Basic Electric Aeration Installation Details

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INTRODUCTION

This **Water Quality Matters** publication provides technical information about the installation of basic aeration systems.

Refer to PFRA Standard Aeration Drawings No.265019 through No.265026

- No.265019 - Standard PFRA Assembly for Small Single Diaphragm Aeration Compressors
- No.265020 - Standard PFRA Assembly for Small Dual Diaphragm Aeration Compressors
- No.265021 - Standard PFRA Assembly for Koenders EL2 Aeration Compressors
- No.265022 - Standard Aeration Installation Components (without condensation tanks)
- No.265023 - Bleeder Device Options for PFRA Standard Aeration Compressor Assemblies
- No.265024 - Standard Aeration Diffuser Connection Details - 1
- No.265025 - Standard Aeration Diffuser Connection Details - 2
- No.265026 - Standard Condensation Tank Construction Details

An electric aeration system usually consists of a small electric compressor, an 'assembly', an air supply line and a diffuser. The compressor sends air through the assembly and supply line to the diffuser, where it is released into the water in the form of fine bubbles. As the air bubbles rise, the surface water circulates and draws oxygen from the surface to the water below.

Installing electric aeration systems requires the operator to have an understanding of the equipment and conditions they operate in. There are two basic environments these systems will encounter - below and above the frost line. In either case, condensation can form in the supply line. There are ways of managing this problem, but at this time there is no practical or economical way to eliminate it.

Regular maintenance will help keep your aeration system in good running condition, while also extending its life. Replacing diaphragms, checking valves, removing water from lines and inspecting diffusers are important tasks that will help keep the system operating.

All systems, regardless of site details, require the following:

- an air supply line no smaller than ½" nominal diameter
- a compressor capable of delivering sufficient airflow
- a diffuser to break the airflow into fine 'diffuse' bubbles as the air enters the water
- brass or stainless steel fittings wherever possible
- a compressor 'assembly' which contains a pressure gauge, a pressure relief valve, a bleeder device, a check valve and a main shutoff valve

Suitable assembly designs for several compressors can be found in PFRA Standard Aeration Drawings No.265019 through No.265021.

INSTALLATION OF SYSTEMS SUBJECT TO FREEZING

Although it is possible to pump air between 2000-3000 feet in a ½" line without significant pressure loss, it is impractical to keep these lines open in the winter. Ice and water will form over the full length of the line making clearing nearly impossible. Four hundred feet should be a maximum length for shallow buried lines. If the location demands a longer supply line, consider burying power to the dugout instead. Short, well-graded supply lines work best.

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Polyethylene pipe measuring ½″ in diameter is recommended as a minimum standard for these systems. Pipes with diameters of up to 1" may be considered but are much harder to submerge and thaw. Be aware that ½″ 'poly pipe' is not dimensionally the same as ½″ tube or hose. Brass air fittings are dimensionally true as are 'tube' and 'hose' diameters. For polyethylene pipe, use *poly insert* fittings. For air hose, use *hose barb* fittings. Please refer to PFRA Standard Aeration Drawings No.265019 through No.265021 for examples of how to fit poly pipe to air lines.

Most shallow buried pipelines can be installed using small trenchers, backhoes or by hand. Above ground placement is acceptable as long as the supply line is not at risk of being damaged or creating a hazard.

When supply lines are exposed to freezing conditions, one can assume that condensation in the lines will freeze. Condensation occurs for a number of reasons and can be affected by many variables. The most important variables are temperature and relative humidity of the ambient air and the system operating pressure. It is not altogether possible to control these variables, but it is possible to reduce their effects. If possible, the intake air temperature should be at, or lower than, the ambient air. Warmer air can be more humid.

If installing a compressor inside a building, be aware that certain types of structures may be less humid than others. Unheated, uninsulated wooden buildings with concrete floors are generally dryer than heated, insulated or steel structures. Buildings with dirt floors are damper than those with wood or concrete bases.

If installing a compressor outside, some type of protection must be supplied (with the exception of Koenders EL2 compressors which are self-contained) to keep the compressor free from rain, snow and debris. Any enclosure must be well-ventilated because small compressors may have operating temperatures of over 50°C. It is important to draw and filter intake air from outside the enclosure. Air inside the enclosure will always be warmer and usually more humid. Small check valves and other system devices are subject to failure from debris. As well, diffusers will collect everything in the air flow.

Generally, shorter, well-graded supply lines are less susceptible to internal frost and ice blockage, but this is not guaranteed because ice can form on vertical slopes and surfaces. The velocity at 1 cfm in a ½″ air supply line is not enough to move standing water. Water that ponds will, when frozen, almost immediately block the supply line. To purge the water from lines, it is necessary to remove the diffuser and apply air at a high velocity from the compressor end. This can be done using a shop compressor and a reservoir tank. Maintaining enough velocity to flush the lines is not easy and usually requires a valve at the diffuser end allowing pressure to build up and then releasing it quickly. This operation will take several cycles. Be careful not to exceed the pressure rating of the supply line pipe.

In all cases, it is better to take precautionary steps to reduce the amount of water entering the supply line. Currently, the best way to do this is to construct a set of 'condensation tanks' made from 3" diameter white PVC thin-wall pipe. In most cases, four tubes constructed to a length of 4' will be sufficient. Please refer to PFRA Standard Aeration Drawing No.265026.

Proper care must be taken any place where the supply line enters the dugout. Encasing it in a larger polyethylene pipe will protect it from ice damage during winter and spring. The supply line must be weighted for the full length of its contact with the water so that it lies against the bottom and slopes. For 1/2" supply lines, a 3/4" polyethylene line filled with sand and fixed to the supply line is enough to submerge it. Take note that some diffusers are self-weighted, while others are not and additional ballast must be added in order to sink them. Avoid using steel or other metals that will rust. Plastic pipes filled with sand and sealed form a more environmentally-friendly weight.

Retrofitting existing dugouts for aeration will require owners to install a supply line in the frost zone or above ground. These systems can function effectively, while offering advantages with respect to repair and maintenance.

INSTALLATION OF SYSTEMS NOT SUBJECT TO FREEZING

Although supply lines buried at 8' or more won't freeze, they will produce internal condensation. When water fills the line for some distance, you can expect pressure losses and erratic behavior especially in lines as large as 1" in diameter. Keep in mind the line exits into the dugout and, when water levels are low, runs the risk of freezing.

If running a compressor from inside a building, consider drawing air in from outside. All other aspects of shallow burial apply to deep buried lines with the exception of freezing.

Basement installations are unique in that the dugout's water level may be higher than the basement floor. In such a case, ineffective check valves can provide a path for water to enter the house. Owners are advised to make regular inspections ensuring check valves are functioning properly.

STANDARD ASSEMBLIES

Please refer to PFRA Standard Aeration Drawings No.265019 through No.265022. Some minor changes may be required to accommodate different compressors, but the layout should remain the same. The four things to note are the 'bleeder' valve, the Pressure Relief Valve (PRV), the check valve and the pressure gauge. They should remain in the order that you see in the example assemblies.

The PRV should be installed in an upright position to keep moisture from settling when the compressor is shut off. The bleeder valve should be installed in a downward position and situated as the lowest orifice in the assembly. The entire assembly should be mounted directly on the compressor to keep it as warm as possible and to keep any devices from freezing. Do not mount the assembly away from the compressor.

GAUGES

Please refer to PFRA Standard Aeration Drawings No.265019 through No.265021. Gauges require header tanks. Pulsation and vibration from the compressor will damage the gauge quickly if not dampened. Header tanks allow for the use of inexpensive dry gauges. Fluid-filled gauges are not required. Use 0-30 psi gauges which will allow for accurate reading even with small-faced gauges.

VALVES AND FITTINGS

Pressure relief valves and check valves are not always easy to find locally. Be careful when purchasing valves because aeration systems operate at low pressure and need valves designed to operate with minimum pressure loss. Any valve used in these systems should have an associated pressure loss of no more than 1 psi at operating pressure. Many distributors are not accustomed to dealing with systems operating at low pressure. Supplier phone numbers for all the devices in the PFRA Standard Assemblies are listed separately with the exception of the brass air fittings. Brass air fittings should be available from local suppliers. Use 1/4" extruded or forged air fittings. Brass plumbing-type fittings are not recommended, as they are prone to splitting when over-tightened and are easily damaged from internal water freezing. In addition, extruded fittings are much easier to work with as pipe wrenches are not required.

FREQUENTLY ASKED QUESTIONS

Q: What's a bleeder valve?

A: With the exception of the Koenders EL2 compressor, all the small Gast and Thomas compressors use low torque motors. This increases efficiency but creates starting problems under load. In other words, the compressor will not start with back pressures of 2 psi or greater. During power outages, this can cause problems. If the system is tight and operating at 10 psi, a quick 'power off - power on' requires the compressor to start at 10 psi back pressure. Generally, the compressor will try to start until it overheats throwing the thermal protection switch. Repeated starting cycles at high ambient air temperatures in conjunction with the already high compressor operating temperatures will eventually damage the motor. The bleeder valve is set to a small controlled leak or 'bleed' of about a 3-5% loss. This allows the assembly to bleed off pressure from the check valve upstream to the bleeder valve in about 3 seconds allowing the compressors to start safely. There are other solutions to this problem. A 'normally open' solenoid valve also works well with the advantage being no pressure loss during operation. However, at a cost of about $120.00, this option is more expensive.

Q: Why the pressure relief valve?

A: Most of these compressors are not designed to run continuously over 20 psi, although they will operate up to and above 60 psi. The pressure relief valve should be adjustable in the ranges of 0-25 psi and be set to about 18 psi. In the event of line blockage, usually due to ice, the PRV will release at the set pressure and protect the compressor from damage.

Q: Why do I need a gauge?

A: Without a gauge there is no accurate way of monitoring the system's operation. It is possible to become familiar with a system by regularly monitoring its pressure. In addition, the pressure gauge is required to accurately set both the PRV and the bleeder valve.

Q: Why do I need a check valve in the assembly when I already have one in the dugout?

A: If you're using a ball valve as a bleeder, then the check valve at the assembly is required to limit the actual air volume the bleeder must release during a 'power-off'. Without this check valve, the bleeder has to empty the entire supply line's excess pressure volume. In short 'power on-offs', this will not be possible resulting in the bleeder becoming ineffective. The check valve in the assembly limits the length of pipe volume to about 6" in the PFRA Standard Assemblies.

Q: Do I need a shut-off valve?

A: Yes. The shut-off valve allows the setting of the PRV and the bleeder valve. It also acts as a manual check valve.

Q: Do I really need a quick coupler at the end of the assembly?

A: No, but it makes disassembly much more convenient.

Q: What's a 'header' tank and why do I need one?

A: Most compressors create a pulsated air flow. When gauges are subjected to pulsation, they will eventually fail. Liquid-filled gauges may be more tolerant of pulsation but not immune. A header tank dampens the pulsation and protects the gauge. Small compressors create a vibration, which is not good for gauges. Mounting the header tank away from the compressor and connecting it with a rubber air line will solve this problem.

Q: Can condensation leave THIS much water in my supply line?

A: Yes. The best thing to do in this circumstance is remove the diffuser from the dugout and line and test the check valve. If the diffuser is faulty, replace it. In either case, the line should be blown out with a high capacity shop compressor at least once a year, preferably in the fall. In one case, 23L (5 ipgm) of water had collected in a 1" supply line in a six-month period. Condensation tanks can remove 1L (0.22 ipgm) or more each month. For condensation tanks, see the PFRA Standard Drawing No.265026.

Q: Will a large diameter supply line solve my freezing problems?

A: No. It may defer the time it takes to freeze, but when it does, there will be more ice present in the pipe making it more difficult to remove. For example, the end area of a 1" pipe is approximately 4 times larger than a 1/2" pipe. This means there is potentially four times more ice in a frozen 1" line than there is in a 1/2" line making it much harder to thaw. Large diameter pipes have advantages in some installations, but in general, 1/2" pipe is acceptable in lines 300 feet or less.

Q: Do I have to clean my diffuser?

A: Yes. Rubber diaphragm diffusers are self-cleaning to an extent, but algae and slime will collect over time. Rubber diaphragms are easy to clean by simply wiping them down with a wet cloth. Airstones are more difficult to clean, but if the systems are run continuously, cleaning is not regularly required. If used intermittently, mud and slime may fill the pores and produce pressure loss. Linear diffusers require regular cleaning. If not, the slits will build up with deposits and dirt and quickly result in pressure loss. Pressure losses in linear diffusers have been known to develop in as short a time as three weeks and have been as high as 8 psi above normal operating pressure.

FURTHER INFORMATION

For more information about aeration see the following **Water Quality Matters** publications: "How to Aerate", "Why Aerate" and "Myths About Dugout Aeration".

For further information on rural Prairie water quality issues:

- read the other publications in PFRA's **Water Quality Matters** series;
- visit the PFRA Website at www.agr.ca/pfra;
- read Prairie Water News available from PFRA, or on the Internet at www.quantumlynx.com/water; or
- **contact your local Prairie Farm Rehabilitation Administration Office** (PFRA is a branch of Agriculture and Agri-Food Canada)

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