

The Underground Connection

Darrick Robbins, Reinders, Inc.

There is a beast under your golf course. You try to keep it captive, but sometimes it escapes despite your best efforts. It's water of course. As a golf course superintendent you are tasked with keeping water captive, and you do that by creating a closed system.

Anyone who has seen photos of a tsunami, or watched the end of a hose get loose under pressure knows that keeping water captive is easier said than done. So how is this accomplished? We create systems that only allow water to escape when and where we want it to. We glue, tighten, lube, restrain, and use all manner of tactic to get things to stay together. Then, just to make it interesting, we apply pressure, and lots of it.

So how do we accomplish this? It is simply really--we take a bunch of components, and we connect them all together to create a closed system. What are the components? What are the connections? What working knowledge do I need to have to maintain my system? Hopefully after you have read this article you will have a decent answer those questions.

The parts of the system include sprinklers, swing joints, swing joints, pipe fittings, quick couplers, repair fittings, hose fittings, and service tees--all of this in addition to the pipe itself. The vast majority of the connections in an irrigation system can be broken into one of a four categories: flanged connections, threaded connections, glued joints, and gasket connections. (HDPE fittings can be different in a variety of ways and won't be discussed here.) In general the larger components of a system, and change of direction fittings are ductile iron. These fittings are usually more durable than PVC and can withstand the rigors of impact more easily.

If you run across a term that you aren't familiar with take a look at the end of the article where you can find a short glossary. Hopefully you can expand your knowledge base as well as have a useful reference for future use.

System Components

Golf Sprinklers

Sizes: Inlets available in 1", 1 1/4" and 1 1/2" sizes in both ACME and NPT depending upon manufacturer.

Materials: Injection molded plastic

Joining Method: Sprinkler inlets are attached to swing joints by a threaded connection, either NPT or ACME.

Ordering Information: Size and thread type of your swing joint outlet (ACME or NPT), how far you need it to throw, and full circle or part circle.



Swing Joints

Function: A swing joint makes a connection between the service tee, and a sprinkler or quick coupler. It allows for movement and adjustment of sprinkler height.

Sizes: Available in sizes from 1/2" up to 3" with different inlet and outlet styles and sizes. Lengths are 10", 12", or 18" based upon manufacturer.



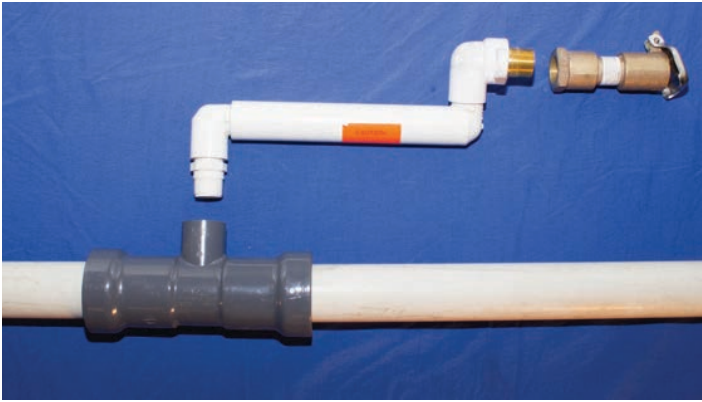


Image of a specialized swing joint with a brass insert for connection to a quick coupler valve.

Inlet: MIPT, ACME, Socket, Spigot, Saddle

Outlet: ACME, MIPT, Brass Insert (for quick coupler valve)

Materials: PVC, Ductile Iron

Joining Method: Swing joints are joined internally (between the two ends) by threads. These connections vary by manufacturer but include NPT threads, buttress threads, and acme threads. This is why inlet and outlet fittings often do not fit with the internal threaded fittings found in a swing joint.

Brass NPT inserts are available as outlet threads which connect to quick coupler valves. These specialized swing joints include holes which allow stakes to restrain the top of the swing joint from the torque created when a quick coupler key is inserted. Brass inserts are available in 1" and 1 1/2" sizes.

Other: Swing joints for golf course systems are almost always 1", 1.25" or 1.5" body size. Each is capable of supplying a certain amount of water to a sprinkler. In other words the size of swing joint a sprinkler utilizes is determined not by the size of the inlet at the bottom of the sprinkler but by the amount of water it uses. Swing joints can have different fittings on the inlet and outlet sides as well (see information on service fittings about commonly used inlet sizes).

When ACME threads were first introduced NPT threads were used at the service tee with ACME threads at the head. It is now common to have ACME threads at both the inlet and the outlet.

Ordering Information: When ordering a swing joint specify brand, length, body size, inlet fitting, and outlet fitting. In this market most swing joints can be identified by color. Most are Lasco (white) or Spears (gray or blue).

Service Fittings

Function: A service fitting is used to create a threaded outlet in the middle, or at the end of a main line for the attachment of a sprinkler or a quick coupler valve.

Inlet/Outlet/Threads: Attachment to main line by gasket or glued fitting. Outlet can be either NPT, or ACME.

Sizes: Most commonly used for 2" mains, but also available up to 8" with a 1.5" ACME outlet, and up to 14" with a 1.5" NPT outlet. Outlets are commonly 1.5" but are available in 1", and 1.25" as well

Materials: PVC and Ductile Iron

Joining Method: Service tees can be joined to the main line by a glue on fitting, or a push-on gasket fitting. It is now common to use gasket fittings. This provides the added benefit of allowing some pipe movement. Over the course of a very long straight run of PVC pipe, movement can be substantial. Gasket fittings allow this movement without compromising the integrity of the piping.

Other: Generally systems installed before 2002 utilize ACME outlet fittings. Looped irrigation systems have taps that are attached to the main line (whatever its size), and a loop of 2" pipe is created for the area being watered



A service fitting creates a threaded outlet along a run of pipe for sprinkler or quick coupler connections.

(green, tee, fairway, etc). This type of design allows the use of service tees that are all 2" x 2" x 1.5" acme. Even systems utilizing sprinklers with smaller inlets will often use a standard 1.5" ACME service tee and the swing joint will have a 1.5" acme inlet to accommodate this. Many irrigation consultants use this standard size service tee even for sprinklers and quick couplers using 1" swing joints. **Ordering Information:** Specify material, size of main line pipe, and size of outlet, either 1" or 1 1/2". Specify threads, NPT or ACME outlet.

PVC Pipe Fittings

Function: Pipe fittings allow for changes in size, gender, or from a threaded fitting to a glue fitting.

Sizes: 1/2, 3/4", 1", 1 1/4", 1 1/2". 2", 2.5", 3", 6", 8", etc.

Inlet: spigot, socket, MIPT, FIPT, FAT (limited to service sizes), MAT (limited to service sizes)

Outlet: Same as inlet

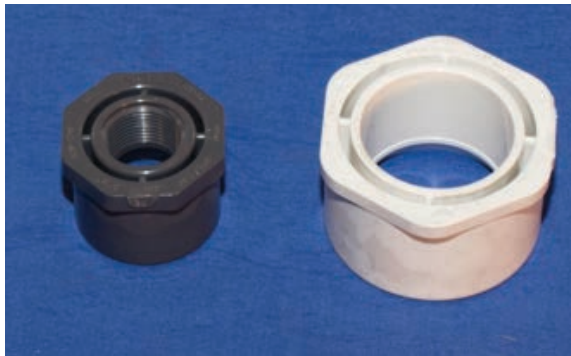
Materials: Most commonly PVC with ductile iron, and other materials in limited sizes.

Joining Method: Fittings are glued, gasketed, or

continued on pg. 18

threaded. Fittings that allow for a change in size and insert into an existing fitting are called bushings.

Other: Nipples are specified lengths of pipe with either a single threaded end (TOE-Threaded One End) or with both ends threaded (TBE-Threaded Both Ends).



PVC pipe fittings come in many sizes, threads and schedules. Schedules are used to describe the thickness of the walls. Schedule 80 is thicker than 40 and can withstand higher pressures.

Ordering Information: Specify Schedule 40 or Schedule 80, size, and type of fitting (tee, elbow, etc.), gender, and threaded or glue fitting.

Repair Fittings

Function: To join two pieces of straight pipe after a repair has been made to a nearby fitting or to the pipe.

Sizes: Same as pipe sizes, except at the larger sizes only knock-on couplers are available. 1", 1.5", 2", 3", 4", 6", 8", 10", 12", 14", etc.

Inlet/Outlet:
Gasket, or Glue

Materials:
PVC, Ductile Iron

Types:
Compression, Knock-on, Telescoping

Joining Method:
Compression fittings are slid on and then tightened with a special wrench. They



Common repair fittings top: knock on, middle: telescoping, bottom: compression.

rely on a gasketed fitting that compresses the gaskets and creates a tighter seal as the ends are tightened.

Knock-on repair couplings require the pipe to be tapered, and application of pipe lube. The pipe ends must be closer together than the length of the coupling. The ends are chamfered, and then the fitting is hammered on to one of the pipe ends until it is almost completely on to one side. It is then pushed across the gap onto the other side.

Telescoping repair couplings are glued onto one side via a glue on coupler, extended and then glued onto the other side.

Ordering Information: Specify size and type. Telescoping repair fixes require a slip by slip coupler as well. Pipe lube is needed for knock-on couplers.

Quick Coupler Key, Quick Coupler Valve, and Hose Swivel

Function: A quick coupler valve and key allow a temporary attachment to the irrigation system.



Sizes: Quick coupler valves are commonly 1", but also available in 3/4", 1", and 1 1/2". Hose swivels are available with 3/4", and 1" NPT inlets and 3/4" and 1" hose thread outlets.

Inlets: All quick coupler valve inlets are NPT.

Outlets: Quick coupler valve outlets are single lug, double lug, or ACME threaded in 3/4", 1", and 1 1/2" sizes. Quick coupler key inlets are available in the same formats.

Materials: Brass

Joining Method: Keys are inserted into valves and twisted down to start the flow of water. ACME

threaded keys have become the norm as they are able to regulate flow more easily.

Other: Quick coupler valves are generally restrained in some way. Methods vary from attaching a length of rebar to the valve to commercially available quick coupler anchors that keep the valve from spinning off the swing joint. Brass insert swing joints are also made (see swing joint page). These have a clamping mechanism that restrains the valve and allows stakes to be driven into the soil to limit movement.



Quick coupler keys have NPT threads on the outlet side that allow attachment to a hose swivel. The tops of some keys are threaded on the inside and the outside to accommodate a variety of hose swivel sizes.

Ordering Information: Order quick coupler valves by model number if possible. These numbers are often printed on the cap of the valve, or on an as-built. Hose swivel outlets should be specified as either 3/4" or 1" based upon the size of hose used at your course.

Hose Fittings

Function: To connect hoses, roller bases, and hose swivels together.

Sizes: 1/2", 3/4", or 1"
Inlet: Hose barb, Threaded fittings of each size, both male and female

Outlet: Hose thread, 1/2", 3/4", or 1"

Materials: Plastic, Brass

Joining Method: Hose threads are a coarse thread used to attach hoses to an array of other items to help distribute water. Some of these items are spigots, hose swivels, roller bases, sprinklers, and a host of other watering devices.



Other: Hose fittings are common in some sizes. Generally homeowners use 1/2", or 3/4" hoses so these sizes have a wide variety of commonly available fittings in a number of different

materials. 1" hose fittings are also available but can be harder to find. The types of fittings that can be found in 1" is limited as well.

Ordering Information: The size and type of the fitting needs to be specified.

System Connections

Flanged Connections

Flanged connections are generally used at the pump station, the drop pipe, and on occasion at transition points of large pipe sizes. Flanged joints require bolts, and a gasket and are very stable. Longer bolts allow flanged joints to attach through valves (Fig 1).



Figure 1. A bolt through flanged valve.

Hose Thread

Hose thread is used on roller bases, spigots, sprinklers, and hose swivels. Hose thread is coarse in comparison to most threads we see on the golf course. Because of its coarse nature it is almost always used with a gasket to insure that there is no leakage. Homeowners often use plastic or PVC hose fittings while golf course systems generally require brass fittings for durability. These threads are often abbreviated as MHT (male hose thread) or FHT (female hose thread).

Martin Design has made some changes. It's a bit more than a fresh coat of paint; it's a change in our company brand.

Don't worry, we haven't changed our Mission

Only focused it.



MARTIN design
Golf Course Architecture

335 N. River Ln. Suite 201, Batavia, Illinois 60510 630-482-2532 www.mdpltd.com



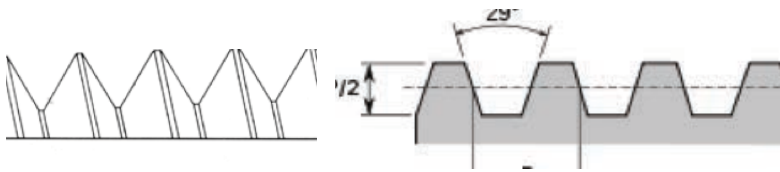


Figure 2. The left thread drawing are national pipe thread, the right drawing is an acme thread

National Pipe Thread (NPT)

National Pipe Thread is a triangular tapered thread that is standard in the United States (Fig 2). Because the thread is tapered it will create a nearly leak proof joint if tightened sufficiently. Even so, pipe thread compound or Teflon tape is often needed to make these joints completely water tight. As these threads tighten to one another they create a seal. The seal is improved by tightening and is directly relate to how tight the connection is. NPT threads are still used in galvanized pipe, and quick coupler valves as well as other metal piping in addition to many PVC fittings. Many irrigation systems installed prior to 2005 utilized NPT threads at the base of each sprinkler and at the service tee. Pipe thread is a versatile choice because of the large range of fittings made with these type of threads.

Acme Thread

Acme thread is common in newer systems (those installed in the past 10 years). Acme threads are a form of trapezoidal thread. In other words, a cross section of the threads themselves show the form of a trapezoid, as opposed to the original square thread (Fig 2). The acme thread is considered superior to national pipe thread (NPT) in a couple of ways. First, the threads themselves are wider, so they are more durable. Secondly, the acme thread configuration includes an o’ring (Fig 3). Acme threads do not need to be tight in order to prevent leakage. The threads themselves hold the pieces together while the water tight function is provided by the o’ring. As long as the o’ring is fully engaged the joint should be water tight. This feature helps keep damage from over tightening to a minimum. Occasionally this advantage can degrade over time as the o’ring hardens and deforms. When moving older swing joints it is always advisable to replace the o’rings that are disturbed.



Figure 3. ACME outlet on swing joint (note o ring that identifies the male threads as ACME)

There are not a wide variety of Acme threaded fittings. They are limited to use mostly as service fittings. Newer systems utilize Acme threads at the service tee, and at the base of the head. Some manufacturers use acme threads for the interior joints on a swing joint (Lasco) as well. Acme threads have also been used more recently on the male threads of quick coupler keys. These threads make it much easier to turn on a quick coupling valve incrementally.

Lateral Valve Swivel Connections

Lateral valves are outlets created on a main line to feed smaller loops or laterals. These can be up to 6” in size. These valve outlets exit the top of the main line and turn 90 degrees to feed an area. They are attached to the main line fitting in such a way that they can be turned 360 degrees. The valve is shown here (Fig 5). This type of fitting allows a valve to be at the change of direction without using a fitting to change direction, and an additional valve to stop flow if needed. These types of fittings are becoming more common in the Chicago area. They lend themselves well to new installations where mainline is at a significant depth, and herringbone systems where many valves are needed. The inlet is a threaded fitting that can be installed in a saddle, or a tee with the proper swivel outlet.



Figure 5. Harco swivel valve

Single/Double Lug Connections

Quick coupling valves (sometimes called snap valves) can be attached by means of lug connections. In these connections a slot is cast in the side of each valve. A corresponding lug on the quick coupler key fits into the slot and gradually pulls the key into the valve. Keys come with either single or double lug fittings (Fig 6).



Figure 6: Single lug quick coupler key with 1” NPT outlet

Gasket Fittings

Gasket fittings rely on the tight fit of the gasket around a pipe or fitting as well as water pressure from inside the fitting creating a tighter seal. Gasket fittings allow some pipe movement where other fittings do not. The spigot fitting must be tapered and lubed in order to fit into the gasket smoothly. Because of their tendency to move, these fittings

are often restrained when used on change of direction fittings, or valves.

Glossary of Terms and Abbreviations

There are a number of designations and acronyms used for thread types. A short glossary is shown below:

- BSP = British Standard Pipe Thread (international)
- MPT (also seen as MIPT) = Male (Iron) Pipe Thread
- FPT (or FIPT) = Female (Iron) Pipe Thread
- MAT = Male Acme Thread
- FAT = Female Acme Thread
- MHT = Male Hose Thread
- FHT = Female Hose Thread
- MBT = Male Buttress Thread
- FBT = Female Buttress Thread
- TPI = Threads Per Inch



Are you calling me FAT?

Female Gasket Fitting = A bell end that includes a gasket at the end. A tapered piece of pipe is lubricated and forced through the gasket. Water pressure pushing against the back side of the gasket helps create a seal.

Coarse Thread - A coarse thread is larger, there are fewer threads per inch.

Fine Thread - A fine thread is smaller, more threads per inch.

Service Tee - A service tee is a fitting that creates an outlet in a main line to bring it to a 1 1/2" swing joint size

Service Elbow - A fitting that converts the end of a main line to 1 1/2" swing joint size.

Spigot - A male pipe sized fitting that can be glued into a socket, or fitted into a gasket fitting. The outside of the fitting shown below

Socket - A female end of a glue fitting.

Inlet - The first portion of a fitting, sprinkler, or pipe that water contacts as it flows through the system to daylight. For example, the inlet on a sprinkler is the bottom fitting.

Outlet - The portion of a fitting, sprinkler, or pipe that is last contacted by water as it flows to daylight. The outlet of a sprinkler would be the nozzles.

Bell End - The expanded end of a pipe that creates a socket for the next portion of pipe to be glued into.



The bell end of a piece of pipe is expanded during manufacturing to make a socket for the next piece to be glued into.

Schedule 40 - Fitting class commonly used for 2 1/2" and smaller fittings in golf irrigation systems. Fittings are white in color.

Schedule 80 - A more robust fitting class commonly used for larger size fittings, change of direction fittings, and service fittings in golf course irrigation systems.

SDR 21 Class 200 - The most commonly used PVC pipe class for golf course irrigation systems. It is rated for 200 psi. @



A problem solved with a little ingenuity and a trip to the local hardware store.