JCM Industries, Inc.
Frequently Asked Questions
Applications on Large Diameter Pipe (36" and larger)

As the leading manufacturer of large diameter repair, connection and branching fittings, JCM is often asked the same questions on a regular basis. The following FAQ and responses are to assist you in understanding the dynamics of selecting and installing bolt-on fittings for large diameter pipe. For information specific to your proposed application, contact JCM Industries Engineered and Technical Sales Team at 1-800-527-8482.

What is considered "large diameter" pipe?

The answer depends on several factors – often the owner's perspective. For some developed urban utilities, 16" nominal pipe may be considered large diameter; for rural systems, the largest pipe may be 12". "Large diameter" is really defined by the person who is responsible for the reliability of service for the pipeline. For these frequently asked questions, we define "large diameter pipe" as nominal size 36" and larger. This benchmark pipe size is being used because industry manufacturers of cast iron fittings and fabricated fittings furnish products up through 30" each and every day without difficulty. Larger pipe – starting at 36" nominal size begins to take on other characteristics that must be contemplated during engineering and producing quality fittings for maximum performance.

Why use large diameter pipe?

For decades passed, water providers and municipalities began to install larger diameter pipe to transport greater amounts of water to quench the thirst of the end user. By thirst, we mean growth of populated areas and manufacturing industries. As cities and suburban areas expanded, the need for water grew at the same and sometimes greater rate. So to move more water, pipe got bigger.

When should we be concerned about our large diameter pipe?

When the system itself dictates with leaks or failure, or when the end users demand more from the pipeline. With expansion and growth, the piping system experiences increased stress and unknown weaknesses are discovered. Older, large diameter systems are reaching an age where repair/rehabilitation is needed and, in cases of suburban growth, requiring access taps (i.e. branches) for additional fluid transmission or distribution lines.

What types of issues does large diameter pipe present when considering pipe fittings?

Mainly, our experience is that large diameter pipe is not "round". Historical methods of pipe manufacturing were not as precise as todays and large, old pipe consistently proves this. Contractors encounter flat spots, ovation, inconsistent pipe wall, antiquated pipe construction and other elements that have a direct effect on the "fit" of the fitting on the pipe. Special techniques during the design and fabrication stage are required to ensure the bolt on fitting – "fits" the pipe and risk required safety factor. Additional issues are fluctuating pressures, space limitations, weakened/unstable pipe integrity and the many unknown problems discovered when the pipe is excavated.

How does the size of pipe influence bolt on fittings?

Large diameter pipe has similar issues as smaller pipe (corrosion, splits, cracks, manmade damage, etc.) – with greater force involved. When making a repair or tapping into large diameter pipe, bolt on fittings require strength, robust weight and potential force resistance engineered into the design to withstand increased forces working with large diameter pipe.

For example – a bolt-on, fabricated tapping sleeve installed on a pipeline experiences a great deal of internal force at the branch/outlet location. The chart below illustrates the amount of internal pressure that a tapping sleeve experiences on a pipeline operating at 100 PSI.

Outlet Size	Force at 100 PSI
6	2,827 lbs.
8	5,027 lbs.
10	7,854 lbs.
12	11,310 lbs.
14	15,394 lbs.
16	20,106 lbs.
24	45,239 lbs.

The internal force at the outlet area can cause the sleeve to "lift" away from the pipe and interrupt the gasket/pipe surface contact creating the opportunity for the gasket to be ripped from its seat or to completely blow out.

With the application dynamics of size and working pressure, the fitting design criteria includes thickness of materials (pressure vessel quality, structural grade material), bolt sizes/strength, body width on the pipe, machining contours and other critical points. Factoring in working formulas for pressure containment such as Barlow's formula, engineers calculate the acceptable balance of fitting design verses application requirements. The external strength containing the line content must be greater than the internal force. This difference is the safety factor of the application.

These design concepts are considered for all types of large diameter fittings including repair clamps, bolted couplings, tapping sleeves and other fittings to be installed.

What about repairing damaged large pipe?

In repair applications to large diameter pipe, there are several factors to consider to maintain pipe integrity and return it to 100% service capacity. These factors, which are critical to the application, include: size and type of pipe, severity of damage, working pressure or service requirements, location of repair and time factor.

Line pressure forces encountered in repair applications will determine the success or failure of a repair fitting. The forces of large pipe reduce the working capability and safety factor of large full circle gasket repair clamps. Performance of these fittings is determined by the relationship of bolting power to gasket area, fastener attachment, bolt efficiency and thickness of metal. Therefore, a repair clamp may not be the proper repair fitting for certain applications. JCM offers various repair fittings which are suitable for repairs to large pipe operating at higher working pressures. To understand the forces involved in the application, see the comparison values listed below relating size of pipe to the internal forces involved.

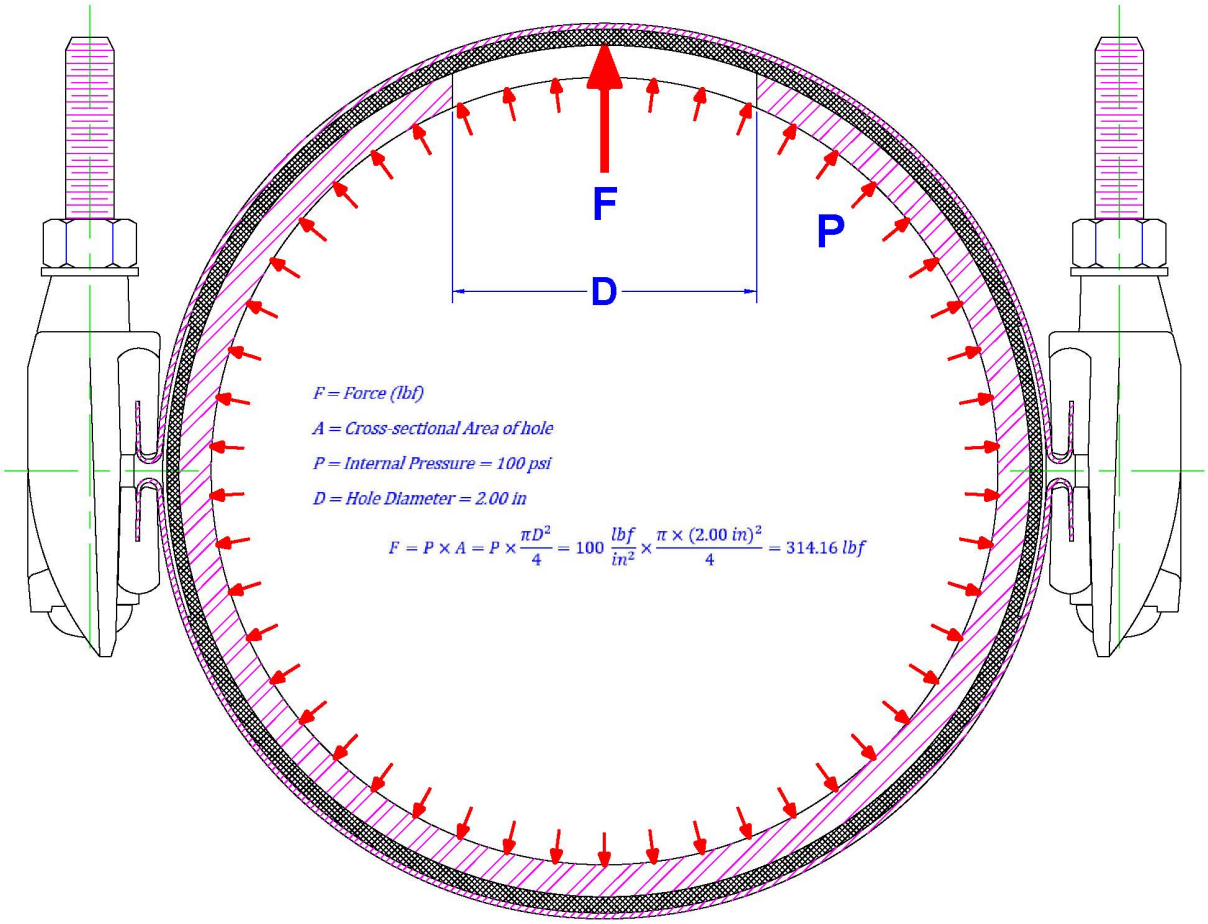
Nominal Pipe Size (in.)	Outside Diameter (in.)	Circumferential Area of 1/4" Beam Break (sq. in.)	Hoop Stress on Clamp at 100 PSI (psi) Operating Pressure
12	13.20	10.37	12,336
16	17.40	13.67	16,262
20	21.60	16.96	20,187
24	25.80	20.26	24,112
30	32.00	25.13	29,907
36	38.30	30.08	35,794
42	44.50	34.95	41,589
48	50.80	39.90	47,477

On a repair clamp the mechanical seal is made by tightening bolts to create a greater force on the gasket (PSI) than is in the pipeline. Safety factor is that amount of sealing capability the clamp has above the operating pressure of the pipeline. Clamps are limited in performance by the relationship of bolting power to gasket area.

Another example of an application that arises often is for a "repair clamp" to repair a significant hole or gouge in the pipe. Addressing this type of damage on large diameter pipe – again – the forces involved in the inside of the pipe have a direct influence on the type of repair fitting that is recommended. The following drawing demonstrates the engineering formula to calculate the force being shoved against the repair clamp.

JCM clamps have been designed to limit traditional clamp weaknesses, thereby giving a higher working capability and safety factor. Even so, they do have a limited capability. Most often we suggest other types of repair fittings be taken into consideration. Fabricated, heavy duty repair sleeves are designed to overcome the forces involved with large diameter pipe and its characteristics.

This data is for general reference only and does not represent expected performance. Each application for repair clamps – small or large diameter – is dependent upon many factors combined. Type of pipe, size and type of damage, fluctuating pressures and others are included in the combination. Taking these factors into consideration along with the size of the pipe will determine the repair fitting best suited for the application.



Force involved in repairing 2" hole in pipe operating at 100 PSI working pressure

Your fittings cost more than your competitors – why?

Dealing with large diameter pipe presents greater challenges than smaller pipe sizes. JCM engineers keep all the factors discussed in these FAQ when engineering a fitting that will accomplish the required task and return the pipeline to 100% working capacity. Larger JCM fittings involve bigger components; for example, in comparison to the standard fittings available in the industry, JCM's usually offers wider bodies for substantial reinforcement of the pipe, thicker body material for strength/safety factor and stouter bolting lug sections. JCM bolt sizes and quantities change as fitting sizes increase – especially in our repair clamps – at 10" pipe size, we upgrade from a 5/8" bolt and lug mass to 3/4" bolts and a much beefier lug design (in both cast ductile lugs and cast stainless steel lugs) – along with a thicker stainless steel gauge material. These increases have a direct impact on long term performance of the fitting – and the cost of the fitting. Compared to competitive products in the industry – the others often consist of the same size bolts and lugs through all nominal size offerings – increasing the quantity of bolts rather than the size/torque capability of the bolts.

What kind of experience does JCM have with large diameter pipe?

JCM's involvement with large diameter applications for repair, connection and branching are a weekly, sometimes daily, occurrence (especially as time passes). Listed here are just a few of the record breaking jobs on larger pipe that JCM played a role in successfully completing for these systems.

- 1983 Milwaukee WI - 60 x 60 - Largest size on size fabricated tap on record to this date
- 1984 Atlantic City, NJ - Manifold - 60 x 48 x 24 – Custom Built Fitting Construction of Trump Taj Mahal
- 1992 Nusonics - 48" Custom designed fittings for electronic transducers to monitor flow rate
- 1996 Central Arizona - 256" Largest CSCP Tap Saddle for insertion of hydrophones
- 1999 Las Vegas, NV/Hoover Dam - 144 x 102 - Largest tapping sleeves (under pressure) to date
- 1999 Baltimore, MD - 96 x 60 Line Stops - Largest line stop fittings to date
- 2006 Chicago O'Hare Airport - Runway Construction/Pipeline Relocation 90 x 60 Line Stop Sleeves operating at 165 PSI
- 2006 Milwaukee, WI - 60 x 60 Mechanical Joint Tapping Sleeve - Largest MJ size on size sleeves
- 2015 Philadelphia, PA/Walsh Project, Maryland - Custom fabricated fittings for 93" riveted pipe, 3" out of round & steel pipe 5" out of round (pipe installed 1932)

The listed jobs were planned applications that in most instances took years to arrange. Planning applications on large diameter pipe allows the engineers, contractors, manufacturer and end users to come together to determine all the information that is needed to manufacture fittings and complete the job. It is the unexpected, emergency applications – pipeline failure, manmade & natural disaster damage – that requires timely response with JCM's emergency services. Our continued participation with applications on large diameter pipe provides JCM with expertise in the requirements of big pipe.