Standart
Pump • Fire Fighting Units • Booster Set

GENERAL INFORMATION ABOUT BOOSTER PUMPS

What is booster pump ?

The pressurization systems which takes low pressured water from a tank or directly from city network and provide it with required flow rate and pressure are called booster pumps. Their operataions are completely automatic according to intended use.
Depending on the intended use, boosters are generally classified as follows;
•Domestic Water Booster Pumps
•Irrigation System Booster Pumps
•Process Water Booster pumps

According to which Standarts booster pumps should be selected ?

Until today, in Europe, widely accepted standart which describes pressurization systems comprehensively is DIN 1988. Domestic water booster pumps are defined in DIN 1988-5, how and under what conditions they are selected and used are described.
The European Union EN 806 standard is valid in the countries of European Union members. However, in some cases it is still being in reference to DIN 1988 norm. Therefore, there is no problem with selections and calculations based on the DIN 1988 standard. Selection and calculation methods in this catalog are taken from DIN 1988-5 and EN 806 standards.

Which parameters should be determined before selecting booster ?

The first condition for long-life booster is selecting according to suitable operating and environmental conditions and determining pump capacities correctly.
In choosing type of booster;
•Positioning of water tank relative to the booster (Does the water come on its own? Or is suction needed?)
•Characteristic of the space where booster will be installed (Is there enough space and air circulation?)
•Correct selection of the number of users and diversity factor
•Properties of the water to be pressurized (hardness, temperature)
•Required head
•Required flow rate and the volume of the expansion tank to be selected
When pump and equipments according to these material and functional characteristics are selected, the right type of booster pump which will be able to work without problems for many years.

How to determine operating pressure range of booster system ?

The pressure in the outlet collector of the booster is the sum of the intake pressure in the inlet collector and the pressure generated by the booster. However, in Turkey boosters are generally supplied from a tank at the same level with the booster and open to atmosphere, so the inlet pressure of the booster is negligible.

While determining operating pressure of booster;
•The static height of the building
•The minimum flow pressure on top fllors
•Friction losses in the pipes
•Water meter losses
•Filters and other equipments losses should be calculated.

Minimum pressure of the booster, if there is no special conditions defined by the user, should be approximately 10-15 mwc on the highest settlement or the most critical user

$$H_{bot} = DPe + Pmin\ fl + S\ (l \times R + DpF) + DPwm + DPap - SPLN \qquad \textbf{(Formula 1)}$$

H_{bot}	*: Booster bottom pressure*
DPe	*: Building height (mWc)*
Pmin fl	*: Minimum flow pressure (mWc)*
S (l x R + DpF)	*: Friction losses in pipes (mWc)*
DPwm	*: Water meter losses (mWc)*
DPap	*: Losses of filter and other equipments if known (mWc)*
SPLN	*: Minimum pressure at the booster inlet (mWc)*

SPLN is often neglected in applications that booster is fed from a tank. However on some cases (especially oil filling plants), towers are used as water tanks. On that situation, 15-20 mWc inlet pressure is generated.

Another type of connection is to take water directly from the pressurized network and pressurize it where the network pressure is not enough. If this is the case, inlet pressure must be calculated.

Calculation of total losses in the installation may not always be easy. To do this, it is necessary to know the types, quantities and measurements of any fixtures, valves, pipes and fittings and to calculate the losses in the water flow that will pass through them.

Example of bottom pressure calculation:

Building Height	*= 30m*
Minimum flow pressure	*= 15m*
Total loss of installation	*= 7,5m*
Water meter loss	*= 7,5m*
Filter and otler losses	*= 0 m*
Inlet pressure	*= 0 m*

Let's calculate bottom pressure value of a booster to be selected for an old apartment

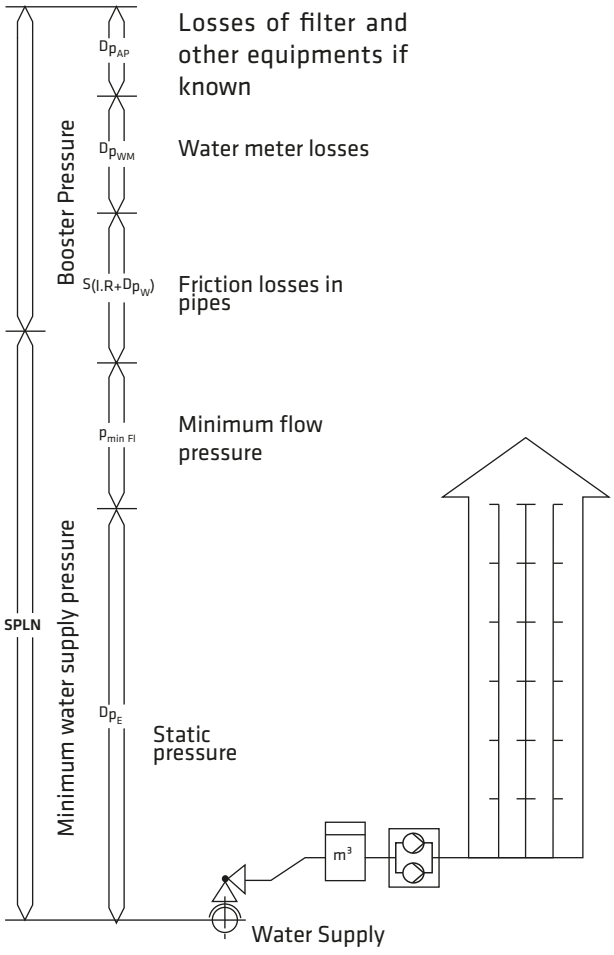


Figure 1

H_{bot} = DPe + Pmin fl + S (l x R + DpF) + DPwm + DPap - SPLN
H_{bot} = 30 + 15 + 7,5 + 7,5 + 0 - 0
H_{bot} = 60 mSS

The pressure difference called as operating pressure of the booster ($H_{üst}$-H_{alt}) should be as small as possible and the booster should be intended to give a constant pressure. As this value increases, surge pressure in the installation increases and the comfort of use decreases.

Therefore, (H_{top}-H_{bot}) 1,5 – 2bar difference as operating range is generally adequate and it is tried to be applied. This difference should not exceed 2.5 bar.
$H_{top} = H_{bot} + 15$ mWc
$H_{top} = 75$ mWc
According to this, our operating pressure is 60-75 mWc.

Another point to be aware of when calculating the required pressure to be ensured by the booster is that static water pressure should not exceed 5 bar (50mWc) at any point in the installation.
To ensure comfortable use of water and proper operation of fixtures, DIN 1988 standart requires the use of pressure reducer or zoning the installation (regional pressurization) if the inlet pressure exceeds 5 bar. (figure 2)

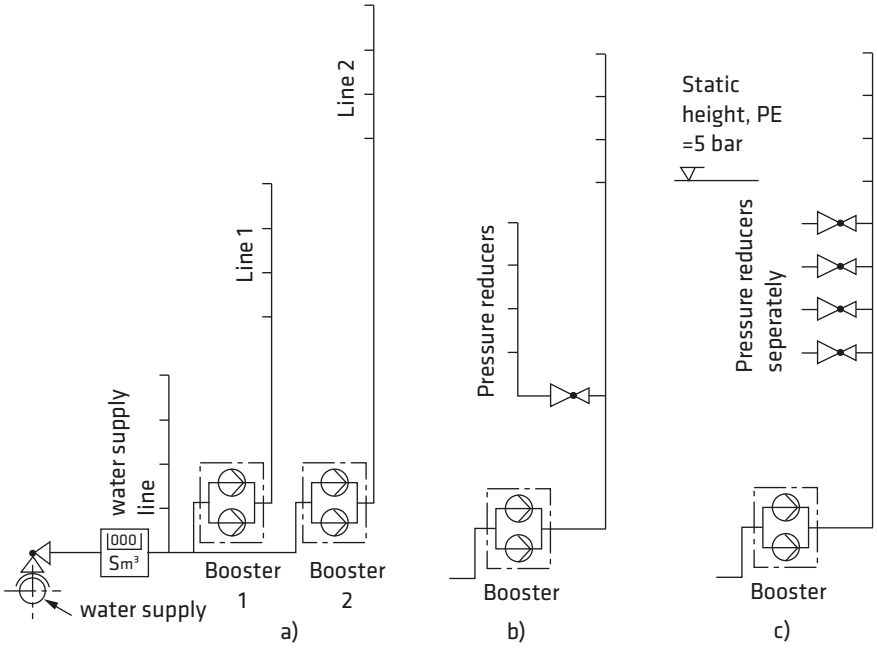


Figure 2

How to determine flow rate of booster system?

Number of flats	Factor of multi-user
4	0,66
5-10	0,45
11-20	0,40
21-50	0,35
51-100	0,30
more than 100	0,25

Table 1

Application Areas	Daily Average. (lt/day)
Corporate housing	150
Luxury housing	200
Luxury Villas	225
Guesthouses	100
Hotels	150
Hospitals	200
Offices	80
Schools	20
Boarding Schools	100
Malls	50

Table 2

Calculation of flow rate has two main criteria. First one is estimated volume of water in unit of time. The other is diversity factor of multi-user systems. We are going to use both critieria when calculating domestic water boosters.

Example of flow rate calculation:

Let's figure out the flow rate of a site where 100 families live in.

EN806 standardında belirtilen formüle göre;

$$Q = \frac{AxBxTxf}{1000} \qquad \textbf{(Formula 2)}$$

- *Q=Booster flow rate (m^3/h)*
- *A=Number of flats*
- *B= Number of individuals in the family*
- *T= Daily average water consumption of the individual (liter /day)*
- *f= Diversity factor*

We may take the number of individuals as 4-5 per average family in Turkey. We will use Table 1 for diversity factor and Table 2 for Daily average water consumption. According to this;

$$Q = \frac{100x4x150x0,30}{1000} = 18\ m^3/h$$

According to this result, we can select a single pump booster that provides 18 m^3/h flow rate. However, as in the above example, it is more accurate to select multiple pump boosters in crowded places such as hospitals.

According to DIN standards pumps must be selected with backups. While the selected spare pump is not working, other operating pumps total flow rate should be equal to our calculated booster flow rate, which is 18 m^3/h

According to this;
- *2x 18 m3/h or*
- *3x 9 m3/h or*
- *4x 6 m3/h might be selected*

CALCULATION AND SELECTION METHODS OF MEMBRANE EXPANSION/PRESSURED TANKS

Small volume membrane expansion tanks in booster sets, according to producers preference, are used from several liters to 5000 liter capacities. Membrane expansion tanks are produced in various types and capacities such as vertical, horizontal, footed and non-footed. Nowadays, the use of expansion tanks that have membrane made out of Butyl, EPDM or natural rubber separation for water and gas parts has become widespread.

When these tanks are not used or for example their membranes are exploded, irregularities occur in booster's start/stop functions and that causes operation difficulties.

The purpose of using membrane tanks connected to the discharge lines of booster sets is limiting number of switches of booster pumps.

Electric motor manufacturers switch number recommendation is around S=20-30 / hour. That means, more than 20-30 times of start/stop in an hour for motors is not recommended. Continuous start/stop function not only shortens the service life of electrical motor, pump parts and electrical panel equipments but also increases electrical energy consumption due to starting current. Therefore, especially for motors bigger than 3kW, it is advisable to limit switch number.

Absorbing possible system shocks, keeping the pressurized water in a certain amount as a reserve in short power cuts are other purposes of the use of these tanks.

In section 5 of DIN 1988 standard estimated volume calculation for membrane expansion tanks is developed based on calculation of pressure controlled air cushioned expansion tank in DIN 4810 standard.

Accordingly, the nominal volume of the expansion tank to be selected is calculated according to the Formule 3.

$$VE = 0{,}33 \times Vmax \quad \frac{H_{top} + 1}{(H_{top} - H_{bot}) \times S} \qquad \textbf{(Formula 3)}$$

- VE : *Nominal volume of selected tank (liter)*
- V_{max} : *Flow rate of a pump at H bottom pressure (m3/hour)*
- H_{top} : *Booster's set top pressure (bar)*
- $(H_{top} - H_{bot})$: *Booster's set operating pressure difference (bar)*
- S : *Required number of switch (1/ hour)*

Example of membrane nominal volume calculation

In an example, the booster set wich has H_{alt} equals to 45 mSS, $H_{üst}$ equals to 65 mSS and 44 m^3/hour are given. Also the number of pump in booster set is four wich are working rotatory. The required number of switch is given 30/hour.

- V_{max} = *44 / 4 = 11 m^3/saat (maximum flow rate of a pump)*
- H_{top} = *6,5 bar*
- H_{bot} = *4,5 bar*
- S = *30 / hour*

The nominal volume of required membrane expansion tank (VE)

$$VE = 0{,}33 \times 11 \quad \frac{6{,}5 + 1}{(6{,}5 - 4{,}5) \times 30} = 0{,}453\ m^3 = 453\ lt$$

The nominal volume of the tank is 500 liters. In the operating conditions of this tank, the useful water volume (VF)

$$VF = VE \quad \frac{H_{top} - H_{bot}}{H_{top} + 1} \qquad \textbf{(Formula 4)}$$

$$VF = 500 \quad \frac{6{,}5 - 4{,}5}{6{,}5 + 1} = 133 \text{ liters are calculated.}$$

Another criteria in membrane expansion tank selection is pressure class that tank should have.

The zero flow rate pressures of the pumps used in boosters are determining the pressure class of the tank. Tank nominal operating pressure should be higher than zero flow rate pressures of pumps.

The pre-air pressure of the tank is dependent of operating conditions and should be set to a value that 10% lower than the H_{bot} operating pressure.

In the above example booster application with H_{bot} =45 mWc, pre-gas pressure of required membrane expansion tank should be set to approximately 40 mWc = 4 bar.

There are varios methods of connecting membrane tanks to the booster's discharge line. Generally, one side of the pressure collector connects to the tank and the other side to the installation. It is also possible to connect the tank to anywhere on building's installation line.

Important point of making connections is that the connections can be quickly detached for membrane change or equivalent situation and can be isolated from installation by using an additional valve.

ACCORDING TO PUMP TYPES RECOMMENDED MINIMUM TANK VOLUMES			
SB M/T 80 PUMPS	100 lt.	CDLF 4 PUMPS	200 lt.
SB M/T 90 PUMPS	200 lt.	CDLF 8 PUMPS	300 lt.
SB M/T 100 PUMPS	300 lt.	CDLF 12 PUMPS	500 lt.
SB /T 130 PUMPS	500 lt.	CDLF 16 PUMPS	500 lt.
GRV VD PUMPS	200 lt.	CDLF 20 PUMPS	750 lt.
GRV VB PUMPS	300 lt.	CDLF 32 PUMPS	750 lt.
SKMV 32 PUMPS	500 lt.	CDLF 42 PUMPS	1000 lt.
SKMV 40 PUMPS	750 lt.	CDLF 65 PUMPS	2x1000 lt.
SKMV 50 PUMPS	1000 lt.	CDLF 85 PUMPS	2x1500 lt.
SKMV 65 PUMPS	2x1000 lt.		

Table 3

INSTALLATION OF BOOSTERS

Boosters can operate connected to a tank or directly to city network. (Figure 3)

For directly connected to city network boosters, it is precondition that inlet pressure is not surging more than 1 bar and is not lower than 0,5 bar. In networks with unfulfilled regarding conditions, it is not true to connect the booster directly to the city network. Due to inadequacy in network pressures, this system is rarely used in Turkey.

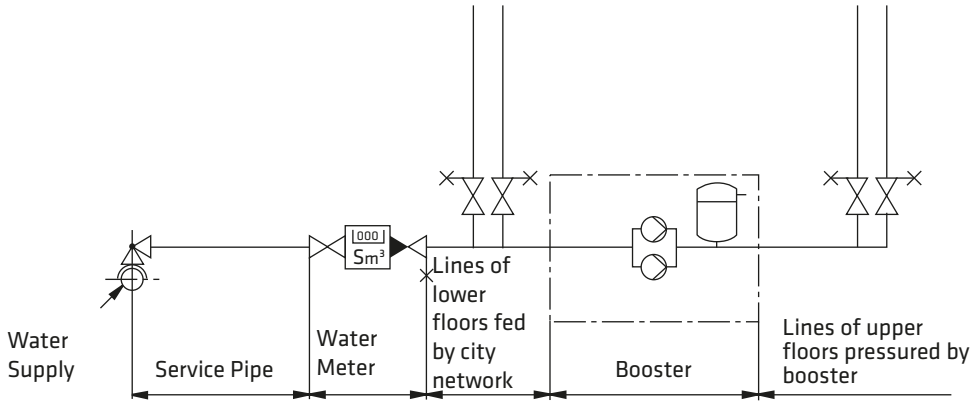


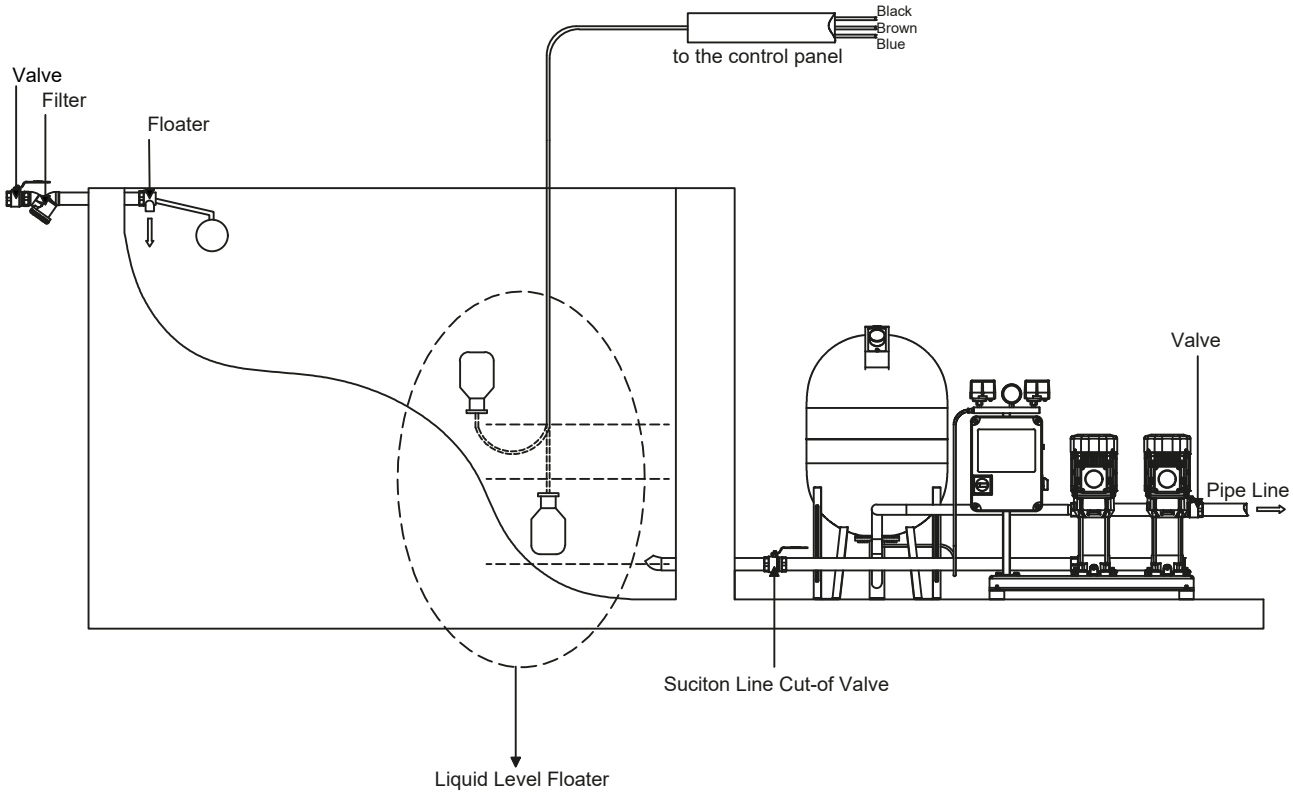
Figure 3

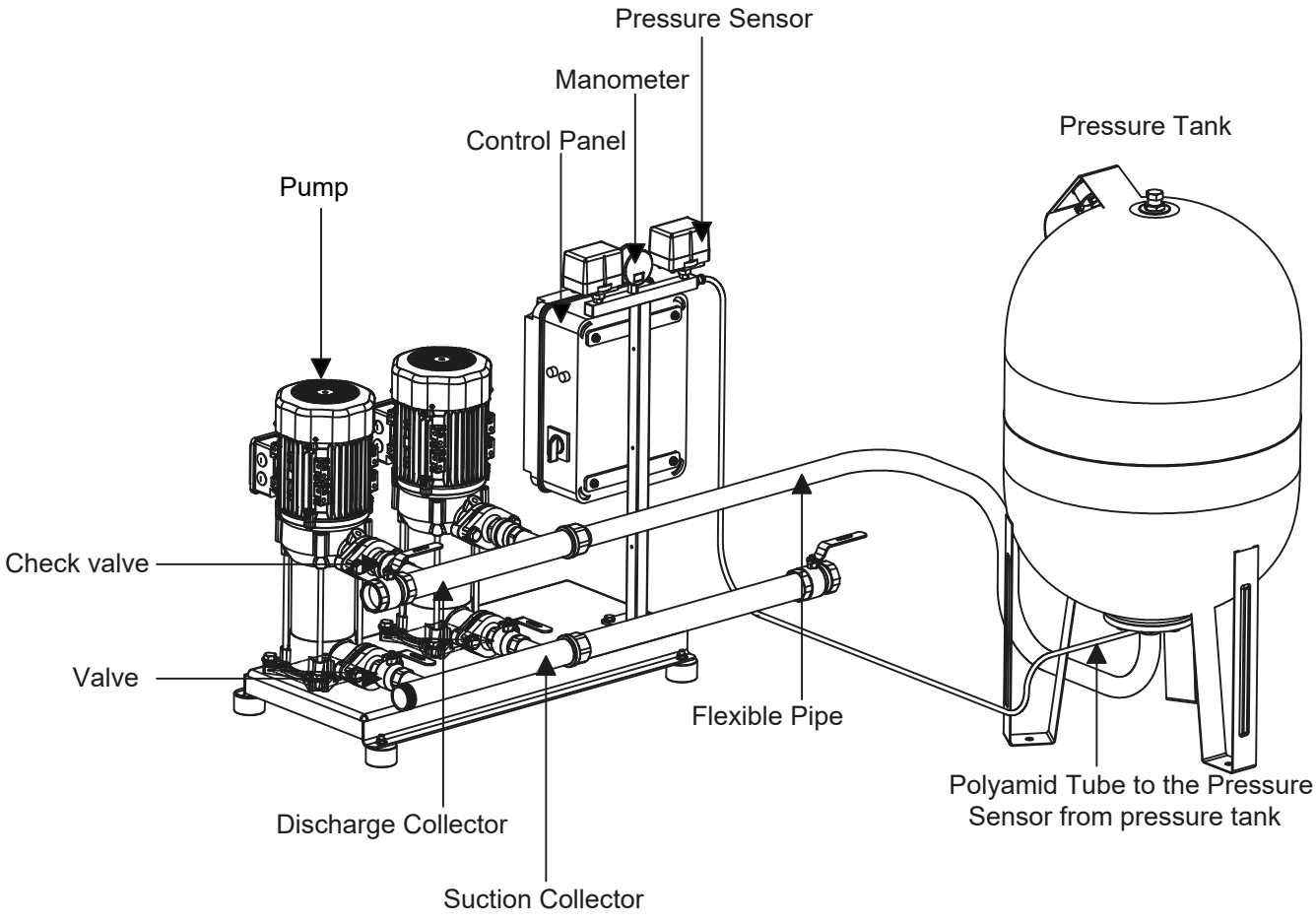
In a booster system that operates by taking water from a tank, the water must be able to flow towards the pump by its own weight and a pre-pressure of about 0.2 bar must be generated at the suction port of the pump.

Operation of the booster by suction is actually not correct. However, when this is forced to, the installation should be designed using a pipe whose internal diameter is at least one diameter wider than the suction mouth of the pump. From the shortest possible path, the installation should be determined using the least amount of elbow and fittings. Valve diameter should be kept as large as possible. It is mandatory that each pump has a separate suction line.

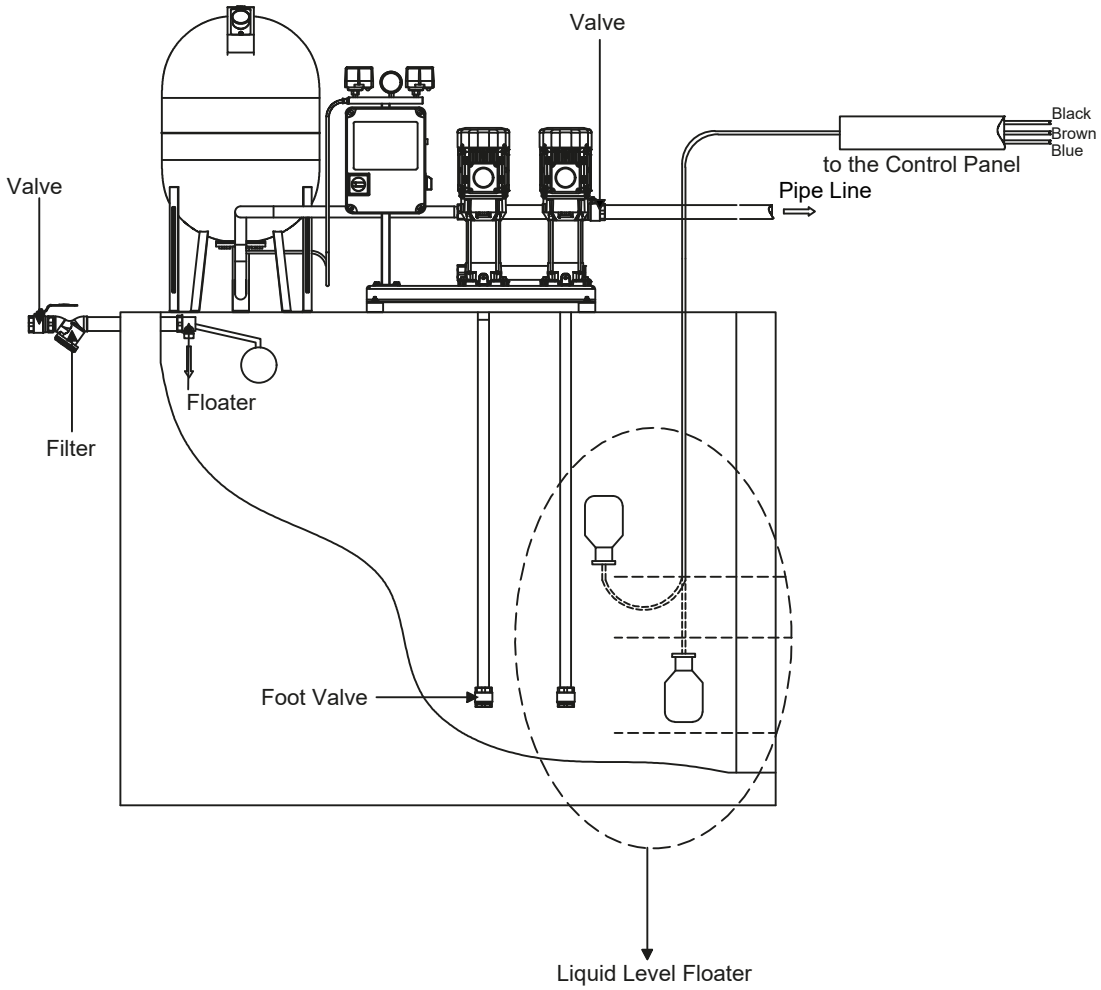
Installation Types

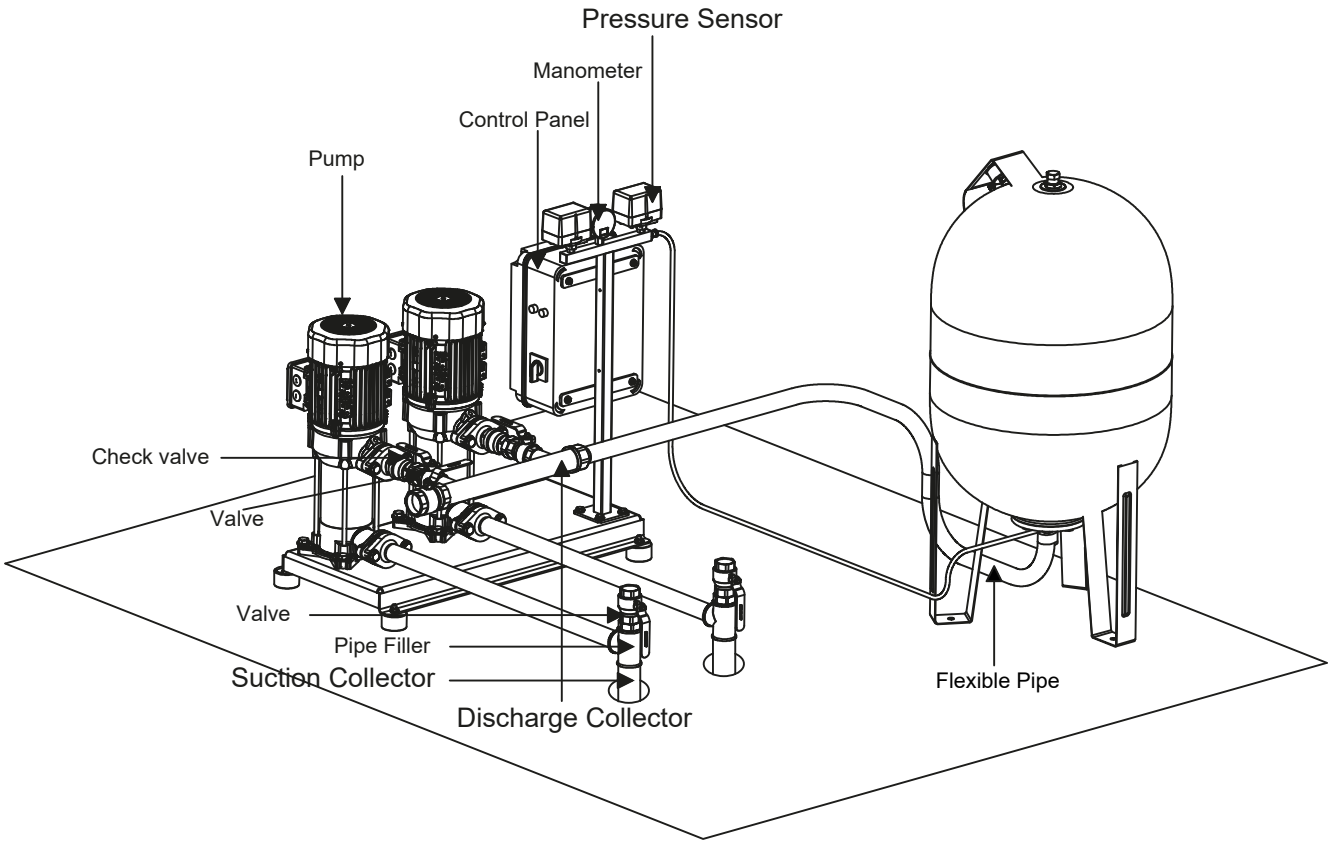
Sample Installation with Suction Height





Sample Installation with Suction Depth





Control Panel Options

Two types of panels are used as standard in boosters.
•The first is pressure switch controlled electrical panels. These panels are run/stopped according to pressure signal received from each pump's separated pressure switches. In this type panel boosters, sufficient volume of expansion tank is used for minimizing number of switches.
•The second is frequency controlled electrical panels. Comfort is important in regarding facilities using these panels. Pressure information received from Transmitter is run on the frequency inverter's PFC macro or PLC and keeps the line pressure constant by reducing the pump's rate according to system flow rate. In this type of panel booster, an expansion tank with a lower volume than the first type is used.

Pressure Switch Controlled Panel Properties

•Works with 380-460 V AC 50 Hz / 60 Hz mains voltage.
•Panel frame is made of thermoplastic material with IP 54 protection class or manufactured from DKP sheet and painted with RAL 7032 electrostatic paint.
•Panels have Manuel – 0 – Automatic selector switch.
•Panels in Automatic position;
-Protection with floater against waterless operation
-Protection against phase interruption and imbalance
-There is co-aging execution by changing turns on each operation.
•During panel's protection relay failure, it works via pressure switches on Manuel position against waterless operation.

Figure 7: Front view of pressure switch controlled panel with triple pump

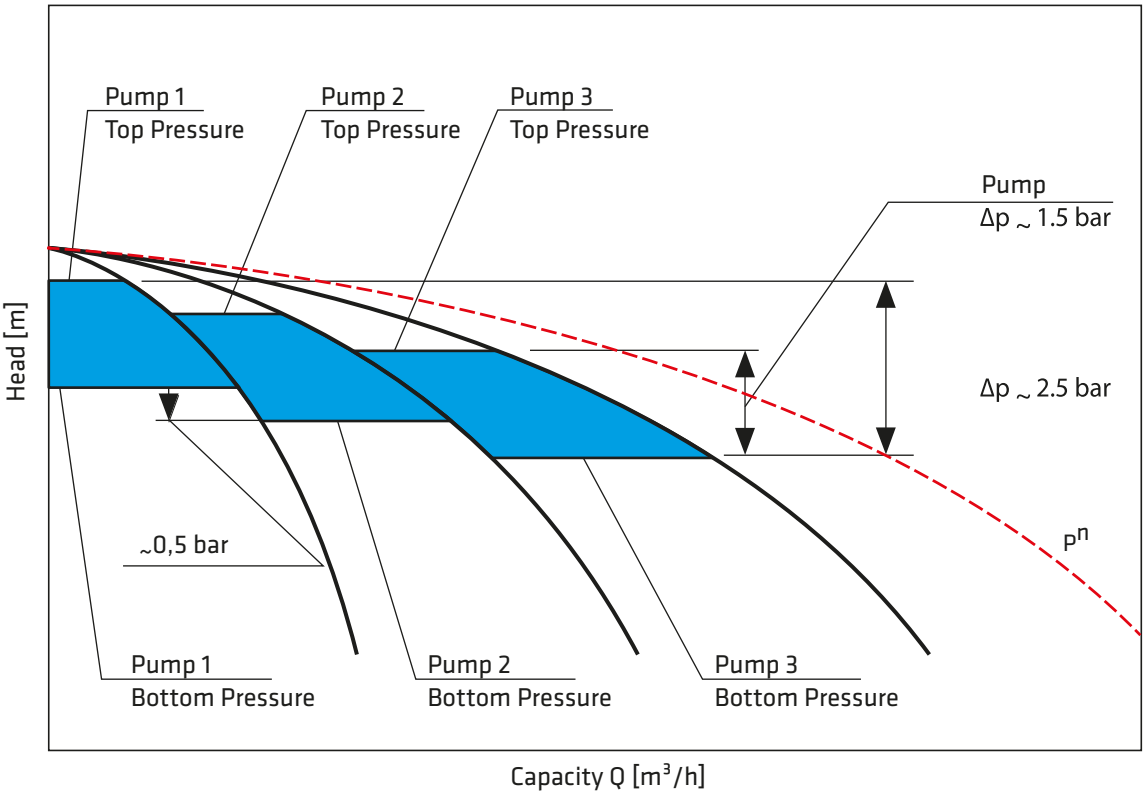


Figure 8. Control Panel With Pressure Sensors

Frequency controlled panel properties

•Works with 380-460 V AC 50 Hz / 60 Hz mains voltage.
•Panel frame is painted with IP 54 protection classed RAL 7032 electrostatic paint
•Panels have ventilation and filter.
•Panel switch can be controlled from front panel.
•Frequency converter device has overheat, motor overheat, motor overcurrent, short circuit, earth leakage, non-overload fault, motor phase loss, over and undervoltage protection and as standard internal EMC and entry shock coil.
•Panel is protected against mains phase loss imbalance and phase reversal.
•During phase fault, user is warned by signal lamps.
•For motors and frequency convertor, there are separate thermal motor protection switches and fuses.
•Up to 4 pump applications in the PFC Macro system, system automation is controlled through PFC macro software and advanced LCD panel by an electronic card on the converter.
•When the number of pumps are 5 or more in PLCOPRT system, PLC and touch panel are used. Via software in the PLC, system automation is controlled by touch panel.
•Upon request, optionally, PLC operator system can be provided in all multi pumps.
•Up to 7,5 kW pumps are operated on direct start, 11 kW and above are operated on star-delta start. Optionally, instead of star-delta start soft start can be used.
•For each motor there are separate ON/OFF keys. Moreover, system can be operated as Automatic or Manuel by separate switch.
•In AUTO position, in the PFC MACRO system, the pressure information from the 1 pressure sensor at the pumps collector output is input to the converter in 4-20mA as analogue. The control software adjusts the pump speed as to provide outlet pressure to the set pressure value from operator panel. When the required pump capacity is exceeded, a second pump is switched on from the network and the pump running on the converter adapts itself according to the new situation and provides regulation. In each additional pump the situation continues in the same way. When the need for water decreases, the pump goes to standby. It steps in again if needed and continues to work in the same way. When there is a problem with any pump, the pump is switched on automatically. After each standby state, the pump entering the circuit runs in sequence.

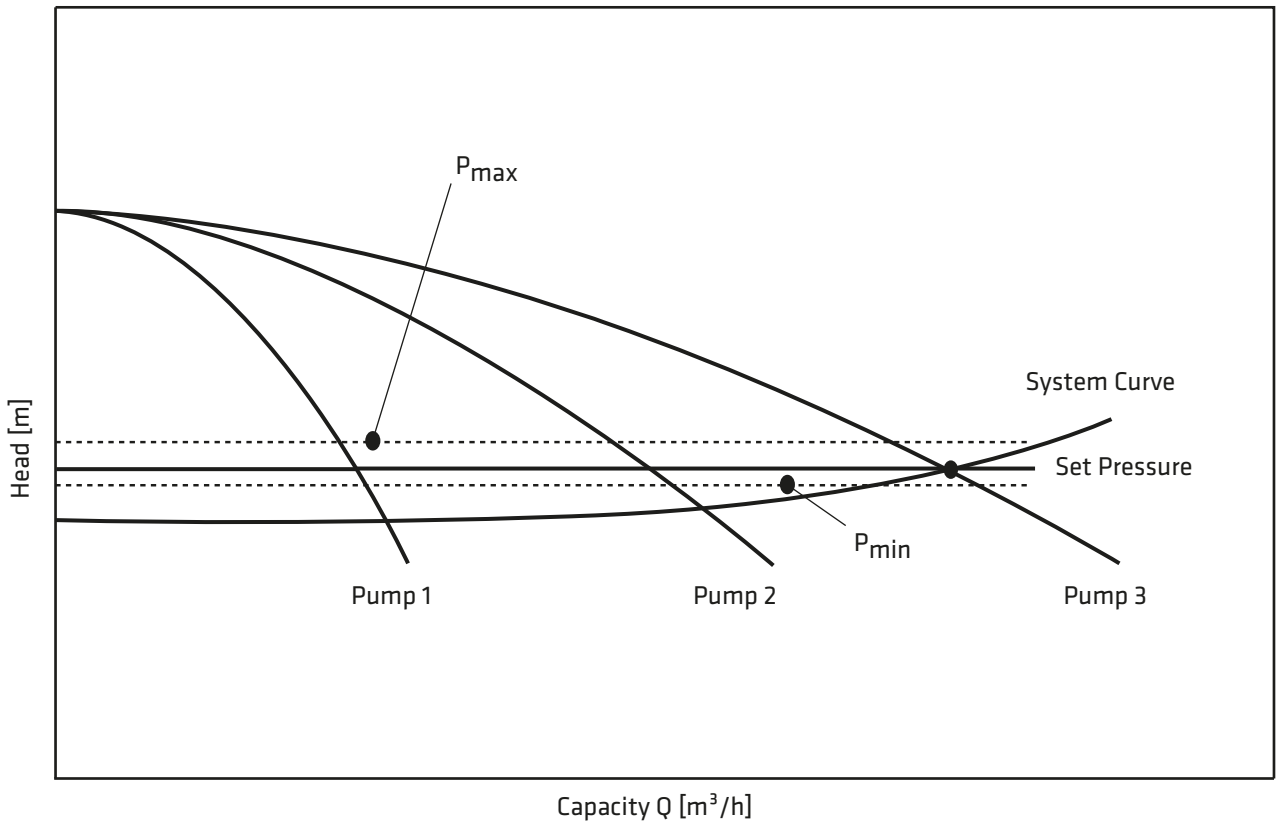


Figure 9. Frequecy Controlled Booster

•The operation in PLC OPRT system in AUTO mode is same as above. The pressure sensor is connected to the PLC and the pumps are controlled via the software in the PLC. System information entries are made via the operator touch panel located on the panel.

•In case of a malfunction on the electronic system or on the converter in MANUEL position, the pumps that are switched on are operated directly or star-delta via the contactors on the panel. In this case, the pressure is adjusted by the pressure switches at the outlet of the collector.

•Separate operating and fault lamp for each motor.
•Lamp for converter failure.
•Lamp for phase protection.
•Dry contact output for general failure.
•Panel is delivered as ready to commissioning.
•The input shock coil is available as STANDARD to reduce the harmonic distortion in the mains supplied by the panel.

Figure 10: Front view of frequency controlled panel with double pump

Minimum Pipe and Valve Diameters for Suction Boosters					
	Suction Pipe	**Flap**		**Suction Pipe**	**Flap**
SB M/T 80	1¼"	1½"	**CDLF 4**	1½"	2"
SB M/T 90	1½"	2"	**CDLF 8**	2"	2½"
SB M/T 100	2"	2½"	**CDLF 12**	2"	2½"
SB T 130	2½"	3"	**CDLF 15**	2"	2½"
GRV VD	2"	2½"	**CDLF 20**	2½"	3"
GRV VB	2"	2½"	**CDLF 32**	2½"	3"
SKMV 32	2"	2½"	**CDLF 42**	3"	4"
SKMV 40	2½"	3"	**CDLF 65**	4"	5"
SKMV 50	3"	4"	**CDLF 85**	4"	5"
SKMV 65	4"	5"			

NOTE: Recommendation for suction pipe diameter is given for steel pipe, if plastic pipe is used diameter of pipe should be increased.

Table 4

Standart

Pump • Fire Fighting Units • Booster Set

TH SB

BOOSTERS

TH SB Rev.11 09.2021

General Information

It is high pressure, quiet running, compact and low power consumption.
SB pumps are suitable for pumping non-abrasive, clean or slighty contaminated, low viscosity liquids without solid & fibrous particles.
Vertical structure saves space.

Technical Data

Flow — up to 25 m^3/h
Head — up to 150 m
Design Temperature — 0 °C to 50 °C
Casing Pressure — 10 - 16 bar

Design Features

•TH SB booster is manufactured with horizontal or vertical pump.
•The boosters are produced as single, double and triple pumps as a standard according to the desired flow. Upon request, up to 6 pumps can be set.
•Single-pump boosters have a water level float (electric floater).
•Phase control system (PCS) is available in single pump, three-phase motorized boosters.
•Sequencing, phase control and liquid level control are standard features for multiple pumped booster pumps.
•Booster pumps can operate in two different modes; automatically and manually.
•Electrical materials used in the booster pump panels are selected from reliable and quality brands.
•The booster pumps can be manufactured as a variable-speed frequency control for convenience.

Material Equivalents

Part Name	Material	
	Standard	Optional
Pump		
Base Plate	GG 25	-
Stage Casing	NORYL	-
Intermadiate Stage	NORYL	-
Impeller	NORYL	-
Shaft	AISI 420	-
Cover Plate	AISI 304	-
Panel	Pressure Switch Controlled	Frequency Controlled
Collector	Steel	AISI 304
Frame	Steel	-
Accessories		
Valve	Brass	-
Check Valve	Brass	-

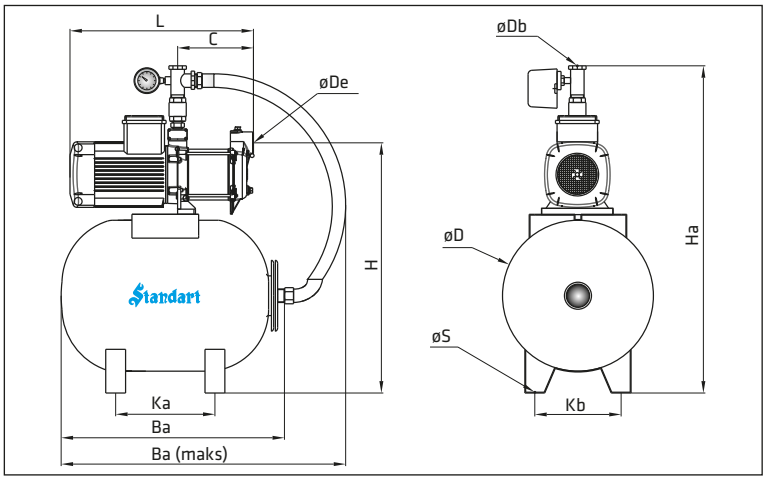
Booster Designation

TH 1x SB T-V 80 /10

Booster Type
Number of Pumps
Pump Type
T : Three-phase M : Mono-Phase
Vertical Installation
Motor Building Size
Number of Stages

Performance Curves and Dimensions

Horizontal boosters with tanks



24 Liter Tank	De	Db	Ba	Ba(maks)	H	Ha	Ka	Kb	L	C	øD	øS	KG
SBM 80/5-24	1 1/4"	1"	480	587	465	669	190	158	455	200	265	10	25,8
SBM 80/6-24									475	230			26,3
SBM 80/7-24									500	250			26,9
SBM 80/8-24									520	270			28,1
SBM 80/9-24									540	295			28,8

24 Liter Tank	De	Db	Ba	Ba(maks)	H	Ha	Ka	Kb	L	C	øD	øS	KG
SBT 80/5-24	1 1/4"	1"	480	587	465	669	190	158	453	206	265	10	24,3
SBT 80/6-24									475	228			24,8
SBT 80/7-24									497	250			26,1
SBT 80/8-24									519	272			26,3
SBT 80/9-24									541	294			26,8
SBT 80/10-24									563	316			28,3
SBT 80/11-24									585	338			29

50 Liter Tank	De	Db	Ba	Ba(maks)	H	Ha	Ka	Kb	L	C	øD	øS	KG
SBM 80/5-50	1 1/4"	1"	600	696	565	779	220	232	453	206	280	10	31,7
SBM 80/6-50									475	228			32,2
SBM 80/7-50									497	250			32,8
SBM 80/8-50									519	272			34
SBM 80/9-50									541	294			34,7

50 Liter Tank	De	Db	Ba	Ba(maks)	H	Ha	Ka	Kb	L	C	øD	øS	KG
SBT 80/5-50	1 1/4"	1"	600	696	565	779	220	232	453	206	380	10	30,2
SBT 80/6-50									475	228			30,7
SBT 80/7-50									497	250			32
SBT 80/8-50									519	272			32,2
SBT 80/9-50									541	294			32,7
SBT 80/10-50									563	316			34,7
SBT 80/11-50									585	338			35

50 Liter Tank	De	Db	Ba	Ba(maks)	H	Ha	Ka	Kb	L	C	øD	øS	KG
SBM 90/4-50	1 1/4"	1 1/4"	600	696	603	796	220	232	489	218	380	10	39,3
SBM 90/5-50									517	246			41,3
SBM 90/6-50									545	274			41,8

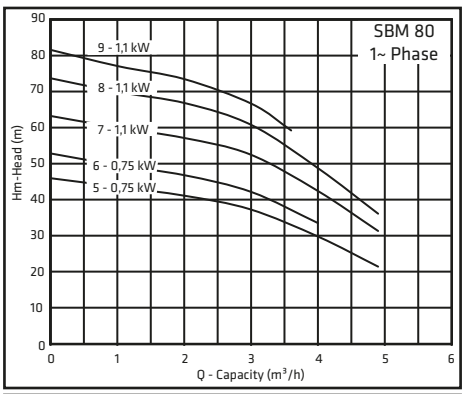
50 Liter Tank	De	Db	Ba	Ba(maks)	H	Ha	Ka	Kb	L	C	øD	øS	KG
SBT 90/4-50	1 1/4"	1 1/4"	600	696	603	796	220	232	489	218	380	10	37,3
SBT 90/5-50									517	246			39,3
SBT 90/6-50									545	274			40,3
SBT 90/7-50									573	302			42,3

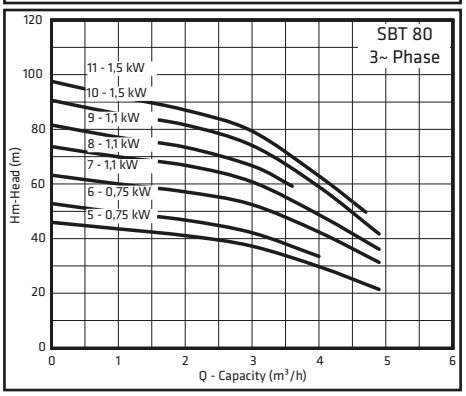
80 Liter Tank	De	Db	Ba	Ba(maks)	H	Ha	Ka	Kb	L	C	øD	øS	KG
SBM 90/4-80	1 1/4"	1 1/4"	635	828	708	901	330	276	489	218	460	10	44,1
SBM 90/5-80									517	246			46,1
SBM 90/6-80									545	274			46,6

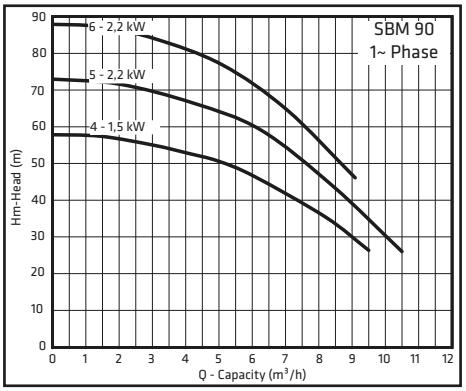
80 Liter Tank	De	Db	Ba	Ba(maks)	H	Ha	Ka	Kb	L	C	øD	øS	KG
SBT 90/4-80	1 1/4"	1 1/4"	635	828	708	901	330	276	489	218	460	10	42,1
SBT 90/5-80									517	246			44,1
SBT 90/6-80									545	274			45,1
SBT 90/7-80									573	302			47,1

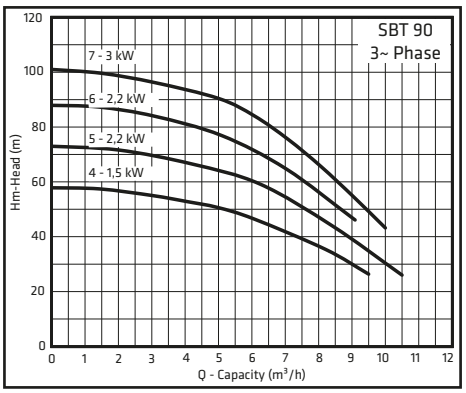
80 Liter Tank	De	Db	Ba	Ba(maks)	H	Ha	Ka	Kb	L	C	øD	øS	KG
SBT 100/3-80	1 1/2"	1 1/2"	635	880	746	1007	330	276	530	219	460	10	51,3
SBT 100/4-80									563	252			52,8
SBT 100/5-80									596	285			58

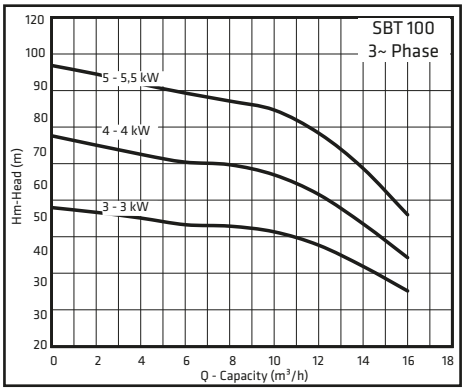
100 Liter Tank	De	Db	Ba	Ba(maks)	H	Ha	Ka	Kb	L	C	øD	øS	KG
SBT 100/3-100	1 1/2"	1 1/2"	820	940	746	1007	330	276	530	219	460	10	52,6
SBT 100/4-100									563	252			54,1
SBT 100/5-100									596	285			59,3



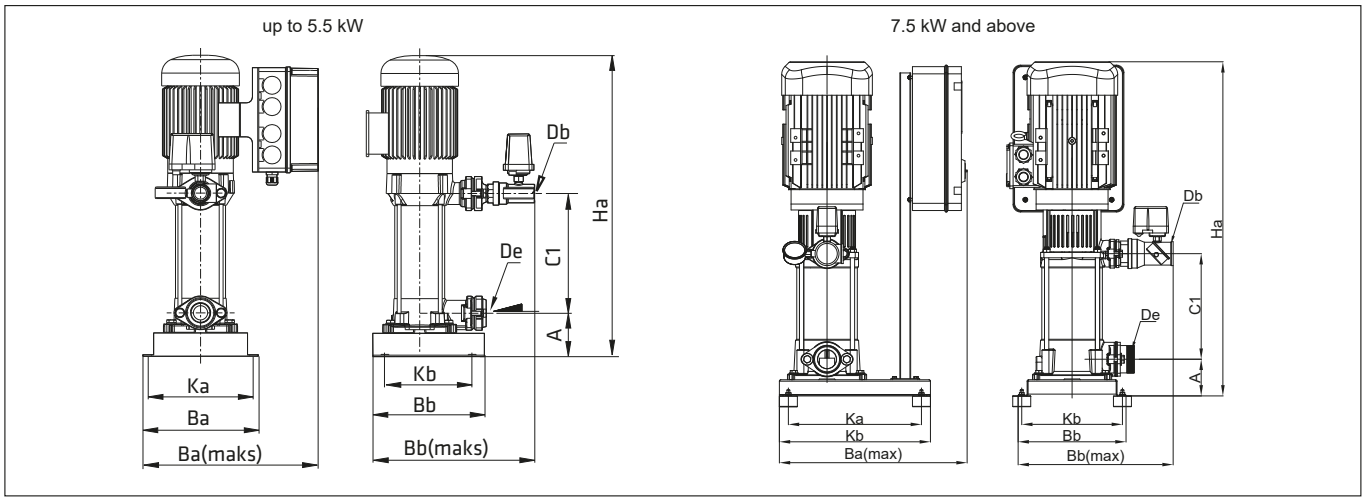




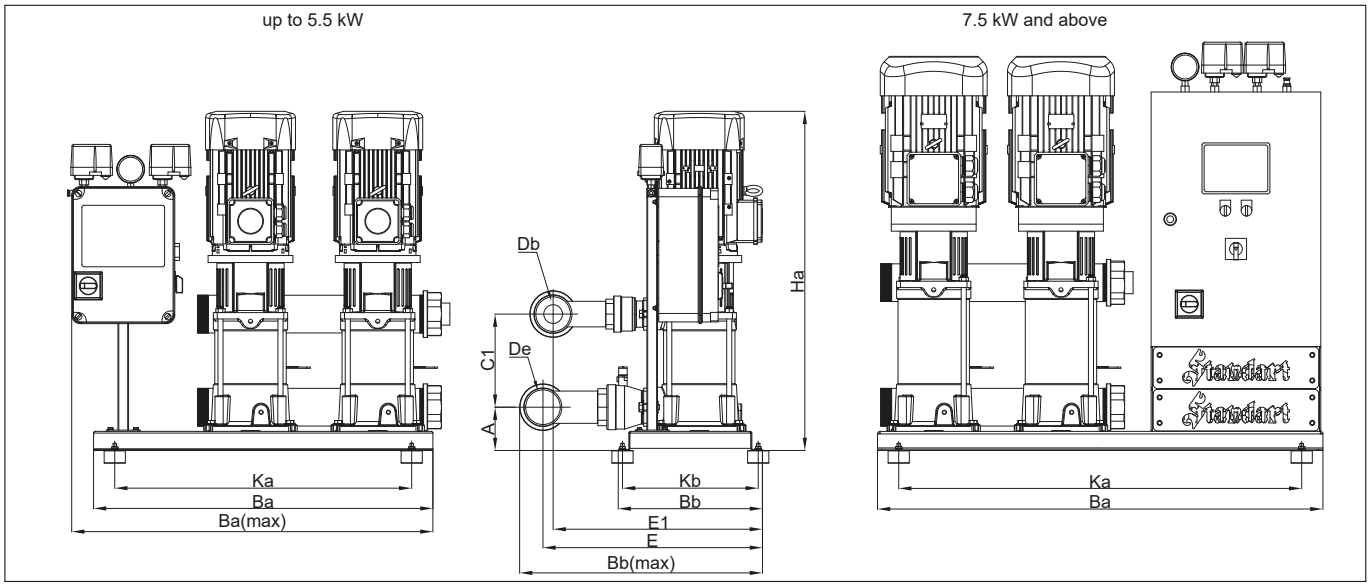




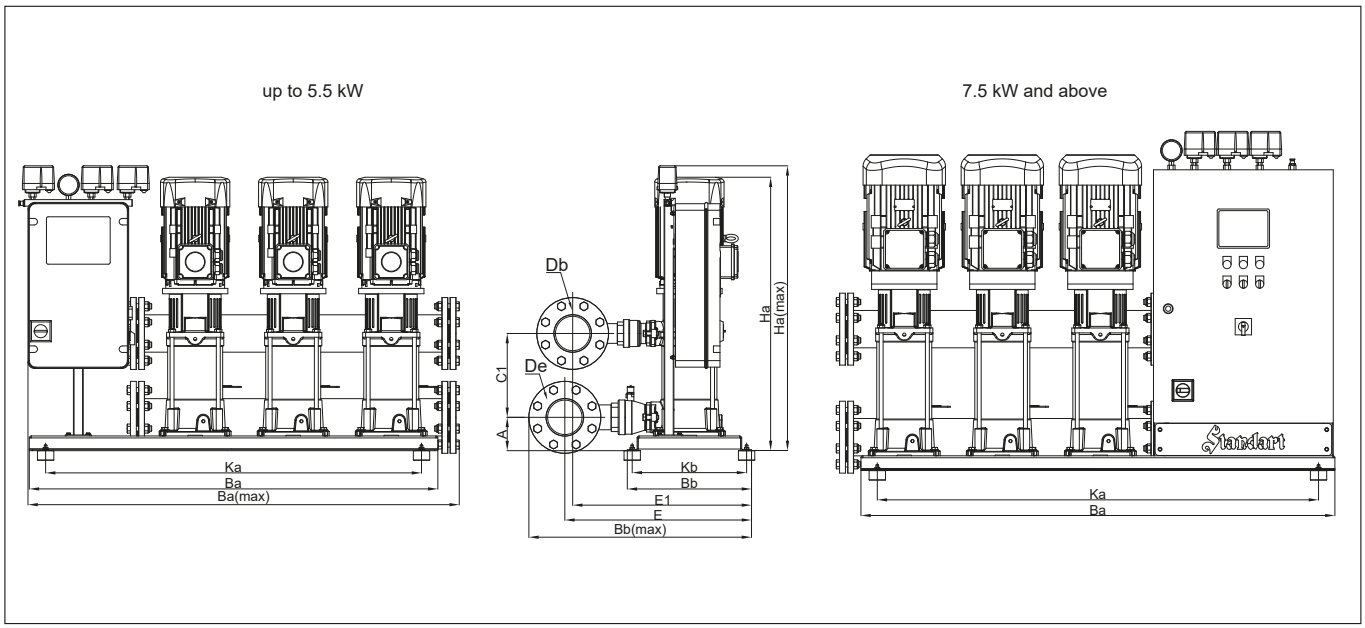
Booster set with one pump



Booster set with two pump



Booster set with three pump



Performance Curves and Dimensions

	De	Db	Ba	Bb	Ba(maks)	Bb(maks)	Ha	Ka	Kb	E	E1	A	C1	KG
1xSBM-V 80/5	1 1/4"	1 1/4"	240	230	360	335	517	220	180	-	-	85	184	26,5
1xSBM-V 80/6							539						206	27
1xSBM-V 80/7							561						228	27,6
1xSBM-V 80/8							583						250	28,8
1xSBM-V 80/9							605						272	29,5

	De	Db	Ba	Bb	Ba(maks)	Bb(maks)	Ha	Ka	Kb	E	E1	A	C1	KG
1xSBT-V 80/5	1 1/4"	1"	230	210	335	315	560	210	160	-	-	85	185	25
1xSBT-V 80/6							580						205	25,5
1xSBT-V 80/7							600						225	26,8
1xSBT-V 80/8							620						245	27
1xSBT-V 80/9							670						275	27,5
1xSBT-V 80/10							690						295	29
1xSBT-V 80/11							730						315	30
1xSBT-V 80/12							770						335	30,5

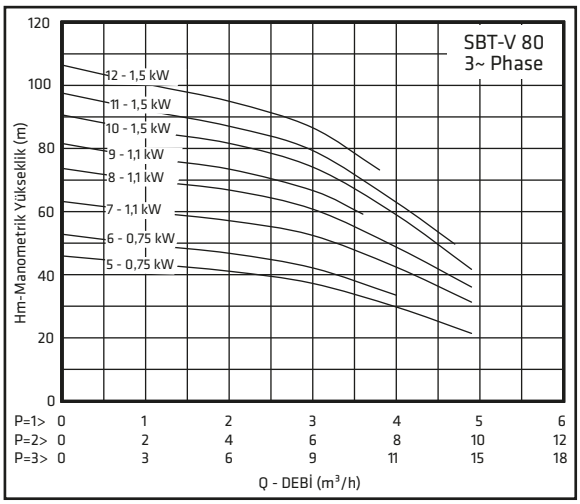
	De	Db	Ba	Bb	Ba(maks)	Bb(maks)	Ha	Ha(maks)	Ka	Kb	E	E1	A	C1	KG
2xSBM-V 80/5	1 1/4"	1 1/4"	700	350	825	445	522	753	630	320	420	390	90	185	66
2xSBM-V 80/6							544							205	67
2xSBM-V 80/7							566							228	69
2xSBM-V 80/8							588							250	71
2xSBM-V 80/9							610							272	72,5

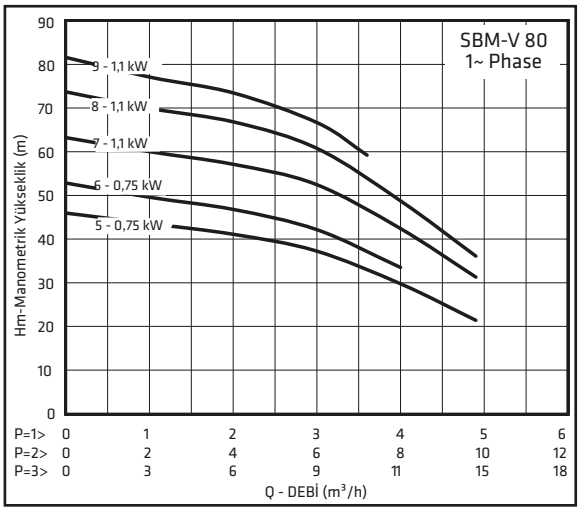
	De	Db	Ba	Bb	Ba(maks)	Bb(maks)	Ha	Ha(maks)	Ka	Kb	E	E1	A	C1	KG
2xSBT-V 80/5	1 1/4"	1 1/4"	650	300	725	405	515	725	550	280	375	370	85	185	63
2xSBT-V 80/6							535							205	64
2xSBT-V 80/7							560							225	66,5
2xSBT-V 80/8							575							245	67
2xSBT-V 80/9							605							275	68
2xSBT-V 80/10							625							295	71
2xSBT-V 80/11							645							315	72,5
2xSBT-V 80/12							665							335	73,5

	De	Db	Ba	Bb	Ba(maks)	Bb(maks)	Ha	Ha(maks)	Ka	Kb	E	E1	A	C1	KG
3xSBM-V 80/5	1 1/4"	1 1/4"	950	350	1085	460	522	810	880	320	430	400	90	184	97,5
3xSBM-V 80/6							543							206	99
3xSBM-V 80/7							566							228	101
3xSBM-V 80/8							588							250	104
3xSBM-V 80/9							610							272	106

	De	Db	Ba	Bb	Ba(maks)	Bb(maks)	Ha	Ha(maks)	Ka	Kb	E	E1	A	C1	KG
3xSBT-V 80/5	1 1/2"	1 1/2"	900	300	1005	420	515	775	800	280	385	380	85	185	93
3xSBT-V 80/6							535							205	94
3xSBT-V 80/7							560							225	98
3xSBT-V 80/8							575							245	99
3xSBT-V 80/9							605							275	100
3xSBT-V 80/10							625							295	105
3xSBT-V 80/11							645							315	107
3xSBT-V 80/12							665							335	109

The specifield dimensions and weights are approximate. Dimensions might be changed.





	De	Db	Ba	Bb	Ba(maks)	Bb(maks)	Ha	Ha(maks)	Ka	Kb	E	E1	A	C1	KG
1xSBM-V 90/4	1 1/4"	1 1/4"	245	230	360	354	544	544	225	180	-	-	85	188	34,5
1xSBM-V 90/5							572	572						216	36,5
1xSBM-V 90/6							600	600						244	37

	De	Db	Ba	Bb	Ba(maks)	Bb(maks)	Ha	Ka	Kb	E	E1	A	C1	KG
1xSBT-V 90/4	1 1/4"	1 1/4"	250	230	360	350	545	230	180	-	-	85	190	32,5
1xSBT-V 90/5							570						215	34,5
1xSBT-V 90/6							600						245	35,5
1xSBT-V 90/7							625						270	37,5
1xSBT-V 90/8							655						300	38
1xSBT-V 90/9							680						325	39

	De	Db	Ba	Bb	Ba(maks)	Bb(maks)	Ha	Ha(maks)	Ka	Kb	E	E1	A	C1	KG
2xSBM-V 90/4	1 1/2"	1 1/2"	700	350	822	460	550	753	630	320	400	432	90	188	80
2xSBM-V 90/5							578							216	84
2xSBM-V 90/6							606							244	85

	De	Db	Ba	Bb	Ba(maks)	Bb(maks)	Ha	Ha(maks)	Ka	Kb	E	E1	A	C1	KG
2xSBT-V 90/4	1 1/2"	1 1/2"	700	340	770	390	545	725	600	320	360	350	85	190	76
2xSBT-V 90/5							570							215	80
2xSBT-V 90/6							600							245	82
2xSBT-V 90/7							625							270	86
2xSBT-V 90/8							655							300	87
2xSBT-V 90/9							680							325	88

	De	Db	Ba	Bb	Ba(maks)	Bb(maks)	Ha	Ha(maks)	Ka	Kb	E	E1	A	C1	KG
3xSBM-V 90/4	2"	2"	950	350	1085	485	550	810	880	320	430	386	90	188	105
3xSBM-V 90/5							578							216	111
3xSBM-V 90/6							606							244	113

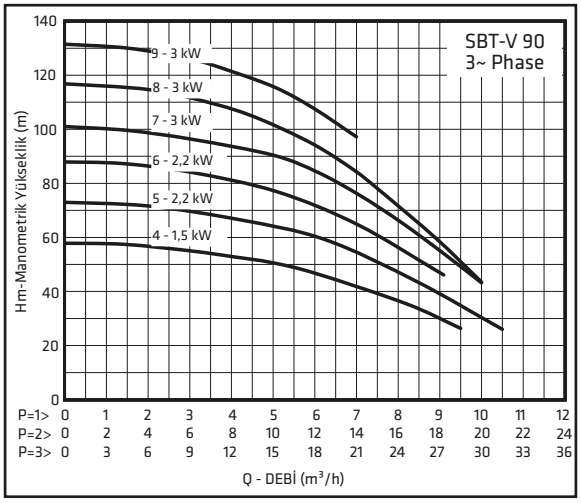
	De	Db	Ba	Bb	Ba(maks)	Bb(maks)	Ha	Ha(maks)	Ka	Kb	E	E1	A	C1	KG
3xSBT-V 90/4	2"	2"	950	340	1085	420	545	810	850	320	375	365	85	190	100
3xSBT-V 90/5							570							215	106
3xSBT-V 90/6							600							245	109
3xSBT-V 90/7							625							270	104
3xSBT-V 90/8							655							300	106
3xSBT-V 90/9							680							325	118

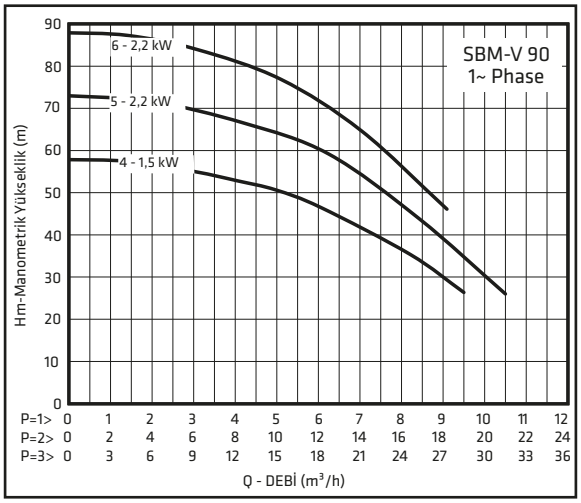
	De	Db	Ba	Bb	Ba(maks)	Bb(maks)	Ha	Ka	Kb	E	E1	A	C1	KG
1xSBT-V 100/3	2"	1 1/2"	300	260	400	400	585	280	210	-	-	95	185	44
1xSBT-V 100/4							615						215	45
1xSBT-V 100/5							650						250	50
1xSBT-V 100/6							685						285	51
1xSBT-V 100/7							715						315	52

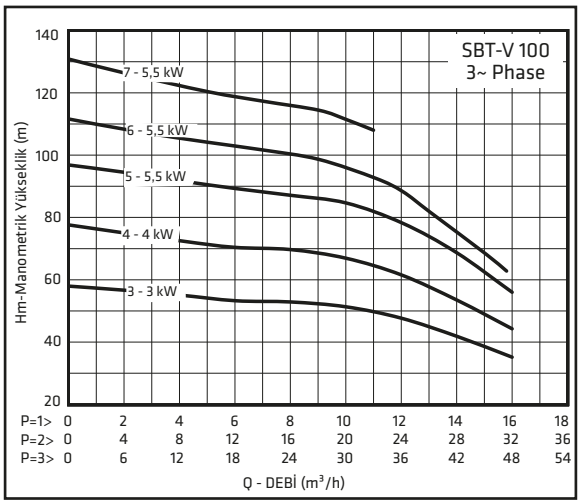
	De	Db	Ba	Bb	Ba(maks)	Bb(maks)	Ha	Ha(maks)	Ka	Kb	E	E1	A	C1	KG
2xSBT-V 100/3	2"	2"	700	340	785	470	585	725	600	320	430	425	95	185	96
2xSBT-V 100/4							615							215	99
2xSBT-V 100/5							650							250	110
2xSBT-V 100/6							685							285	111
2xSBT-V 100/7							715							315	112

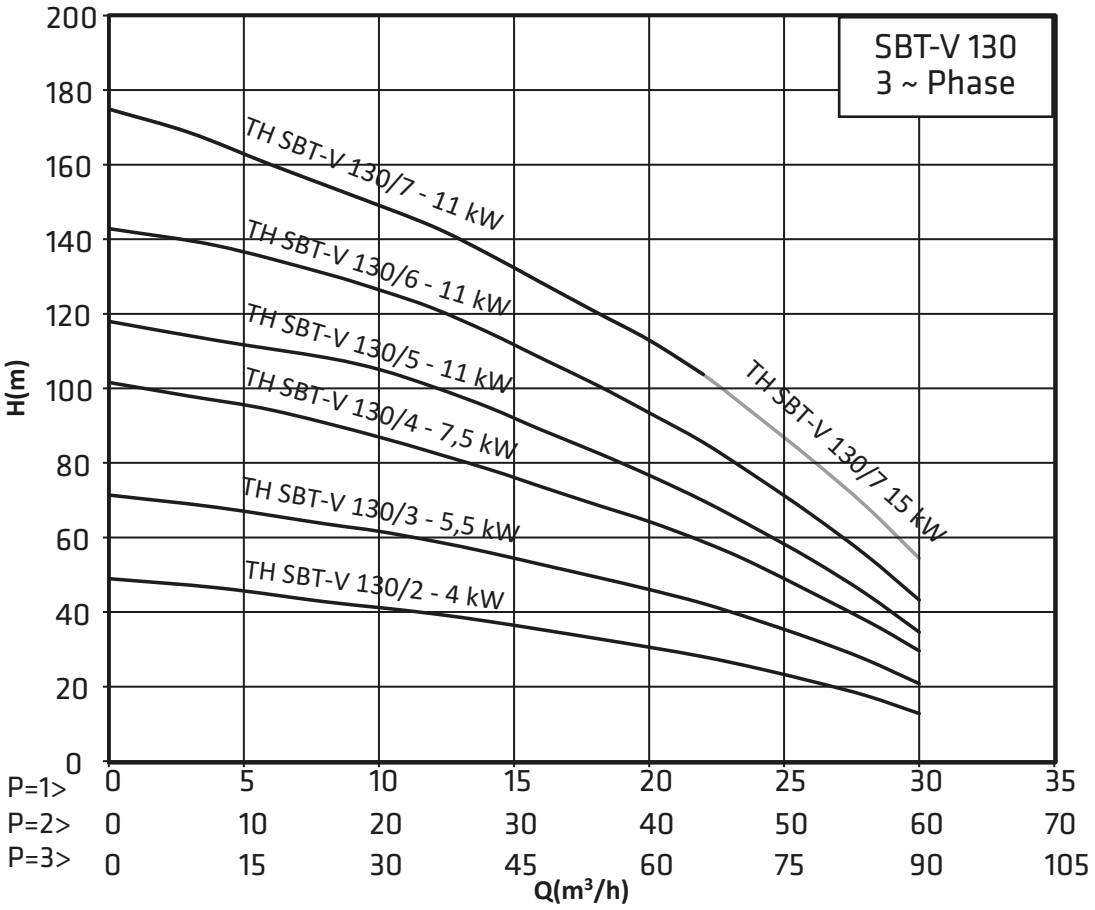
	De	Db	Ba	Bb	Ba(maks)	Bb(maks)	Ha	Ha(maks)	Ka	Kb	E	E1	A	C1	KG
3xSBT-V 100/3	2 1/2"	2 1/2"	950	340	1060	500	585	780	850	320	435	430	95	185	143
3xSBT-V 100/4							615							215	148
3xSBT-V 100/5							650							250	163
3xSBT-V 100/6							685							285	165
3xSBT-V 100/7							715							315	166

The specifield dimensions and weights are approximate. Dimensions might be changed.









	De	Db	Ba	Bb	Ba(maks)	Bb(maks)	Ha	Ka	Kb	E	E1	A	C1	KG
1xSBT-V 130/2	2 1/2"	2"	420	300	420	455	763	370	280	-	-	102	183	62
1xSBT-V 130/3							800						220	65
1xSBT-V 130/4							837						257	70
1xSBT-V 130/5					522		929						294	140
1xSBT-V 130/6							966						331	145
1xSBT-V 130/7							1005						368	152

	De	Db	Ba	Bb	Ba(maks)	Bb(maks)	Ha	Ha(maks)	Ka	Kb	E	E1	A	C1	KG
2xSBT-V 130/2	3"	3"	800	340	855	615	763	720	700	320	560	535	102	183	180
2xSBT-V 130/3							800							220	200
2xSBT-V 130/4							837							257	210
2xSBT-V 130/5			1050	380	1050		929	865	950	350	590	565		294	300
2xSBT-V 130/6							966							331	310
2xSBT-V 130/7							1005							368	315

	De	Db	Ba	Bb	Ba(maks)	Bb(maks)	Ha	Ha(maks)	Ka	Kb	E	E1	A	C1	KG
3xSBT-V 130/2	4"	4"	1150	380	1350	685	763	825	1150	350	560	575	102	183	255
3xSBT-V 130/3							800							220	260
3xSBT-V 130/4							837							257	285
3xSBT-V 130/5			1450	380	1450		929	965	1350	350				294	460
3xSBT-V 130/6							966							331	470
3xSBT-V 130/7							1005							368	485

The specifield dimensions and weights are approximate. Dimensions might be changed.