Irrigation System Winterization and Pressurization Procedures

Introduction

Any time that an irrigation system is filled and pressurized, or when the system is drained and water flushed from the system, there is potential for excessive pressures to be present leading to possible damage of the system components. For instance, each winter, in many parts of the world, irrigation systems must be completely drained and shut down to prevent damage due to freezing water in the system components. Then, in the spring, the irrigation system must be filled and started. This is also true for new installations and after repairs requiring system drainage. Serious damage can occur to system components and/or personal injury may result if improper start-up and winterization methods are used. This document contains the required procedures and specifications for start-up and winterization of irrigation systems 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 your Toro distributor.

WARNING

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 (CFM)

Designs have changed. Systems now include:

- More sprinklers, typically with smaller nozzles
- More single head control
- More pipe
- Larger pipe

Difference relating to winterization – blow-out:

- Smaller nozzles allow less CFM that will not move as much water and/or compressed air
- Single head control and smaller nozzles further reduces CFM
- More pipe means more system volume of air and water
- Larger pipe means more system volume of air and water

Benefit of blowing out using riserless bodies:

- Higher CFM, it is volume of CFM and not PSI that is needed to clear water from piping
- Most designs use mid range nozzles, the CFM through a riserless body can equate to that of 7 – 8 sprinklers, see the charts 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.
- Reduced time, labor, and compressor run time.

Riserless Body Process:

- Blow out the swing joint and sprinkler head **ONCE** from water to air (using the Compressed Air method described on pages 4-7 of this document), the compressed air pressure is not to exceed 50 psi (3,4 bar). This is all that is required to clear water from the swing joint and sprinkler to prevent winter freeze damage. Blowing through the sprinkler a second or third time is not recommended and may result in component damage.
- Instead, if a second or third flush is required to clear the piping, use the riserless body method. Remove the internal or conversion assembly 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** – assuming 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 1 ½ inch (25 mm) or 2 inch (40 mm) piping one internal should be enough, on larger piping 2 internals may be required.

CFM through open riserless bodies:

1.5” (40 mm) riserless body opening = **340 CFM** @ 50 psi (3,4 bar)

1.0” (25 mm) riserless body opening = **150 CFM** @ 50 psi (3,4 bar)

CFM through sprinkler nozzles:

This chart shows the CFM for each nozzle set at 35 psi (2,4 bar) and 50 psi (3,4 bar) line pressure, a 1 ½” (40 mm) body, and nozzle set numbers as shown.

	Sprinkler CFM Use	
Nozzle	**35 psi (2,4 bar)**	**50 psi (3,4 bar)**
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

Therefore from a #54 nozzle at 35 psi you would be getting approx. 43 CFM, a riserless 1 ½” body would give you the equivalent of approx. **8** - #54 nozzled sprinklers.

The benefit is reduced time, and we believe a better job.

- Reduced Labor
- Reduced compressor run time
- Reduced fuel costs

Winterizing of Golf Courses with Compressed Air

WARNING
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

CAUTION
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

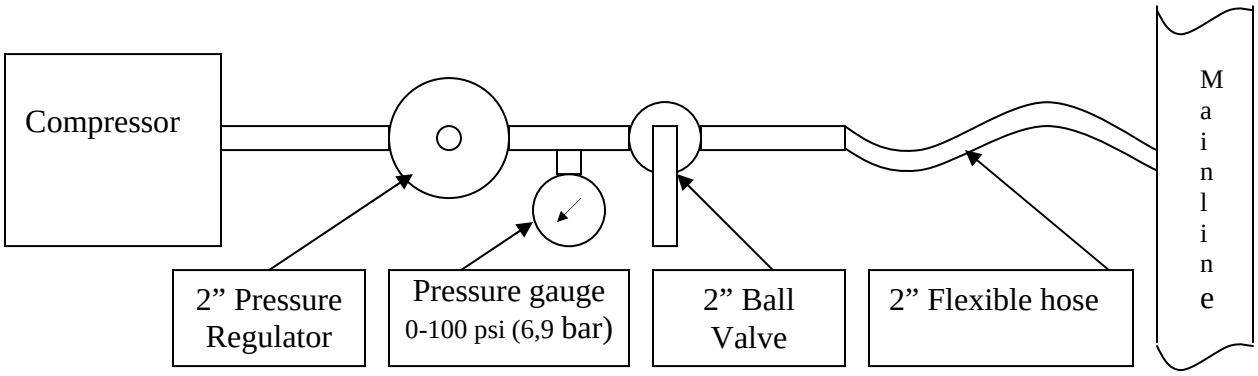
The gravity drain/compressed air method utilizes gravity flow to remove water from the mainline through drains, quick couplers and sprinklers at the lowest elevation points and in low lying areas. This is followed by using compressed air to move any residual water that may have collected in the piping 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.

Before starting to winterize the system ask yourself:

- 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 you communicate changes in the field back to the pump/compressor to assure that pressure and velocity stay within recommendations?
- Is there an external air pressure regulator with a gauge installed on the compressor? *(See Picture 1, for an example, Contact your local Toro Distributor)*

Gravity Drain/Compressed Air Process

1. Close the main supply water valve.
2. Open drain valves, quick coupler valves and/or remove sprinkler riser assembly and valve at the lowest elevation points and any known low spots in the system.
3. Install quick coupler keys into quick coupler valves or remove sprinkler riser assembly and valve at the highest elevation points to provide the venting required that promotes 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 above) through an external pressure regulator adjusted to the lowest possible pressure to adequately remove water from the system and attached to the mainline through a 2" (50mm) diameter hose with the shortest length possible.



Note: Golf course systems require a higher 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" (50mm) galvanized pipe to dissipate the heat prior to 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.

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

   Note – 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 pressure and heads that possibly will not operate; activating too few heads will result in higher pressures than desired and may cause damage to parts of the system and possible personal injury. Each crew should have a gauge that will move with them from location to location to monitor pressure.

7. Starting at the highest elevation locations 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 to the lowest elevation points closing each drain location until all drain locations are closed.

8. Adjust pressure regulator at the compressor to 40 psi (2,8 bar) in 2 psi increments as needed. Do not exceed 50 psi (3,4 bar) 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.

Table 2

			Compressor CFM							
	Sprinkler CFM Use		250		500		750		1000	
Nozzle	35 psi (2,4bar)	50 psi (3,4bar)	35 psi (2,4bar)	50 psi (3,4bar)	35 psi (2,4bar)	50 psi (3,4bar)	35 psi (2,4bar)	50 psi (3,4bar)	35 psi (2,4bar)	50 psi (3,4bar)
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

Note - Electric valve in head sprinklers require a minimum air pressure of 35 psi (2,4 bar) to operate and may require additional time to operate

Caution

Operating the sprinklers on air alone will generate heat that could potentially cause damage. When the air/water coming from the sprinkler becomes a light mist, that sprinkler should be turned off. Never allow the sprinkler to operate on air alone for more than 2 minutes.

10. Starting at the highest elevation points, electrically activate the maximum number of sprinklers (from step 11) simultaneously.

Note - 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. When this discharge changes from a stream to a mist, electrically activate the next sprinkler(s) and then turn off the sprinkler(s) that 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****.*

WARNING

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 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

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 break repairs. This procedure requires a maximum pressure of 50 psi (3,4 bar) and a fill rate velocity of less than 2 feet per second (0.6 m/s). 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). It is also designed to eliminate pockets of trapped air that could be compressed to pressures much higher than normal creating personnel safety concerns and damage to system components

Note – 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.

Important!

Having knowledge of the piping system is very 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 lowest venting points first allowing the air to continue venting at the higher locations then working your way from the lowest points to the highest points until all venting locations are closed.

Before starting to re-pressurize the system ask yourself:

- How do you slowly fill the system at low pressure?
- Is there a pressure relief valve, can you 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 you communicate changes in the field back to the pump to assure that pressure and velocity stay within recommendations?

1. Per your plan, open drain valve(s), which will be in the low areas of the system. Also, insert quick coupler keys and/or turn sprinklers to the manual “ON” position at all tees and greens at high points on the course and at 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 system.
2. Adjust pressure regulation at the water source to 50 psi (3,4 bar) maximum. Supply water to the system at a velocity fill rate of less than two feet per second (0.6 meters/second). Reference table 1 below to determine the maximum gallons per minute for your particular pipe size to maintain less than two feet per second (0.6 m/s).
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 or turn the sprinkler “OFF” and 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 (3,4 bar) 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 you can 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.

Caution

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 (lpm)	Velocity - Feet per second (meters/ second)
1” (25mm)	5 (19)	1.50 (0.45)
1 ½” (40mm)	10 (38)	1.41 (0.43)
2” (50mm)	20 (76)	1.80 (0.55)
2 ½” (65mm)	30 (114)	1.84 (0.56)
3” (75mm)	45 (170)	1.86 (0.57)
4” (102mm)	75 (284)	1.87 (0.57)
6” (152mm)	150 (568)	1.73 (0.53)
8” (203mm) and above	200 (757)	<1.50 (0.45)