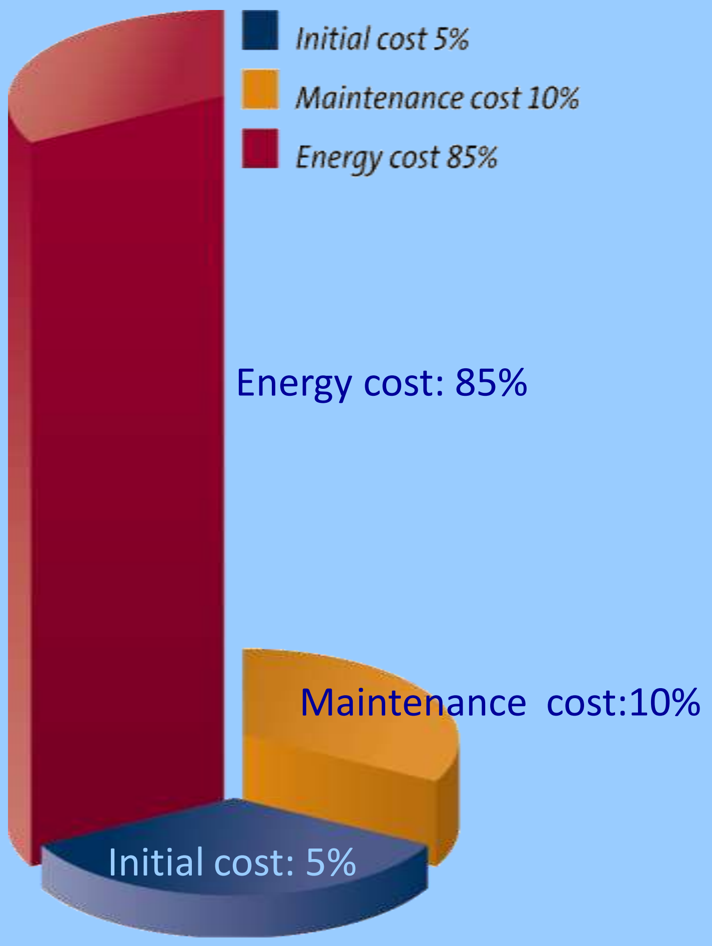
High Pressure Pump

- Low Flow & Medium Flow
- High Pressure
- Multi Stage
- Space Constraints

Use of VFD and Smaller Capacity Parallel Pumps

- Where to Use VFD, Misconception Installing VFDs
- Feedback Systems / Automations systems using VFDs
- VFDs on RO systems
- Boiler Feed Pumps
- Where to Use Small Capacities Parallel Pumps

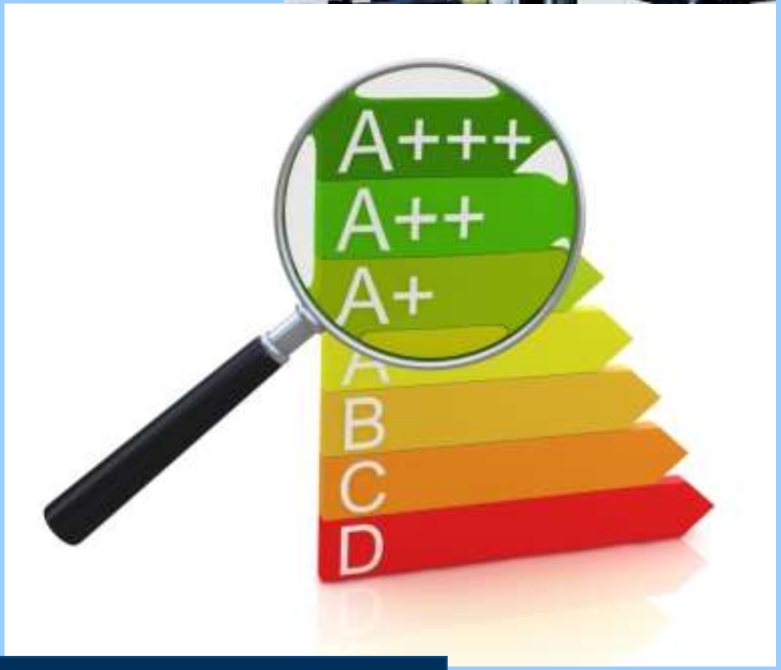
LIFE CYCLE COSTS:



Focus on Life Cycle Cost

- Energy

GRUNDFOS IN ENERGY AUDIT



Grundfos is committed to promote energy savings through energy audits of pumps and subsequently help our customers to save energy and coat. The energy audit is being carried out by systematically measuring the flow, pressure developed by the pump and power absorbed. Overall, an increased profit to our customers. This is our way of ensuring a cleaner, greener and sustainable environment for the future.

The number of Audit conducted between 2006 to 2012:
683 audits with Power savings of 15590 Kw/h

Major Reasons for Excess Power Consumption

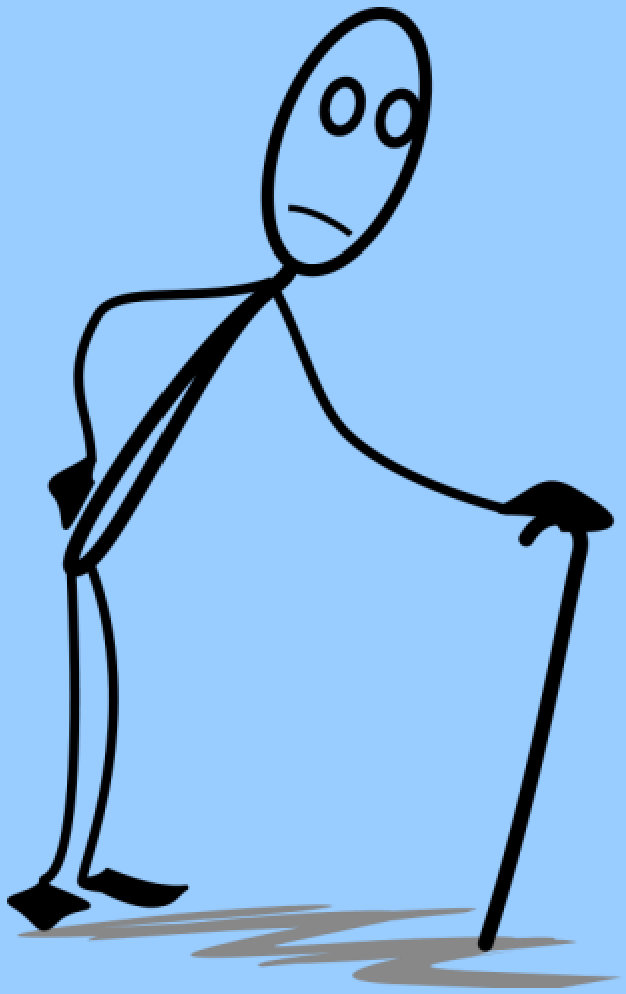
Over Design

Major Reasons for Excess Power Consumption

Peculiar site where the suction as well as the delivery valves are throttled due to over sizing at design stage

Major Reasons for Excess Power Consumption

Old and Inefficient



Major Reasons for Excess Power Consumption

Inefficient pump of more than 20 Years old operated at 25% efficiency

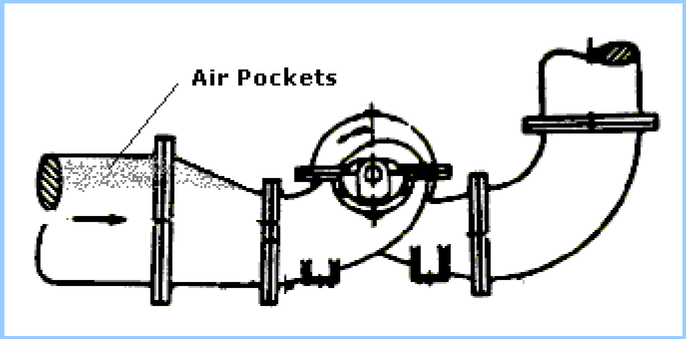
Major Reasons for Excess Power Consumption

Improper Layout/Piping

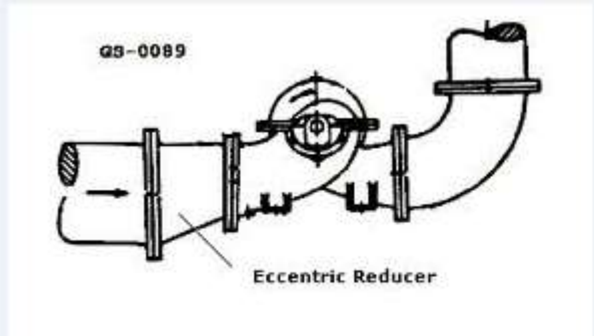
Major Reasons for Excess Power Consumption

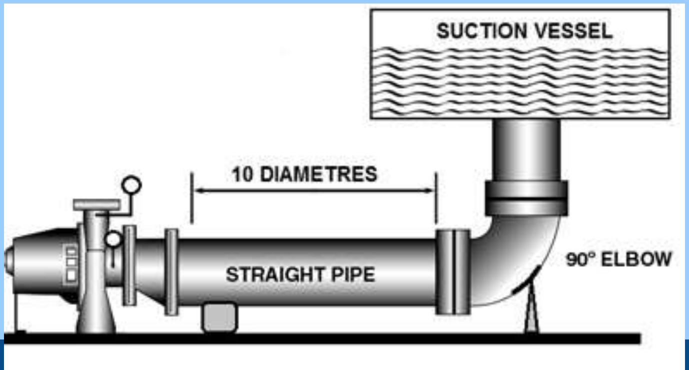
Inefficient pump of more than 20 Years old operated at 25% efficiency

Incorrect



Correct





INSTRUMENTS
USED

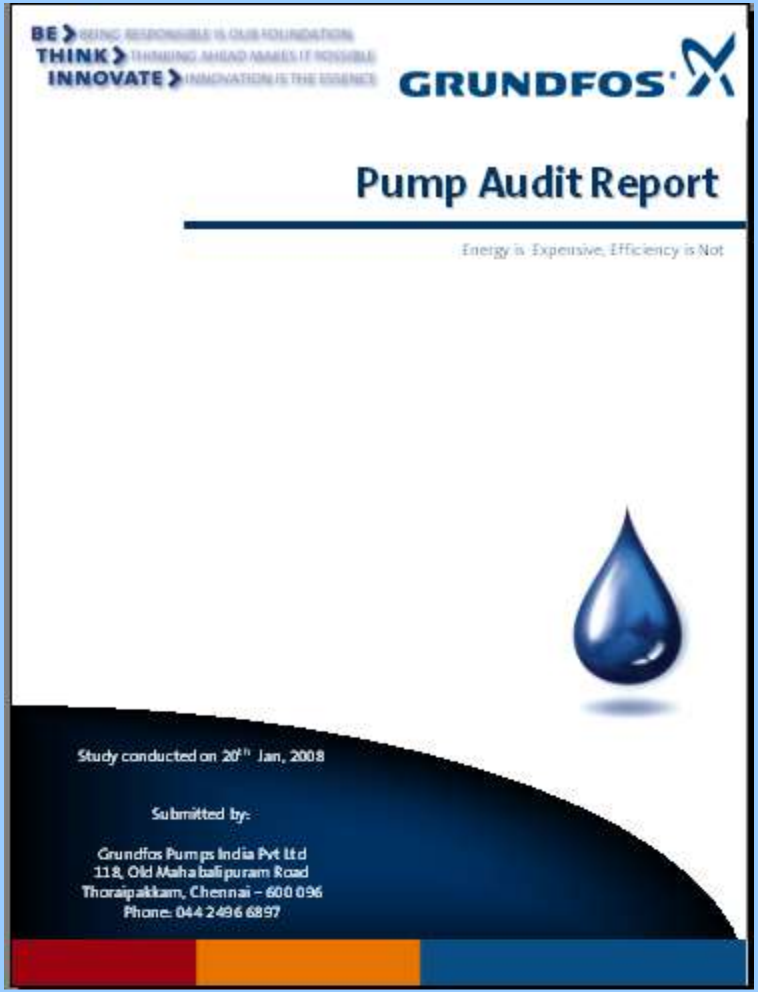
Ultrasonic Flow meter for water and sewage (EESIFLO capable of measuring flow in pipes up to DN 2500 mm) – EESIFLO make

Calibrated pressure gauges (Glycerine filled)

Power Analyzer (Up to 1000 Amps) Krykard make

FINAL REPORT

- Executive summary
- Introduction
- Write-up
- Existing and new system layout
- Detailed calculations
- Commercial offers
- Technical brochures
- Sum up


BE
THINK
INNOVATE
GRUNDFOS

Pump Audit Report

Energy is Expensive, Efficiency is Not

Study conducted on 20th Jan, 2008

Submitted by:

Grundfos Pumps India Pvt Ltd
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Thoraipakkam, Chennai – 600 096
Phone: 044 2496 6897

Cost of Ownership is about thinking ahead and knowing what is hidden under the iceberg

QUESTIONS?

THANK YOU FOR YOUR ATTENTION!