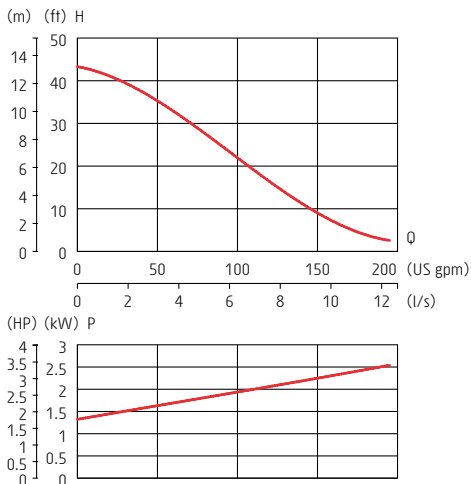
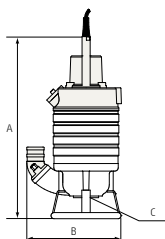




SALVADOR INOX



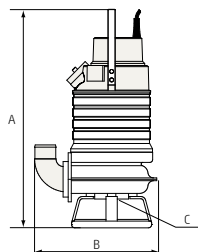
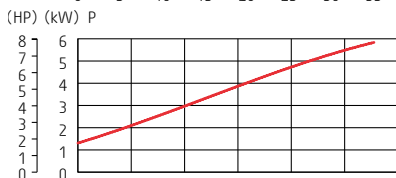
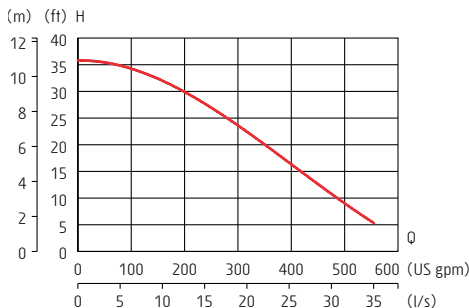
Technical data

Discharge connection	3"
Rated output	3.1 HP (2.3 kW)
Max power consumption	2.9 kW
Shaft speed	3320 RPM
Rated current at 460 V	4.2 A
Rated current at 575 V	3.4 A

A: 25.4" (645 mm) **B:** 14.8" (375 mm) **C:** Ø 2" (50 mm) **Weight:** 106 lbs (48 kg)

Specifications can be changed without notice.

SENIOR INOX



Technical data

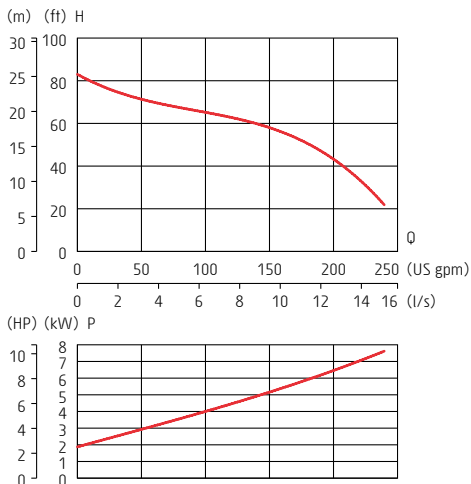
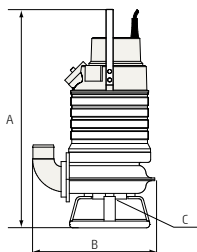
Discharge connection	4"
Rated output	6.6 HP (5.1 kW)
Max power consumption	6.2 kW
Shaft speed	1670 RPM
Rated current at 460 V	9 A
Rated current at 575 V	7.3 A

A: 30" (775 mm) **B:** 19" (480 mm) **C:** Ø 3.1" (80 mm)

Weight: 191 lbs (86 kg)

Specifications can be changed without notice.

SANDY INOX



Technical data

Discharge connection	3"
Rated output	9.0 HP (6.7 kW)
Max power consumption	7.6 kW
Shaft speed	3455 RPM
Rated current at 460 V	11 A
Rated current at 575 V	8.6 A

A: 30" (775 mm) **B:** 19" (480 mm) **C:** Ø 1.8" (46 mm) **Weight:** 191 lbs (86 kg)

Specifications can be changed without notice.

Materials in sludge pumps made of stainless steel

	Salvador INOX	Senior INOX	Sandy INOX
Material			
Upper seal			
Carbon - silicon carbide	•	•	•
Lower seal			
Silicon carbide - silicon carbide	•	•	•
Casted parts			
Stainless steel (EN 10283-1.14412)	•	•	•
Outer casing			
Stainless steel (EN 10088-3-1.14436)	•	•	•
Motor shaft			
Stainless steel (EN 10088-3-1.14460)	•	•	•
Impeller			
Stainless steel (EN 10283-1.14412)	•	•	•
Screws and nuts			
Stainless steel (A4)	•	•	•
O-rings			
Viton rubber	•	•	•
Pump housing			
Nitrile rubber	•	•	•

Specifications can be changed without notice.

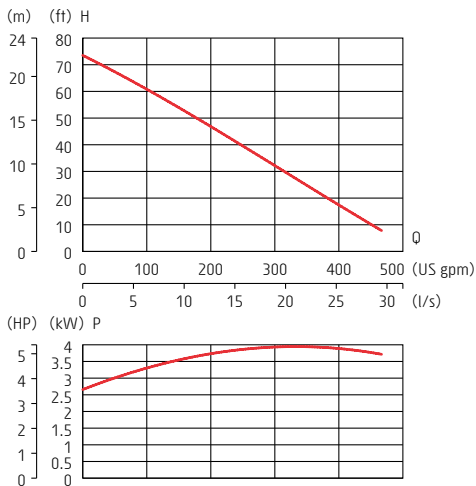
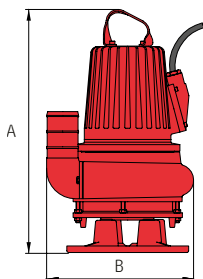
Slurry pumps, BRAVO

Grindex slurry pumps are designed for use in quarries, mines, dredging, cleaning of settling ponds and other abrasive other industries that require pumps with very high durability. Each part of the BRAVO pump is designed for maximum endurance and reliability – an absolute must when pumping slurry.

All BRAVO pumps can handle liquids with pH values from 5.5 up to 14. The Bravo 400 to 900 are equipped with agitator beneath the pump intake to stir up settled material toward the pump intake. The Bravo 400 to 900 can also be fitted with an optional cooling jacket for use in dry pit applications.



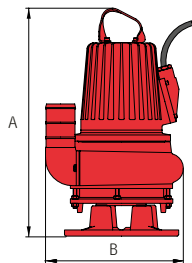
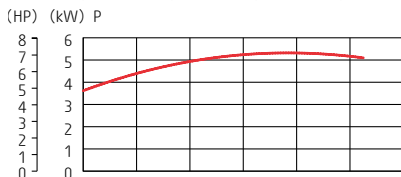
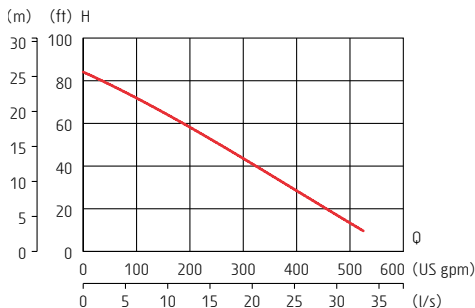
BRAVO 200



Technical data

Discharge connection	4"
Rated output	7.5 HP (5.6 kW)
Max power consumption	6.7 kW
Shaft speed	1740 RPM
Rated current at 460 V	9.6 A
Rated current at 575 V	7.8 A
Solids passage (no agitator)	50 mm (2")

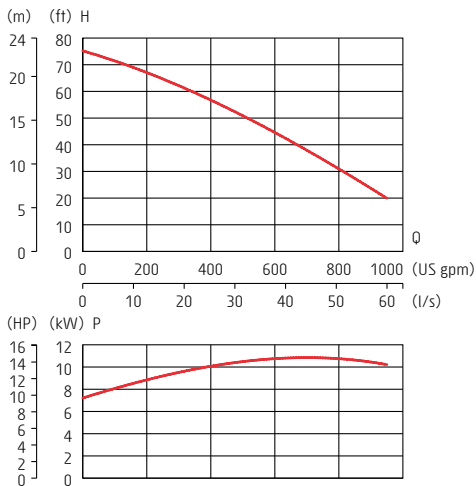
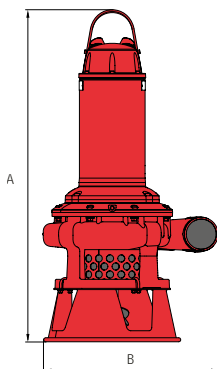
A: 30" (760 mm) **B:** Ø 18" (460 mm) **Weight:** 346 lbs (157 kg)

BRAVO 300**Technical data**

Discharge connection	4"
Rated output	10 HP (7.5 kW)
Max power consumption	8.9 kW
Shaft speed	1735 RPM
Rated current at 460 V	13 A
Rated current at 575 V	10 A
Solids passage (no agitator)	50 mm (2")

A: 30" (760 mm) **B:** Ø 18" (460 mm) **Weight:** 346 lbs (157 kg)

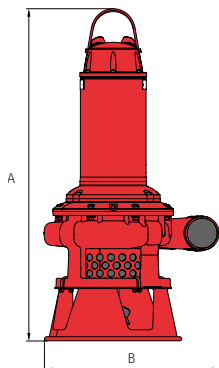
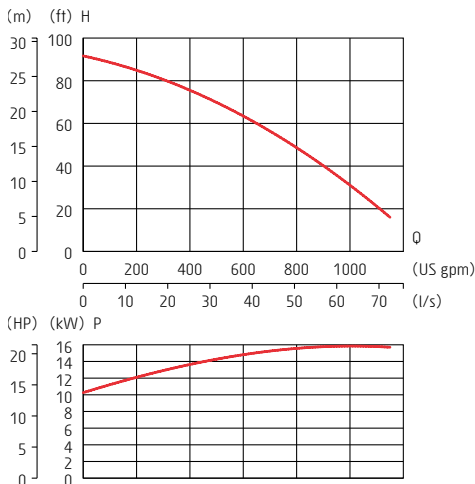
BRAVO 400



Technical data

Discharge connection	4"
Rated output	20 HP (15 kW)
Max power consumption	17 kW
Shaft speed	1755 RPM
Rated current at 460 V	26 A
Rated current at 575 V	21 A
Solids passage (with agitator)	30 mm (1 3/16")

A: 45" (1148 mm) **B:** Ø 23.4" (595 mm) **Weight:** 509 lbs (231 kg)

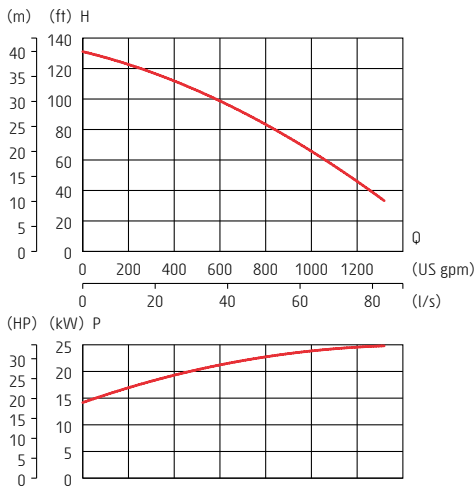
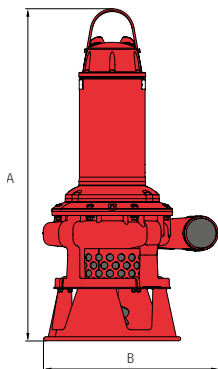
BRAVO 500**Technical data**

Discharge connection	4"
Rated output	25 HP (19 kw)
Max power consumption	21 kW
Shaft speed	1755 RPM
Rated current at 460 V	30 A
Rated current at 575 V	25 A
Solids passage (with agitator)	40 mm (1 9/16")

A: 1273 mm (50") **B:** Ø 23.4" (595 mm) **Weight:** 646 lbs (293 kg)

Specifications can be changed without notice.

BRAVO 600

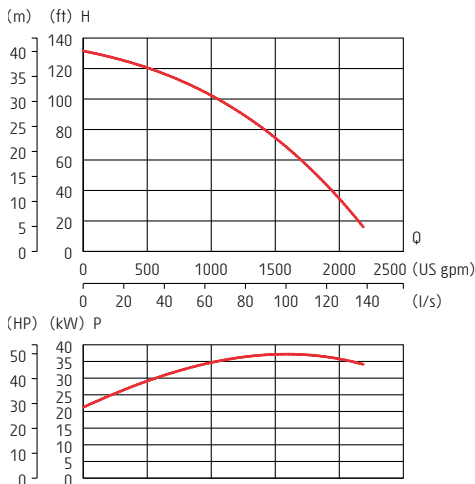


Technical data

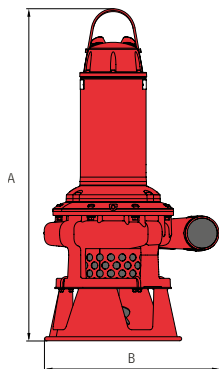
Discharge connection	4"
Rated output	34 HP (25 kW)
Max power consumption	28 kW
Shaft speed	1760 RPM
Rated current at 460 V	40 A
Rated current at 575 V	32 A
Solids passage (with agitator)	40 mm (1 9/16")

A: 50" (1273 mm) **B:** Ø 23.4" (595 mm) **Weight:** 646 lbs (293 kg)

Specifications can be changed without notice.



BRAVO 700

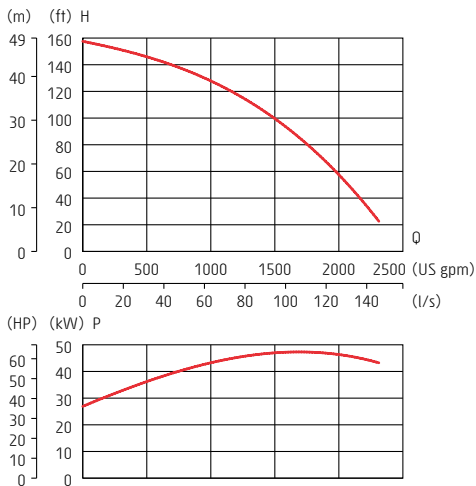
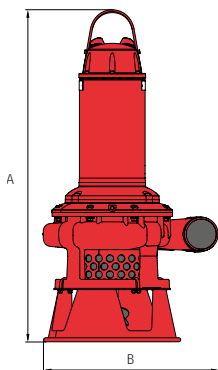


Technical data

Discharge connection	6"
Rated output	60 HP (45 kW)
Max power consumption	48 kW
Shaft speed	1775 RPM
Rated current at 460 V	69 A
Rated current at 575 V	55 A
Solids passage (with agitator)	36 mm (1 7/16")

A: 65" (1652 mm) **B:** Ø 34.5" (875 mm) **Weight:** 1351 lbs (613 kg)

BRAVO 800



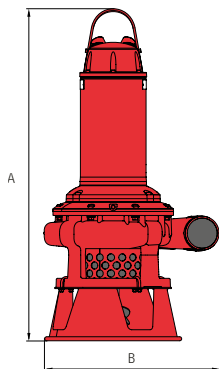
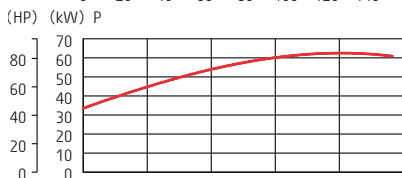
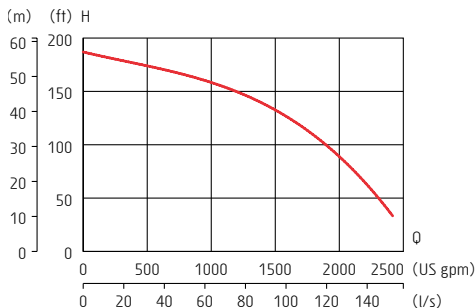
Technical data

Discharge connection	6"
Rated output	70 HP (52 kW)
Max power consumption	56 kW
Shaft speed	1775 RPM
Rated current at 460 V	80 A
Rated current at 575 V	63 A
Solids passage (with agitator)	36 mm (1 7/16")

A: 65" (1652 mm) **B:** Ø 34.5" (875 mm) **Weight:** 1351 lbs (613 kg)

Specifications can be changed without notice.

BRAVO 900



Technical data

Discharge connection	6"
Rated output	105 HP (78 kW)
Max power consumption	84 kW
Shaft speed	1775 RPM
Rated current at 460 V	125 A
Rated current at 575 V	101 A
Solids passage (with agitator)	36 mm (1 7/16")

A: 1779 mm (70") **B:** Ø 34.5" (875 mm) **Weight:** 1863 lbs (845 kg)

Specifications can be changed without notice.

Pumping slurry

Pumping fluids with high solids concentrations is more complicated than pumping water. To avoid sedimentation in the system you need to choose the right pump size and dimensions of hoses and pipes. The concentration of solids together with their size and shape may also affect pump performance and power requirements and therefore pump choice. Remember that settled solids might need external agitators, water jets or mixers to get them back in suspension and allow them to be pumped.

As each application requires its own calculation, we recommend you to contact your Grindex dealer for more information about slurry pumping.



Materials in slurry pumps

	Bravo 200	Bravo 300	Bravo 400	Bravo 500	Bravo 600	Bravo 700	Bravo 800	Bravo 900
Material								
Drive unit								
Cast iron	•	•	•	•	•	•	•	•
Suction cover								
Nitrile rubber	•	•	—	—	—	—	—	—
Pump housing								
Cast iron	•	•						
Hard-Iron™			•	•	•	•	•	•
Hose connector								
Cast iron	•	•	—	—	—	—	—	—
Impeller								
Hard-Iron™	•	•	•	•	•	•	•	•
Lifting handle								
Galvanised steel	•	•						
Stainless steel			•	•	•	•	•	•
Motor shaft								
Galvanised steel	•	•	•	•	•	•	•	•
Studs, screws and nuts								
Stainless steel	•	•	•	•	•	•	•	•

— Not available

Accessories

Some applications require the use of additional devices. Here is a list of Grindex accessories and what pump they can be used with.

- Available
- Not an optimal choice
- x Not available
- Together with external starter
- () Letter in parentheses refer to pump model

	Zinc anodes	Low suction collar	Float switch	Tandem connection	Pump raft
Drainage pumps					
Mini	x	○	○	x	○
Minex	○	○	○	x	○
Minette	○	○	○	x	○
Minor	○	○	○	○	○
Major	○	○	○	○	○
Master	○	x	□	○	○
Master SH	○	x	□	○	○
Matador	○	x	□	○	○
Maxi	○	x	□	○	○
Magnum	○	x	□	○ (H)	○
Mega	○	x	□	x	○

	Zinc anodes	Low suction collar	Float switch	Tandem connection	Pump raft
Sludge pumps					
Solid	X	X	○	X	●
Salvador	○	X	○	X	●
Senior	○	X	○	X	●
Sandy	○	X	○	X	●
Drainage pumps made of stainless steel					
Minette Inox	○	○	□	X	●
Major Inox	○	○	□	X	●
Master Inox	○	○	□	X	●
Sludge pumps made of stainless steel					
Salvador Inox	○	X	□	X	●
Senior Inox	○	X	□	X	●
Sandy Inox	○	X	□	X	●
Slurry pumps					
Bravo 200	X	X	□	X	○
Bravo 300	X	X	□	X	○
Bravo 400	X	X	□	X	○
Bravo 500	X	X	□	X	○
Bravo 600	X	X	□	X	X
Bravo 700	X	X	□	X	X
Bravo 800	X	X	□	X	X
Bravo 900	X	X	□	X	X

Grindex Pump school

The school consists of technical articles, intended to help pump users with common matters in pumping with submersible pumps.

Part 1: Choosing the right pump type for the job

A drainage pump is the most commonly used pump type at construction sites. It is used for pumping water with less abrasive solids, like clay. Sand and solids in suspension can also be pumped, up to the size of the strainer holes (normally 0.3-0.5" / 7-12 mm). As sand is quite abrasive to the pump, it must not be too concentrated.



Sludge pumps are suitable for pumping water with solids, as well as for pumping sludge. The solids can be up to the size of the pump inlet diameter (normally 1.3-3.1" / 32-80 mm).



Pumps made of stainless steel are often used in copper mines, gold mines and other applications with corrosive fluids. An Aluminum pump can handle water with pH values from 5-8, while a stainless steel pump can cope with pH values from 2-10.



Slurry pumps are designed to handle abrasive solids in suspension, like sand, gravel and concrete, in high concentration. They are also frequently used to move sand in suspension, i.e. at a dredging operation. To cope with the abrasives, the hydraulic parts of a slurry pump are often made of a very hard metal alloy. For improved performance, big slurry pumps are equipped with an agitator.



Plug and pump

An electrical submersible pump is easy to use, just plug it in and pump. Several small pumps, placed where the need is for the moment, can pump the water to a dedicated collecting pit through long hoses. As the smaller pumps only weights 22-40 lbs (10-25 kg), you can carry the pump with you as the works moves to different spots at the site.

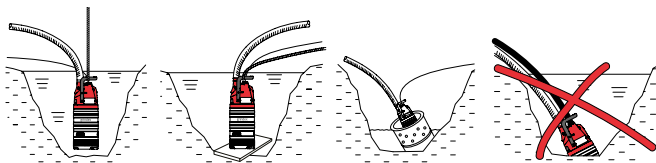


In the collection pit, a bigger pump is installed and pumps the water away from the site. By connecting hoses from several pumps to the pit, you can easily dewater a large area with just a few pumps.



Part 2: Pump arrangement

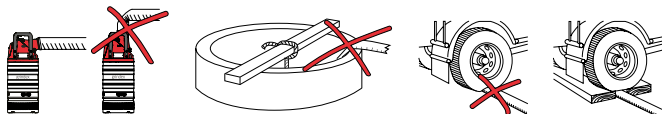
Despite the simplicity, there are a few details to consider for optimizing the pumping:



Arrange the pump so it doesn't burrow itself into sand or clay. This is a common problem at construction sites. It can be avoided quite simple by placing the pump on a bed of coarse gravel or a plank. The pump can also be hung freely by a rope or chain, or put into a cut-down and perforated oil drum.

Avoid sharp bend on the hose.

As sharp bends, kinks and pinching of the hose are reducing the capacity of the pump, a lot is won by avoiding those circumstances. Turning the pumps discharge connection so the hose doesn't begin with at kink is easily arranged; it can be fitted vertical or horizontal on almost all Grindex pumps.

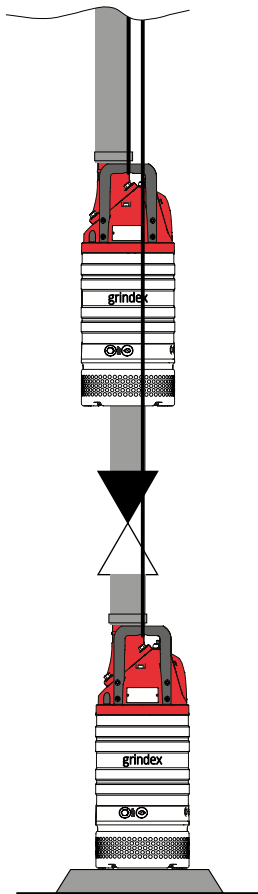


Tandem connection

In order to achieve higher pumping heads, two or more drainage pumps can be connected in series. For this purpose, a series connecting flange is available as an accessory. It is important that the hoses are equipped with check valves, preventing the pumps from suffering from wear when the water runs back from high heads uncontrolled if a power failure should occur.

Long distance pumping

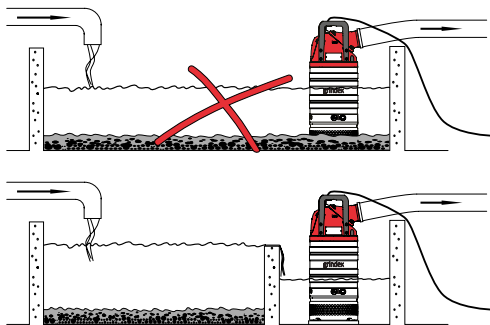
Tandem connection of pumps can also be used when the water needs to be pumped a longer distance. A simple arrangement can be pumping the water to a dedicated collection pit. The pit should be equipped with another pump, passing the water on. This technique can also be used for dewatering a greater area with several pumps spread out, pumping the water to a collection pit. The pit is then equipped with a greater pump, that pumps the water away from the site.



Part 3: Sedimentation

The pumped water is often containing solids that cause wear on pumps, valves and other dewatering equipment. This problem is very common in mines and tunnel construction sites. When pumping water that contains solids (like drill cuttings and sand), there is a risk of sedimentation in the system. A typical symptom is pipes and/or hoses that get filled with sediment, resulting in capacity losses. When the amount of solids increases, there is also an increase of wear on the pump.

One way to prevent this is by using sedimentation tanks where the drill cuttings may settle while the rest of the water is pumped away. The tank needs to be as close to the source as possible, ensuring that the solids are pumped as short distance as possible where the solids can settle in peace. To ensure the efficiency of the sedimentation tank, it needs to have as big surface area as possible. The more solids present in the water, the more careful the design of the sedimentation system is necessary.



For applications where solids can not be avoided, there are recommendations for the velocity of the medium in the discharge line:

Mixture	Min. velocity in discharge line
1. Water + coarse gravel	13.1ft/s (4 m/s)
2. Water + gravel	11.5 ft/s (3 m/s)
3. Water + sand	
Sand particles < 0.004 in (0.1 mm)	8.2 ft/s (1.5 m/s)
Sand particles < 0.024 in (0.6 mm)	4.9 ft/s (2.5 m/s)



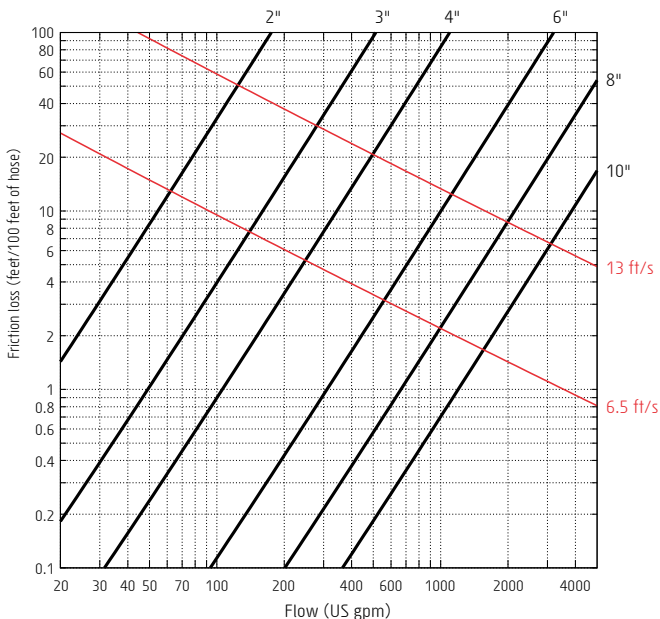
Limitations for Grindex pumps

Limitations	Drainage pumps	Sludge pumps
Max. submersion depth (IP68)	66 ft (20 m) Mini: 33 ft (10 m) Mega: 246 ft (75 m)	66 ft (20 m) Solid: 33 ft (10 m)
Max. liquid temperature	104°F (40°C)	104°F (40°C)
Max. liquid density	68 lbs/ft ³ (1100 kg/m ³)	68 lbs/ft ³ (1100 kg/m ³)
pH of the liquid	5-8 Mega: 6-13	5-8

Limitations	Stainless steel pumps	Slurry pumps
Max. submersion depth (IP68)	66 ft (20 m)	66 ft (20 m)
Max. liquid temperature	104°F (40°C)	104°F (40°C)
Max. liquid density	68 lbs/ft ³ (1100 kg/m ³)	68 lbs/ft ³ (1100 kg/m ³)
pH of the liquid	2-10	5.5-14

Chart for calculating friction losses in hoses

All pump capacities are measured for clean water, directly at the discharge outlet. When collection a hose you need to consider the friction losses that comes from the size and length of the hose. The chart below shows this.



Formulas calculating friction losses in hoses and tubes

The chart at page 57 was created using the following formulas:

Friction loss (meters)	Velocity (m/s)	Reynolds number	Friction factor (Swamee & Jain formula)
$H_{friction} = \frac{1000 \times f \times L \times v^2}{2 \times g \times D}$	$V = \frac{1274 \times Q}{D^2}$	$Re = \frac{v \times D}{1000 \times \mu}$	$f = \frac{0.25}{\left[10 \log \left(\frac{\epsilon}{3.7 \times D} + \frac{5.74}{Re^{0.9}} \right) \right]^2}$
f = friction factor L = length (m) v = avg. velocity g = 9.81 m/s ² D = pipe Ø (mm)	Q = flow (l/s) D = pipe Ø (mm)	v = velocity D = pipe Ø (mm) μ = viscosity = 1.161 × 10 ⁻⁶ m ² /s = 1 cSt	ε = roughness factor (mm) D = pipe Ø (mm) Re = Reynolds number

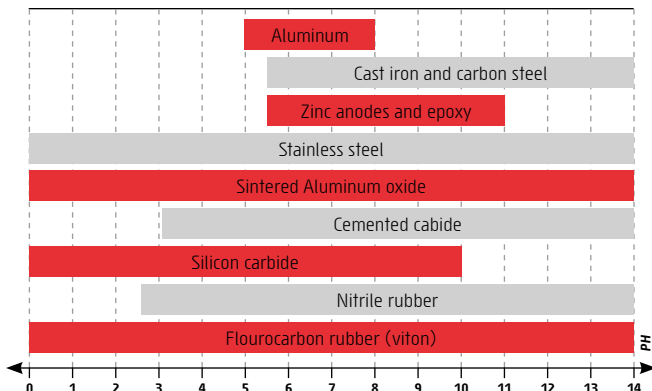
Friction factor

Material	Cast iron	Stainless	PVC	HDPE	Concrete	Hose
ε new (mm)	0.25	0.10	0.05	0.05	0.50	0.25
ε used (mm)	1.00	0.25	0.25	0.25	3.00	1.00

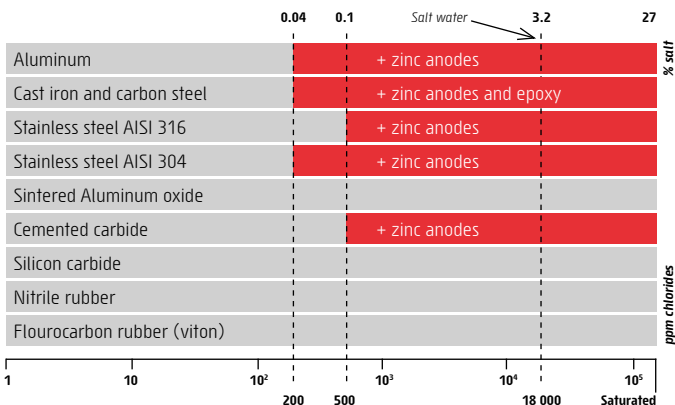
Sludge/slurry solids concentration

By volume (C _v)	By mass/weight (C _m)	Mixture
$C_v = \frac{V_{solids}}{V_{solids} + water}$	$C_m = \frac{m_{solids}}{m_{solids} + water}$	$\frac{SV_{mixture}}{SV_{solids}} = \frac{C_v}{C_m}$
V_{solids} = volume of solids V_{solids+water} = total sludge volume	m_{solids} = mass of solids m_{solids+water} = total sludge mass	SV = Specific weight

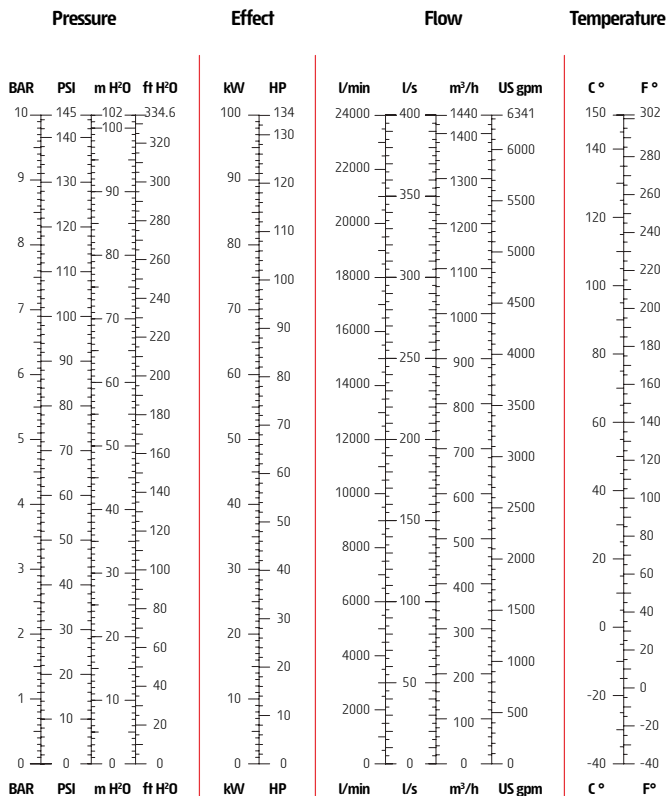
pH tables



Salt tables



Translation charts



Recommended generator sizes

Voltages 3-ph 460 V, 60 Hz

Pump model	Max. power consumption	Rated current	Permissible cable length	Delayed fuse	Generator set
Minex	2.4 HP/1.8 kW	2.6 A	980 ft	10 A	5 kVA
Minette	4.2 HP/3.1 kW	4.7 A	650 ft	10 A	8 kVA
Minor N H	6.8 HP/5.1 kW	7.3 A	490 ft	20 A	15 kVA
Major N H	10.3 HP/7.7 kW	11.0 A	490 ft	20 A	20 kVA
Master SH	16.0 HP/12.0 kW	16.0 A	360 ft	25 A	30 kVA
Master N H	17.5 HP/12.8 kW	18.0 A	490 ft	30 A	35*/40 kVA
Matador N H	30.0 HP/22.0 kW	31.0 A	290 ft	50 A	60*/70 kVA
Maxi N H	64.3 HP/48.0 kW	65.0 A	360 ft	100 A	120*/150 kVA
Maxi L	56.3 HP/42.0 kW	64.0 A	390 ft	100 A	110*/130 kVA
Magnum	98.0 HP/73.0 kW	107 A	360 ft	125 A	200*/250 kVA
Mega	147 HP/110 kW	148 A	520 ft	170 A	275*/350 kVA
Minette Inox	3.9 HP/2.9 kW	4.2 A	820 ft	10 A	8 kVA
Major Inox	10.1 HP/7.6 kW	11 A	490 ft	20 A	20 kVA
Master Inox	14.7 HP/11.0 kW	15 A	590 ft	20 A	30 kVA

Salvador	4.1 HP/3.1 kW	4.7 A	980 ft	10 A	8 kVA
Senior	7.64 HP/5.7 kW	8.6 A	650 ft	20 A	15 kVA
Sandy	10.3 HP/7.7 kW	11.0 A	490 ft	20 A	20 kVA
Salvador Inox	3.8 HP/2.9 kW	4.2 A	820 ft	10 A	8 kVA
Senior Inox	8.2 HP/6.1 kW	9.0 A	650 ft	20 A	16 kVA
Sandy Inox	10.2 HP/7.6 kW	11 A	490 ft	20 A	20 kVA

*Y/D start

Voltages 1-ph 230 V, 60 Hz

Pump model	Max. power consumption	Rated current	Permissible cable length	Delayed fuse	Generator set
Mini	1.47 HP/1.1 kW	4.8 A	160 ft	10 A	4 kVA
Minex Lite	1.74 HP/1.3 kW	5.6 A	230 ft	10 A	4 kVA
Minex	2.4 HP/1.8 kW	8.2 A	160 ft	20 A	5 kVA
Minette	2.95 HP/2.2 kW	9.9 A	230 ft	20 A	6 kVA

Solid	1.47 HP/1.1 kW	4.8 A	160 ft	10 A	4 kVA
Salvador	2.95 HP/2.2 kW	9.9 A	230 ft	20 A	6 kVA

Note

- In general, delayed fuse shall be dimensioned by rated current x 1.75
- The above given kVA values are meant as guidelines to simplify the choice of generator size.

Regarding size of generator set, each different type has different characteristic; therefore it is always recommended to consult the manufacturer of generator to find out if the actual generator is capable of operating the pump.

Make sure that the cable is sized to allow a voltage drop of max. 5% of the nominal voltage.

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[illegible]

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