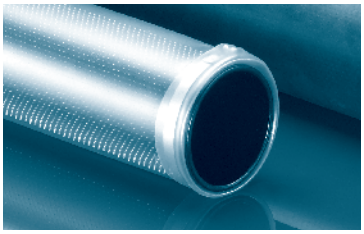
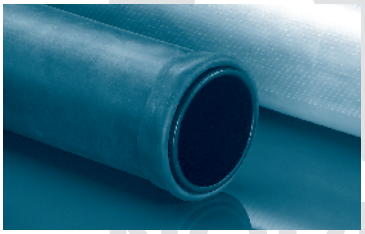
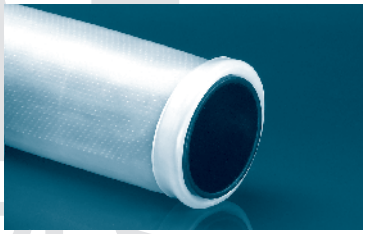
NORRES
UMWELTTECHNIK
ENVIRONMENTAL SOLUTIONS

Pre-PUR® FREE OF SOFTENER MADE IN GERMANY

Contents

1.0	Packaging, transport and goods inspection	S. 2
2.0	General information	S. 2
2.1	Storage and temperature	S. 2
2.2	Lighting and ozone	S. 3
2.3	Medium: Normal ambient air	S. 3
2.4	Mechanical preliminary cleaning	S. 3
3.0a	Preparation for fitting PRO$_2$AIR diffuser membranes	S. 4
3.1a	Start of fitting	S. 4
3.2a	How to fit the PRO$_2$AIR diffuser membranes	S. 5
3.0b	Preparation for fitting PRO$_2$AIR membrane tube diffusers	S. 6
3.1b	Start of fitting	S. 7
3.2b	How to fit the PRO$_2$AIR membrane tube diffusers	S. 7
3.3b	Replacement / How to fit the PRO$_2$AIR diffuser membranes	S. 7
4.0	Leak and functional tests	S. 8
5.0	Measuring the oxygen supply in clean water	S. 8
6.0	Operation and testing of the PRO$_2$AIR diffuser tubes	S. 9
7.0	Maintenance	S. 10
7.1	Purging/cleaning	S. 10

PRO$_2$AIR diffuser membranes / membrane tube diffusers – quality products from the NORRES stable – are mainly used for intermittent, fine-bubble, compressed air aeration (nitrification/denitrification). The balanced controllability of these diffuser tubes allows the aeration system to be operated based on the load. Our membrane materials – polyurethane (Pre-PUR®), EPDM and silicone – exhibit very good resistance to municipal wastewater according to the latest version of the DWA-M 115 Advisory Leaflet. Careful selection of the material, a slit perforation matched to the material quality and suitably sized tubes assure an aeration system that is optimised for each individual application and characterised by efficient and stable operation.

Our DIN EN ISO 9001:2000 certified total quality management concept underlies our consistently high standard. State-of-the-art production technology, high-grade material components and our own patented designs form the bedrock of our acknowledged product quality.

Please ask NORRES for advice before using our membrane diffuser tubes / membrane tube diffusers in industrial wastewater. We will help you choose the optimal membrane material, depending on the water constituents and concentrations.

1.0 Packaging, transport and goods inspection

The diffuser membranes / membrane tube diffusers are delivered unstacked in transport packaging. They must not be stacked for onward transport (if any) or after unloading.

The goods must be examined immediately upon receipt. Any damage to the packaging, and in particular to the diffuser tubes / tube diffusers, must be notified to the forwarder and the supplier without delay.

If possible, the diffuser membranes / membrane tube diffusers should be removed from the packaging at their place of use. Be careful not to damage the diffuser tubes / tube diffusers with pointed or sharp objects.

2.0 General information

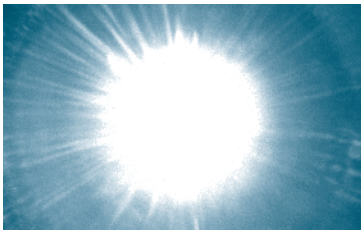
The physical properties of our Pre-PUR® Polyurethan products are altered by improper handling or unfavourable storage conditions. The service and / or useful life of the products may be shortened as a result. Therefore the handling and storage conditions should be in accordance to DIN 7716, Edition 05.82.

2.1 Storage and temperature

PRO$_2$AIR diffuser membranes / membrane tube diffusers must be stored in such a way that they are not exposed to the influence of the weather, for example to hail, frost or direct sunlight. They must also be protected against mechanical damage.

The diffuser tubes / tube diffusers should be stored in a dark room that is free of dust. The room temperature should be between 0 °C and +35 °C. If the storeroom needs to be heated, the radiator must be fitted with a suitable shield and the goods stored approximately 1 m away from the heat source.

The relative humidity in the storeroom should not exceed 65 %. Damp rooms should not be used for storage.



2.2 Lighting and ozone

Do not expose the products to artificial light with a high ultraviolet content or to direct sunlight. Any windows in the room should be painted red or orange for this reason. Never use blue paint to protect the products.

Ozone likewise has a destructive effect on the material. The storage areas must therefore not contain any electric motors or other equipment or devices that produce ozone or that are liable to produce sparks or static discharges.

No oils, chemicals or acids, solvents and disinfectants with a tendency to degas highly volatile substances must be kept in the same storeroom.

2.3 Medium: Normal ambient air

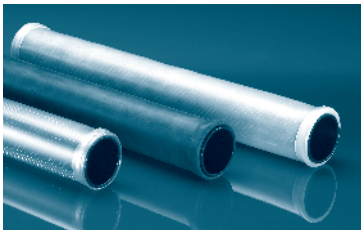
Only oil-free (dry-running) compressors may be used to deliver the air. Dust filters for ambient dust with a separating efficiency > 90 % acc. to DIN EN 779 (filter class EU4) should also be used.

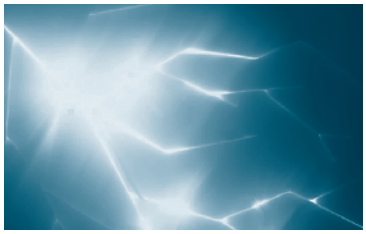
The air temperature at the inlet of the membrane tube diffuser should not exceed the following range:
Temperature Range:

Type 601, 602, 620, 621, 622, 611, 626	: -40 °C to +90 °C
Type 610 und 625	: 0 °C to +85 °C

2.4 Mechanical preliminary cleaning

Proper and reliable operation of a fine-bubble, compressed air aeration system presupposes that the wastewater has undergone suitable preliminary cleaning with a screen, a grease separator and a grit chamber.





3.0a Preparation for fitting PRO$_2$AIR diffuser membranes

PRO$_2$AIR diffuser tubes with an inner Ø of 64.5 mm to 65.5 mm are suitable for all standard supporting bodies from other manufacturers with an outer Ø of 63 mm. It is important to replace all the tubes on a lockable diffuser pipe because a new diffuser tube loses less pressure than a used tube.

If deposits are visible on the supporting bodies, we recommend cleaning the bodies thoroughly prior to fitting the tubes. It is also a good idea to inspect the diffuser pipes and the air distribution pipes for contamination or sludge deposition and clean them thoroughly.
Any stones, timber, broken glass or other rubbish must be removed from the basin.

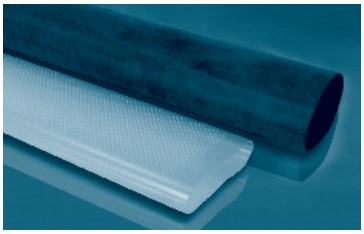
If individual supporting bodies are damaged, they must be replaced with new bodies. The seals between the diffuser pipe and the supporting body must likewise be inspected and if necessary replaced. Make sure the supporting bodies are securely fastened and seated. Tighten, or if necessary replace, any loose screws or fixing elements (refer to the assembly instructions provided by the manufacturer).

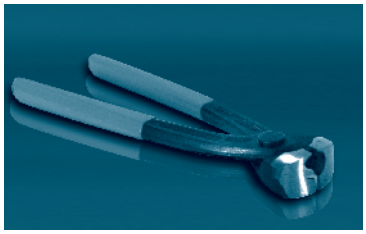
The diffuser pipes should be height-adjustable. All the diffuser elements must be aligned in such a way that a maximum height difference of 5 mm is not exceeded.

3.1a Start of fitting

The diffuser elements are susceptible to damage due to the influence of the weather or ongoing construction work. We therefore recommend not fitting the tubes until immediately prior to starting up and filling the basin.

During and after fitting, be careful not to tread on the diffuser elements or tubes and avoid placing any sharp, pointed or other objects on them.





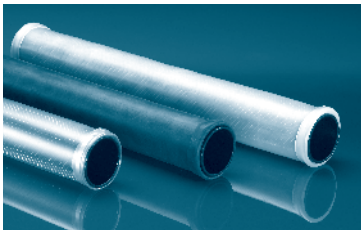
3.2a How to fit the PRO$_2$AIR diffuser membranes

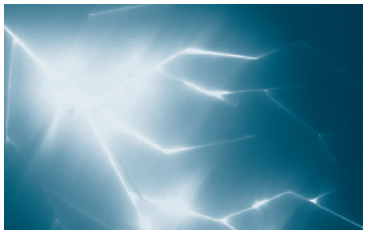
When fitting the new membranes onto the supporting bodies, make sure the non-perforated sections are on the top and bottom (6 a.m. and 12 noon). The air outlets on the supporting bodies should also be on the top and bottom if possible.
Fit the clamps onto the membranes ends and tighten or fasten them, taking account of the shape of the bodies.

The PRO$_2$AIR diffuser membranes must not be directly exposed to the influence of the weather, e.g. to strong sunlight, for longer than one day after fitting. If the basin cannot be completely filled, the tubes must be submerged to a minimum water depth of 0.50 m.

An additional water depth of 10 cm per degree Celsius must be ensured during the winter months when the diffusers are not in service if the temperature falls below freezing point (e.g. -10 °C = 1.0 m additional water column).

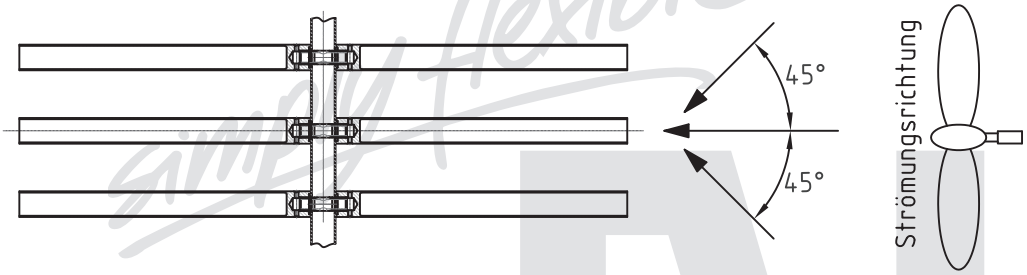
Please continue as described in sections 4. „Leak and functional tests“ to 7.1 „Purging/cleaning“.





3.0b Preparation for fitting PRO$_2$AIR membrane tube diffusers

The membrane tube diffusers should be arranged so that the inflow angle in the axial direction does not exceed 45°, bearing in mind the operating mode of the agitators (separate or simultaneous propulsion). If the stirrers (including bottom stirrers) are arranged close to the bottom, a sufficient clearance of at least 5.0 m should be allowed between them and the diffuser elements. If this is not possible owing to a lack of space, the ends of the membrane tube diffusers must be fastened stress-free to the bottom of the basin with suitable (pipe) clamps. NORRES can supply suitable fastening materials for this purpose.

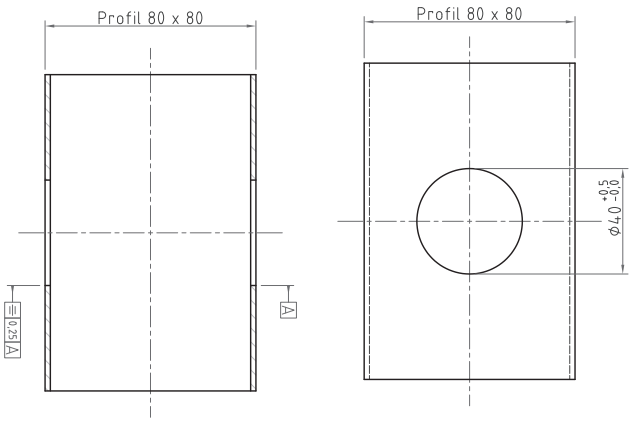


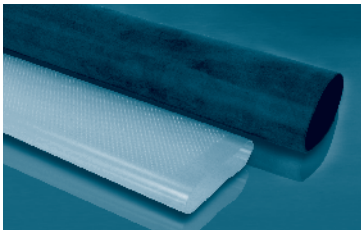
Drain pipes should be mounted at the lowest points of the individually isolatable aeration grids to facilitate future maintenance. The outlet should be located a maximum of 25 cm above the water level. These drain pipes can be opened either manually or by means of motorised isolation valves. The air volume flow that is simultaneously present should not exceed the maximum operating point of the diffuser elements mounted on the aeration grid concerned.

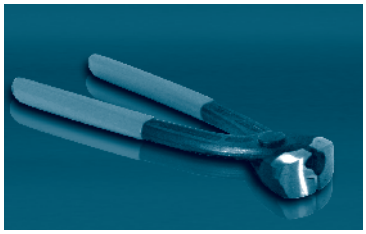
The air ducts, air downcomers, air distributors and diffuser pipes should be purged with an adequate quantity of clear water prior to mounting the diffusers. Make sure all impurities are removed from the air ducts. Any stones, timber, broken glass or other rubbish must be removed from the basin.

The standard connecting elements take the form of 80 mm rectangular profiles with a width of 40, 60, 80 or 100 mm for mounting on both sides. Please ask NORRES for advice before using other profiles or sizes.

Congruent, burr-free holes with a diameter of 40 mm +0.5/ -0.0 mm are required on both sides to mount a pair of diffusers.
The diffuser pipes should be height-adjustable. All the diffuser elements must be aligned in such a way that a maximum height difference of 5 mm is not exceeded.







3.1b Start of fitting

The diffuser elements are susceptible to damage due to the influence of the weather or ongoing construction work. We therefore recommend not fitting the tubes until immediately prior to starting up and filling the basin.

During and after fitting, be careful not to tread on the diffuser elements or tubes and avoid placing any sharp, pointed or other objects on them.

3.2b How to fit the PRO$_2$AIR membrane tube diffusers

The double fastening nipple is screwed into diffuser 1 over the complete thread length.
The threaded end is designed so that approx 2.0 mm are inserted into the Ø 41 mm hole in the rectangular profile. This guarantees a horizontal (level) alignment of all diffusers on the diffuser pipe. Next, the flat gasket supplied with the diffusers should be carefully positioned around the protruding thread. The screwed-in double fastening nipple can then be inserted through the two holes. Make sure the end of the tube diffuser fits exactly into the hole. The second flat gasket should be carefully positioned around the protruding thread of diffuser 2. Diffuser 2 can now be screwed onto the double fastening nipple. Make sure the end of the tube diffuser fits exactly into the hole.

Under no circumstances must the membranes be grasped and tightened by hand!

The tube diffusers are only allowed to be tightened using the enclosed open-ended spanners. Suitable flats are provided on the diffuser head for this purpose.
Note: The open-ended spanners are intended as a mounting tool for PRO$_2$AIR membrane tube diffusers. They should not be used for any other purpose.

The tube diffusers must be aligned on the diffuser pipe so that the unperforated surfaces are at the top and bottom (6 and 12 o'clock).
If they cannot be aligned in this position straight away, loosen one of the diffusers again slightly (no more than half a turn) and tighten the other diffuser accordingly.

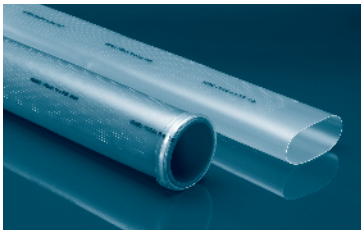
If the final inspection reveals that individual diffusers or pairs of diffusers are not aligned horizontally, the diffusers concerned should be loosened, then re-inserted into the holes so that they fit exactly and re-tightened.

The PRO$_2$AIR membrane tube diffusers must not be directly exposed to the influence of the weather, e.g. to strong sunlight, for longer than one day after fitting. If the basin cannot be completely filled, the tubes must be submerged to a minimum water depth of 0.50 m.

An additional water depth of 10 cm per degree Celsius must be ensured during the winter months when the diffusers are not in service if the temperature falls below freezing point (e.g. -10 °C = 1.0 m additional water column).

3.3b Replacement / How to fit the PRO$_2$AIR diffuser membranes

Please see section 3.2a



4.0 Leak and functional tests

After all diffusers and membranes have been fitted correctly and the diffuser pipes aligned carefully, the basin can be filled with clean or drinking water so that the diffusers are submerged in 5 to 10 cm of water. A relatively low specific air flow to the system (2 to 4 $Nm^3/h*m_{aer.}$) is recommended in order to test for leaks because it enables coarse or large bubbles to be recognised more easily. The tightness of the diffuser system has an important influence on its subsequent ability to operate correctly and perform efficiently.

The leak test should therefore be carried out conscientiously and in the proper manner.

Any leaks that are detected must be repaired prior to repeating the test. A higher specific air flow to the membrane tube diffusers (8 to 10 $Nm^3/h*m_{aer.}$) should then be set for a minimum period of 16–24 h before commencing the functional test (uniform bubble pattern).
If some parts of the diffuser system have a tendency to discharge fewer bubbles, this could be due to the sub-optimal alignment of the diffuser pipe. If the system also contains water, it will flow to the lowest point, where it can result in a cross-sectional constriction.

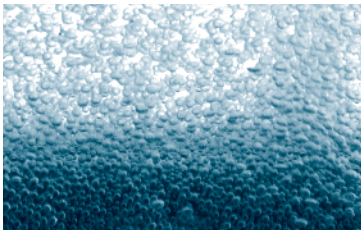
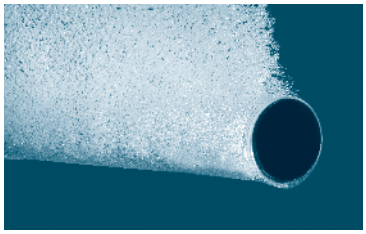
Small amounts of air may still escape from the membranes of the tube diffusers if the blowers are switched off following the leak and functional tests. This discharge can be disregarded because the pressure in the system is slightly higher than the ambient pressure for a short time.

5.0 Measuring the oxygen supply in clean water

Water that complies with drinking water quality (clean water) should be used for the clean water tests. These tests must be performed in accordance with the latest version of DWA-M 209 and DIN EN 12255 Part 15.

The membrane tube diffusers must have been operated with a specific air flow of 8–10.0 $Nm^3/(h*m_{aer.})$ for approx. one week prior to starting the tests. The air supply to the diffusers should be interrupted or switched off for five minutes two times a day during this time.

It is important to heed these instructions/this information in order to guarantee an optimal opening characteristic of the slit perforation and a correspondingly low opening pressure loss of the membrane.

6.0 Operation and testing of the PRO$_2$AIR diffuser membranes / membrane tube diffusers

The diffusers are designed for both intermittent and continuous aeration of liquids. They represent an ideal solution for selective nitrogen removal (nitrification and denitrification).

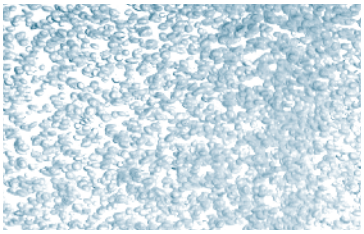
Operating ranges of PRO$_2$AIR diffuser membranes / membrane tube diffusers		
Minimum Nm³/(h*m$_{aer.}$)	**Normal Nm³/(h*m$_{aer.}$)**	**Maximum Nm³/(h*m$_{aer.}$)**
1,0	3,0 - 8,0	15,0

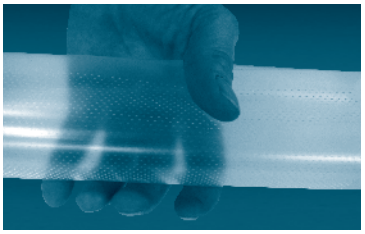
A specific air flow to the tube diffusers of up to 18.0 Nm³/(h*m$_{aer.}$) is permitted for short periods (refer also to „Maintenance-Purging/cleaning“).

Appropriate steps must be taken to ensure that the above-mentioned maximum air flow per metre diffuser length is not exceeded because the diffusers could be damaged as a result.

The efficiency and reliability of our membrane tube diffusers can be increased by optimising and adapting the operating parameters. The permanent elasticity of the membrane has a crucial influence on the uniformity of the opening characteristic of the slit perforation over the full operating range. This in turn ensures a largely constant performance of the fine-bubble, compressed air aeration system.

The diffusers should be switched off for approximately five minutes twice a day if they are operated continuously. Please also ensure a sufficient wastewater circulation during the aeration intervals in order to prevent sludge deposition in the vicinity of the diffusers (flow velocity ≥ 0.3 m/s).





7.0 Maintenance

Regular inspections and maintenance on the fine-bubble aeration system are vital to guarantee reliable and efficient operation of the equipment. Its efficiency is crucially supported by the membrane's good expansion and compression properties as well as by the uniform opening characteristic of the slit perforation.

The bubble pattern should be checked once every day. The rising bubbles should be practically homogeneous in terms of size. Turbulent flow in an aerated basin in which an agitator is simultaneously operating can lead to local accumulations of bubbles.

The pressure loss should likewise be measured and documented regularly (once every month).
A precision pressure gauge with a measurement range that is optimally adapted to the actual operating conditions and has a high accuracy class is recommended for this purpose.

Wastewater constituents, added chemicals (for precipitation, flocculation or sludge conditioning) and/ or other aids can impair optimal functioning if deposits form on the membranes. The amount of aids added should be appropriate to the intended purpose.
Increased pressure losses (Δp measurement with the precision pressure gauge) or a non-uniform bubble pattern can be an indication of sludge deposition.

The use of a raisable lance, equipped with one or more diffusers that are operated under identical conditions (mounting depth, air flow) is also a suitable test method.

7.1 Purging/ cleaning

An intermittently operation of the diffusers (the air supply should be switched off for approximately five minutes and afterwards switched on again for another 5 minutes, this process should repeat three times a day) causes the mechanical cleaning and is based on the expansion and compression effects. The method is only guaranteed to work if the system is purged immediately after starting up.
Purging (integrated in the blower controller) should take place at regular intervals that are adapted to actual requirements on the basis of the pressure loss measurements and the bubble pattern.

If it should happen in rarely cases that deposits on the diffusers cannot be adequately prevented by purging, the air supply of the intermittently purging operation could be raised to the maximum value. In addition a high-pressure cleaner could be used to achieve a more intensive cleaning. The nozzle should be held a minimum distance of 50 cm away from the diffuser; the spray water temperature must not be higher than 50 °C. It is not permissible to use a dirt blaster.
The deposits can also be removed carefully by wiping the surface with a cloth or using a soft brush. The membrane must always be wetted with water for this purpose. Furthermore there is the possibility of using diluted acetic acid or other cleaning supplies for removal of deposits.
The application of such has to be cleared with NORRES.