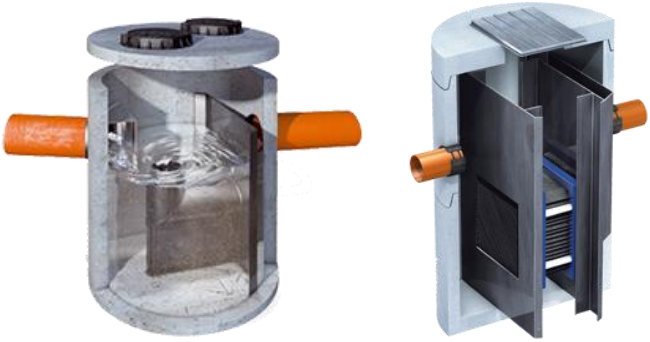
OPERATION AND MAINTENANCE MANUAL



SETTLING TANKS

SEPARATORS

Gdańsk, March 2015

www.ecol-unicon.com

LIST OF CONTENT

1. Basic safety requirements

The term "employee" it should be understood as employees and persons employed in the work as presented below regardless of the type and method of work.

1.1 Loading, unloading, storage

Transportation, loading, unloading and storage should be carried out using suitable equipment and with the participation of trained staff with appropriate qualifications.

- Participants of this process should have completed a slinger signaller course and a briefing carried out at the workplace including the assessment of occupational risks. Participants should be equipped with personal protective equipment such as helmet, gloves, glasses, footwear.
- The above mentioned activities should be carried out using suitable lifting devices (in accordance with the instructions provided in Section 1.3).
- Transport by means of lifting devices should be such that the height of the bottom part of the transported element should be carried of at most 0.5 m above the terrain level.
- The area in which loading and unloading of precast takes place should be fenced off in order to hinder the access of outsiders (signs and warning tape).

1.2 Trench preparation and well assembly

- Trench prepared for well installation should be done in accordance with the construction project and safety regulations.
- Before lowering well elements the technical condition of slings, transport handles and anchor should be check whether their technical condition meets the requirements of safe work (wear, cracks, looseness).
- The trench should be adequately secured (depending on depth) by side walls formwork, suitable struts or edges of the escarpment sloped properly so that there is no possibility of spontaneous backfilling of the trench. In addition, the trench must be equipped with the ladder.

- Drainage of the trench should be undertaken before placing the tank elements.
- The area around the trench should be adequately protected from falling bystanders (signs and warning tape).
- Prior to lowering into the trench the precast must be prepared in accordance with the **precast concrete installation instructions**. Possibly all preparatory activities should be carried out next to the trench and not inside it.
- Precast is lowered to the place of its foundation. Then after preparing the next element it should be lowered on the already placed element so that a minimum height required for its proper setting is maintained.
- An employee who is responsible for the proper connection of precast before entering the trench should be equipped with a harness and safety line.
- If possible: stabilize (precise embedding) of precast in the trench should be done outside the trench through additional ropes.

It is categorically forbidden to enter the trench and into the well in order to prepare it for installation when lowering the next element.

- Prior to the work related to the installation, familiarize yourself with the specification sheet of the materials used cards during this installation.

1.3 Safety instruction for a safe work by assembly tasks with a lifting device

1. General information

- Staff member operating any lifting device must have an appropriate qualification certificate.
- Lifting device must be operated in accordance with the manufacturer's technical manual and its instruction must be known and respected by the employee-operator.
- Lifting device manual must be in the operator's cab.
- Lifting device must be technically efficient. It is forbidden to run the lifting device damaged.

- The employee operating the lifting device must have a permission (even if verbal only) of his superior.

2. It is forbidden to:

- Move cargo using slings, ropes, etc. with an indefinite permissible load, as well as with other means in any way damaged, pieced, twisted.
- **Stay under suspended loads.**
- **Move loads over workplaces or over people.**
- Lift objects from the ground that are not directly (in a vertical line) under the hook of the lifting device.
- Move loads of unknown weight.
- Lift loads weighing more than the capacity of the lifting device.
- **Approach the lowering weight to the distance less than 5 m.**

3. Recommendations

- The staff member operating the lifting device is obliged to warn others about its planned motion and is responsible for ensuring that the loads cannot be moved over other people.

- The staff member operating the lifting device is obliged to carry the helmet, gloves, shoes with steel toes and high visibility vest.
- Employees participating in the process of setting the moving weight controls it using ropes previously connected to the weight (object) to be moved.
- During this operation, it is forbidden to approach the moving weight at a distance closer than indicated by the foreman, but not less than 4 m. If the foreman did not specify a safe distance as above - the work cannot be done. Distance mentioned above is assumed as the horizontal distance between the employee and the closer edge of the weight (in elevation view).
- Direct approach to the burden for its precise setting can take place only after the weight is lowered to a height of not more than 20 cm in relation to the preset level or the surface on which it is set.
- When setting the weight at the point of destination take extra precautions.
- Lifting device operators and cooperating staff must have the knowledge of relevant safety signals. Confirmation of such knowledge is a completed relevant training or a statement of the head of the employees with the names to which the statement relates.

4. Tasks before getting started

Before starting work, make sure that:

- The lifting device is technically efficient,
- Lifting device start-up does not cause threat to others,
- hook, slings and other accessories do not indicate any damage,
- ropes which holds the suspended weight are not combined, lengthen, do not have knots and twists,
- on weight sharp edges weight suitable pads are imposed for protection of ropes and chains,
- moved object is suspended in an correct way and giving full safety guarantee,
- no employees are on the transmission path of the weight,

• object transferred does not exceed the capacity of the lifting device or sling load capacity,

• employees positioning the lowering weight set up cables of proper length to drive it,

• hook of the lifting device is placed in a vertical position above the weight to be lifted.

5. Actions during work

- **Setting the transferred weight over its foundation location must be carried out using ropes of length confirmed by the site manager.**
- Manual setting of the transferred weight may begin when the distance between it and the plane of the foundation or the edge of another element is not greater than 20 cm.
- Before final lowering of the weight below 20 cm make sure that no hands or feet will be accidentally crushed.

• weights moved horizontally should be raised at least 50 cm above objects encountered on the way.
• it is forbidden to lift weights from the ground at an inclined position of the lifting device rope.
• When operating the lifting device should be used hand signals compliant with current regulations.
• Follow the instructions indicated by the technical manual and this safety instruction.
• When staying at the heights the worker must be protected against falls from height in accordance with safety regulations. Personal protection must be used as specified by the manufacturer.

6. Actions after work

- Secure the work place in accordance with applicable safety regulations so as to prevent occurrence of an accident.
- Report abnormities noticed during work to direct superior.

In case of an failure or other unforeseen circumstances which may result in loss of life or health work task must be stopped and problem reported to the superior, who decides how to proceed. Raised load should be abandoned and based on the ground.

2. Device intended use

Settling tank is designed for removal of mineral suspension from storm water or process water. Mineral suspension and suspended solids are trapped inside the settling tank due to the sedimentation process. In vortex settling tanks, the centrifugal force aids the efficiency of purification.

Vortex settling tank EOW-2

The settling tank may come with a trapped outlet - it serves an additional function of gravitational separation of oil.

Oil separator is designed to remove oil of density 0.85–0.95 g/cm³ from storm and process waters. Removal of oil takes place due to gravitational separation of oil from water, as well as coalescence effects, aided by specially directed water flow through the device.
In order to limit the possibility of oil separator damage by mineral suspension in the inflowing waste water, the device should be coupled with a settling tank.

Grease separator is designed for treatment of waste water containing fats and oils of vegetable and animal origin present in higher amounts than in case of normal domestic waste water. Oils and fats are removed by gravitational separation and flotation processes.
Grease separator that is fed by waste water containing large easy settling digested solids should be preceded by a straining device (e.g. a sieve), and cooperate with a settling tank.

3. Construction

Device includes a tank made of concrete, reinforced concrete and/or PE elements. Technology set is made of stainless steel, aluminium or plastic and/or PE elements, fastened by means of sleeve anchor bolts made of stainless steel or galvanised iron.

Depending on type, devices are delivered as monolithic tanks or separate elements to be assembled on site. Depending on the depth of the feed stream sewer, superstructure rings may be applied.

4. Transport, loading and unloading

Transport, loading and unloading should be carried out according to the guidelines in accordance with the **precast concrete installation instructions**.

5. Storage

Devices may be stored on open space, in the same position as assembled on site. Well tank should be protected against water freezing inside.

Weather conditions are not detrimental to devices' elements, except for technology sets made of plastic (lamella sections, inner weirs) and separator

coalescence foam, which are to be stored in an area unexposed to sunlight and exposed to direct influence of weather conditions (e.g. rain and snow).

6. Assembly

Preparation of the foundation trench, the method of tank assembly, connection of piping and trench backfilling are to be carried out according to the manual found in the **precast concrete installation instructions.**

Assembly of technology set – according to guidelines described in section 9. In some devices part or complete set of fittings can be assembled in the manufacturing plant and so delivered on site.

During assembly works, caution should be exercised and Occupational Health and Safety Regulations should be observed.

When placing the device in the trench, proper direction of inlet and outlet location in terms of waste line direction should be ensured.

7. Designation

Devices possess outer markings indicating device's name and type (Fig.1.1). Inlet and outlet are properly marked. Additionally, devices are provided with a data plate (Fig 1.2), fixed inside the tank above the water surface, containing information, e.g. about:

Fig. 1.2 Sample separator name plate

Producent / Producer:
ecol-unicon
Ecol-Unicon Sp. z o.o.
ul. Równa 2, 80-067 Gdańsk, Poland

Urządzenie / Device:
Osadnik OS / Sediment trap OS
Typ / Type:
OS .....

Aprobata Techniczna IOŚ nr /
Technical Approval IOŚ:
AT/2009-08-0231/A1

Dopuszczalne obciążenie/Maximum load:
..... [kN]

Pojemność osadnika /
Volume of sediment trap:
..... [m³]

Nr seryjny / Serial number:
.....

Rok budowy /
Year of production: 20.....

Fig. 1.1 Outer marking

- device type,
- producer's name,
- operating capacities,
- year of production.

8. Start-up

Prior to device start-up, the following is to be carried out:

- any solid wastes, garbage, debris or other items inside the tank, that are washed into sewers from the building site, should be removed,

- fill the device with clean water till water overflows the outlet,

- install the remaining accessory components (e.g. lamella sections, float, coalescence insert, etc.).

The producer cannot be held liable for any damages arising from negligence of cleaning the device and inlet and outlet pipes prior to device start-up.

9. Technical-maintenance parameters and accessory components assembly

9.1 Settling tanks

9.1.1 OS settling tank consists of a tank equipped with a baffle, which is installed inside the tank on device's inlet.

OS settling tank

Assembly

1. Assemble the precast elements without the cover slab.

2. Pump out water from the bottom slab and thoroughly clean interior of the tank (if necessary).

3. Assemble the accessory components, including:

a) Directional baffle - should be installed in axis of the inlet pipe. The baffle is fixed to tank wall by M8x95 sleeve anchor bolts (e.g. PSR, Throughbolt or equivalent).

b) Weir on outlet (in a trapped outlet version) should be positioned in such a way that weir's top edge is located over the top edge of the pipe. It is fixed to tank wall by M8x95 sleeve anchor bolts (e.g. PSR, Throughbolt or equivalent).

4. Once the superstructure rings are assembled and sealing works finished, a reinforced concrete cover slab is placed on the last ring on a layer of mortar. The slab should be installed in such a way that the maintenance opening is near the inlet to the settling tank.

5. A manhole shall be installed over each slab opening.

9.1.2 Single chamber vortex settling tanks consist of a tank equipped with a directional baffle assembler inside on the device inlet, orifice and outlet socket.

Assembly

1. Assemble the precast elements without the cover slab.

2. Pump out water from the bottom slab and thoroughly clean interior of the tank (if necessary).

3. Assemble the accessory components:

EOW1 single chamber settling tank

a) Directional baffle - should be installed in axis of the inlet pipe so that the feed sewage is directed tangentially to the tank

wall generating rotary motion. The baffle is fixed to tank wall by M8x95 sleeve anchor bolts (e.g. PSR, Throughbolt or equivalent).

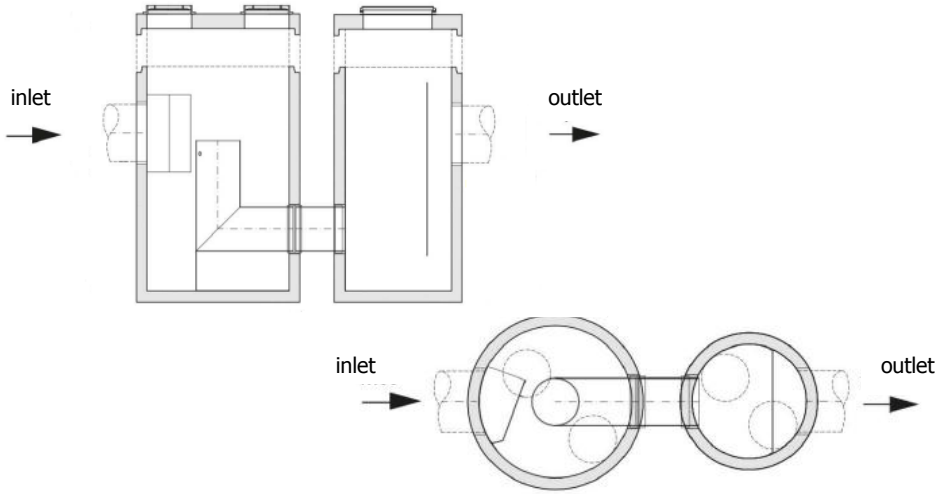
b) Overflow elbow with orifice.

- Before installation of the weirs self-adhesive gaskets (provided with the unit) are glued to its cleaned and dried edges. Gaskets are placed on all weir-tank wall connection edges.
- Place the weir inside second tank (by means of a lifting device). Weir is fixed to tank wall and orifice base by M6x85 sleeve anchor bolts (e.g. PSR, Throughbolt or equivalent) + M6 washer.

4. Once the superstructure rings are assembled and sealing works finished, a reinforced concrete cover slab is placed on the last ring on a layer of mortar. The slab should be installed in such a way that the maintenance opening is near the inlet to the settling tank.

5. A manhole shall be installed over each slab opening.

9.1.3 Double chamber vortex settling tanks include of two tanks. The first tank contains tangential inlet pipe or directional baffle and orifice made from a tee or a 90° elbow, whilst the second tank - a weir and outlet socket.



Assembly

1. Assemble the precast elements without the cover slab.

2. Pump out water from the bottom slab and thoroughly clean interior of the tank (if necessary).

3. Assemble the accessory components:

a) Directional baffle - should be installed in axis of the inlet pipe so that the feed sewage is directed tangentially to the tank wall generating rotary motion. The baffle is fixed to tank wall by M8x95 sleeve anchor bolts (e.g. PSR, Throughbolt or equivalent).

b) inlet piping - shall be mounted tangentially to internal tank wall

c) Connection piping joining the first and the second tank of the vortex settling tank.

d) tee or overflow elbow – shall be mounted centrally inside the first tank.

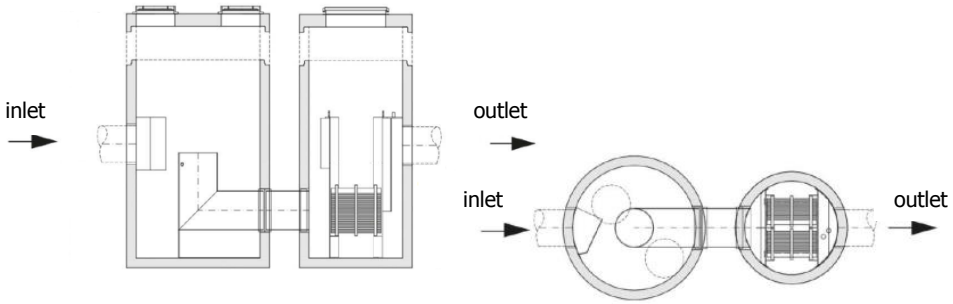
e) Install the weir inside the second tank:

- Before installation of the weirs self-adhesive gaskets (provided with the unit) are glued to its cleaned and dried edges. Gaskets are placed on all weir-tank wall connection edges.
- Place the weir inside second tank (by means of a lifting device). Weir is fixed to tank wall by M6x85 sleeve anchor bolts (e.g. PSR, Throughbolt or equivalent) + M6 washer.

4. Once the superstructure rings are assembled and sealing works finished, reinforced concrete cover slabs are placed on the last rings on a layer of mortar. The maintenance opening in the first tank should be near the inlet to the settling tank, in the second tank the openings should be arranged on both side of the inner weir.

5. A manhole shall be installed over each slab opening.

9.1.4 Integrated vortex settling tank with lamella insert include two tanks. The first tank contains tangential inlet pipe or directional baffle and orifice made from a tee or a 90° elbow, whilst the second tank - inner weirs, lamella section and outlet socket. Both wells are connected by one connection piping.



Assembly

1. Assemble the precast elements without the cover slab.

2. Pump out water from the bottom slab and thoroughly clean interior of the tank (if necessary).

3. Assemble the accessory components:

a) Directional baffle - should be installed in axis of the inlet pipe so that the feed sewage is directed tangentially to the tank wall generating rotary motion. The baffle is fixed to tank wall by M8x95 sleeve anchor bolts (e.g. PSR, Throughbolt or equivalent).

b) inlet piping - shall be mounted tangentially to internal tank wall

c) connection piping joining the first and the second tank of the vortex settling tank.

d) tee or overflow elbow – shall be mounted centrally inside the first tank.

e) install the inner weirs. Accessory components of the second tank are installed according to section 9.2.4.

f) install the pipe to elongate the duct connector (in devices at risk of periodical flooding of the sewerage system).

g) place the lamella sections inside the separator.

4. Once the superstructure rings are assembled and sealing works finished, reinforced concrete cover slabs are placed on the last rings on a layer of mortar. The maintenance opening in the first tank should be near the inlet to the settling tank, in the second tank the openings should be arranged on both side of the inner weir.

The manhole on the second tank shall be placed according to guidelines in section 9.2.4.

5. A manhole shall be installed over each slab opening.

It is recommended to place lamella sections just before device activation (separator shall be cleaned from impurities). In this way, the sections are protected from potential damage by sand, debris, cobbles, pieces of building timber and other solid wastes washed from the construction site to the sewage system.

9.2 Separators

9.2.1 ESK COALESCENCE SEPARATORS consists of a tank equipped with inlet and outlet pipes, basket with coalescence insert and closing float valve. The coalescence insert is made of polyurethane foam with specific parameters. ESK-S and ESK-HS separators include an additional polymer sorbent.

The separator is normally equipped with a safety installation: a float valve which prevents oil from escaping the separator when their volume inside the tank reaches the designed maximum value. The float is calibrated for density equal to 0.85 g/cm3. The applied solution prevents leakage of oil to the sewerage system.

Coalescence separator ESK

Coalescence separator with sorbent ESK-S

Assembly

In case of separators delivered as separate elements to be assembled on site:

1. Assemble the precast elements without the cover slab in accordance with the precast concrete installation instructions.
2. Pump out water from the bottom slab and thoroughly clean interior of the tank (if necessary).

3. Assembly the accessory components:

a) place inlet and outlet pipes in their corresponding sockets marked as INLET/OUTLET. The sockets should be fitted with a rubber lip seal or a tight passage. The pipes are fixed to tank wall by M8x95 sleeve anchor bolts (e.g. PSR, Throughbolt or equivalent).

c) install float's guide bar.

d) Place the float.

e) install the basket with coalescence insert on the guide bar.

4. Once the superstructure rings are assembled and sealing works finished, a reinforced concrete cover slab is placed on the last ring on a layer of mortar. The slab should be installed in such a way that the maintenance opening is located directly over the coalescence column (what makes removal of coalescence insert during inspection and cleaning of the separator possible). In slabs with two maintenance openings, the opening near slab's centre should be located directly over the coalescence column.

5. A manhole is mounted on each opening.

6. After the assembly, lift the float and fill the separator with clean water until water overflows the outlet socket.

When the float is not lifted during the filling process, it may be sucked blocking water outflow from the separator.

In order to secure the basket with coalescence insert and the float against damage, they are inserted into cleaned separator from possible impurities (sand stones, wood and concrete waste as well as other impurities flushed from construction site) just before the device is put in operation. In case of contaminating the float by sludge submergence and outflow blocking of this element is highly possible.

9.2.2 ESK-B COALESCENCE SEPARATORS WITH BY-PASS consist of a tank equipped with a by-pass pipe with overflow orifice, an inlet pipe, an inlet closing float valve, an outlet pipe, a basket with coalescence insert and a float.

Coalescence separator with by-pass ESK-B

The overflow orifice inside the by-pass pipe ensures that the nominal discharge is directed to separator pre-treatment system. Rise/fall of liquid's level inside the tank allows to control the amount of sewage flowing into the separator by the closing float valve at the inlet. Discharges larger than the nominal

value do not undergo pre-treatment as they are directed to the outlet of the by-pass pipe avoiding the separator chamber.

The separator is normally equipped with a safety installation: a float valve which prevents oil from escaping the separator when their volume inside the tank reaches the designed maximum value. The float is calibrated for density equal to 0.85 g/cm3. The applied solution prevents leakage of oil to the sewerage system.

Assembly

In case of separators delivered as separate elements to be assembled on site:

1. Assemble the precast elements without the cover slab.

2. Pump out water and thoroughly clean interior of the tank (if necessary).

3. Assembly the accessory components:

a) place inlet (A) and outlet (C) elements of the by-pass in their corresponding socket marked as INLET/OUTLET. The sockets should be fitted with a rubber lip seal or a tight passage.

b) fix the middle element (B) of the by-pass.

c) install the inlet closing float valve,

d) float guide bars,

e) insert the float,

f) insert the basket with the coalescence column- should be assembled on the guide bars.

4. Assemble the cover slab. Once the superstructure rings are assembled and sealing works finished, a reinforced concrete cover slab is placed on the last ring on a layer of mortar. The slab should be installed in such a way that the maintenance opening is located directly over the coalescence column (what makes removal of coalescence insert during inspection and cleaning of the separator possible).

5. A manhole is mounted on each opening.

6.After the assembly, lift the float and fill the separator with clean water until water overflows the outlet socket. When the separator is filled with water, the float should be freely lowered.

When the float is not lifted during the filling process, it may be sucked blocking water outflow from the separator.

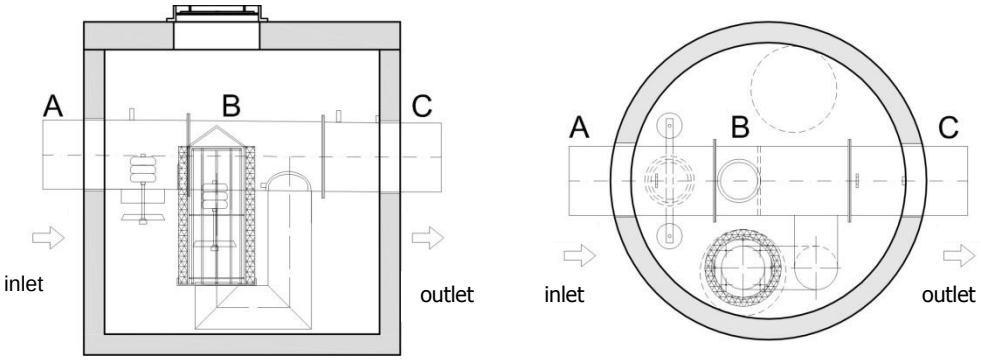


Fig. 1.3 ESK-B & ESK-BH coalescence separator with inside by-pass (top and cross-

In order to secure the basket with coalescence insert and the float against damage, they are inserted into cleaned separator from possible impurities (sand stones, wood and concrete waste as well as other impurities flushed from construction site) just before the device is put in operation. In case of contaminating the float by sludge submergence and outflow blocking of this element is highly possible.

Hydraulic by-pass conduit runs through the whole tank interior (Fig. 1.3). The pipe comprises of 3 parts (Fig. 1.4) connected by flanged joints during the process of assembly:

A – inlet part with closing float valve

B – middle part with separator outlet pipe integrated with by-pass pipe

C – outlet part

In ESK-B/ESK-BH separators tight through passages should be applied for by-pass piping ≥ Ø 500 mm. During the assembly, attention should be paid to direction in which pipes are fitted (from tank centre – to the outside).

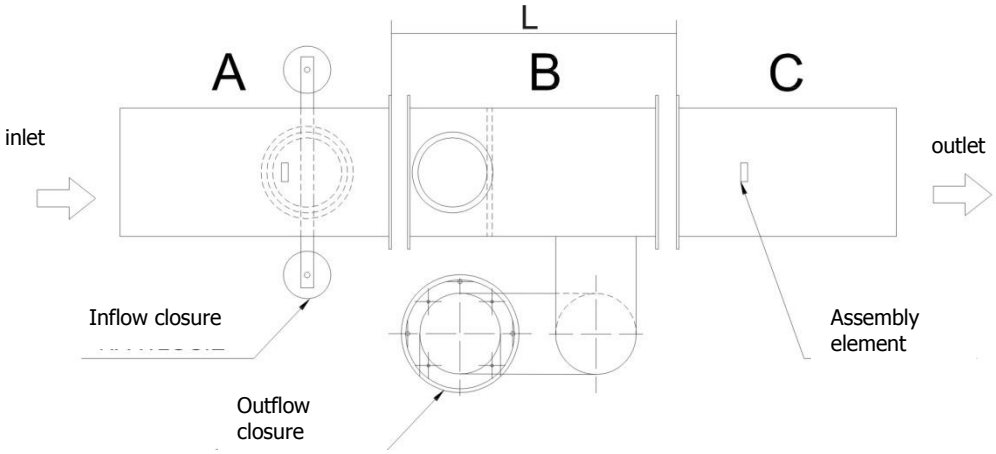


Fig.1.4 ESK-B & ESK-BH separator internal equipment elements

Technology set assembly (Fig 1.4):

1. Outlet part C is placed inside the tank and inserted into a gasket or a tight passage, that is fixed in the outlet opening, until the part is locked by the assembly component.

2. Element Inlet part A is placed inside the tank and inserted into a gasket or a tight passage fixed in the inlet opening. Part A pipe should be adjusted so that connector of float's buoyant parts in the inlet pipe is in a horizontal position. Otherwise, float may be blocked in guide bars.

3. Length of distance L between flanges of A and C parts should be adjusted by shifting part A so that distance L is 20 mm longer than middle part B (see Tab. 1 ESK-B separators, Tab. 2 ESK-BH separators).

4. Polyurethane sealant is applied into the inside of assembly flanges.

5. Middle part B is inserted between A and C parts and flanges are screwed by bolts.

6. Assembly component of outlet part C is fastened to the tank wall by M8x95 A4 sleeve anchor bolts (e.g. PSR, Throughbolt or equivalent).

9.2.3 ESK PE COALESCENCE SEPARATORS IN PE TANK consist of a polyethylene (PE) tank equipped with inlet and outlet pipes, a basket with coalescence insert and a closing float valve.
The coalescence insert is made of polyurethane foam with specific parameters.

The separator is normally equipped with a safety installation: a float valve which prevents oil from escaping the separator when their volume inside the tank reaches the designed maximum value. The float is calibrated for density equal to 0.85 g/cm3. The applied solution prevents leakage of oil to the sewerage system.

Coalescence separator ESK in PE tank

Transport
During transport, protruding pipes and lateral tank surfaces should be secured against potential mechanical damage.

PE tank loading / unloading
PE tanks are equipped with transport handles for convenient loading/unloading of the device.? Loading/unloading can be carried out manually (by smaller devices) are handled manually or with the use of mechanical devices adapted to the tank weight.

During the loading/unloading process, the device should be manipulated only by handles fixed to the tank, protruding pipes should be properly secured.

Storage
Tanks made of polyethylene are to be stored in a non-lit area, where the polymer elements are not exposed to direct sunlight. Till the assembly, tanks should be stored on a flat surface.

Trench preparation
The trench is prepared according to the guidelines found in the **precast concrete installation instructions**.
If the groundwater table reaches device's foundation level, conditions of stability should be calculated for most unfavourable conditions - when groundwater table has reached its highest elevation and the device has been emptied.

The separator foundation depends on soil conditions

On load bearing soils the separator shall be placed on a 10cm thick layer of gravel concentrated to Is>0,95 or on a 10 cm thick C8/C10 class concrete foundation.

In the case of difficult water and ground conditions for a stable foundation of the device a base plate can be used. The size and thickness of the base plate depends on local conditions. In order to protect against buoyancy the separator tank can be anchored to the base plate using sleeve anchor bolts attached peripherally in the bottom extension (Fig. 1.5).

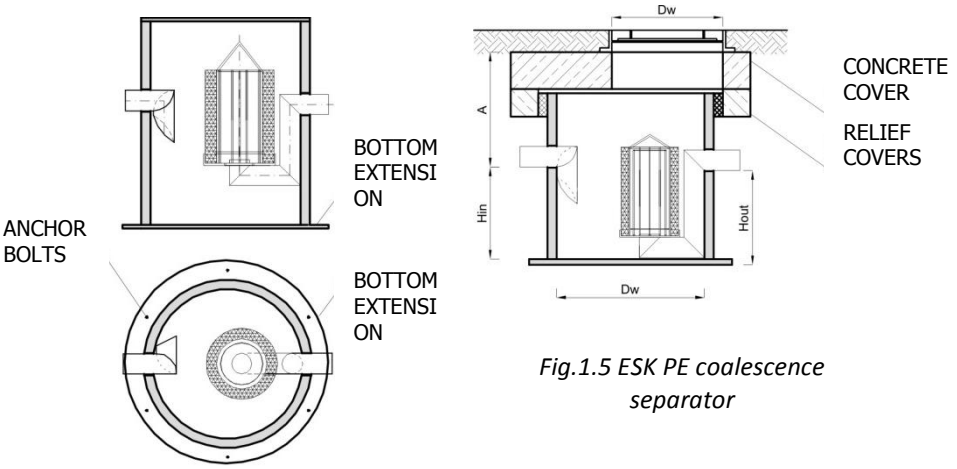


Fig.1.5 ESK PE coalescence separator

Detailed method of foundation and anti-buoyancy protection should always be determined by a person with appropriate permissions.

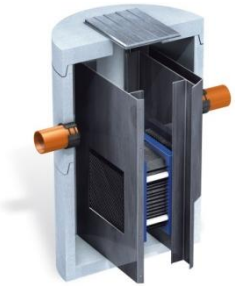
Assembly

- Place the separator tank on the designed level and in axis of the feed sewer.
- Connect the piping in conformity with code of practice for construction and testing of civil works.
- Side fill the trench by compacting it in about 20 cm thick even layers according to valid building code. Additionally the soil around the tank may be additionally treated with cement admixture added to the backfill soil. The side fill should not be made from cohesive and organic soils.
- Side filling and soil compaction is to be performed with utmost care, the tank and piping should be protected from hitting by cobbles.
- At the same time, the separator should be filled with water to the level of inlet pipe bottom.
- Separator float should be lifted prior to tank filling (so the float is not sucked). When the separator is filled with water, the float should be freely lowered.
- When the separator is located in driver-over ground it is necessary to Apple a cover slab placed on a load distribution ring (Fig. 1.6) – traffic loads cannot be distributed on the PE tank directly. During assembly of load distribution ring and cover slab Carnot come into contact with device tank. The slab should be installed in such a way that the maintenance opening is located directly over the coalescence column (what makes removal of coalescence insert during inspection and cleaning of the separator possible).
- A manhole shall be installed over each slab opening. In traffic-free areas manhole cover can be assembled directly on separator tank.

When the float is not lifted during the filling process, it may be sucked blocking water outflow from the separator.

In order to secure the basket with coalescence insert and the float against damage, they are inserted into cleaned separator from possible impurities (sand stones, wood and concrete waste as well as other impurities flushed from construction site) just before the device is put in operation. In case of contaminating the float by sludge submergence and outflow blocking of this element is highly possible.

9.2.4 ESL LAMELLA SEPARATORS consists of a tank equipped with inner weirs and lamella sections.



High efficiency lamella separator ESL

In case of separators delivered as separate elements:

1. Assemble the precast elements without the cover slab (according to the **precast concrete installation instructions**).
2. Pump out water from the bottom slab and thoroughly clean interior of the tank (if necessary).
3. Assemble the accessory components:

a) install the inner weirs. Self-adhesive gaskets (provided with the unit) are glued to cleaned and dried weir edges. Gaskets are placed on weir-tank wall connection edges (Fig.1.7).

- place the weirs inside the tank (by the use of a lifting device) (Fig.1.8).

Fig. 1.7 Assembly of gaskets on the weirs

Fig.1.8. Placing the weirs inside the separator tank

When two weirs are installed, they should be placed perpendicularly to sewer axis (inlet weir next to the inlet pipe, outlet weir next to the outlet pipe) and expanded by spreaders (min. 4 pcs) mounted at top and bottom edges of the weirs (Fig.1.9).

Before the assembly, weirs should be inspected whether they are placed parallel to each other and the required distance L between them is kept (Fig.1.10). Values of distance L are given in tables with devices parameters (Tab.1.3).

- once the weirs are in place, bores for sleeve anchor bolts are made in the tank (Fig.1.11). Maximum depth of bores in a concrete element is equal to 70 mm.
- fasten the weirs by sleeve anchor bolts (Fig.1.13).

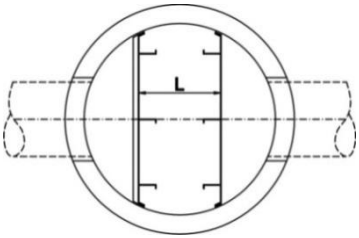


Fig.1.10. L parameter as the distance between lamella separator inner weirs.

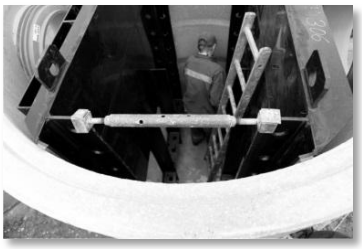


Fig.1.9. Inner weirs before connecting it with the separator tank

It is recommended to use sleeve anchor bolts M6x85 (e.g. PSR, Throughbolt or equivalent) and widened washer M6 (Fig.1.12).

Fig.1.11.Openin drilling for anchors connecting weirs with the tank

Fig.1.12. Sleeve anchor bolts and washer

Fig.1.13. Connected elements

- in devices at risk of periodical flooding of the sewerage system, install the pipe to elongate the duct connector (optional for ESL separators).

4. Once the superstructure rings are assembled and sealing works finished, a reinforced concrete cover slab is placed on the last ring on a layer of mortar. The slab should be installed in such a way that the maintenance opening is located directly over the coalescence column (what makes removal of coalescence insert during inspection and cleaning of the separator possible).

Model Q_{nom}/Q_{max} *	Distance between weirs L [mm]	
	min	max
3/30	-	-
6/60	-	-
10/100	-	-
15/150	640	670
20/200	840	870
30/300	640	670
40/400	840	870
50/500	840	870
60/600	840	870
65/650	840	870
70/700	1040	1070
75/750	1040	1070
80/800	1040	1070
90/900	1240	1270

Model Q_{nom}/Q_{max} *	Distance between weirs L [mm]	
	min	max
100/1000	1040	1070
110/1100	1240	1270
120/1200	1240	1270
125/1250	1240	1270
130/1300	1240	1270
140/1400	1240	1270
150/1500	1240	1270
160/1600	1240	1270
170/1700	1240	1270
180/1800	1240	1270
190/1900	1240	1270
200/2000	1240	1270
210/2100	1240	1270

*) Relates to ESL, ESL-H devices

Tab.1.3. Parameter L value for lamella separators

The method of cover slab assembly depends on manhole shapes:

Rectangular manholes:

The manhole should be assembled so that opening shorter edge is parallel to the inner weirs (what makes removal of coalescence inserts during cleaning of the separator possible). When separator cover slab is equipped with an additional inspection opening Ø400, the slab should be placed in such a way that the opening is located above device inflow chamber.

Circular manholes:

The cover slab should be placed in such a way that the opening Ø800 is located directly above the lamella sections.

When superstructure rings are not applied and the cover slab is placed directly on well tank, the assembly handle needs to be cut off prior to slab placement.

5. Install the manhole or the manhole cover on the cover slab.

6. Once the assembly works are finished, lamella sections are inserted into the separator interior (lowered by ropes) (Fig.1.15). Standard rope length equals 4 m.

When the sewerage system runs deeper, ropes should be extended. It is recommended to hook the ropes on a holder fixed to separator cover slab directly under the manhole (Fig.1.14).

It is recommended to insert the lamella sections into the separator just before the device is put in operation (accumulated impurities should be removed). In this way, the sections are protected from potential damage by sand, debris, cobbles, pieces of building timber and other solid wastes washed from the construction site to the sewage system.

Fig.1.14. Hook in the cover slab

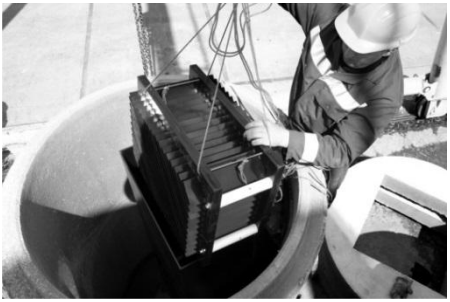


Fig.1.15. Lamella section removal and insertion

EXTENSION OF ROPES FOR LAMELLA SECTIONS

In case of lamella separators founded deeper than 4 m, the rope for lamella sections is extended by means of an extension rope (Fig.1.16).

Extension rope set: 5 lin.m. rope (1 pc), rope clip 4 galvanised iron (2 pcs), shackle (1 pc).

One side of the extension rope ends with a metal snap hook (Fig.1.17), and the other - with a loop (Fig.1.18) that is used to hook the rope to the cover slab. The rope is extended by connecting the snap hook of the extension rope to the ends of ropes fastened to the lamella section (Fig.1.19).

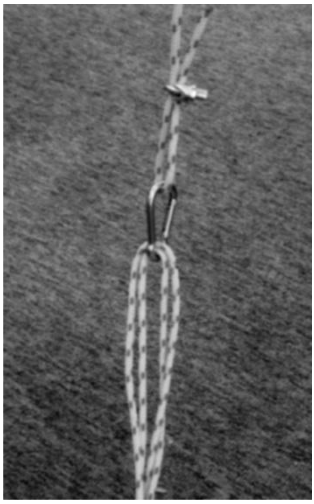


Fig.1.19. Extended rope for lamella package

Fig.1.16. Extension rope

Fig.1.17.Rope end with a metal snap hook

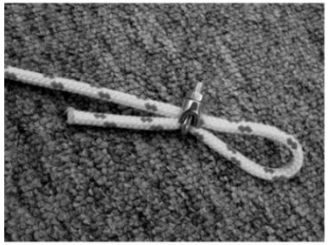
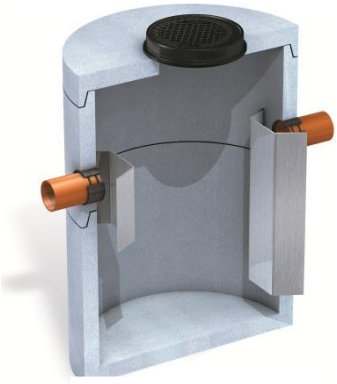


Fig.1.18. Rope end with a loop

9.2.5 EST GREASE SEPARATORS consists of a tank equipped with weirs installed inside the tank on inlet and outlet pipes.



EST grease separator

Assembly

In case of separators delivered as separate elements:

1. Assemble the precast elements without the cover slab.

2. Pump out water and thoroughly clean interior of the tank (if necessary).

3. Assemble the accessory components:

a) the inflow weir is fastened to tank wall in such a way that weir's top edge is located on the same level as the top edge of the inlet pipe.

b) the outflow weir is fastened to tank wall in such a way that weir's top edge is located above the top edge of the outlet pipe by a distance H1 (Fig.1.23). Weirs are fastened to tank wall by M8x95 sleeve anchor bolts (e.g. PSR, Throughbolt or equivalent).

4. Reinforced concrete cover slab is placed on the top ring on a layer of mortar in such a way that the maintenance openings are located over the baffles.

5. A manhole is mounted on each maintenance opening.

Device [mm]	H1
EST 1	60
EST 2	80
EST 4	80
EST 7	80
EST 10	80
EST-H 1/100	80
EST-H 1/200	80
EST-H 2/200	80
EST-H 2/400	80
EST-H 4/400	80
EST-H 4/800	80
EST-H 7/700	80

Device [mm]	H1
EST-H 7/1400	80
EST-H 10/1000	80
EST-H 10/2000	80
EST 15	100
EST 20	100
EST 25 (S)	100
EST-H 15/1500	100
EST-H 15/3000 (S)	100
EST-H 20/2000 (S)	100
EST-H 20/4000 (S)	100
EST-H 25/2500 (S)	100
EST-H 25/5000 (S)	100

10. Device maintenance

Regular inspection and servicing of equipment extends their lifespan and ensure their long-term, proper work. By doing periodic preventive maintenance you can avoid the hassle of defect of the device at the least expected moment.

Overview of the equipment shall be exercised in accordance with the manual of the device.

10.1 Device inspection

Depending on device type, inspection should include the following activities:
1. Visual check of the cover slab and the manhole/manhole cover.
2. Opening of the manhole/manhole cover.
3. Inspection of the amount of accumulated suspended solids and/or (depending on device's intended use): oil film or grease layer thickness. Measurement execution details are described in section 10.3
4. Visual check of accessory components: baffles, weirs, internal piping, coalescence foam, lamella section.
5. Closing of the manhole/manhole cover.

10.2 Frequency of inspection

Frequency and scope of inspections differ depending on the device type. The details are presented in the table 1.45. In case of lamella and coalescence separators, inspection and cleaning of accessory components (lamella section, coalescence insert, float) should be done during separators cleaning.

10.3 Inspection details and device cleaning

Inspection of suspended solids layer thickness is done by the use of a measuring staff or a disc probe. When the suspended solids storage capacity is filled to 1/2÷2/3, the device should undergo the cleaning process. When the device does not include a suspended solids section, the preceding settling tank should be inspected in terms of an overflow. Inspection of separated oil film and grease layer thickness is done by the use of a measuring staff and special paste for water detection. The paste applied on the surface of the staff discolours when coming into contact with water. Thickness of oil/grease layer thickness should not exceed values provided in tables with devices parameters (Tab. 1.5-Tab. 1.8). When the maximum allowable level of accumulated oil/grease layer is exceeded, the device should undergo the cleaning process.

Results of each inspection should be noted down in the Device Control Sheet, provided with the operations manual (fig. 1.22).

Fig. 1.21

When the maximum permissible amount of contaminants, as defined in tables, is exceeded, the device should undergo the cleaning process. Depending on device's type, cleaning should include the following activities:

1. Removal of large-size floating solid wastes.
2.Pumping out of sewage, oils, grease, sludge and sand accumulated in the device.
3. In case of oil separators, disassembly of lamella sections or coalescence foam, and the float, their washing by intensive water stream under pressure. Discharge of oily water into oiled waste water treatment system.

Inspection frequency	Device type	Scope of inspection	Possible outcome/comments	Recommended maintenance works
Twice a year	OS, EOW-1 settling tank	Amount of floatable impurities check.	High amount of impurities spotted.	Removal of impurities.
		Sediment level check.	Sediment level exceeds the allowable value (given in the table with parameters).	Settling tank cleaning by a licensed company.
	V2B1, EOW-2L rotational settling tank	Amount of floatable impurities check.	High amount of impurities spotted.	Removal of impurities.
		Sediment level in the first chamber check.	Sediment level exceeds the allowable value (given in the table with parameters).	Settling tank cleaning by a licensed company.
		Oil film thickness in the second chamber check.	Oil film thickness exceeds 20 cm.	
	ESL, ESL-H, PSW Lamela, PSW Lamela S separator, second chamber of V2B1 and EOW-2L rotational separator with lamella inser	Amount of solid wastes in the inlet chamber check.	High amount of impurities spotted.	Removal of impurities.
		Sediment level in the sediment section (below the lamella packet) check; and/or sediment level in the preceding settling tank check (if applicable).	Sediment level is lower by about 5 cm than the lamella packet bottom.	Separator, settling tank cleaning by a licensed company.
			Sediment level exceeds the allowable value (given in the table with parameters).	
		Oil film thickness check.	Oil film thickness exceeds 20 cm	
	PSK II, PSK-V, PSK-H, ESK, ESK-H, ESK-B, ESK-BH, ESK-S, ESK-HS separator	Amount of floatable impurities check.	High amount of impurities spotted.	Removal of impurities.
		Float/floats check.	Impurities spotted.	
		Sediment level in the separator check; and sediment level in the preceding settling tank check (if applicable).	Sediment level exceeds the allowable value (given in the table with parameters).	Separator, settling tank cleaning by a licensed company.
		Oil film thickness check.	Oil film thickness exceeds 10 cm.	
		Coalescence material check.	Impurities spotted.	Coalescence material cleaning.
		Sorbent check (applies to ESK-S and ESK-HS).	Impurities spotted.	Sorbent replacement.
		Overflow orifice check (applies to ESK-B and ESK-BH).	Impurities spotted.	Overflow orifice cleaning.
Twice a month	EST, EST-H grease separatorr	Amount of floatable impurities check.	High amount of impurities spotted.	Removal of impurities.
		Sediment level in the separator check; and sediment level in the preceding settling tank check (if applicable).	Sediment level exceeds the allowable value (given in the table with parameters).	Separator, settling tank cleaning by a licensed company.
		Grease layer thickness check.	Grease layer thickness exceeds 15 cm.	
Once a year	Device technical condition check (during device cleaning).		Mechanical damage.	Damage repair.
	Sorbent check (applies to ESK-S and ESK-HS).		Impurities spotted; or no impurities.	Sorbent replacement

Tab. 1.5. Scope and frequency of settling tank and separator inspection

Model type ESL	Permissible thickness of suspended solids layer [cm]	Permissible thickness of oil layer [cm]
ESL 3/30 ÷ ESL 6/60	10	20
ESL 10/100 ÷ ESL 210/2100	20	20

Model type ESL-H	Permissible thickness of suspended solids layer [cm]	Permissible thickness of oil layer [cm]
ESL-H 3/30/300	30	20
ESL-H 3/30/600	30	20
ESL-H 6/60/600	30	20
ESL-H 6/60/1200	20	20
ESL-H 10/100/1000	20	20
ESL-H 10/100/2000	20	20
ESL-H 10/100/3000 S	30	20
ESL-H 15/150/1500	15	20
ESL-H 15/150/3000	20	20
ESL-H 20/200/2000	20	20
ESL-H 20/200/4000 S	25	20
ESL-H 30/300/3000 S	20	20
ESL-H 30/300/6000 S	35	20
ESL-H 40/400/4000 S	25	20
ESL-H 40/400/8000 S	35	20
ESL-H 50/500/5000 S	20	20
ESL-H 50/500/10000 S	45	20

Tab. 1.6. Permissible thickness of sludge and oil layers in lamella separators

Model type: ESK-H (in PE)	Permissible thickness of suspended solids layer [cm]	Permissible thickness of oil layer [cm]
ESK-H 1,5/150 PE	16	10
ESK-H 1,5/300 PE	20	10
ESK-H 3/300 PE	20	10
ESK-H 3/600 PE	27	10
ESK-H 6/600 PE	27	10
ESK-H 6/1200 PE	54	10
ESK-H 10/1000 PE	46	10
ESK-H 15/1500 PE	43	10
ESK-H 20/2000 PE	57	10

Permissible thickness of suspended solids layer for ESK, ESK-S, ESK-B, ESK PE: 10 cm

Model type ESK-H	Permissible thickness of suspended solids layer [cm]	Permissible thickness of oil layer [cm]
1,5/150	10	10
1,5/300	25	10
3/300	25	10
3/600	25	10
3/2500	40	10
6/600	25	10
6/1200	35	10
6/2500	40	10
6/5000	50	10
10/1000	30	10
10/2000	35	10
10/5000	50	10
15/1500	25	10
15/3000	50	10
20/2000	35	10
20/4000	45	10
30/3000	50	10
30/6000 S	60	10
40/4000	40	10
40/8000 S	60	10
50/5000 S	35	10
50/10000 S	70	10
60/6000 S	45	10
65/6500 S	50	10
70/7000 S	50	10
80/8000 S	60	10
90/9000 S	65	10
100/10000 S	70	10

Model type ESK-HS	Permissible thickness of suspended solids layer [cm]	Permissible thickness of oil layer [cm]
1,5/150	10	10
1,5/300	25	10
3/300	25	10
3/600	25	10
3/2500	40	10
6/600	25	10
6/1200	35	10
6/2500	40	10
6/5000 S	50	10
10/1000	30	10
10/2000	35	10
10/5000 S	50	10
15/1500	25	10
15/3000	50	10
20/2000	35	10
20/4000 S	45	10
30/3000 S	50	10
30/6000 S	60	10
40/4000 S	40	10
40/8000 S	60	10
50/5000 S	35	10
50/10000 S	70	10
60/6000 S	45	10
65/6500 S	50	10
70/7000 S	50	10
80/8000 S	60	10
90/9000 S	65	10
100/10000 S	70	10

Model type: ESK-BH	Permissible thickness of suspended solids layer [cm]	Permissible thickness of oil layer [cm]
3/30/300 (DN1200)	10	10
3/30/300 (DN1500)	10	10
3/30/600 (DN1200)	25	10
3/30/600 (DN1500)	15	10
6/60/600 (DN1500)	15	10
6/60/1200 (DN1500)	30	10
10/100/1000 (DN1200)	15	10
10/100/2000 (DN 1500)	55	10
10/100/3000 (DN 2000)	45	10
15/150/1500 (DN 1500)	40	10
15/150/3000 (DN 2000)	15	10
20/200/2000 (DN 1500)	55	10
20/200/4000 (DN 2000)	60	10
30/300/3000 (DN 2000)	45	10
30/300/6000 S (DN 2500)	60	10
40/400/4000 S (DN 2000)	60	10
40/400/8000 S (DN 2500)	80	10
50/500/5000 S (DN 2500)	50	10
50/500/10000 S (DN 3000)	70	10
60/600/6000 S (DN 2000)	95	10
60/600/6000 S (DN 2500)	60	10
60/600/12000 S (DN 3000)	80	10

Model type: ESK-BH	Permissible thickness of suspended solids layer [cm]	Permissible thickness of oil layer [cm]
65/650/6500 S (DN 2000)	100	10
65/650/6500 S (DN 2500)	65	10
65/650/13000 S (DN 3000)	90	10
70/700/7000 S (DN 2000)	110	10
70/700/7000 S (DN 2500)	70	10
75/750/7500 S (DN 2000)	110	10
75/750/7500 S (DN 2500)	75	10
80/800/8000 S (DN 2000)	120	10
80/800/8000 S (DN 2500)	80	10
90/900/9000 S (DN 2500)	90	10
90/900/9000 S (DN 3000)	60	10
100/1000/10000 S (DN 2500)	100	10
100/1000/10000 S (DN 3000)	70	10
110/1100/11000 S (DN 3000)	75	10
120/1200/12000 S (DN 3000)	80	10
125/1250/12500 S (DN 3000)	85	10
130/1300/13000 S (DN 3000)	90	10
140/1400/14000 S (DN 3000)	95	10
150/1500/15000 S (DN 3000)	105	10
160/1600/16000 S (DN 3000)	110	10
170/1700/17000 S (DN 3000)	120	10

Tab. 1.7. Permissible thickness of sludge and oil layers in coalescence separators

Model type **EST**	Permissible thickness of suspended solids layer [cm]	Permissible thickness of grease layer [cm]
EST 1	-	15
EST 2	-	15
EST 4	-	15
EST 7	-	15
EST 10	-	15
EST 15	-	15
EST 20	-	15
EST 25 S	-	15

Model type **EST-H**	Permissible thickness of suspended solids layer [cm]	Permissible thickness of grease layer [cm]
EST-H 1/100	5	15
EST-H 1/200	10	15
EST-H 2/200	10	15
EST-H 2/400	20	15
EST-H 4/400	10	15
EST-H 4/800	20	15
EST-H 7/700	10	15
EST-H 7/1400	20	15
EST-H 10/1000	15	15
EST-H 10/2000	30	15
EST-H 15/1500	15	15
EST-H 15/3000	30	15
EST-H 20/2000 S	15	15
EST-H 20/4000 S	30	15
EST-H 25/2500 S	20	15
EST-H 25/5000 S	40	15

Tab. 1.8. Permissible thickness of sludge and grease layers in grease separators

Model type **OW** D_w/V_{cz*}	Permissible thickness of suspended solids layer [cm]	Permissible thickness of oil layer [cm]
OS 1200/1,0	44	-
OS 1200/1,5	66	-
OS 1200/2,0	88	-
OS 1500/2,0	56	-
OS 1500/2,5	71	-
OS 1500/3,0	85	-
OS 2000/3,0	48	-
OS 2000/3,5	56	-
OS 2000/4,0	64	-
OS 2000/5,0	80	-
OS 2000/6,0	95	-
OS 2000/7,0	111	-
OS 2000/7,5	119	-
OS 2000/8,0	127	-
OS 2500/5,0	51	-
OS 2500/6,0	61	-
OS 2500/7,0	71	-
OS 2500/7,5	76	-
OS 2500/8,0	82	-
OS 2500/9,0	92	-

Model type **EOW-2L** $Q_{nom}(80\%)$ / Q_{max*}	Permissible thickness of suspended solids layer [cm]	Permissible thickness of oil layer [cm]
EOW-2L 3/30	77	90
EOW-2L 6/60	77	90
EOW-2L 10/100	77	90
EOW-2L 15/150	77	40
EOW-2L 20/200	77	40
EOW-2L 25/100	88	90
EOW-2L 25/150 S	100	40
EOW-2L 25/200 S	100	40
EOW-2L 30/300	75	40
EOW-2L 35/100 S	88	90
EOW-2L 35/150 S	100	40
EOW-2L 35/200 S	100	40
EOW-2L 35/300 S	100	40
EOW-2L 35/400 S	108	105
EOW-2L 40/400	75	55
EOW-2L 40/400 S	108	105
EOW-2L 50/500	83	55
EOW-2L 50/500 S	105	100
EOW-2L 60/600	83	55
EOW-2L 60/600 S	105	100

OS 2500/10,0	103	-
OS 2500/11,0	114	-
OS 2500/12,0	123	-
OS 2500/12,5	127	-
OS 2500/13,0	133	-
OS 3000/10,0	71	-
OS 3000/11,0	78	-
OS 3000/12,0	85	-
OS 3000/12,5	88	-
OS 3000/13,0	92	-
OS 3000/14,0	99	-
OS 3000/15,0	106	-
OS 3000/16,0	113	-
OS 3000/17,0	120	-
OS 3000/18,0	127	-
OS 3000/19,0	134	-
OS 3000/20,0	141	-
OS 3000/22,5	159	-
OS 3000/25,0	177	-
OS 3000/27,5	195	-
OS 3000/30,0	212	-

EOW-2L 65/300 S	115	40
EOW-2L 65/400 S	108	105
EOW-2L 65/600 S	108	100
EOW-2L 65/650	83	55
EOW-2L 65/650 S	105	100
EOW-2L 70/700	83	55
EOW-2L 70/700 S	105	100
EOW-2L 75/750	83	55
EOW-2L 75/750 S	105	100
EOW-2L 80/800	83	55
EOW-2L 80/800 S	105	100
EOW-2L 90/900	83	55
EOW-2L 90/900 S	103	95
EOW-2L 100/400 S	108	105
EOW-2L 100/600 S	108	100
EOW-2L 100/750 S	108	100
EOW-2L 100/1000	83	55
EOW-2L 100/1000 S	100	90
EOW-2L 110/1100 S	100	85
EOW-2L 120/1200 S	100	85
EOW-2L 125/1250 S	100	85
EOW-2L 130/1300 S	100	85
EOW-2L 140/1400 S	99	80
EOW-2L 150/1500 S	99	80
EOW-2L 160/1600 S	99	80

Model type **EOW-1** $Q_{nom}(80\%) / Q_{max*}$	Permissible thickness of suspended solids layer [cm]	Permissible thickness of oil layer [cm]
EOW-1 3/30	40	20
EOW-1 6/60	40	20
EOW-1 10/100	71	20
EOW-1 15/150	71	20
EOW-1 20/200	60	20
EOW-1 30/300	89	20
EOW-1 40/400	67	20
EOW-1 50/500	70	20
EOW-1 60/600	70	20
EOW-1 65/650	70	20
EOW-1 70/700	86	20
EOW-1 75/750 S	86	20
EOW-1 80/800 S	86	20
EOW-1 90/900 S	74	20
EOW-1 100/1000 S	74	20

Model type **EOW-2** $Q_{nom}(80\%) / Q_{max*}$	Permissible thickness of suspended solids layer [cm]	Permissible thickness of oil layer [cm]
EOW-2 3/30	37	20
EOW-2 6/60	37	20
EOW-2 10/100	77	20
EOW-2 15/150	77	20
EOW-2 20/200	77	20
EOW-2 25/250 S	97	20
EOW-2 30/300	74	20
EOW-2 35/350 S	86	20
EOW-2 40/400	69	20
EOW-2 50/500	69	20
EOW-2 60/600 S	91	20
EOW-2 65/650 S	91	20
EOW-2 70/700	66	20
EOW-2 75/750	66	20
EOW-2 80/800 S	89	20

EOW-1 110/1100 S	104	20
EOW-1 120/1200 S	104	20
EOW-1 125/1250 S	104	20
EOW-1 130/1300 S	104	20
EOW-1 140/1400 S	104	20
EOW-2 90/900 S	89	20
EOW-2 100/1000 S	89	20
EOW-2 110/1100 S	85	20
EOW-2 120/1200 S	85	20
EOW-2 125/1250 S	85	20
EOW-2 130/1300 S	85	20
EOW-2 140/1400 S	99	20
EOW-2 150/1500 S	99	20
EOW-2 160/1600 S	99	20

Tab. 1.9. Permissible thickness of sludge and oil layers in settling tanks

4. Depending on device type: tank, weirs, baffles, central piping washing and inlet and outlet pipe unclogging.

5. Pumping out of device content.

6. Devices technical condition check

7. Assembly of accessory components depending on separator type:

- lamella separators: installation of lamella sections, filling of the separator with clean water until overflow at the outlet,
- coalescence separators: filling of the separator with clean water until overflow at the outlet, free lowering of the float
(float shall be placed in the separator after filling it with clean water otherwise it may be sucked blocking water outflow from the separator and causing backwater), installation of
coalescence foam,
- other devices: device is filled with clean water after technical condition check.
8. Closing of the manhole/manhole cover.

Separated oil, grease and sludge are removed by the use of a septic tanker equipped with a pump and a soft hose. Soaked sorbents should be treated as substances that soak the sorbent. The company collecting wastes needs to possess adequate hazardous waste collection and transport permit.

The user is obliged to follow the minimum frequency of devices inspection in accordance with relevant regulations.

Devices can be additionally equipped with an measurement and control apparatus (oil film or suspended solids thickness sensor, overflow sensor) that indicate the exceeding of permissible values of measured parameters. Apparatus assembly is described in a separate manual.

During operation, repair and maintenance works Occupational Health and Safety Regulations should be observed, in particular the Occupational health and safety manual for operation, repair and maintenance of devices for water and sewage treatment, provided in section 10.5.

10.4 Safety requirements for devices maintenance

Inside settling and separator tanks are a risk zone within the meaning of health and safety regulations – Works carried out inside the tanks shall be classified as especially dangerous.

Settling tanks and separators during its operation do not classify as devices at risk of explosion or self-ignition during their operation. Interior of settling tanks with trapped outlet and separators is classified as explosion threat zone EX Z1.

While draining the devices it should be enabled to dissipate static electricity by connecting the slurry tank with a copper cable with a cross section of at least 18 mm2 with duct connector - grounding post outside the hazardous area.

Devices are not equipped with manhole steps due to safety considerations. Maintenance and service of these type of devices are provided by specialist companies possessing adequate waste collection, transport and disposal permits. These companies have sufficient equipment for devices cleaning and maintenance and service works (ladders, safety ropes, personal protection equipment) at their disposal.

Routine inspections (visual check of devices technical condition, amount of oil and suspended solids accumulated in tanks) can be carried out from the ground level, without the need to enter the device interior.

10.5 Occupational health and safety manual for usage, renovation and conservation of water and sewage cleaning devices

1. Repair and assembly works should be supervised by a qualified person.

2. Only workers possessing actual appropriate medical certificate and valid OSH training, can be allowed to work inside the tank. Workers with skin abrasions on hands or other exposed tank parts should be prevented from work in conditions allowing for direct contact with sewage.

3. Workers employed for works inside devices should be provided with work boots and clothing, and personal protection equipment as specified in personal protections catalogue and internal equipment standards.

4. Time schedule of works inside the device should be approved by device users as sewage discharge will be stopped throughout duration of the works.

5. The worksite should be fenced or surrounded by safety barriers, properly signed and well lit at night; backup lighting should be provided in case of blackout.

6. Service works carried out on streets or motorways should be signed as temporary work zones according to traffic regulations, and closed for unauthorized persons.

7. Workers operating on roadways should wear safety vests or work clothing with safety colours and well visible markings.

8. Works conducted inside devices should follow critical technical-organizational means that ensure occupational health and safety as specified in this manual.

9. Manhole cover of a device located under roadways or walkways can be removed only when the worksite is fenced from both traffic lanes. Manhole opening should be marked with a red warning flag, additionally, during the night or when needed, warning lights can be employed.

10. Manhole covers should be removed only by means of hooks made of spark-proof material.

11. Manhole covers should not be de-frozen by open fire; smoking during manhole opening and working inside the device is prohibited.

12. Manhole covers fastened with hinges should be secured against uncontrolled closing.

13. During ventilation and works carried out by the open manhole, the opening should be properly secured against accidental fall of workers or other people inside the tank.

14. Device bottom can be accessed only during emergency, once the sewage inflow is stopped, and sewage and deposits remaining in the tank are pumped out. Before entering the device, the interior should be ventilated.

15. Device interior should be ventilated for at least 30 min., when manhole covers of at least two tanks, on both sides on the device being ventilated, are removed or opened. Device interior can also be ventilated by a mobile mechanical fan for at least 10 min. prior to entering. After the ventilation process, chemical indicators or safety lamps should be used to check whether substances harmful to peoples life and health are present.

16. Protective measures against rapid rise in sewage level and exceeding of allowable concentrations of substances harmful to people's life and health should be applied prior to beginning of works inside the device.

17. Works inside the tank should be conducted by a team of least 4 workers, with only 2 working inside the device. The remaining persons should stay outside and safeguard those inside the device.

18. While works are in progress, workers inside the device should stay in contact with the safeguarding personnel.

19. Workers responsible for manhole safeguarding should not abandon their posts until works inside the device are finished.

20. A first aid kit, additional flashlights and a safety rope of adequate length ending with snap hooks should be readily available at the worksite near the device manhole.

21. An evacuation mechanical device should be placed over the tank manhole in case peoples life or health is in danger.

22. The person entering the tank interior should wear safety harness and be safeguarded by safety ropes.

23. The person should take notice of the slippery bottom and possibility of falling.

24. The safeguarding personnel should have a list of names of all the workers employed inside the tank, and in case of communications failure, instantly run a rescue operation.

25. The device interior can be lit by an electrical lamp with voltage no higher than 25 V or by explosion safety flashlights. If electrical lighting is to be used, the supply voltage must not exceed 12 V.

26. Transport of tools, materials, liquid and solid wastes removed from the tank should not jeopardize the safety of the worker occupying the device.

27. Once all the works are completed, equipment, tools and materials used should be removed from the device, worksite - cleaned, peoples life and health risk - eliminated. Additionally, the user should follow other relevant safety requirements concerning occupational health and safety during operation, repair and maintenance of sewerage systems; and all other valid regulations.

28. Device clearing should be undertaken according to this operations and maintenance manual.

Additionally, the user should follow other relevant safety requirements concerning occupational health and safety during operation, repair and maintenance of sewerage systems; and all other valid regulations.