



Specialist for Pumping Technology

Session 4 - Selecting the Right Pump for the Application

Simon Smith June 2021



Presenter Profile – Simon Smith

Simon graduated with an honours degree in Chemical Engineering from the University of Surrey in 1978 and began a long career in the engineered pump industry spanning 40 years (so far!) with Peerless Pump, BW/IP International / Flowserve, SPP Pumps, Ruhrpumpen and Ebara Cryodynamics.

Over his long career he has filled various roles as Applications Engineer / Manager, Project Manager, Key Account Specialist, Vertical Pump Product Specialist, International Sales Engineer / Manager / Director and he has considerable experience in Training & Mentoring young engineers.



RUHRPUMPEN AT A GLANCE

**VERTICAL
INTEGRATION**

**SALES
OFFICES IN
+35 COUNTRIES**

**MANUFACTURING
FACILITIES
IN 10 COUNTRIES**

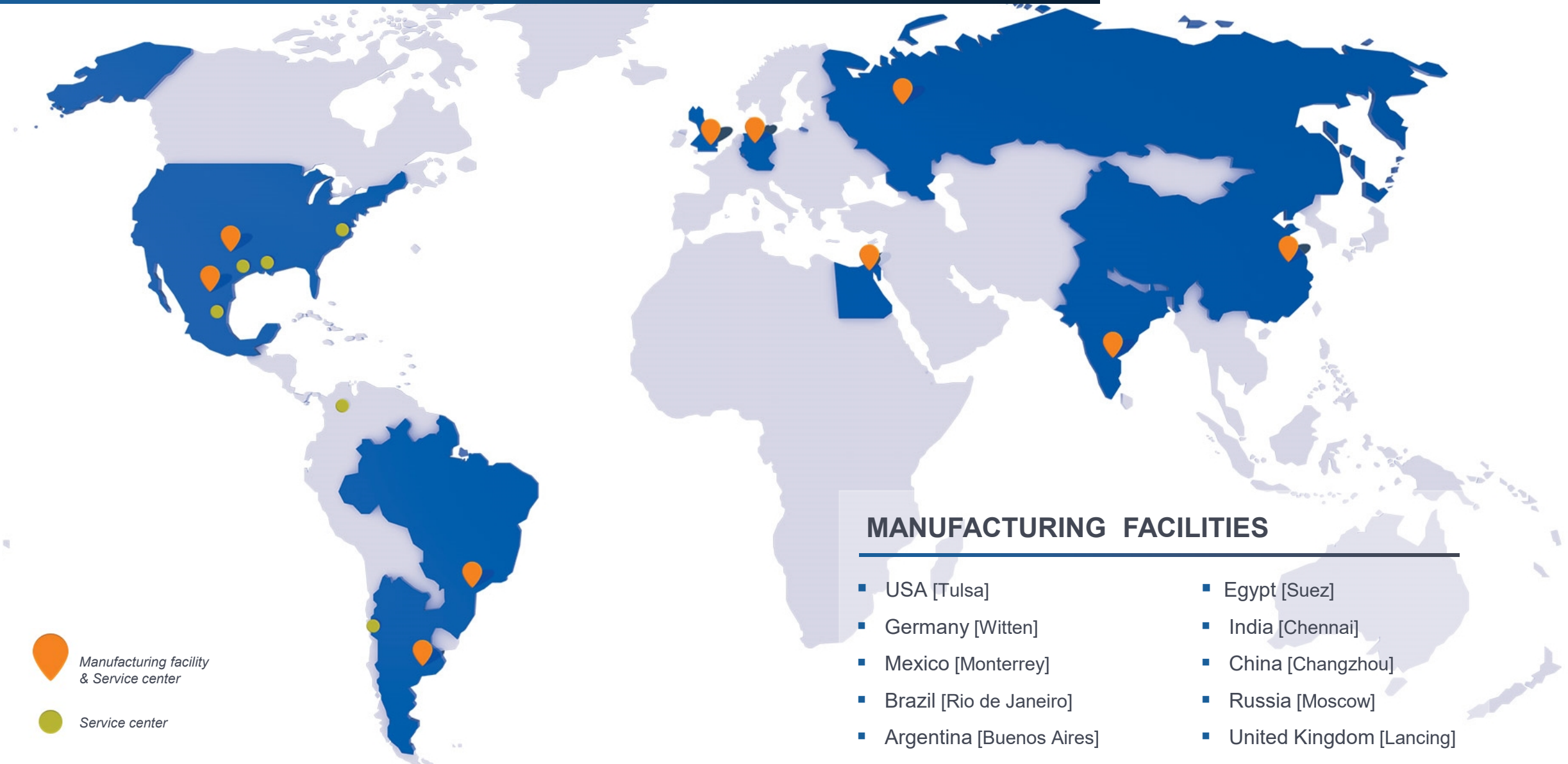
**+70 YEARS
OF EXPERIENCE**

**+2,000
EMPLOYEES**

**15 SERVICE
CENTERS**

+70,000 PUMPING SOLUTIONS INSTALLED WORLDWIDE

A GLOBAL COMPANY



MARKETS WE SERVE

Our commitment to create innovations that offer reliable solutions to our customers allow us to provide a complete range of pump systems to support **core markets** as:



OIL & GAS



CHEMICAL



INDUSTRIAL



POWER



WATER



OUR PUMP LINES

Ruhrpumpen offers a broad range of highly engineered and standard pumping products that meet and exceed the requirements of the most demanding quality specifications and industry standards.

Our pumps can handle head requirements as high as 13,000 ft (4,000 m) and capacities up to 300,000 gpm (68,000 m³/hr). Moreover, our pump designs cover temperatures from cryogenic temperatures of -310 °F (-196 °C) up to 752 °F (400 °C).



Products include:

- Single Stage Overhung Pumps
- Between Bearings Pumps
- Horizontal Multi-Stage Pumps
- Vertical Multi-Stage Pumps
- Vertical Mixed Flow & Axial Flow Pumps
- Positive Displacement Pumps
- Full Range of Industrial Pumps
- Submersible Pumps
- Magnetic Drive Pumps
- Decoking Systems
- Packaged Systems
- Fire Systems

Session 4 – “Selecting the Right Pump for the Application”

Covering such topics as when to transition from an OH2 to a BB2; when to consider VS6 pumps; Barrel vs Horizontal Split Case multi-stage pumps.



Scenario A

Process Engineer or Mechanical / Rotating Equipment Engineer

You have preliminary process data for a pump

For example:

200m³/hr, 200m TDH, 5m NPSHA, SG 0.7, Temp 150°C, 50 Hz

What sort of pump will this be?

You guess OH2

Are you right?

I am going to give you the tools to be able to check this out & save you getting yourself into trouble.



Scenario B

Sales or Applications Engineer

Your customer (from Scenario A) has phoned you up with the same preliminary data

200m³/hr, 200m TDH, 5m NPSHA, SG 0.7, Temp 150°C

“What sort of pump do I need, just a quick check, don’t spend long on it?”

What do you do?

Do you immediately plug the duty into your pump selection program and tell your customer the first selection it comes up with?



Size			Speed, rated (rpm)	Motor poles	Bowl Efficiency (%)	Pump Efficiency (%) ▼
<input type="checkbox"/>	SM 6x14 (A) (BB3) CH		1485	4	-	76.19
<input type="checkbox"/>	SM 4x11 (A) (BB3)		2960	2	-	75.78
<input type="checkbox"/>	SM 4x11 (D) (BB3) CH		2960	2	-	75.54
<input type="checkbox"/>	SM 4x9.5 (A) (BB3)		2960	2	-	75.43
<input type="checkbox"/>	SM 4x11 (C) (BB3) CH		2965	2	-	75.08
<input type="checkbox"/>	SM 4x11 (C) (BB3) CH		2965	2	-	73.62
<input type="checkbox"/>	AB 8x6x15 C-C (A) CH		1485	4	-	72.86
<input type="checkbox"/>	SM 4x11 (C) (BB3) CH		2965	2	-	72.56
<input type="checkbox"/>	SM 4x11 (B) (BB3)		2960	2	-	71.77



Size			Speed, rated (rpm)	Motor poles	Bowl Efficiency (%)	Pump Efficiency (%) ▼
<input type="checkbox"/>	4X15J (BB2)		2975	2	-	69.80
<input type="checkbox"/>	4X15JH (BB2)		2975	2	-	69.80
<input type="checkbox"/>	RON 6x14 (A)		2960	2	-	69.68
<input type="checkbox"/>	⚠ JTN 6 x 4 x 9 1/2 (A) (BB3)		2960	2	-	69.05
<input type="checkbox"/>	⚠ AB 6x4x12 (B)		2960	2	-	68.74
<input type="checkbox"/>	RON-D 6x13 (A) CH		2960	2	-	68.64
<input type="checkbox"/>	RON-D 6x13 (B) CH		2960	2	-	68.64
<input type="checkbox"/>	SCE 6x4x16 (A) Inducer 1 (OH2)		2960	2	-	66.77
<input type="checkbox"/>	SCE 6x4x16 (A) (OH2)		2960	2	-	66.77



Lessons Learned

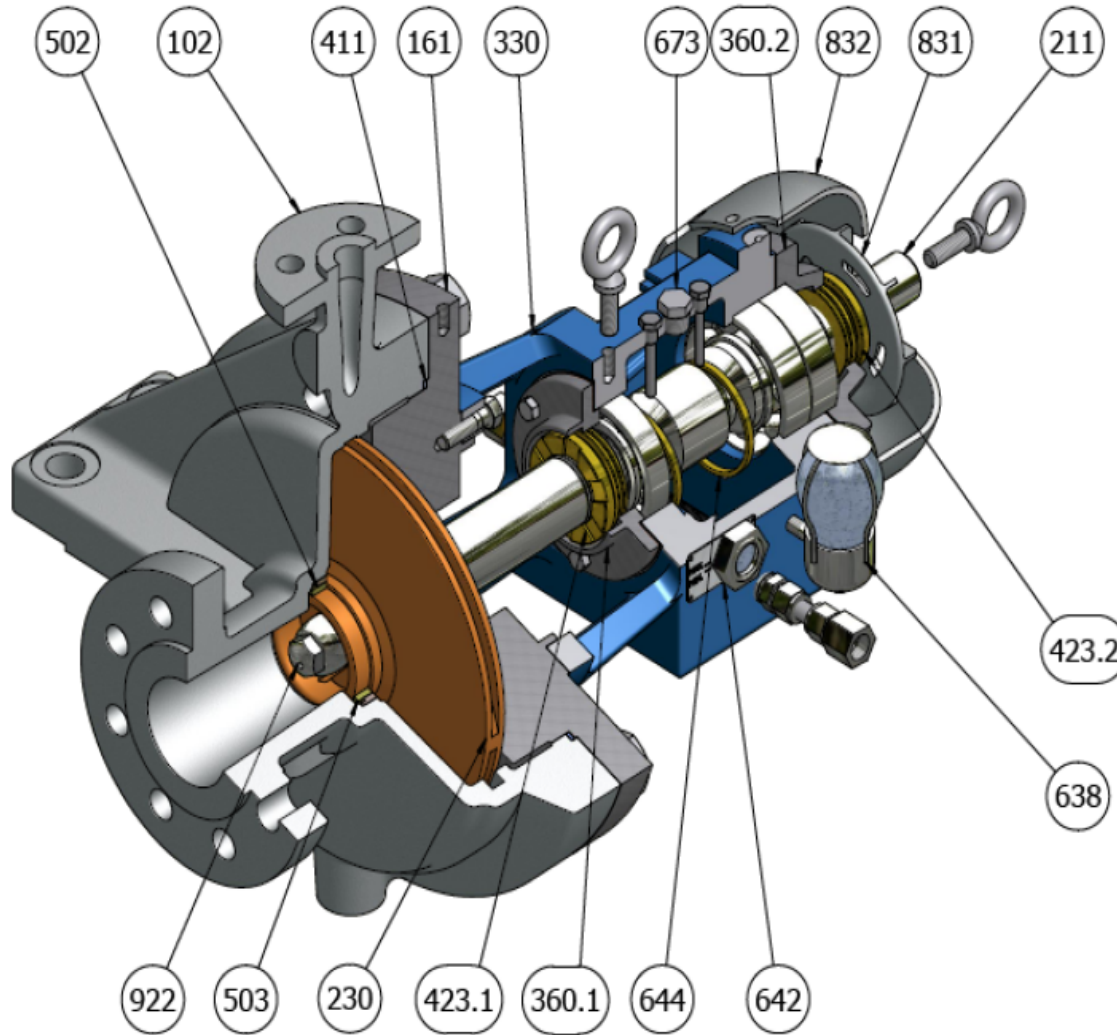
- Pump selection programs are STUPID
- They are a great tool but a poor master
- ALWAYS KNOW THE PUMP YOU EXPECT TO SEE BEFORE YOU USE THE PUMP SELECTION PROGRAM

I am going to give you the tools to be able to check this out & save you getting yourself into trouble.

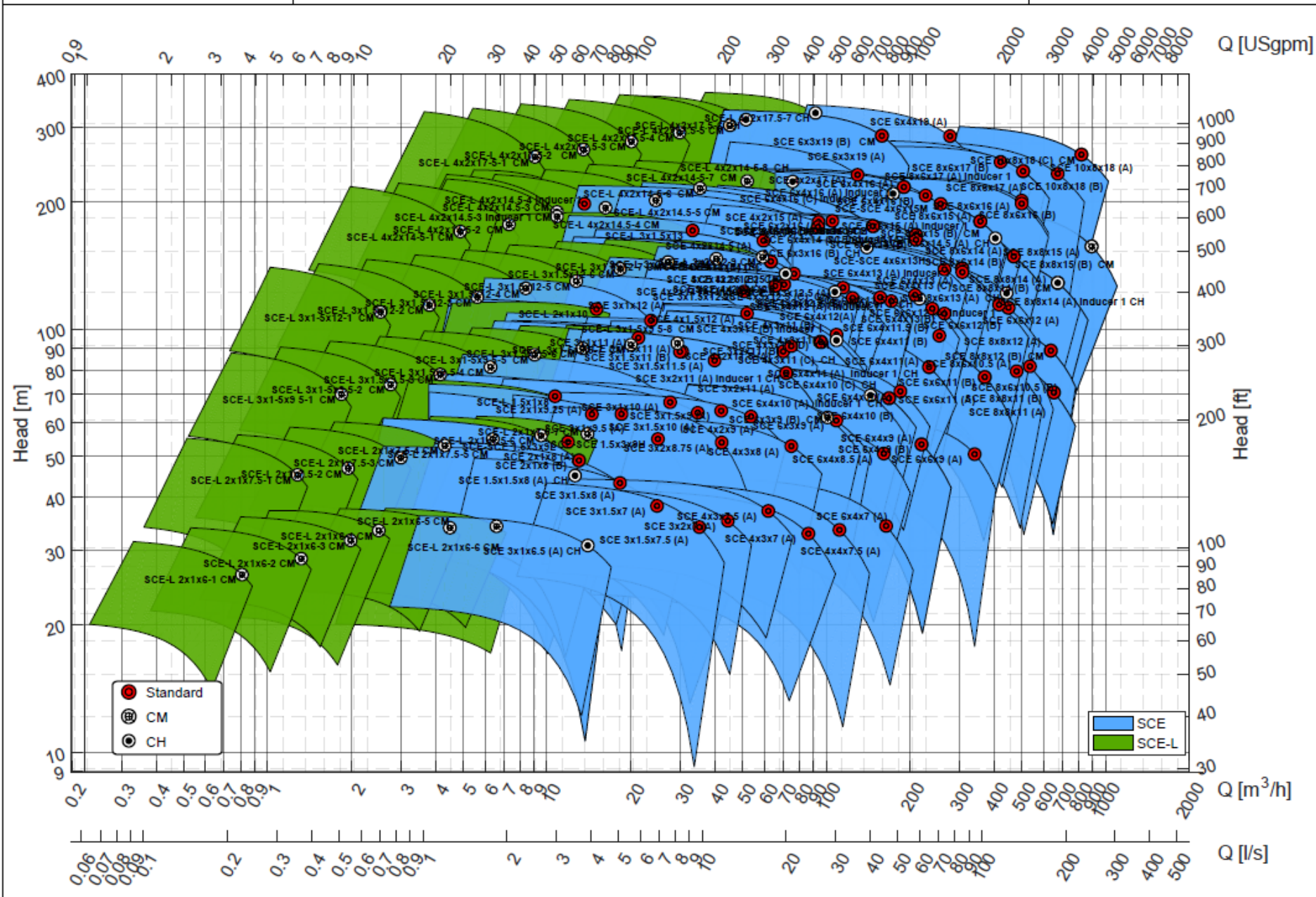


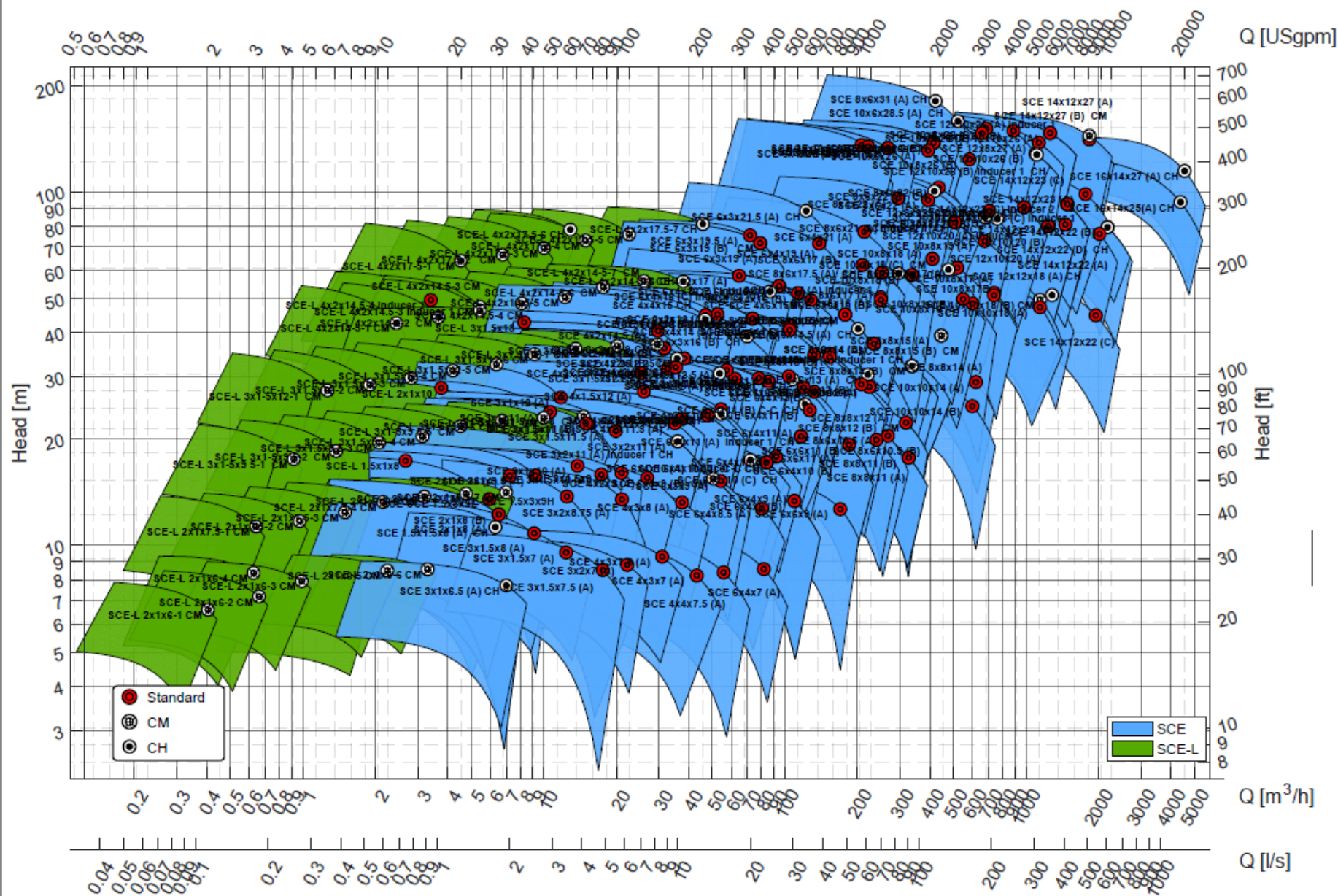
SCE Pump

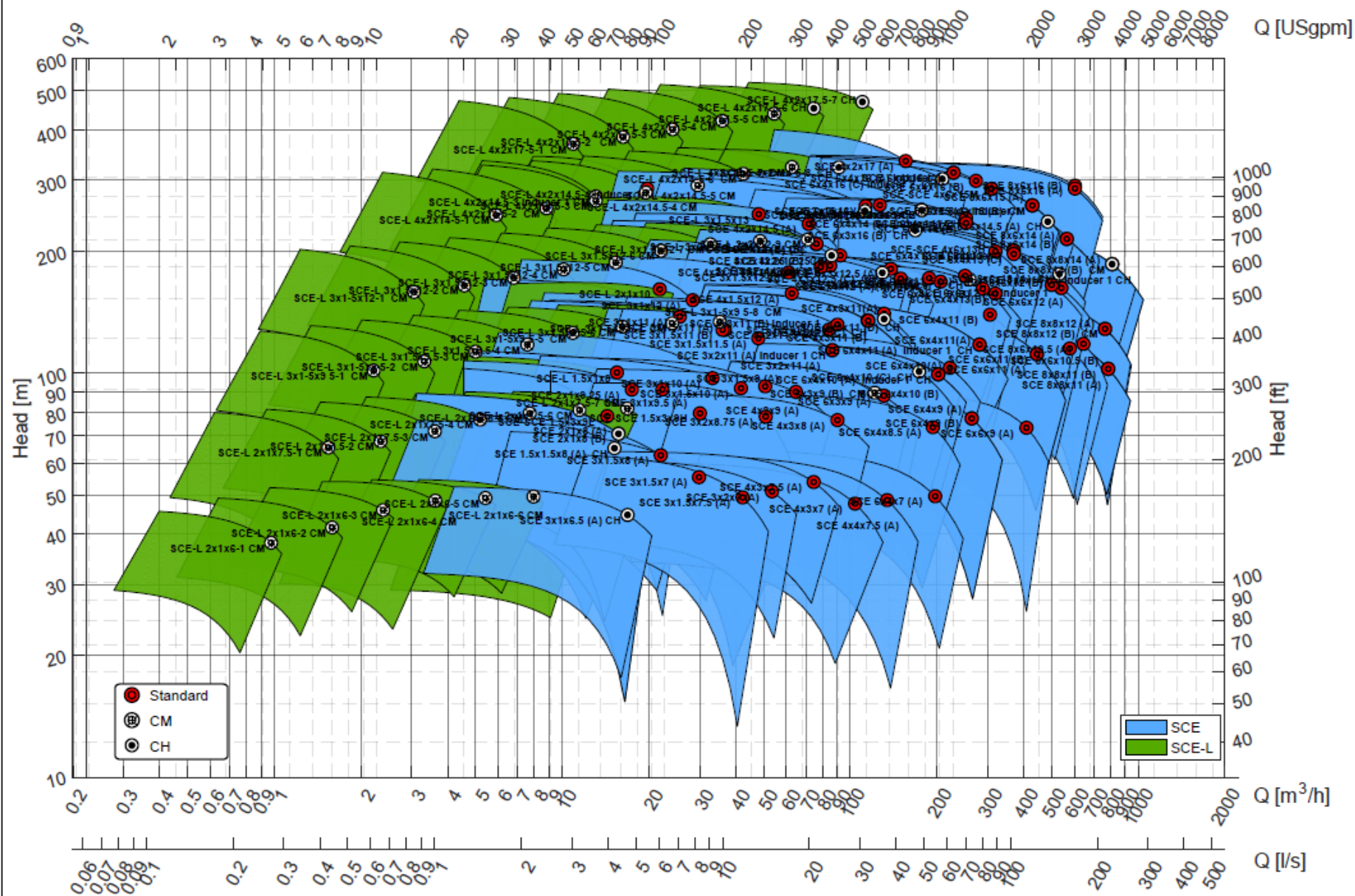
Type OH2

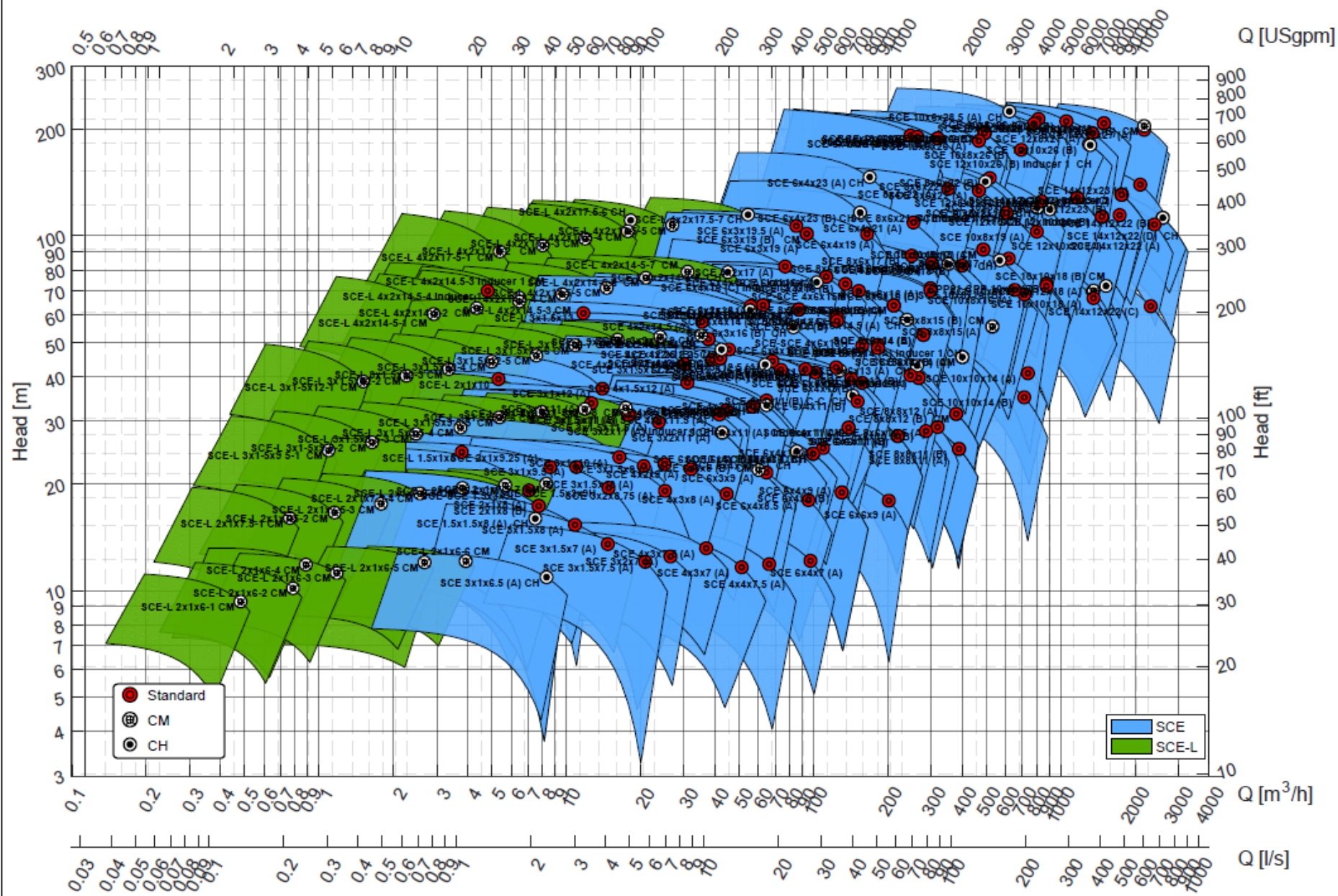


PARTS LIST		
ITEM	QTY	DESCRIPTION
102	1	VOLUTE CASING
161	1	CASING COVER
211	1	PUMP SHAFT
230	1	IMPELLER
330	1	BEARING BRACKET
360.1	1	BEARING COVER
360.2	1	BEARING COVER
411	1	JOINT RING
423.1	1	LABYRINTH RING
423.2	1	LABYRINTH RING
456	1	STUFFING BOX BUSHING
502	2	CASING WEAR RING
503	2	IMPELLER RING
638	1	CONSTANT LEVER OILER
642	1	OIL LEVEL SIGHT GLASS
644	2	LUBRICATING RING
673	2	VENT FILTER
831	1	VENTILATOR FAN
832	1	VENTILATOR CAP
922	1	IMPELLER NUT





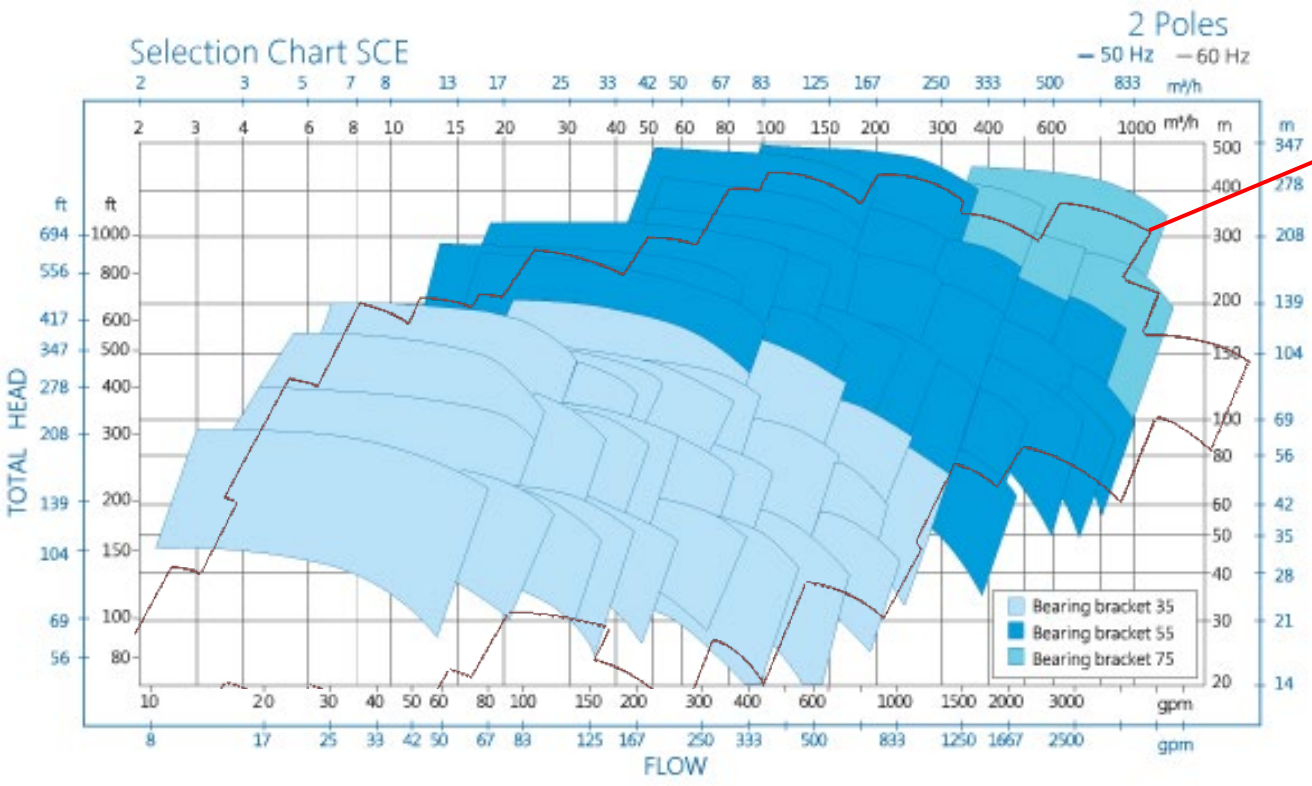
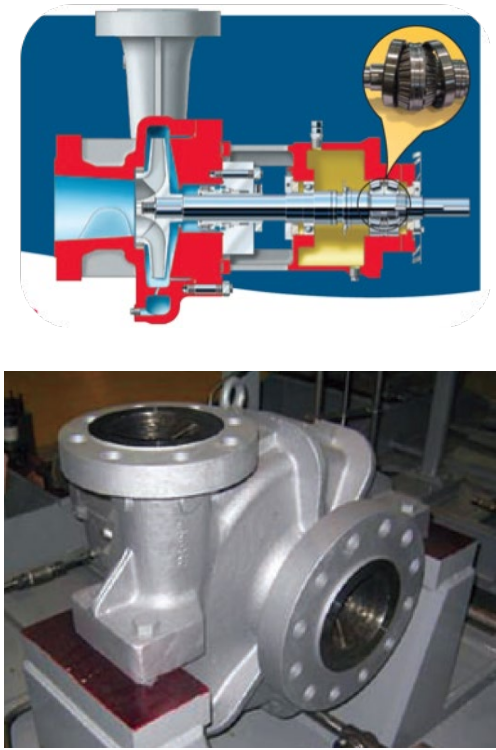




Benchmark

Ruhrpumpen vs Flowserve

Benchmark



<https://www.flowserve.com/files/Files/Literature/ProductLiterature/Pumps/pss-10-5.3-ea4.pdf>



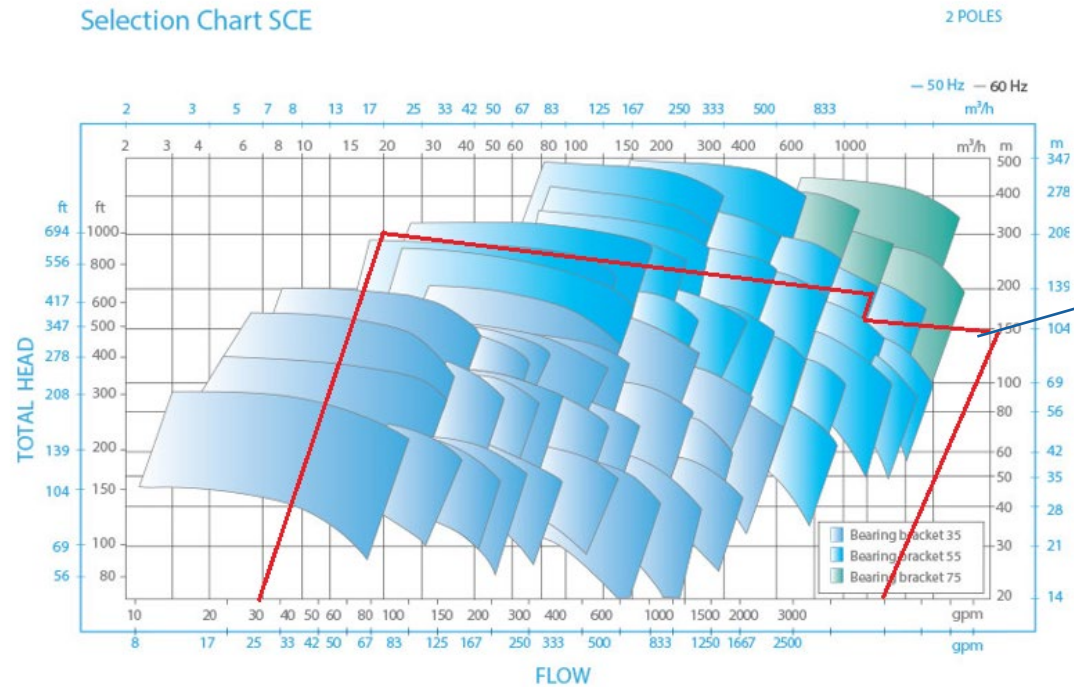
Benchmark

Ruhrpumpen vs Sulzer

Benchmark



Selection Chart SCE



Sulzer

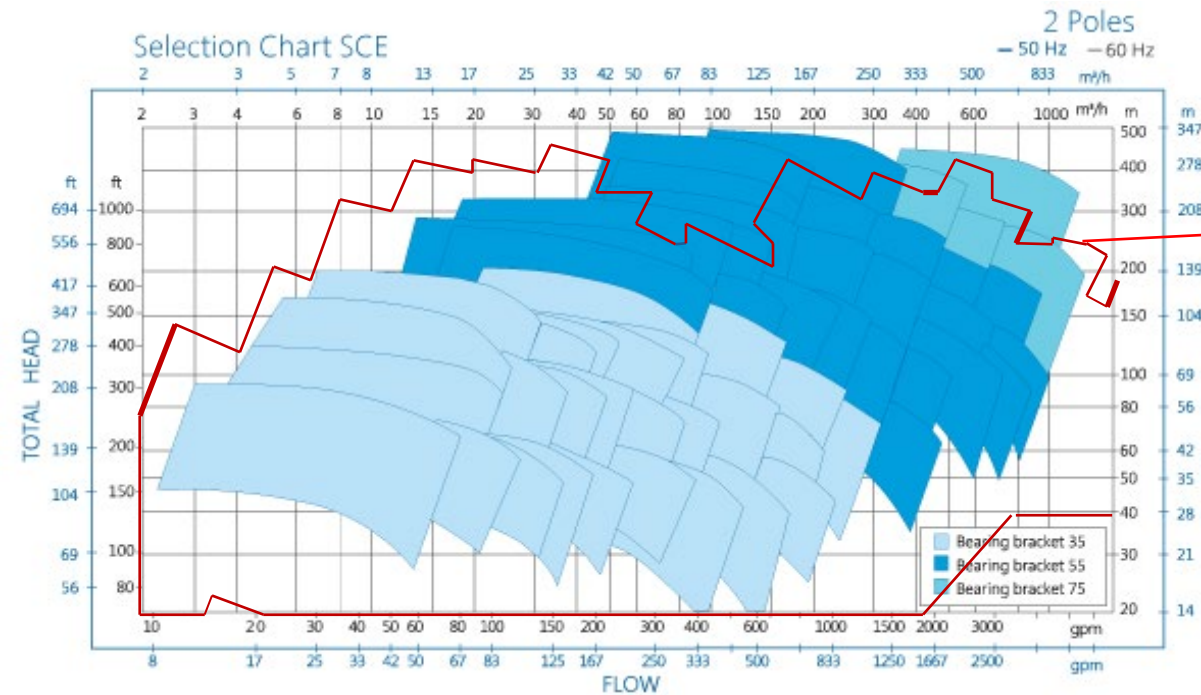
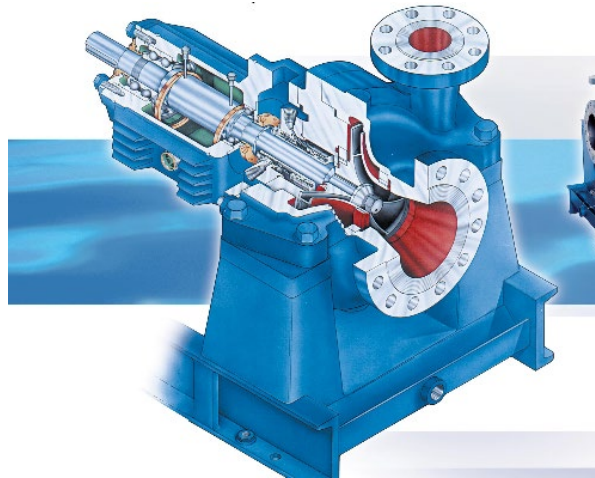
- Optional triple row thrust bearing and roller radial bearing
- Optional high pressure casing



Benchmark

Ruhrpumpen vs Goulds

Benchmark



Goulds

http://www.gouldspumps.com/ittgp/medialibrary/goulds/website/Products/3700/3700_reader_spreads.pdf?ext=.pdf



Do you have enough $NPSH_A$?

- You have established that the pump flow and head falls within the general range for most vendors of OH2 Pumps
- But do you have enough NPSH available?
- Use this simple NPSH/Nss Calculator to check.
- (A copy of this calculator will be sent to all participants when we send out the copy of this Session's slides.)



NPSH / Nss Calculator

$$N_{SS} = N_{(RPM)} Q_{(BEP\ Full\ Dia)}^{0.5} / NPSH_{(BEP\ Full\ Dia)}^{0.75}$$
$$N_{SS(Metric)} = N_{SS(US)} \times 1.16 \text{ (m}^3/\text{hr, m, rpm)}$$

Is there a commercially available pump to meet your NPSH requirement?

Enter rated flow, available NPSH, and pump speed below (in the units of your choice).

The calculator will calculate the Suction Specific Speed (Nss) of the theoretical pump that will meet your requirements with a 1m (3ft) NPSH margin.
If you see a Nss value at or below 11,000 (US units) or 12,760 (metric units) then there is probably a pump that will meet your needs
If not, try a lower speed (e.g 1450rpm instead of 2950rpm)
If the Nss is still too high, increase the NPSHA until you DO find a theoretical pump

ENTER DATA ↓	
Flow m3/hr	200
NPSHA (M)	5
RPM	2960

ENTER DATA ↓	
Flow (USGPM)	1100
NPSHA (FT)	25
RPM	3550

Theoretical Nss of a pump to do this duty with a 1m (or 3ft) NPSH margin

Single Suction Pump

m3/hr,m,rpm units	14800
USGPM,Ft,RPM units	12759

Single Suction Pump

USGPM,Ft,RPM units	11591
m3/hr,m,rpm units	13445

Try a slower speed or increase the NPSH available

Try a slower speed or increase the NPSH available

Double Suction Pump

m3/hr,m,rpm units	10465
USGPM,Ft,RPM units	9022

Double Suction Pump

USGPM,Ft,RPM units	8196
m3/hr,m,rpm units	9507

SUCCESS! There is probably a suitable double suction pump for your NPSH condition

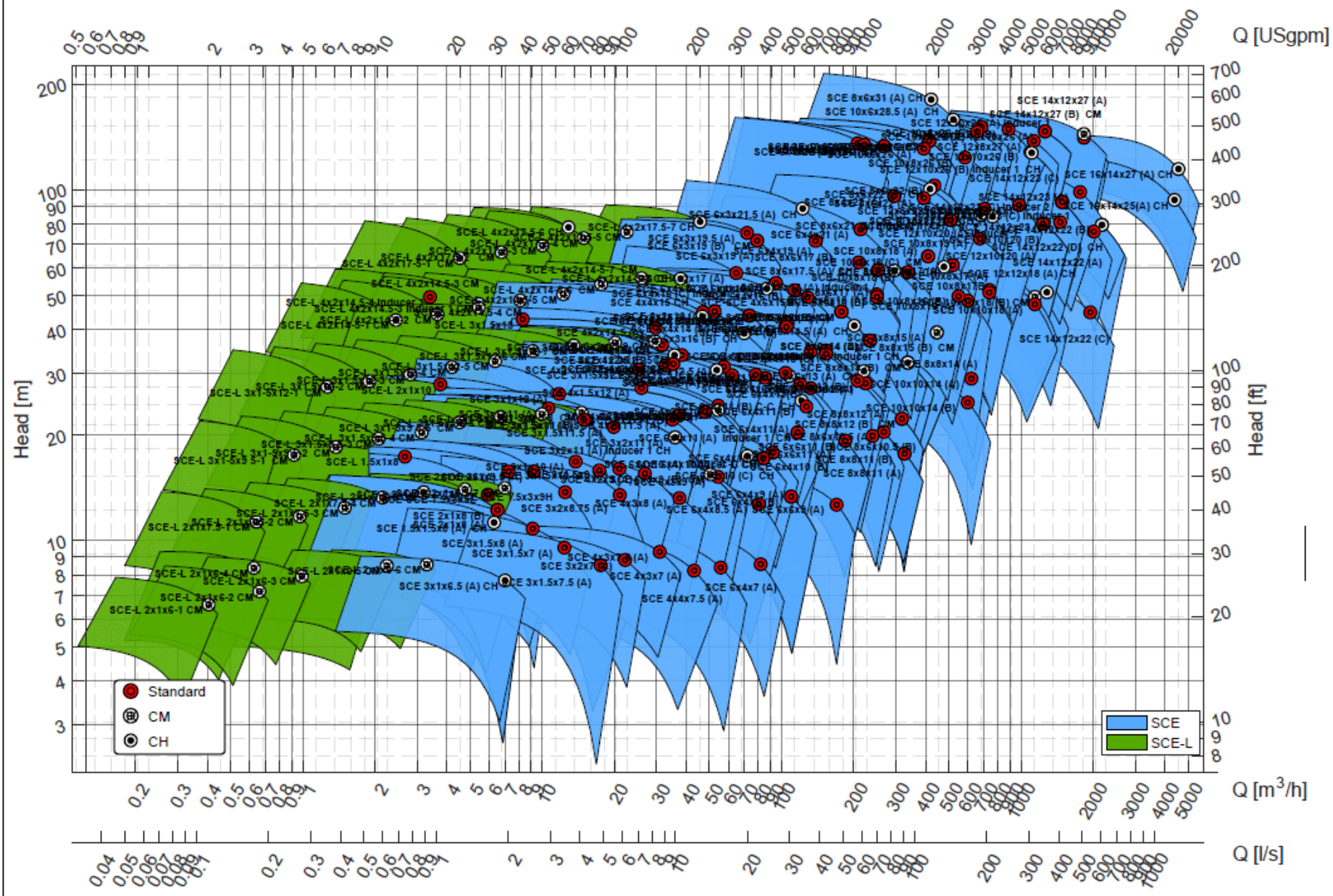
SUCCESS! There is probably a suitable double suction pump for your NPSH condition



Do you have enough $NPSH_A$?

So your options are:-

- Is there a 4 Pole OH2 selection available?





Do you have enough $NPSH_A$?

So your options are:-

- Is there a 4 Pole OH2 selection available
- Can you find a bit more $NPSH_A$?



N_{ss} Calculator

NPSH / Nss Calculator

$$N_{SS} = N_{(RPM)} Q_{(BEP \text{ Full Dia})}^{0.5} / NPSH$$
$$N_{SS(Metric)} = N_{SS(US)} \times 1.16 \text{ (m}^3/\text{hr, m, rpm)}$$

Is there a commercially available pump to meet your NPSH requirement?

Enter rated flow, available NPSH, and pump speed below (in the units of your choice).

The calculator will calculate the Suction Specific Speed (Nss) of the theoretical pump that will meet your requirements with a 1m (3ft) NPSH margin.

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If not, try a lower speed (e.g 1450rpm instead of 2950rpm)

If the Nss is still too high, increase the NPSHA until you DO find a theoretical pump

ENTER DATA ↓	
Flow m3/hr	200
NPSHA (M)	6
RPM	2960

ENTER DATA ↓	
Flow (USGPM)	1100
NPSHA (FT)	25
RPM	3550

Theoretical Nss of a pump to do this duty with a 1m (or 3ft) NPSH margin

Single Suction Pump		Single Suction Pump	
m3/hr,m,rpm units	12519	USGPM,Ft,RPM units	11591
USGPM,Ft,RPM units	10792	m3/hr,m,rpm units	13445

SUCCESS! There is probably a suitable single suction pump for your NPSH condition

Try a slower speed or increase the NPSH available

Double Suction Pump		Double Suction Pump	
m3/hr,m,rpm units	8852	USGPM,Ft,RPM units	8196
USGPM,Ft,RPM units	7631	m3/hr,m,rpm units	9507

SUCCESS! There is probably a suitable double suction pump for your NPSH condition

SUCCESS! There is probably a suitable double suction pump for your NPSH condition



Do you have enough $NPSH_A$?

So your options are:-

- Is there a 4 Pole OH2 selection available
- Can you find a bit more $NPSH_A$?
- Is there a BB2 pump available?



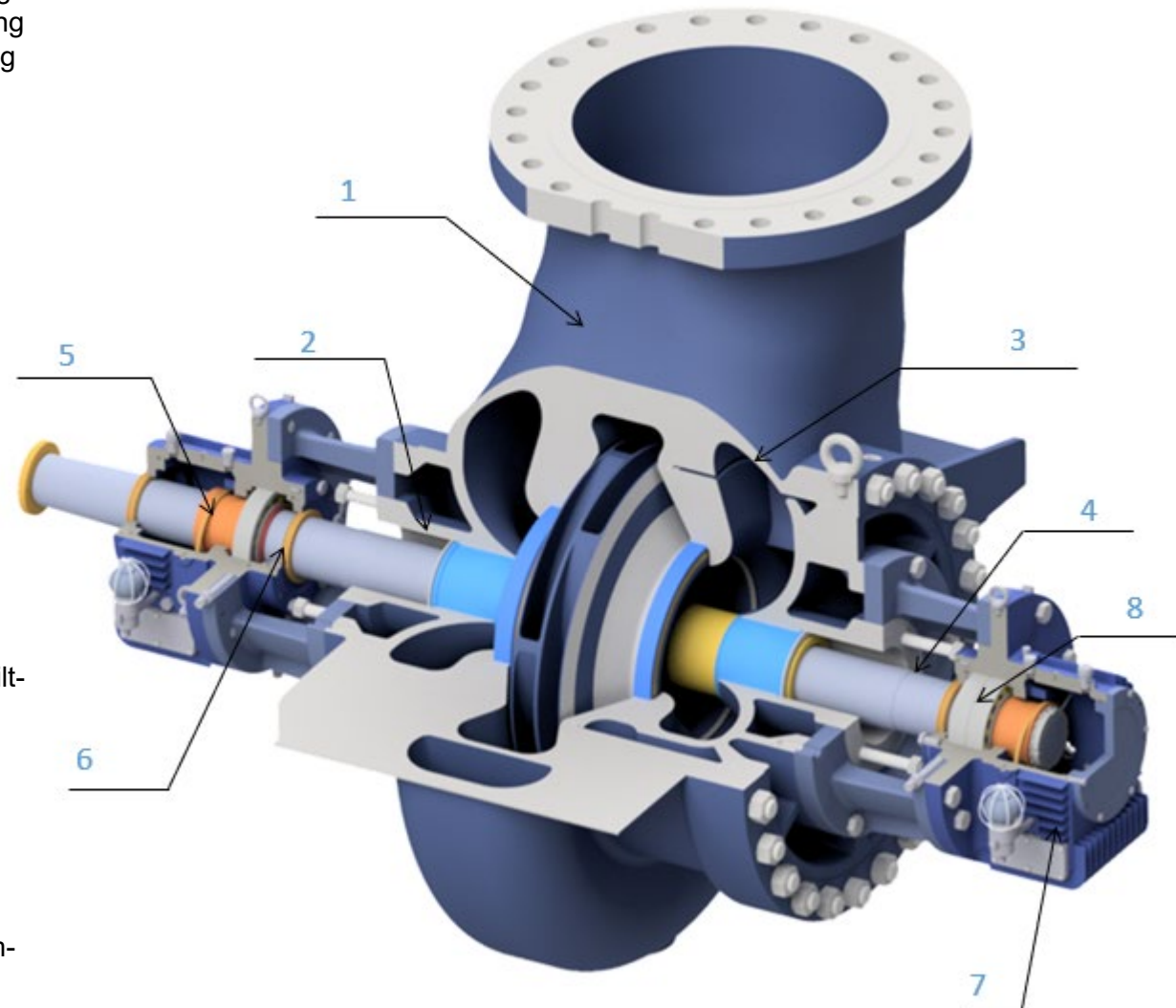
Type BB2



Pump Type BB2

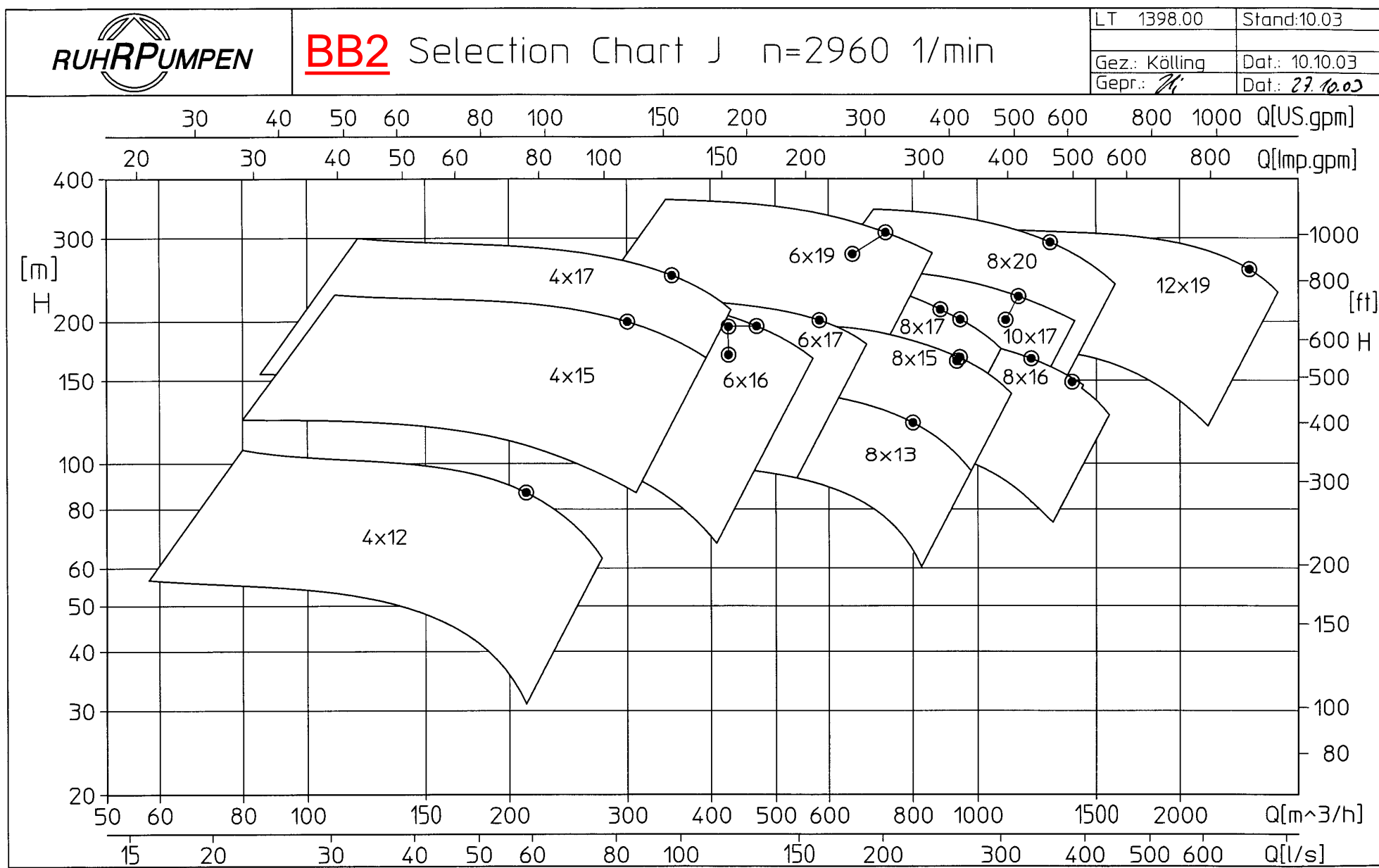
Full API Compliant

- 1 Heavy duty, dual volute, centerlined supported, radial split casing designed to reduce the effects of piping loads, thereby maximizing the life of bearings, seals and wear rings. The single cover casing minimizes alignment problems.
- 2 Wide dimensioned shaft sealing chamber fitting for all commercially available designs (single, dual unpressurized and pressurized mechanical seal).
- 3 Dynamically balanced, double suction impeller minimizes thrust problems, reduces NPSH requirements and provides smooth operation for longer mechanical seal and bearing life.
- 4 Between bearing, stiff shaft design reduces shaft deflection for longer bearing and mechanical seal life
- 5 Positive positioned oil rings assure complete oil penetration into the bearing without foaming and thereby extend bearing life. Provisions for oil mist lubrication are standard design.
- 6 Labyrinth flingers at each end of the bearing housing provide built-in protection of the lubrication against contamination
- 7 Standard finned cooling inserts reduce bearing temperatures on hot services and lengthen bearing life. The insert is made of corrosion-resistant materials to handle the most difficult cooling liquids.
- 8 Optional bearing designs and lubrication systems can be custom-fit to application. Pressure lubrication systems to API 610 or 617 are available.





BB2 50Hz 2 Pole





Do you have enough $NPSH_A$?

So your options are:-

- Is there a 4 Pole OH2 selection available
- Can you find a bit more $NPSH_A$?
- Is there a BB2 pump available?
- Is an inducer acceptable?
- Is a higher N_{ss} impeller acceptable?
- Select a VS6 Pump (vertical barrel pump, low $NPSH_R$)
- DON'T Select a 3 stage BB3 and lose the project!

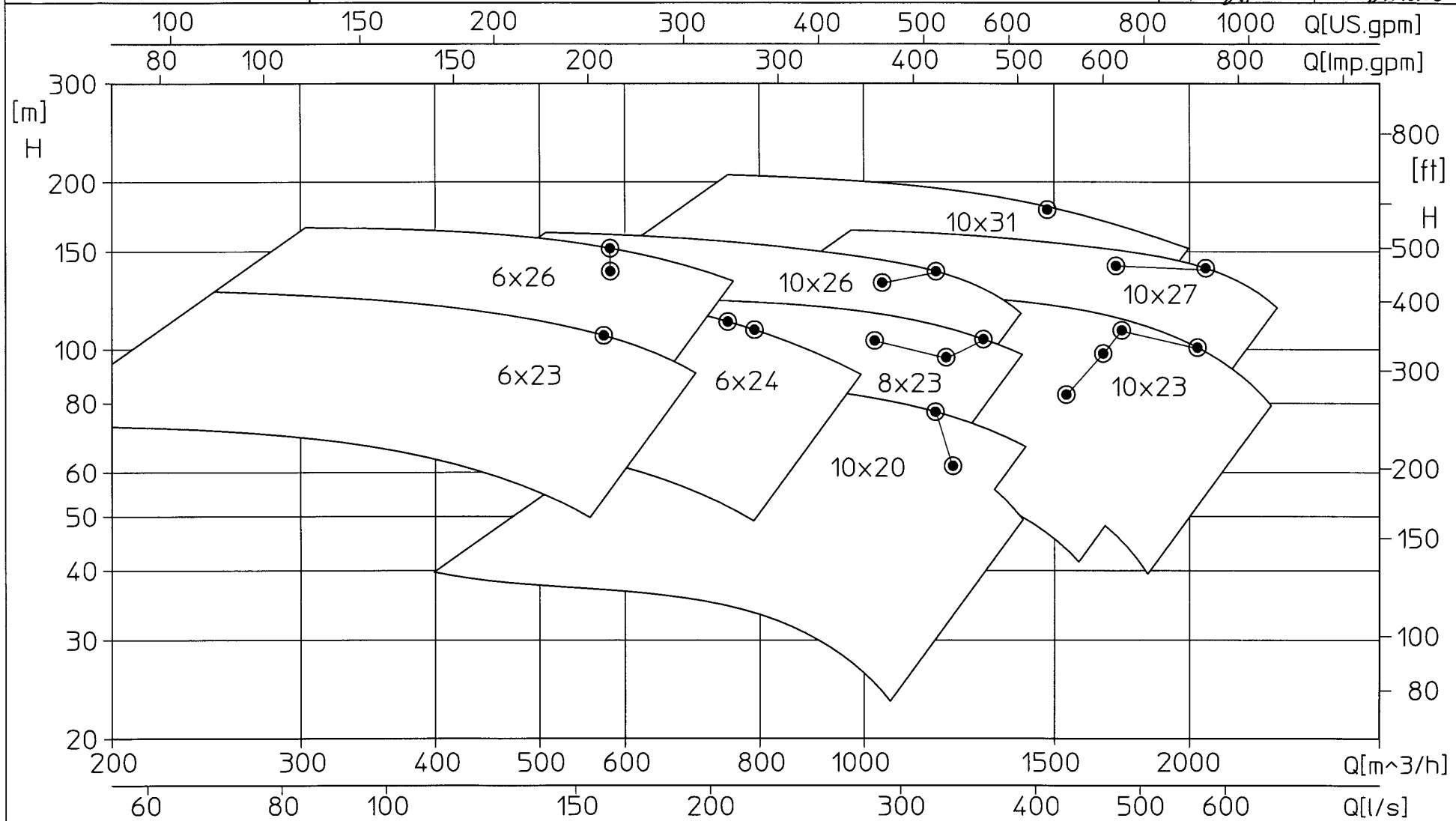


BB2 50Hz 4 Pole



BB2 Selection Chart J n=1480 1/min

LT 1401.00	Stand:10.03
Gez.: Kölling	Dat.: 21.10.03
Gepn: <i>Hi</i>	Dat.: <i>27.10.03</i>



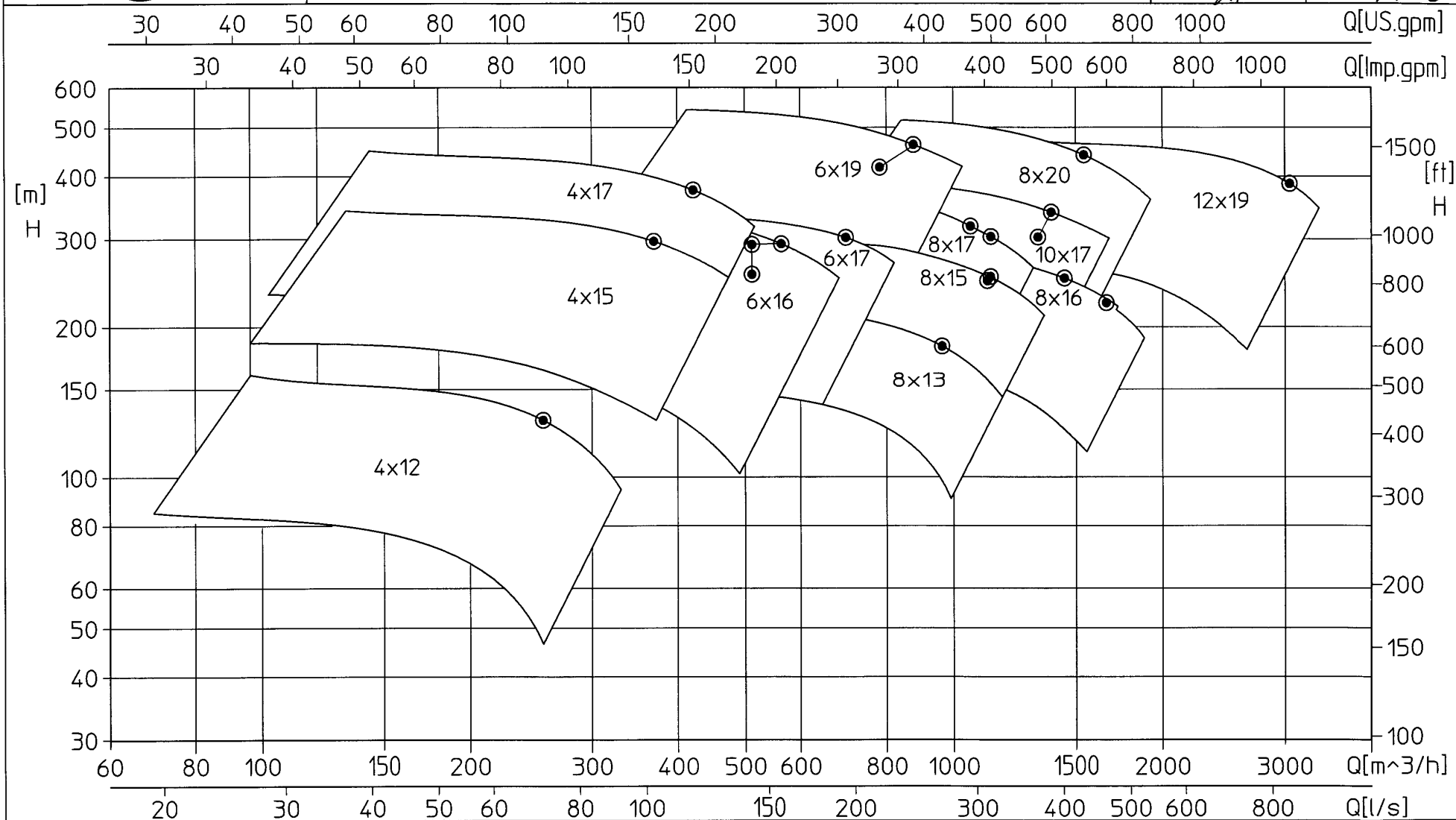


BB2 60Hz 2 Pole



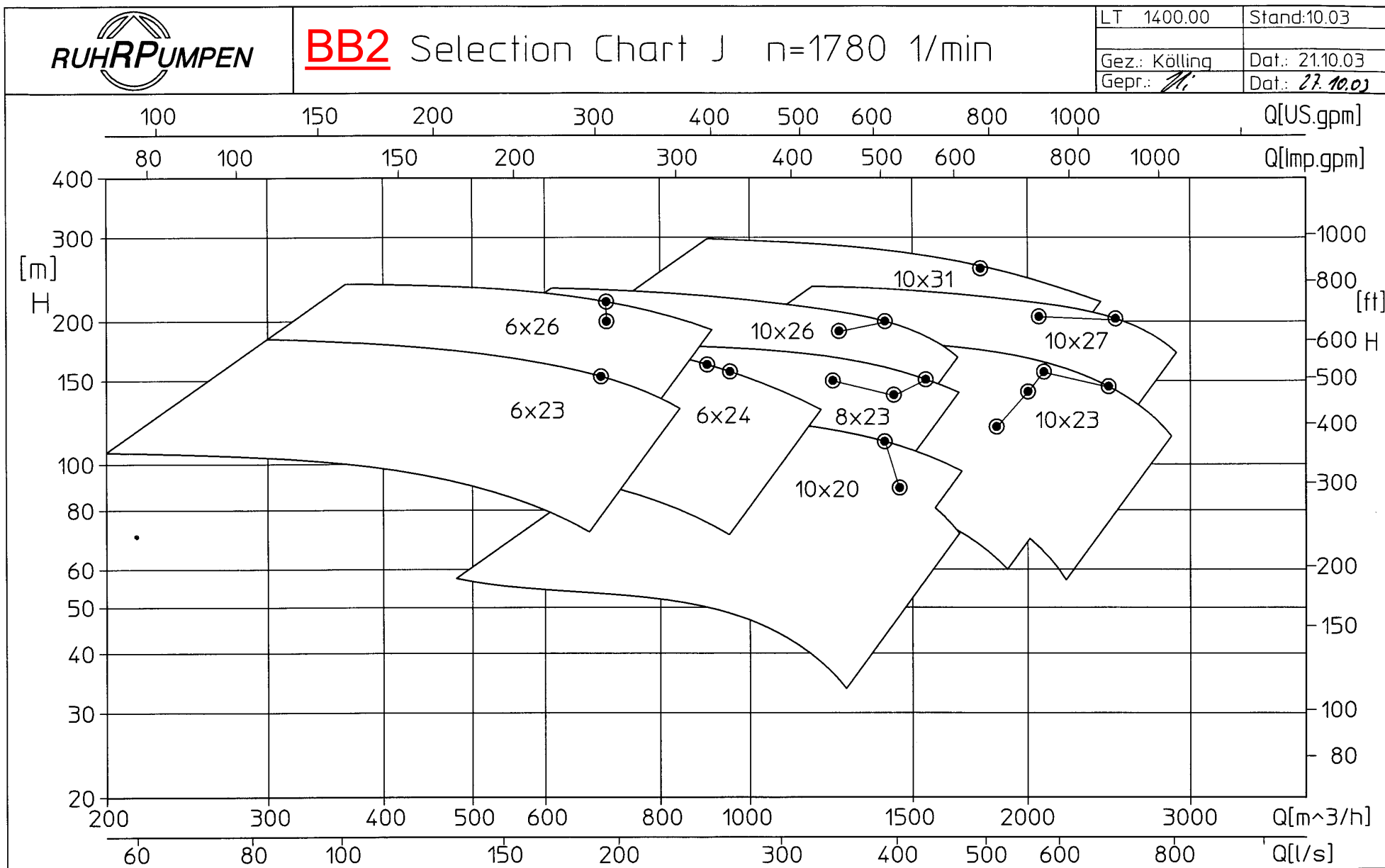
BB2 Selection Chart J n=3560 1/min

LT 1399.00	Stand:10.03
Gez.: Kölling	Dat.: 20.10.03
Gepr.: <i>Hi</i>	Dat.: 27.10.03





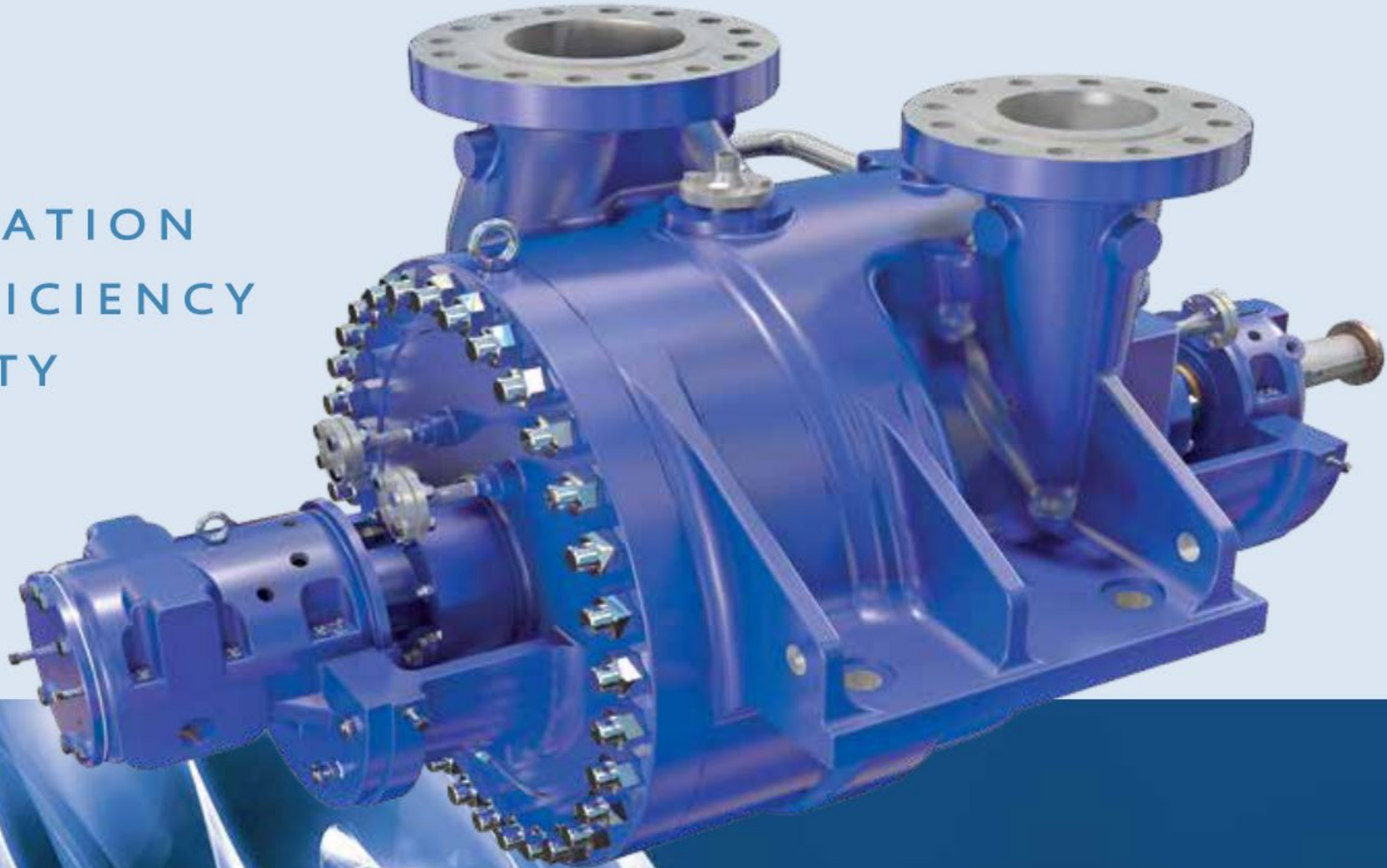
BB2 60Hz 4 Pole





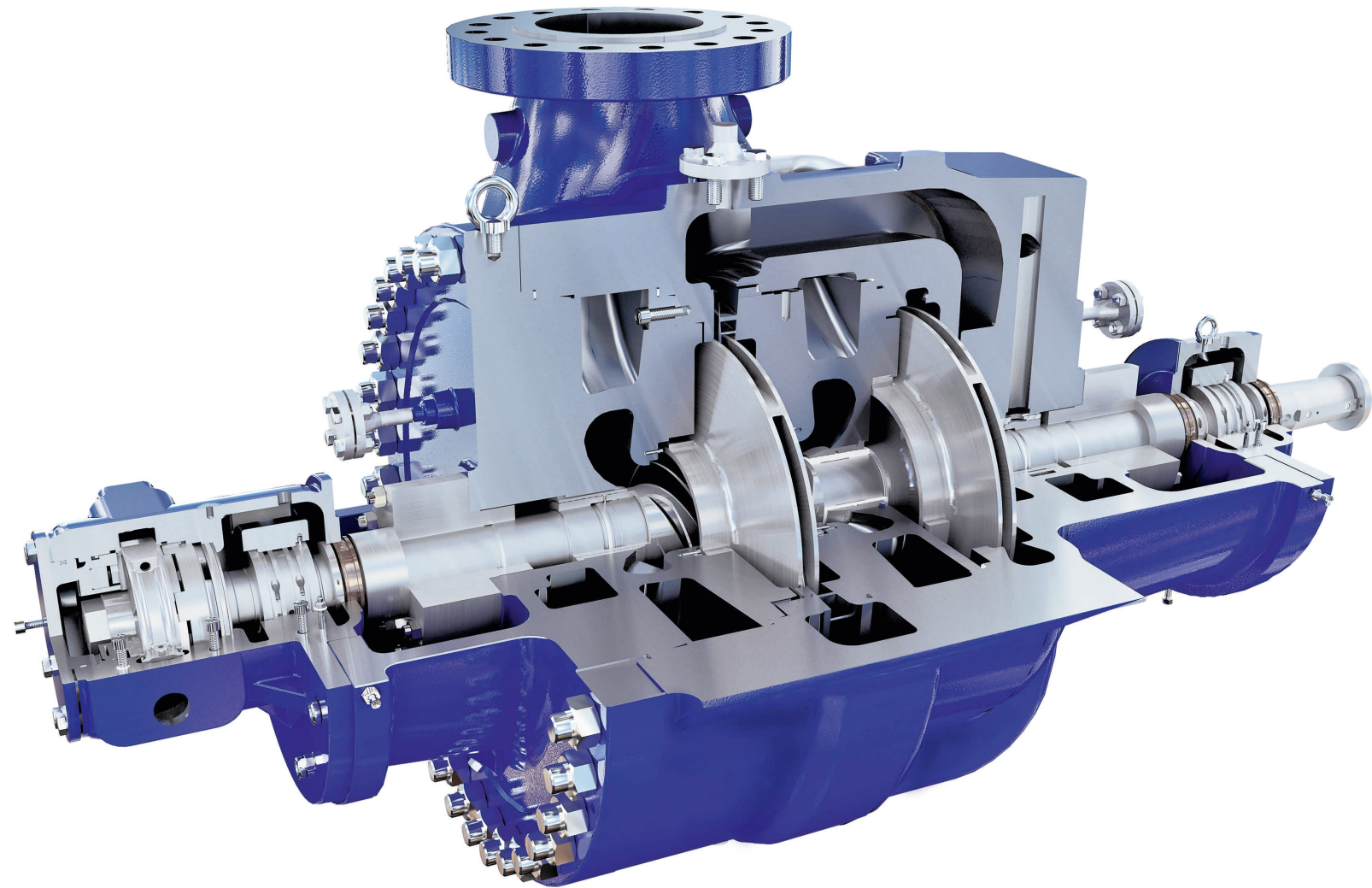
BB2- 2 Stage Pumps

INNOVATION
EFFICIENCY
QUALITY



BB2- 2 Stage Pumps

Available in Single Suction and Double Suction 1st Stage construction.





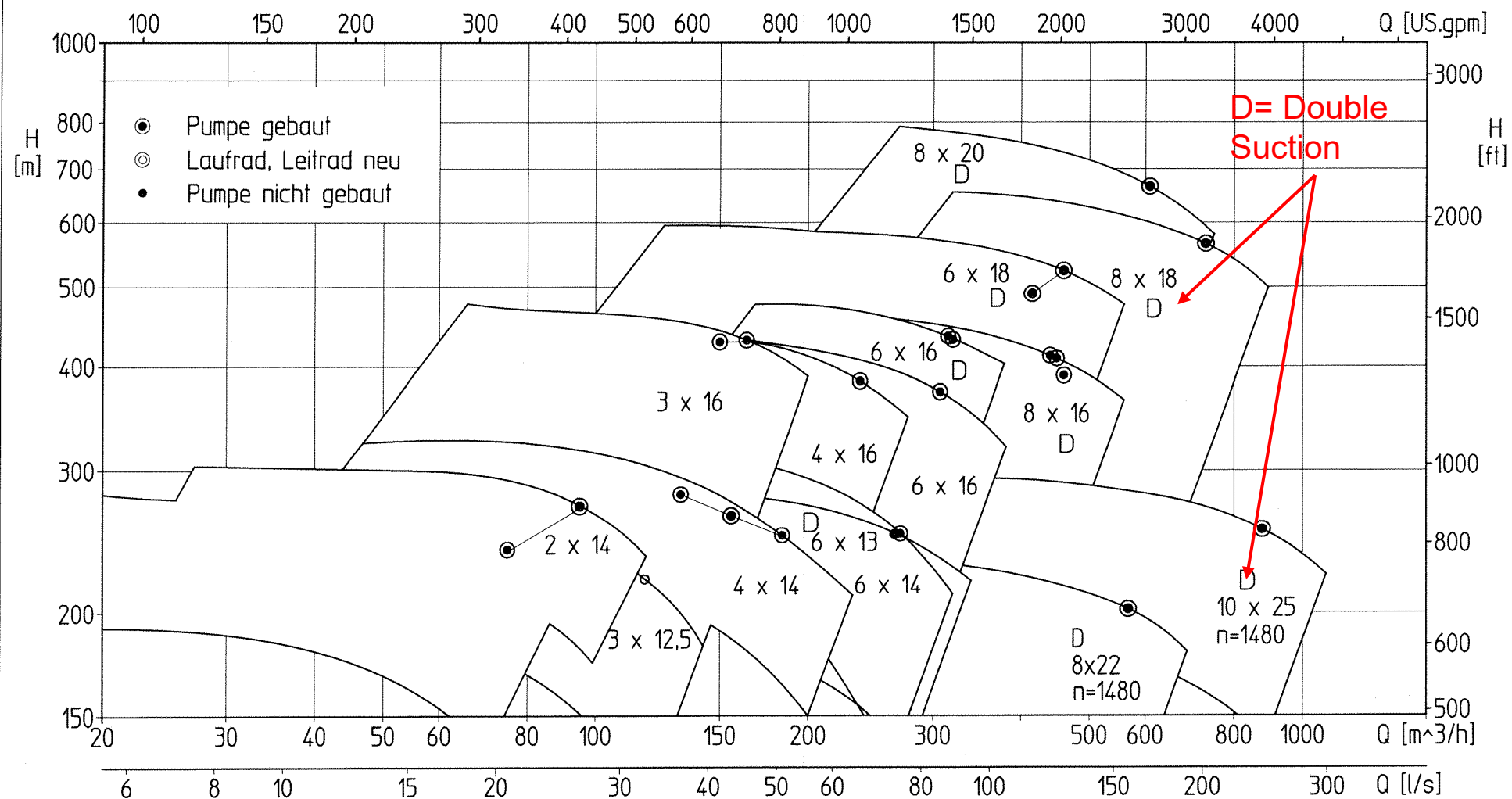
BB2 - 2 Stage, 50 Hz 2 Pole

BB2 - 2 Stage



Selection Chart RON $n = 2960 \text{ 1/min}$

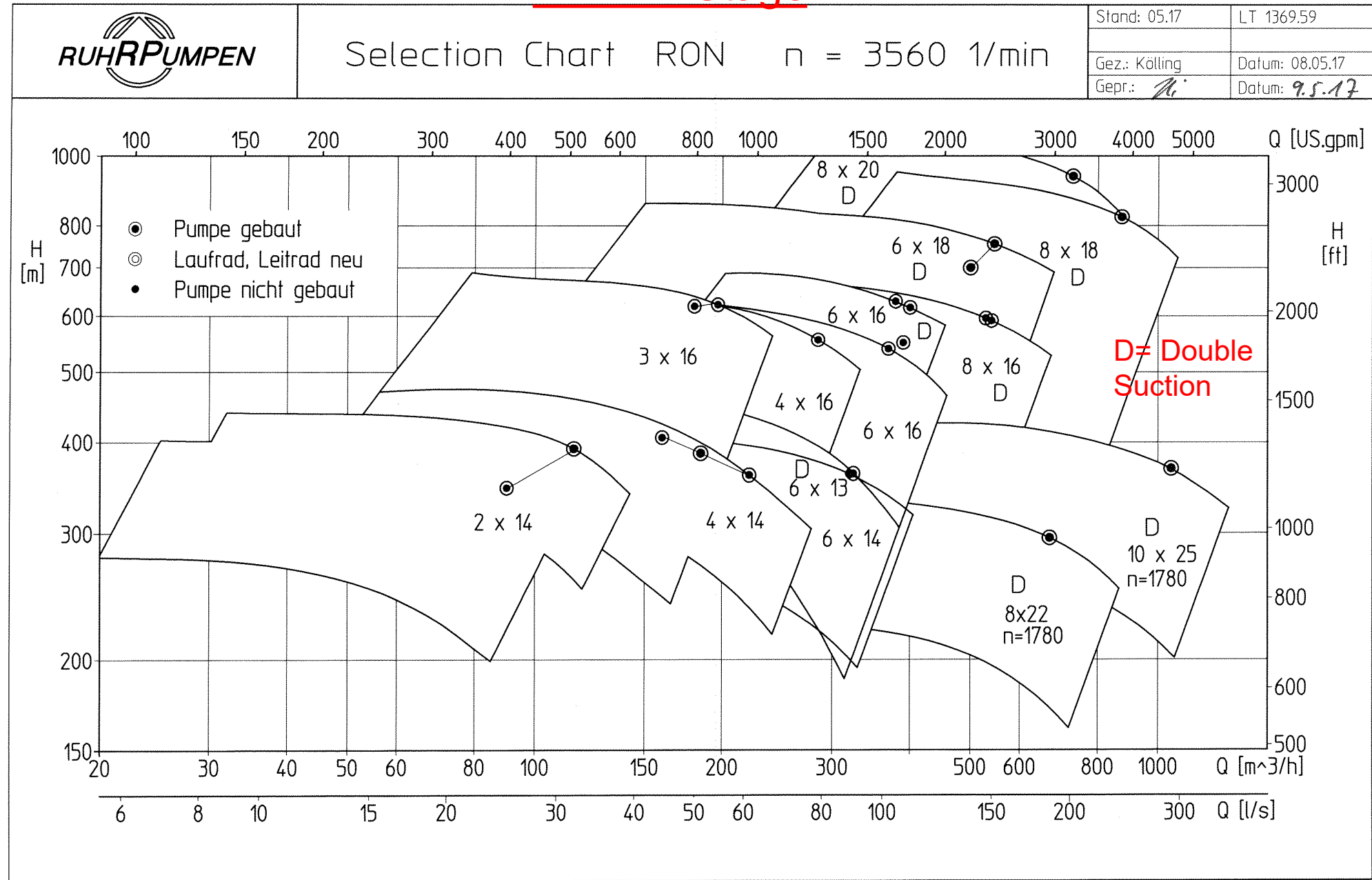
Stand: 07.17	LT 1285.39
Gez.: Kölling	Datum: 05.07.17
Gepr.: <i>U</i>	Datum: <i>6.7.17</i>





BB2 - 2 Stage, 60 Hz 2 Pole

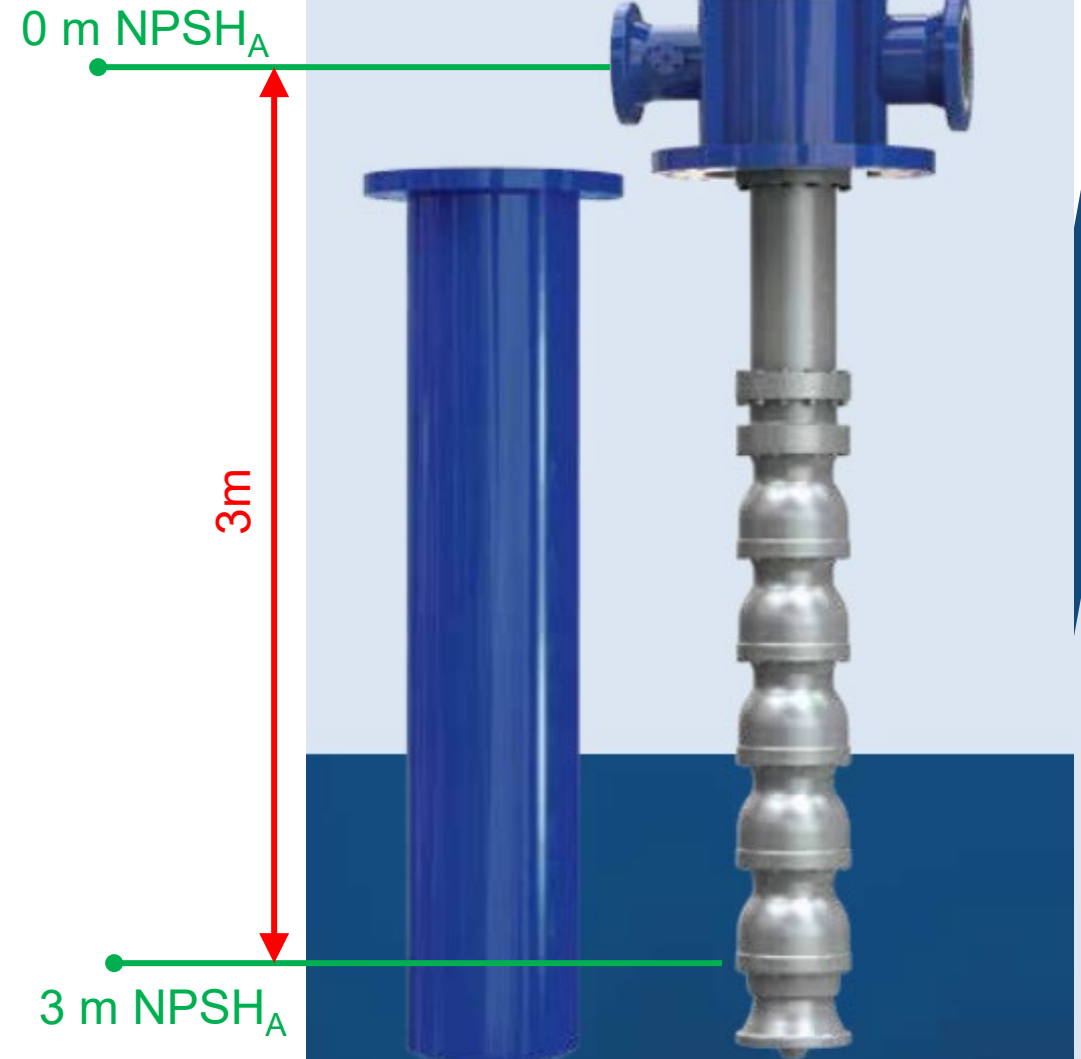
BB2 - 2 Stage



VS6 Pumps – Zero NPSH_R

The Spacesaver and Costsaver

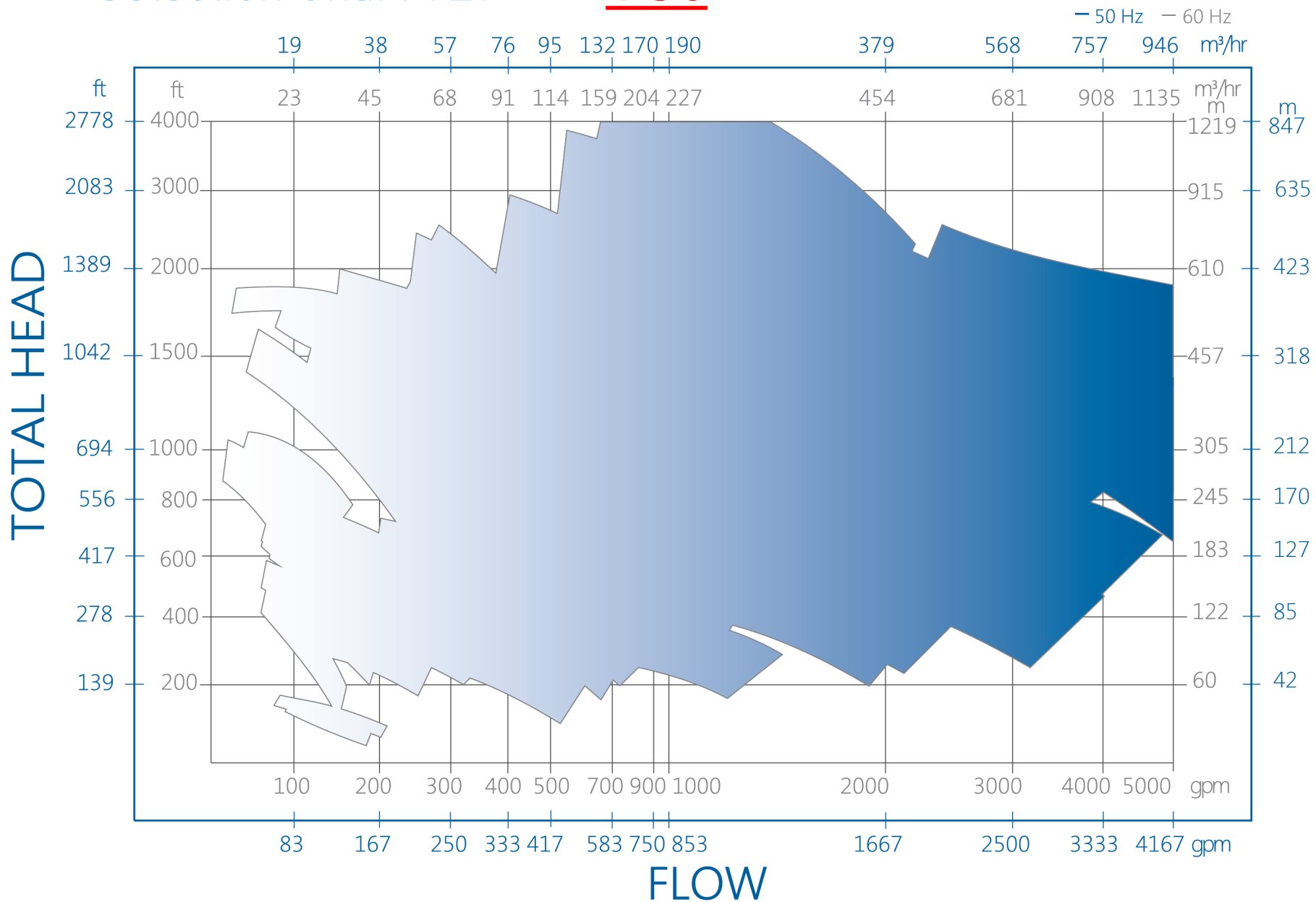
- You've looked OH2 pumps and at BB2 pumps and you still have an NPSH problem
- Not just an NPSH saver but a space saver too. Around 20% of the floorspace of the equivalent BB2
- And a cost saver too. Less expensive than the equivalent BB2
- One seal, one sealing system
- Once you can persuade your civil engineers to dig a hole you are saving all the way.





VS6 – Multispeed – Semi Engineered Range

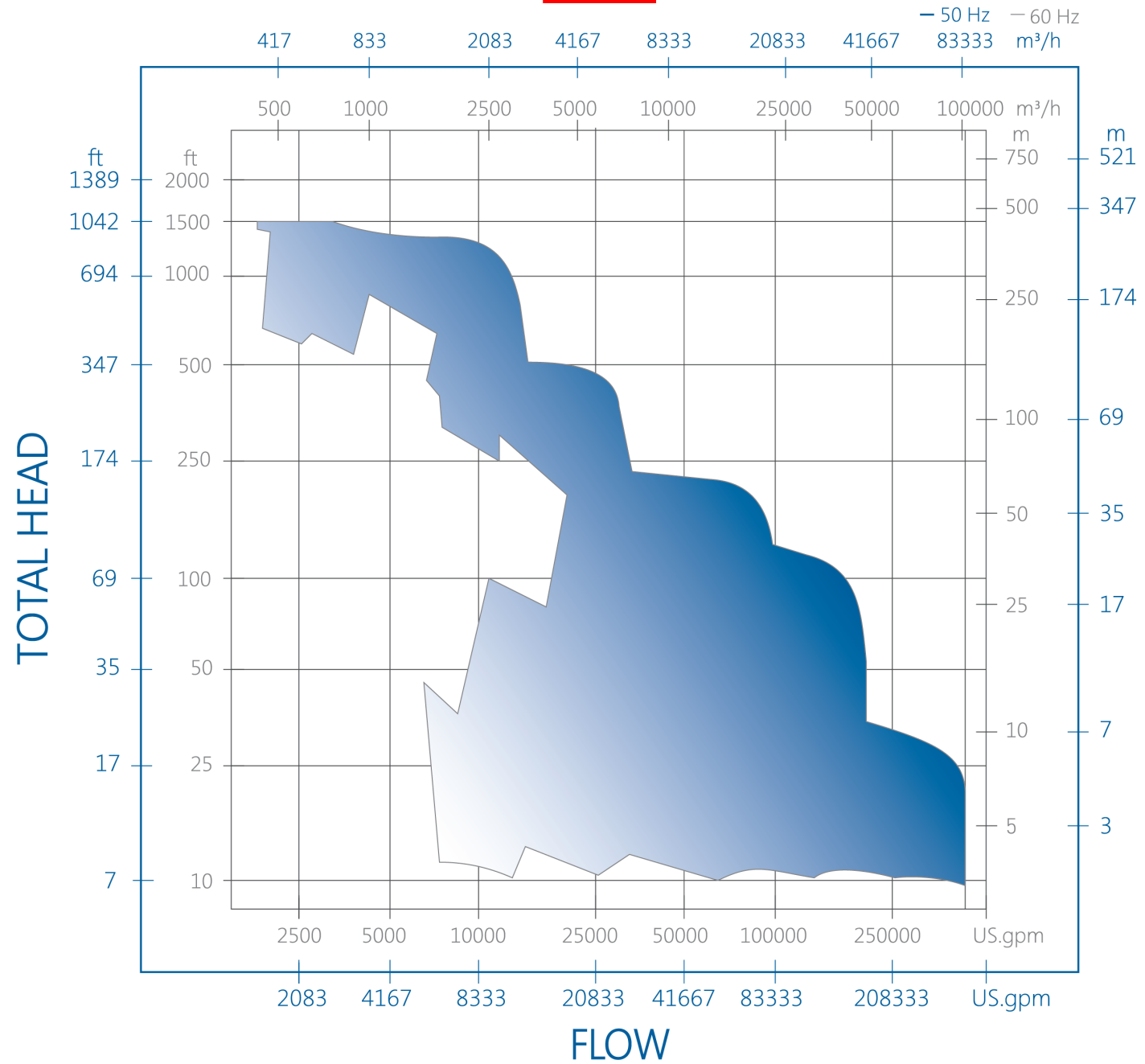
Selection Chart VLT VS6





VS6 – Multispeed – Engineered Range

Selection Chart VMT VS6





Axially Split Pumps BB1 & BB3

Pipeline Pumps



Axially Split Pumps BB1 & BB3

Limitation from API610 on use of axially split pumps

- 6.3.9 Unless otherwise specified, pumps with **radially split** casings are required in services for any of the following conditions:
 - a) **pumping temperature of 200 C (400 F)** or higher (a lower temperature limit should be considered if thermal shock is probable);
 - b) liquids with a **relative density of less than 0,7** at the specified pumping temperature;
 - c) liquids at a rated **discharge gauge pressure above 10 MPa (100 bar; 1450 psi)**.
- Axial split casings have been used successfully beyond the limits given above, generally for off-plot applications at higher pressure or lower relative density (specific gravity). The success of such applications depends on the margin between design pressure and rated pressure, the manufacturers experience with similar applications, the design and manufacture of the split joint, the user's ability to correctly remake the split joint in the field. The purchaser should take these factors into account before specifying an axial split casing for conditions beyond these limits.
- For an excellent article by Simon Bradshaw on this subject, follow this link
- <https://www.linkedin.com/pulse/thngs-api-610-got-wrong-part-5-simon-bradshaw/>



INNOVATION
EFFICIENCY
QUALITY



ZM I to III

Axially Split Case, Heavy Duty
API 610 Process Pump (BB1)

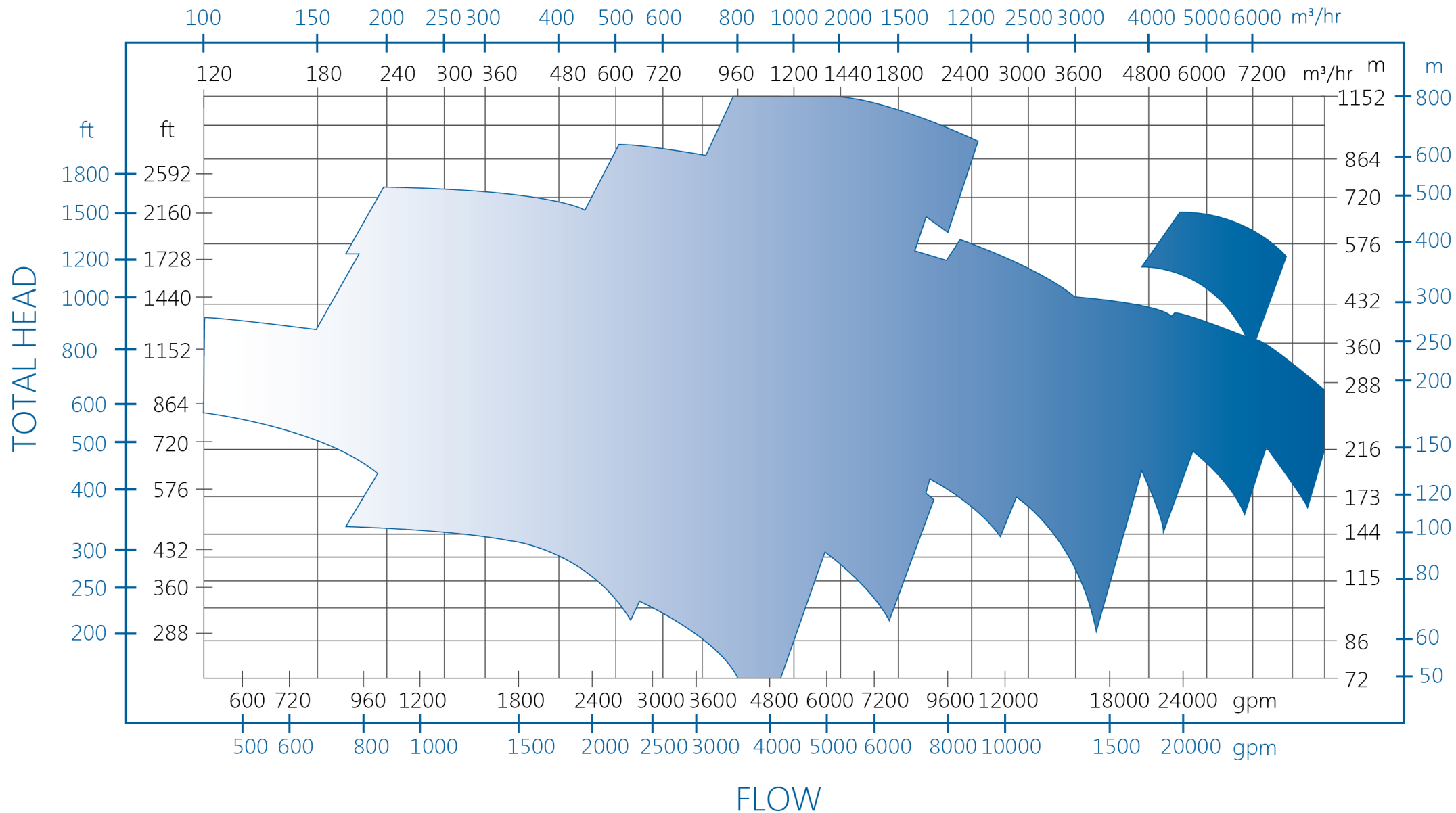


Selection Chart ZM I

BB1- B

2 POLES
50 Hz 60 Hz

BB1, 50 & 60 Hz, 2 Pole





Selection Chart ZM II

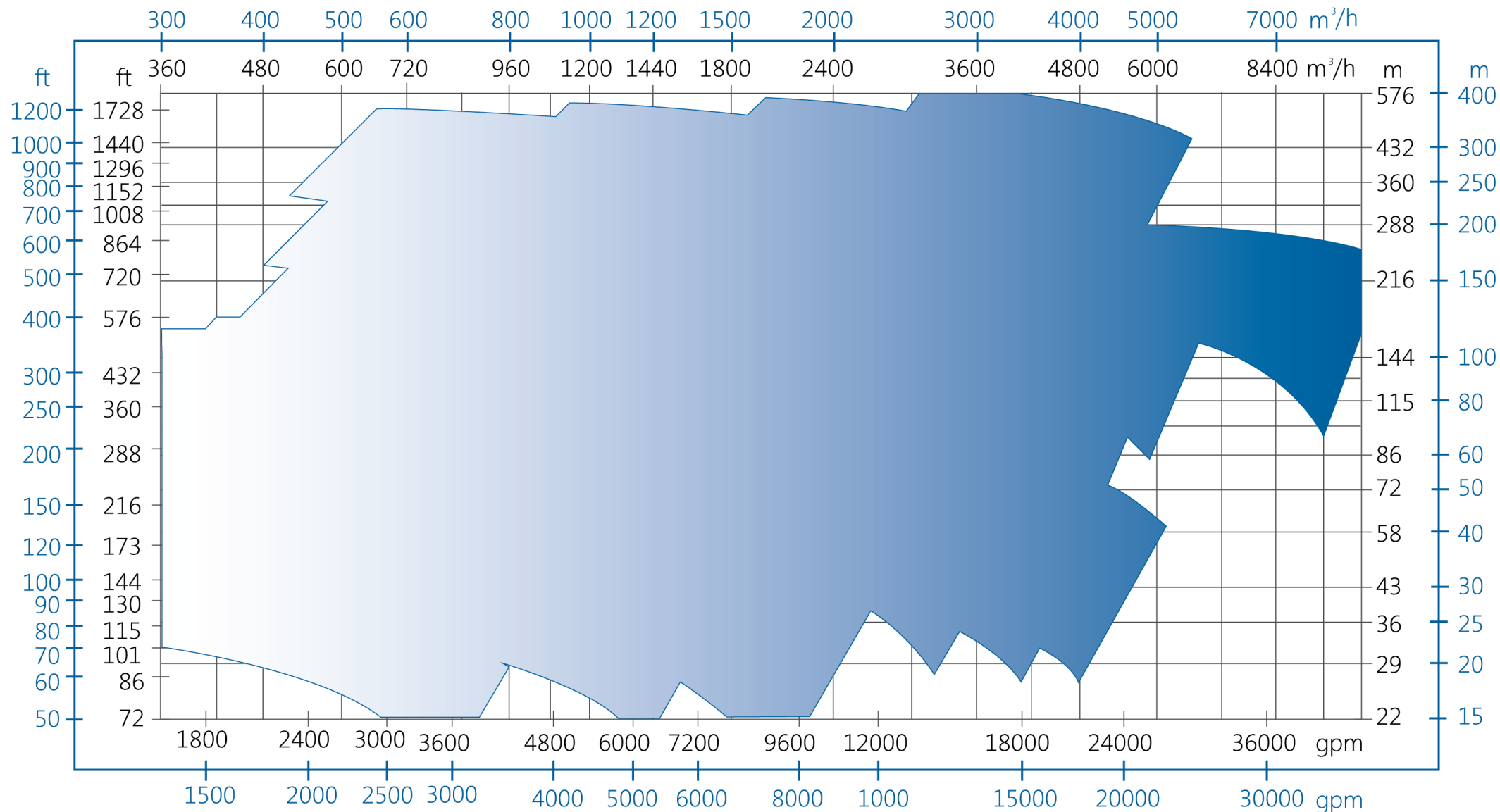
BB1- B

4 POLES

— 50 HZ — 60 HZ

BB1, 50 & 60 Hz, 4 Pole

TOTAL HEAD





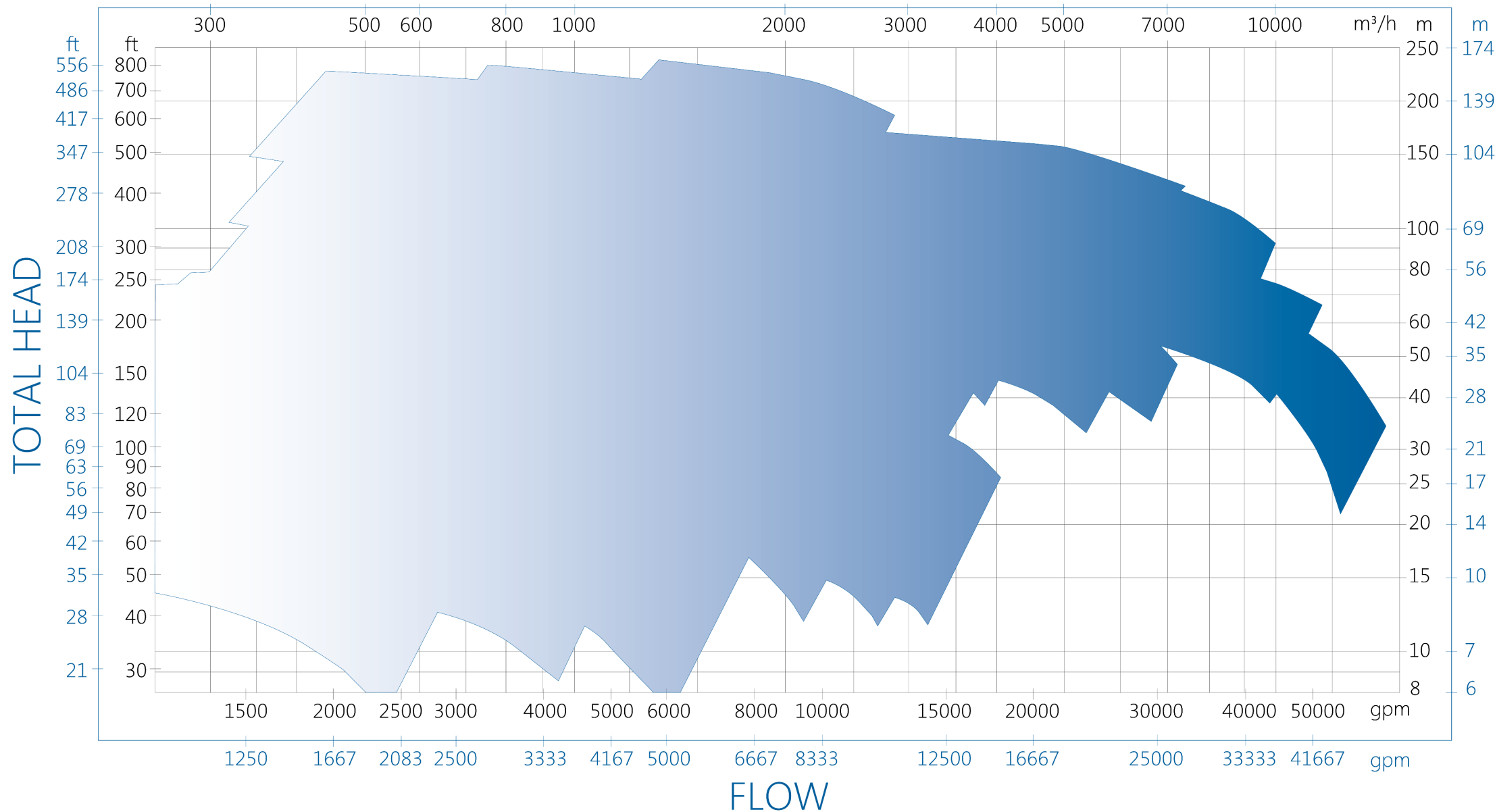
Selection Chart ZM III

BB1- B

6 POLES

50 Hz 60 Hz

BB1, 50 & 60 Hz, 6 Pole





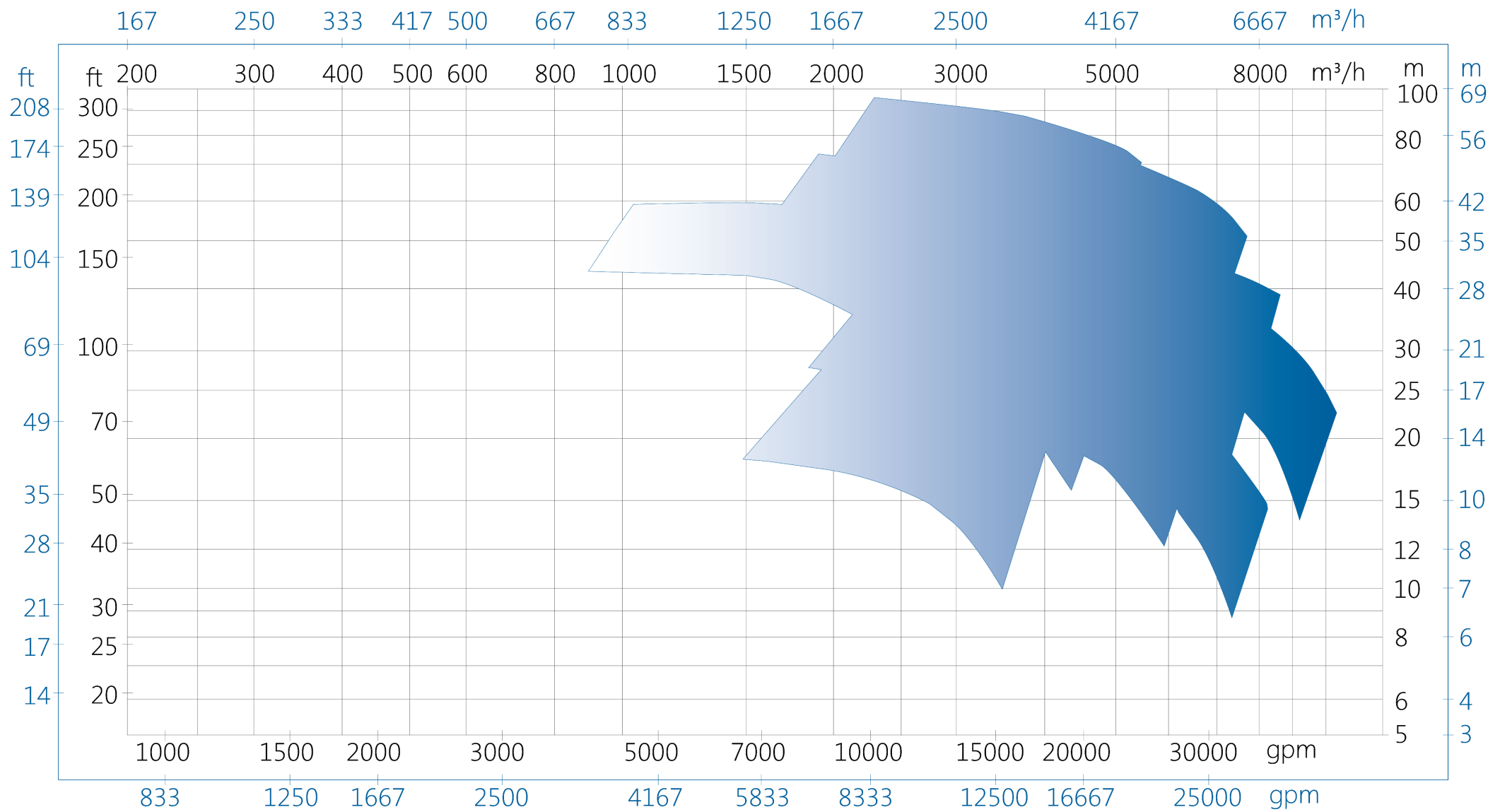
Selection Chart ZM IV

BB1- B

8 POLES
50 Hz 60 Hz

BB1, 50 & 60 Hz, 8 Pole

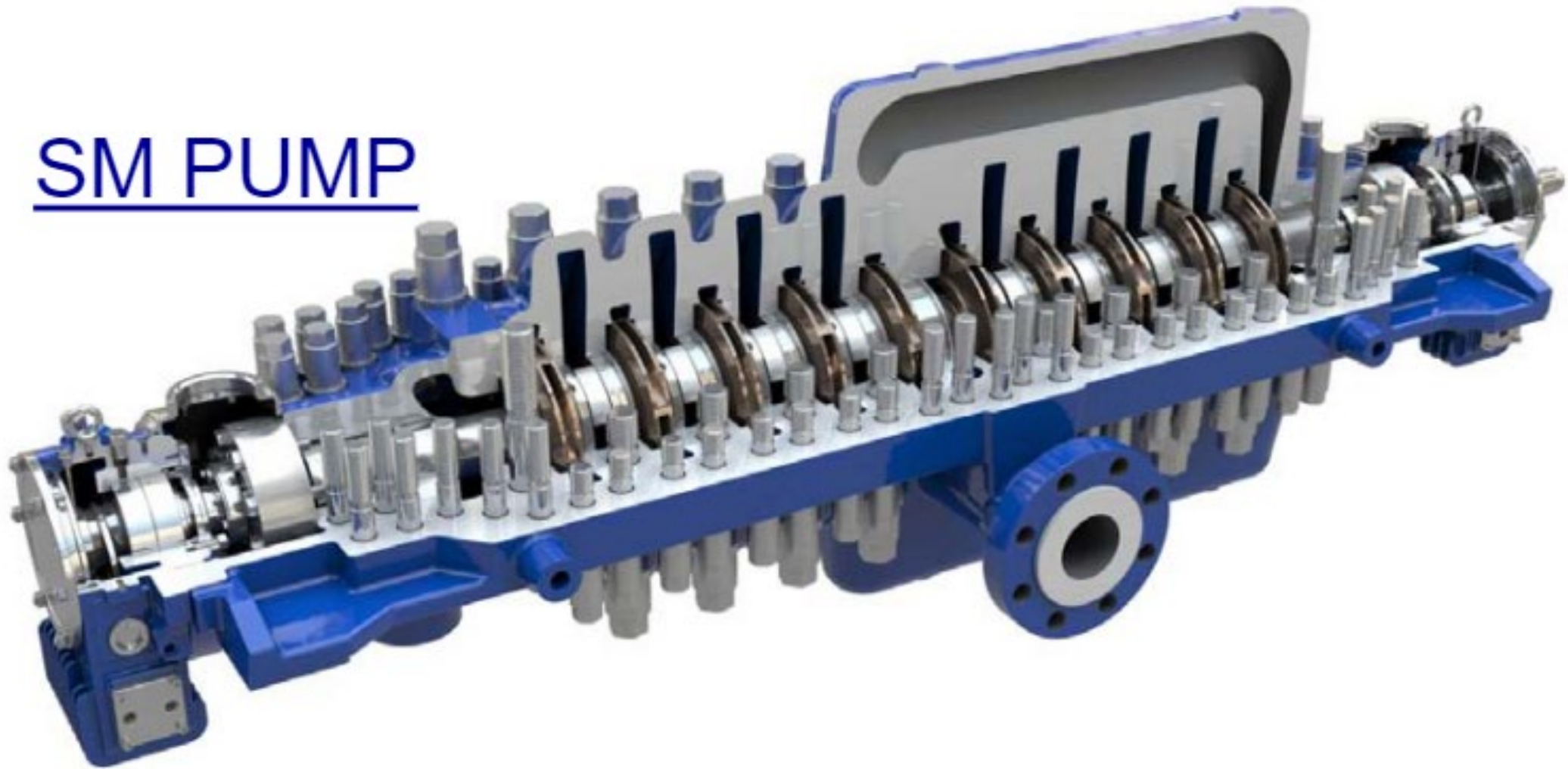
TOTAL HEAD



FLOW

Axially Split Multistage Type BB3

SM PUMP



Axially Split Type BB3

Interstage Bolting ensures gasket compression in this area and prevents erosion caused by fluid washover.

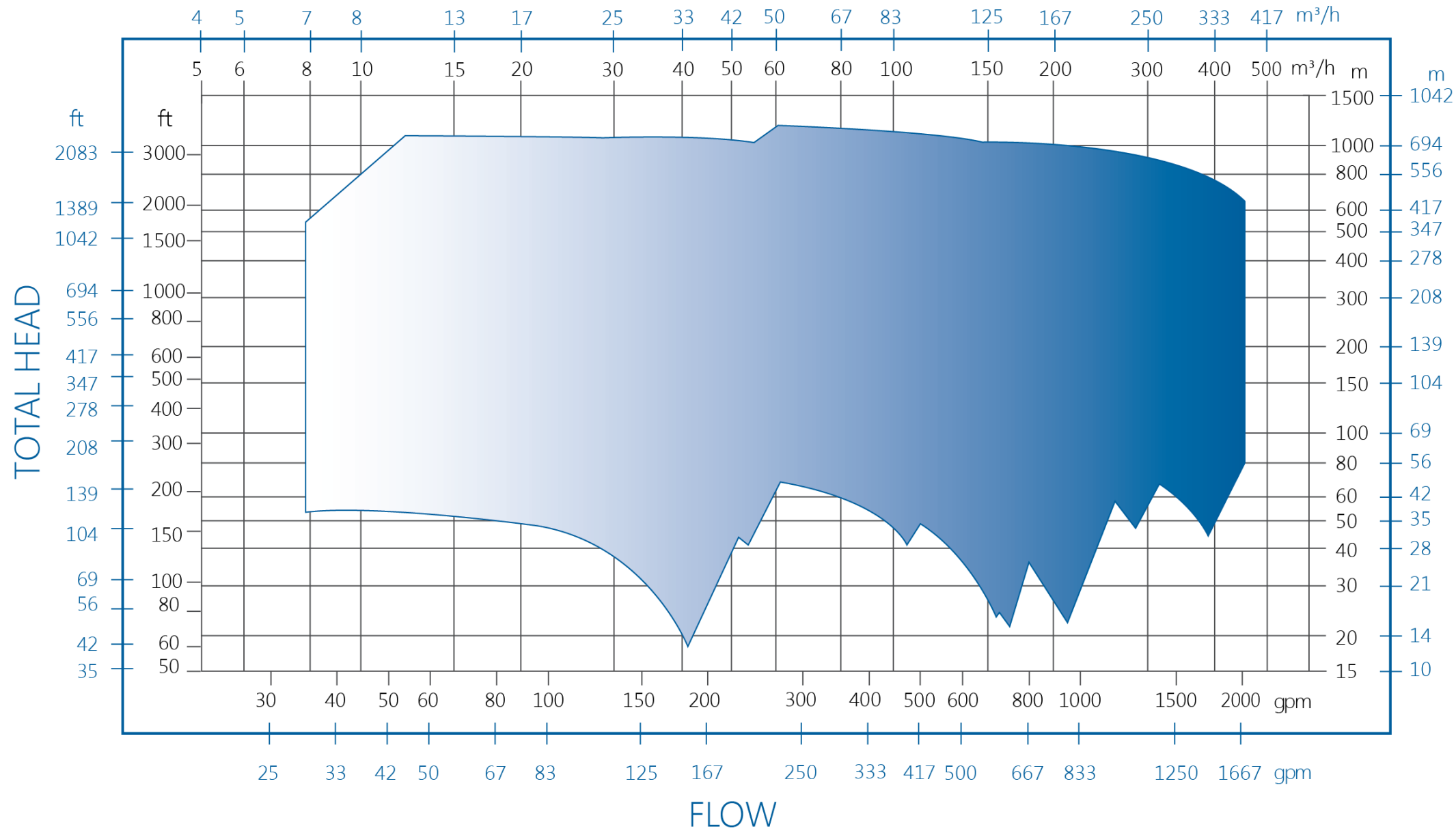
It means this design is good for SG as low as 0.4 and pressures to 180 Bar.



BB3

— 50 Hz — 60 Hz

BB3 Smaller Sizes, 50 & 60 Hz, 2 Pole



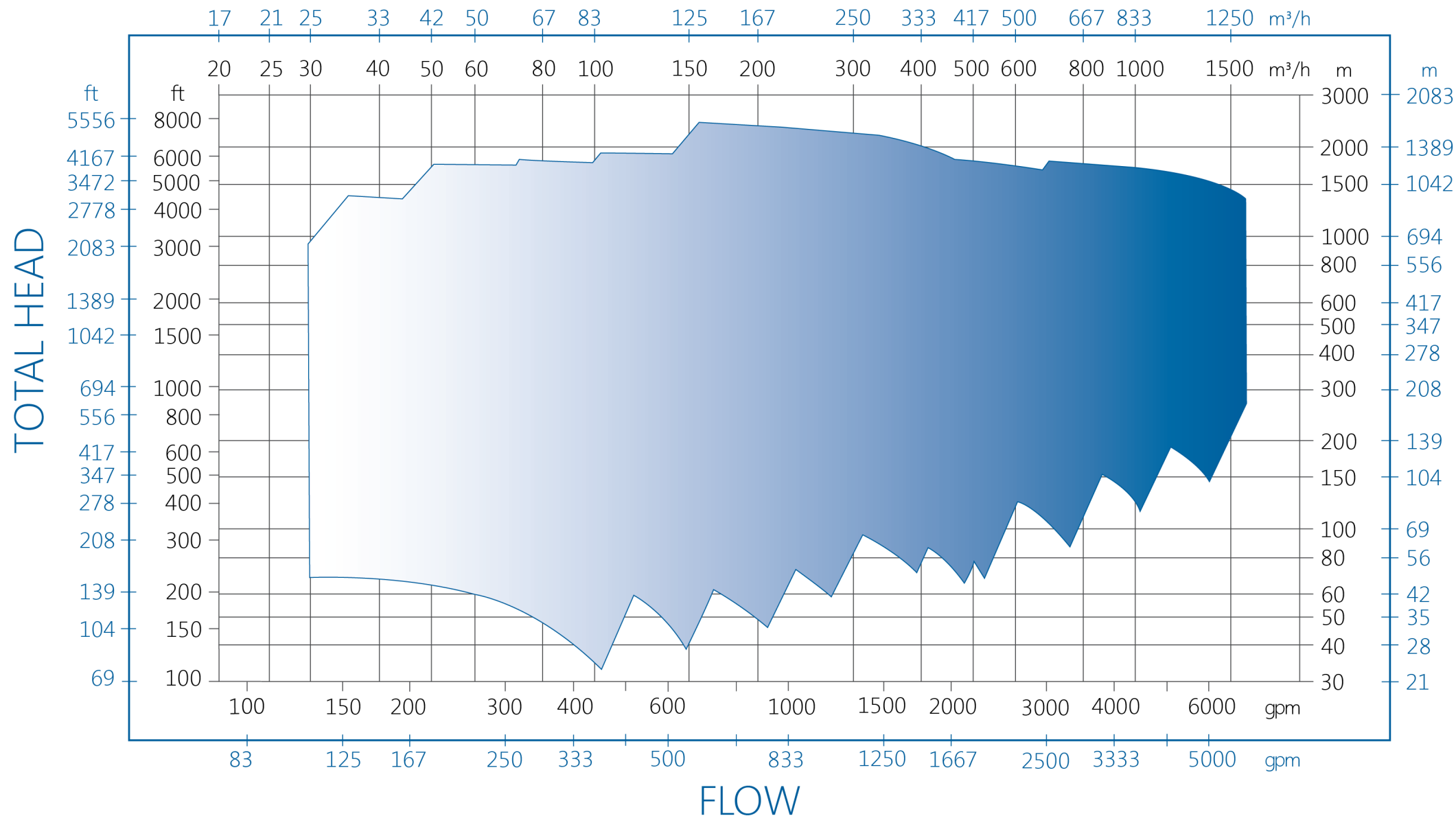


Selection Chart SM/SMI

BB3

2 POLES
(2960 / 3560 RPM)
— 50 Hz — 60 Hz

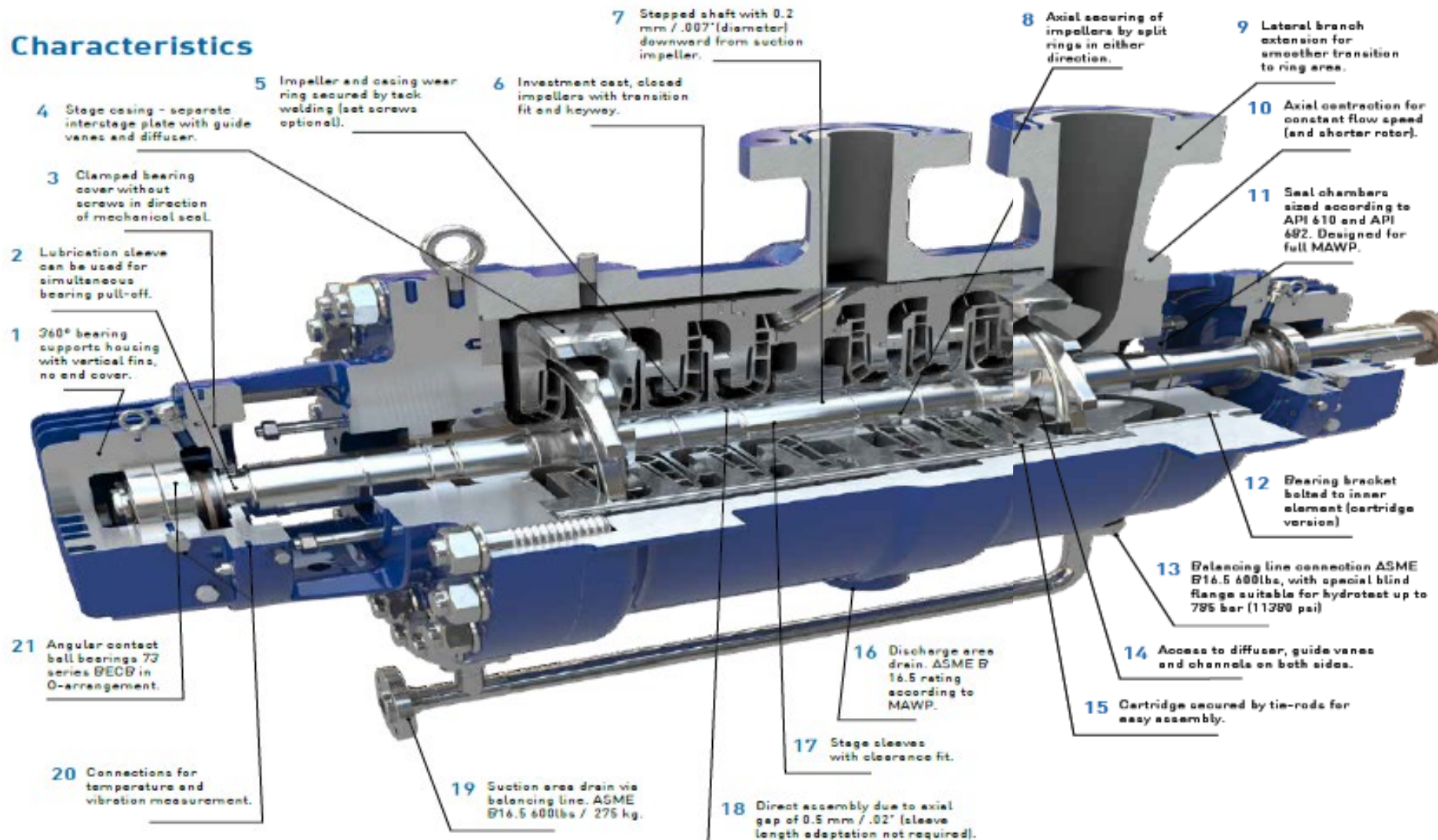
BB3 Larger Sizes, 50 & 60 Hz, 2 Pole





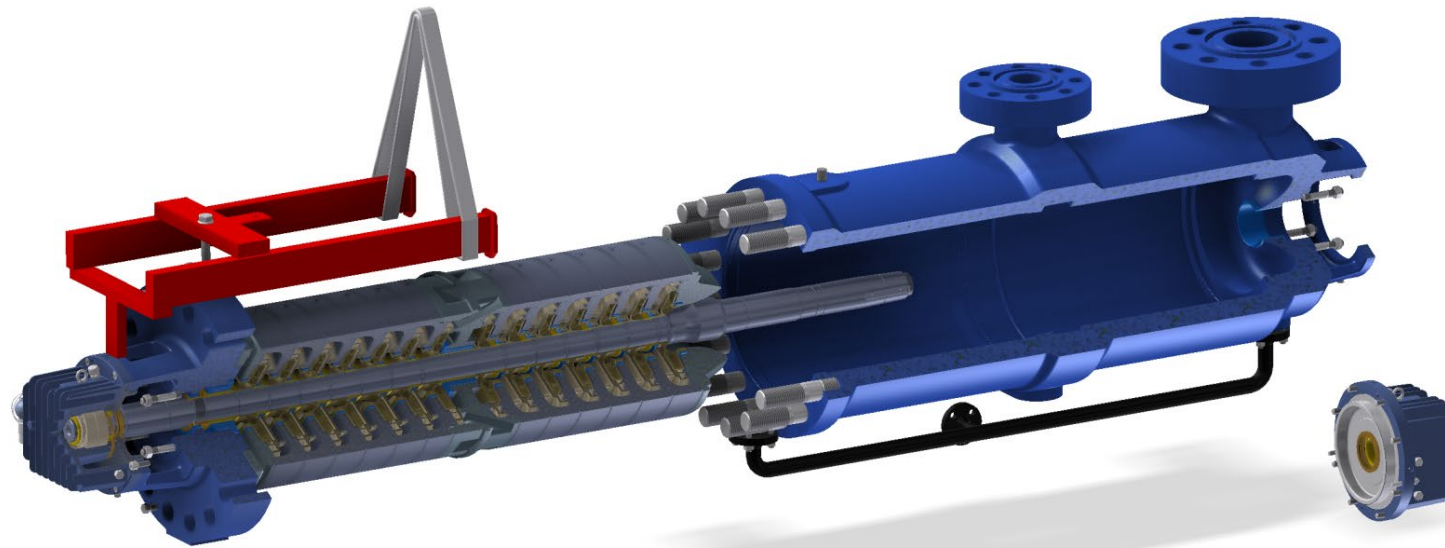
Double Case Pump Type BB5

Characteristics



Double Case Pump Type BB5

Pull-out Design





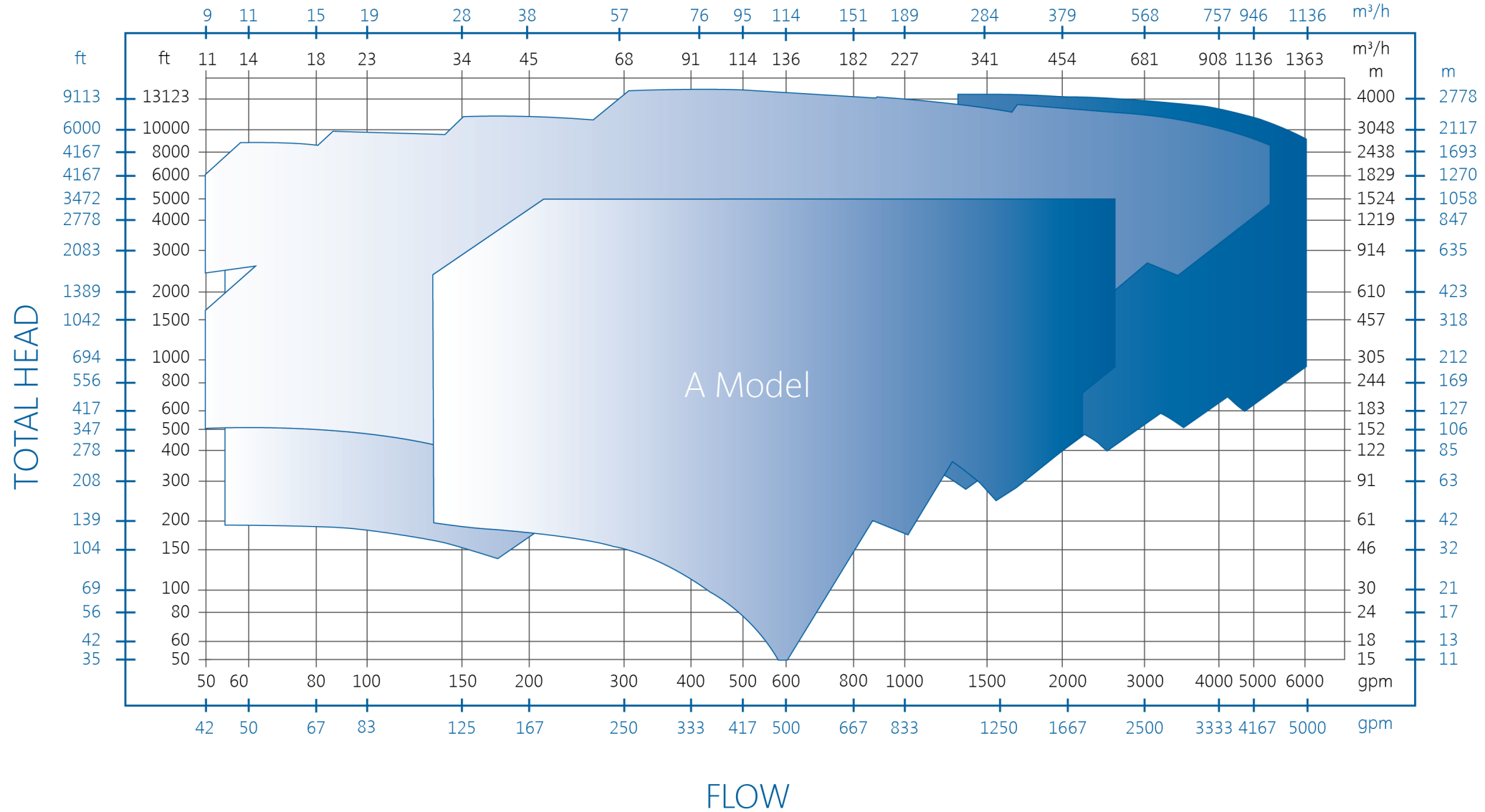
SELECTION CHART A-LINE

BB5

2 POLES

— 50 Hz — 60 Hz

BB5, 50 & 60 Hz, 2 Pole





Specialist for Pumping Technology

www.ruhrpumpen.com

info@ruhrpumpen.com



Coming Attractions 😊

“NPSH Made Simple (or simpler anyway!)”

Thur 1st July – 08.00 (UK BST) (Eastern Hemisphere) & 17.00 (UK BST) (Western Hemisphere)

Aimed at Process and Mechanical Engineers and Consultant Engineers specifying pumping equipment as well as Applications & Sales Engineers selecting and quoting them. Develop an understanding of the fundamentals and practical aspects of NPSH – probably the most difficult and misunderstood concept in pumping

Will cover such topics as Cavitation damage, Suction Specific Speed and the “11,000 limitation”, understanding the NPSH Curve

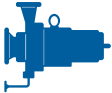





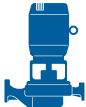
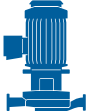
There will be a break in these Short Courses during the summer holiday period of July and August. We will recommence in September.

Future subjects in preparation include:

- Double Case Pumps (Barrel Pumps – BB5)
- Mechanical Seals & Systems
- Fire Pump Systems & Packages



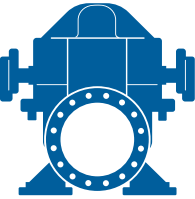




OVERHUNG PUMPS

CATEGORY	RP MODEL	DESIGN STANDARD	
Sealless Magnetic Drive Pumps	CRP-M / CRP-M-CC	ISO 2858 & 15783 HI design (OH11)	
	SCE-M	API 685	
Foot Mounted OH1 and General End Suction Pumps	IPP	HI design (OH1)	
	CPP / CPP-L	HI design (OH1) ANSI B73.1	
	CPO / CPO-L	HI design (OH1) ANSI B73.1	
	CRP	HI design (OH1) ISO 2858 & 5199	
	GSD	HI design (OH0)	
	SHD / ESK / SK / SKO SKV / ST / STV	HI design (OH1)	
	SWP	HI design (OH3A)	
Centerline Mounted	SCE	API 610 (OH2)	
Vertical In-Line Pumps	SPI	API 610 (OH3)	
	IVP / IVP-CC	HI design (OH4 / OH5)	
	IIL	HI design (OH5) Dimensionally compliant with ANSI B73.2	
	SPN	API 610 (OH5)	











BETWEEN BEARING PUMPS

CATEGORY		RP MODEL	DESIGN STANDARD	
1 and 2 stage	Axially split	HSC / HSD / HSL HSR / ZW	HI design (BB1)	
		HSM	HI design (BB3)	
		ZM / ZMS ZLM / ZME	API design (BB1)	
	Radially split	HVN / J	API design (BB2)	
		RON / RON-D	API design (BB2)	
Multi-stage	Axially split	SM / SM-I	API design (BB3)	
		JTN	API design (BB3)	
	Radially split <i>single casing</i>	GP	API design (BB4)	
	Radially split <i>double casing</i>	A LINE	API design (BB5)	













VERTICAL PUMPS

CATEGORY		RP MODEL	DESIGN STANDARD	
Single casing	Diffuser	VTP	HI & API 610 (VS1)	
		VCT	HI & API 610 (VS1)	
		HQ	HI & API 610 (VS1)	
		VLT	HI & API 610 (VS1)	
	Volute	DSV / DX	HI & API 610 (VS2)	
	Discharge through column – Axial flow	VAF	HI & API 610 (VS3)	
	Separate discharge line	VSP / VSP-Chem	HI & API 610 (VS4)	
Double casing	Diffuser	VLT / VMT	HI & API 610 (VS6)	
	Volute	DSV / DX	HI & API 610 (VS7)	
Submersible pumps		SMF	HI design (OH8A)	
		VLT-Sub / VTP-Sub	HI design (VS0)	





SPECIAL SERVICE PUMPS

CATEGORY	RP MODEL	DESIGN STANDARD	
Pitot tube pumps	COMBITUBE	HI design	
Reciprocating pumps	RDP	API 674 ISO 13710	
Vertical turbine generator	VTG	HI design (VS6)	
Barge	LS BARGE	HI design	
Floating dock pumps	ZVZ	HI design	
	LVZ	HI design	
Cryogenic pumps	SVNV	-	
	VTG Cryogenic	-	
	VLT Cryogenic VLTV	-	
Pre-packaged fire pump systems	Fire systems incorporate pumps, drivers, control systems and pipework in a single container. They can be skid mounted, with or without enclosure and supplied with electric motor or diesel engine.		 NFPA-20-850 UL and FM approved components



