We know how water works

ABS Nopon
Disc Diffuser Aeration System

41001-0000

41001 GB 03.2008

GB Installation, Operating and Maintenance Instructions

www.absgroup.com

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1 General

ABS reserves the right to change or amend these instructions without notice.

In the event of incorrect or misleading information being portrayed please refer to the English version.

1.1 Introduction

These **Installation, Operating and Maintenance Instructions** together with the separate **ABS Group Products Safety Instructions** contain the guide lines which must be followed during the transportation, installation and operation of ABS Nopon disc diffuser systems. For this reason it is essential that they are read by all people involved in the planning, handling or installation of such systems and should be available with every installation.

ATTENTION Failure to observe the instructions marked with "*ATTENTION*" may lead to permanent damage of the aeration system and / or prevent it functioning to its full potential.

1.2 Applicability

These instructions apply to all ABS Nopon aeration systems in which the diffusers are attached to PVC or stainless steel pipes. For the purposes of this manual, the aeration system will refer to a disc diffuser system designed for installation on a level, concrete floor of an aeration basin (Figure 1). The diffusers deliver compressed air to the aeration basin in the form of fine bubbles.

These instructions cover the following diffuser types:

PIK 300 V D90	PRK 300 D90	KKI 215 D90	HKL 215 D90	MKL 215 D90	Sucoflow DS 20
PIK 300 S D88.9	PRK 300 D88.9	KKI 215 D88.9	HKL 215 D88.9	MKL 215 D88.9	
	PRK 300 R ½	KKI 215 R ½	HKL 215 R ½	MKL 215 R ½	
	PRK 300 R ½ K	KKI 215 R ½ K	HKL 215 R ½ K	MKL 215 R ½ K	
	PRK 300 BSF ½	KKI 215 BSF ½	HKL 215 BSF ½	MKL 215 BSF ½	
	PRF 300				

PIK 300, PRK 300, KKI 215, HKL 215 and MKL 215 may be delivered with or without pipework, all other diffusers are delivered without pipework. If the diffusers are delivered without pipework, the buyer is responsible for constructing the pipework system in accordance with these instructions in order to achieve the best results.

If the diffusers are delivered with pipework, the aeration system is pre-assembled at the factory and supplied in the form of diffuser elements, water collection pipes, and zone headers. Usually the limit of supply on the air incoming side is the zone header flange located approximately 300 mm above the centre line of the zone header. This flange is used to connect the dropleg to the aeration grid. The limit of supply for the condensate drainage pipe is the coupling to which the customer connects the drainage pipe or hose, this is then routed to the top of the basin.

2 Safety

Read the separate ABS Group Products Safety Instructions and these instructions carefully upon receipt of the equipment. Obey local safety regulations. If anything is not clear or you have any questions as to safety, contact your local sales representative.

Equipment which has been installed in areas potentially hazardous to health must be decontaminated before any works commence.

3 Warranty

Any warranty concerning the mechanical construction of the equipment is only valid if all instructions have been obeyed. The ABS warranty does not cover damage howsoever caused by careless handling before, during or after installation.

The warranty will be valid only if a data log is maintained (see Chapter 13.4) and the instructions given in this manual are followed. Included in this manual is an "installation inspection form", which must be completed, signed and returned to the manufacturer in order for the warranty to take effect.

In case of warranty issues, contact your local sales representative.

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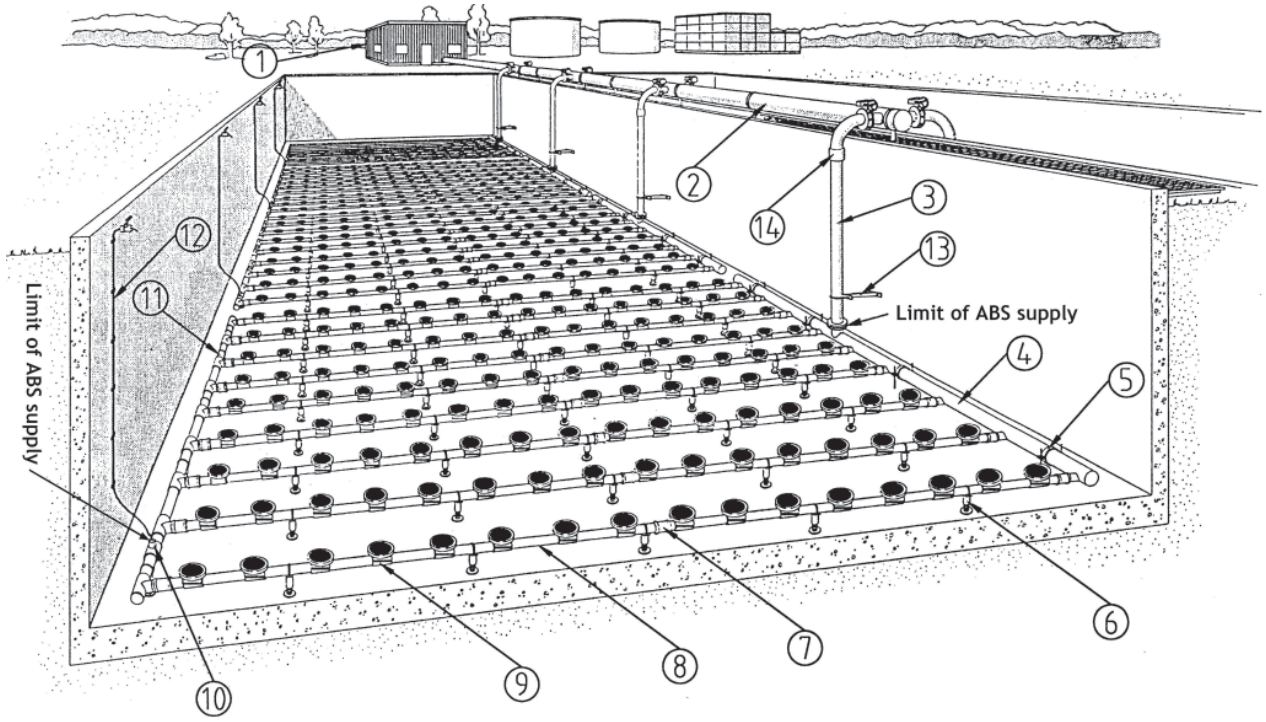


Figure 1 Typical bottom-mounted aeration system

1	Blower house	6	Bottom mounting bracket HPK 210	11	Water collection pipe
2	Air supply header	7	Connection sleeve HSY 90-90	12	Purge hose/pipe
3	Dropleg	8	Diffuser element	13	Pipe support
4	Zone header	9	Diffuser (here KKI 215)	14	Expansion joint
5	Bottom mounting bracket TPK 150	10	Drainage coupling VPL 90		

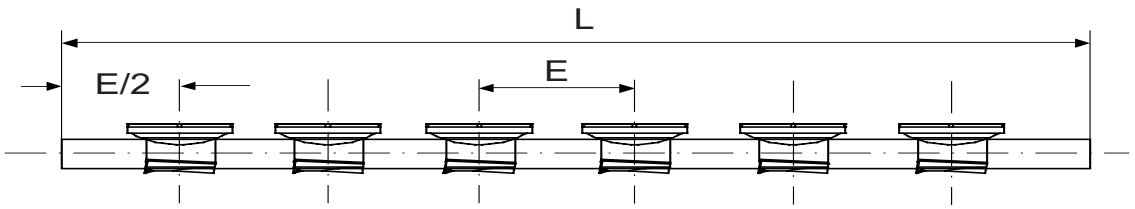
4 Aeration system components

The aeration system components are identified by the descriptions given in Figure 1. The basic unit in the system is the aeration group. There can be one or several such groups in an basin. Air is supplied to the group via a dropleg. The zone header distributes the air within the aeration group.

Zone headers can be made of PVC or stainless steel depending on the diameter required. Zone headers with a diameter of 90 mm are usually made of PVC. Zone headers have right-angled branches connecting the diffuser elements to the header. With PVC zone headers, the branches have an outside diameter of 90 mm. With steel zone headers, the outside diameter is usually ø 88.9 mm. Depending on the layout of the group, branches can be located on both sides of the header or one side only. Branches are connected to the zone header either through its centre line or with a flat bottom.

A diffuser element is a pre-assembled cut-to-length part of ø 90 mm PVC pipe with diffusers mounted onto the pipe. Depending on the type of diffuser attached to the element, designations PIKEV, PRKE, KKIE, HKLE and MKLE are used for the aeration systems. An example of type designation is KKIE 3000-6/500 (250, 250). This means that the element length L is 3000 mm, it has 6 KKI 215 diffusers and the distance E between the diffusers is 500 mm. The measurements in brackets show the distance from the end of the pipe to the centre of the diffuser nearest to the pipe end. Normally it is half of the distance between the diffusers.

Figure 2 shows the minimum distances for different diffusers.



	PIK 300	PRK 300	KKI 215	HKL 215	MKL 215
E min	400 mm	400 mm	350 mm	350 mm	350 mm
E/2 min	300 mm	175 mm	175 mm	175 mm	175 mm

Figure 2 Minimum distances in diffuser elements

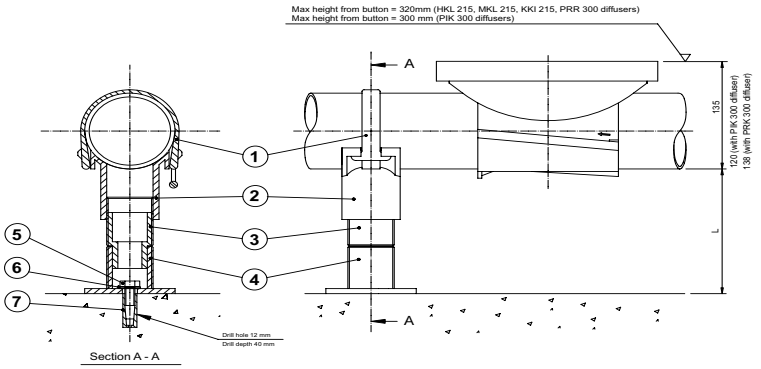
The parts of the PRK 300, KKI 215, HKL 215 and MKL 215 diffusers complete with type designations are shown in Figure 5 and PIK 300 diffuser in Figure 6.

The purpose of the water collection pipe is to collect condensed water from the pipework system and to ensure a uniform air distribution (Figure 1). The water collection pipe consists of a ø 90 mm PVC pipe, HTK 90/90 cross-junctions and HTP 90 end caps.

Condensed water is drained through the drainage coupling VPL 90 in the water collection pipe. Sludge that finds its way into the pipe as a result of a leak, etc. cannot be removed via this junction. If the system does not include a water collection pipe, the drainage coupling is connected to the zone header or one of the diffuser elements. When using large zone headers (ø over 90 mm), water drainage coupling is usually in the zone header and the branches connecting diffuser rows are connected into the centre line of the zone header.

The diffuser elements are fixed to the basin floor via bottom mounting brackets HPK 210 (Figure 3). If necessary, the bracket height can be adjusted using extension sleeves HJA 210. The elements are fastened to the bottom mounting brackets using HPA 210 straps.

Steel and large PVC zone headers are fixed in position using stainless steel bottom mounting brackets TPK 125 - TPK 350 (Figure 4).



HPK 210

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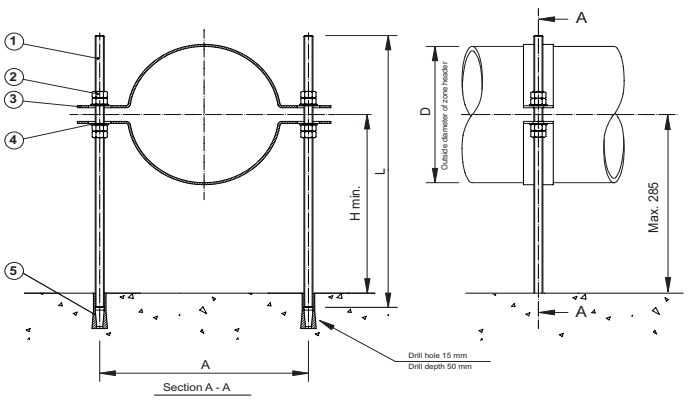
1.	Strap	HPA 210
2.	Pipe holder	HKI 210
3.	Extension sleeve	HJA 210
4.	Foot	HTU 210
5.	Hex screw	M10 x 20
6.	Washer	KL 11/28
7.	Drop-in anchor	LAH 10

Figure 3. Bottom mounting bracket HPK 210



TPK 125…350

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1.	Threaded rod	M12
2.	Hex nut	M12
3.	Holder	125…350
4.	Washer	M12
5.	Drop-in anchor	LAH 12

Figure 4 Bottom mounting brackets TPK 125 - TPK 350

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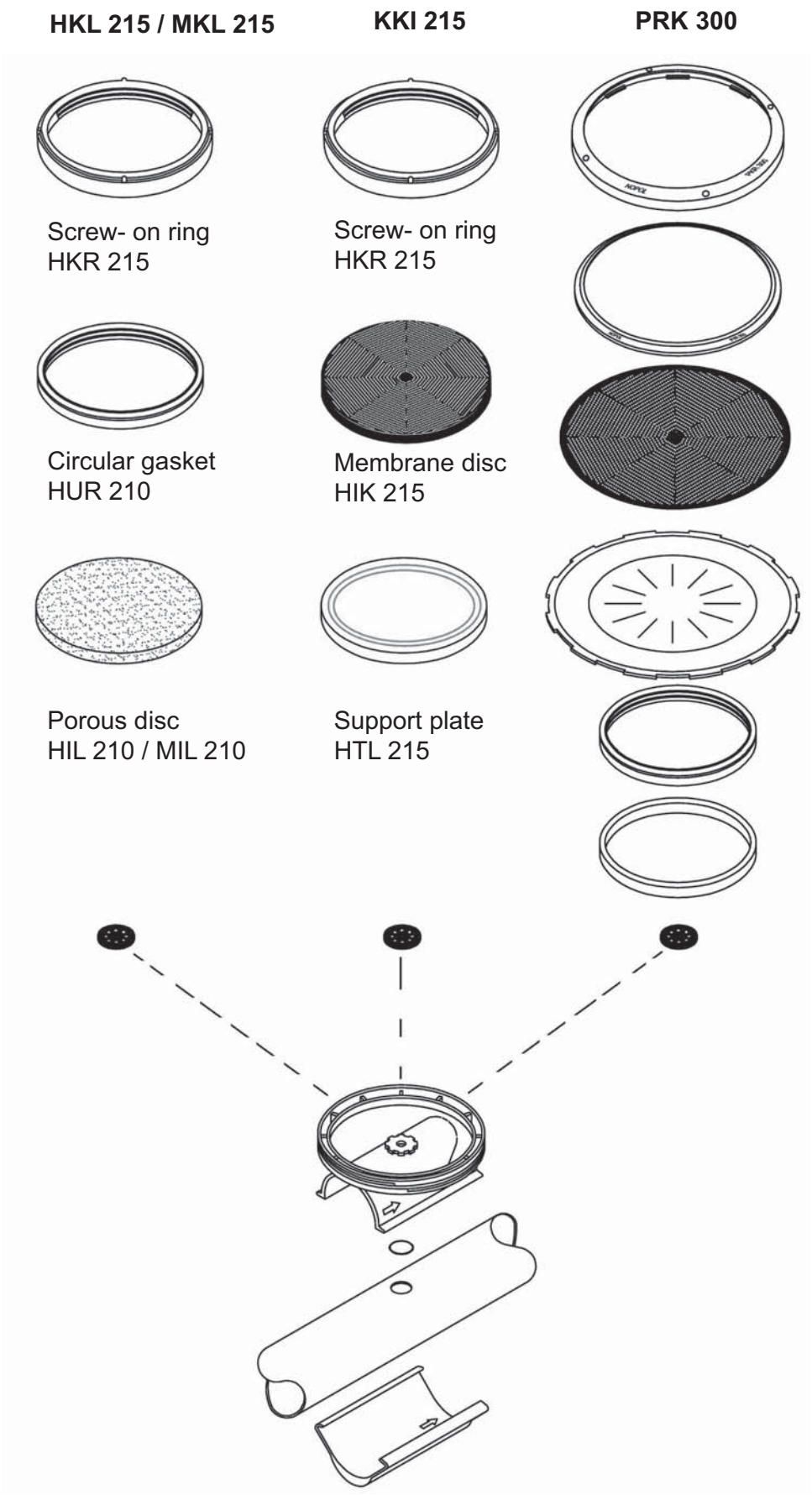

Figure 5 HKL 215, MKL 215, KKI 215 and PRK 300 diffuser components for ø 90 mm piping

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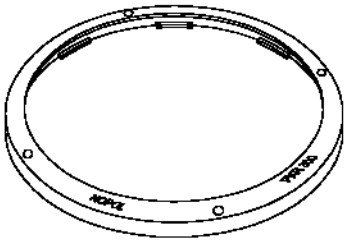
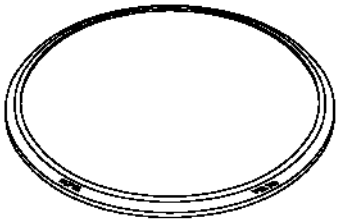
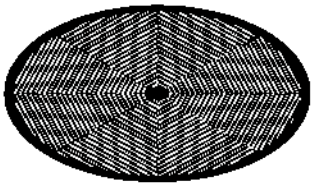
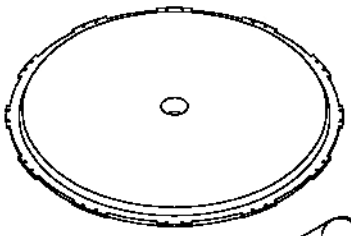
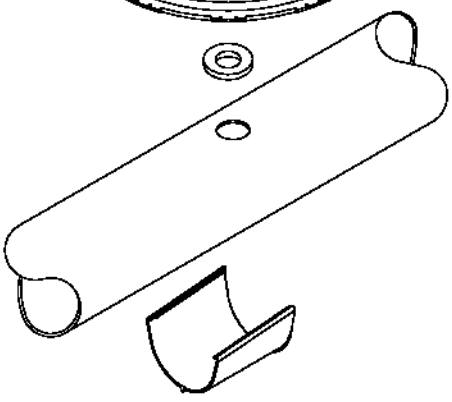
Screw-on ring		PKR300
Sliding ring		PVR300
Membrane disc		HIK300
Non-return valve		PTV15
Ball		
O-ring		
Main body		PSA300
Flat seal		PLT15/4 (ø 90 PVC pipe) PLT15/5 (ø 88,9 pipe)
Wedge piece		PSK90

Figure 6 PIK 300 diffuser

5 Delivery, handling and storage

5.1 Scope of delivery

The delivery comprises of a complete aeration system or a part of one depending on the order and / or supply arrangements.

A complete aeration system will include the following:

- pre-assembled diffuser elements
- zone headers (PVC or AISI 316)
- water collection pipes
- appropriate bottom mounting brackets
- pipe connection pieces
- drainage couplings
- a small number of additional parts to replace components that may be damaged during transportation or installation
- the necessary installation tools.

5.2 Accompanying documents

The aeration system will be supplied complete with the following documents:

- Diffuser group layout drawings
- Bottom mounting bracket drilling layout
- Installation, operating and maintenance manual including the installation inspection form

An installation video will be supplied separately by mail.

5.3 Packaging and transportation

Diffuser elements, zone headers and water collection pipes are usually supplied in plywood cases (Figure 7/1). Other methods of packaging are also available. Other system components will be supplied in cardboard boxes that are packed into a case or placed on pallets wrapped in a clear plastic film (Figure 7/2).

Typical case dimensions are 5,40 x 1,12 x 1,12 (m). The gross weight of a loaded case is approx. 1000 kg. Case height and width are usually standard however case lengths may vary according to the length of the elements. Cases with a length of over 5,40 m are only used when necessary, such as for the transportation of long zone headers. The maximum height of a consignment on a pallet is 2,00 m.

To minimise transportation costs, each case is packed as full as possible. As a result one case may contain components belonging to several groups. Before installation, the drawings and dimensions must be checked to make sure that the right parts will go to the right groups. Diffuser elements, zone headers and water collection pipes are marked with stickers to help identification.

Usually the cases and pallets are delivered to the customer by trucks with trailers or semi-trailers. For carriage by sea, suitable packaging is used.

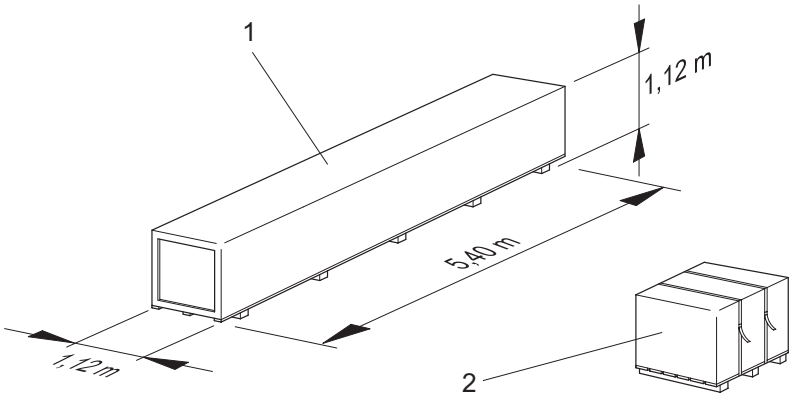


Figure 7 Packaging options for aeration systems

5.4 Acceptance of delivery

After receiving the equipment, check the packaging and equipment for transportation damage. Carefully check the packaging for documents and small components before discarding. If the equipment you receive does not match what you ordered, please contact your local sales representative immediately. If damage occurred during shipping, please contact the shipper and inform your local sales representative immediately.

5.5 Handling

To unload the goods, use a forklift truck and unload from the side of the cargo bay. Make sure there is ample room on the unloading site for a truck carrying a case to manoeuvre safely. In addition, a large delivery vehicle will need sufficient space for manoeuvring if no through passage is provided.

Move the goods to the aeration basin in their original packaging using a suitable hoist, or carry the elements there one by one. Care must be taken to avoid damage to the diffusers and pipework at all times during offloading. Do not unpack the goods until they are to be installed. Diffuser elements must be kept clean of dust, etc. Empty packing material need not be returned and should be disposed of responsibly.

At low temperatures (below +5 °C), PVC and PP become brittle. Special care must be taken when ambient temperature drops below -10 °C. Recommended ambient temperature for installation is above +15 °C. Also the temperature of the components to be installed should be above +15 °C. It is not recommended to install an aeration system when temperature is below +5 °C.

5.6 Storage

To prevent distortion of the PVC components the temperature during storage should be between +5 and +35 °C. Good ventilation is essential to prevent high temperatures. It is advisable to leave some space between the cases during storage. Special notice should be paid to transportation and storage of containers. Aeration equipment has to be protected from UV radiation, sub-zero temperatures and dirt.

The plywood cases must be stored on a level base shielded from direct sunlight. Do not stack more than two identical cases on top of each another. The pallets must not be stacked. Protect them from rain. Exposure to sunlight is detrimental to the rubber parts of the diffusers and may cause plastic components and pipes to deform. When storing packages, make sure they are not subject to loads that may deform or damage the parts inside.

Dust, sand and water must be kept out from the aeration equipment, especially from the pipes.

Membrane discs HIK 215, HIK 300 and HIKD20 should be stored at room temperature in closed boxes protected from sunlight. Make sure that the membranes do not get stuck to one another by inserting a piece of cardboard between each of them.

Porous discs HIL 210 and MIL 210 are preferably stacked on a level surface. The disc must not be allowed to bend. Protect the diffuser discs from direct sunlight and low (< 0 ºC) temperatures.

Plastic components must be stored at room temperature protected from direct sunlight. Make sure that the parts are not deformed or subjected to any loads.

6 Installation of the aeration system

6.1 Installation steps

To ensure correct operation of the system, it is extremely important that:

- diffuser rows are straight
- diffusers are at the same level
- system is leak proof
- air is uniformly distributed to all diffusers.

Before installation, the basin bottom must be cleaned with care. Mark and drill holes for the bottom mounting brackets according to the drilling layout and fix the brackets in position. Piping with a diameter of 90 mm will be fixed to the basin bottom using the HPK 210 mounting brackets (Figure 3) whereas zone headers with a diameter of over 90 mm will be fixed using TPK 125 - TPK 350 mounting brackets (Figure 4). After fixing adjust the height of the brackets so that they are level with each other.

Once the mounting brackets have been height-adjusted, install the zone header, diffuser elements and water collection pipe. Proceed from the zone header towards the water collection pipe.

Finally, fix the purge hose/pipe and connect the diffuser groups to the droplegs.

6.2 Installation preparation

Before fixing the bottom mounting brackets in position, remove all superfluous materials from the basin. Clean the basin bottom to facilitate measurements and marking of the bracket fixing points.

Bottom mounting brackets are supplied in parts, see Figure 3 and 4.

Temperature at the installation site must not exceed +50 °C.

At low temperatures (below +5 °C), PVC and PP become brittle. Recommended ambient temperature for installation is above +15 °C. Also the temperature of the components to be installed should be above +15 °C. Installation in temperatures below +15 °C has to be done cautiously. It is not recommended to install an aeration system when temperature is below +5 °C.

6.3 Installation of bottom mounting brackets

6.3.1 Determining the location of bracket fixing points

Locations of the mounting bracket fixing points for each aeration group are indicated on the drilling layout. To achieve the best possible aeration efficiency, the distance between the group and basin wall should be uniform on all sides. Usually the dimensions of the basin do not determine the exact position of the fixing points. Often the fixing point positioning is determined by the position of droplegs. If several groups are installed in the same basin, group layout must be planned as a whole.

Once the positions of diffuser groups have been tentatively determined, mark the fixing points for drop-in anchors on the basin floor. It is extremely important that the drop-in anchors are aligned as shown on the drilling layout. If not, the piping can be subjected to lateral forces during operation.

6.3.2 Installing bottom mounting brackets

Drill holes at the marked locations for drop-in anchors. Hole sizes to be used:

bracket HPK 210 drop-in anchor LAH 10	ø 12 mm x 40 mm
bracket TPK drop-in anchor LAH 12	ø 15 mm x 50 mm

Remove any debris from the hole using compressed air. Insert the anchor so that it is flush with the basin floor. Fix the drop-in anchor in position by hitting it with the tool as shown in Figure 8. Make sure that the shoulder of the tool strikes the top of the drop-in anchor.

Once the drop-in anchors are fixed in position, fasten the HPK 210 mounting bracket HTU 210 foot to the drop-in anchor using the KL 11/28 washer and M10 x 20 hex screw. Take care not to damage the plastic. Make sure that the basin floor under the foot is clean and level.

Screw M12 threaded rods of TPK mounting brackets directly into drop-in anchors.

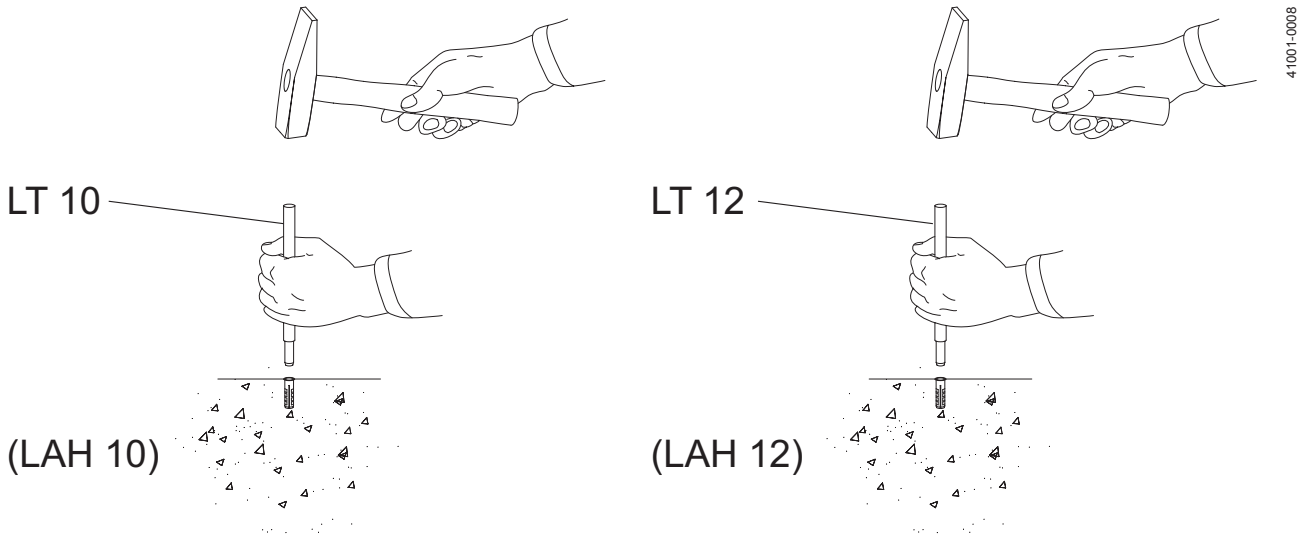


Figure 8 Fixing the LAH 10 and LAH 12 drop-in anchors in position

6.3.3 Adjusting the height of HPK 210 bottom mounting bracket

To achieve maximum aeration efficiency, the plane on which the diffusers lie must be as close to the basin bottom as possible. In a finished group, the variation in height between individual diffusers must be less than ±10 mm. The diffuser heights in various basins should be as uniform as possible. Sometimes the diffuser height must be raised because of limited compressor capacity or other structures at the floor of the basin. If so, the bottom mounting brackets can be installed at a greater height using special fixings. Such fixings are not included in the delivery.

The easiest way of adjusting diffuser height is to use the height of the pipe holder HKI 210 (Figure 9) (on which the diffuser element rests) as the reference point. Start adjusting the height of the diffusers from the highest point of the basin floor. Screw the mounting brackets at this point as far down as they will go. Then adjust all other brackets to this height.

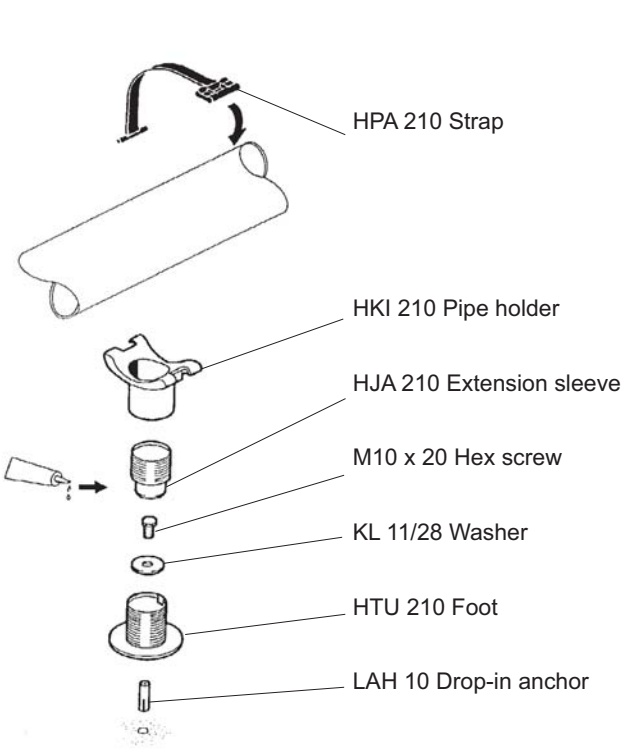


Figure 9 HPK 210 bottom mounting bracket's extension sleeves are fixed to one another and to the foot with adhesive

If necessary, the mounting bracket heights can be raised using the HJA 210 extension sleeve. If the height of the pipe holder from the basin floor is from 68 to 108 mm, no extension sleeve is required. Mounting bracket height can be increased by 40 mm with the addition of one extension sleeve. The maximum number of extension sleeves is two, which are then able to compensate for basin floor height variations of up to 120 mm. If the height variation is greater than this, the height of the mounting bracket must be increased by some other means in order to ensure that the diffusers are on the same level and height.

The extension sleeves are connected to one another and to the foot with adhesive (Figure 9) because the bottom mounting brackets will be subject to pipework buoyancy when in water. For gluing, use standard PVC adhesives (such as Tangit or Pevicol) and comply with the manufacturer's instructions. The standard delivery will include one extension sleeve for each bottom-mounting bracket. Adhesive is not included in the delivery.

6.4 Adjusting the height of TPK bottom mounting bracket

TPK bottom mounting brackets are used for steel and large PVC (ø over 90 mm) zone headers. Screw the lower nuts onto the M 12 threaded rods and then place the washer and the lower half of the holder on top of them. Lift the zone header pipe onto the lower half of the holders. Then place the diffuser elements, closest to the zone header, on their bottom mounting brackets. Use the nuts of the TPK bracket to adjust the height of the zone header. Zone header branches must be horizontally and vertically aligned with the diffuser elements.

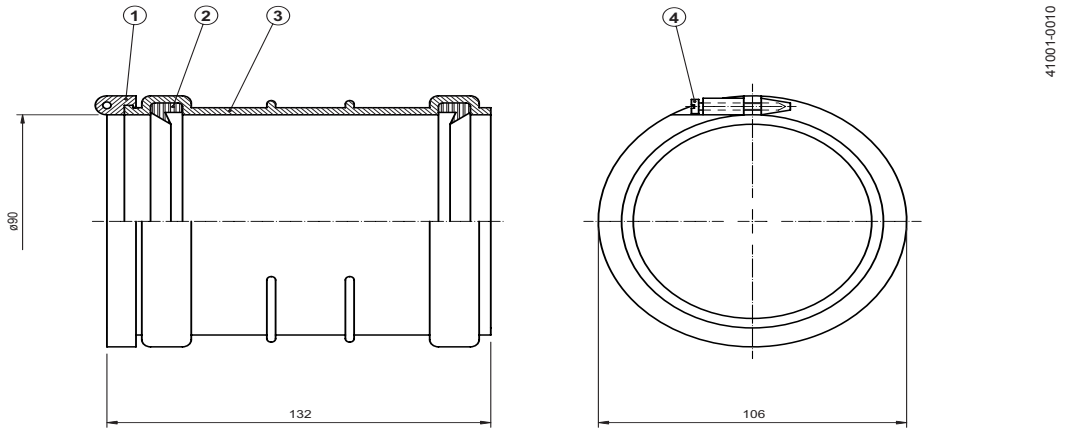
A multi-section zone header must be adjusted to correct height section by section.

Steel multi-section zone headers have flanged joints. When fixing the flanged joint, tighten the bolts uniformly to ensure that the flange does not bend. Plastic multi-section zone headers have sleeve joints. With a sleeve joint, the seal and the end of the pipe have to be lubricated with soap solution to ease the installation.

6.5 Installing diffuser elements

When installing diffuser elements, start from the zone header and proceed towards the water collection pipe. The water collection pipe in each group must not be installed until all other components have been fixed in position. Place diffuser elements on the pipe holders as shown in the layout plan and connect them using HSY 90-90 connection sleeves which permit thermal expansion (Figure 10). Ensure that all diffusers are exactly horizontal. The straps of the bottom mounting brackets must not be fitted until the water collection pipe has been installed. When installing the elements, ensure that the internal surface of the pipe is clean.

Before installing the connection sleeve, insert a lock ring in the groove at one end of the sleeve. When the connecting sleeve has been installed, tighten the lock ring using the correct screwdriver. When installing sleeves that connect the zone header directly to the diffuser element, the lock ring must face the zone header. With other connection sleeves, the lock ring must face the water collection pipe (Figure 11). When an element is correctly installed, one of the two indication lines at the element end remains visible. The ends of the elements are then approx. 20 mm apart.



1	Lock ring LUR 90	3	Body HSY 90R
2	Gasket HLT 90	4	Screw 3,5 x 3,5

Figure 10 Connection sleeve HSY 90-90

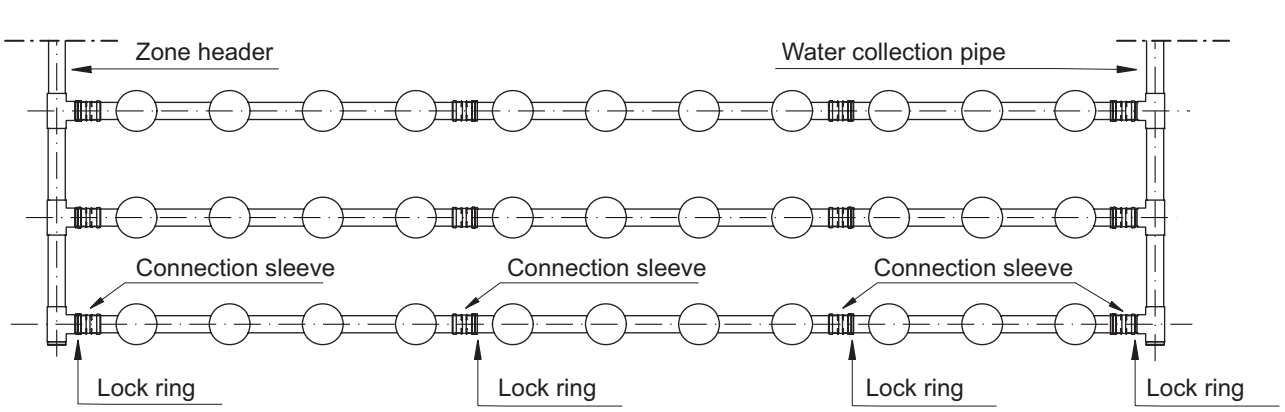


Figure 11 Overview

When installing connection sleeves that connect the zone header directly to the diffuser element, the lock ring must face the zone header. With other connection sleeves, the lock ring must face the water collection pipe.

Lubricate the connection sleeve gasket with a soap-based lubricant before fixing the element. Never use lubricants that may damage the rubber.

6.6 Installing water collection pipe

Install the water collection pipe after all the diffuser elements have been connected. At this point, the elements are still resting on top of the mounting brackets so that the connection sleeve gives some play. Long water collection pipes consist of multiple sections, which are inter-connected using connection sleeves HSY 90-90.

6.7 Fixing the system

To fix the elements to HPK 210 mounting brackets, use HPA 210 straps. Use the special tool HPAAT (Figure 12) to install the straps. The straps can be removed with the same tool however we recommend that used straps are replaced.

The straps must be installed when warm. At low temperatures (< 5 °C), the strap becomes stiff and may break when installed. Straps can be warmed in water before installation.

Finally check the alignment of the zone header and fix the top halves of the TPK brackets in position and tighten them in place with the top bracket nuts.

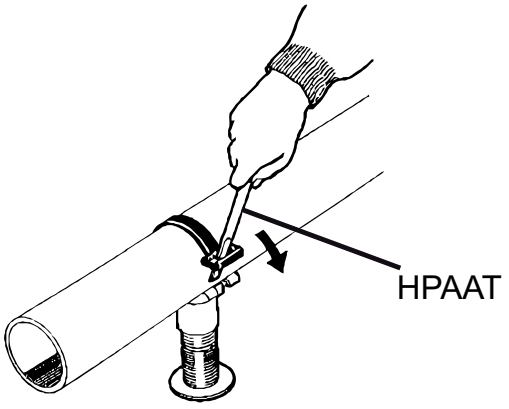


Figure 12 Fixing the pipe to the bottom mounting bracket HPK 210 using the special tool HPAAT

6.8 Connection of the dropleg and condensate release pipe / hose

Before connecting the aeration group to the dropleg, remove any debris / contamination from the air supply header and droplegs using compressed air. To prevent debris / contamination from entering the aeration grid pipework installed on the basin floor all zone header flanges and open pipes should be covered.

After the piping has been cleaned, connect the group dropleg flange to the zone header flange. When tightening the flange, make sure that the zone header does not move.

The dropleg must be fixed to the basin wall or to the floor to ensure that the zone header and its flange are not subjected to any load. In addition, the upper end of the dropleg must be fitted with a connection sleeve that permits thermal expansion and prevents movement due to expansion from being transmitted to the diffuser group.

The material of the water drainage coupling is AISI 316. Connect the purge pipe or hose to the drainage coupling VPL 90. Drainage couplings can also be located in large zone headers. The other end of the pipe or hose must be fitted with a valve and fixed above the water surface. The rising angle of the pipe or hose must be at least 40º along its entire length, and supports must be provided on the basin wall or other structures at least every 50 cm.

For basins where strong currents are produced, use a purge pipe and fix it with due regard to the forces generated by the currents.

The purge pipe or hose is not included in the delivery.

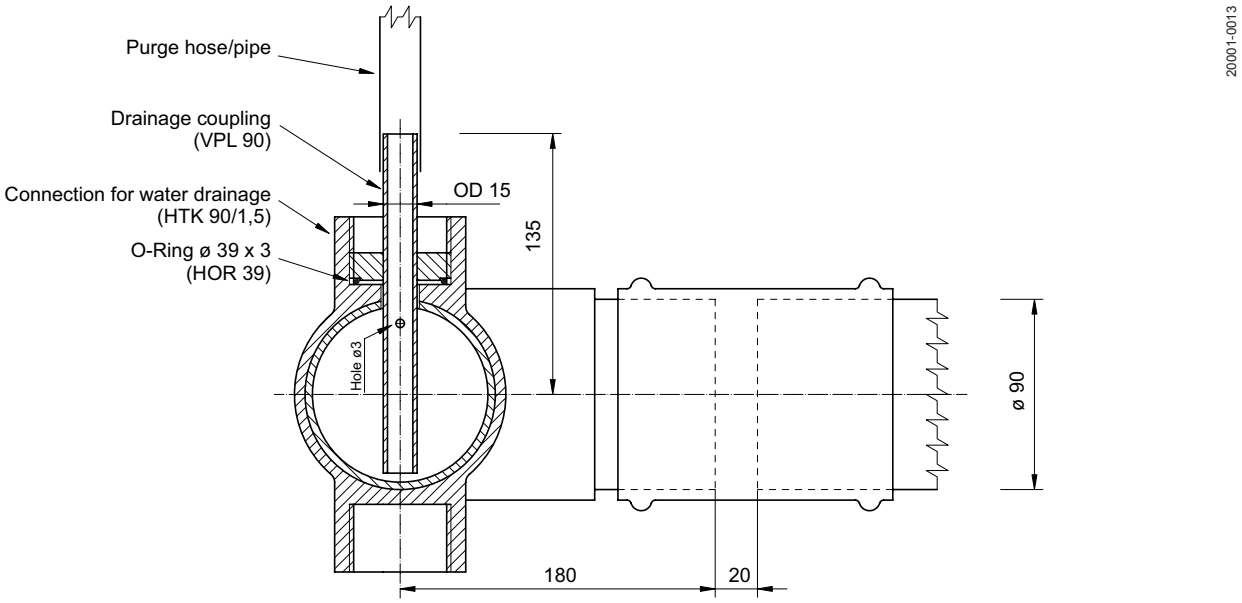


Figure 13 Connecting the drainage coupling VPL 90 to the piping

6.9 Post-installation procedures

When the installation is completed, carry out a system leak test (see Chapter 12).

If the leak test is not carried out immediately after installation, fill the basin with clean water. Make sure that the water level is at least one metre above the diffusers. Water protects the diffusers from UV radiation, sub-zero temperatures and dirt. If porous discs HIL 210 or MIL 210 are used, aeration must be switched on to prevent the diffusers from becoming blocked. The air supply should be started “softly” i.e. with a low air flow which is then increased slowly.

Keep the aeration basin clean. No heavy objects, debris or soil should be allowed to fall in the basin, any of which can damage or block the diffusers. Drops of paint and welding sparks can also damage the diffusers.

7 Installation of screw-on diffusers

7.1 Delivery

The following diffusers are of the screw-on type:

PRK 300 R ½	KKI 215 R ½	HKL 215 R ½	MKL 215 R ½
PRK 300 R ½ K	KKI 215 R ½ K	HKL 215 R ½ K	MKL 215 R ½ K
PRK 300 BSF ½	KKI 215 BSF ½	HKL 215 BSF ½	MKL 215 BSF ½

R ½ has a parallel thread and R ½ K taper thread. For larger thread sizes, an adapter is installed between the diffuser and pipe. It is not advisable to mount diffusers on smaller thread sizes. Screw-on diffusers are similar in design to diffusers mounted with the wedge piece (HSK 215) except for the main body (Figure 5 and Figure 14).

As a rule, the diffusers are supplied fully assembled. The piping and pipe threading are not included in the delivery. The diffusers are packed in cardboard boxes. For instructions on handling or storing the diffusers refer to clauses 5.5 and 5.6.

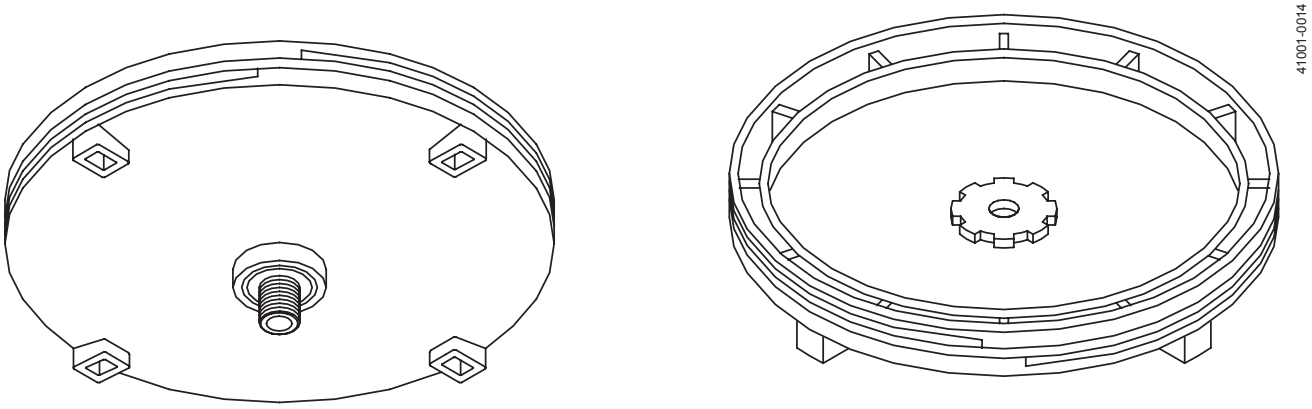


Figure 14 Main body of screw-on diffuser

7.2 Installation

Before installation check the O-ring around the threaded nipple and the pipe threading. Carefully screw the diffuser onto the pipe by hand. Damage can be caused to the diffuser or the pipe if the diffuser is over tightened. Make sure that the O-ring remains exactly in position to ensure a leakproof joint. Sealing tape or sealing material (such as Loctite 5331) may also be used.

When finished drain any excess water which may have collected in the pipes. One method is to use the condensate purge pipe shown in Figure 13. This method is regularly used to drain condensed water from the system.

When the installation is completed, carry out a system leak test (see Chapter 12).

If the leak test is not carried out immediately after installation, fill the basin with clean water. Make sure that the water level is at least one metre above the diffusers. Water protects the diffusers from UV radiation, sub-zero temperatures and dirt. If porous discs HIL 210 or MIL 210 are used, aeration must be switched on to prevent the diffusers from becoming blocked. The air supply should be started “softly” i.e. with a low air flow which is then increased slowly.

Keep the aeration basin clean. No heavy objects, debris or soil should be allowed to fall into the basin, any of which can damage or block the diffusers. Drops of paint and welding sparks can also damage the diffusers.

Note the critical assembly temperatures, which are specified in Chapter 6.2.

8 Installation of Sucoflow DS 20

8.1 Delivery

As a rule, the Sucoflow DS 20 diffusers are supplied fully assembled. The piping and pipe threading are not included in the delivery. The diffusers are packed in cardboard boxes. For instructions on handling or storing the diffusers please refer to clauses 5.5 and 5.6.

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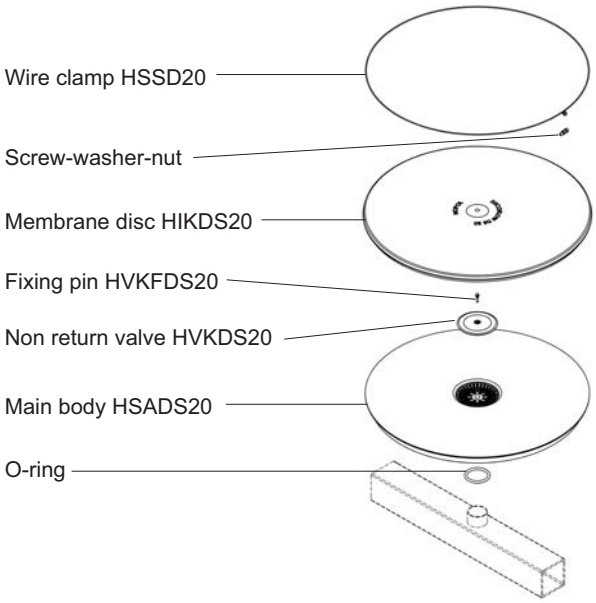

Figure 15 Sucoflow DS 20 diffuser

The pipework must be built in accordance with the instructions given in Chapter 6. The buoyancy is 0.15kN/diffuser. The distances between the anchors for the pipework and the fasteners have to be sized accordingly.

8.2 Installation

Sucoflow DS 20 diffusers can be installed on round and rectangular piping. The diffusers are screwed onto straight nipples threaded over the complete length (G 1 ½“). To fasten diffusers to rectangular steel pipes a special plastic nipple (Part No. 196019) can be used (see Figure 17). For connection to plastic pipes drilled and tapped pipe clips with double nipples must be used.

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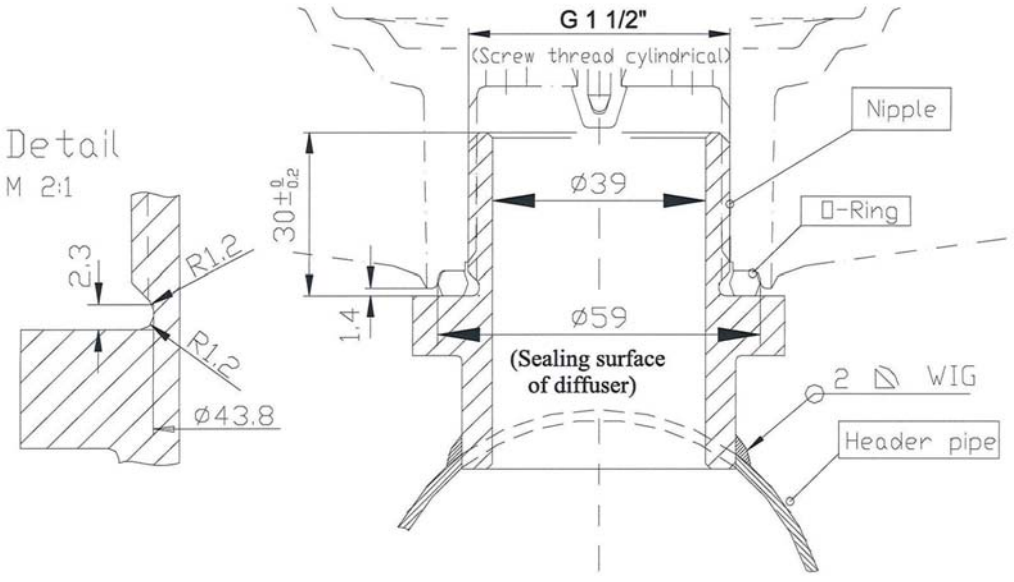

Figure 16 Installation on round piping

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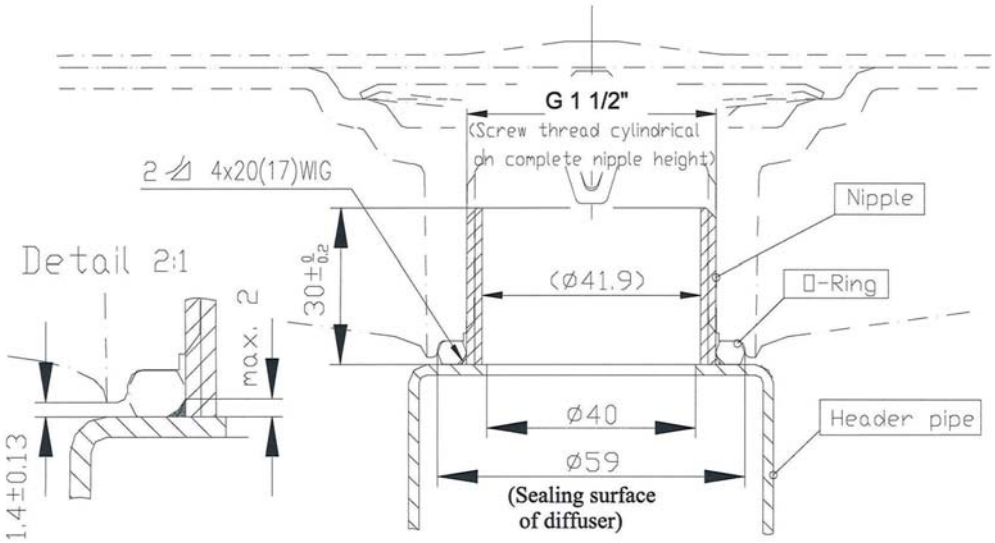

Figure 17 Installation on rectangular piping

- In case of rectangular stainless steel piping: insert the plastic nipple Art. No. 196019 into the hole and turn clockwise to the stop.
- Place the sealing ring (O-Ring 47.00 x 5.34) on top of the threaded nipple and roll it down to the flat surface. Make sure that the O-ring remains exactly in position to ensure a leakproof joint. Sealing tape or sealing material (such as Loctite 5331) may also be used.
- Place the Sucoflow DS 20 diffuser horizontally on the threaded nipple and turn it carefully in clockwise direction.
- Be careful not to damage the thread of the Sucoflow DS 20 diffuser while turning it.
- The Sucoflow DS 20 diffuser should not be over tightened.
- Rotate the Sucoflow DS 20 diffuser until the hub is in firm contact with the sealing ring. Fasten the diffuser with an **additional ¼ turn = 90°**. (When using the plastic nipple Part No. 196019, the diffuser should never be turned counter-clockwise. Should this happen accidentally, the diffuser must be removed and the complete process repeated.)
- When the installation is completed, carry out a system leak test (see Chapter 12). Should a diffuser be leaking at the hub (air bubbles below the disc), then fasten additionally by ⅛ turn = 45° as a maximum.

ATTENTION ***Excessive tightening of the diffusers may result in damage. There is no warranty coverage for such a case.***

When finished drain any excess water which may have collected in the pipes. One method is to use the condensate purge pipe as shown in Figure 13. This method is regularly used to drain condensed water from the system.

If the leak test is not carried out immediately after installation, fill the basin with clean water. Make sure that the water level is at least one metre above the diffusers. Water protects the diffusers from UV radiation, sub-zero temperatures and dirt. The air supply should be started “softly” i.e. with a low air flow which is then increased slowly.

Keep the aeration basin clean. No heavy objects, debris or soil should be allowed to fall into the basin, any of which can damage or block the diffusers. Drops of paint and welding sparks can also damage the diffusers.

Note the critical assembly temperatures, which are specified in Chapter 6.2.

9 Modification kit PRF 300

The modification kit PRF 300 can be used to increase the capacity of an existing system without increasing the number of diffusers. No alterations to the existing piping are required however in some cases it may be necessary to replace the zone header due to the increased air flow rate.

9.1 Delivery

The modification kit PRF 300 is similar to PRK 300 (Figure 5) except that it is supplied without the main body HSA 215 and wedge piece HSK 215. The delivery includes the following:

screw-on ring	PKR 300
sliding ring	PVR 300
membrane disc	HIK 300
extension plate	PTL 300
circular gasket	HUR 300
support ring	HTR 300

The modification kit is fully assembled at the factory and packaged in cardboard boxes. For instructions on handling or storing the diffusers please refer to clauses 5.4, 5.5 and 5.6.

9.2 Installation of the modification kit

The modification kit PRF 300 can be used to replace any diffusers having the HSA 215 main body.

Before installation drain the basin and clean the outsides of diffusers and headers. Then remove the screw-on ring of the old diffuser using the special tool HKLAT 215 or HKLIT 215 provided (Figure 25). Then remove the porous or membrane disc including their support plates and clean the inside of the diffuser main body.

If the non-return valves in the diffusers have been used for a long time or if they are in bad condition, replace the rubber part of the HVK 215 valve. Check the other diffuser parts as well.

Begin the installation by positioning the circular gasket HUR 300 and the support ring HTR 300, which fits inside the gasket, into the main body HSA 215. Ensure that the gasket is seated correctly onto the main body. Lubricate the upper surface of the gasket with a soapy solution. Screw the modification kit onto the main body HSA 215 by manually tightening the joint.

Note the critical assembly temperatures, which are specified in Chapter 6.2.

When installation is completed, carry out a system leak test (see Chapter 12). Use tool RFIT 300P if necessary to tighten PRF 300 further.

If the leak test is not carried out immediately after installation, fill the basin with clean water. Make sure that the water level is at least one metre above the diffusers. Water protects the diffusers from UV radiation, sub-zero temperatures and dirt.

Keep the aeration basin clean. No heavy objects, debris or soil should be allowed to fall into the basin, any of which can damage or block the diffusers. Drops of paint and welding spark can also damage the diffusers.

10 Installation of additional diffusers

10.1 Using additional diffusers

To increase system capacity, diffusers can be added to an existing system. Extra diffusers can either be added to the existing elements, or the number of diffuser rows in the group can be increased. When new rows are added, the zone headers and water collection pipes must also be replaced because of the higher number of rows and greater air flow rate.

Extra diffusers can be added to a KKIE/ HKLE / MKLE system if c/c diffuser spacing in the existing system is at least 480 mm (Figure 18). With PRKE and PIKEV systems, extra diffusers can be added if spacing is at least 800 mm (Figure 19).

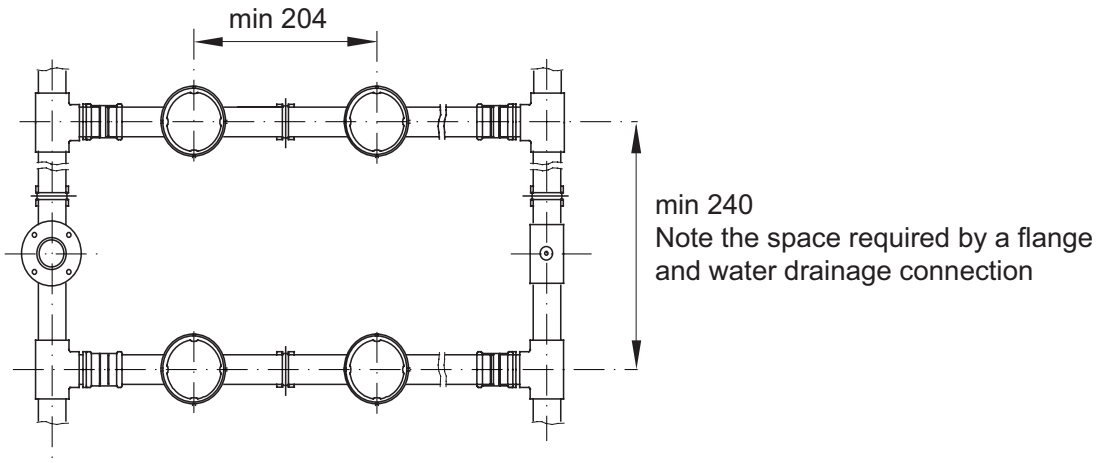

Figure 18 Advisable minimum spacing of diffusers and rows for KKIE, HKLE and MKLE aeration systems

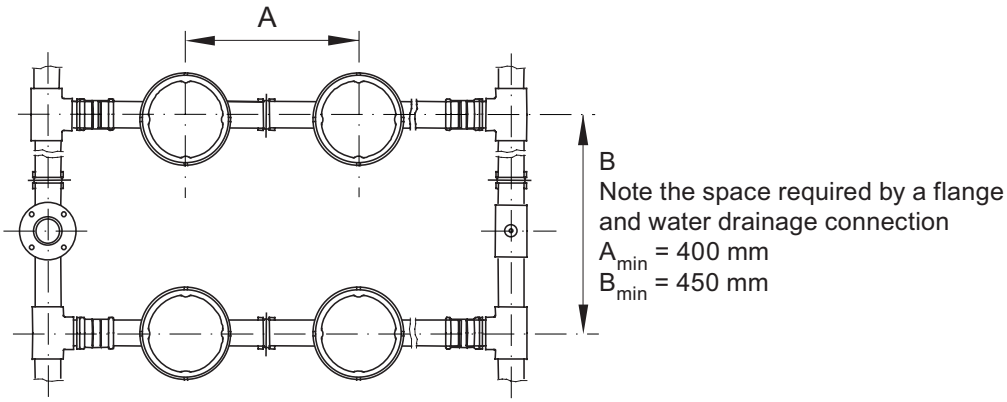

Figure 19 Advisable minimum spacing of diffusers and rows for PRKE and PIKEV aeration systems

10.2 Before installation

Before installation drain the basin and clean the diffusers and piping. This also gives a good opportunity to check the condition of the existing system and diffusers. Parts that are defective or in bad condition must be replaced.

The diffusers will be supplied in parts or fully assembled as specified. If additional diffusers are supplied as elements, the delivery usually includes new zone headers and water collection pipes.

For instructions on handling and storing the diffusers please refer to clauses 5.4, 5.5 and 5.6.

Note the critical assembly temperatures, which are specified in Chapter 6.2.

10.3 Installing new diffusers to existing piping

Drill the holes for new diffusers at the top of the element pipe perpendicularly to the existing diffuser plane (Figure 20). Required hole diameter X is 20 $^{+0,5}/_{-0}$ mm for PRK 300, KKI 215, HKL 215 and MKL 215 diffusers. For PIK 300 diffuser, the required diameter of the hole X is 15 $^{+0,5}/_{-0}$ mm when using PVC or steel pipes. PIK 300 with flat seal PLT 15/4 is used for ø 90 mm PVC pipe and with flat seal PLT 15/5 for ø 88.9 mm steel pipe. All new diffusers must be level and aligned with existing diffusers. Make sure that the drilled hole is clean and free from burrs to ensure a leakproof joint between the diffuser and the pipe.

In steel pipes the outer edge of the hole has to be rounded (R 0.3 mm).

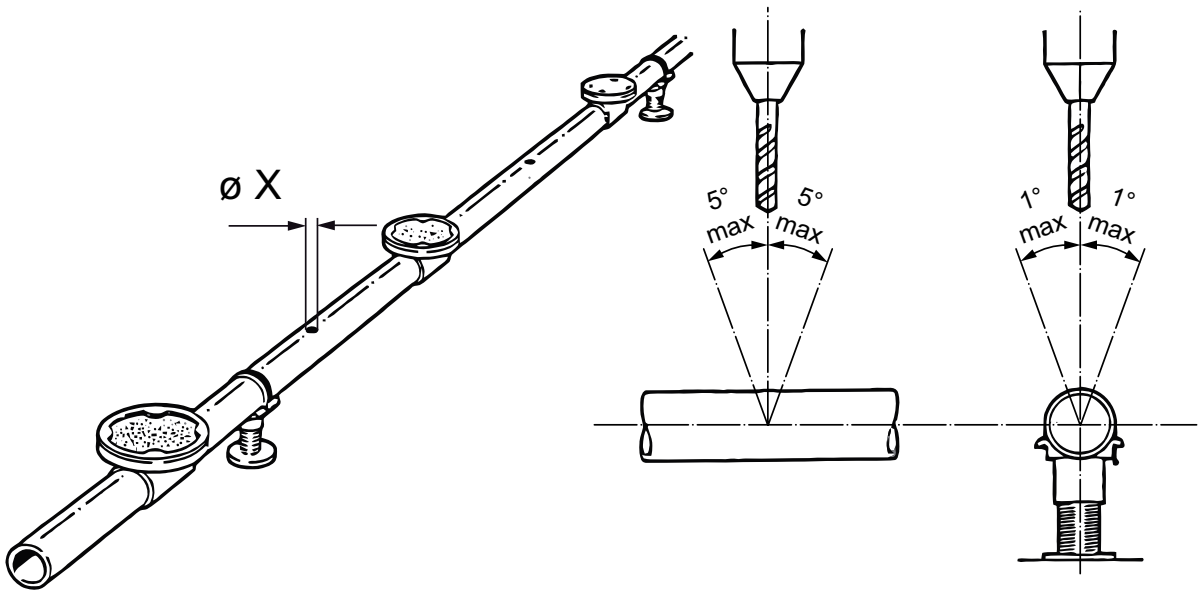

Figure 20 Making a hole in the diffuser element

The additional diffusers should be spaced as uniformly as possible within the group. Uniform distribution will ensure uniform air supply in the group.

The extra diffuser is inserted in the drilled hole and the wedge is moved into position using a rubber-headed hammer as shown in Figure 24. Installation tool TWP is required for PIK 300 diffuser as shown in Figure 27. When installing PIK 300 diffuser, lubricate the underside of the pipe with a soap solution to assist with the fitting of the wedge piece. Finally make sure that the diffuser top is level. If the element is removed from the group for installation, follow the instructions given in Chapters 6.5-6.8 when reassembling the group.

When the installation is completed, carry out a system leak test (see Chapter 12).

If the leak test is not carried out immediately after installation, fill the basin with clean water. Make sure that the water level is at least one metre above the diffusers. Water protects the diffusers from UV radiation, sub-zero temperatures and dirt. If porous discs HIL 210 or MIL 210 are used, aeration must be switched on to prevent the diffusers from becoming blocked. Air supply should be started “softly” i.e. with a low air flow which is then increased slowly.

Keep the aeration basin clean. No heavy objects, debris or soil should be allowed to fall into the basin, any of which can damage or block the diffusers. Drops of paint and welding sparks can also damage the diffusers.

10.4 Adding new diffuser rows

To begin with, remove the existing water collection pipe and existing zone header. Then follow the instructions given in Chapter 6. Start by fixing the bottom mounting brackets.

When the installation is completed, carry out a system leak test (see Chapter 12).

If the leak test is not carried out immediately after installation, fill the basin with clean water. Make sure that the water level is at least one metre above the diffusers. Water protects the diffusers from UV radiation, sub-zero temperatures and dirt. If porous discs HIL 210 or MIL 210 are used, aeration must be switched on to prevent the diffusers from becoming blocked. Air supply should always be started “softly”, that is with small air flow which can later be increased gradually.

Keep the aeration basin clean. No heavy objects, debris or soil must be dropped in the basin that could damage or block the diffusers. Drops of paint and welding sparks can also damage the diffusers.

11 Installation of diffusers on OD 88.9 mm pipe

11.1 Delivery

Diffusers that are suitable for OD 88.9 mm pipe (PVC or stainless steel) are PIK 300 S D88.9, PRK 300 D88.9, KKI 215 D88.9, HKL 215 D88.9 and MKL 215 D88.9. Code D88.9 means that the diffuser is designed for use with pipes having an outer diameter of 88.9 mm. The diffusers are of standard construction but use O-ring HOR 18. PIK 300 S D88.9 diffuser is equipped with flat seal PLT 15/5 which fits ø 88.9 mm PVC and steel pipes.

Usually the delivery contains whole, loose diffusers. Pipework is not included in the delivery. Diffusers are packed in cardboard boxes. For instructions on handling and storing the diffusers refer to clauses 5.4, 5.5 and 5.6.

11.2 Installation

Drill the holes for new diffusers at the top of the element pipe perpendicularly to the existing diffuser plane (Figure 20). Required diameter of the hole is 20 $^{+0,5}/_{-0}$mm for PRK 300, KKI 215, HKL 215 and MKL 215 diffusers. For PIK 300 diffuser, the required diameter of the hole is 15 $^{+0,5}/_{-0}$mm when using PVC or steel pipes. All new diffusers must be level and aligned with existing diffusers. Make sure that the drilled hole is clean and free from burrs to ensure a leakproof joint between the diffuser and the pipe.

In steel pipes the outer edge of the hole has to be rounded (R 0.3 mm).

The requirements for PVC pipes are:

outer diameter	88.9 ± 0.2 mm
roundness	88.9 ± 0.76 mm
wall thickness, minimum	3.5 mm

When using stainless steel pipes ISO DN80 (outer diameter 88.9 mm), the pipe diameter tolerance has to be ± 0.75 % and deviations from a perfect circle have to be included in the diameter tolerance. Wall thickness has to be at least 1.5 mm.

The diffuser is located into the hole drilled in the pipe and the wedge piece moved into position as shown in Figure 24 for PRK 300, KKI 215, HKL 215 and MKL 215 diffusers. For PIK 300 diffuser, the TWP installation tool for the wedge piece is used as in Figure 27. When installing PIK 300 diffuser, lubricate the underside of the pipe with a soap solution to assist with the fitting of the wedge piece.

Refer to Section 6 for instruction when installing an aeration system comprising of diffusers supplied by ABS and pipework supplied by the customer.

When installation is completed, carry out a system leak test (see Chapter 12).

12 System leak testing

12.1 Procedures and permissible air flow rates for leak tests and trial runs

When fully installed, the aeration system must be free from leaks. All air entering the water must be delivered through the diffusers. Any leaks in the aeration system will increase energy consumption, and if sludge is allowed to enter the system there is a high risk of blocking the diffusers.

The aeration system must be tested for leaks in three stages by using clean water and feeding air into the system. Any leaks will then be detected as bubbles.

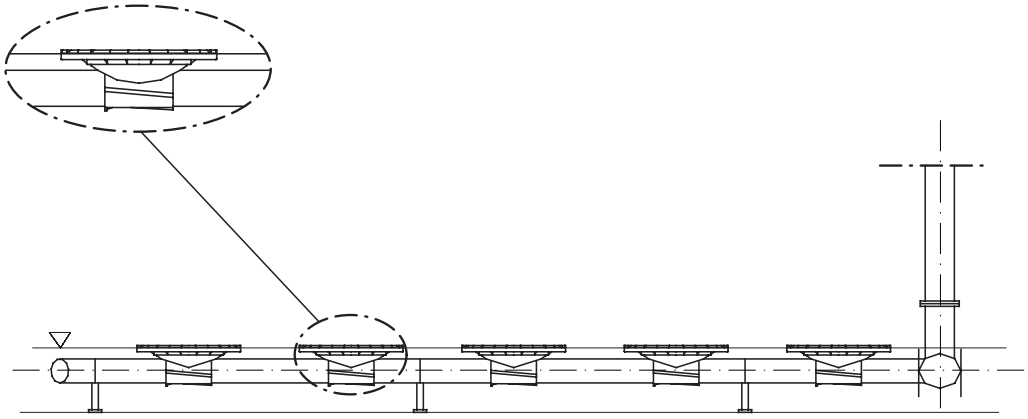

Figure 21 Stage 1: Raise water level until it is halfway up screw-on ring HKR 215 / PKR 300 or main body HSADS20

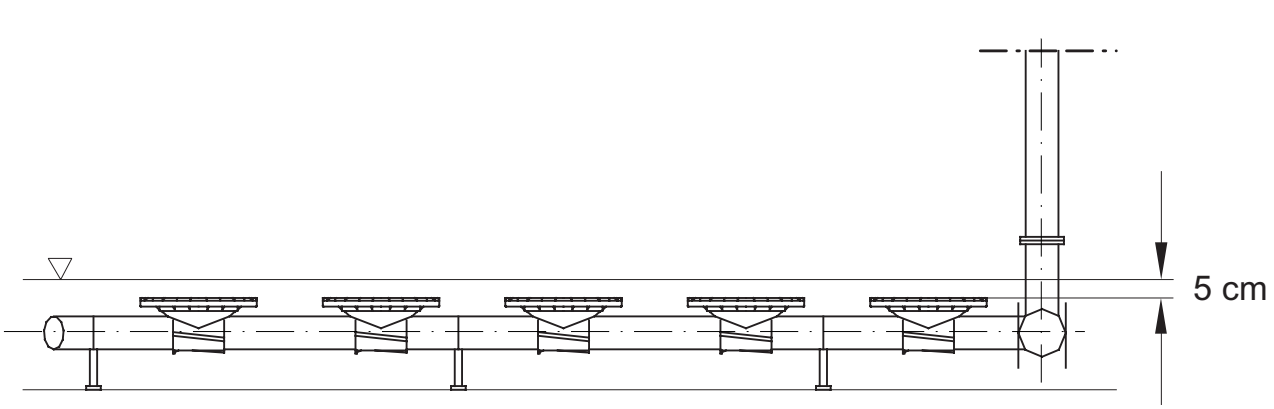

Figure 22 Stage 2: Raise water level until it is approximately 5 cm above the diffusers

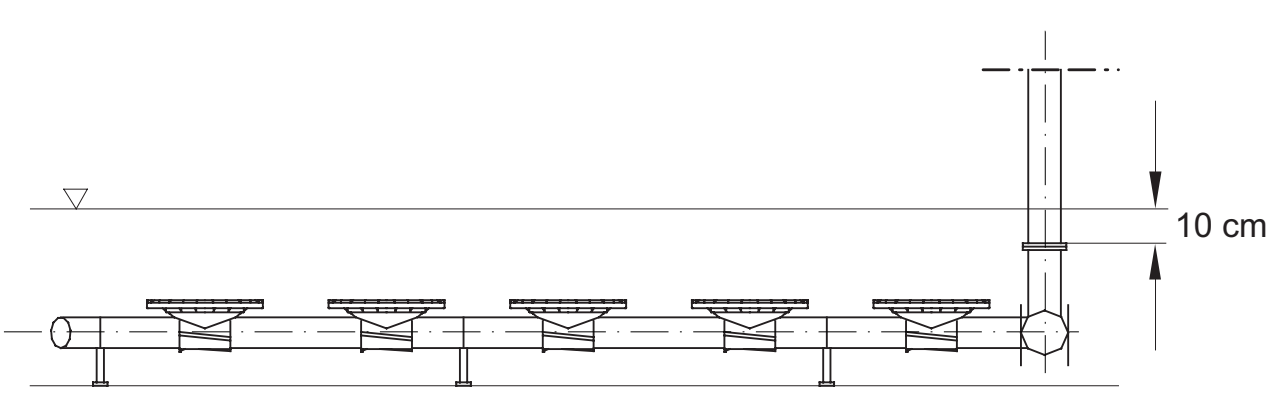

Figure 23 Stage 3: Raise water level until it is approximately 10 cm above the flanged joint of the dropleg

The maximum air flow rates permitted in leak tests and trial operation are:

PIK 300	8.0	Sm^3/h/diffuser	(20 ºC, 101,325 kPa)
PRK 300	8.0	Sm^3/h/diffuser	(20 ºC, 101,325 kPa)
KKI 215	4.0	Sm^3/h/diffuser	(20 ºC, 101,325 kPa)
HKL 215	5.0	Sm^3/h/diffuser	(20 ºC, 101,325 kPa)
MKL 215	6.0	Sm^3/h/diffuser	(20 ºC, 101,325 kPa)
Sucoflow DS 20	15.0	Sm^3/h/diffuser	(20 ºC, 101,325 kPa)

Trials to see that the blowers operate correctly should be carried out before the pipes supplying process air to the diffusers are connected. However, if air is supplied to the group during blower trials, the maximum air flow rates indicated above must not be exceeded. Air volumes can be calculated on the basis of blower output. Make sure that all the necessary valves are open.

If there is a long time interval between installation and leak test, the basin should be emptied before the leak test. The aeration system is drained of possible water by opening one HSY 90-90 connection sleeve on the water collection pipe and supplying air to the system. If the diffuser group does not have water collection pipe, one connection sleeve at the end of each branch should be opened.

The air supply should be started “softly” i.e. with a low air flow which is then increased slowly.

Any defects found during leak tests must be entered in the installation inspection form and then repaired immediately. A number of spare parts are supplied with the system to replace components that may be damaged during transportation and installation.

12.2 First leak test

For the first leak test, raise the water level halfway up the diffuser screw-on ring HKR 215 / PKR 300 or in case of Sucoflow DS 20, main body HSADS20. The diffuser tops will remain above the water surface. Switch on the air supply and check for any leaks:

- at connection sleeves HSY 90-90
- the joint between main body HSA 215/PSA 300 and element pipe
- the lower section of screw-on ring HKR 215/PKR 300
- the thread between support plate PTL 300 and main body HSA 215
- thread connection of Sucoflow DS 20
- the water collection pipe and zone header.

Leakage from connection sleeve HSY 90-90 is usually due to a misaligned rubber gasket or incorrect installation of the sleeve. One of the indicating lines marked at the element end must be visible. Repair any defects by re-installing the sleeve. Any damaged connection sleeves must be replaced.

The PRK 300, KKI 215, HKL 215 or MKL 215 diffuser must be detached from the element (Figure 24) if air bubbles escape from between the main body HSA 215 and the element pipe. To remove the diffuser gently release the wedge piece HSK 215 from the locating peg with a screwdriver whilst at the same time knocking the wedge with a soft faced hammer in the direction opposite to the arrow. Once the diffuser is removed, check the main body and O-ring and reinstall the components. Any defective parts must be replaced.

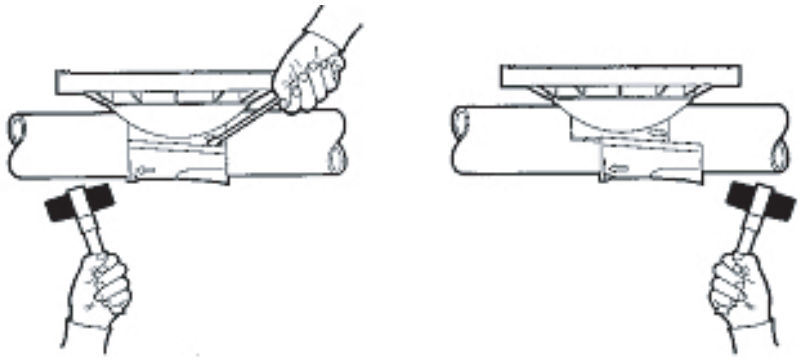

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Figure 24 Removing and attaching PRK 300, KKI 215, HKL 215 and MKL 215 diffusers

If there is leak under the screw-on ring, the ring is probably not tight enough or misaligned. The leak can also be due to a misaligned porous or membrane disc. To repair the fault, tighten the ring or unscrew it and tighten again (Figure 25). Replace defective parts.

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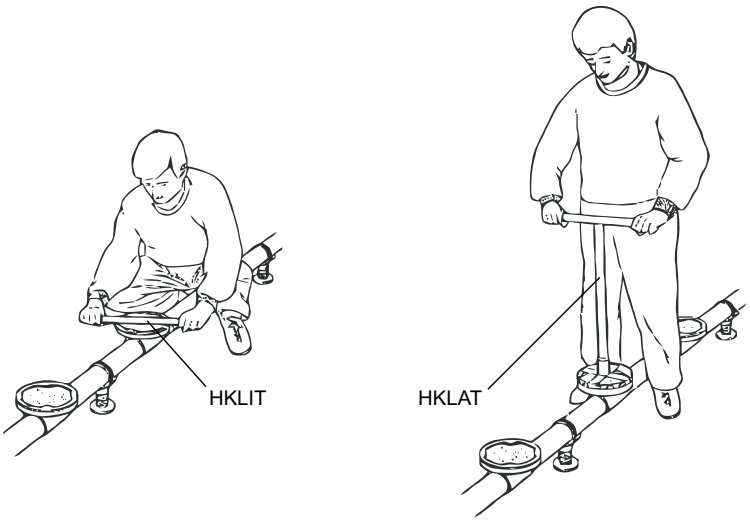

Figure 25 Special tools HKLIT 215 and HKLAT 215 for the screw-on ring

If a PRK 300 diffuser leaks from the screw-on ring or between the support plate and main body, it is advisable to remove the PRF 300 from the main body with RFIT 300 P tool (Figure 26). Place the defective PRF 300 on the VASTE 300 tool and repair it.

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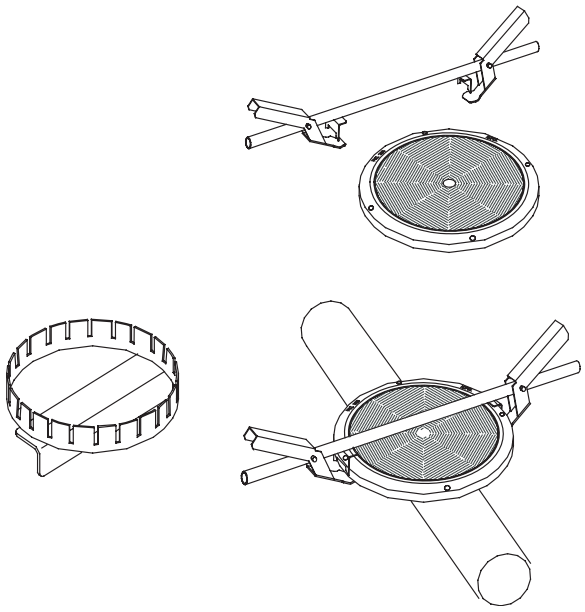

Figure 26 Special tools VASTE 300 and RFIT 300P for the screw-on ring

With PIK 300 diffuser, if air bubbles escape from between the main body PSA 300 and the pipe, the diffuser must be detached from the pipe (Figure 28). To remove the diffuser gently release the wedge piece PSK 90 frp, the locating peg with a screwdriver whilst at the same time knocking the wedge with special tool TWP in the direction opposite to the arrow. Once the diffuser is removed, check the hole, main body and seal and reinstall the components. Any defective parts must be replaced. The hole must be cleaned if needed. When reinstalling the wedge piece, lubricate the underside of the pipe with a soap solution to assist with the fitting of the wedge piece.

If the PIK 300 diffuser leaks from below the screw-on ring, the screw-on ring or the diffuser is not placed correctly. To correct this, open the screw-on ring and reinstall the components carefully. Required special tools are shown in Figure 29. Defective parts must be replaced.

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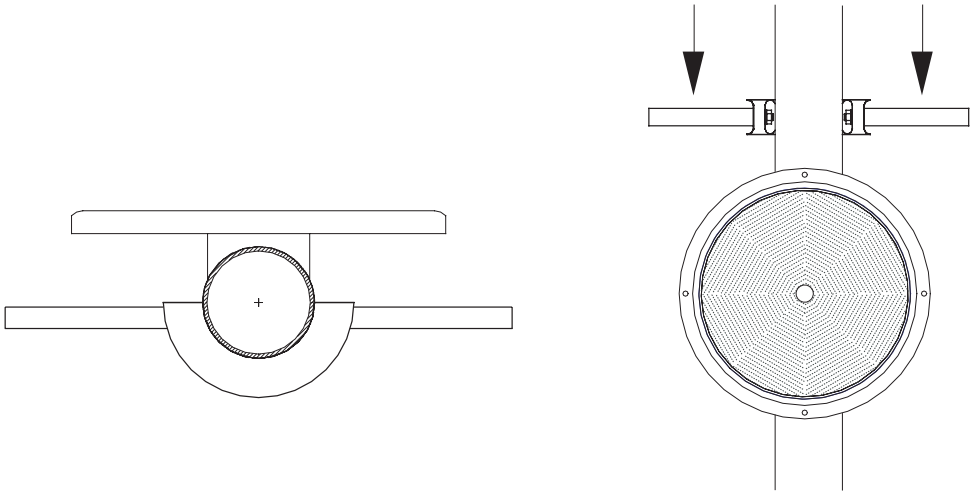

Figure 27 Attaching PIK 300 diffuser to the pipe with TWP tool

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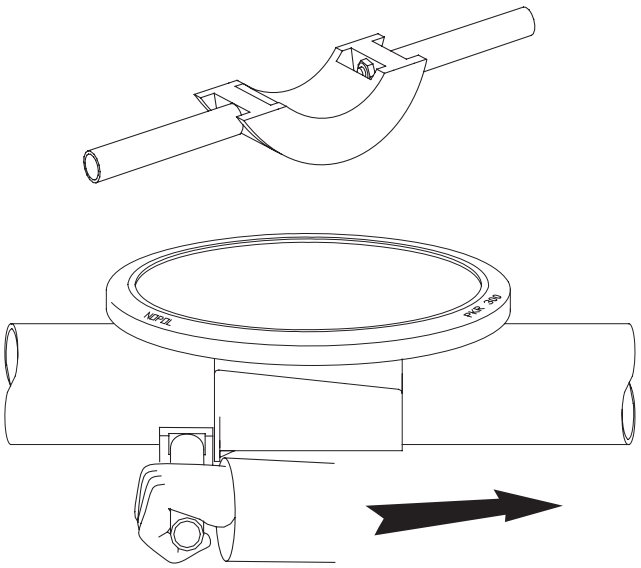

Figure 28 Removing the PIK 300 diffuser with the help of the TWP tool

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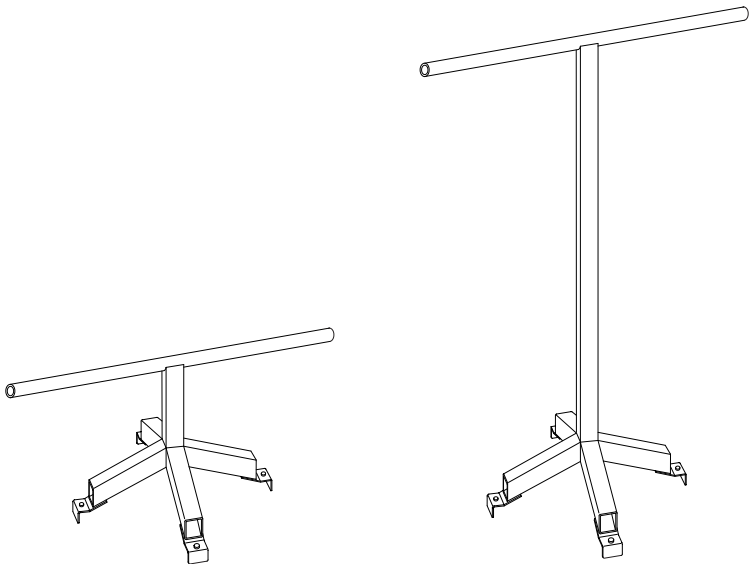

Figure 29 Special tools PKLAT 300 big and small for PIK 300 diffuser

Typical leak sites in the water collection pipe and zone header are:

the joints between cross-junction HTK 90/90 and piping

the joint between drainage connection HTK 90/1,5 and water collection pipe

at drainage coupling VPL 90

the end plug joints.

To seal any leaks in cross-junctions and end plugs, use PVC adhesive as a filler. If a drainage coupling leaks, unscrew it and check the O-ring.

12.3 Second leak test

For the second leak test, raise the water level 5 cm above the diffusers. The idea is to raise the water level high enough but not too much to make it possible for the crew to move around in the basin. Switch on the air supplies and check the system for leaks. Typical leak sites include:

the support plate PTL 300 connection to main body HSA 215

the screw-on ring HKR 215/PKR 300

As a result of increased back-pressure, leaks can also appear in locations checked during the first leak test.

If there is a leak between the screw-on ring HKR 215/PKR 300 or support plate PTL 300 and the main body, the joint is not tight enough or the membrane or porous disc or the circular gasket with support ring is not in correct position. To repair the defect, tighten the ring or unscrew it and reposition the membrane or porous disc (Figure 26). Replace defective parts. Lubricate the porous disc gasket or membrane disc edge with soap and screw the screw-on ring in position. In the case of a PRK 300 diffuser, it is advisable to replace it and take the defective diffuser to a suitable location for repairs.

Check that the screw-on ring and extension body are correctly tightened (max 50 Nm). When necessary tighten the diffusers when they are submerged. Diffusers may have become loose due to the temperature changes they could have experienced since leaving the factory.

If the PIK 300 diffuser leaks from between the screw-on ring and the main body, the screw-on ring is not tight or the membrane is not correctly positioned. This is corrected by removing the screw-on ring and reinstalling the components carefully. Defective parts must be replaced.

If a Sucoflow DS 20 diffuser leaks at the hub (air bubbles below the disc), then fasten additionally by ⅛ turn = 45° as a maximum.

To evaluate air distribution across the group, use an air flow rate of 5.0 to 6.0 Sm^3/h per diffuser for PIK 300 and PRK 300, 3.0 to 4.0 Sm^3/h per diffuser for KKI 215 and HKL 215, 4.0 to 5.0 Sm^3/h per diffuser for MKL 215 and 11.0 to 12.0 Sm^3/h per diffuser for DS 20. The air distribution is usually not even with low air flow rates and shallow water depths. This does not affect the fulfilment of SOTR guarantee.

If air supply through any diffuser is exceptionally low or stopped, the diffuser's non-return valve may not be functioning properly and it should be checked. With porous discs HIL 210 and MIL 210, surface tension and the capillary action may sometimes trap water inside the diffuser, which makes it impossible for the air to escape through the porous disc. The non-return valve and the water blocking the pores can sometimes be released by tapping the diffuser. If this is not successful the diffuser will have to be opened. Defective PRK 300 or PIK 300 diffusers should be replaced and the defective diffusers repaired in a suitable location.

If any of the diffusers passes much more air than the other diffusers, the membrane/porous disc and/or non-return valve must be replaced.

12.4 Third leak test

For the third test, raise the water level about 10 cm above the flanged joint between the dropleg and zone header. Check the following points:

- the zone header along its entire length
- the dropleg-to-zone-header connection, joint and pipe alignment. To seal any leak, reposition the gasket and tighten the nuts.
- the purge pipe or hose connection.

The even distribution of the aeration air is checked when air-feed is normal. The correct operation of the water purge system is checked by opening the drainage valve and making sure that air or air mixed with water is drained.

12.5 Storage of system and protection before start-up

If the basin is not commissioned right after the leak test, fill the basin with clean water. Make sure that the water level is at least one metre above the diffusers. Water protects the diffusers from UV radiation, sub-zero temperatures and dirt. If porous discs HIL 210 or MIL 210 are used, aeration must be switched on to prevent the diffusers from becoming blocked.

Keep the aeration basin clean. No heavy objects, debris or soil should be allowed to fall into the basin, any of which can damage or block the diffusers. Drops of paint and welding sparks can also damage the diffusers.

If it takes several weeks before the basin is actually used, it is advisable to carry out another system leak test before commissioning.

13 Operating instructions

13.1 Permissible air flow rates

Air flow rates must be maintained within the limits shown in Table 1.

Excessively high air flow rates may damage the diffusers. In the worst case, the porous discs may rupture and membranes may be torn. In all cases the service life of discs and membranes will be adversely affected by overloading.

If the air flow rate is too low, porous diffusers can become blocked because the air flow is not high enough to keep the diffuser clean. Normally, membrane diffusers are not blocked even at low air flow rates, but air may be unevenly distributed within the group. Also air distribution pattern among the various groups may change if the supplied air volume cannot be specifically regulated to each group.

Table 1: Permissible air flow rates per diffuser (20 ºC, 101,325 kPa)

	minimum (Sm^3/h)	normal (Sm^3/h)	maximum (Sm^3/h)
PIK 300	1.5	5.0	8.0
PRK 300	1.5	5.0	8.0
PRF 300	1.5	5.0	8.0
KKI 215	0.5	2.5	4.0
HKL 215	1.0	3.5	5.0
MKL 215	1.5	4.0	6.0
Sucoflow DS 20	1.5	12.0	15.0

* These rates must not be exceeded by more than 25 % even during short time (max 15 min) peak loads.

In theory due to the structure of the membrane diffuser, the lower limit for the adjustment range is zero. However, to ensure uniform air distribution, a lower limit of 1.5 Sm^3/h for PIK 300, PRK 300, PRF 300 and Sucoflow DS 20 and 0.5 Sm^3/h for KKI 215 is recommended.

In some circumstances it is advisable to use lower maximum values for air flows in order to extend the service lifetime of the porous disc or rubber membrane. Use lower air flows if:

- wastewater contains chemicals which may harm the properties of the membrane
- water temperature exceeds 30 °C
- aeration air temperature exceeds 60 °C

The maximum aeration air temperature for PIK 300 and Sucoflow DS 20 diffusers is 100 °C. For PRK 300, PRF 300, KKI 215, HKL 215 and MKL 215 diffusers it is 80 °C.

13.2 Air filtration

The purpose of air filtration is to avoid internal clogging of the diffusers.

Feed air must be conducted through a fine filter. In order to reduce the load on fine filters and to prolong their life, coarse filters should always be used as pre-treatment before fine filtering.

There are many types of filters available on the market, but here is a suggested combination:

For PIK 300, PRK 300, KKI 215 and Sucoflow DS 20 diffusers:
Coarse filter with an efficiency of 38 – 42 % at 2,0 – 3,0 µm particle size, and fine filter with an efficiency of 35 – 40 % at 0,75 – 1,0 µm particle and 80 – 85 % at 2,0 – 3,0 µm).

For HKL 215 and MKL 215 diffusers:
Coarse filter as above and fine filter with an efficiency of 95 - 99 % at 0,75 – 1,0 µm particle size.

If the air intake contains excessive amounts of harmful gases like SO_2, Cl_2 or H_20, it may be necessary to complement the air filtering system, for example with an active carbon filter. In special cases please consult with ABS.

Note that the normal blower intake filters are for the protection of the blower alone. Generally these are not enough for the protection of the diffusers. When filtration is carried out according to the above requirements, the blower suction filters can be omitted.

Fibreglass type of filters or silencers may not be used.

13.3 Commissioning

13.3.1 Pre commissioning

Before commissioning, check the aeration system with care and carry out a leak test. Also ensure that there is no debris or sludge inside the piping which could block the diffusers. Condensed water in the piping must be removed via the drainage system.

If the system is not put into operation immediately after installation, the basin must be filled with water so that the water level is at least one metre above the diffusers. (Figure 30). Water protects the diffusers against UV radiation, sub-zero temperatures and dirt. If the basin is filled with water, HKL 215 and MKL 215 diffusers must be continuously supplied at the minimum air flow rate (Table 1).

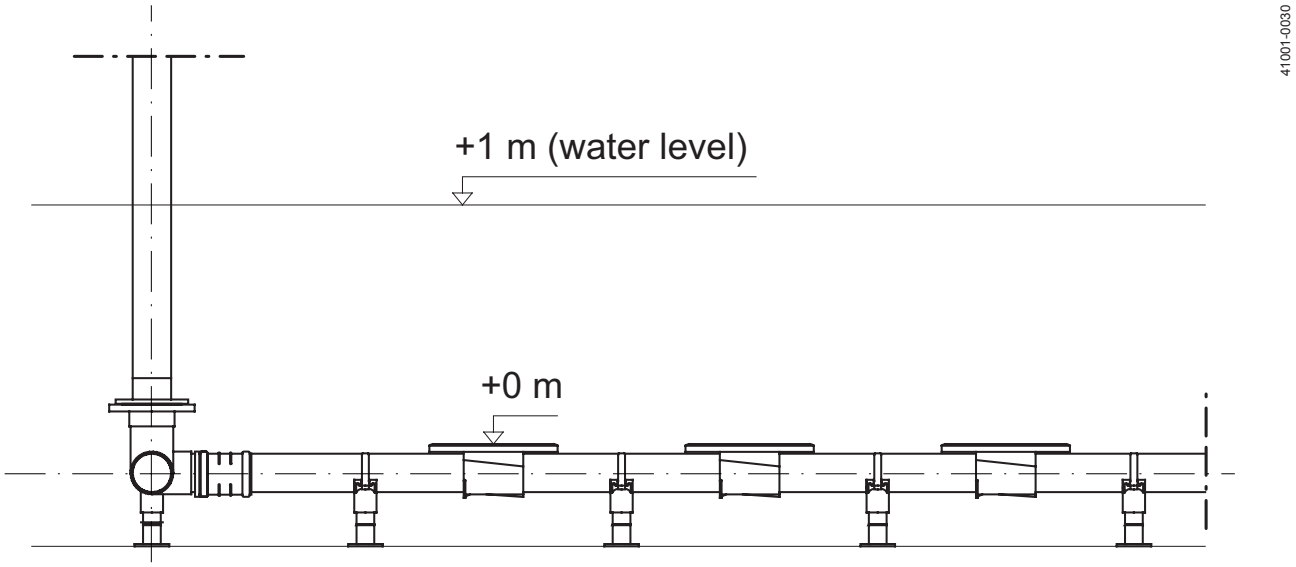

Figure 30 When the system is not in operation, water level must provide at least a one-metre blanket above the diffusers

The air supply should be started “softly” i.e. with a low air flow which is then increased slowly.

13.3.2 Filling the basin

- **Aeration must remain switched on throughout the filling operation**
  As the basin is filled up, adjust the air supply rate in response to the backpressure caused by the rising water level. The maximum air flow rates given in Table 1 must not be exceeded at any point during the filling process.
- **Beware of ice**
  At low outdoor temperatures, ice may develop on the basin floor. Floating ice may damage the aeration system or other structures in the basin.
- **Fill the basin carefully**
  A strong current may damage the aeration system or its support structures.
- **Watch the system during filling**
  If any leaks or other defects are detected, stop filling and repair the defect.
- **When the basin is full, remove condensed water by alternately opening and closing each water drainage valve**
- **Adjust aeration according to process conditions**

13.4 Performance monitoring

For any wastewater treatment plant, aeration is an essential and the most costly single process in terms of energy consumption. From the point of view of aeration, the system should be monitored for the following:

- air flow rates
- blockage of diffusers
- leaks

A data log has to be maintained showing the operating conditions for the full operating period. The data log shall include at least the following: volume of air used, pressure loss of the system and details of any failures in the air supply system.

The indicators to be monitored during aeration include:

- air compressor
  - energy consumption
  - condition of the filter
  - maintenance
- aeration basin
  - water temperature
  - oxygen content
  - water quality
  - maintenance
- aeration
  - uniformity of bubble pattern and size
  - back-pressure
  - air flow rates
  - condition of air supply piping joints and valves
  - supply air temperature
  - outdoor air temperature
  - maintenance
  - downtime
  - quantity and quality of condensed water (check this once a week)
- quantity of additives fed into the system

To ensure correct diffuser operation, the air compressors must be properly monitored as well as maintained. Blocked or defective suction filters can lead to a blockage of the diffuser suction side. Monitoring the compressor energy consumption also gives an indication of the condition of the aeration system and any blockages. When diffusers are blocked, back-pressure and energy consumption increase.

Other factors that affect the performance of the aeration system are temperature and quality of the water in the basin as well as the amount of maintenance carried out. Oxygen depletion, over-aeration or increased energy consumption can also be due to changed loads or the composition of the waste water.

Condensed water must be drained from the piping on a regular basis. The amount and quality of the condensed water gives an indication of the condition of the aeration system. Usually the condensed water is clear. If the amount of condensed water is high and the water is dirty, there is probably a leak in the aeration system.

14 Maintenance instructions

14.1 System shutdown

If the basin has not been drained before the aeration system is shut down, a minimum air supply must be maintained to porous disc diffusers HKL 215 and MKL 215 to prevent potential blockages.

If aeration is discontinued for a period of over two weeks, drain and clean the basin.

Draining the aeration basin:

- **Cut off waste water supply and return sludge flow to the basin**
- **Keep aeration on while the basin is being drained**
  Continued aeration prevents the silt from settling during drainage.
- **Throttle air supply as water level drops**
  As the basin is drained, adjust the supply air flow rate according to the back-pressure caused by the descending water level. Never exceed the maximum air flow rates shown in Table 1.
- **Beware of ice**
  If the aeration has been switched off before the basin is drained, there may be a blanket of ice in the basin. Do not drain a basin if there is any ice in it because ice may damage the diffusers or bend the pipes.
- **Clean the diffusers**
  Cleaning prevents dirt from drying and hardening on the diffuser surface. If the aeration basin is out of use for more than 48 hours, it is advisable to clean the basin and piping to avoid odour problems. The inside of the piping can also be cleaned by removing the water collection pipes and the zone headers of each group.
- **Check the condition of the system**
  Pay special attention to gaskets and seals. In case of Sucoflow DS 20 diffuser, inspect the screw nipples and welds for rust. Rust spots should be treated with resisting agent.
- **If the shutdown lasts over two weeks, fill the basin with clean water. To protect the diffusers, make sure that there is at least one metre of water above the diffusers**
  The layer of water will protect the diffusers from UV radiation from the sun. Add some suitable algaecide during warm seasons.

14.2 Clogging

The diffusers may become clogged on either side (air or water) of the disc or membrane.

Clogging on the air supply side can be due to:

- impurities in the supply air
- poor condition of the compressor air filter
- failure of the compressor silencer
- pipe corrosion
- pipe breakdowns
- welding debris in the piping
- leaks in piping through which sludge can enter the system

Clogging on the fluid side can be due to:

- chemical deposits such as iron, calcium, magnesium
- oil or grease contained in waste water
- organic solids, fine silt or sand
- slime and microbial growth build-up on the diffuser

If the BOD of the activated sludge is high, blockage may be accompanied by slime build-up on the diffuser surface (at the front end of a plug-flow basin, industrial waste water). Slime build-up alone does not increase back-pressure but it reduces aeration efficiency as the bubbles get bigger.

When diffusers become clogged:

- back-pressure in the aeration system increases
- as a result of increased back-pressure, electricity consumption and thus operating costs increase
- the bubble pattern may become uneven
- if the diffusers are heavily clogged, they can be damaged if air is forced through them.

When diffusers become clogged, back-pressure increases slowly. If back-pressure changes quickly, it is usually due to a blockage in the air supply header or in a valve.

Following guidelines shall be followed in diffuser cleaning:

Pressure rise above original value*	Cleaning method
< 20 mbar	Bumping
20 – 50 mbar	Nopon Clean equipment
> 50 mbar	Chemical / mechanical cleaning

* measured at start up with clean diffusers

ATTENTION ***Exceeding the design operating pressure by 50 mbar can cause serious damage to the diffuser. Pressure should be monitored frequently and diffusers should be cleaned before the increase reaches 50 mbar. This is the responsibility of the operator.***

Air bumping can be used to prevent clogging and to clean lightly clogged diffusers. Bumping is carried out by increasing the air flow from the minimum acceptable to the maximum acceptable value for the diffuser (see Table 1). Bumping should not be used for heavily clogged diffusers. If air flow is increased rapidly under these conditions there is a risk of damage to the diffusers.

The Nopon Clean system makes use of formic acid. The acid is dispensed as a spray into the dropleg (Figure 31). Formic acid dissolves salts and some organic material during normal operation so it is not necessary to drain basins or for the diffusers to be removed. Nopon Clean is a practical method of maintaining optimum efficiency in the aeration process. Diffusers can be cleaned even after low increases in back pressure. ABS recommends the use of Nopon Clean on a frequent basis.

Mechanical cleaning for chemically or biologically heavily fouled diffusers can be done by using high pressure cleaning or brushing. This method is normally effective enough for biologically fouled membrane diffusers. In order to remove chemical precipitation from the diffusers, acid treatment might be needed. This is done by putting the membranes / porous discs into a solution of formic acid for 2 - 24 hours until the deposits have been dissolved. Then rinse the membranes / porous discs at high pressure with an alkaline solution.

If diffusers are clogged due to sludge in the pipework or air side fouling the diffusers and non return valves will need to be dismantled and cleaned thoroughly. All sludge has to be removed from the pipework before restarting the aeration system by using normal high pressure jet cleaner.

If a complete set of porous discs or membranes for one basin are stocked at the plant, any soiled diffusers can be replaced immediately during the cleaning process. As a result, the interruption to operation will be shorter and soiled porous or membrane discs can be cleaned when convenient.

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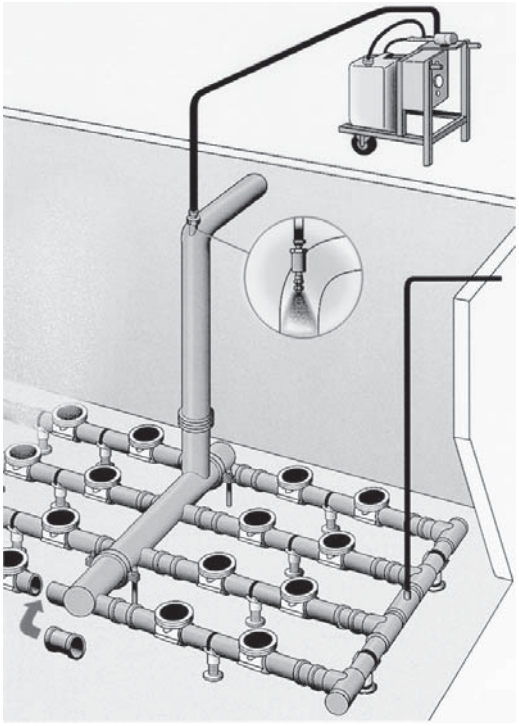

Figure 31 Nopon Clean formic acid cleaning system

14.2.1 Mechanical cleaning of clogged membrane diffusers

STEP 1: Whilst they are still attached to the pipes wash the diffusers with a water jet to remove the loose dirt from the membranes. The water level in the basin should be below the level of the diffusers prior to washing.

STEP 2: Introduce air flow of 4 - 5 Sm^3/h/diffuser (20 °C, 101,325 kPa) for PIK 300, PRK 300 and Sucoflow DS 20 diffusers, and repeat the washing operation with the water jet. For KKI 215 diffusers use an air flow of 3 Sm^3/h/diffuser (20 °C, 101,325 kPa). The air flow causes the membranes to inflate. Directing the water at an angle of 30 - 40° will remove deposits from the slits as they are forced open by the air.

STEP 3: Ensure that air is passing through all diffusers in the zone. This can be checked by ensuring that all membranes are inflated. If there is a blockage the membrane will stay flat.

PIK 300
If there are PIK 300 diffusers where no air is coming through this could be due to the ball being stuck to the viton O-ring, the membrane could still clogged, or both of these. In such cases the following procedure should be adopted:

- Gently hit the diffuser and see if this frees the non-return valve ball and allows air to pass through the diffuser
- Mark non-operating diffusers and shut down air flow
- Open the diffuser
- Replace the non-return valve with a new one
- Hand wash by rolling and pressing the membrane in a wash basin for approximately two minutes under warm tap water (see figure 32). This process should free deposits from the slits and wash them away.
- Assemble the diffuser and check that air is coming through.

PRK 300 and KKI 215
Mark non operating diffusers and shut down air flow. Open the clogged diffusers and hand wash the membranes by rolling and pressing them against washing basin for a couple of minutes under warm tap water. Assemble the diffusers and check that air is coming through.

Figure 32 Washing technique of the membrane. Washing is done under water

STEP 4: If still no air is coming through the membrane, open the diffuser and replace the membrane with a new one. If a lot of membranes in the same zone are in need of replacement then ALL membranes should be replaced to ensure an even distribution of air across the zone. It is not recommended to use old and new membranes in the same zone because of different head losses.

14.3 Interruptions in air supply

A short interruption in the air supply will not cause problems, however for interruptions of over three hours the pressure exerted by water can force dirt into the porous diffusers. This is not a problem with membrane diffusers.

If the air supply has been interrupted, the system back-pressure must be checked. If the back-pressure remains permanently above the cleaning limit, the diffusers must be cleaned, for example by using acid cleaning. With the Nopon Clean method, the system should be cleaned when back-pressure increases by 20 mbar. With other methods, the limit is 50 mbar.

During an extended stoppage, a bio-film may build up on the diffuser surface. To remove it, it is necessary to drain the basin and clean the diffuser discs one by one.

When restarting the system, be careful. During an interruption in air supply, sludge deposits on the diffuser surface. It is also possible that water has entered the aeration system. If the system is restarted too quickly, the diffusers may be damaged. Air supply should always be started “softly”, that is with small air flow which can later be increased gradually.

15 Disassembly and reassembly of the diffusers

15.1 Temperature requirements

At low temperatures (below +5 °C), PVC and PP become brittle. Special care must be taken when the ambient temperature drops below –10 °C. Recommended ambient temperature for disassembly and reassembly of the diffusers is above +15 °C.

15.2 KKI 215, HKL 215 and MKL 215

- Unscrew the diffuser screw-on ring HKR 215 using tool HKLIT 215 or HKLAT 215 (Figure 25).
- Remove porous disc HIL 210 or MIL 210 including gasket or diffuser membrane HIK 215. The membrane is attached to the support plate.
- Clean the inside of the diffuser main body.

- Replace the diffuser non-return valve when necessary. Check the condition of the other diffuser components and replace if defective.
- Wash the porous discs or membranes after removing them.
- Replace the porous disc including gasket or diffuser membrane carefully inside the main body HSA 215. When replacing the porous disc HIL 210, make sure that the side with the finer texture faces upwards.
- Lubricate the inside of the screw-on ring with a soapy solution and screw it into position with tool HKLIT 215 or HKLAT 215.

15.3 PRK 300

- Unscrew the diffuser with tool RFIT 300 P (Figure 26). The diffuser separates between the main body and the support plate. The main body remains on the pipe. Leave the circular gasket HUR 300 and the support ring HTR 300 inside the main body.
- Fix VASTE 300 tool in a suitable location.
- Place the diffuser on top of VASTE 300 and unscrew the screw-on ring with tool PKLAT 300. The required turning angle is 15° counter-clockwise.
- Remove membrane disc HIK 300.
- Clean the inside of the diffuser.
- Replace any defective parts.
- Wash the membranes one by one.
- Place the membrane on top of the support plate and the sliding ring PVR 300 on top of the membrane on the VASTE 300 tool.
- Screw the screw-on ring in position using tool PKLAT 300.
- Check the non-return valve, the circular gasket and the support ring for any damage. Clean the parts. If they are in bad condition, replace them.
- Lubricate the upper surface of the circular gasket HUR 300 with a soapy solution and place it carefully with the support ring inside main body HSA 215.
- Install the top section of the diffuser on the main body. Tighten the joint manually.

15.4 PIK 300

- Detach screw-on ring PKR 300 by turning it with tool PKLAT 300 (Figure 29). The required turning angle is 15° counter-clockwise. The screw-on ring, sliding ring and membrane can now be removed. The main body remains on the pipe.
- Clean the upper part of the main body, the sliding ring and the screw-on ring.
- Replace defective parts with new ones.
- Wash the membranes one by one.
- Clean and check the non-return valve and replace it if needed. The body of the non-return valve is attached to the main body by a snap connection.
- Place the membrane centrally to the main body.
- Install the sliding ring and the screw-on ring top of the main body.
- Tighten the screw-on ring with tool PKLAT 300.

15.5 KKI 215 R½, KKI 215 R½K, KKI 215 BSF½, HKL 215 R½, HKL 215 R½K, HKL 215 BSF½, MKL 215 R½, MKL 215 R½K and MKL 215 BSF½

- Remove the screw-on diffuser from the piping with the tool HKLAT 215 (Figure 25).
- For the duration of cleaning, fix the VASTE 215 tool (Figure 33) to the basin floor or other suitable location.

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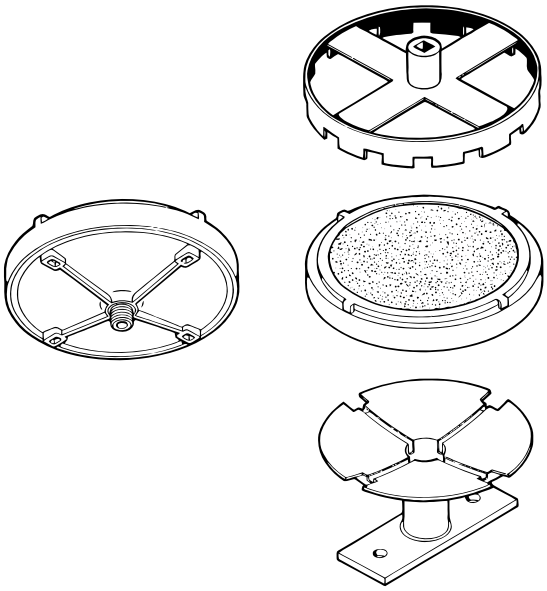

Figure 36 Special tool VASTE 215

- Place the diffuser on the VASTE 215 tool and remove the screw-on ring using tool HKLAT 215 or HKLIT 215.
- Remove porous disc HIL 210 or MIL 210 including gasket, or the diffuser membrane HIK 215. The membrane disc is fitted to the support plate.
- Clean the inside of the diffuser main body.
- Replace the diffuser non-return valve when necessary. Check the other parts as well and replace if defective.
- Clean the porous discs or membranes one by one.
- Put the porous disc HIL 210 or MIL 210 and its gasket or diffuser membrane HIK 215 with its support plate carefully back inside the main body HSA 215. Place the disc the same way it used to be. A new porous disc HIL 210 is installed with the finer texture on top.
- Lubricate the inside of the screw-on ring with a soapy solution and tighten the ring with tool HKLIT 215 or HKLAT 215.
- Screw the diffusers carefully onto the piping while ensuring that the main body threaded nipple is not torn off the pipe. Check also the O-ring around the threaded nipple. Make sure that the O-ring seals the joint. Sealing tape can also be used on the thread.

15.6 PRK 300 R½, PRK 300 R½K and PRK 300 BSF½

- Remove the diffuser from piping manually or with tool RFIT 300 P (Figure 26).
- If the diffuser has been removed from the piping complete, place the diffuser on the tool VASTE 215 and unscrew the diffuser from the main body with tool RFIT 300 P.
- In order to disassemble the upper section of the diffuser, fix the VASTE 300 tool to the basin floor or other suitable location.
- Place the diffuser on VASTE 300 tool and unscrew the screw-on ring with tool PKLAT 300 (Figure 29). The required turning angle is 15° counter-clockwise.
- Remove diffuser membrane HIK 300 and the sliding ring PVR 300.
- Clean the inside of the diffuser and the main body.
- Clean the other parts and replace if defective.
- Wash the membranes one by one.
- Place the membrane on top of the support plate and the sliding ring on top of the membrane on the VASTE 300 tool.

- Screw the screw-on ring into position with tool PKLAT 300.
- Lubricate the upper surface of the circular gasket HUR 300 with a soapy solution and place it with the support ring carefully inside main body HSA 215.
- Place the diffuser top section in the main body that is on the tool VASTE 215. Seal the joint by tightening it manually.
- Screw the diffuser carefully onto the piping while ensuring that the main body threaded nipple is not torn off the pipe. Check also the O-ring around the threaded nipple. Make sure that the O-ring seals the joint. Sealing tape or sealing material can also be used on the thread.

16 Troubleshooting

A number of common malfunctions and their potential causes are listed below. Note that malfunctions in aeration may be due to factors other than the system itself, such as the plant load, condition of air compressors, control valve operation, oxygen sensor performance, etc.

16.1 Compressor pressure increases, yet insufficient process air supply

1. **Diffusers clogged**.
   Check the diffuser back pressure. Clean the diffusers.
2. **Malfunction of air flow control valve**.
   Check valve operation and repair any defects.
3. **Compressor air filter clogged.**
   Check pressure across the filter. Replace or clean the filter according to the manufacturer's instructions.

16.2 Air consumption increases while BOD remains constant

1. **Actual oxygen content of the basin is greater than the setting**.
   Check and calibrate the oxygen sensors.
2. **Air escapes from the headers.**
   Check the piping for leaks and make the necessary repairs.
3. **Air consumption per kg of BOD increases.**
   The system is running at longer sludge retention times than assumed.
4. **Diffusers clogged.**
   Check back pressure. Clean the diffusers.
5. **Intense nitrification.**
   Check load and sludge retention time.
6. **Oxygen transfer performance impaired.**
   Diffusers are too old. The bubble producing parts should be replaced.
7. **Reject water load not taken into account.**
   Check the additional load caused by reject water.

16.3 Large bubbles or clusters of bubbles

1. **Slime build-up on diffusers.**
   Slime build-up can be prevented by re-arranging water supply or cleaning the system regularly with formic acid.
2. **Pipe leakage or broken or leaking diffuser.**
   Drain the basin, check the system for leaks and replace any defective parts.

16.4 "Dead" spots in the aeration basin

1. **Insufficient air flow rate.**
   Make sure that the air flow rate for the zone or the entire basin does not fall below the recommended minimum air flow rate. Check and calibrate the air flow meters.
2. **Diffusers completely clogged.**
   Drain the basin. Clean or replace porous discs or membranes.
3. **Non-uniform air distribution in the basin.**
   Adjust the air distribution valves to ensure uniform supply air distribution across the basin.

16.5 Local oxygen depletion in the aeration basin

1. **Organic loading is unevenly distributed or air distribution is incorrect.**
   Adjust air distribution or add diffusers in the depleted area.

2.

17 SOTR testing

The test protocol for SOTR testing of ABS Nopon aeration systems should be sent to ABS two weeks before testing. Test protocol should include all necessary information about test methods, test conditions, description of measurement systems, calculation method etc. Tests are performed in clean water with air flow measured accurately. Deviation from these and other conditions mentioned in ASCE (American Society of Civil Engineers) Standard Measurement of Oxygen Transfer in Clean Water testing method should be agreed before testing, otherwise ABS will not accept any responsibility for meeting guarantee values.

The membrane surface properties have an important effect on SOTE. In order to create realistic surface sliming, diffusers should be operated under water at least one week before testing in normal temperatures 10 - 20 °C. In case of lower temperatures contact ABS. The aeration has to be on all the time during the conditioning period.

18 Installation inspection form

Please complete this form for each basin and return to:

Cardo Italia srl / ABS Production Aeration
Via Cadorna, 67
20090 Vimodrone (MI)
ITALY
FAX +39 02 27438299

Plant name _____

Person and company responsible for installation _____

_____

Basin number		Total number of basins	
Basin dimensions		Design water depth	
Number of aeration groups / basin		Number of diffusers / aeration group	
Total Number of aeration groups		Total number of diffusers	
Diffuser type			

	First leak test	Second leak test	Third leak test
Date			
Water depth, m			
air flow, Sm^3/h (20 °C, 101,325 kPa)			
Leakages noticed			
Position of leakages			
Replaced parts and their number			

The positions of leakages can be marked on the aeration group drawings and enclosed to the installation inspection form.

Does the water purge system function properly? YES_____ NO _____

pressure loss_____ mbar at design water depth_____ m with air flow _____ Sm^3/h

Comments_____

_____

_____

_____

_____

_____

_____

This is to certify that the installation, leak tests and any repairs required have been carried out according to installation instructions and good manufacturing practice.

Place _____ Date _____ Signature _____

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41001 GB