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:

$200m^3/hr$, 200m TDH, 5m NPSHA, SG 0.7, Temp 150^0C, 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

200m^3/hr, 200m TDH, 5m NPSHA, SG 0.7, Temp 150^{0}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 (%)
SM 6x14 (A) (BB3) CH	1485	4	-	76.19
SM 4x11 (A) (BB3)	2960	2	-	75.78
SM 4x11 (D) (BB3) CH	2960	2	-	75.54
SM 4x9.5 (A) (BB3)	2960	2	-	75.43
⚠ SM 4x11 (C) (BB3) CH	2965	2	-	75.08
⚠ SM 4x11 (C) (BB3) CH	2965	2	-	73.62
AB 8x6x15 C-C (A) CH	1485	4	-	72.86
⚠ SM 4x11 (C) (BB3) CH	2965	2	-	72.56
SM 4x11 (B) (BB3)	2960	2	-	71.77

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

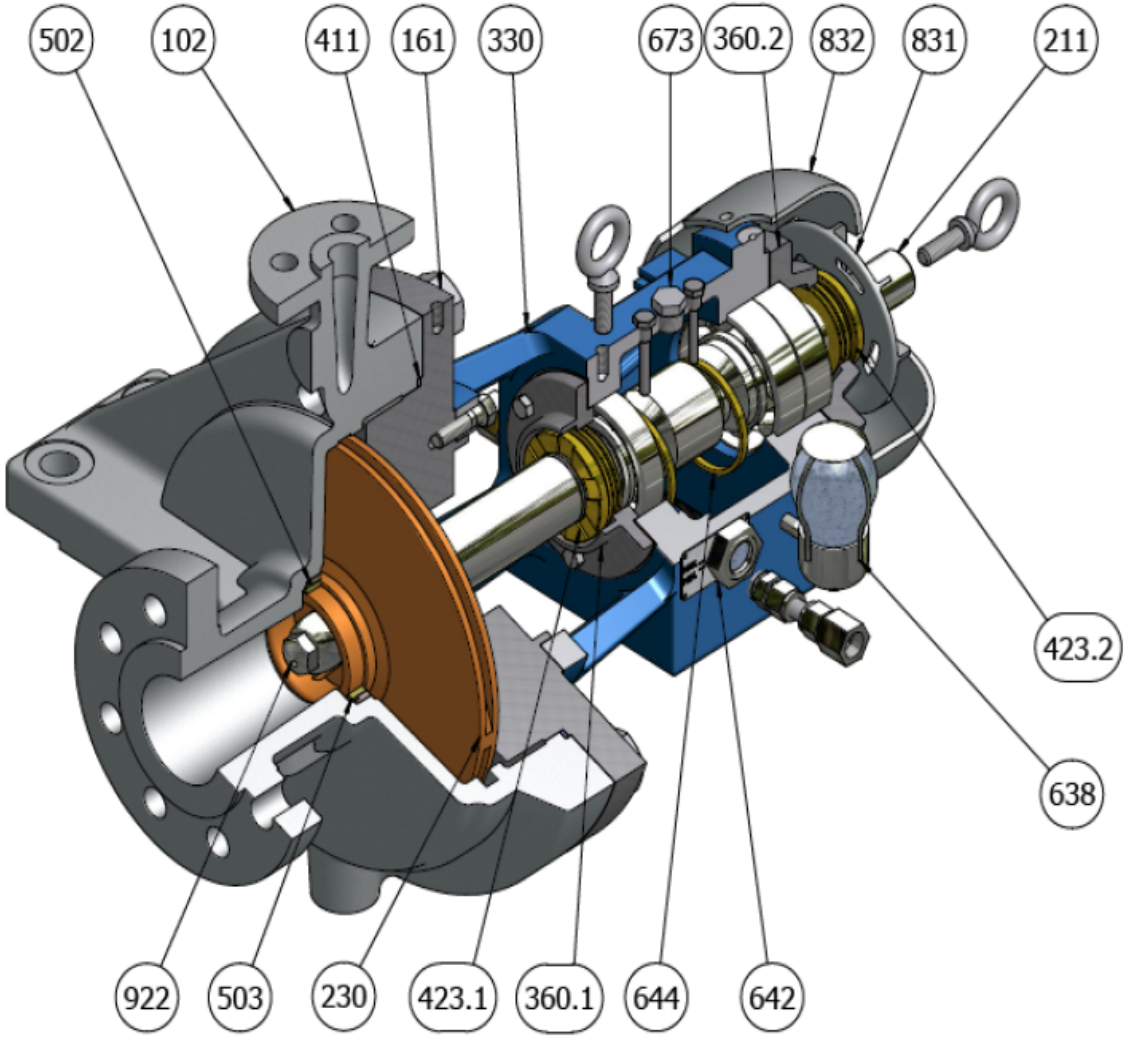
Lessons Learned

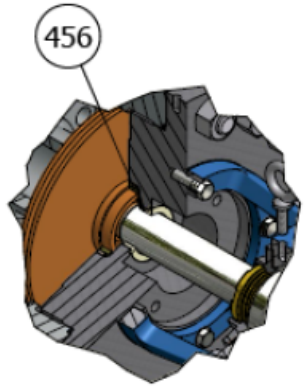
- Pump selection programs are STUPID
- They are a great tool but a poor master
- ALWAYS KNOW THE PUMP YOU EXPECT TO SEE BEFORE YOU USE THE PUMP SELECTION PROGRAM

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

Features and Benefits

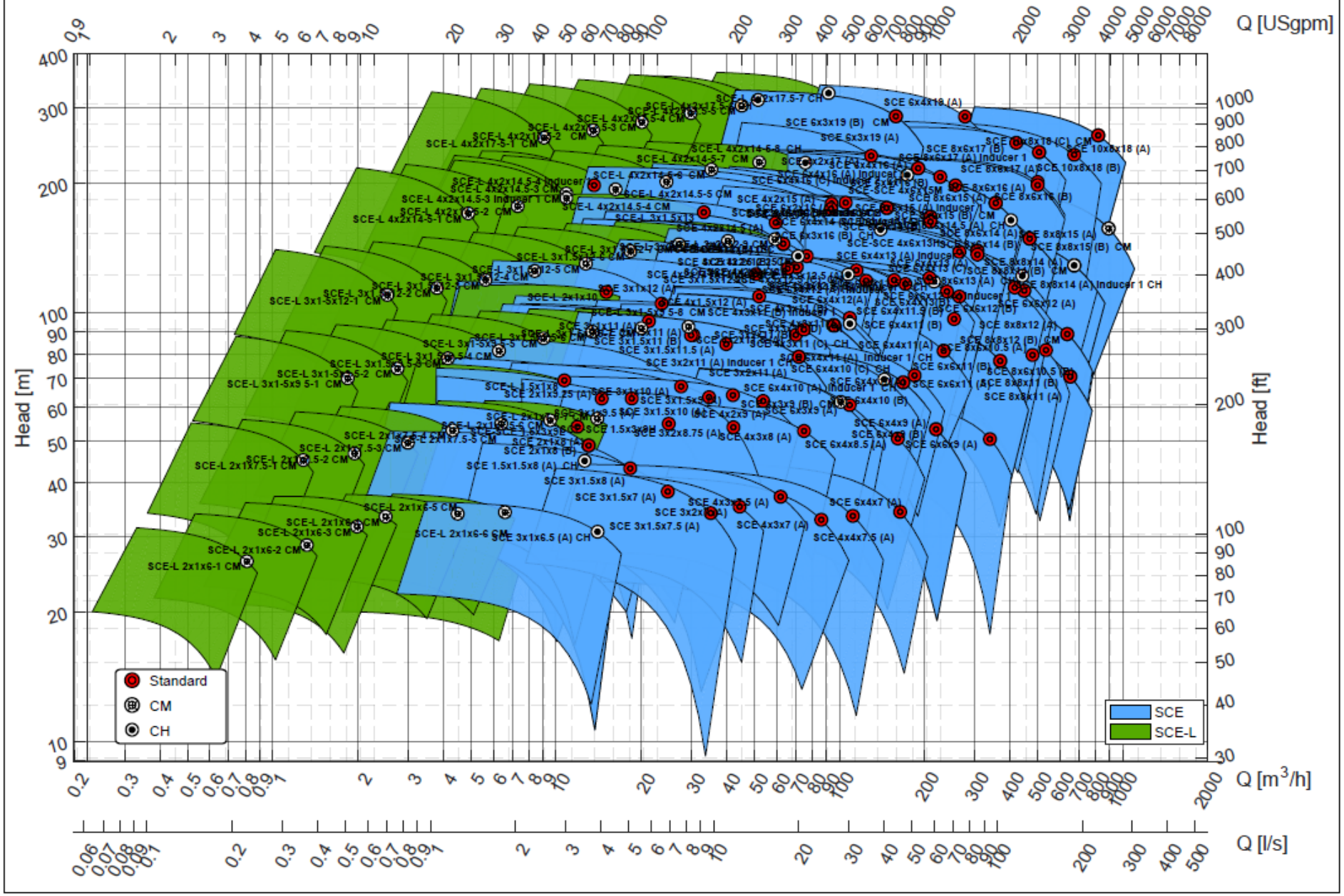
OH2 50Hz 2 Pole

RUHRPUMPEN

OH2

SCE Selection Chart
50 Hz 2 poles (2960 rpm)

Drawn by:	ACR
Date:	28-May-2021
Drawing:	01
Version:	01



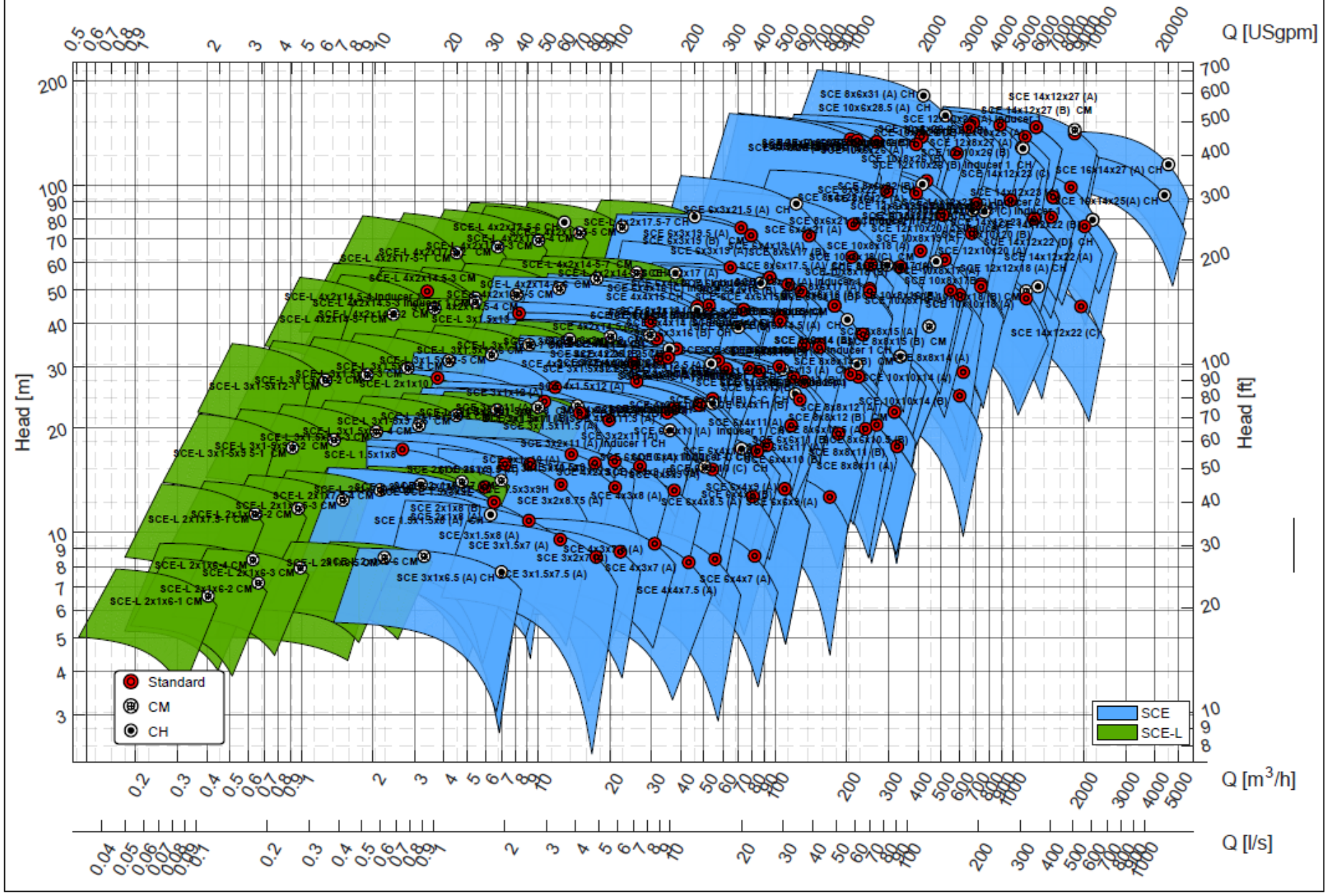
OH2 50Hz 4 Pole

RUHRPUMPEN

OH2

SCE Selection Chart
50 Hz 4 poles (1480 rpm)

Drawn by:	ACR
Date:	28-May-2021
Drawing:	02
Version:	01



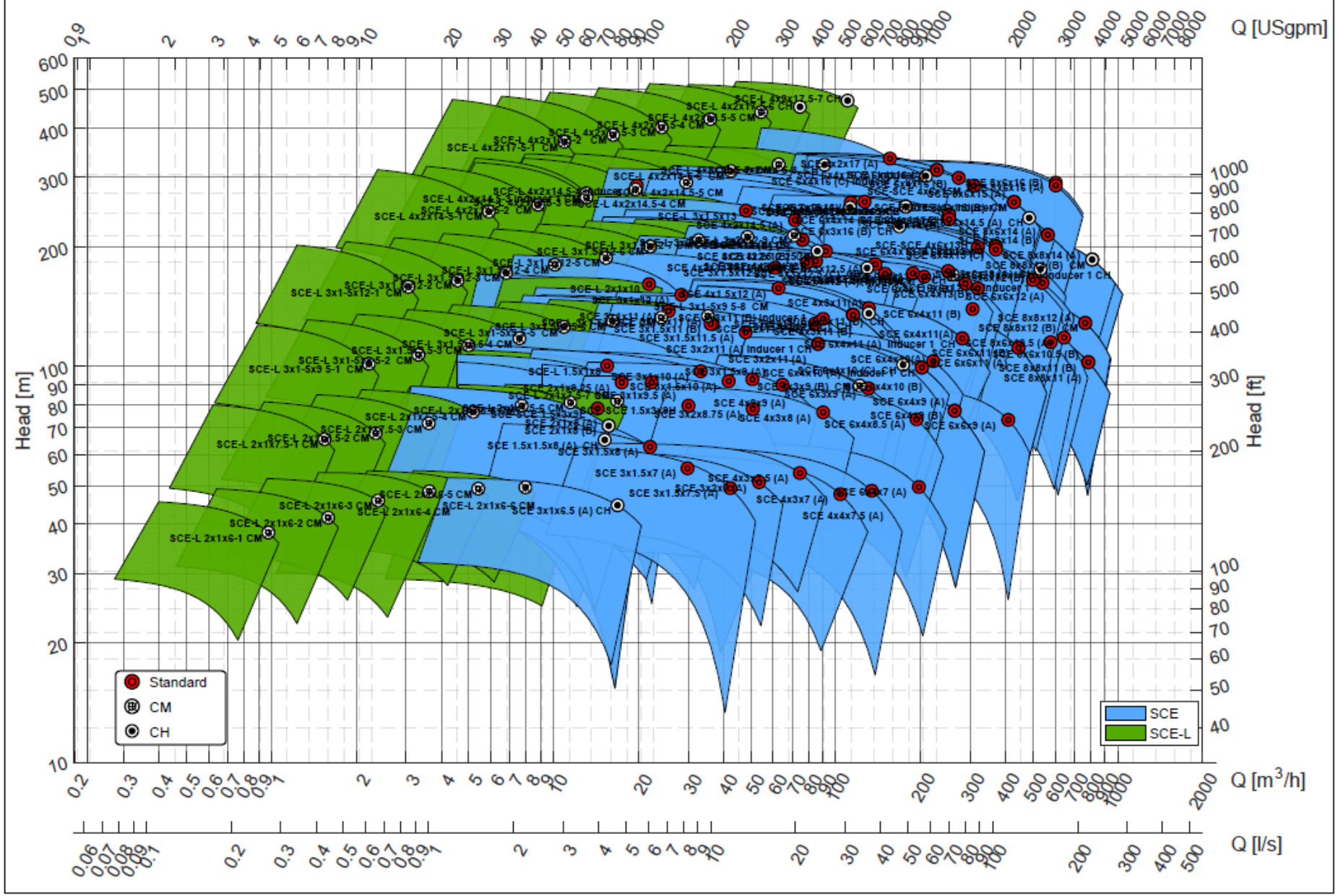
OH2 60Hz 2 Pole

RUHRPUMPEN

OH2

SCE Selection Chart
60 Hz 2 poles (3560 rpm)

Drawn by:	ACR
Date:	28-May-2021
Drawing:	04
Version:	01



OH2, 60Hz 4 Pole

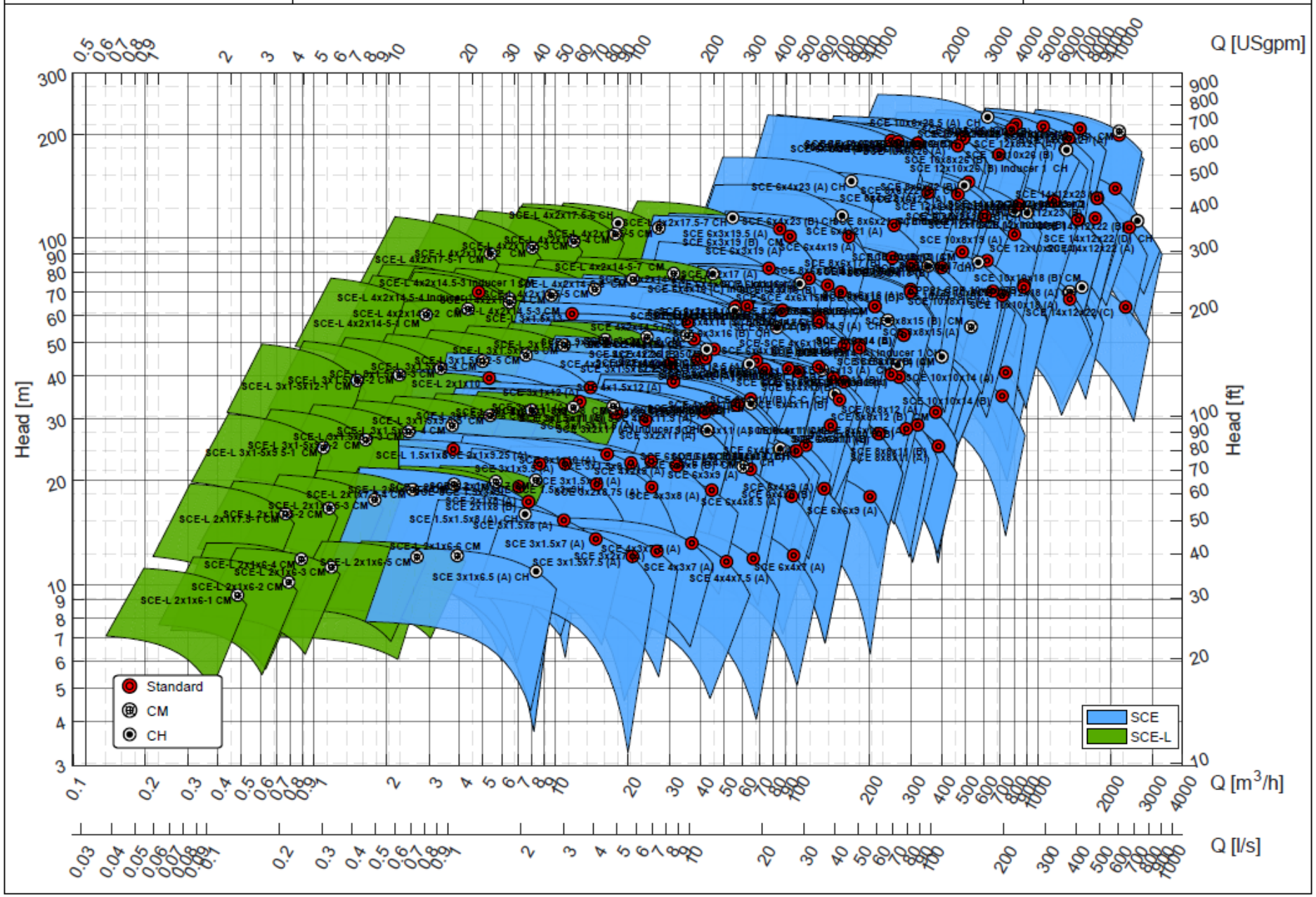
RUHRPUMPEN

OH2

SCE Selection Chart

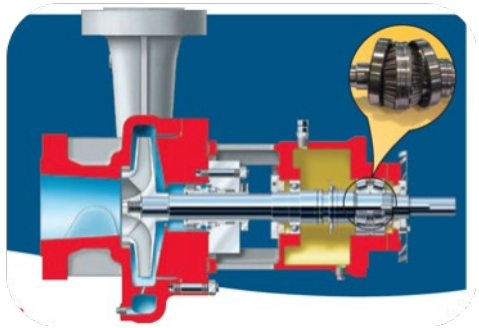
60 Hz 4 poles (1760 rpm)

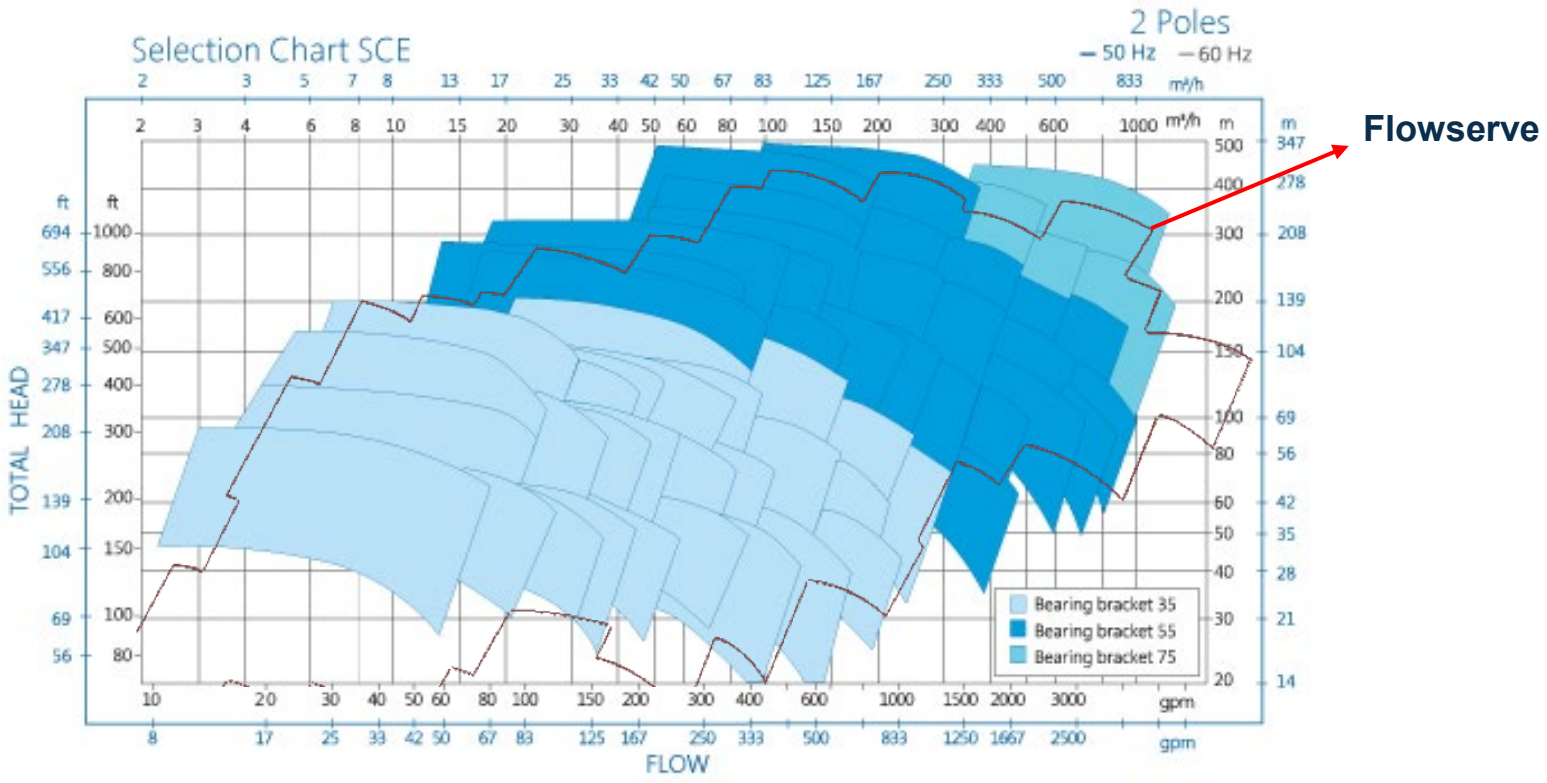
Drawn by:	ACR
Date:	31-May-2021
Drawing:	05
Version:	01



Benchmark

Ruhrpumpen vs Flowserve

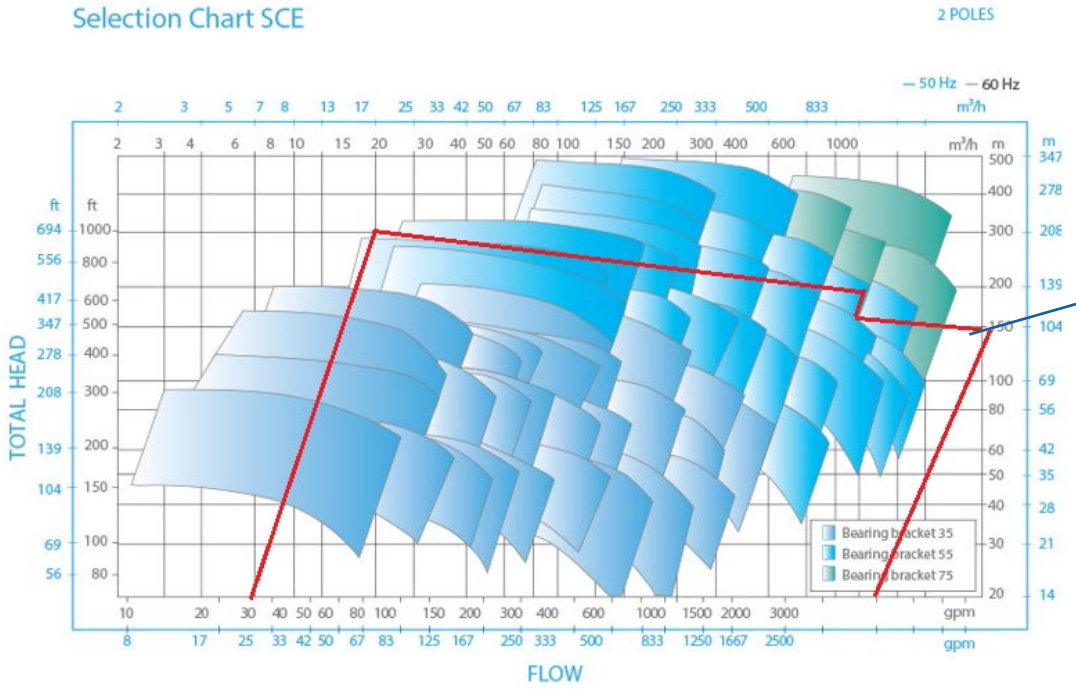




https://www.flowserve.com/files/Files/Literature/ProductLiterature/Pumps/pss-10-5.3-ea4.pdf

Benchmark

Ruhrpumpen vs Sulzer

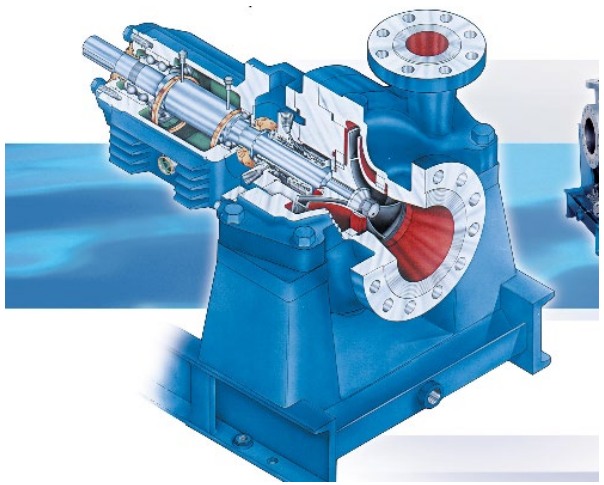


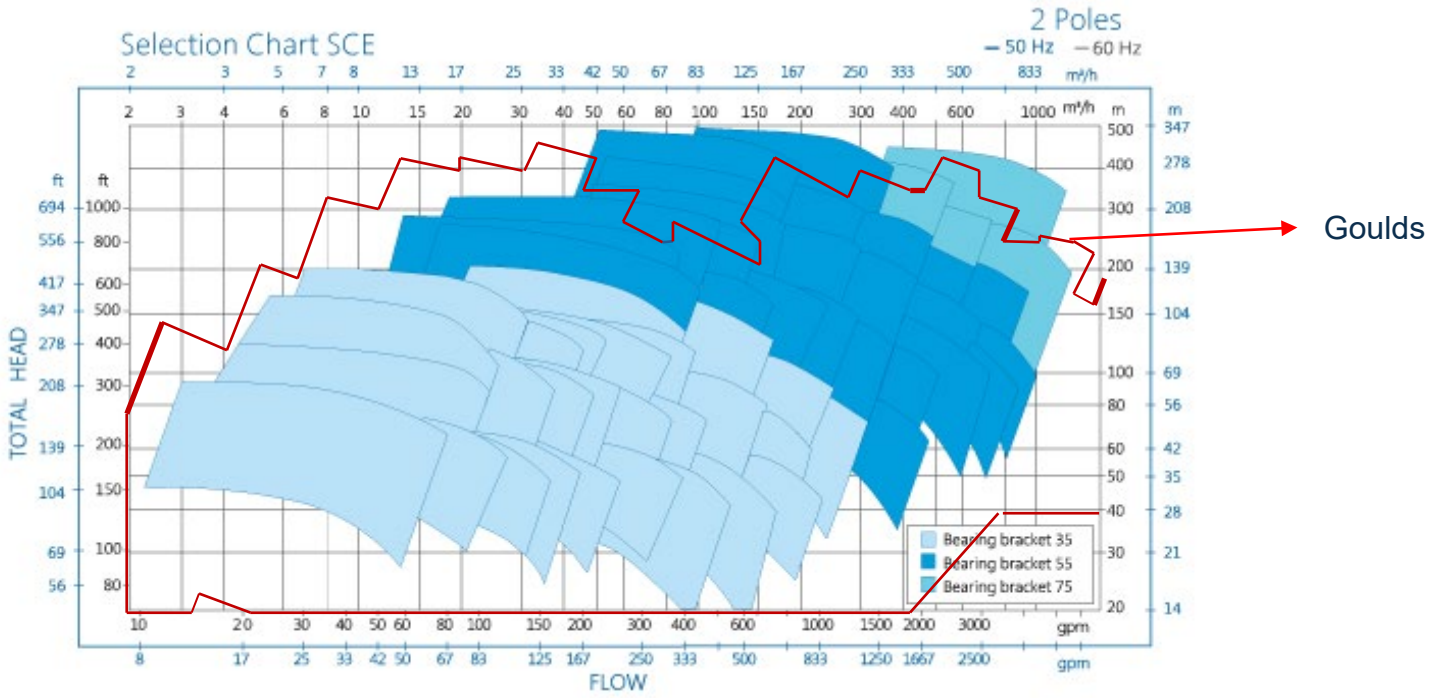
Sulzer

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

Benchmark

Ruhrpumpen vs Goulds





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

$$N_{SS} = N_{(RPM)} Q_{(BEP\ Full\ Dia)}^{0.5} / NPSH_{(BEP\ Full\ Dia)}^{0.75}$$

$$N_{SS(Metric)} = N_{SS(US)} \times 1.16 \quad (m^3/hr, m, rpm)$$

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 requirments 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

Try a slower speed or increase the NPSH available

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

Try a slower speed or increase the NPSH available

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

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

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

Do you have enough $NPSH_A$?

So your options are:-

- Is there a 4 Pole OH2 selection available?

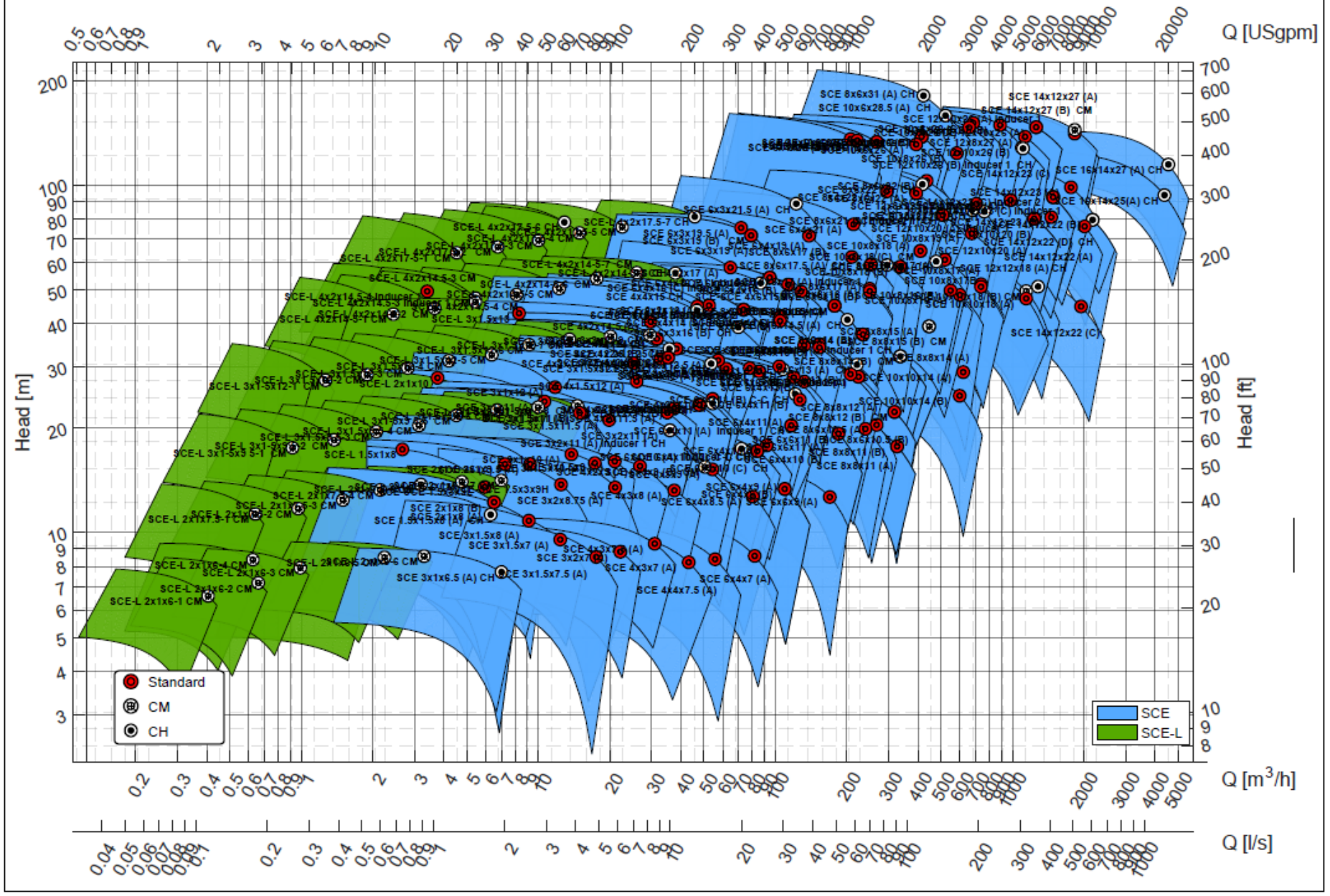
OH2 50Hz 4 Pole

RUHRPUMPEN

OH2

SCE Selection Chart
50 Hz 4 poles (1480 rpm)

Drawn by:	ACR
Date:	28-May-2021
Drawing:	02
Version:	01



Do you have enough $NPSH_A$?

So your options are:-

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

N_{ss} Calculator

NPSH / Nss Calculator

$$N_{SS} = N_{(RPM)} Q_{(BEP\ Full\ Dia)}^{0.5} / NPSH$$

$$N_{SS(Metric)} = N_{SS(US)} \times 1.16\ (m^3/hr, m, rpr$$

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 requirments 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)	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	
m3/hr,m,rpm units	12519
USGPM,Ft,RPM units	10792

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

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

Try a slower speed or increase the NPSH available

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

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

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

Do you have enough $NPSH_A$?

So your options are:-

- Is there a 4 Pole OH2 selection available
- Can you find a bit more NPSHA?
- 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.

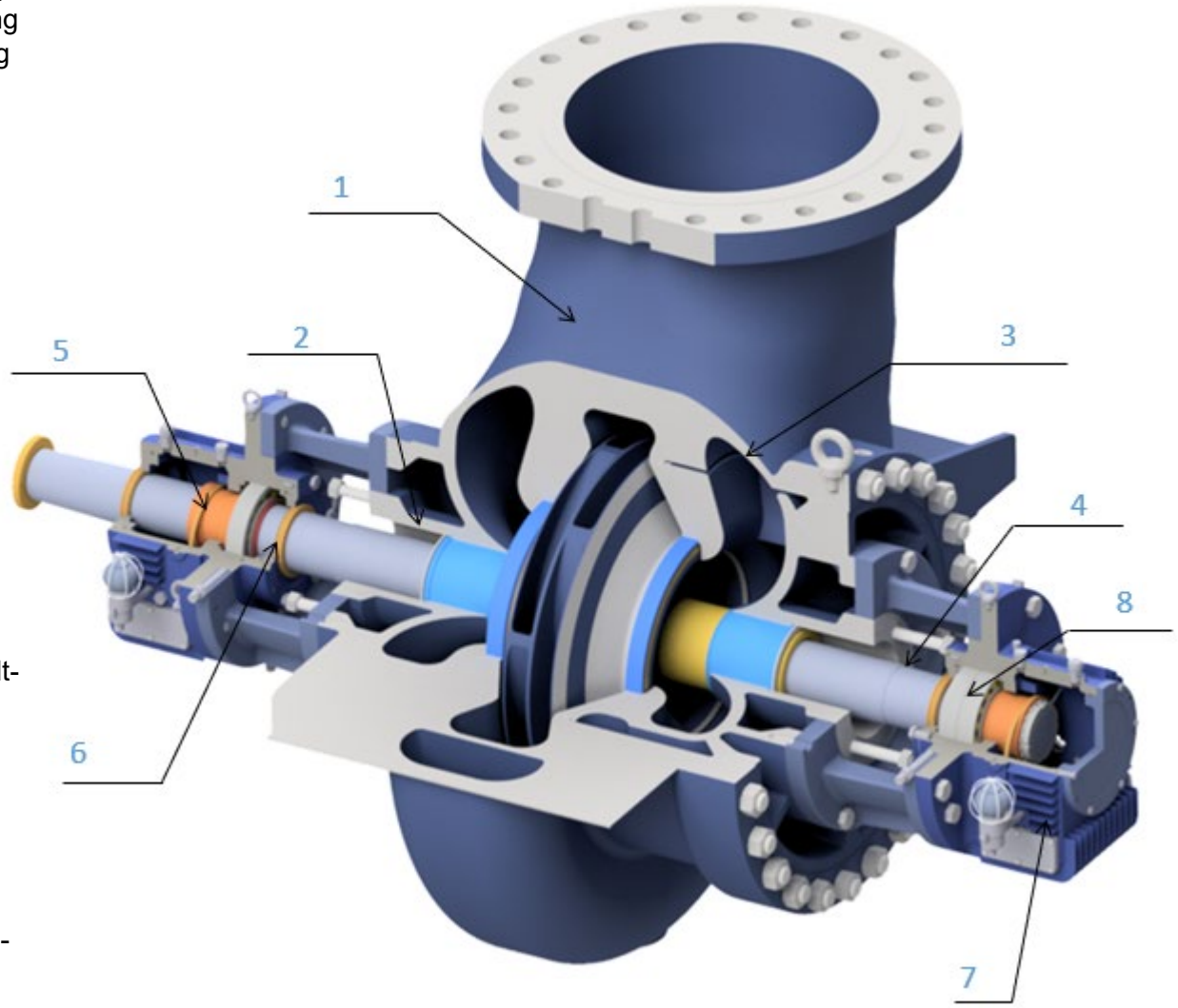
4. Between bearing, stiff shaft design reduces shaft deflection for longer bearing and mechanical seal life

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.

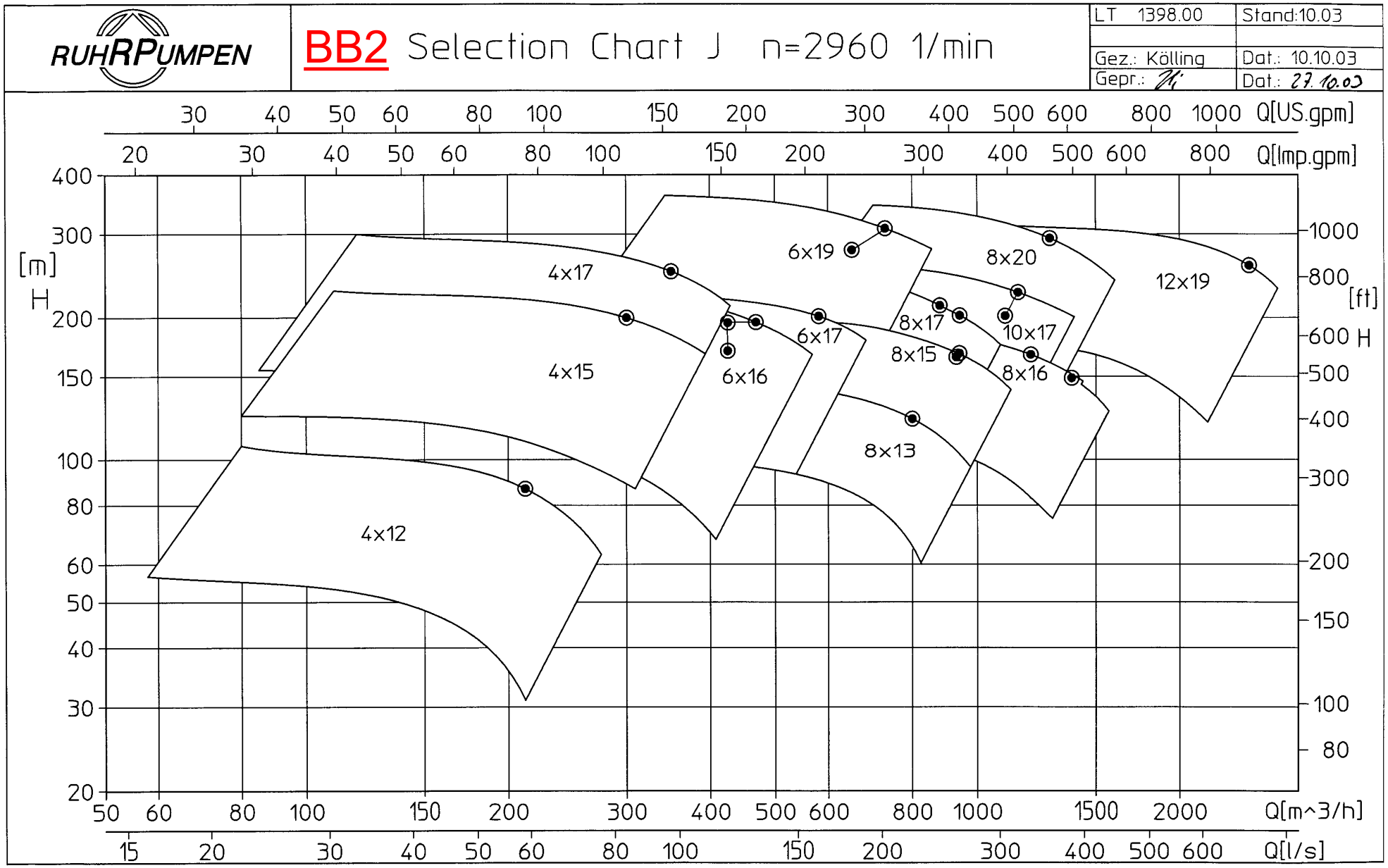
6. Labyrinth flingers at each end of the bearing housing provide built-in protection of the lubrication against contamination

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

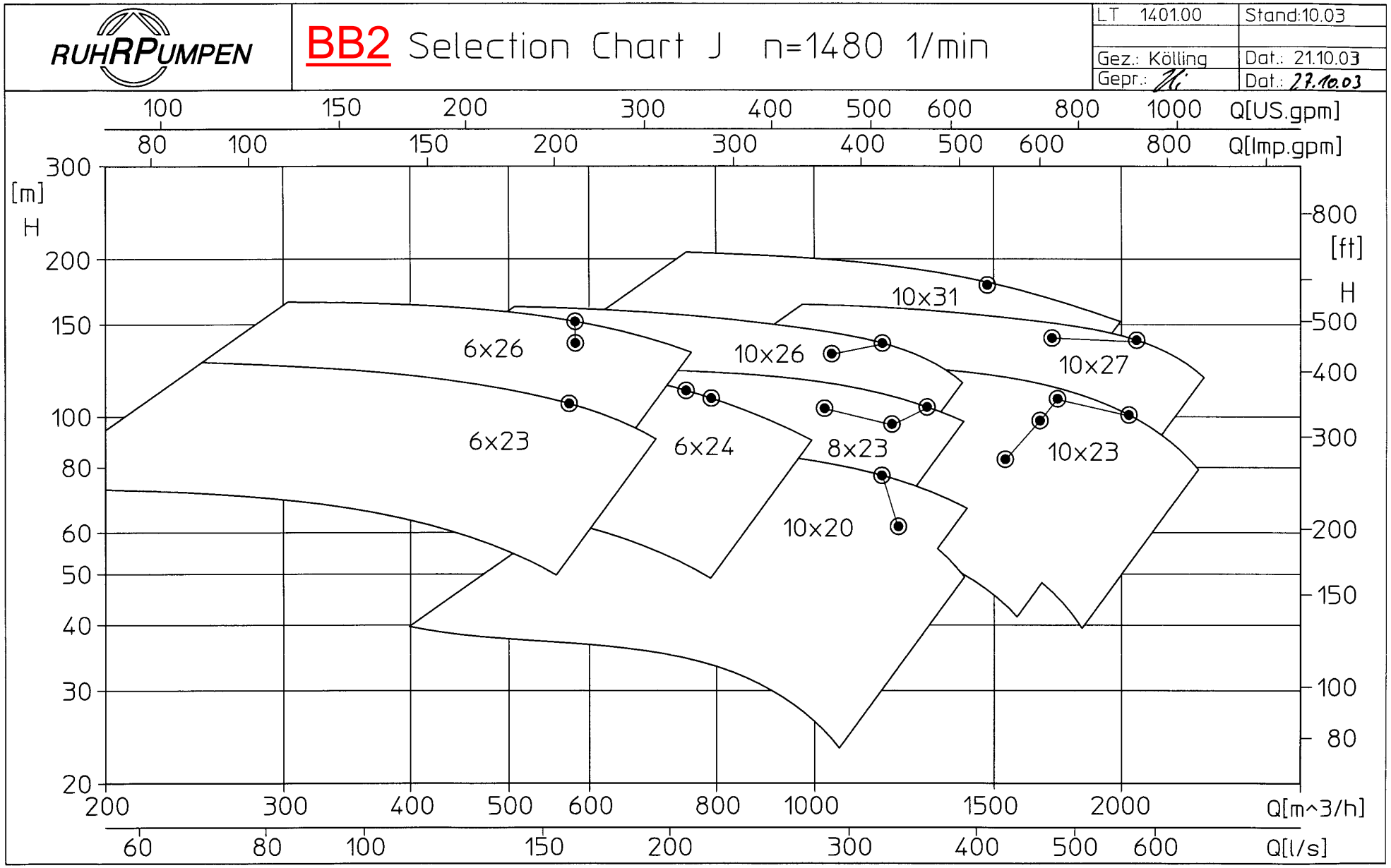


Do you have enough $NPSH_A$?

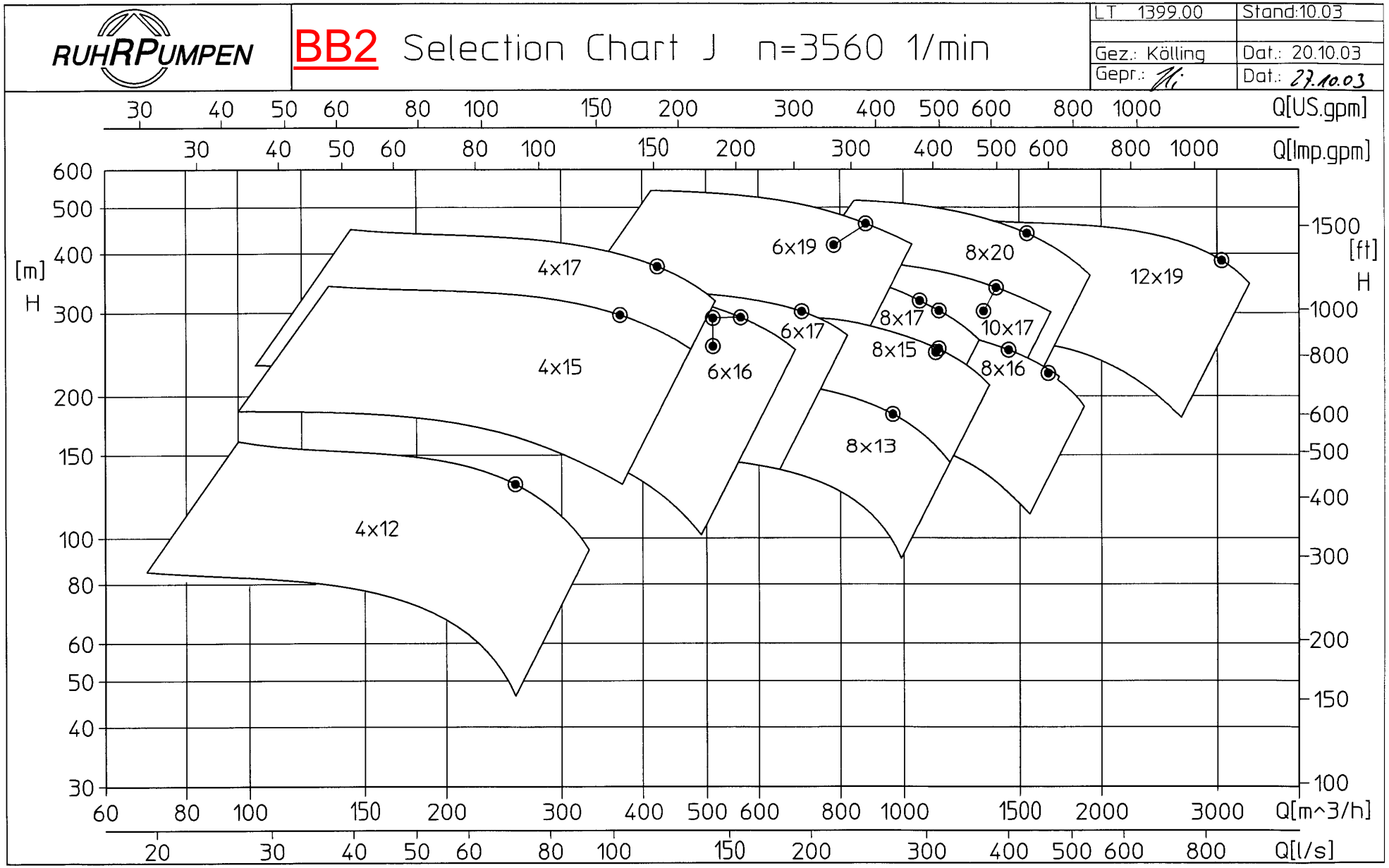
So your options are:-

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

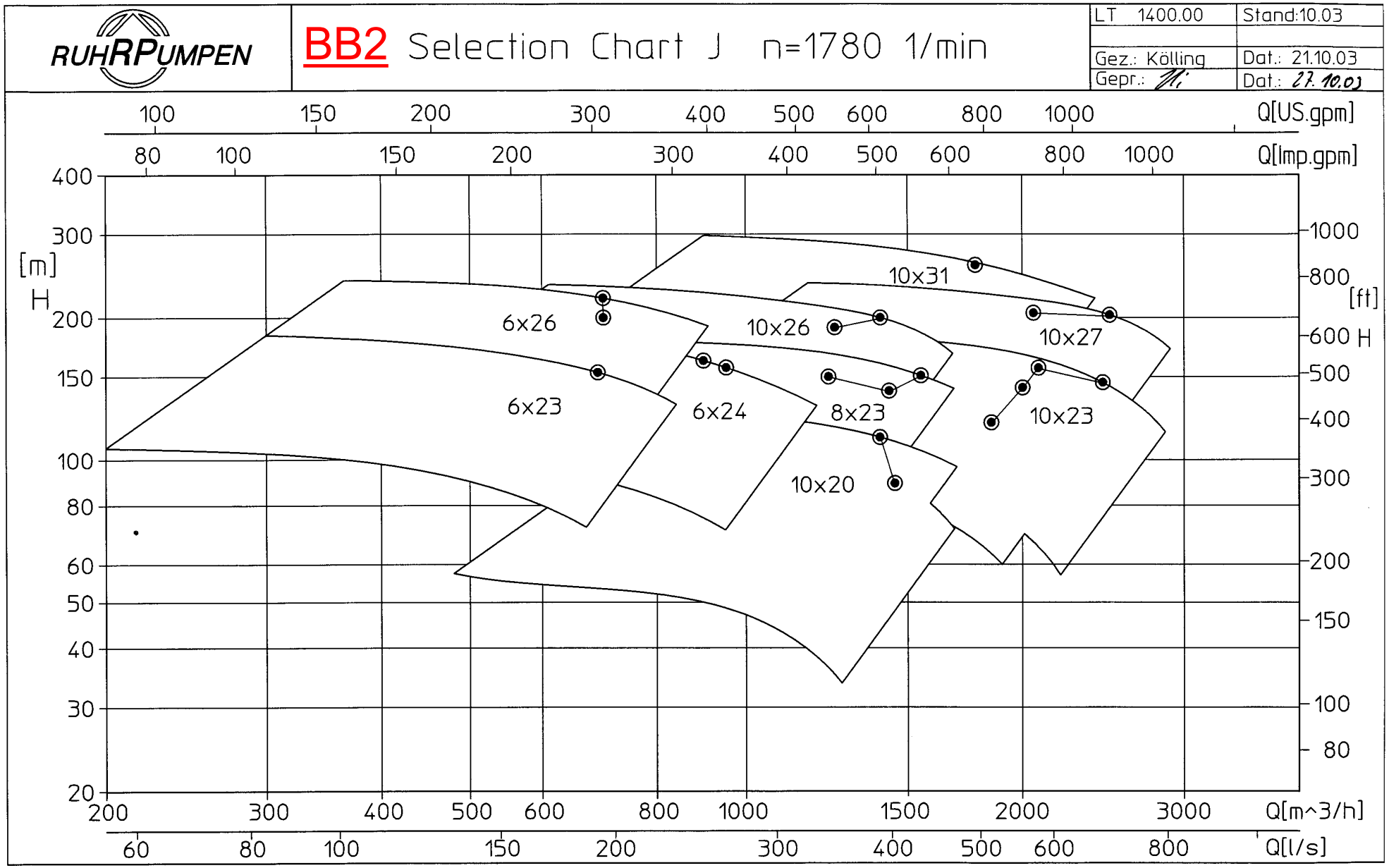
BB2 50Hz 4 Pole



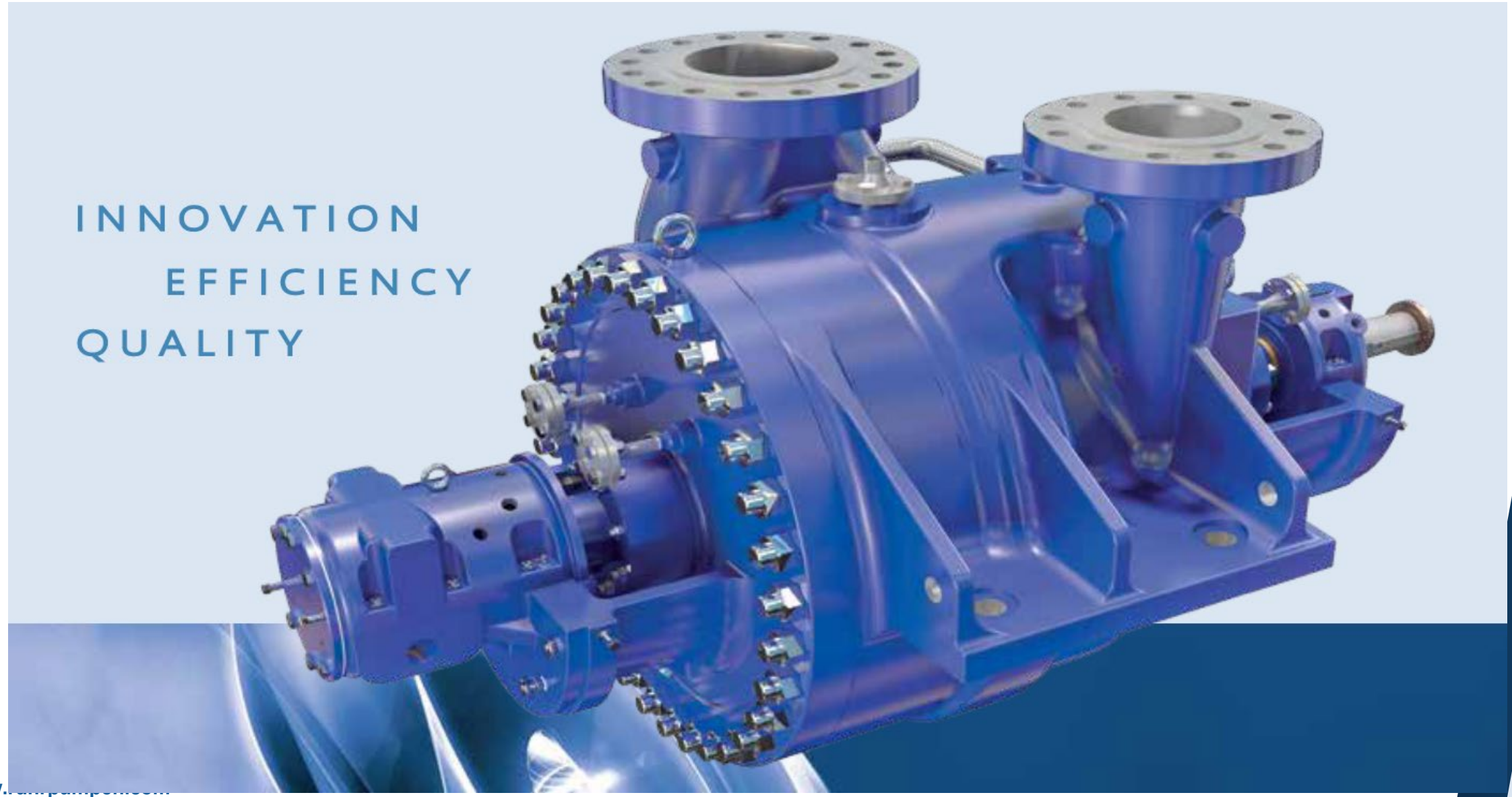
BB2 60Hz 2 Pole



BB2 60Hz 4 Pole

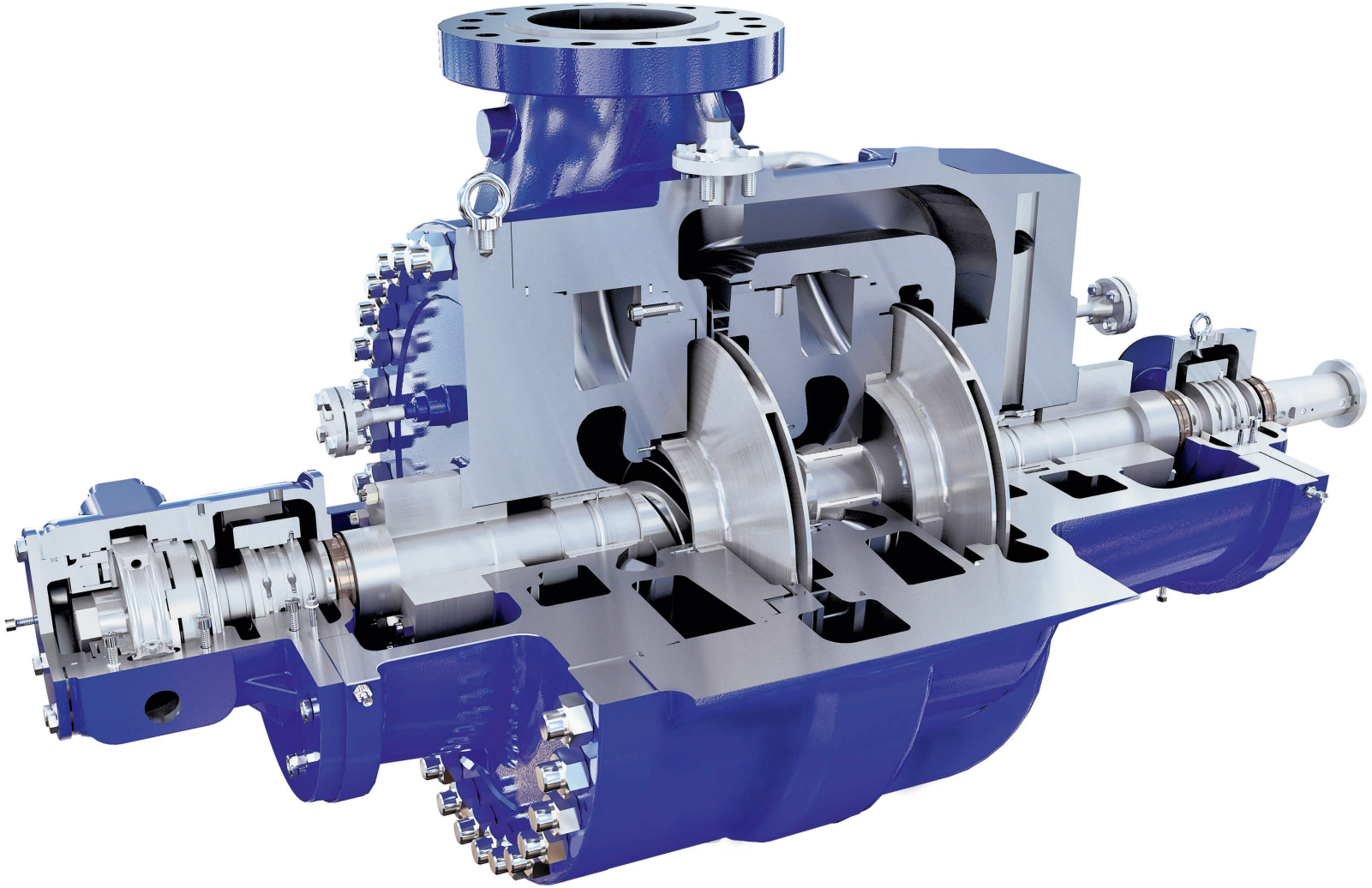


BB2- 2 Stage Pumps



BB2- 2 Stage Pumps

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



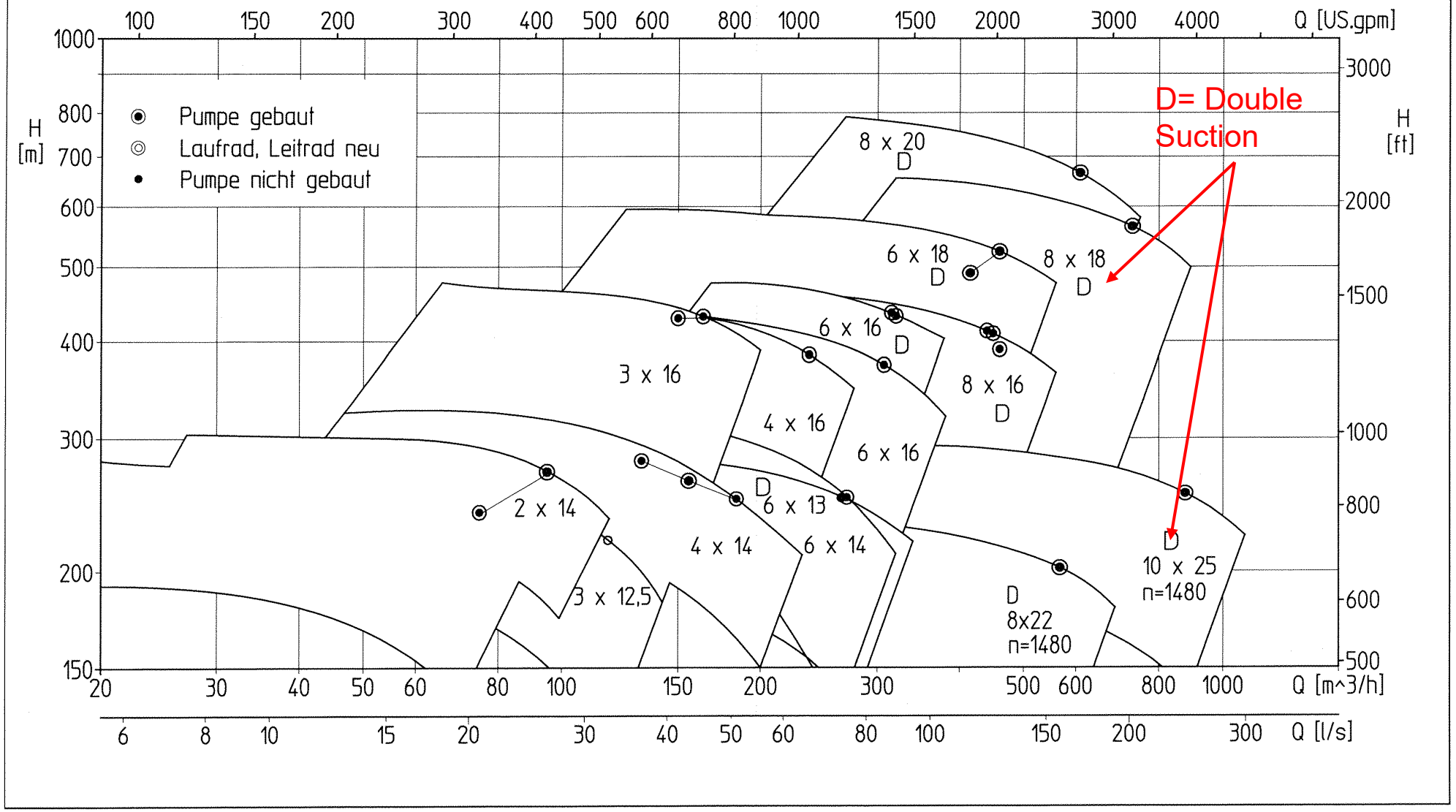
BB2 - 2 Stage

BB2 – 2 Stage, 50 Hz 2 Pole

RUHRPUMPEN

Selection Chart RON n = 2960 1/min

Stand: 07.17	LT 1285.39
Gez.: Kölling	Datum: 05.07.17
Gepr.:	Datum: 6.7.17



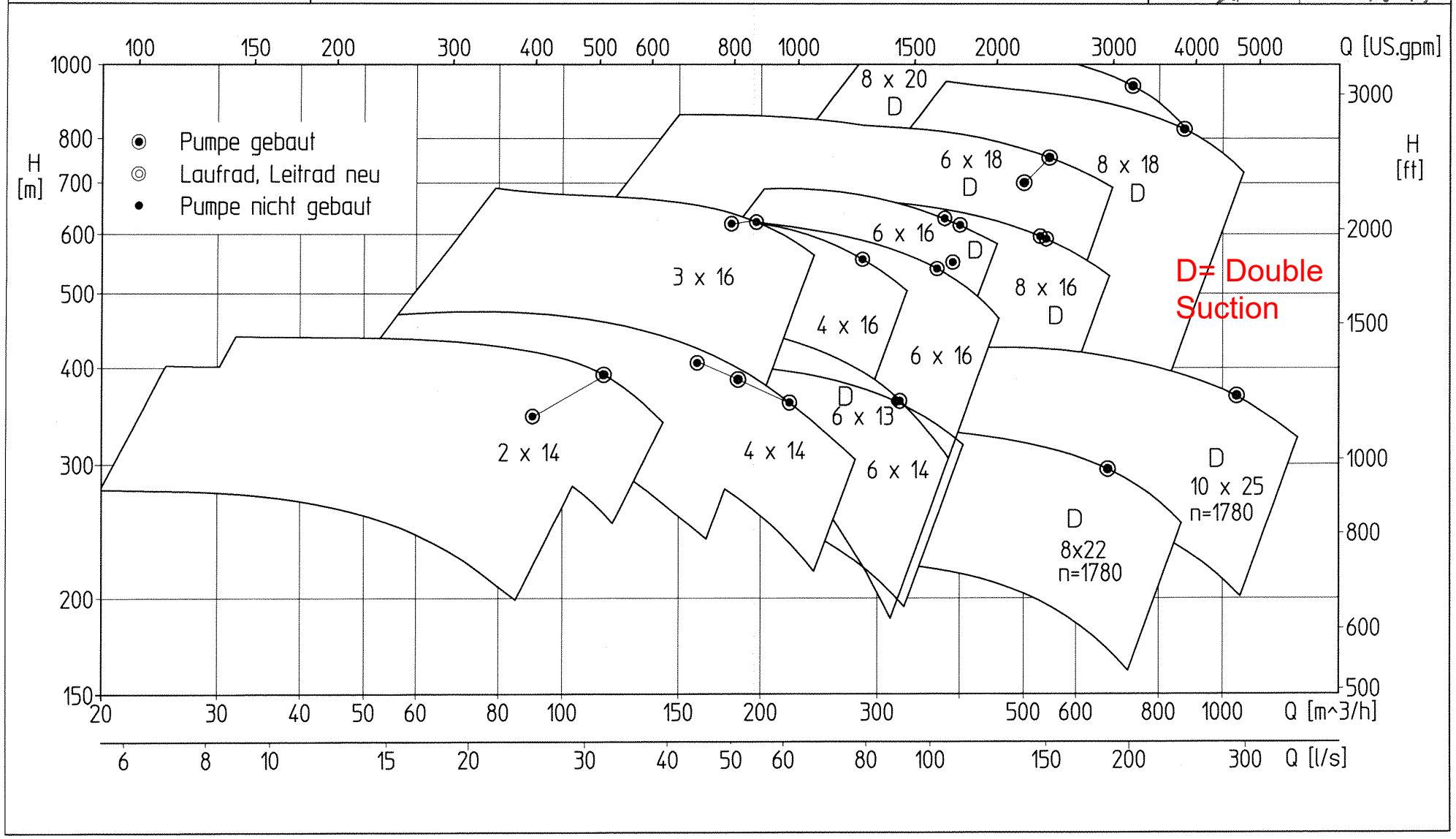
BB2 - 2 Stage

BB2 – 2 Stage, 60 Hz 2 Pole

RUHRPUMPEN

Selection Chart RON n = 3560 1/min

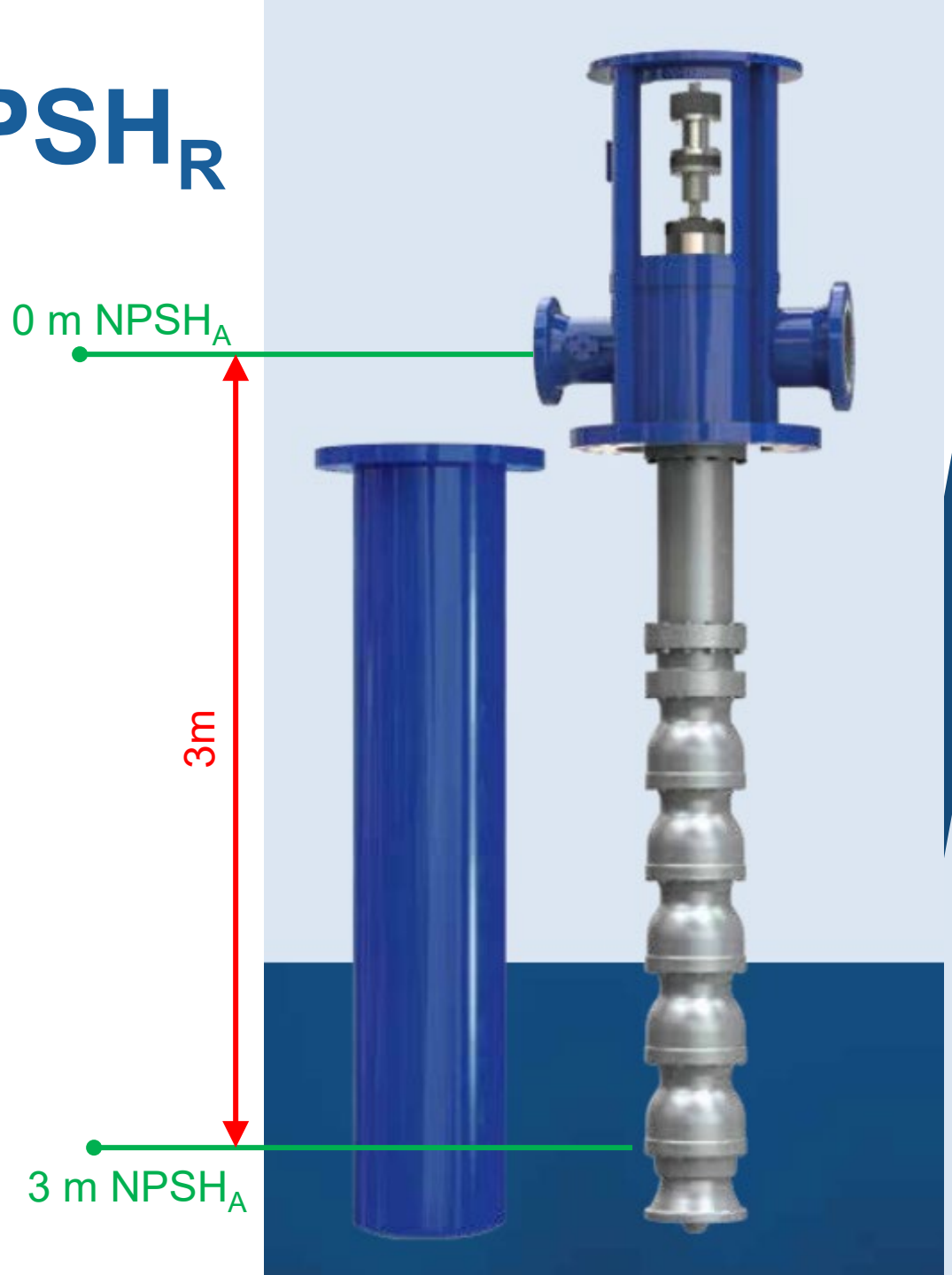
Stand: 05.17	LT 1369.59
Gez.: Kölling	Datum: 08.05.17
Gepr.:	Datum: 9.5.17



VS6 Pumps – Zero $NPSH_R$

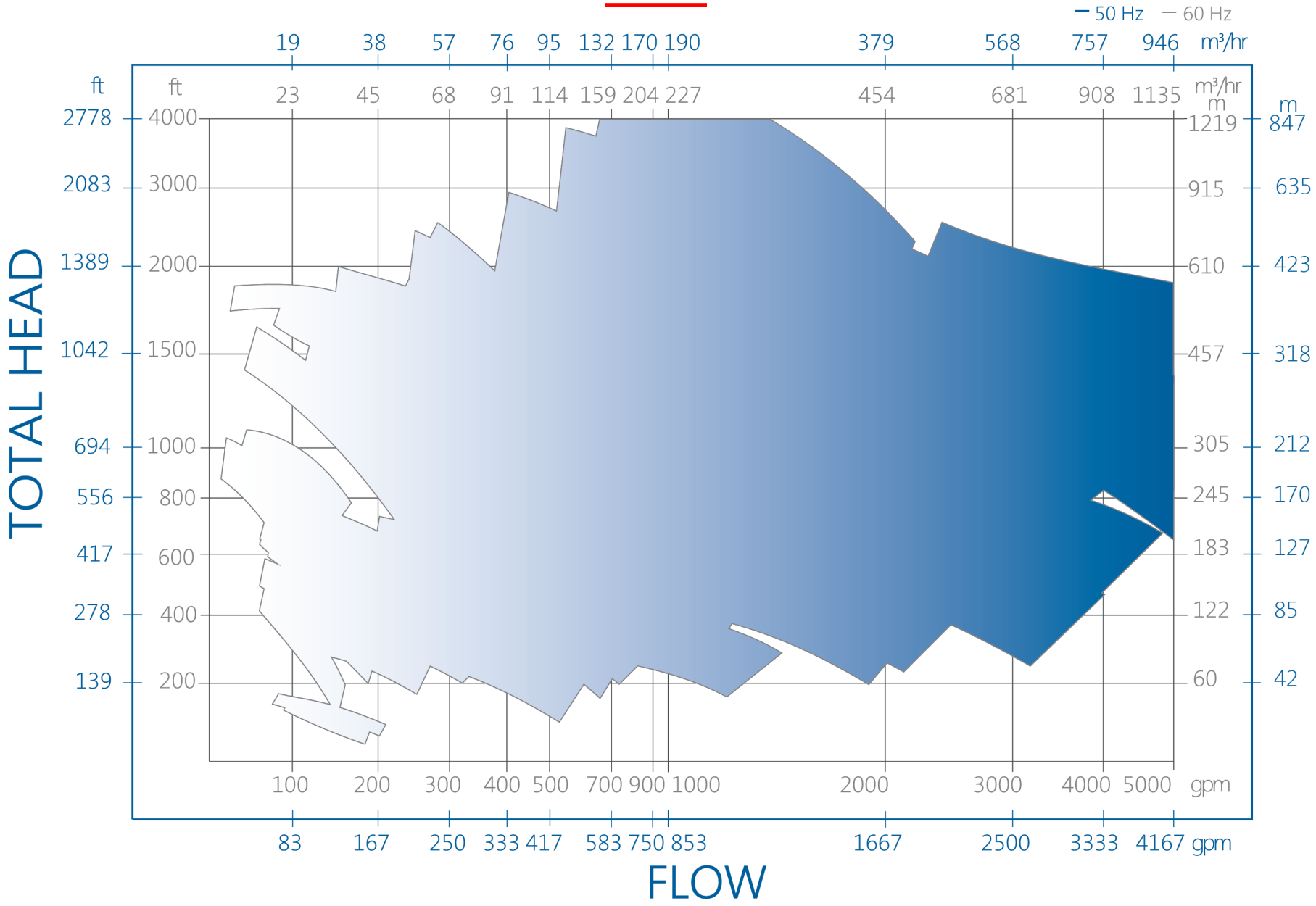
The Spacesaver and Costsaver

- 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.

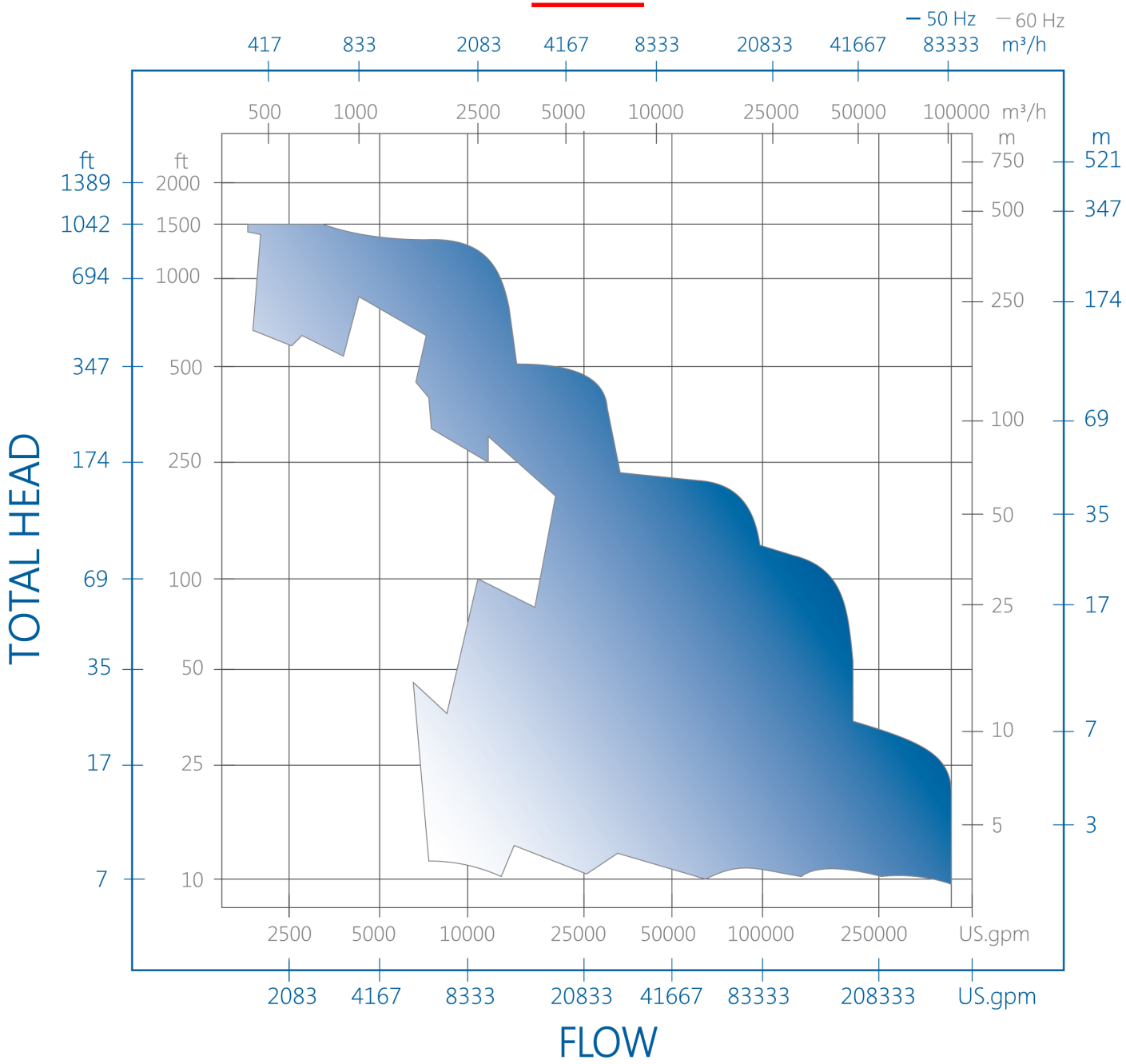


Selection Chart VLT VS6

VS6 – Multispeed – Semi Engineered Range



Selection Chart VMT VS6



VS6 – Multispeed – Engineered Range

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 then 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

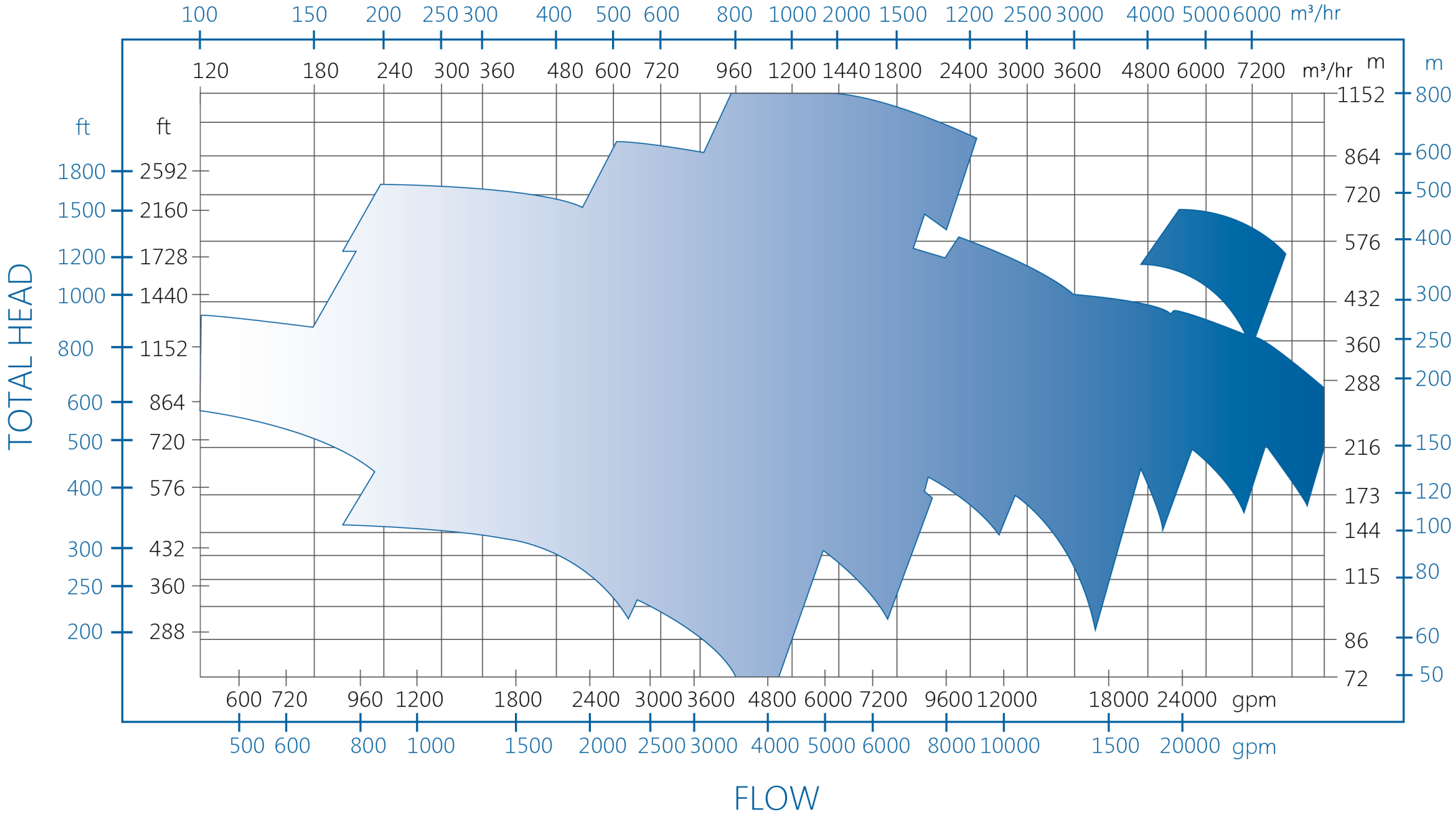
Axially Split Case, Heavy Duty API 610 Process Pump (BB1)

BB1, 50 & 60 Hz, 2 Pole

Selection Chart ZM I

BB1- B

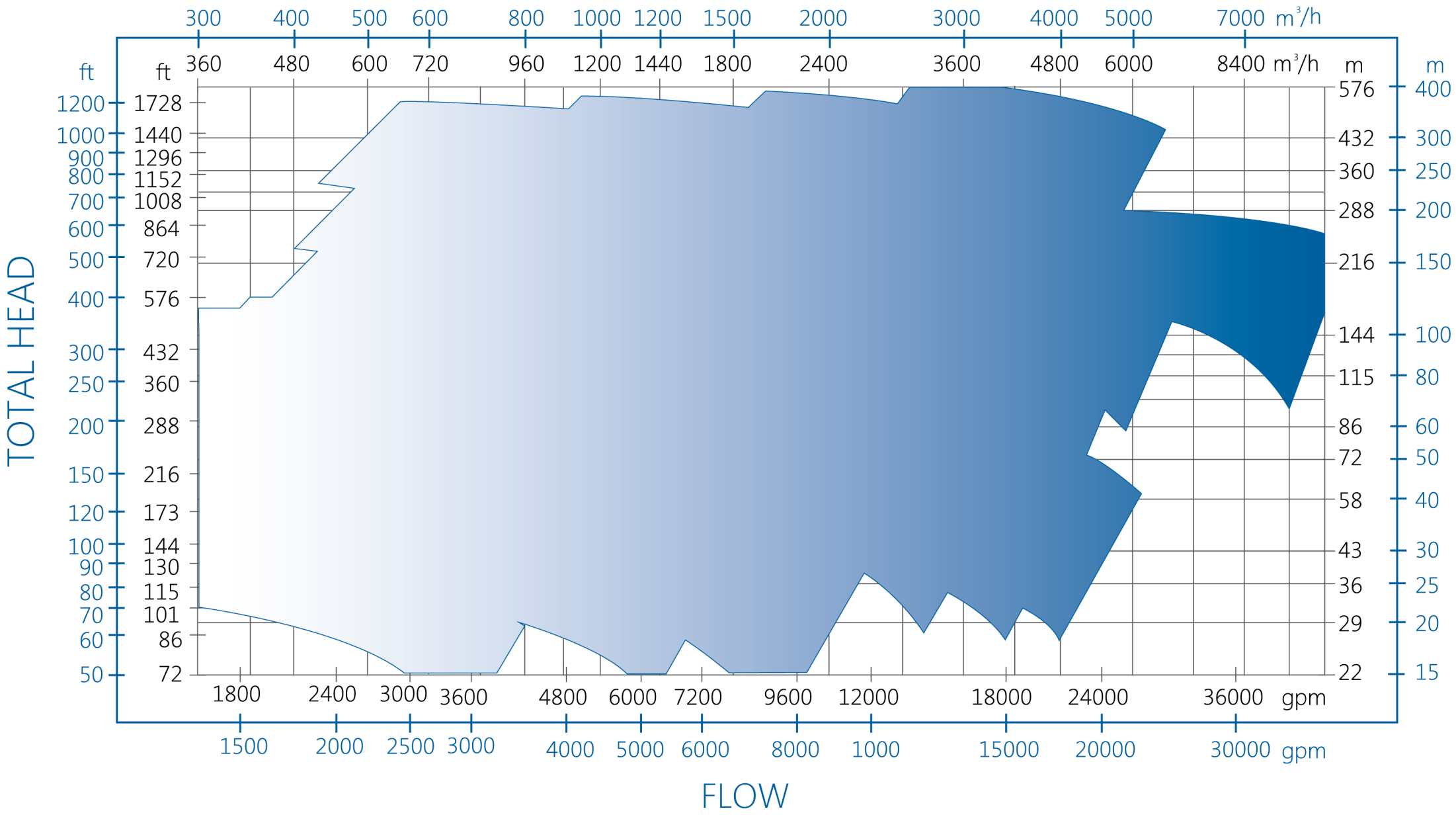
50 Hz 2 POLES 60 Hz



Selection Chart ZM II BB1- B

4 POLES
– 50 HZ — 60 HZ

BB1, 50 & 60 Hz, 4 Pole



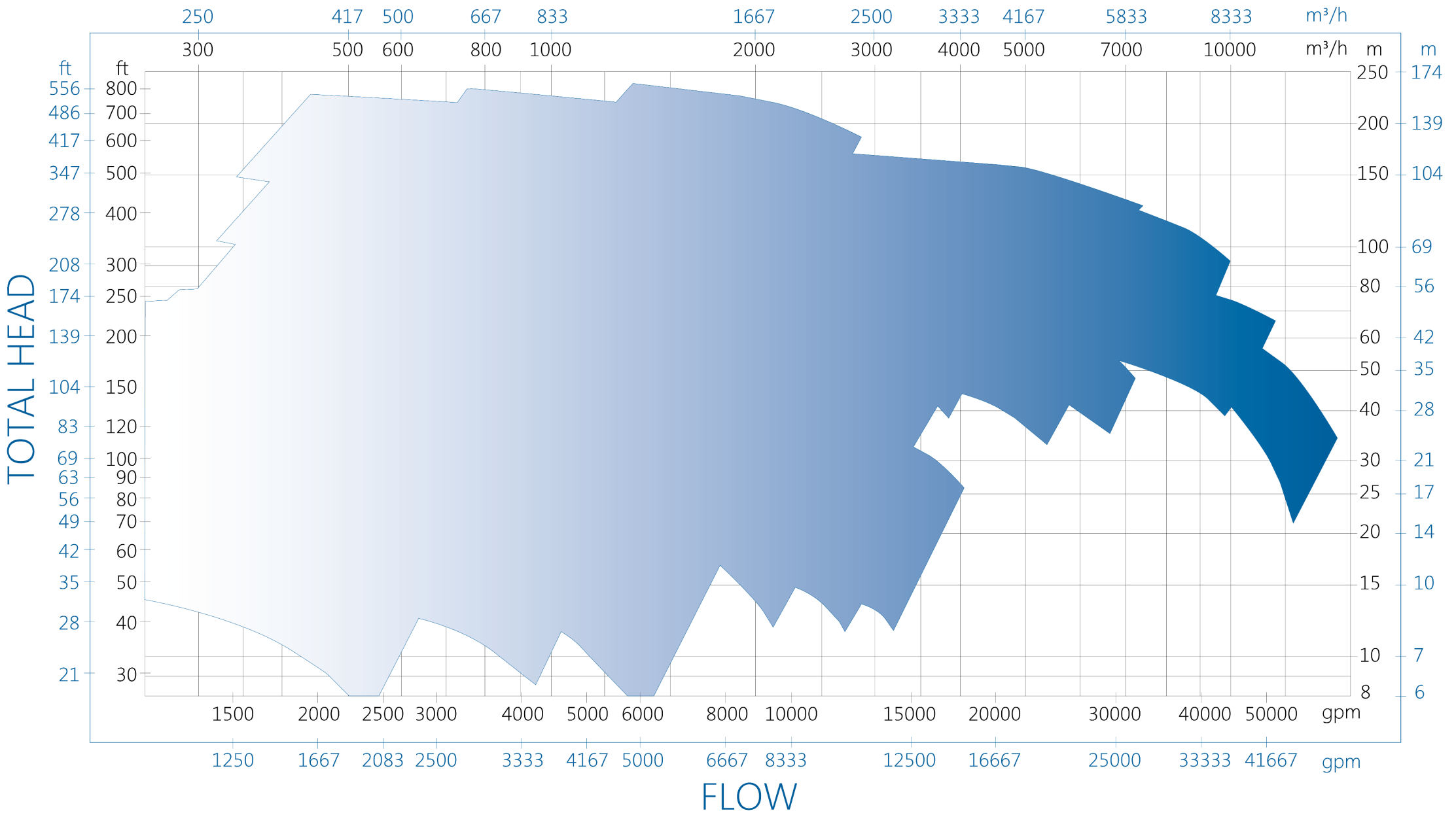
Selection Chart ZM III

BB1- B

6 POLES

50 Hz 60 Hz

BB1, 50 & 60 Hz, 6 Pole

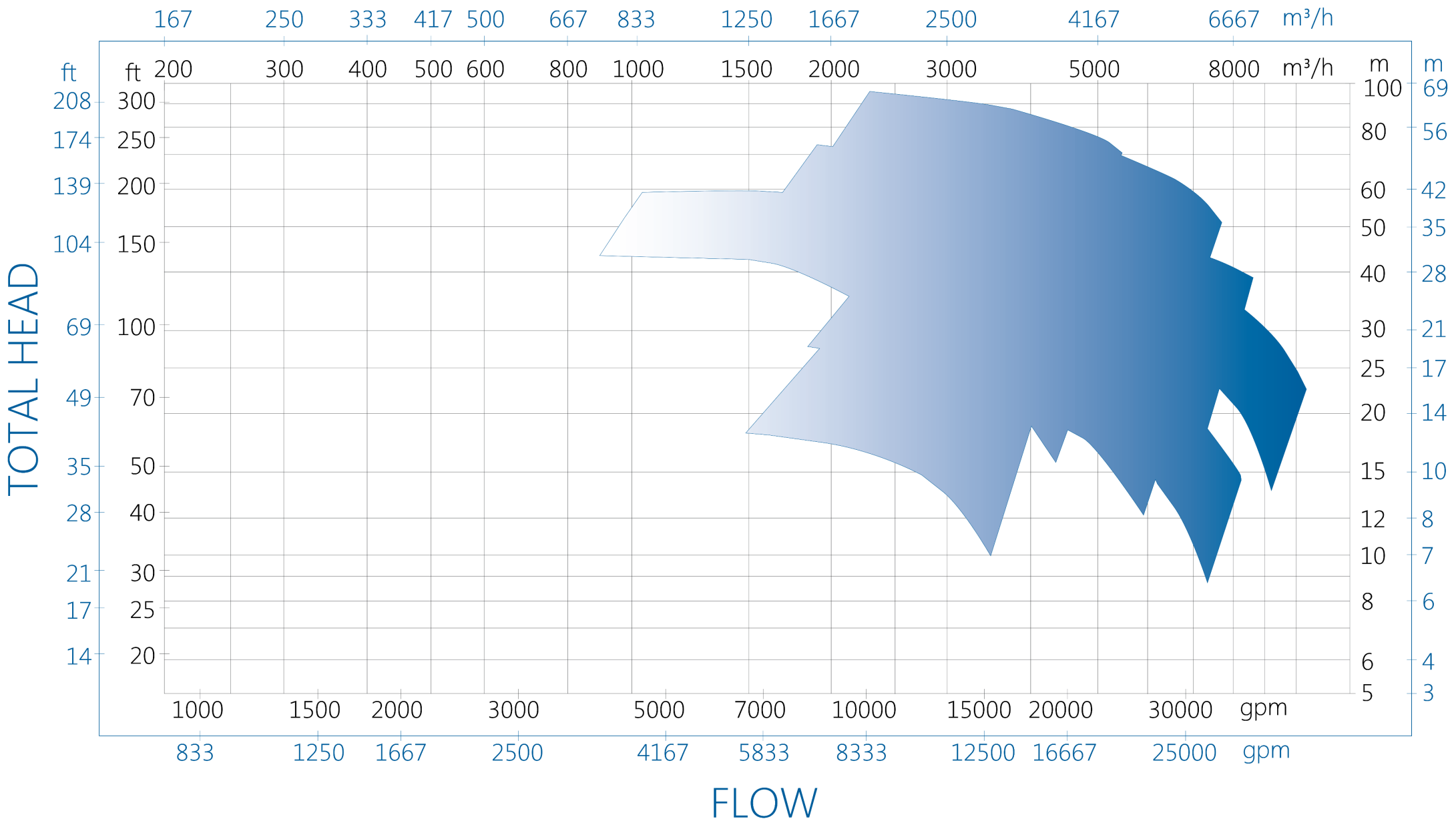


BB1, 50 & 60 Hz, 8 Pole

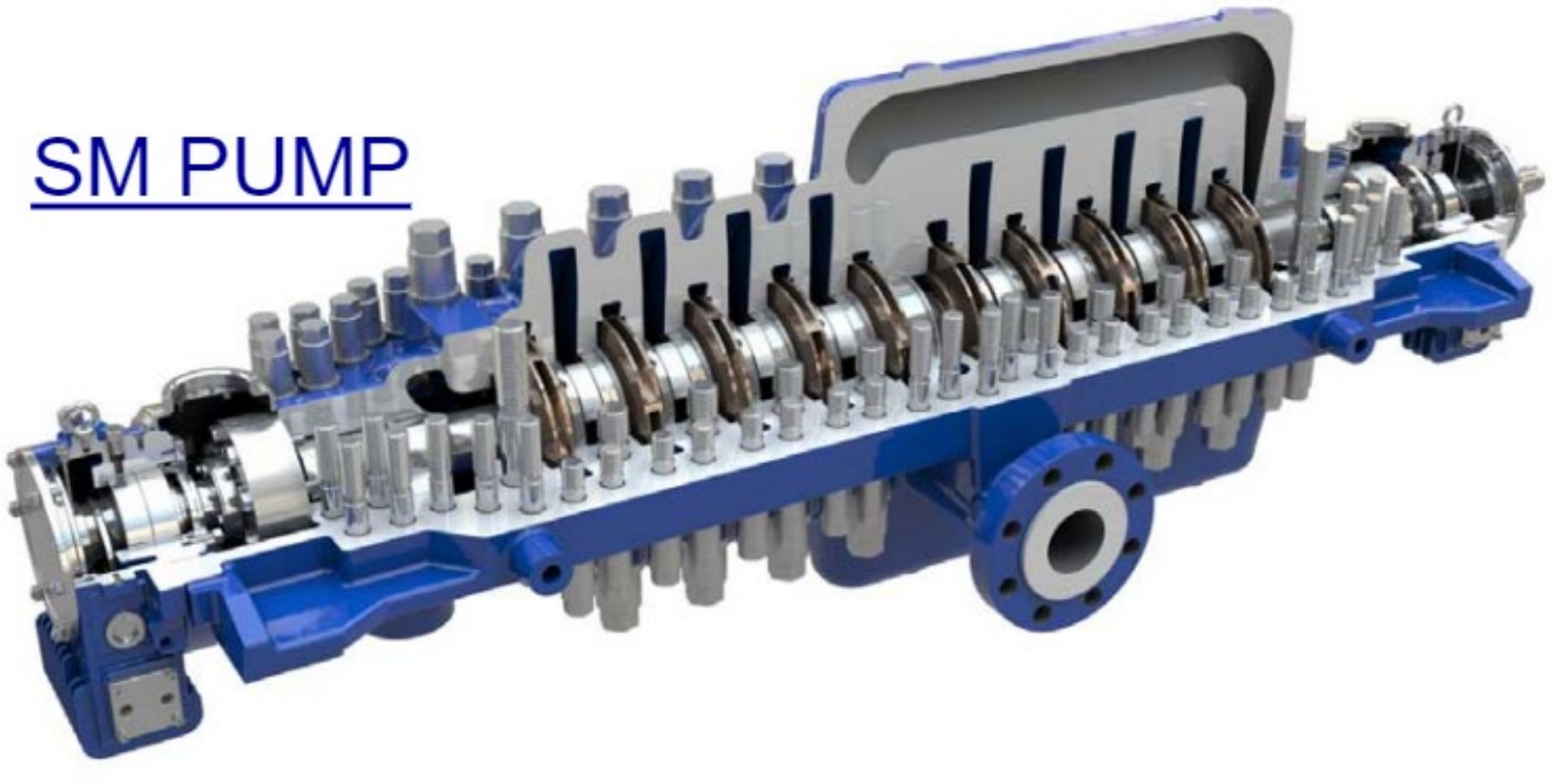
Selection Chart ZM IV

BB1- B

8 POLES
50 Hz 60 Hz



Axially Split Multistage Type BB3



Axially Split Type BB3

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

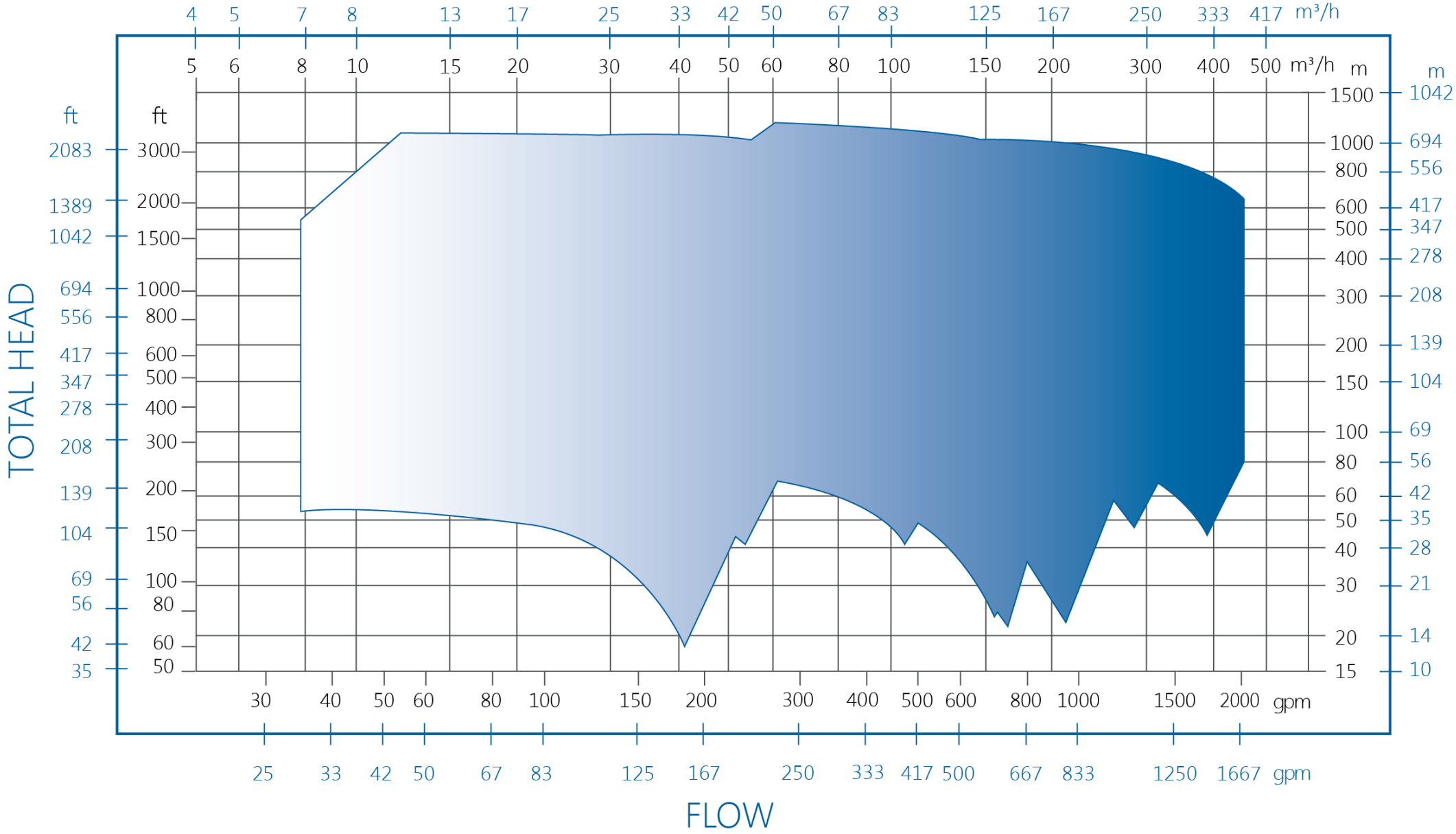
It means this design is good for SG as low as 0.4 and pressures to 180 Bar.

Selection Chart JTN

BB3

2 Poles
— 50 Hz — 60 Hz

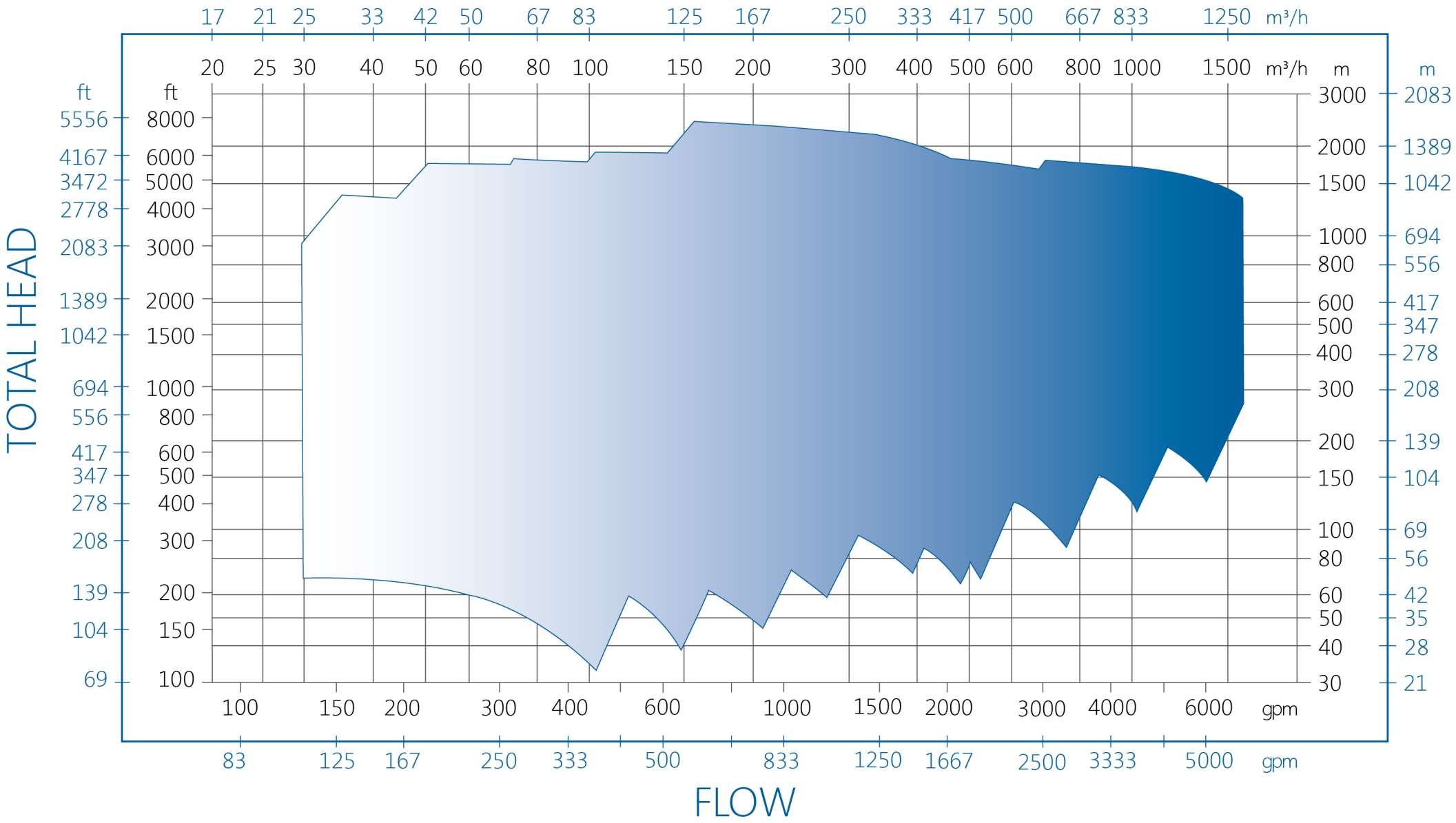
BB3 Smaller Sizes, 50 & 60 Hz, 2 Pole



Selection Chart SM/SMI

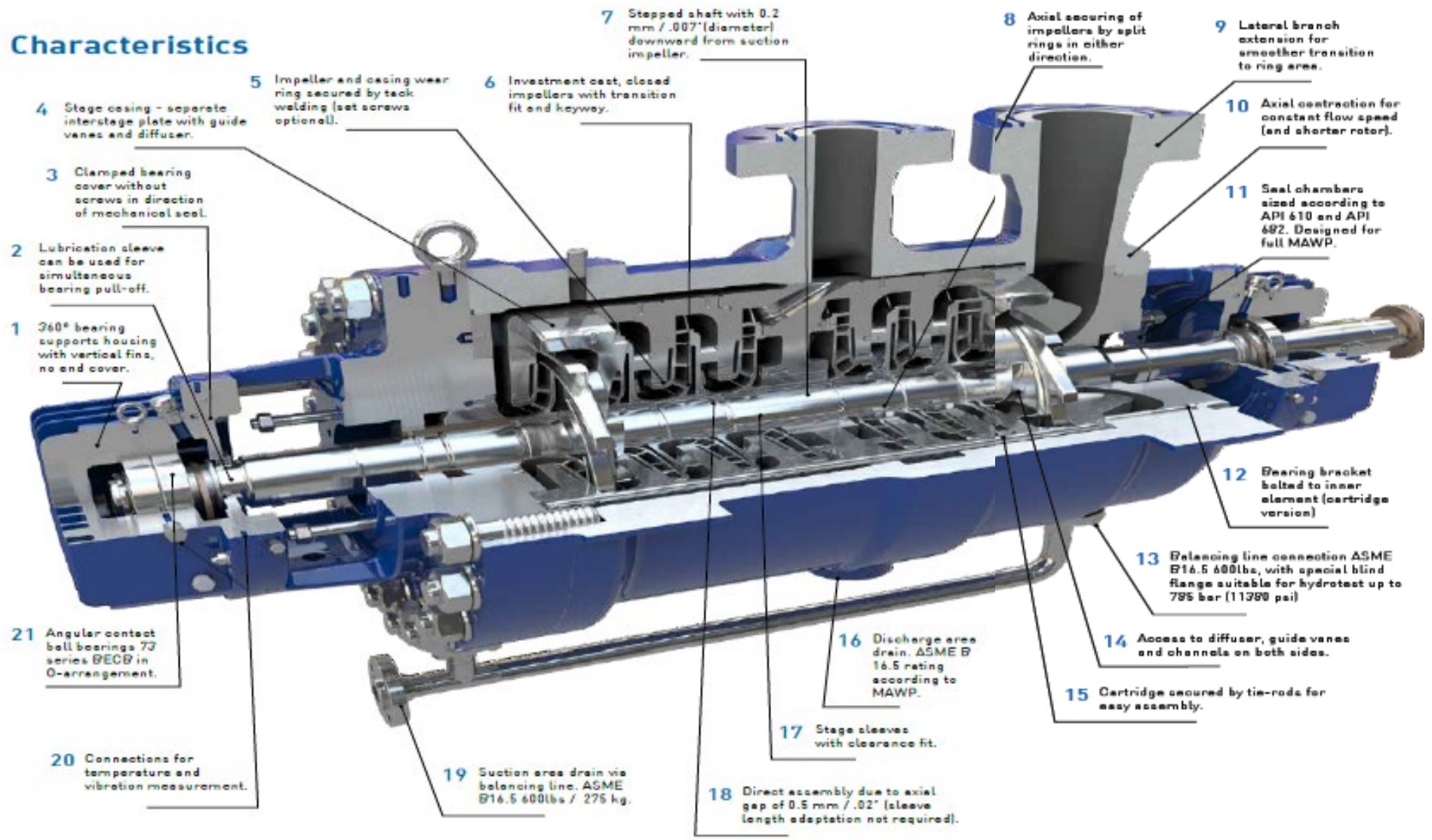
BB3

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



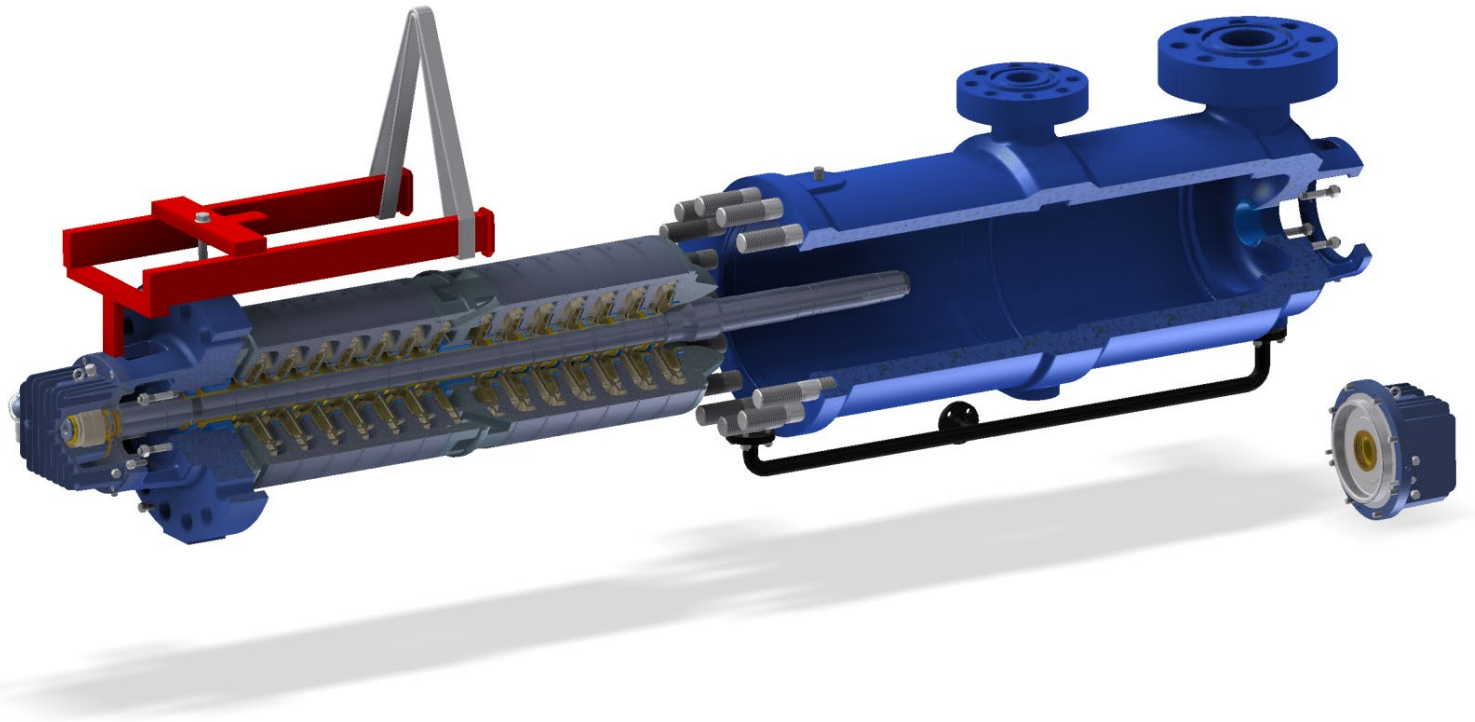
BB3 Larger Sizes, 50 & 60 Hz, 2 Pole

Double Case Pump Type BB5



Double Case Pump Type BB5

Pull-out Design



SELECTION CHART A-LINE

BB5

BB5, 50 & 60 Hz, 2 Pole