

COMPONENTS OF THE DWV SYSTEM

Engineers and designers have a number of materials from which to choose as they design sanitary and storm drainage systems for residential and commercial projects. Due to its exceptional strength and combination of being non-combustible and extremely quiet, cast iron soil pipe is a very popular choice for commercial construction. Upscale homes often feature cast iron stacks combined with plastic used for lavs, showers and tubs for a system Charlotte Pipe calls a "Quiet House[®]" design.

Cast iron soil pipe is primarily used in the construction of buildings. It serves well in sanitary-drain, storm-drain, waste-line, and vent-line applications. The product is widely used in commercial, industrial, and residential construction. Common examples include hospitals, schools, stadiums, prisons, and private dwellings. Cast iron soil pipe is the primary DWV material used in high-rise building construction.

Inside homes and buildings, sanitary piping is installed within partitions and is connected to tubs, lavatories, water closets and other fixtures. The main component of the DWV system is called the cast iron soil stack. This is the vertical piping line that runs upward from the building drain, continues up through the structure, and penetrates the plane of the roof. Waste lines convey waste from the fixtures to the main stack. Vent lines are the system's source of outside air, which allows the system to function properly by preventing a vacuum from forming. Vent lines are tied into the system at a point above the highest fixture. In some installations vent lines are connected to a separate vent stack.

A lower section of horizontal piping within the structure's DWV system is called the drain. It receives discharge from the upper portion of the system and carries it to the building's sewer. The building sewer routes discharge to the point outside the structure prescribed by the local plumbing code, where it connects to the city sewer, or a septic tank.

Within the area of building construction, cast iron soil pipe and fittings are widely used for storm drainage from roofs, yards, areaways, and courts. Cast iron piping is used for collecting runoff from sub-soil drains, which are positioned around the foundation. These drains relieve the foundation from groundwater by channeling it into a storm drainage system, or a sump pump.

Soil pipe also serves well as roof leaders and storm drains.

The design specifications for high-rise structures with large setbacks often call for soil pipe to carry large amounts of rain water and snow melt. Outside the area of building construction and storm drainage, cast iron piping is used in condensate lines, bridge drainage, and swimming pool drainage lines.



PERFORMANCE

Cast Iron is a generic term that identifies a large family of ferrous alloys. Cast irons are primarily alloys of iron that contain more than 2% carbon and 1% or more of silicon. Cast iron can be cast into intricate shapes because of its excellent fluidity. Because of the excellent properties obtainable with these low-cost engineering materials, cast iron finds wide application in environments that demand good corrosion resistance including water, storm and sanitary drain, waste and vent applications.

Quality gray iron castings, like the ones produced by Charlotte Pipe and Foundry, have an abundance of free graphite present in their microstructure. When Charlotte products are exposed to most corrosive agents, an insoluble layer of corrosion protection is left behind, which helps provide a durable barrier against additional corrosion.

Unique corrosion-resistance characteristics make it ideally suited for plumbing applications. The metallurgical composition of our cast iron products, specifically the presence of free graphite, ensures that if there is corrosion, it will occur only on the exposed surface and to extremely shallow depths. The graphite layer prevents additional corrosion.

NOTICE: A small percentage of very special wastes may not be suitable for cast iron plumbing systems. Such waste streams can emanate from laboratories, some concentrated or undiluted carbonated soft drink sources, and sites where specific types of cleaning chemicals are discharged, particularly when the effluent is undiluted. The very low pH wastes from such sources can corrode exposed cast iron.

GENERAL INFORMATION

Gray Iron Physical Properties

Tensile Strength	20,000 p.s.i. — 60,000 p.s.i. (21,000 p.s.i.)
Elastic Modulus (Young's modulus)	10 - 23 x 10 ⁶ p.s.i.
Hardness (Brinell)	150 - 250 BHN
Thermal Conductivity	0.110 - 0.137 calories/cm ² /Sec/cm/ °C
Thermal Expansion	10 x 10 ⁻⁶ / °C 6 x 10 ⁻⁶ / °F
Density	0.25 - 0.28 lb./in ³ 6.95 - 7.35 gm/cm ³
Specific Heat	0.13 BTU / lb / °F 0.13 cal / gm / °C

Composition of Gray Iron

The following are typical ranges of elements present in unalloyed gray cast iron normally produced in commercial practice:

Carbon (C)	2.60 - 3.85%
Silicon (Si)	1.25 - 2.90%
Manganese (Mn)	0.40 - 1.00%
Phosphorus (P)	0.02 - 0.90%
Sulfur (S)	0.04 - 0.20%

INSTALLATION PROCEDURES FOR CAST IRON

WARNING

Failure to follow proper installation practices, procedures, or techniques may result in personal injury, system failure or property damage.

- Always use protective equipment including eye protection and safety clothing while installing or cutting pipe.
- Power equipment can be dangerous if used improperly. Always review and carefully follow the manufacturer's operating and safety instructions.

Employ the knowledge and skill of an expert, licensed plumbing contractor for the best possible installations. Follow good plumbing practices and observe all safety precautions. Cast iron soil pipe and fittings should be installed in accordance with all applicable local plumbing codes and regulations. Equally important, follow all appropriate engineering specifications, building regulations and manufacturers' instructions.

NOTE: The following information is intended for use by licensed plumbing contractors and contains only suggested installation and testing procedures. The information is not meant to be a complete form of instruction.

Always take care during the installation of drain, waste and vent (DWV) systems to assure their satisfactory performance. **WARNING:** Failure to follow proper installation practices, procedures, and techniques can result in system failure, property damage, or personal injury. Please read all of the following information.

WARNING

To reduce the risk of serious or fatal injury to the operator and/or bystanders:

- Always read and follow the machine/tool manufacturer's instructions.
- Always secure pipe before cutting so that it cannot roll, drop or slip.

CUTTING METHODS FOR CAST IRON SOIL PIPE

There are several methods of cutting cast iron soil pipe. They may be grouped into two basic categories: those that require external power for their operation and those that require only hand operation. Methods that require external

power are used primarily in fabrication work or high-volume cutting operations. Examples of this type of equipment include the abrasive saw (sometimes called a chop saw), the power hack saw, and the electrically actuated hydraulic snap cutter. The abrasive saw is an efficient tool for cutting 8" and larger pipe.

There are two types of hand-powered cutting tools used in the industry today: the standard steel pipe cutter uses cutting wheels designed specifically to cut cast iron soil pipe; the snap cutter is used more commonly to cut cast iron soil pipe in the field. Several types of snap cutters are available.

Cutting Cast Iron Soil Pipe with a Snap Cutter

1. Read and follow instructions from manufacturer of the snap cutter.
2. Measure the required pipe length and mark it for the cut.



3. Position the snap cutter's chain squarely around the pipe to assure that the cut is straight. Set the chain so that the maximum number of cutting wheels come into contact with the pipe.



4. Score the pipe by applying pressure on the handles, which causes the cutting wheels to indent the pipe's

INSTALLATION PROCEDURES FOR CAST IRON

surface. Scoring the pipe prior to the actual cut is the key to making a straight, clean cut. If a piece of pipe is unusually tough, score it several times before making the final cut.

5. Rotate the pipe a few degrees within the chain. Then apply quick final pressure with the handles to complete the cut.

JOINING METHODS FOR CAST IRON

SOIL PIPE

There are generally three methods for joining cast iron soil pipe. A compression gasket or caulked joint can be used to join hub and spigot, while a hubless coupling may be used to join hubless cast iron.



Compression Gaskets

A compression gasket is a molded one-piece gasket made of an elastomer that meets ASTM C 564. The physical characteristics of this elastomer help to insure that the gasket will not decay or deteriorate from contact with materials carried in the piping system, or from contact with the soil or air around the pipe.

NOTICE

To reduce the risk of property damage, service compression gaskets must only be used with service pipe, while extra heavy compression gaskets must only be used with extra heavy pipe.

Charlotte Pipe and Foundry Company strongly recommends that its cast iron hub and spigot pipe and fittings be joined with compression gaskets sold by our Company. Our hub and spigot pipe and fittings are manufactured to very specific manufacturing tolerances which conform to ASTM A 74. Our gaskets, produced in conformity with ASTM C 564, are especially designed to work with our pipe and fitting tolerances.

It has been the experience of our Company that gaskets designed by other manufacturers, even though they may be manufactured to the same consensus standards, may give less than satisfactory test and performance results. Consequently, failures in installations using gaskets not

recommended by Charlotte Pipe® are not the responsibility of this company.

WARNING

Follow all safety procedures in this manual and use protective eye wear, clothing and equipment when making any compression gasket joint to reduce the risk of serious injury.

Neoprene is well known for its low degree of permanent deformation (or compression set), even under heavy loading for long periods of time. Properly compounded neoprene gaskets not only provide a positive seal, but will retain this sealing capacity for many years.

Neoprene is one of the few elastomers that is well suited to direct burial because it will withstand the natural corrosive components of soil, as well as sanitary effluent.

Although all rubber materials, including neoprene, tend to stiffen at low temperatures, neoprene gaskets are readily installed in winter weather. Charlotte® compression gaskets will perform best if kept above 50°F. To make joining easy in cold conditions, keep gaskets in warm water until ready to use.

WARNING

Testing with or use of compressed air or gas in Cast Iron pipe or fittings can result in explosive failures and cause severe injury or death.

AIR/GAS



- NEVER test with or transport/store compressed air or gas in Cast Iron pipe or fittings.
- NEVER test Cast Iron pipe or fittings with compressed air or gas.
- ONLY use Cast Iron pipe and fittings for drain, waste and vent or sanitary sewer applications.

WARNING: The maximum working temperature for neoprene gaskets is 212°F, with a maximum working pressure of (0) zero Psi. Therefore, the Charlotte Seal and Quick-tite gaskets are not rated for pressure applications.

Joint deflection using a compression gasket has a maximum limit of up to 5 degrees. Maximum deflection should not exceed 1/2 inch per foot of pipe. This would allow 5 inches of deflection for a 10 foot piece of pipe and 2-1/2" for a 5 foot piece of pipe. Installation should initially be completed in a straight line and then deflected to the appropriate amount. This helps assure a good tight joint. For more than 5 degrees of deflection, fittings should be used.

INSTALLATION PROCEDURES FOR CAST IRON

Making A Compression-Gasket Joint

1. Clean the hub and spigot so they are free of all dirt, mud, sand, gravel, and other foreign materials.
2. Remove sharp edges by filing or tapping with a ball-peen hammer. Insert the gasket into the hub. This may be done by using one of three methods.



- **Double Folding:** Squeeze the gasket together with both hands, then insert it into the hub. As you withdraw your hands, the gasket will unfold and snap into proper position.



- **Thumb Fold:** Hold the outside circumference of the gasket and press thumbs down and in, as though turning the gasket inside out. Place the gasket into the hub and release it, allowing it to snap into proper position.



- **Drive-In:** Place the gasket into the hub as far as possible, then tap the gasket's outer lip with a rubber mallet or flat board until it becomes seated. This method works best on two- or three-inch gaskets.
3. Regardless of which insertion method you use, the gasket must be completely inserted into the hub. Only the gasket's flange that shows identification information should remain exposed outside the hub.

! WARNING

To reduce the risk of serious injury:

- Keep pipe joint and adhesive lubricant from touching eyes or skin.
- Only use adhesive lubricant with proper ventilation.
- Read and carefully follow the manufacturer's application and safety instructions, particularly when working around sources of heat, sparks or open flame.
- In case of an accident, follow hazardous warning and medical treatment statement shown on the product's label.

4. Lubricate the gasket following the pipe joint lubrication manufacturer's recommendations. For small-diameter pipe and fittings (2" - 4"), coat the inside of the gasket with lubricant using a paint brush or rag, and then coat the outside of the spigot.

INSTALLATION PROCEDURES FOR CAST IRON



Installing Fittings with Compression-Gasket Joints

There are several techniques that may be used to assemble fitting compression-gasket joints. Review the following suggestions to determine which best suits your needs.

! WARNING

Follow all safety procedures in this manual and use protective eye wear, clothing and equipment when making any compression gasket joint to reduce the risk of serious injury.

For large-diameter pipe and fittings (5" - 15"), we recommend that an adhesive lubricant be used to ensure a water-tight seal. Adhesive lubricants should be applied to the inside of the gasket, the outside of the spigot and the inside of the hub.



NOTICE

To reduce the risk of joint leaks and property damage with cast iron pipe and fittings in sizes 5" and larger, adhesive lubricant should be applied to the inside of the gasket, the outside of the spigot and the inside of the hub. The use of adhesive lubricant is not a substitute for proper joint restraint.

- Align the pipe so that it is straight, then push or pull the spigot through all the sealing rings of the gasket. Charlotte plain-end pipe is manufactured with beveled ends to make insertion easy. As the spigot barrel is forced into the gasket, the gasket is compressed and completely seals the joint in both displacement and compression. When seated correctly, you will feel the spigot end of the pipe "bottom" in the hub.

- Using a Lead Maul:** Almost all plain-end fittings may be installed by driving them into place with a lead maul or a mallet. After installing and lubricating the gasket, align the spigot and strike the fitting on its driving lug, or across its full hub, with a lead maul. Driving lugs are standard on all Charlotte plain-end bends and they make joining easy. The fitting may be struck as hard as necessary, since the lead maul will deform before damaging the fitting.

INSTALLATION PROCEDURES FOR CAST IRON

Cast Iron Installation



- **Using a Mallet:** If you prefer to use a mallet, place a wooden block over the fitting's hub. After installing and lubricating the gasket, align the spigot and carefully strike the wooden block with the mallet until the spigot is properly seated.
 - **Joining by Jolting:** Pre-assembly of fittings and short lengths of pipe can be done by jolting on a piece of wood or other sturdy surface. After installing and lubricating the gasket, align the spigot in the gasket, then push or pull the spigot into the gasket as far as you can. Next, jolt the assembly on a piece of wood or other sturdy surface until the spigot "bottoms" in the hub.
 - **Using a Pry-bar:** A pry-bar can speed installations, particularly on long runs of straight pipe being installed below ground. After installing and lubricating the gasket, align the spigot in the gasket, then apply the pry-bar to force the pipe through seal. It is correctly seated when it "bottoms" in the hub.
 - **Making Adjustments:** You can reposition a fitting's alignment after forming a compression-gasket joint.
- **Cold Weather Installations:** All elastomers tend to stiffen as the ambient temperature drops. Charlotte® compression gaskets will perform best if kept above 50 degrees F. To make joining easy in cold conditions, keep gaskets in warm water until ready for use. Cold gaskets that have become stiff can quickly be made pliable by bringing them into a heated space or immersing them in warm water.

Important Reminders and Helpful Hints about Compression Gasket Joints

- Use only Charlotte® Service or Extra Heavy pipe and fittings with Charlotte compression gaskets.
- Service pipe and fittings must be joined with Service gaskets. Extra Heavy pipe and fittings must be joined with Extra Heavy gaskets.
- Before inserting the gasket, make sure that the hub is clear of all dirt and other foreign materials that would interfere with assembly.
- Lubricate the inside of the gasket and the outside of the spigot.
- When installing large-diameter pipe (5" - 15"), we recommend using adhesive-type lubricant.
- Make certain that the pipe or fitting is in good alignment (not cocked) before pulling the plain-end spigot into the gasket.
- The spigot must pass through both seals until it "bottoms" firmly in the base of the hub.
- If pipe is cut in the field and you are having difficulty making it bottom out, you may be snagging the gasket with the pipe's cut end. To solve this problem, smooth the sharp spigot by filing.
- To make joining easy in cold conditions, keep gaskets in warm water until ready for use.
- **NOTICE:** If adhesive lubricant has been used and allowed to set, repositioning the pipe or fitting will damage the adhesive bond.

NOTICE

Turning the fitting does not damage Charlotte compression gaskets when non-adhesive lubricant has been correctly used. However, if adhesive lubricant has been used and allowed to set, repositioning the fitting will damage the adhesive bond.

INSTALLATION PROCEDURES FOR CAST IRON

A caulked joint may also be used to join hub and spigot cast iron soil pipe, as follows:

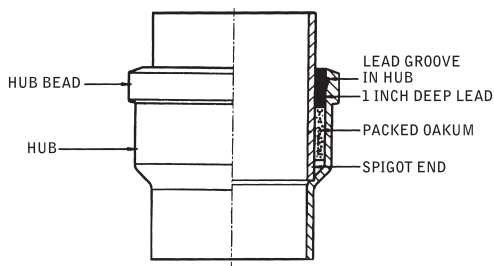
1. Place the spigot end of a pipe or fitting inside the hub of another pipe or fitting and align correctly, making sure that all surfaces are clean and dry.
2. Place oakum into the joint using a yarning iron.
3. Pack the oakum to the proper depth using a packing iron.
4. Pour molten lead into the joint, filling it to the top of the hub. For a horizontal joint, use a joint runner to retain the molten lead in the hub.

! WARNING

To reduce the risk of serious or fatal injury from explosions or burns, use caution when handling molten lead.

- Never allow molten lead to contact liquids including water, because it may explode.
- Molten lead is extremely hot and handling can be dangerous.
- Always utilize protective eye wear, safety clothing and equipment when making a caulked joint.

5. After the lead has cooled somewhat and solidified, the joint is ready to be caulked. Caulk the joint with inside and outside caulking irons. Caulking the joint sets the lead and makes a leak-free joint.



HUBLESS JOINTS

The shielded coupling for hubless cast iron soil pipe and fittings provides a more compact installation without sacrificing the quality and performance of cast iron. The hubless coupling system typically uses a one-piece neoprene gasket and a shield of stainless steel retaining clamps. The great advantage of the system is that it permits joints to be made in limited-access areas. The 300 series stainless steel, which is always used with hubless couplings, was selected because of its superior corrosion resistance. It is resistant to oxidation, warping and deformation, offers rigidity under tension with

substantial tension strength, and still provides sufficient flexibility.

The neoprene gasket absorbs shock and vibration, and helps eliminate galvanic action between the cast iron and the stainless steel shield. The neoprene sleeve is protected by a non-combustible stainless steel sleeve. Joint deflection using a shielded hubless coupling has a maximum limit of up to 5 degrees. Maximum deflection should not exceed 1/2 inch per foot of pipe. This would allow 5 inches of deflection for a 10 foot piece of pipe. Installation should initially be completed in a straight line and then deflected to the appropriate amount. This helps assure a good tight joint. For more than 5 degrees of deflection, fittings should be used.

Hubless couplings are used to connect cast iron pipe and fittings. The couplings are composed of a stainless-steel shield, clamp assembly and an elastomeric sealing sleeve made of neoprene. It is important to note that hubless couplings are manufactured to CISPI 310 and ASTM C 1277, while the heavy duty couplings are manufactured to ASTM C 1540.

NOTE: In hubless cast iron installations, Charlotte Pipe's warranty will not apply if products are joined with unshielded hubless couplings. Charlotte Pipe requires that its hubless cast iron pipe and fittings be joined only with shielded hubless couplings manufactured in accordance with CISPI 310, ASTM C 1277 and certified by NSF® International or with Heavy Duty Couplings meeting ASTM C 1540. Failures in installations using couplings not recommended by Charlotte Pipe or not conforming to CISPI 310, ASTM C 1277 or ASTM C 1540 are not the responsibility of this company.

Horizontal pipe and fittings five (5) inches and larger must be suitably braced to prevent horizontal movement. This must be done at every branch opening or change

! WARNING

Horizontal pipe and fittings five (5) inches and larger must be suitably braced to prevent horizontal movement. This must be done at every branch opening or change in direction by the use of a brace, block, rodding or other suitable method, to prevent movement or joint separation. Heavy Duty or wide body couplings are not a substitute for proper thrust restraint. Failure to properly restrain branch openings or changes in direction will result in joint movement or separation, causing system failure and potential serious injury.

INSTALLATION PROCEDURES FOR CAST IRON

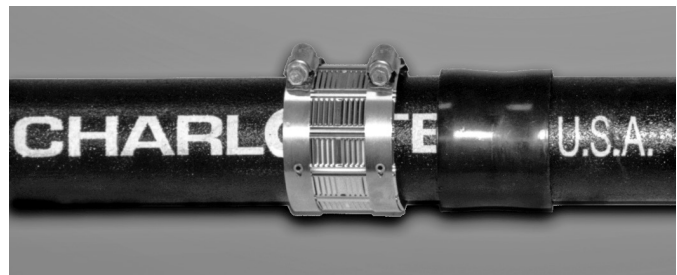
in direction by the use of a brace, block, rodding or other suitable method, to prevent movement or joint separation.

A heavy duty hubless coupling should only be used when a more rigid joint is needed. Heavy duty couplings provide additional sealing clamps. However, heavy duty couplings are not a substitute for proper thrust restraints. The dimensions specified in ASTM C 1540 result in couplings that extend beyond the "W" dimension of the hubless pipe fittings in 1-1/2" through 6" diameters. Therefore, ASTM C 1540 (heavy duty) couplings will extend beyond the gasket positioning lug and may also cover raised lettering on some fittings.

Both regular and heavy duty couplings are to be installed using a torque wrench. Regular hubless couplings are typically tightened with a preset torque wrench set to 60-inch pounds, while heavy duty couplings are typically tightened with a preset torque wrench set to 80-inch pounds. The tightening sequence is essential when installing both regular and heavy duty couplings. Torque settings and sequencing vary by coupling manufacturer. Couplings must be installed per the requirements of the coupling manufacturer.



2. Insert gasket over pipe or fitting until end of pipe or fitting butts against the gasket's integrally molded shoulder. Slide the coupling assembly over the other pipe or fitting to be joined.



3. Insert the second pipe or fitting into the gasket until both ends of pipe or fittings butt against the integrally molded shoulder in the center of gasket.



4. Slide the coupling assembly into position centered over gasket. At this point, it is recommended to hand tighten all the clamps in the coupling assembly with a wrench.

WARNING

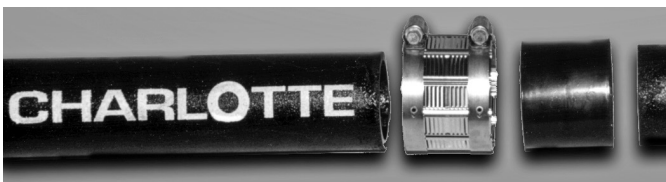
Hubless couplings are not rated for pressure.

WARNING

Failure to follow proper installation practices, procedures, or techniques may result in personal injury, system failure or property damage.

- Always use protective equipment including eye protection and safety clothing while installing or cutting pipe.
- Power equipment can be dangerous if used improperly. Always review and carefully follow the manufacturer's operating and safety instructions.

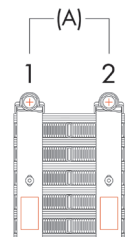
Making Hubless Joints



1. Lay out components as shown. Pipe ends are to be cut as squarely and smoothly as possible. Check coupling and gasket for foreign material, clean if necessary.

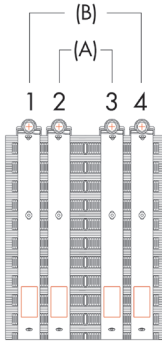
Standard Duty Couplings

- Coupling sizes 1 1/2", 2", 3" and 4" have two clamps. Use a preset, or dial indicating type torque wrench and tighten to 60 inch pounds of torque. Tighten clamp 1 and then clamp 2 alternately in 20 lbf-in increments until the recommended 60 lbf-in is reached.



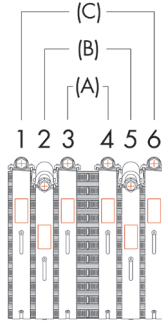
INSTALLATION PROCEDURES FOR CAST IRON

- Coupling sizes 5", 6", 8", and 10" have four clamps. Use a preset, or dial indicating type torque wrench and tighten to 60 inch pounds of torque. First, the inner clamps "A" are to be tightened alternately in 20 lbf-in increments until the recommended 60 lbf-in load is reached. Next, the outside clamps "B" are to be tightened alternately in 20 lbf-in increments until the recommended 60 lbf-in is reached.



Note: When O.D. difference between pipe and fitting is visibly different the following torque pattern is recommended; 1-3 and 2-4.

- Coupling sizes 12" and 15" have six clamps. Use a preset, or dial indicating type torque wrench and tighten clamps to 120 inch-pounds of torque. First, the inner clamps "A" are to be tightened alternately in 20 lbf-in increments until the recommended 120 lbf-in is reached. Next, the middle clamps "B" are to be tightened alternately in 20 lbf-in increments until the recommended 120 lbf-in is reached. Finally, the outer clamps "C" are to be tightened alternately in 20 lbf-in increments until the recommended 120 lbf-in is reached.



Note: When O.D. difference between pipe and fitting is visibly different the following pattern is recommended; 1-4, 2-5, and 3-6.

Heavy Duty "HD" and "MD" Couplings

- Coupling sizes 1 1/2", 2", 3", and 4" have four clamps. Use a preset, or dial indicating type torque wrench and tighten to 80 inch pounds of torque. First, the inner clamps "A" are to be tightened alternately in 20 lbf-in increments until the recommended 80 lbf-in is reached. Then, the outer clamps "B" are tightened alternately in 20 lbf-in increments until the recommended 80 lbf-in is reached.

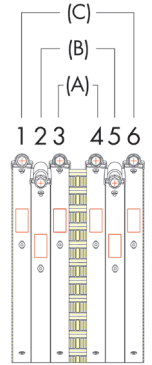


Note: When the O.D. difference between pipe and fitting is visibly different the following torque pattern is recommended; 1-3 and 2-4.

Coupling sizes 5", 6", 8" and 10" have six clamps. Use a preset, or dial indicating type torque wrench and tighten to 80 inch pounds of torque. First, the inner clamps "A" are to be tightened alternately in 20 lbf-in increments until the recommended 80 lbf-in

is reached. Next, the middle clamps "B" are to be tightened alternately in 20 lbf-in increments until the recommended 80 lbf-in is reached. Finally, the outer "C" clamps are to be tightened alternately in 20 lbf-in increments until the recommended 80 lbf-in is reached.

Note: When the O.D. difference between pipe and fitting is visibly different the following torque pattern is recommended; 1-4, 2-5, and 3-6.



Note: Charlotte Pipe does not recommend or warrant installations joined with un-shielded hubless couplings.

- Charlotte Pipe requires that its hubless cast iron pipe and fittings be joined only with shielded hubless couplings manufactured in accordance with CISPI 310, ASTM C 1277 and certified by NSF® International or with Heavy Duty Couplings meeting ASTM C 1540.
- Failures in installations using couplings not recommended by Charlotte Pipe or not conforming to CISPI 310, ASTM C 1277 or ASTM C 1540 are not the responsibility of the company. For more information please see our Limited Warranty in this manual, call 800-438-6091 or visit www.charlottepipe.com.

UNDERGROUND INSTALLATION PROCEDURES

The physical properties of cast iron soil pipe and fittings make cast iron an ideal drain, waste, and vent material for underground installations. Two key elements for proper underground installations are trench preparation and backfilling.

The trench should be wide enough for easy assembly of the joints. Total load on the pipe includes both earth load and live load. Safety procedures including OSHA and other laws applicable to trenching should be observed, including provisions to avoid collapse of the trench wall. Cast iron, being a rigid material, does not depend upon sidefill for support. The trench bottom should be stable enough to support the complete barrel of the pipe. If possible, the barrel of the pipe should rest on even and undisturbed soil. Holes should be provided at each joint for each hub or coupling to allow for continuous support of the barrel along the trench bottom. If the ditch must be excavated deeper than the depth of the drainage pipe, place and tamp backfill material to provide uniform support for the pipe barrel.

Many times in the installation of underground cast iron,

INSTALLATION PROCEDURES FOR CAST IRON

It is necessary to make adjustments to the direction of the drain line. Cast iron soil pipe and neoprene compression gaskets will allow this through deflection in the joints. Installation should initially be completed in a straight line and then deflected to the appropriate amount. Maximum deflection should not exceed 1/2 inch per foot of pipe. This would allow 5 inches of deflection for a 10 foot piece of pipe. For changes in direction greater than these deflections, an appropriate fitting should be used.

While backfilling, use cradling and partial backfilling of pipe to stabilize its position and maintain its correct alignment. While pouring slabs, stabilize piping securely to prevent any misalignment during the pour. Firmly secure all closet bends installed under a slab.


Where unstable soil requires the drain and waste line to be supported with hangers attached to the concrete slab, sway bracing should always be a part of the support system. Sway bracing will help keep the system in proper alignment and help eliminate movement from side to side.

Once the underground installation is completed, the section is ready for testing. Charlotte Pipe recommends testing at 10 feet of hydrostatic (water) pressure (4.3 pounds per square inch.) See the Testing and Inspection section of this manual for more information. Because underground drainage pipe is usually the largest diameter pipe, it is necessary to restrain the system or joints from movement at changes in direction and end of runs prior to testing. This may be done by partially backfilling and leaving the joints exposed for inspection or rodding and or bracing.

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AIR/GAS



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- NEVER test Cast Iron pipe or fittings with compressed air or gas.
- ONLY use Cast Iron pipe and fittings for drain, waste and vent or sanitary sewer applications.

After testing is completed, the trench can be properly backfilled. When backfilling, care should be taken to protect the pipe from large rocks, stones, or frozen fill material that could damage the pipe. Cast iron soil pipe laid on a solid trench bottom does not require special backfilling or procedures.

Installers should always consider local conditions, codes, manufacturers' instructions, and engineers' instructions in any installation.

NOTE: This manual is not a complete engineering reference addressing all aspects of design and installation of cast iron soil pipe. The Cast Iron Soil Pipe Institute handbook is also an excellent reference for engineers.

In-slab Installation

Although cast iron soil pipe, fittings, couplings and gaskets are unaffected by direct contact with concrete, care must be taken to properly support any piping system when pouring concrete so that the weight of the concrete does not affect the piping system. While not required due to any corrosion issues, a good practice to aid in any future maintenance or excavation of a system would be to loosely wrap both hub-and-spigot joints and hubless couplings with polyethylene sheet so that concrete does not become imbedded into crevices, shields or clamps on couplings.

Some codes require sleeving or protection of piping at slab penetrations. While not necessary due to any corrosion issues, always follow applicable code requirements on any installation.

ABOVE GROUND INSTALLATION PROCEDURES

! WARNING

Unsecured piping can fall and cause serious injury. Always properly support and secure piping to help prevent injury. Always wear protective clothing, including hard hats, during installation.

Installing Vertical Piping

1. Secure vertical piping at intervals sufficiently close to maintain correct pipe alignment and to support the weight of the pipe and its contents. Support stacks at their bases and at sufficient floor intervals to meet the requirements of local codes. Use approved riser clamps, floor clamps, or friction clamps for this purpose. If the building is over two stories in height, support the stack at the base and at each floor with an approved clamp.

! WARNING

Failure to follow proper installation practices, procedures, or techniques may result in personal injury, system failure or property damage.


- Always use protective equipment including eye protection and safety clothing while installing or cutting pipe.
- Power equipment can be dangerous if used improperly. Always review and carefully follow the manufacturer's operating and safety instructions.

INSTALLATION PROCEDURES FOR CAST IRON

2. If vertical pipe is required to stand free of any support by design specifications, or if no structure is available for support and stability during construction, secure the piping in its proper position with metal stakes and braces fastened to the pipe. Support the weight of vertical pipe risers at the point or points above and closest to their center of gravity.

Installing Horizontal Piping—Suspended

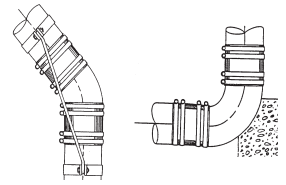
Horizontal pipe and fittings five (5) inches and larger must be suitably restrained to prevent horizontal movement and possible joint separation. This must be done at every branch opening or change in direction by the use of a brace, block, rodding or other suitable method, to prevent movement or joint separation.

 **WARNING**

Unsecured piping can fall and cause serious injury. Always properly support and secure piping to help prevent injury. Always wear protective clothing, including hard hats, during installation.

1. Support horizontal piping and fittings at intervals sufficiently close to maintain correct pipe alignment and to prevent sagging or grade reversal. Support each length of pipe with an approved hanger located as close to the joint as possible, and not more than 18 inches from the joint. For 12" and 15" hubless pipe, hangers should be placed on both sides of the coupling when installing full ten-foot lengths. Installation requiring multiple joints within a four foot developed length shall be supported at every other or alternating couplings.
2. Support terminal ends of all horizontal runs or branches, and each change of direction or alignment, with an approved hanger.
3. Firmly secure all closet bends installed above ground.
4. Most plumbing codes require that five-foot pipe be supported at five-foot intervals, and that ten-foot pipe be supported at ten-foot intervals. Support each length of pipe properly in accordance with all applicable codes to prevent sagging and misalignment.
5. When installing large-diameter horizontal piping (five inches or larger), restrain joints to prevent horizontal movement. Use sway bracing as needed to stabilize side movement of the piping system. Use blocks, rods, bracing or other suitable methods at each branch opening or change in direction. Examples of restraints are shown here:

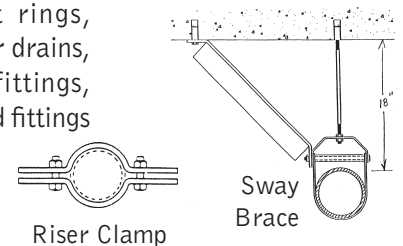
NOTE: Engineers, designers and installers should use additional references concerning hanging, restraint and support of pipe in the Cast Iron Soil Pipe Handbook published by the Cast Iron Soil Pipe Institute (www.cispi.org) and/or the ASPE Plumbing Engineering Design Handbook, chapter 6, Hangers and Support in Vol. 4, published by the American Society of Plumbing Engineers (www.aspe.org).




Installing Horizontal Fittings

NOTE: The following procedures are intended only as general guidelines. Specific installation instructions and techniques may be required as a result of applicable plumbing and building codes, engineering specifications and instructions.

1. Use hangers as required to provide proper alignment and grade. Install a hanger at every horizontal branch connection. Always install hangers within 18 inches of the joint to maintain correct system alignment and to prevent structural sagging. For 12" and 15" hubless pipe, hangers should be placed on both sides of the coupling when installing full ten-foot lengths. Installation requiring multiple joints within a four-foot developed length shall be supported at alternating couplings. The correct spacing of hangers will enable proper piping system grade.
2. Use sway bracing, as needed, to stabilize hanging systems against horizontal movement. Sway bracing is a non-rigid form of structural support that is well suited to installations in which components hang from a height greater than 18 inches.
3. The following components should be stabilized from movement in any direction: closet bends; traps; trap-arms; all similar branches. Closet bends installed above ground must be stabilized. Stabilize all vertical closet stubs against all vertical and horizontal movement.
4. When a hubless blind plug is used for a required cleanout, the complete coupling and plug must be accessible for removal and replacement.
5. Use caulked lead and oakum or compression joints to connect closet rings, floor drains, shower drains, similar slip-over fittings, and hubless pipe and fittings to soil pipe hubs.




It is important to test all cast iron piping installations for leaks after the roughing-in has been completed. Before testing, the installer should notify the inspector of the local administrative authority having jurisdiction over plumbing installations. Leave concealed work uncovered until the required tests are performed and the system receives approval.

 **WARNING**

Testing with or use of compressed air or gas in Cast Iron pipe or fittings can result in explosive failures and cause severe injury or death.

AIR/GAS



- NEVER test with or transport/store compressed air or gas in Cast Iron pipe or fittings.
- NEVER test Cast Iron pipe or fittings with compressed air or gas.
- ONLY use Cast Iron pipe and fittings for drain, waste and vent or sanitary sewer applications.

Various procedures are used to test installed cast iron soil pipe and fitting systems. They include the use of water (hydrostatic), smoke, and peppermint.

For testing purposes, the system should be properly restrained at all bends, changes of direction, and ends of runs.

 **WARNING**


Use proper safety procedures, equipment, eye-wear and clothing during any testing procedures.

Note: In all installations, installers should be aware of local conditions, codes and regulations. Comply with all local codes, regulations, manufacturers' instructions and architect/engineer specifications.

Water or Hydrostatic Testing

This is the most common type of test used to test a completed cast iron soil pipe installation, and it is the test most often recommended by plumbing codes. Its purpose is to check the installation for leaks and to correct these prior to putting the system into service. Use the following steps to perform a water test:

1. Since visual inspection of the system is required, conduct this test prior to enclosing above-ground installations, or backfilling below-ground installations.
2. Isolate each floor or section being tested by inserting plugs into the test tees in the stacks.
3. Plug or cap all other openings with test plugs or test caps.

 **WARNING**

Horizontal pipe and fittings five (5) inches and larger must be suitably braced to prevent horizontal movement. This must be done at every branch opening or change in direction by the use of a brace, block, rodding or other suitable method, to prevent movement or joint separation. Heavy Duty or wide body couplings are not a substitute for proper thrust restraint. Failure to properly restrain branch openings or changes in direction will result in joint movement or separation, causing system failure and potential serious injury.

4. Fill the system with water at its highest point. Do this slowly to allow any trapped air to escape as the water level rises. Note: Failure to remove entrapped air may cause faulty test results, so be sure all entrapped air has been removed to obtain reliable test results.
5. As water fills a vertical pipe, it creates hydrostatic pressure. This pressure increases as the height of the water in the vertical pipe increases. Charlotte Pipe recommends water testing with ten feet of hydrostatic pressure (4.3 pounds per square inch).
6. After filling the stack to ten feet of head, visually inspect the section you are testing for any leaks around its joints.
7. In hubless systems, leaks can often be traced to hubless couplings that were not tightened properly to the recommended torque. In these cases, correctly tightening the couplings should eliminate the leak.
8. If leaks are detected in hub and spigot systems, disassemble the joints and check to determine if the correct installation procedures were used.
9. Water test each portion of the system for 15 minutes. This is sufficient time for any problems to be detected.
10. After a successful test, drain the system and prepare the next section for testing.

TESTING AND INSPECTION


THRUST FORCES

Thrust or displacement forces are encountered as the pipe is filled with water. The higher the fill, the greater the force acting to separate a joint. The table below shows the pounds of force tending to cause joint separation when using pipe from 1-1/2" to 15" and a head of water from 10 feet to 120 feet.

Thrust or Displacement Forces Encountered in Hydrostatic Testing of Cast Iron Soil Pipe

Pipe Size		1 1/2"	2"	3"	4"	5"	6"	8"	10"	12"	15"
Head, Feet of Water	Pressure PSI	Thrust lb.	Thrust lb.	Thrust lb.	Thrust lb.	Thrust lb.	Thrust lb.	Thrust lb.	Thrust lb.	Thrust lb.	Thrust lb.
10	4.3	12	19	38	65	95	134	237	377	538	847
20	8.7	25	38	77	131	192	271	480	762	1088	1714
30	13.0	37	56	115	196	287	405	717	1139	1636	2562
40	17.3	49	75	152	261	382	539	954	1515	2164	3409
50	21.7	62	94	191	327	479	676	1197	1900	2714	4276
60	26.0	74	113	229	392	574	810	1434	2277	3252	5124
70	30.3	86	132	267	457	668	944	1671	2654	3790	5971
80	34.7	99	151	306	523	765	1082	1914	3039	4340	6838
90	39.0	111	169	344	588	860	1216	2151	3416	4878	7685
100	43.4	123	188	382	654	957	1353	2394	3801	5429	8552
110	47.7	135	208	420	719	1052	1487	2631	4178	5967	9400
120	52.0	147	226	458	784	1147	1621	2868	4554	6505	10247
AREA, OD, in. ²		2.84	4.34	8.81	15.07	22.06	31.17	55.15	87.58	125.09	197.06

Thrust = Pressure x Area


WARNING

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The Smoke Test

Should a smoke test be specified by an engineer, architect, or plumbing code, proceed as follows:

1. Permanently connect all fixtures and fill all traps with water.
2. Be prepared to test all parts of the plumbing drainage and ventilation system.
3. Close all windows in the building until the test has been completed.
4. Fill the system with a thick, penetrating smoke that has been generated by one or more smoke-producing machines.
5. When smoke begins to appear at the stack opening on the roof, close off that opening.

WARNING

To reduce the risk of fire, smoke inhalation, chemical inhalation or burns, never use chemical mixtures for producing smoke. These mixtures may be dangerous and can cause serious personal injury.

6. Continue filling the system with smoke until a pressure equal to one inch of water is built up.
7. Maintain this pressure for fifteen minutes or longer, as required to test the entire system.
8. Check all components of the system to help ensure that smoke is not escaping. Smoke should not be visible at any point, connection, or fixture.

The Peppermint Test

This test is most often used in older installations to detect faulty plumbing.

1. Permanently connect all fixtures and fill all traps with water.
2. Be prepared to test all parts of the plumbing drainage and ventilation system.
3. Close all windows in the building until the test has been completed.
4. Mix two ounces of peppermint oil with one gallon of hot water.
5. Pour the mixture into the system's roof opening.
6. Tightly close the roof opening.
7. Have a person other than the one that poured the mixture into the system inspect the system for any odor of peppermint.
8. Inspect all system points, connections, and fixtures. There should be no odor of peppermint within the building.

WARNING

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AIR/GAS



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- NEVER test Cast Iron pipe or fittings with compressed air or gas.
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HOW TO DETERMINE RIGHT OR LEFT HAND INLETS

Use the following illustrations and descriptions to determine whether a fitting has a right- or left-hand inlet.



- **Closet Bends and P Traps** — Place the inlet upright near you, with the spigot facing away. If the side inlet is on your right, it is a right-hand inlet.



- **All Branch Fittings** — Place the spigot near you, with the branch facing upwards. If the side inlet is on your right, it is a right-hand inlet.
- **All Bends** — Place the fitting upright, with the spigot near you. If the side inlet is on your right, it is a right-hand inlet.

PAINTING CAST IRON SOIL PIPE

If desired, Charlotte Pipe's cast iron soil pipe and fittings can be painted to coordinate with surrounding surfaces.

WARNING

To reduce the risk of serious injury, carefully review and follow the paint manufacturer's instructions.

- Always allow proper ventilation of paint fumes and avoid eye or skin contact.
- Use extreme caution near sparks, heat or open flame.
- In case of an accident, follow the hazardous warning and treatment statements printed on the paint container label.

Follow these steps for a high-quality painted finish:

1. Clean the pipe's surface of all dirt, oil and grease.
2. Apply a primer coat of high-quality, oil-based primer paint. Allow it to dry according to the paint manufacturer's specifications.
3. Apply a top coat of high-quality, oil-based enamel paint. Allow the painted components to dry according to the paint manufacturer's specifications before handling them.

SIPHONIC ROOF DRAINS

Instructions from the manufacturer of the siphonic roof drains and applicable local plumbing and building codes should be followed.

NOTE: These drains produce both positive and negative pressure at elevated velocity, and the specifier or engineer designing the system should specify piping products meeting the requirements of the application. Charlotte Pipe recommends contacting the manufacturer of these drains for recommendations. Providing appropriate thrust restraints and anchors is crucial.

See ASPE Standard 45-Siphonic Roof Drainage for additional information.

MATERIAL SELECTION AND ENGINEERING CONSIDERATIONS

MATERIAL SELECTION AND ENGINEERING CONSIDERATIONS

Throughout the years engineers, inspectors, installers, and building owners have recognized cast iron as the best material for use in drain, waste, vent, and storm piping applications. There are many different alternative materials utilized in these systems with varying degrees of success, but cast iron has remained the industry standard. Some general considerations are listed below.

Maximum Working Temperature

Plumbing codes restrict discharges into sanitary lines to 140° F, but the reality is that commercial kitchens and equipment discharges can sometimes exceed these temperatures guidelines. Cast iron soil pipe with neoprene gaskets has a maximum working temperature of 212° F.

Thermal Expansion

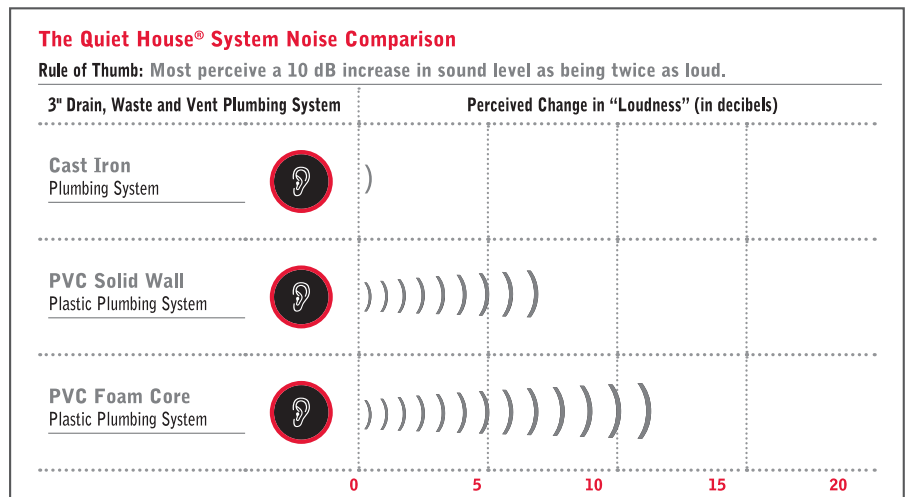
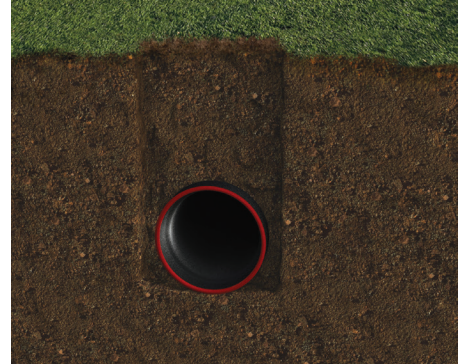
Cast iron soil pipe and fittings will expand 0.745" per 100 feet of pipe with a 100° F temperature change. The movement of cast iron is close to that of structural steel and concrete, meaning it literally "moves with the building" and usually requires no compensation for expansion or contraction.

Sound Attenuation

A material's ability to block the transmission of sound is a function of the material's density. Cast iron soil pipe and fittings are very dense due to the molecular structure. Sound attenuation is especially important in main drainage stacks and storm systems in multi-family housing, office buildings, dwellings where individuals spend the night (hotels and hospitals) and in classroom settings.

Burial of Cast Iron

The term "crush strength" or "crush rating" derives from rigid pipe such as cast iron and refers to its ultimate strength at rupture. These terms do not apply to thermoplastic pipe which is classified as a flexible conduit in civil engineering terms. Rigid piping materials like cast iron soil pipe fail when it crushes and specific strength charts are published irrespective of soil, bedding or backfill. Reference charts for burial of cast iron soil pipe are available in The Cast Iron Soil Pipe Handbook which can be found at www.cispi.org.



Hanger Spacing & Fall

Properly installed DWV piping systems require consistent fall without flat or low points in the piping system that can impede flow. Model Plumbing Codes require PVC DWV pipe to be supported horizontally every 4 feet. Cast iron soil pipe and fitting offer greater structural strength, which significantly reduces hanger requirements and provides consistent fall. Cast iron soil pipe and fittings only needs to be supported within 18" of each joint and every 10 feet horizontally.

Combustibility & Use in Plenum Spaces

Combustibility of construction materials is defined by ASTM E 136 and is a consideration for selection of materials when penetrating fire-separations or for inclusion in un-ducted return air plenum spaces. Materials classified as combustible must pass the ASTM E 84 test protocol with index values of less than 25 flame spread and 50 smoke developed. Cast iron soil pipe and fittings are classified as non-combustible and can be installed in plenum areas without further consideration. Because cast iron soil pipe and fittings are non-combustible, they will not burn away leaving a hole in the fire-rated assembly. Therefore, installers are only required to seal the annular space between the wall and the pipe when cast iron pipe penetrates fire-rated assemblies. Typically mineral wool batting and fire-resistant caulking are used to fill the annular space.

Engineered Applications

Over the past few years many new innovations have been introduced to the industry including siphonic roof drainage, solvent, air admittance devices and other products. Some of these products do not conform to existing standards or to the requirements of the model plumbing codes. Rather, they are designed into the system by engineers and approved as an alternate material within the code.

Charlotte Pipe and Foundry manufactures pipe and fitting systems that conform to published ASTM and Cast Iron Soil Pipe Institute standards. Products are warranted to conform to the requirements of applicable standards when used for the applications defined within these standards. Charlotte Pipe and Foundry will not accept liability for applications that do not conform to the standards to which we manufacture.

The Original Green Piping System

Cast iron soil pipe and fittings are made from recycled scrap iron and steel. Each year we prevent more than 350 million pounds of scrap iron and steel from entering overcrowded landfills by converting it into cast iron soil pipe and fittings. Additionally, at the end of the life of a building, the cast iron piping can be recovered and recycled again to make new cast iron pipe and fittings or other metallic products. Charlotte Pipe and Foundry Company certifies that its cast iron soil pipe and fitting products are made from 96% post-consumer recycled material (0% post-industrial material).