API 685 – Applications and Limits

Sundyne *HMD Kontro*
Sealless Pumps

API 685 Annex A (informative) Application Information

A.1 General

Some additional understanding of differences between sealless pumps and mechanically sealed centrifugal pumps is necessary for proper application. Information is presented within this section to point out factors which need to be considered in application, and identify factors which are different from considerations for centrifugal pumps with shaft seals.

API 685 Annex A (informative) Application Information

A.2 Circulation Plan Selection and Application

Selection of appropriate circulation plan (Annex D):

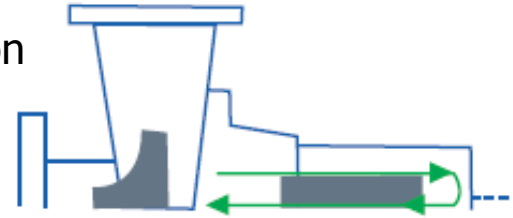
- Cleanliness
- Volatility of liquid
- Toxicity
- Viscosity
- Specific Heat
- Specific Gravity
- Vapour Pressure

Also to be considered are intended operation, flow rates, NPSH, frequency of starts, and cooling or heating availability.

API 685 Annex A (informative) Application Information

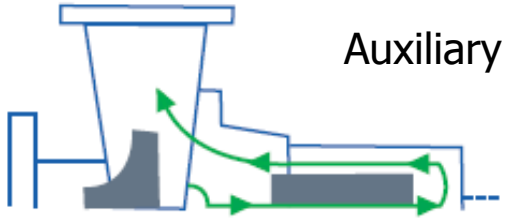
A.2 Circulation Plan Selection and Application – Annex D

Back to suction

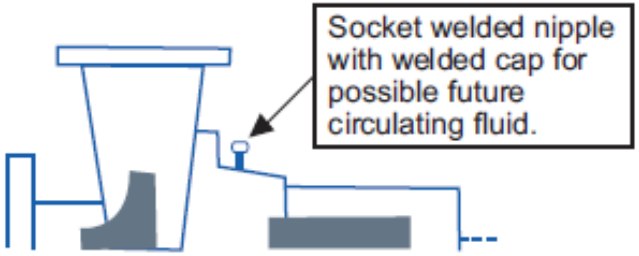


PLAN 1-S	Internal recirculation through drive chamber back to suction.

Auxiliary impeller

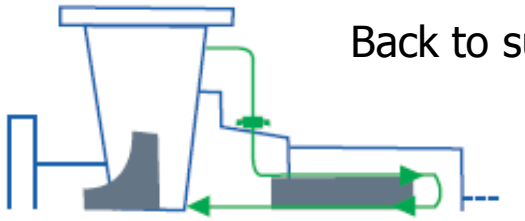


PLAN 1-SD	Internal recirculation from high pressure through the rotor chamber to an auxiliary impeller and back to pump discharge.



PLAN 2-S	Dead-ended rotor chamber with no circulation of flushed fluid (used for temperature thinning viscous fluids).

Back to suction

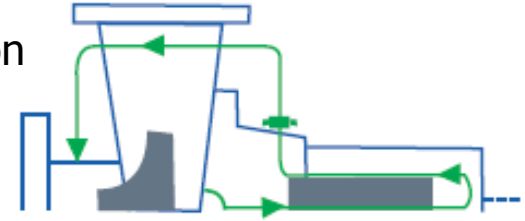


PLAN 11-S	Recirculation from pump discharge through an orifice to the rotor chamber and back to suction.

API 685 Annex A (informative)

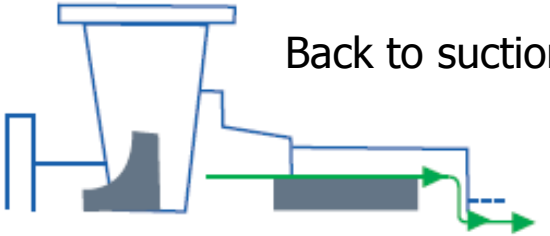
A.2 Circulation Plan Selection and Application – Annex D

Back to suction



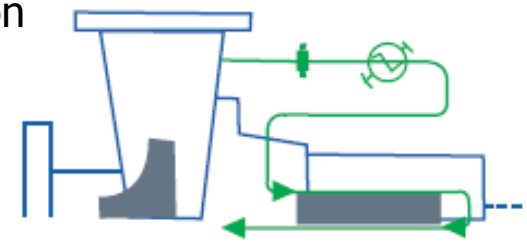
PLAN 13-S	Recirculation from impeller discharge to the rotor chamber, through an orifice and back to pump suction.

Back to suction Vessel



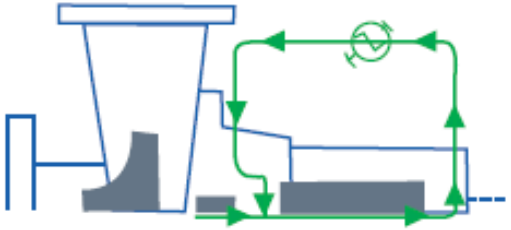
PLAN 13-SE	Reverse circulation from impeller discharge through the rotor chamber to an external suction vessel.

Back to suction



PLAN 21-S	Recirculation from pump discharge through an orifice and cooler to the rotor chamber and back to pump suction.

Auxiliary device



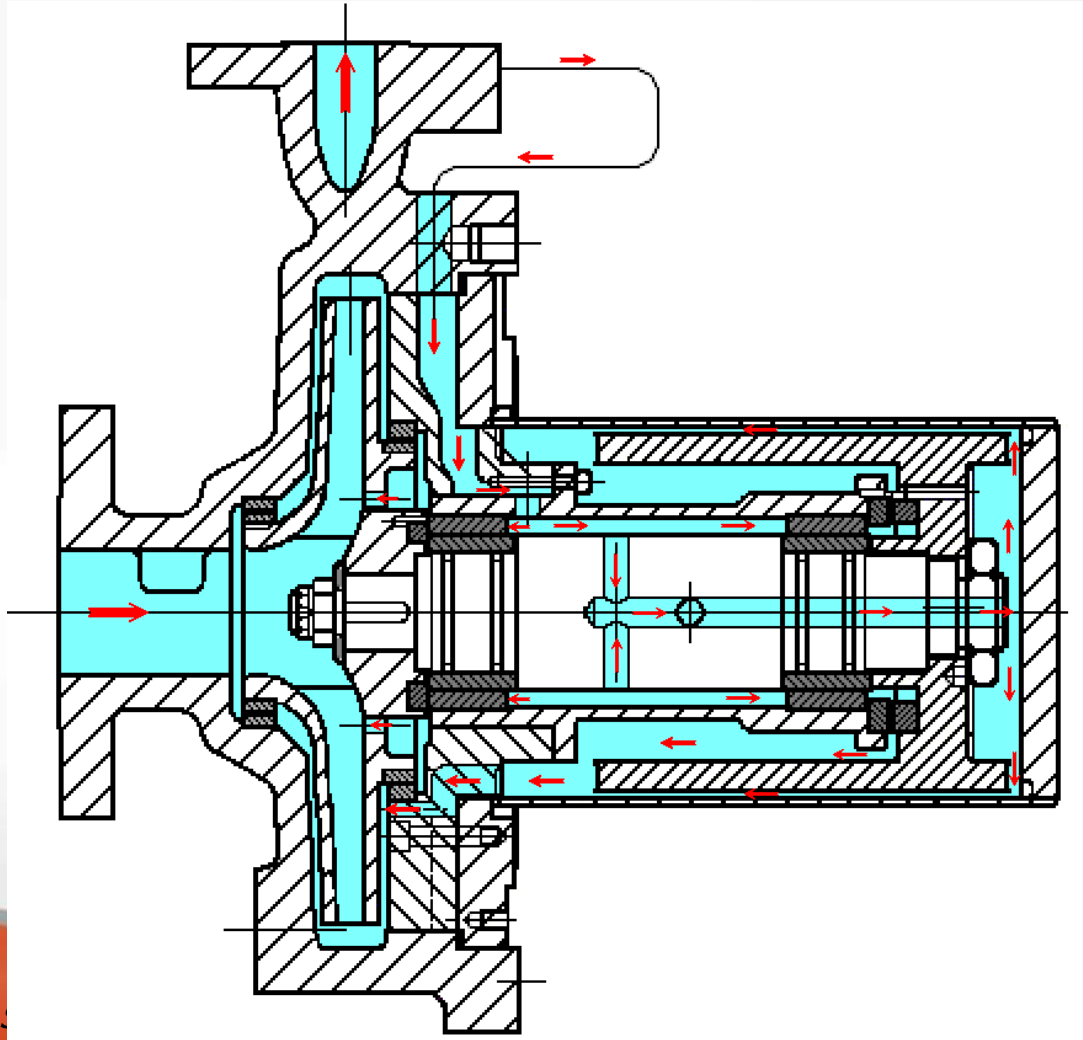
PLAN 23-S	Recirculation from rotor chamber through a cooler back to rotor chamber using an auxiliary pumping device.

API 685 Annex A (informative)

A.2 Circulation Plan Selection and Application

Discharge to Discharge Flow Regime

- Return to suction is avoided
- Does not interfere with flow into suction, improving NPSH performance
- Allows Inducers to be used
- Less likely to cause VP issues
- No auxiliary Impeller needed



API 685 Annex A (informative) Application Information

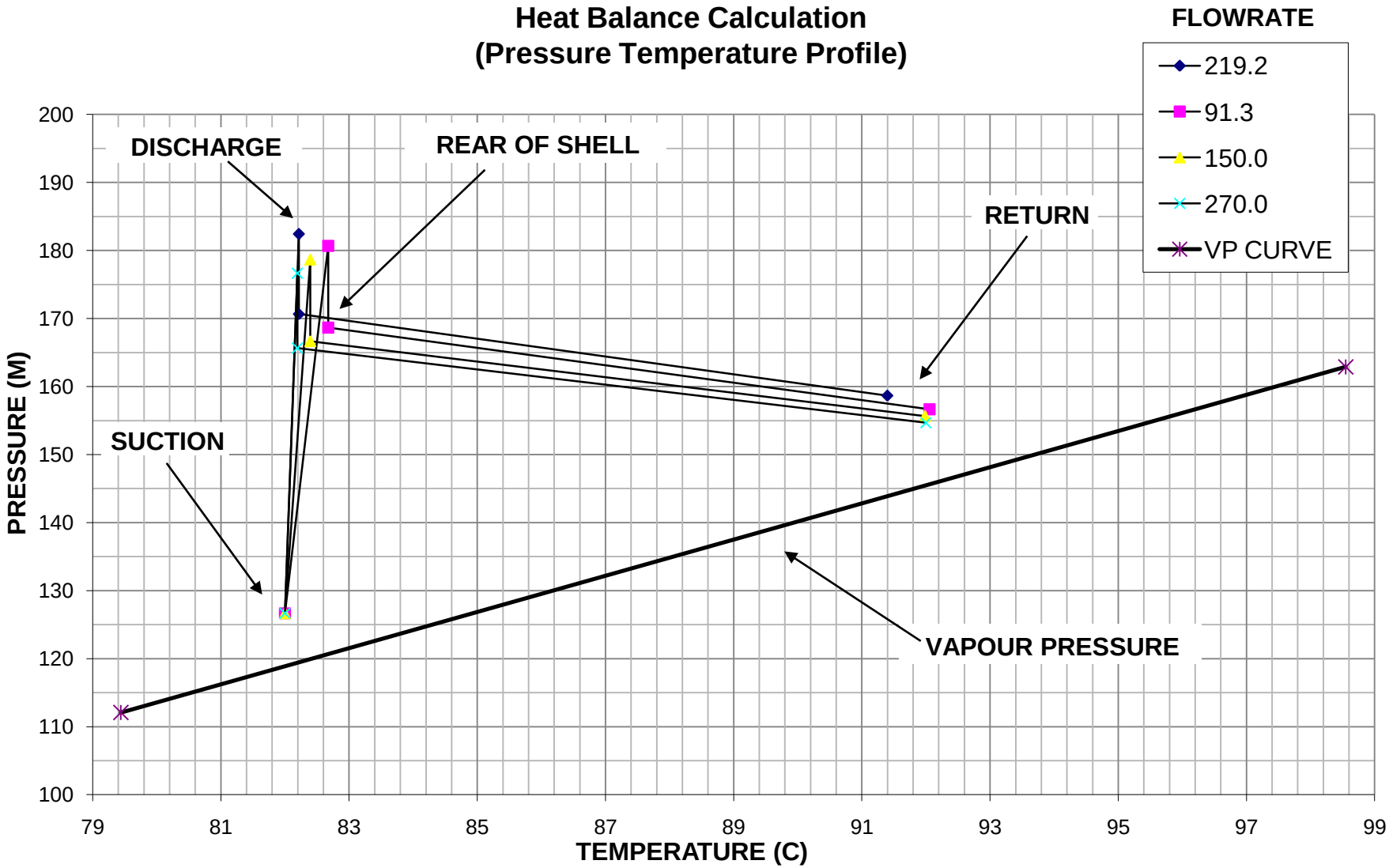
A.2.2 Comments on Individual Considerations

A.2.2.3 Volatile Fluids/Limited NPSH Available

Reverse circulation and pressurized circulation plans may be used to avoid the thermal effect of drive heating on pump NPSH requirements. Consideration of vapour pressure increase with temperature and of specific heat of fluid is required

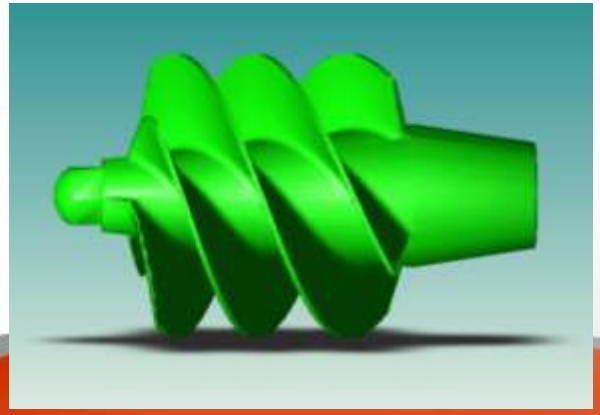
- Pressure Temperature Profile
- Inducers

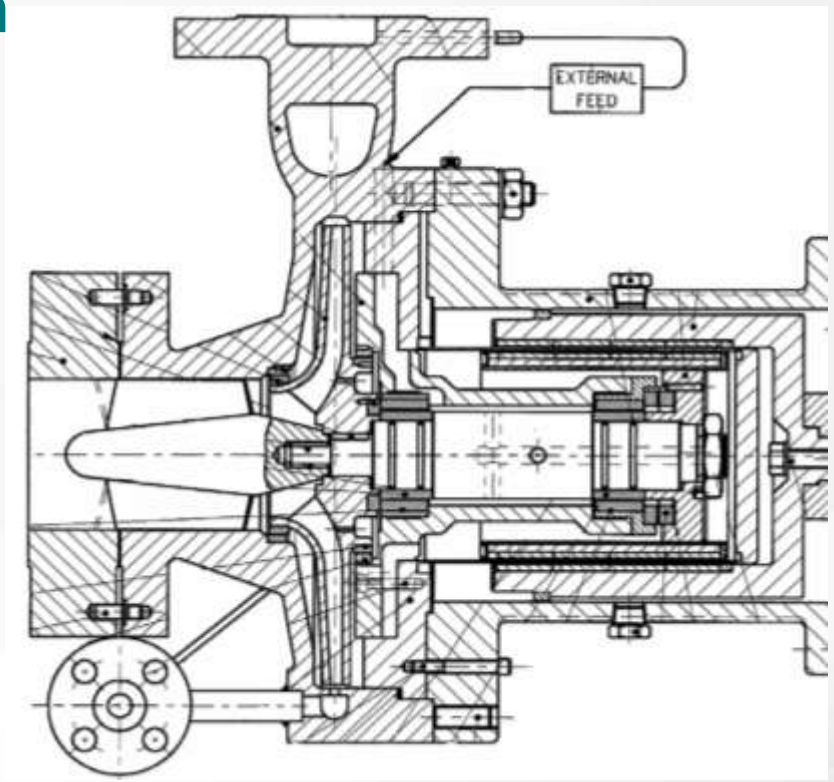
API 685 Annex A (informative)



API 685 Annex A (informative) Application Information

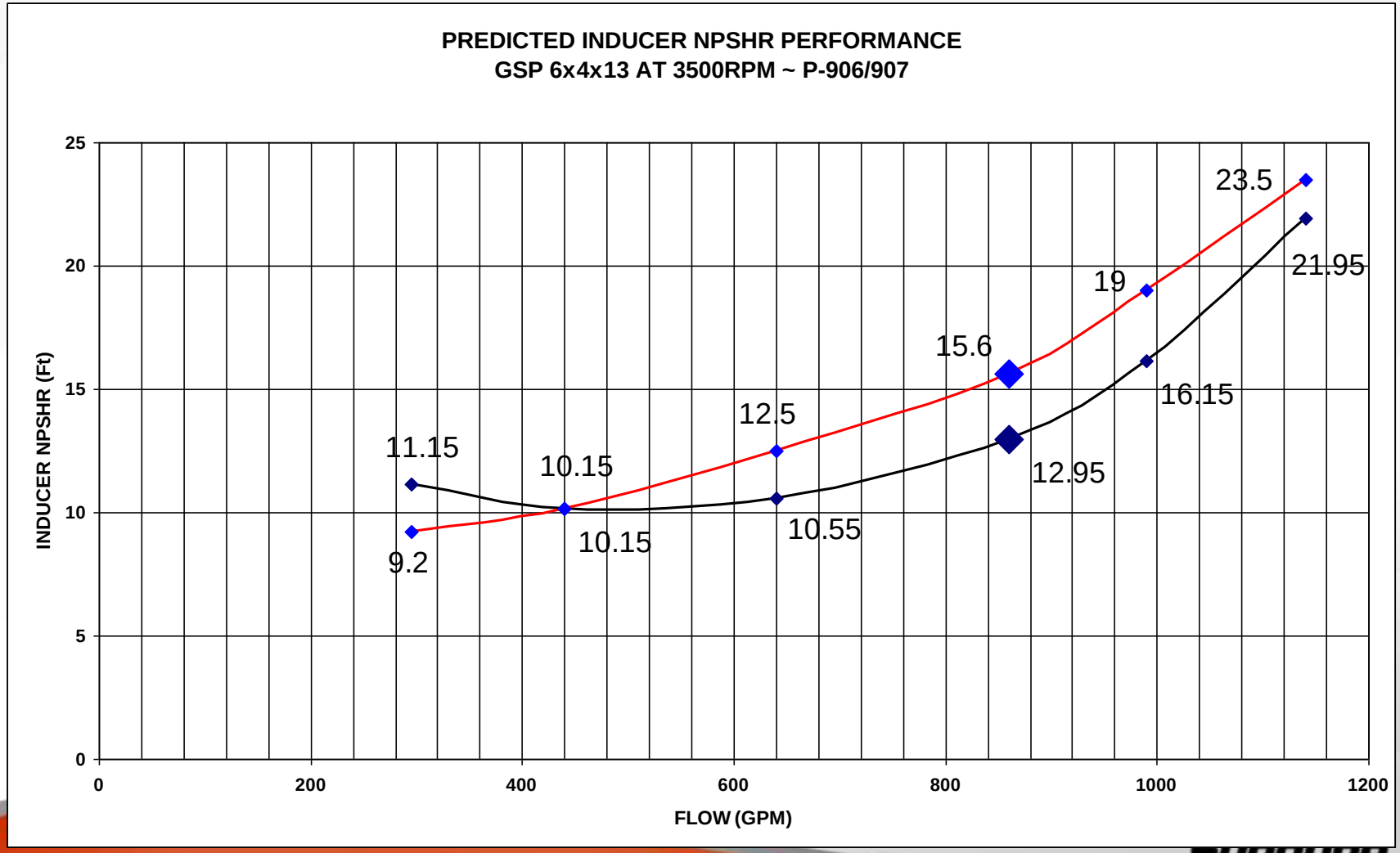
Inducers





- Proven Sundyne Technology
- Rapid Prototyped Design
- Investment Casting
- Application Specific

API 685 Annex A (informative) Application Information



API 685 Annex A (informative) Application Information

A.2.2 Comments on Individual Considerations

A.2.2.5 Fluids Containing Abrasive Particles may Cause Objectionable Wear

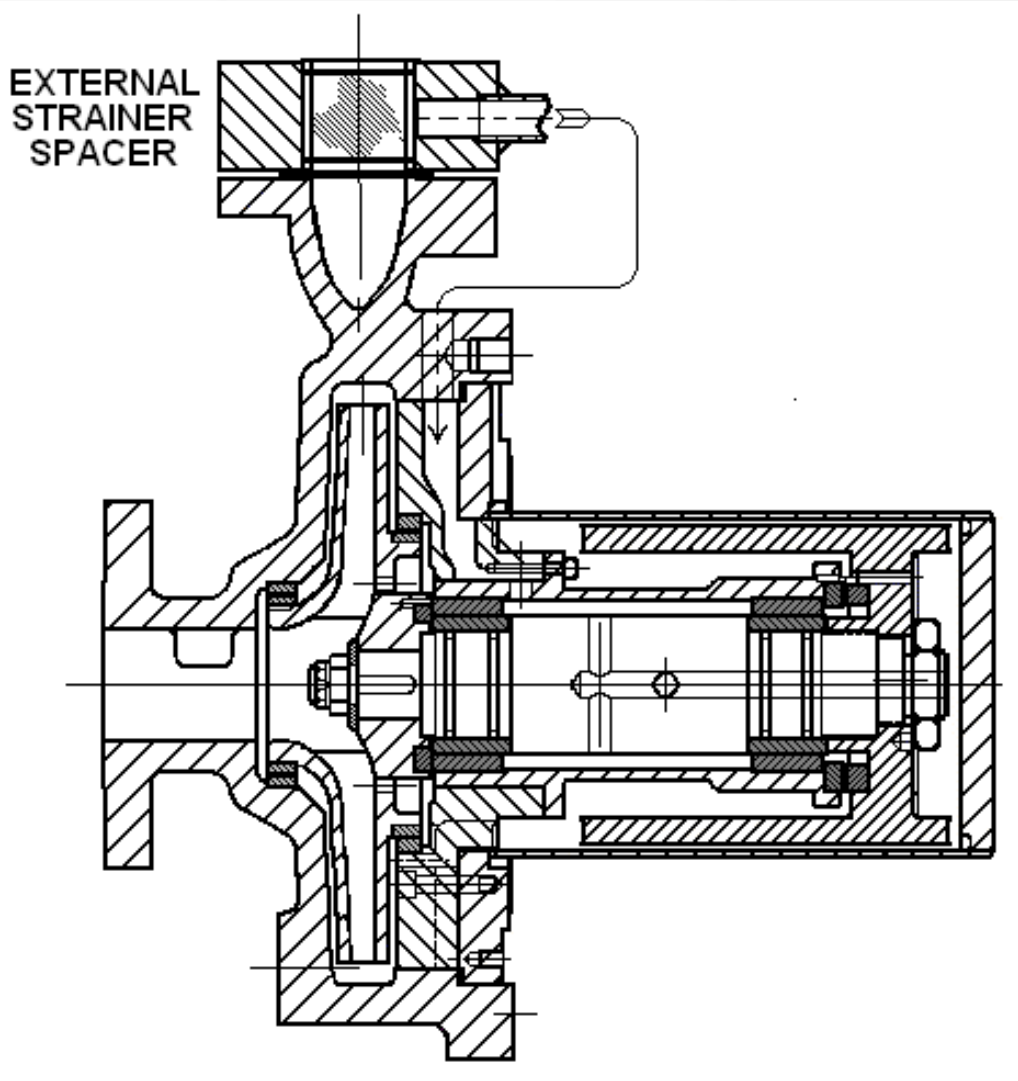
Centrifugal separation, mechanical filtration, or injection of a separate, clean buffer fluid may be used to remove particles from the circulation fluid or avoid exposure to those particles. In the case of mechanical filtration, consideration should be made to monitor such a system for blockage.

- Inline Self-cleaning Filter
- External Cartridge Filter

API 685 Annex A (informative) Application Information

Inline Self-Cleaning Filter

- Mounted on Discharge Flange
- Provides a 'cleaner' feed to the internal product lubricated bearings
- Can be used in conjunction with Mono or Duplex filters
- 5% wt wt up to 250 microns



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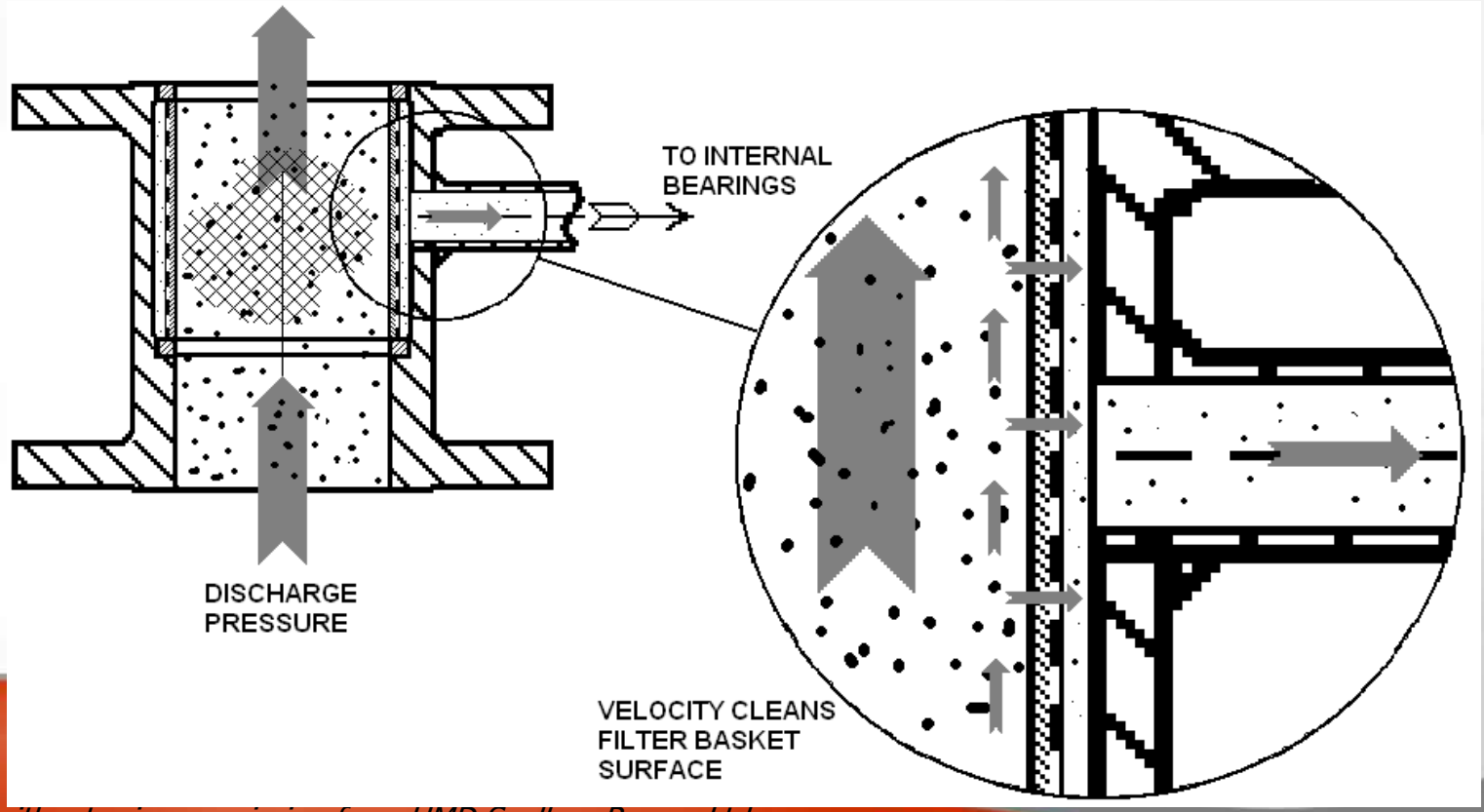
Inline Self-Cleaning Filter

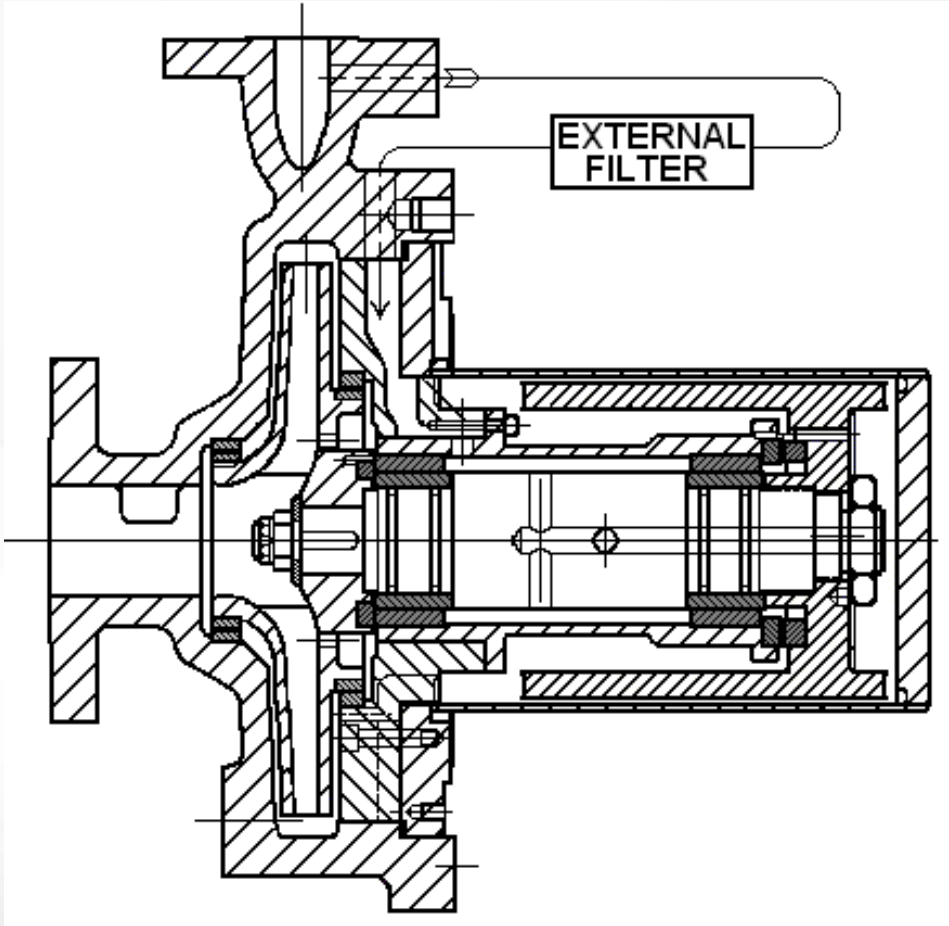
- Typically 40 mesh
- Discharge velocity 'sweeps' solids away.
- Can be fitted with DP measurement points to establish blinding



API 685 Annex A (informative) Application Information

External Cartridge Filter

- Typically 80 mesh filtration
- Mono or Duplex options
- Same pressure rating as pump
- Use of DP measurement to establish condition of filter basket
- 5% wt wt up to 250 microns

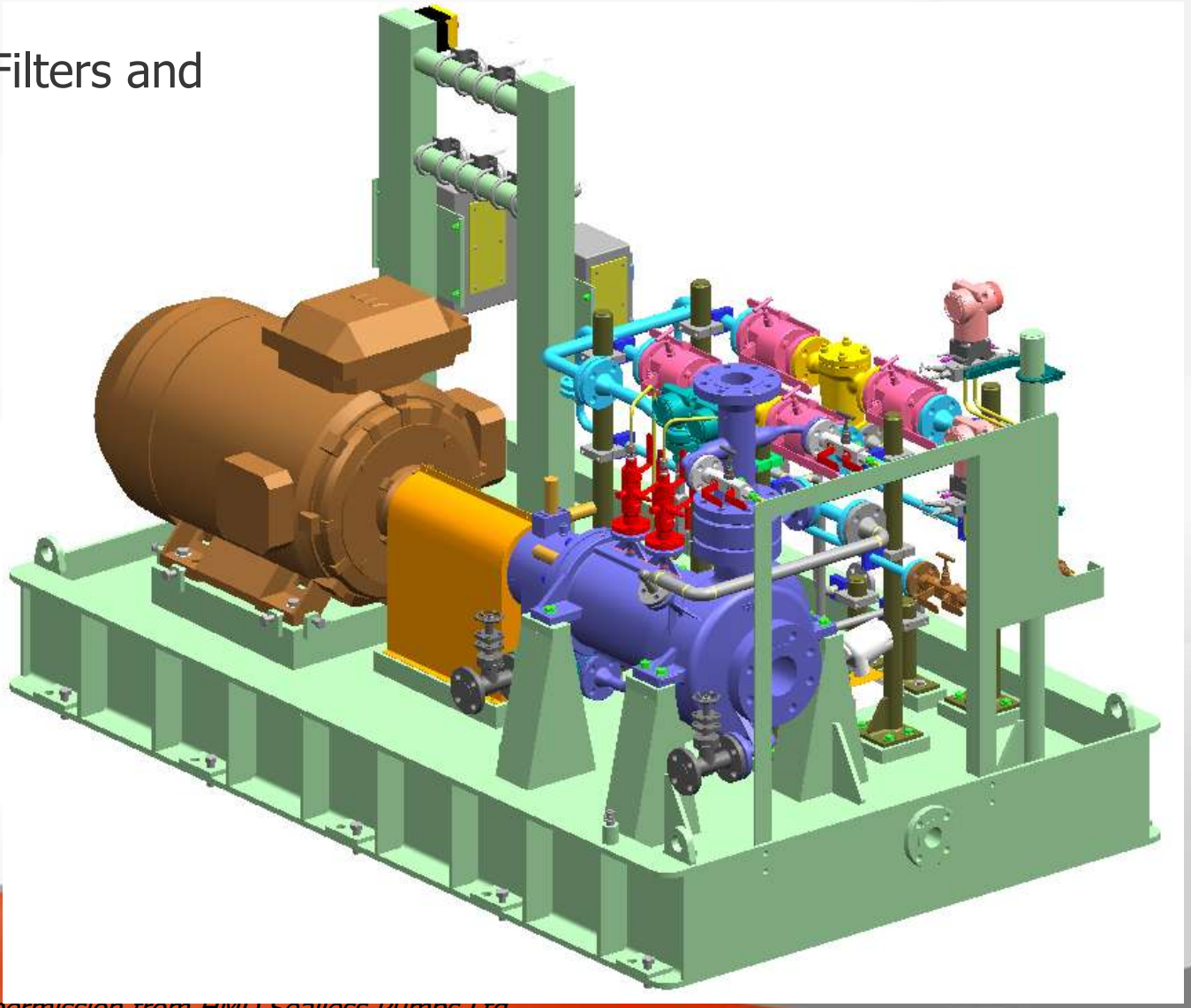


API 685 Annex A (informative) Application Information

External Cartridge Filters

API 685 Annex A (informative) Application Information

External Cartridge Filters and DP measurement



API 685 Annex A (informative) Application Information

A.2.2 Comments on Individual Considerations

A.2.2.7 High Viscosity

Viscosities which would cause objectionable drag losses in the drive section or inadequate bearing lubrication. Start-up, as well as operating viscosity, needs consideration.

- Typical limit is 200 Cps maximum

A.2.2.8 Low Viscosity

Viscosities which may reduce the ability of the bearing system to develop a sufficient fluid film to support the hydraulic loads.

- Typical limit is 0.1 Cps minimum

API 685 Annex A (informative) Application Information

A.3.1.3 Drive and Driver Sizing—Magnetic Drive Pumps

Rapid overheating may occur if the inner and outer magnets decouple during operation. The drive motor needs to be selected to cover the projected operating range.

Correct sizing of the motor should ensure the magnetic drive does not decouple during acceleration.

Because of limitations on available magnetic coupling designs, motor soft-start may be necessary on some applications.

API 685 Annex A (informative) Application Information

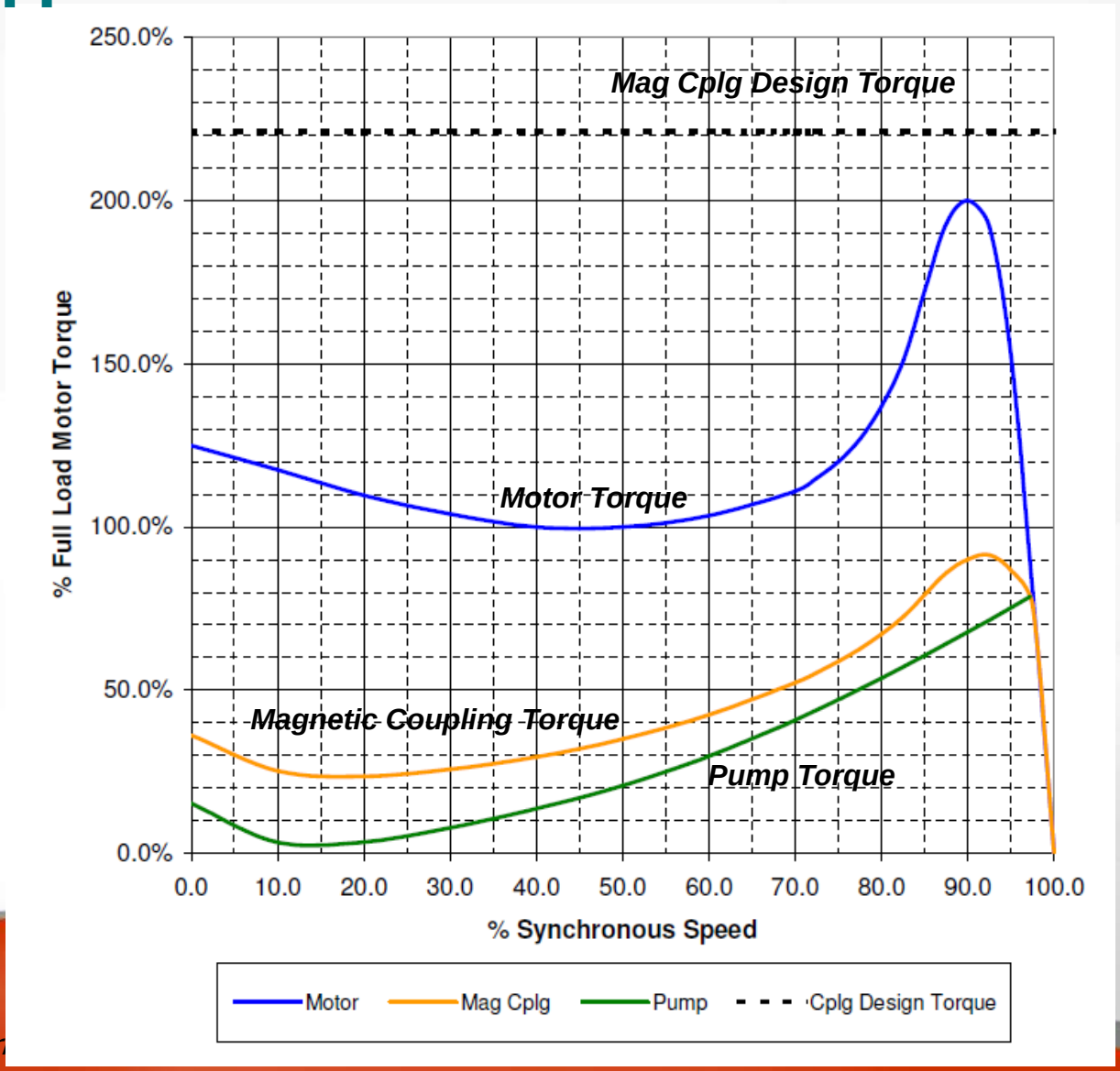
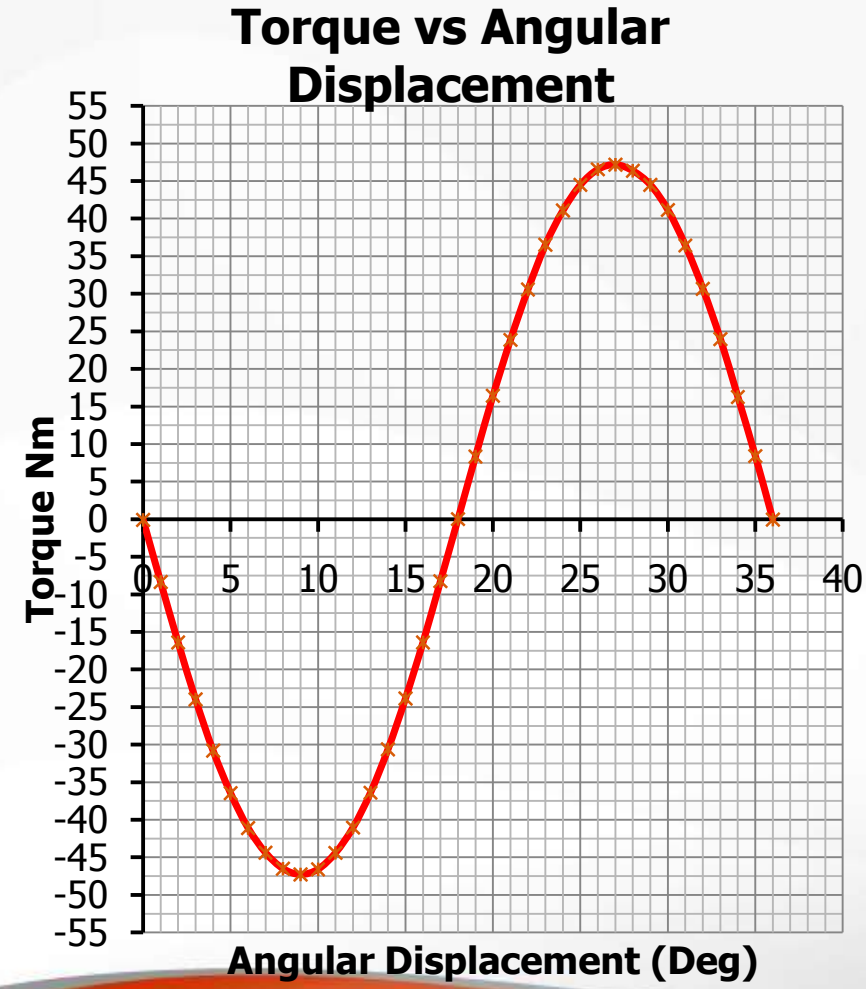
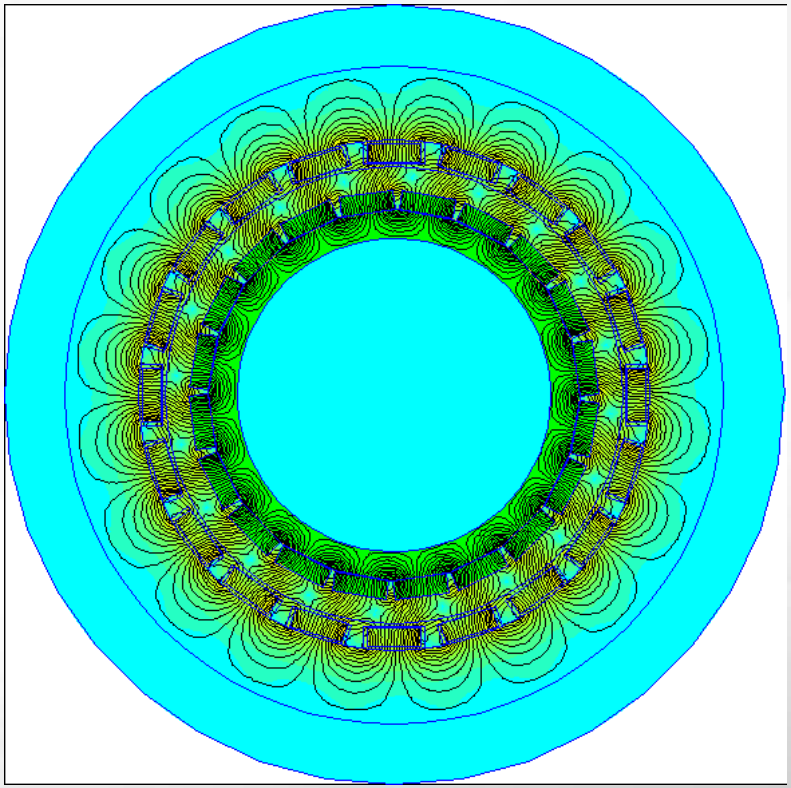


Figure 9. – Speed Torque Curve

API 685 Annex A (informative) Application Information

Figure 9. – Speed Torque Curve





API 685 Annex A (informative) Application Information

A.3.1.4 Thermal Effects on NPSH

The pump design and circulation system should provide the margin of safety between pressure and vapour pressure within the drive area over the projected operating range Consideration should also be given to any specified variation in suction pressures, to ensure this margin of safety is always present.

API 685 Annex A (informative) Application Information

A.3.1.4 Thermal Effects on NPSH

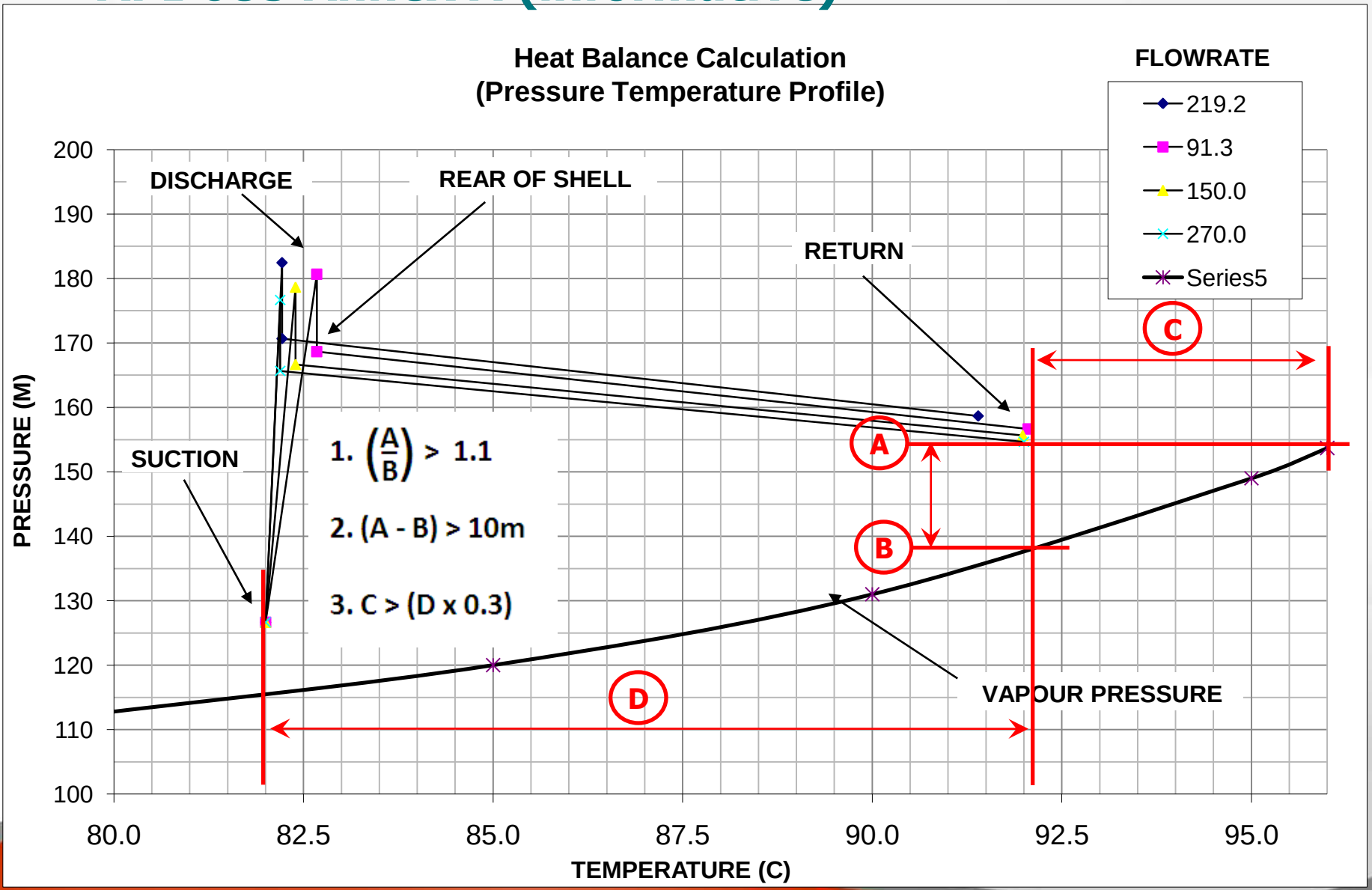
What is a safe margin? – All of the following should be true.

A. Ratio of return pressure and vapour pressure at the lowest pressure point in the magnetic drive system should be greater than 1.1

B. The difference between the return pressure and vapour pressure at the lowest pressure point within the magnetic drive system should be greater than 10m.

C. The difference between the predicted return temperature and boiling point of the liquid at the lowest pressure point in the magnetic drive system should be greater than 30% of the total temperature rise.

API 685 Annex A (informative)



API 685 Annex A (informative) Application Information

A.3.1.5 Low Specific Gravity Performance

Pumps pumping low specific gravity fluids (0.5) may perform differently than pumps pumping fluids with specific gravities close to 1.0 (water). Different specific gravities may affect thrust balance, mechanical stability, temperature rise, and power required.

Low SG liquids usually also have low specific heat values, resulting in higher temperature rise, and careful consideration should be taken in selecting the correct circulation piping plan.

API 685 Annex A (informative) Application Information

A.3.1.6 High Specific Gravity Performance

Some liquids such as refrigerants have the characteristic of a high specific gravity but also have a low specific heat. These are typically the toughest liquids to handle.

The high SG will affect the sizing of the magnetic drive and the motor, and will also affect the temperature rise, and the low specific heat will also affect the temperature rise.

API 685 Annex A (informative)

A.3.1.8 Entrained, Non-Condensable Gas

Collection of vapours at pump suction and at fluid lubricated bearing area must be avoided by use of an appropriate circulation plan.

API 685 Annex A (informative) Application Information

A.5 Installation, Operation, and Maintenance

A.5.1 General

A.5.1.1 Avoid dry bearing operation

A.5.1.2 Avoid air entrainment.

The pump casing and containment shell must be fully primed and properly vented prior to pump start-up.

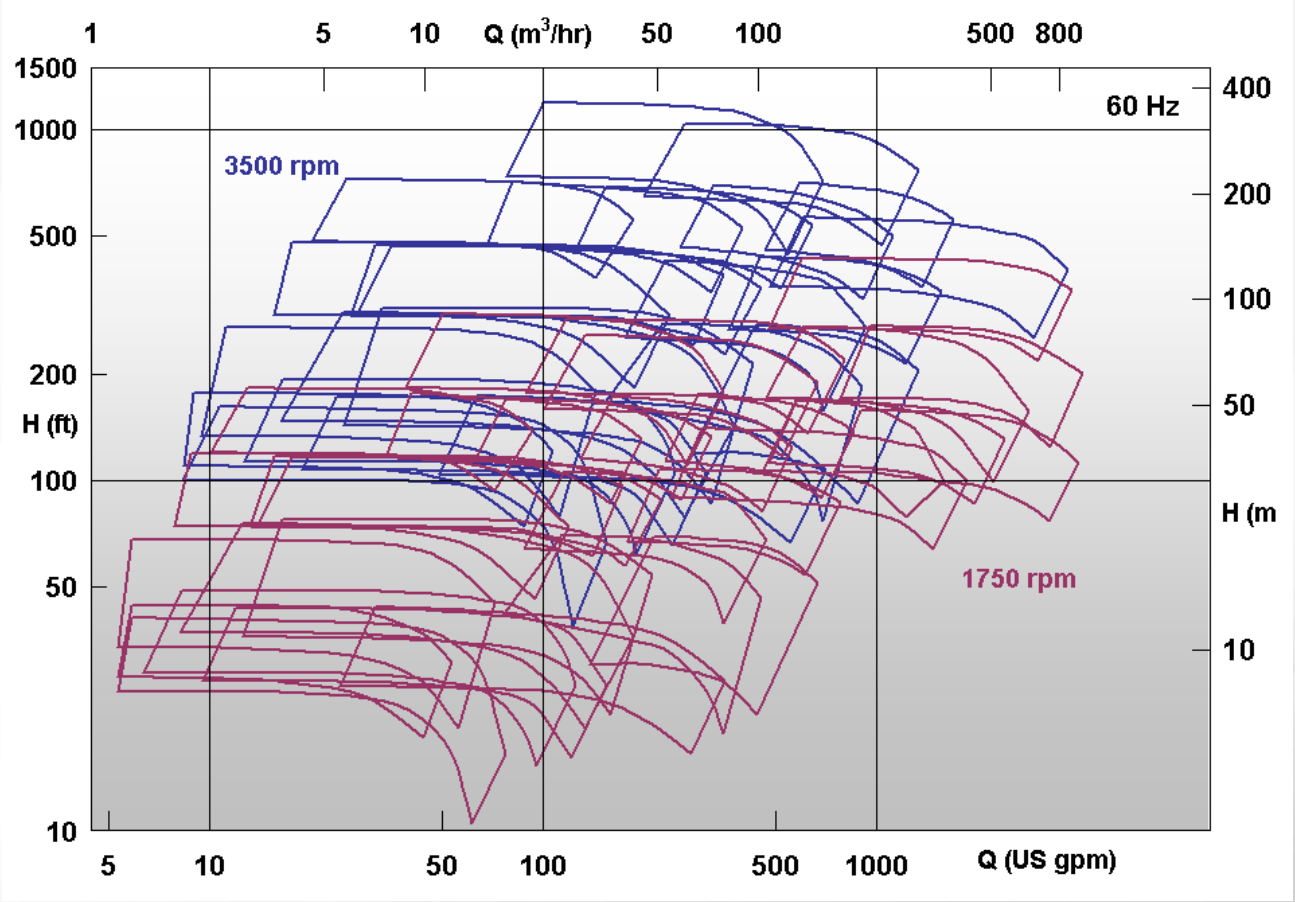
A.5.2 Special Consideration for Magnetic Drive Pumps

A.5.2.3 Avoid decoupling magnets. Decoupling of the inner and outer magnets can result in demagnetization of the inner magnets in a short period. Decoupling will also result in rapid temperature rise of the liquid in the containment shell and the magnet assemblies.

Operational Parameters
60 Hz, Metric Units

60 Hz

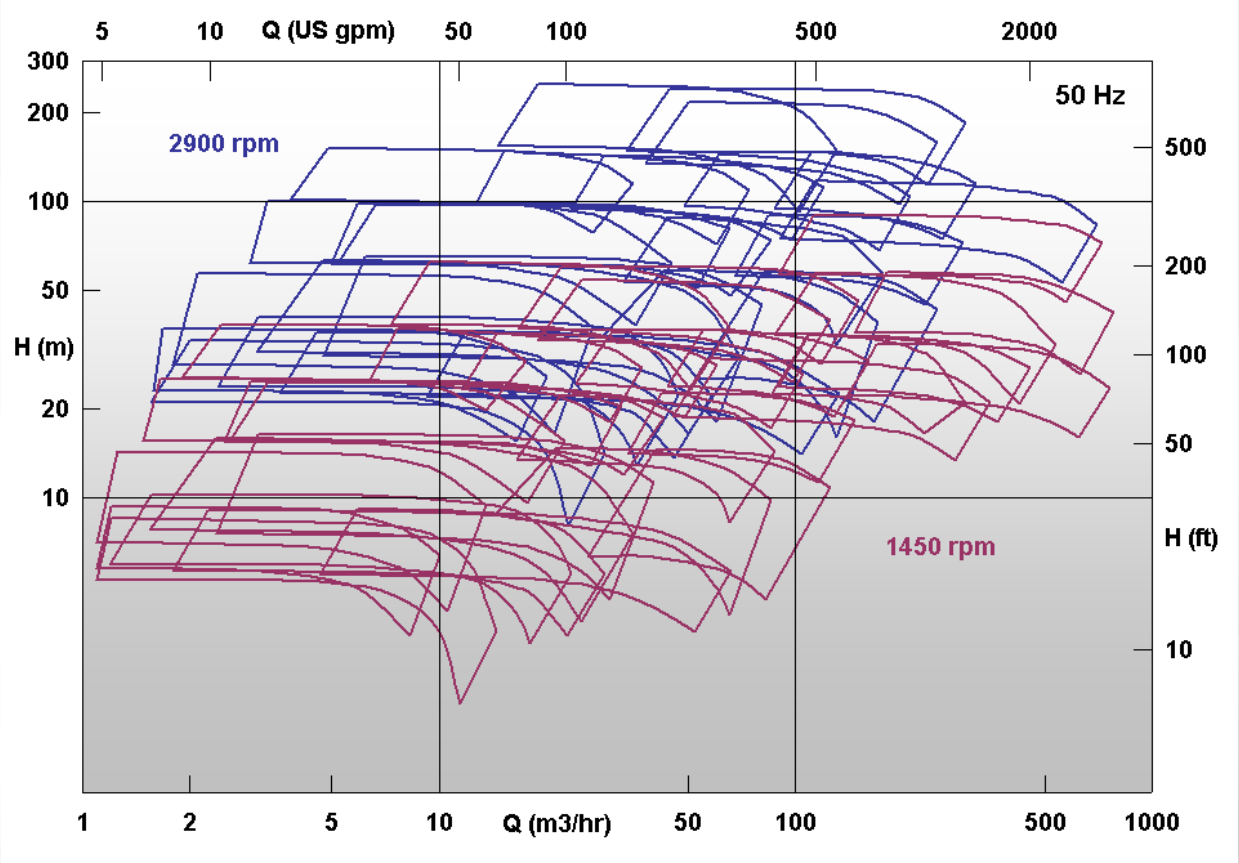
- Flows to 750m^3/hr
- Differential Heads to 350m
- Design Pressure 40 Bar
- Temperatures -40 to 315°C
- Solids 5% wt wt up to 150 microns
- Viscosity < 200 cps
- Materials: S5, A8, D1, Alloy C, Alloy 2



Operational Parameters

50 Hz

- Flows to 700m^3/hr
- Differential Heads to 250m
- Design Pressure 40 Bar
- Temperatures -40 to 315°C
- Solids 5% wt wt up to 150 microns
- Viscosity < 200 cps
- Materials: S5, A8, D1, Alloy C, Alloy 20



Operational Parameters Engineered Product

System Pressures up to 225 Bar

Design Temperatures up to 450C – Without Cooling

Heating Jackets

Vertical Configuration

Increased solids handling capacity

Applications and Limits

Questions