Irrigation System Winterization and Pressurization Procedures

Introduction

Each winter in many parts of the world, irrigation systems must be completely drained and shut down to prevent damage to system components due to freezing water. In the spring, the irrigation system must be refilled and restarted.

Similar measures must be taken in new irrigation system installations and for repairs that require complete system drainage.

Any time an irrigation system is filled and pressurized, or when the system is drained and water flushed from the system, there is potential for excessive water and air pressures to be present. These high pressures can lead to possible damage of system components. Serious damage to system components and/or personal injury can occur if improper start-up and winterization methods are used.

The Toro Company, therefore, has created this document to detail the required procedures and specifications for start-up and winterization of irrigation systems. This document explains the procedures utilizing components manufactured by The Toro Company, Irrigation Division. Failure to follow these procedures could result in damage to equipment, possible injury to personnel, and could affect your Toro product warranty.

Please take the time to properly plan, prepare and perform these procedures. Always avoid shortcuts that could put personnel and system components at risk.

Please read the entire contents of this document before attempting any of these procedures. If you have any questions regarding the application of these procedures in your area, please contact a Toro distributor or call 1-800-367-8676 for assistance.

THE WINTERIZATION AND PRESSURIZATION OF IRRIGATION SYSTEMS EXPOSE PERSONNEL AND EQUIPMENT TO COMPRESSED AIR THAT MAY REACH PRESSURES MUCH GREATER THAN NORMAL. GREAT CARE SHOULD BE TAKEN ANYTIME THE SYSTEM IS BEING SERVICED OR MANUALLY OPERATED DURING THESE PROCEDURES. NEVER STAND DIRECTLY OVER ANY COMMERCIAL OR LARGE TURF SPRINKLER WHEN FILLING THE SYSTEM OR WHEN ACTIVATING MANUALLY.

Understanding the Effective Use of Compressed Air

Modern irrigation systems, in comparison to older systems, are much more complicated. Typically they have:

- more sprinklers, typically with smaller nozzles
- more single head control
- more pipe
- larger pipe

The process of preparing a modern irrigation system for winter "blow out" is different too.

- Smaller nozzles allow less Cubic Feet per Minute (CFM). Smaller nozzles do not move as much water and/or compressed air.
- Single head control further reduces CFM.
- More pipe means more system volume of air and water
- Larger pipe means more system volume of air and water

An irrigation system that uses riserless bodies allows for an easier blow out process. The benefits include:

- Increased CFM. To clear water from piping, it is the volume of CFM that matters most, not pounds per square inch (psi).
- Most designs use mid-range nozzles. The CFM through a riserless body can equate to that of 7-8 sprinklers (see the chart below). This volume will be much more effective than blowing through nozzled sprinklers.
- Reduces wear and tear on internal conversion assemblies. High air pressure and lengthy blow out times can reduce the life of components.
- Reduces time, labor, and air compressor run-time.

Riserless Body Method

Using the Compressed Air method (described on page 4 of this document), blow out the swing joint and sprinkler head ONCE from water to air. The compressed air pressure should not exceed 50 psi. 50 psi is all that is required to clear water from the swing joint and sprinkler to prevent winter freeze damage. Blowing air through the sprinkler a second or third time is not recommended and may result in component damage.

If a second or third flush is required to clear the piping, use the riserless body method:

Remove the internal or conversion assembly ("internals") and activate those sprinklers as follows:

- FAIRWAYS - Remove one or two internals on each leg of the fairway loop, either in the middle of the lateral run or at a low point on the fairway.
- GREENS – If the green is looped, remove one or two of the internals mid-way on the loop. If the green is *not* looped, remove the end-of-line internals.
- TEES – Remove one of the internals at the end of the line.
- DEAD END PIPING – Remove one or two of the internals at the end of the pipe. On 1½" or 2" piping, one internal removal should be enough. On larger piping, removing two internals may be required.

CFM through open riserless bodies:

1.5” riserless body opening = 340 CFM @ 50 psi
1.0” riserless body opening = 150 CFM @ 50 psi

CFM through sprinkler nozzles:

The chart below shows the CFM for each nozzle set at 35 and 50 psi line pressures, a 1½” body, and nozzle set numbers as shown.

Sprinkler CFM Use		
Nozzle	**35 PSI**	**50 PSI**
51	23	28
52	30	33
53	35	38
54	43	48
55	48	53
56	50	55
57	53	58
58	59	64
59	65	70

Looking at the chart above, a #54 nozzle at 35 psi would receive approximately 43 CFM. Therefore, a riserless 1½” body would give you the equivalent of approximately eight #54 nozzled sprinklers.

Besides a better blow out, the benefits of using riserless bodies are:

- reduced time
- reduced labor
- reduced compressor run time
- reduced fuel costs

Winterizing Golf Courses with Compressed Air

TO PREVENT PERSONAL INJURY, NEVER ATTEMPT TO DISASSEMBLE SYSTEM WHILE UNDER PRESSURE.

TO PREVENT PERSONAL INJURY, DO NOT STAND DIRECTLY OVER ANY LARGE TURF SPRINKLER WHEN ACTIVATING MANUALLY AT THE SPRINKLER.

Do not exceed 50 psi of air pressure in any system. Exceeding 50 psi could result in severe equipment damage and personal injury.

Activate each sprinkler only once!
Subsequent activations with no water in the sprinkler will result in high speed activation and excessive pressure spikes, possibly resulting in equipment damage and personal injury..

Pressure will build if the compressor is left running and no devices are left open to relieve the pressure. This can cause pressure to build to a dangerous level that may damage the irrigation system and create a hazardous situation.

Gravity Drain / Compressed Air Method

The gravity drain/compressed air method utilizes gravity flow to remove water from the mainline through drains, quick couplers and sprinklers at the lowest elevation points and in low-lying areas. Compressed air is then used to move any remaining water that may have collected in the piping system out the open drains. Once the mainline is clear and drains are closed, compressed air is then used to force the remaining water out of each individual sprinkler head.

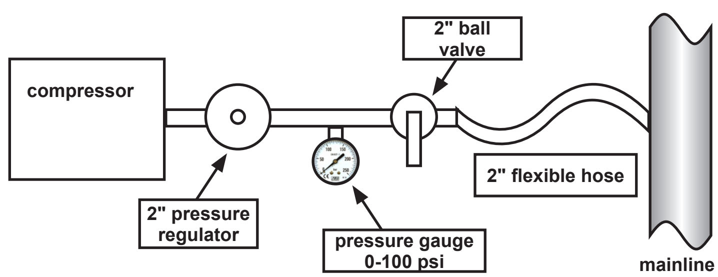
Issues to address before beginning:

- Will the compressor provide enough cubic feet per minute (CFM) for an adequate blow-out (typically 375-900 CFM. See diagram.)
- Are there pressure gauges in the field to monitor fill pressure?
- Can I communicate changes in the field back to the pump/ compressor to ensure that pressure and velocity stay within recommendations?
- Is there an external air pressure regulator with a gauge installed on the compressor? (See **Picture 1**, page 3. Contact your local Toro Distributor to order one.)

Having foreknowledge of the piping system is extremely useful. Please take the time to review the system as-built drawing to identify the locations of all drains, quick couplers, the highest and lowest elevation points and all piping dead ends. Water will always flow to the lowest points first. Develop a plan for how you will sequentially close the high point vent first allowing the compressed air to force the water out of the low point drains. Work from the highest to the lowest points until all vents are closed.

Steps

1. Close main supply water valves.
2. Open drain valves and quick coupler valves. At low and lowest elevation points, remove sprinkler riser assemblies and valves in the system.
3. At the highest elevation points, install quick coupler keys into quick coupler valves or remove the sprinkler riser assembly and valve. This provides the venting required for proper draining.
4. Allow system to gravity drain until all water is removed.
5. Connect the air compressor, sized appropriately for your system (See Table, 2 next page). Use an external pressure regulator adjusted to the lowest possible pressure to remove water from the system. Be sure it is attached to the mainline through a 2” diameter hose, cut to the shortest length possible.



Golf course systems require a high volume air compressor. Excessive heat will be generated at the point of air connections to the system. To avoid damage to PVC piping systems, use a length of 2” galvanized pipe to dissipate the heat prior to the compressed air entering the irrigation piping system.

6. Open ball valve at compressor to allow air to pressurize the piping system and assist in the evacuation of water from the piping system.

The key to successful water removal is volume (CFM) not pressure.

The Toro Company recommends the use of pressure gauges installed into the areas where sprinklers are being electrically activated. Monitoring this pressure allows you to maintain the appropriate number of activated sprinklers at any one time. Activating too many heads will result in low air pressure and heads will possibly will not operate. Activating too few heads will result in higher pressures and may cause damage to parts of the system and possible personal injury. Each crew should have a pressure gauge that will move with them from location to location to monitor pressure.

7. Starting at the highest elevation locations (A), monitor the drain points for the presence of air. When there is no water present and only air at that drain location, close the drain, remove the quick coupler key and/or select the sprinkler to the manual "AUTO" position. Continue working your way from the highest (A) to the lowest C) elevation points, closing each drain location until all drain locations are closed.

8. Adjust pressure regulator at the compressor to 40 psi in 2 psi increments as needed. Do not exceed 50 psi in the field.

9. Determine the maximum number of sprinklers that can be operated at one time with the compressor in use. See **Table 2** below.

Electric valve-in-head sprinklers require a minimum air pressure of 35 psi to operate and may require additional time to operate.

10. Starting at the highest elevation points (A), electrically activate the maximum number of sprinklers (from step 6) simultaneously.

Operate the sprinklers in a logical sequence so that water moves in one direction though the system from high point to low point. Moving from tee to green or green to tee, forcing the water towards low end points will minimize water pockets in low-lying areas (3). When the discharge changes from a stream to a mist, electrically activate the next sprinkler(s) and then turn off the sprinkler(s) that is/are misting. Always turn "ON" the next head(s) before turning the misting head(s) "OFF". Continue this process until every sprinkler has been electrically activated only ONCE.

If you feel there could be more water in a lateral loop, remove the sprinkler riser assembly at the mid-points of the loop and blow again. On a 2", 2.5", or 3" loop, a compressor will easily blow the water through the line. Water will not re-enter the piping system via the sprinkler head.

11. Turn "OFF" the compressor and open low elevation drains (4) to allow residual water to drain and to relieve air pressure.

12. Close all drains.

Picture 1 (Air Pressure Regulator)

Speedaire Dayton Regulator Model 4ZM12 or equivalent

Table 2

			Compressor CFM							
	Sprinkler CFM Use		**250**		**500**		**750**		**1000**	
Nozzle	**35 psi**	**50 psi**	**35 psi**	**50 psi**	**35 psi**	**50 psi**	**35 psi**	**50 psi**	**35 psi**	**50 psi**
0	10	13	25	20	50	40	75	60	100	80
1	23	28	11	9	22	18	33	27	44	36
2	30	33	8	8	17	15	25	23	33	31
3	35	38	7	7	14	13	21	20	29	27
4	43	48	6	5	12	11	18	16	24	21
5	48	53	5	5	11	10	16	14	21	19
6	50	55	5	5	10	9	15	14	20	18
7	53	58	5	4	10	9	14	13	19	17
8	59	64	4	4	8	8	13	12	17	16
9	65	70	4	4	8	7	12	11	15	14

Pressurization and Start-Up Procedures

The following procedure is used anytime water is filling an empty piping system. This applies to new system pressurization, start-up in the spring following a winterization in the fall, or after the piping system has been depressurized for any other reason such as to repair a break. This procedure requires a maximum pressure of 50 psi and a fill rate velocity of less than 2 feet per second. The velocity is the speed at which the water is flowing in the piping system and is determined by the pipe size and the flow rate (See Table 1 below). Velocity is also designed to eliminate pockets of trapped air that could be compressed to pressures much higher than normal, creating personnel safety concerns and possible damage to system components.

When filling with a pump station, please contact the pump manufacturer service representative for best practices with your specific station. Pump stations vary widely and one particular process may not be suitable for all pump stations.

Having foreknowledge of the piping system is extremely useful. Please take the time to review the system as-built drawing to identify the locations of all drains, quick couplers, the highest and lowest elevation points and all piping dead ends. Water will always flow to the lowest points first. Develop a plan for how you will sequentially close the high point vent first allowing the compressed air to force the water out of the low point drains. Work from the highest to the lowest points until all vents are closed.

Issues to address before beginning:

- How do I slowly fill the system at low pressure?
- Is there a pressure relief valve? Can I adjust the variable frequency drive (VFD) pump or outlet valves to control flow and pressure while filling the system?
- Are there pressure gauges in the field to monitor fill pressure?
- Can I communicate changes in the field back to the pump to ensure that pressure and velocity stay within recommendations?

Steps

1. Per your plan, open drain valve(s) in the low areas of the system. At all high points, insert quick coupler keys and/or turn sprinklers to the manual “ON” position at all tees and greens. Same for all dead ends. This will allow air to bleed from system lines during the filling process. Do not compress air and then relieve; bleed air while filling the system.
2. Adjust pressure regulation at the water source to 50 psi maximum. Supply water to the system at a velocity fill rate of less than two feet per second. Reference Table 1 below to determine the maximum gallons per minute for your particular pipe size to maintain less than 2 feet per second.
3. Starting at the locations closest to where the piping system is being filled, and at the lowest elevation points, monitor the open drains, quick couplers and sprinklers that have been selected “ON” for air and water flow. When steady water flow is detected at that location, close the drain, remove the quick coupler key, and/or turn the sprinkler “OFF”. Proceed to the next higher location. Repeat this process until air is evacuated, water is present, and all venting locations have been closed.
4. While maintaining a maximum pressure of 50 psi in the field, activate each sprinkler electrically to allow any remaining air to escape. Take this opportunity to identify correct operation and flag any system components that require additional service.
5. Once all air has been removed from the system and system repairs have been verified, adjust system pressure to normal operating pressure.

Tip: Over time it is possible to identify locations where trapped air is a persistent problem and install an air relief valve(s). These areas can be identified by sprinklers running air or air/water mix for a significant amount of time after the system was thought to be completely filled with water.

The following table assumes the piping system has been designed to minimize pipe friction loss and maintain a safe operating water velocity in the pipes at 5 feet per second or less. Select the system pipe size where the fill water is being introduced.

Table 1: System Fill Rate Specification

Pipe Size	GPM	Velocity (feet per second)
1”	5	1.50
1½”	10	1.41
2”	20	1.80
2½”	30	1.84
3”	45	1.86
4”	75	1.87
6”	150	1.73
>=8”	200	<1.50

TORO. Count on it.

