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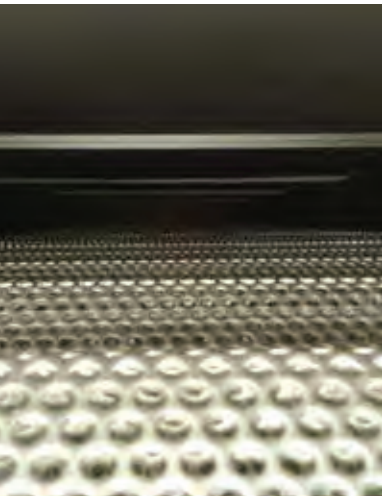
PARS ADVANCED TREATMENT

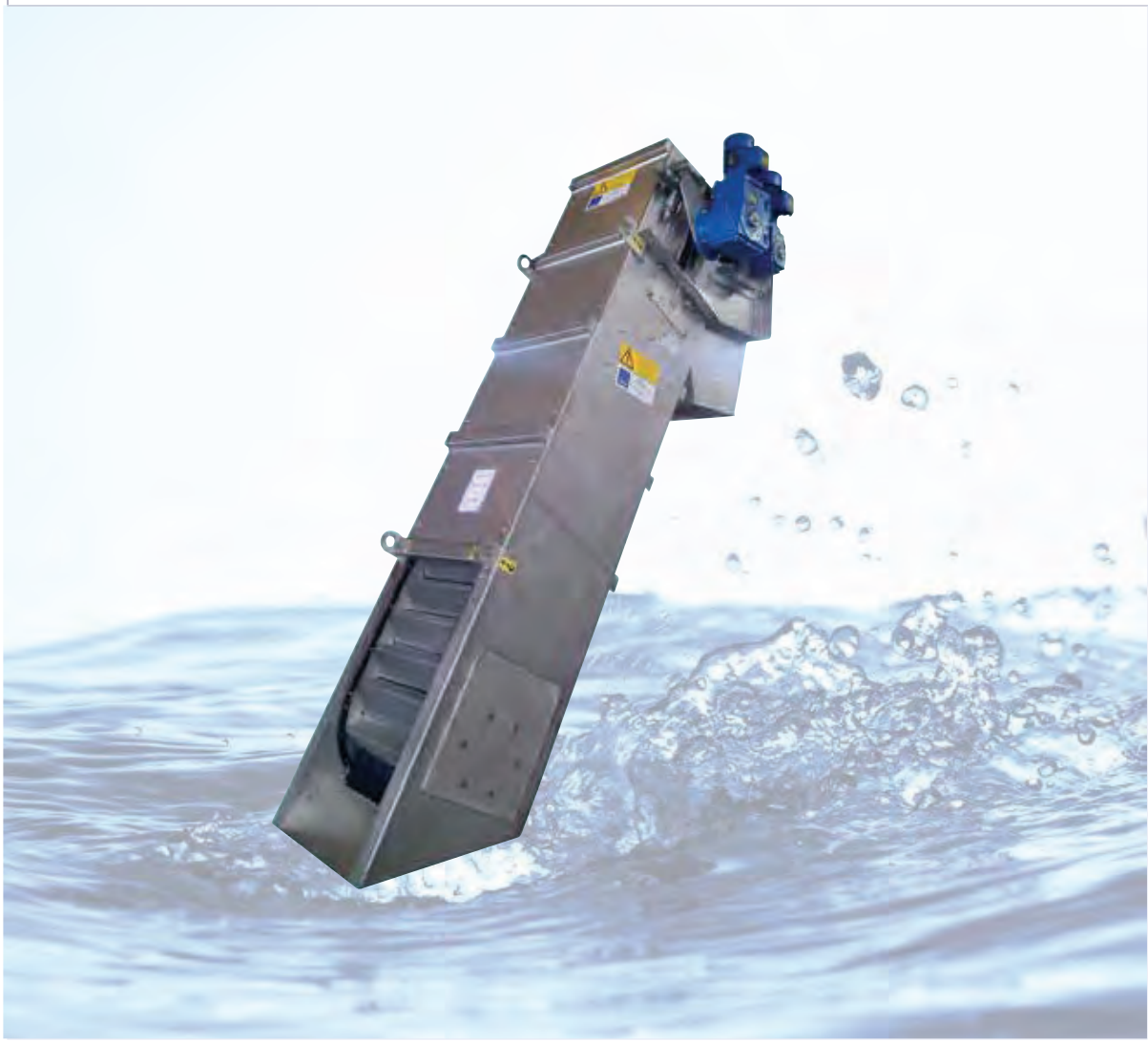
EPC Contractor of Environmental Projects

WASTE WATER TREATMENT

Fine Belt Screens

PATEC





Fine Belt Screens
PATEC

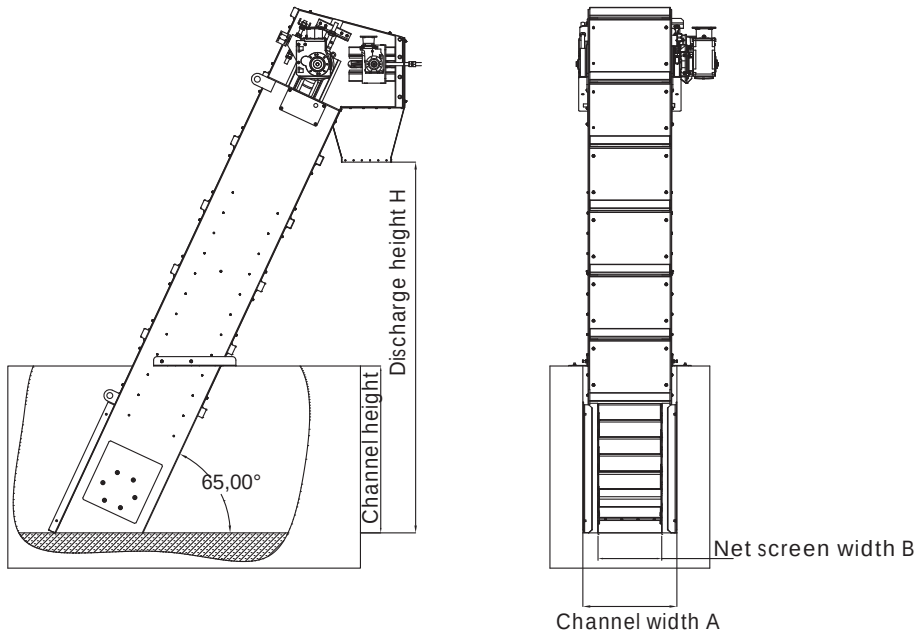
THE BEST CHOICE FOR IN-CHANNEL FINE SCREENING

PARS TREATMENT Fine Belt Screens are used for fine screening of waste water. They are designed for in-channel installation. They consist of a set of filtering steps manufactured from perforated plate media which are moved by two chains equipped with chain stretcher, as well as anti-friction and anti-noise sliding blocks.

Solids screened from waste water are conveyed by the filtering belt to the outlet on top of the screen. The arrangement of the filter elements forms a “step belt” which ensures that screenings are picked up and easily removed. The screen is equipped with a chute in front of the filtering belt to avoid clogging.

A double cleaning system composed of a motorised roller brush equipped with synthetic bristles and of a washing bar cleans the filter elements. The chains are moved by sprockets fitted on a drive shaft that is connected to the gear reducer. The latter has to be equipped with a torque limit switch.

Overall Dimensions



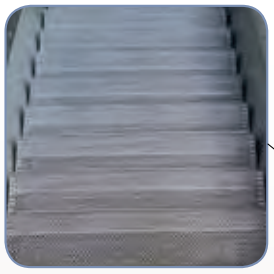
MODEL	CHANNEL WIDTH A mm	NET SCREEN WIDTH B mm	DISCHARGE HEIGHT FROM CHANNEL BOTTOM H mm	OPENING SIZES mm	CHAIN POWER kW	BRUSH POWER kW
VFR 750	750	500	customer's requirement	3 - 5 - 7	0.75	0.55
VFR 1000	1,000	750	customer's requirement	3 - 5 - 7	1.1	0.55
VFR 1250	1,250	1,000	customer's requirement	3 - 5 - 7	1.1	0.55
VFR 1500	1,500	1,250	customer's requirement	3 - 5 - 7	1.5	0.55
VFR 1750	1,750	1,500	customer's requirement	3 - 5 - 7	1.5	0.55
VFR 2250	2,250	2,000	customer's requirement	3 - 5 - 7	1.5	0.55

Benefits

- ✓ **Reduced service requirements (no need to take the screen out of the channel)**
- ✓ **Special design of filtering elements for easy maintenance and replacement;**
- ✓ **High capture efficiency of solids.**

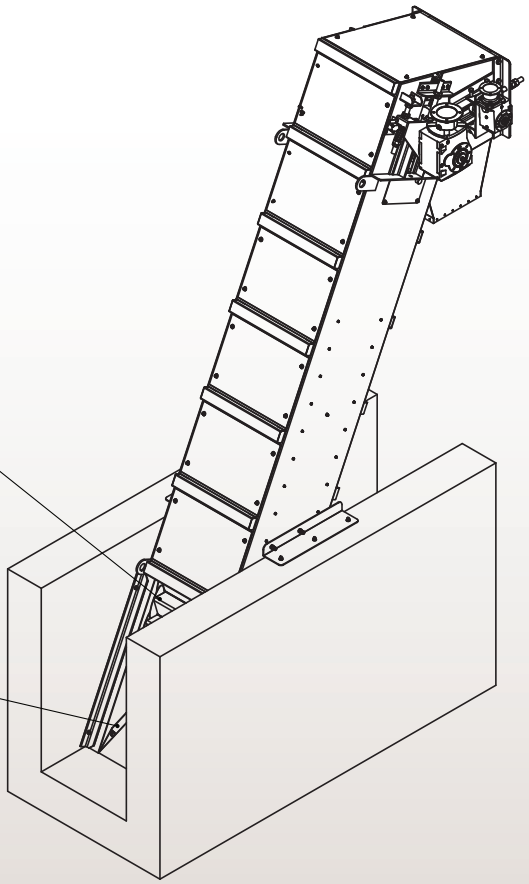
Technical Features

- 6 up to 2,000 mm wide sizes available
- 65 degree incline angle
- Perforated media openings from 3 to 7 mm
- Chain drive recessed into the side rails
- Double cleaning system
- Material: hot dip galvanised steel, 304 L / 316 L SS



Filtering Panel

Sealing System



Accessories

- Control panel (optional)

Screens PATEC

grab type bar screen GSR

The screen unit is consisting of 2 pce. of heavy duty guide frames made of folded plates and furnished with guide strips made of UHMW-PE.

Drive motion is transmitted by means of primary drive to the guide roller chains. The guide chains are covered into wear guide strips.

All drive chain and sprockets above max. water level.

The screen rake is made of machined and folded stainless steel plate. It is connected to the drive frame by two spring loaded eccentric cranks.

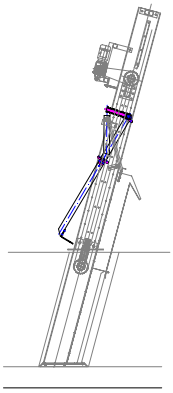
Due to this the screen unit it protected against overload caused by screenings with ab-normal size.

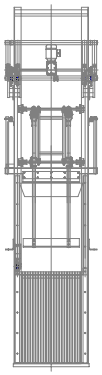
The screen bar assembling is bolted to both guide frames. Discharge of screenings took place via a stainless steel apron.

material specification

frame and rack:	steel w/ coating
screen, rake & chute :	stainless steel
castors :	polyamide
wiper :	UHMW-PE
drive units :	according to manufacturer standard

Others specifications are available on request.



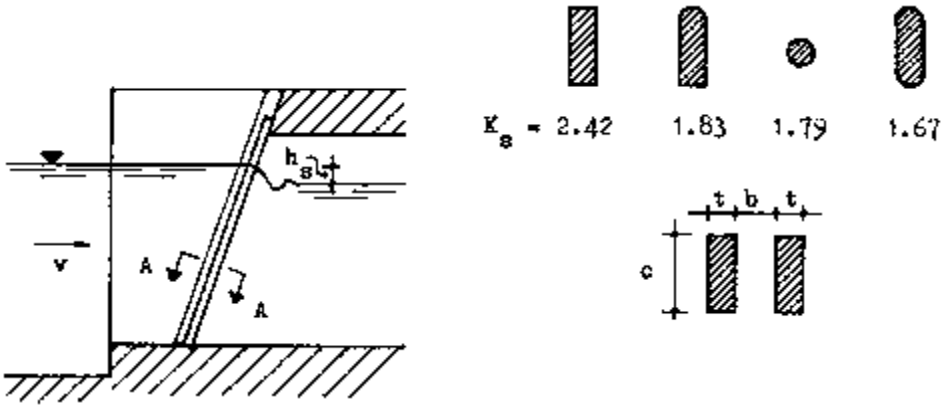


- Current plant flows – future plant flows
- Required screenings capture rate or required bar spacing (does the plant process require a certain capture rate, E.g. MBR plants)
- Headloss across the screen
- Screenings handling, processing and disposal
- Existing or new construction – available space
- Relationship between daily average flow and peak flow
- Wastewater characteristics (grit, gravel, branches, leaves, FOG content, tools and sheets -> prisons)
- Construction, capital cost vs. Life-cycle cost
- Outdoor or indoor installation
- Controls

Typically, at least two mechanical screens should be installed so that one unit can be taken out for service or maintenance. If only one unit is to be installed a manual bar rake must be installed to provide an emergency bypass. One slide gate shall be installed prior and one after the screen. Please take care to allow enough space for the pivoting, if the screen system comes with such a feature.

Headloss of fine screens: An important figure in the design of a screenings system and the design of a WWTP is the headloss associated with a screen. Most screen manufacturer use one or another form of the Kirschmer formula for calculating the headloss of a fine screen.

Head loss in screens, values of screen loss coefficient K_s for various bar shapes (Mosonyi, 1963)



Kirschmer's formula

$$h_s = K_s \left(\frac{t}{b}\right)^{\frac{4}{3}} \frac{v^2}{2g} \sin\alpha$$

where

h_s = loss of head, m
K_s = screen loss coefficient
t = thickness of bars, m
b = clear spacing between bars, m
v = velocity of approach, m/sec
a = angle of bar inclination, degree

Figure 6- Step Screen at Reno Stead, NV

Figure 7- Step Screen at Gardner, KS

Figure 8- Deep Channel SSV at Rhinelander, WI (Replacing a grinder)

Figure 9- 2xSSV at Morris, IL

Figure 10 - SSV + Vacuum Conveyance System at North Davis, UT

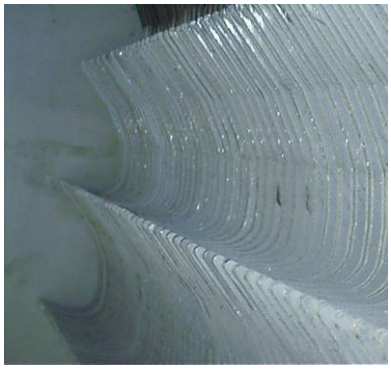


Figure 11- SSV lamellae shape

The Step Screen has the highest hydraulic capacity of any fine screen due to its larger open surface area when compared to any other Fine Screen technology. Step Screens are available with either 3mm or 2mm thick movable and 3mm or 2mm fixed lamellas. For the 2mm option, the open surface area for a clean screen is 75% (3mm thick lamellas = 60%). For 6 mm bar spacing the open area is 60% (3mm thick lamellas = 50%). That makes the step screen an excellent choice for applications where hydraulic constraints are of major concern. Compared to other fine screens, the step screens require a smaller surface area in the channel due to its high hydraulic capacity. As a result civil engineering costs can be minimized. Step Screens works well for plant expansions replacing coarse screens. Depending on length and location, many Step Screens can be designed to pivot out for easy maintenance. Many step screen designs feature a sprocket and chain drive system, which requires regular maintenance while Huber's step screen has a fixed

linkage system without any sprockets or chains. No maintenance is necessary except the replacement of the linkage bushings which typically last around three years.

Traditionally, step screens are installed between 45 and 53°. Step Screen with rectangular shaped lamellas (Figure 5) should not be installed at steeper angles due to the danger of screenings roll backs. Huber manufactures a special version of the step screen, the Step Screen Vertical or SSV, which can be used for deep channel applications of up to 22ft. The specially designed lamellae allow the screen to be installed of up to 75°, thus achieving high discharge heights (Figure 9).

The step screen should not be used for applications with heavy gravel loads without design modifications to the channel or to the screen. If heavy gravel loads are present, rock traps prior to the screen can be installed. Huber has a screen design which features an automatic flush bar at the bottom of the screen. This flush bar flushes grit and gravel away from the danger zone underneath the screen towards the grit trap. In order to take full advantage of this feature the screen should be installed at a recess. A mechanically operated “grit flap” door is not a proper substitution for this design of an automatic bottom flush system.

It is also important to note the proper operation of a Step Screen. Step Screens should be operated on a pressure differential (headloss) between upstream and downstream of the screen. One upstream and one downstream ultrasonic monitor should be installed to control the operation of the screen. A mat or screenings carpet must be formed on the surface of the screen. The thickness of the mat can easily be adjusted by having the screen step more or less often. The proper operation of the screen minimizes the daily operating time of the unit, thus reducing energy cost. Reports from a study in Ashland, Wisconsin, shows that the average daily operating time for a Huber Step Screen is only 8min/day measured over a period of 2 years. The minimal running time significantly reduces wear and tear on the screen and also reduces energy cost. With a properly operating mat, the capture rate of a step screen also increases to about 55% for 1/8” bar spacing which should be sufficient for all WWTP processes except MBR plants.


Figure 12, 13 – Proper screenings mat for a Step Screen

D


Figure 14 – SSV for cooling water intake


Figure 15 – Tank mounted Step screens

Advantages	Disadvantages
High hydraulic capacity	Average screening capture rate
Self cleaning, no wash water or brush required	Limited to 6 ½ ft channel width
Low maintenance, no lubrication necessary	
Energy efficient – One motor only	
Pivoting possible	
Enclosed design	
Well proven – Thousands of installations worldwide	

- Available widths: 18” to 6.5 ft with max. flows of up to 60 MGD per unit
- Available bar spacing: 0.04” (1mm), 1/8” (3mm) and ¼” (6mm)
- Can be installed in tanks

MULTI-RAKE SCREEN


RakeMax® Multi-Rake Screen

This screen is a mechanically cleaned bar screen. The screen consists of a stationary bar rack and multiple rakes mounted on the chain. The rakes clean the bar rakes from the front side of the screen. The RAKEMAX screen has the highest screenings removal rate of any fine screen. This is especially important for deep channels and combined sewers which can see significant variations in the screenings amount to be handled. Multi-bar rake screens are equipped with a two speed motor or a VFD, which allows for the chain drive motor to speed up to increase the screenings removal rate. Additional rakes can also be mounted onto the chain, further increasing the screenings removal capacity. Multi-Bar screens are used mostly in applications were previously Climber-Type screens have been used. They combine the benefits of climber screens (wide, deep channels, rugged) with the benefits of fine screens (finer bar spacing thus higher screenings capture rates, fast screenings removal, lower headroom required for installation). Climber-type screens might be overwhelmed with the screenings amount generated under peak flow conditions during the first hour, especially when mounted in deep channels.

Some Multi-Bar screens do not use a lower sprocket and bearing on the lower turnaround point. This is a questionable engineering practice. With such designs, a guiding ledge (wear ledge) is used to drag the chain around the lower turnaround point. This creates significant wear on the guiding ledge and of course also on the chain rollers. If the guiding rail is not maintained properly (replacing the wear pieces on a regular basis), the chain and the perforated panels will have to be replaced prematurely, at considerable costs to the owner. More advanced designs will use an upper AND lower turnaround sprocket. That will ensure a constant chain tension across the length of the chain and a very precise guidance of the chain and thus a precise alignment of rakes within the bar rack. This is very important for smaller bar spacing (1/2" and less). The lower bearings are fully enclosed and do not need to be lubricated for the Huber design.

The installation angle of the Multi-Bar Screen should be kept between 70° and 75°. This allows for larger screenings debris to be properly conveyed up the front of the screen. This is especially important for screens installed in deep channels.

Advantages	**Disadvantages**
High hydraulic capacity	Lower screening capture rate
Self cleaning, no wash water or brush required	
Low maintenance, no lubrication necessary	
Energy efficient – One motor only	
Pivoting possible for smaller sizes	
Available for channels up to 13ft wide and 60 ft deep	
Low profile above channel floor	
High screenings loads	
Extremely sturdy	

- Available widths: 2ft to 13 ft with max. flows in excess of 100 MGD per unit
- Available bar spacing: 3/16" (5mm) to 6" (150mm)

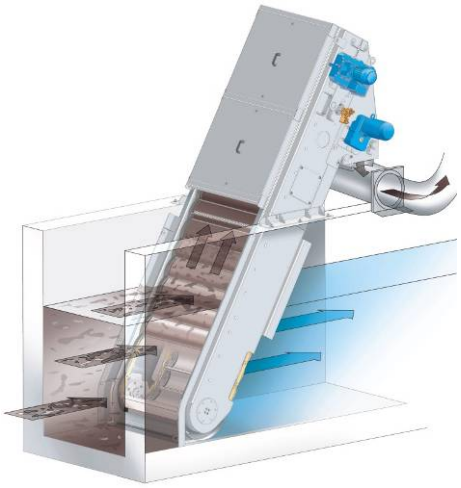


Figure 20 – EscaMax® Perforated band screen

Figure 21 – Perforated band screen (covers removed)

Figure 22 – Between panels

Figure 23 – Lifting fingers

Advantages	**Disadvantages**
High screenings capture rate	Wash water and brush required for cleaning
High screenings removal rate	High headloss through the screen
Pivoting possible for smaller sizes	Screenings carry-over
Low profile above channel floor	Higher operational and maintenance cost
Suitable for grit and gravel	

b) The center fed band screen: The waste water enters the screen through the center of the screen and exits it on the side. Although, this type of band screen can handle higher flow rates than a double pass screen due to its larger screening area, the disadvantage of this installation is that channel needs to be widened in the area where the screen has to be installed (Figure 23). Just like for a Rotary Drum Screen the advantage of this screen is that screenings carryover is eliminated thus making this screen suitable for MBR plants.

SCREENINGS WASHING AND COMPACTION

1. Screenings Amount

Figuring out the screenings amount by calculating it is quite complex. Fortunately, choosing the proper screenings washing/compacting equipment is much easier when using the following guidelines:
General:

- Consult with operators: Owners/operators often have a very good idea of the screenings amount in their plant
- Differentiate between locations: Different locations will have different requirements. For example, combined sewers in locations with long periods of rain will see the most amounts of screenings during the first storm event.
- Sewer and collection systems: The screenings amount in these systems will be significantly higher than those of a separate system. Our European colleagues have observed a screenings amount peaking factor of 3 to 4 for combined systems when compared with separate systems. Separate sewer systems with constant periods of rains will see the fewest screenings. Therefore the most challenging applications in the US are big plants in the Mid-West and the Northwest where dry summers are typically followed by large rain events in the Fall.
- Consider the type of screen: Coarse and rake bar screen require larger screenings washing equipment due to the fact that these screens can deposit huge quantities of screenings within a very short time period. These technologies also require a more rugged piece of equipment accepting larger debris.

Specific:

- Bar spacing and screenings media: Associated with the finer bar spacing have higher screening capture rates. Furthermore the SCR depends on the screenings media (bar, step, wedge wire, perforated plate, and woven mesh). For example, screens which utilize a 1/8" perforated band have a screenings capture rate of up to 92%. A significant amount of organic matter will be removed together with the inorganic matter. That not only creates significant more disposable screenings, it also "robs" the plant of food by removing the organic matter as well. It is essential to return as much of the organic matter back into the treatment process. Properly washed screenings are easier to dewater, thus the volume and weight reduction is optimized. That not only creates a safer work environment by having reduced odors, it also creates savings in the form of reduced disposal costs.
- FOG (Fat, Oil, and Grease): If heavy FOG amounts are present, a hot water connection should be added to the screenings washer/compacting equipment, to keep the drainage slots or perforations of the screenings washing equipment unclogged. This particularly is recommended for slots, especially for those smaller than 1/5" (5mm).

Screenings amount for various types of screens:

Opening size, mm	**Screening capture rate (SCR) in %**	**Moisture content, %**	**Specific weight, kg/m3**	**ft³/Mgal**	
				Range	**Typical**
25 (bar screen)	15-25	50-80	600-1000	2-5	3
12.5 (bar screen)	20-30	60-90	700-1100	5-10	7
6 (bar screen)	30-40	80-90	900-1100	7-20	13
6 (perf. plate)	70-81	80-90	900-1100	10-28	22
3 (perf. Plate)	80-93	80-90	900-1100	12-35	27
Membrane Screen					
0.5 (woven mesh)*		85-90	1000-1100	40-60	55

* preceded by a 3mm fine screen, followed by grit removal
Data: ATV-DVWK, Metcalf and Eddy, Wastewater Engineering, UKWIR

Criterias For Screen Selection

Considerations:			Structural			Hydraulics			Wastewater		
	Deep channel	Low headroom	Outdoor inst.	No service water	Capture rate	High water level	Screenings load	Grit, rocks, gravel	Grease	Septic sludge
Ro1	☹	☺	☺	😐	😐	☹	☺	😐	☺	☺
Ro2	☹	☺	☺	☹	☺	☹	☺	☺	😐	☹
Ro9	☹	☺	☺	😐	☺	☹	☹	☹	☹	☹
Ro9 XL	☹	☺	☺	😐	☺	☺	☺	☹	☹	☹
RPPS	☹	☺	☺	☹	☺	☹	☺	☺	😐	☹
RoMem	☹	☺	☺	☹	☺	☹	☺	😐	☹	☹
RoMesh	/	☺	☺	☺	☺	/	☺	😐	😐	☹
SSF	☹	☺	☹	☹	☺	☺	☺	☹	☹	☹
SSV	☺	☺	☹	☹	☺	☺	☺	☹	☹	☹
ClimbMax	☺	☹	☹	☺	☹	😐	😐	☺	☺	☺
EscaMax	☺	☺	☹	☹	☺	☺	☺	😐	☹	☺
RakeMax	☺	☺	☹	☺	😐	☺	☺	☺	☺	☺