

# SELECTING PIPE FITTINGS FOR GOLF COURSE IRRIGATION SYSTEMS

By Bill Koonz Jr., CID

**F**ittings for golf course irrigation systems are not that costly. Their costs are low compared to the total cost of a golf course irrigation project. However, costs can be high if you have fittings that fail. Replacing failed fittings costs more and requires more labor than other components of an irrigation system of a golf course. Moreover, you can face astronomical costs if failed fittings trigger erosion damage. Choosing fittings for the project should be made as carefully as selecting components such as sprinklers and controllers.

Modern golf course irrigation systems have unique characteristics that stress piping systems unlike those of any other industry. Systems are continuously pressurized and feed water to hundreds of valve-in-head sprinklers throughout the golf course. Highly advanced control systems open and close valves randomly throughout the golf course to operate pumps at peak capacity, balance flow and pressure and prevent runoff. The opening and closing of these valves creates pressure surges that oscillate throughout the piping system through sound waves. These surges, often referred to as "water hammer," are the most damaging influence inherent in today's piping systems. On average, a golf course piping system can be subjected to as many as 100,000 surges per year, with magnitudes as high as 80 psi above normal operating pressure. These cyclic surges are the major cause of failure in PVC piping systems.

As data collected from tests conducted by R.W. Jeppson on the effects of cyclic surges on PVC pipe indicates, PVC pipe can withstand more than 1.5 million cycles without failure. The Bliesner report indicates that the tensile-strength traits

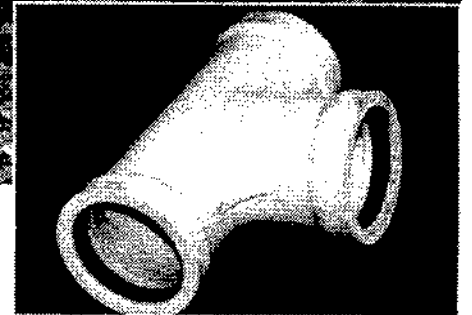


**Above: Failed PVC fittings produce scenes like this at golf courses all over the country. Repeated replacement can be avoided by using ductile-iron fittings on any full-dimension tee or mainline change of direction that is three inches or larger.**  
*Photos courtesy: The Harrington Corporation.*

**Above right: Pressure surges cause persistent expansion and contraction of PVC fittings that lead to a rupture in the fitting. Data from testing shows PVC molded fittings fail after only 16,000 cycles, compared with 1.5 million cycles for PVC pipe.**

of PVC pipe remain relatively constant even after years of service. This data indicates that PVC pipe is well-suited for use in golf course irrigation systems because it is resistant to those stresses that are most prevalent in these piping systems.

So why do PVC piping systems fail at all? The pipe has proven to be well-suited for all stresses associated with golf course irrigation. The problems lie mainly in the way in which the pipe is joined and the selection of pipe fittings used for making these connections.



Four major types of fittings are used in PVC piping systems:

- 1) Injection-molded PVC fittings that are solvent-welded or glued to the sections of pipe being joined;
- 2) Injection-molded PVC fittings that are joined to the corresponding PVC fittings through mechanical gasket connections;
- 3) Fabricated epoxy-coated steel fittings that are joined to the pipe through gaskets; and
- 4) Ductile iron gasket-jointed fittings.

Each of these pipe joining methods has strengths and weaknesses, depending to how they are applied. I will only describe those characteristics that are applicable.

Golf irrigation piping systems data gathered by Edwards, Lehman and Cohen during extensive testing of large-

diameter, injection-molded PVC fittings under cyclic surge conditions indicate the tensile strength of these fittings declines greatly in a short period of time. As discussed earlier, PVC pipe can withstand more than 1.5 million cycles before failing. PVC injection-molded fittings began to fail under these conditions after only 16,000 cycles. The three researchers concluded that the "fittings are the weak link in terms of their ability to withstand fatigue cycles that involve large pressure differences."

These failures can be attributed to several factors. The material used for molding plastic fittings is the same as the material used for extruding PVC pipe.

Highly advanced control systems open and close valves randomly throughout the golf course to operate pumps at peak capacity, balance flow and pressure and prevent runoff.

However, the orientation of the intersection of the cylindrical pipe sections causes stresses that are often twice those of the intersecting pipe sections. These factors combined with the inability of solvent-welded fittings to allow for expansion and contraction, which lead to early failure.

PVC gasket fittings differ from solvent-welded fittings because they enable expansion and contraction where the pipe sections intersect. Additionally, gasket-jointed PVC fittings eliminate installation errors where joints are glued. These fittings have the same positive qualities of solvent-welded fittings, excellent corrosion resistance and low initial costs. However, they also have negative qualities, particularly the inability to withstand long-term cyclical loading. As a result of these findings and the advent of more durable fittings, the use of PVC injection-molded fittings have become limited to two- and 2.5-inch sizes on most golf course irrigation systems.

Designers and installers of golf course irrigation systems began to look to other industries to try to find suitable fittings for their piping systems. Epoxy-coated steel fittings have been used widely in agricultural irrigation. The use of epoxy-coated steel fittings in golf course irrigation started in the late '70s. The short-term results looked quite favorable, as the fittings exhibited traits needed by the industry.

The cost was not prohibitive, the fittings were readily available and allowed for expansion. Moreover, the use of gaskets made installer error unlikely. The only characteristic that epoxy-coated steel fittings lacked at that time was good resistance to corrosion. Under certain soil conditions in different parts of the country, epoxy-coated steel fittings began to fail because of corrosion after



## Harco Ductile Iron

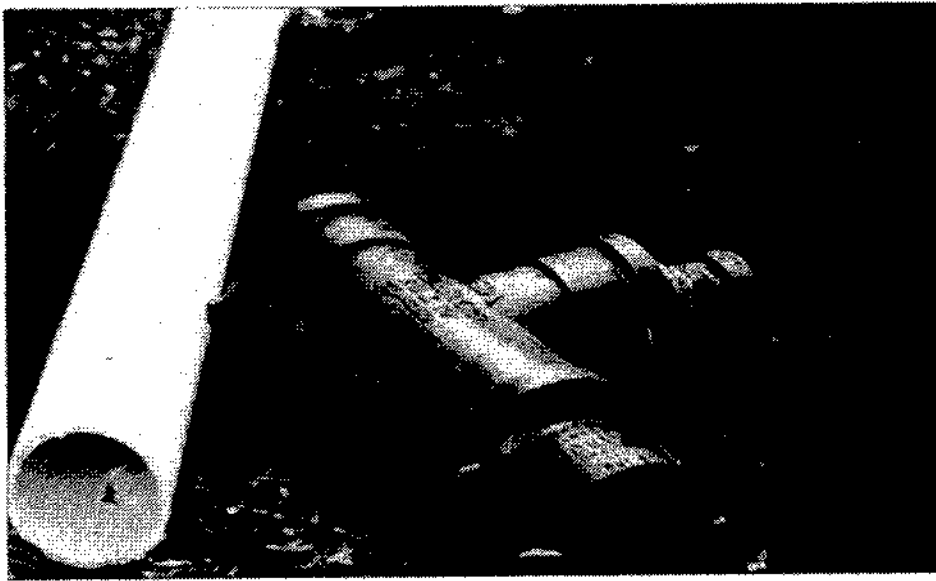
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**Above:** Today's ductile-iron pipe fittings are designed to work with PVC pipe on the golf course. The cost of ductile-iron is much higher than PVC, but the replacement and repair of PVC fittings will far exceed the initial cost of ductile-iron fittings.

### Pipe Fittings

only a few years in the ground. In spite of recent advances made to solve the corrosion problem in epoxy-coated steel fittings, the golf course community resumed its search for better methods of joining pipe.

Consultants, designers and installers turned to the waterworks industry to solve the problem experienced in golf course irrigation piping systems. They initially overlooked the use of ductile-iron fittings for PVC piping systems for two reasons. First, the fittings were very expensive and, secondly, they were adaptations of waterworks fittings and not specifically intended for use on PVC pipe. Mechanical joints with transition gaskets were the only way to adapt these fittings to PVC pipe as the fittings were sized for ductile-iron pipe.

Historically, before the use of PVC pipe became widespread, ductile-iron fittings were used in golf course irrigation systems — first on ductile-iron pipe and later on asbestos cement pipe. Ductile-iron offered all of the qualities required by irrigation piping systems on golf courses. Ductile-iron fittings withstand even the harshest cyclic surges. The use of gaskets allows for expansion and contraction and eliminates the likelihood of installation errors caused by improper gluing. And most important, ductile-iron fittings have passed the test of time with regard to corrosion resistance.

Ductile-iron has been used all over the world for centuries in waterworks systems. A ductile-iron water main that was installed in France more than 300 years

ago is still functioning today. Initial corrosion forms a layer of insoluble graphite that protects the fitting from further corrosion.

With the advent of PVC-sized, push-on ductile-iron fittings, the problems of availability were solved and the golf course industry finally had the answer to all its pipe-joining concerns. A fitting that was intended for use on golf course irrigation systems that use PVC pipe was being produced. But what about our last fitting criteria? Sorry, ductile-iron

fittings are expensive. However, as we discussed earlier, the cost of repairing or replacing fittings that have failed and repairing the damage that can be caused will far exceed the additional cost of ductile-iron fittings.

### Making the Right Fit

The choice is yours to make. Golf course irrigation consultants and installers mix different types of fittings to complete a golf course piping system. Solvent-welded or gasket-jointed PVC fittings remain widely used in the small-size ranges, specifically two-inch ones. PVC gasket-jointed fittings are being used in places that are not subjected to the full forces of pressure surges. This applies specifically to three- and four-inch-

diameter threaded service tees. But it has become a general rule of thumb that when the going gets tough, the ductile-iron gets going. Any full-dimension tee or mainline change of direction, three inches or larger, should be considered for ductile-iron.

The importance of proper design and prudent selection of system components cannot be emphasized enough. By overlooking components such as fittings, electrical splices and swing joints, a golf course could be doomed to a long-term maintenance nightmare regardless of the quality and performance of the primary irrigation components such as sprinklers and control systems. A prudent person would not build a house without consulting experts such as architects and engineers. So why would a golf course superintendent not seek advice and expertise from a golf course irrigation consultant?

The quality of play and the condition of the golf course reflect the level of maintenance enjoyed by the course. An antiquated or poorly designed irrigation system ties the hands of an otherwise talented superintendent. The proper selection and installation of golf course irrigation systems reduces labor and utility costs for a club through efficient, responsible watering. The higher quality of play and the enhanced beauty of the golf course are a major concern for club members.

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On average, depending on what part of the country you come from, a properly designed and installed irrigation system should last more than 20 years.

The additional costs associated with hiring an irrigation consultant and investing in superior components are relatively insignificant when amortized over the life span of an irrigation system at the golf course. The costs to repair or replace inferior components and improper installation will be realized in a short period of time. Choose wisely and enjoy the game. □

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