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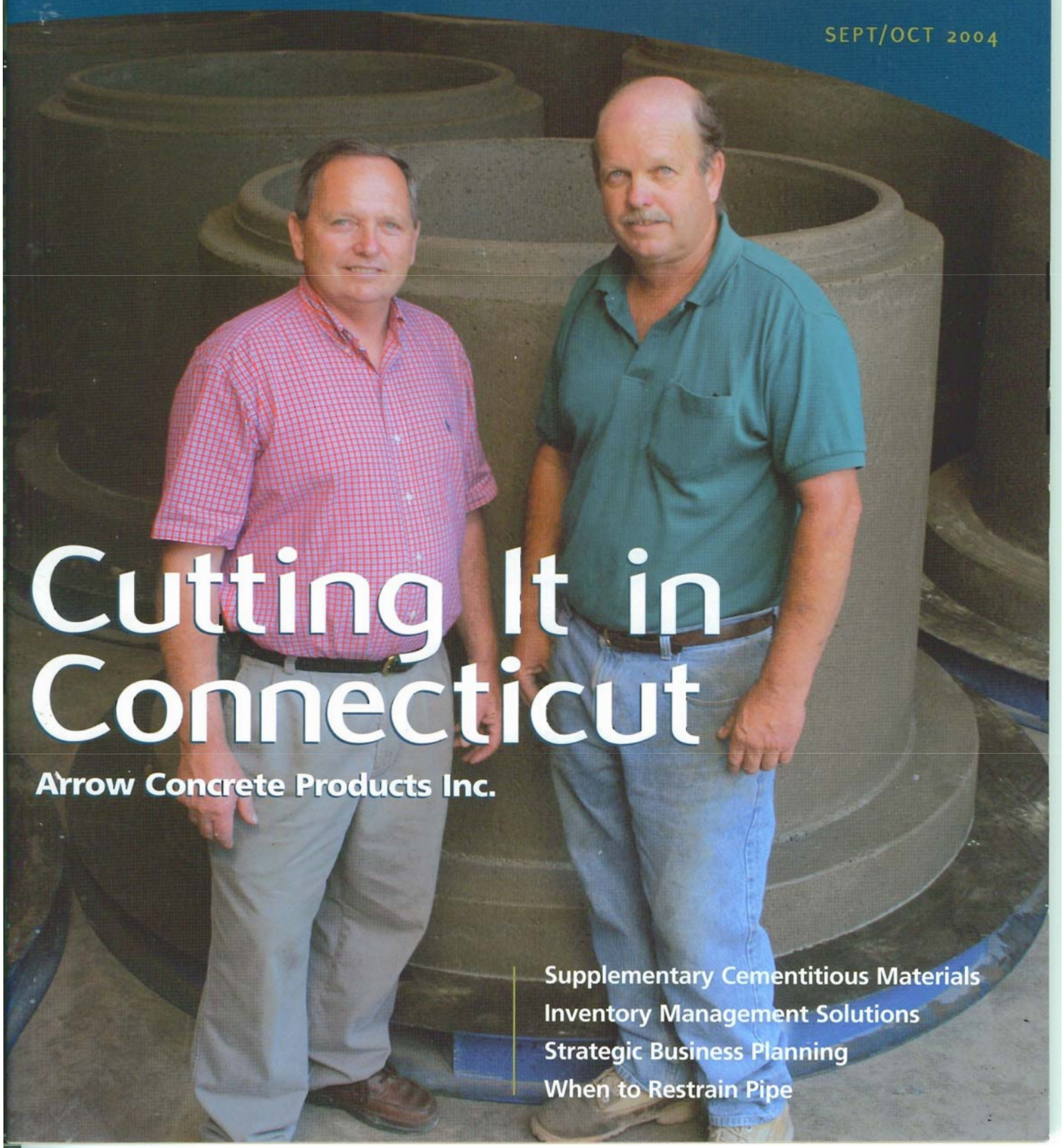


Cutting It in Connecticut

Arrow Concrete Products Inc.

Supplementary Cementitious Materials
Inventory Management Solutions
Strategic Business Planning
When to Restrain Pipe

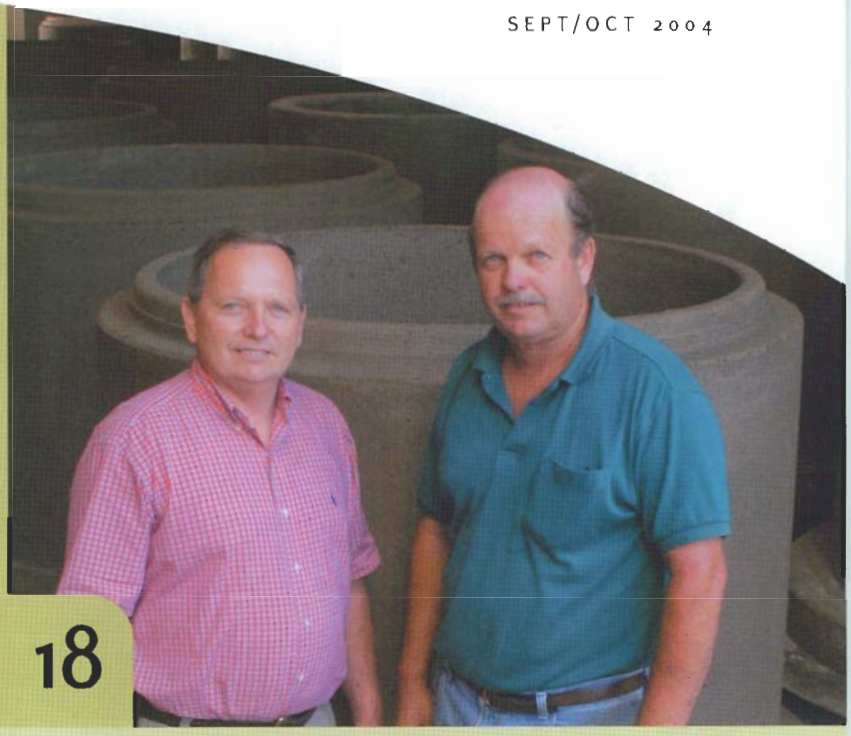
COVER STORY

Cutting It in Connecticut

Arrow Concrete Products Inc.

From easily serviceable silos to high-tech automation to an upscale surveillance system, Kurt and Ron Burkhart of Arrow Concrete Products Inc. went to great lengths in planning their all-new plant in Granby, Conn.

Photo by Ron Hyink



FEATURES

DEPARTMENTS

Know When to Restrain Pipe

A few pennies of prevention could save many dollars of repair.

BY MICHAEL R. MILLER | ILLUSTRATIONS BY DICK TAROZZI

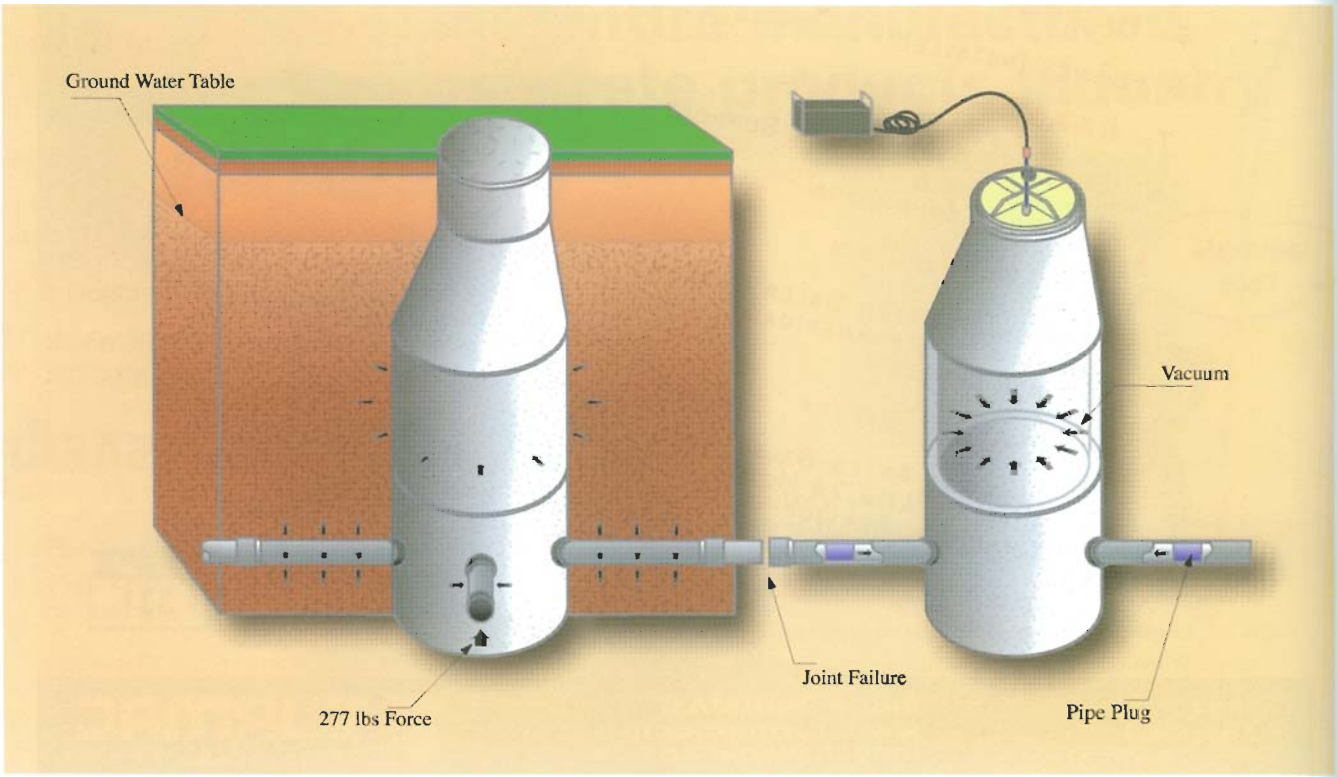
If you are a precast concrete manhole manufacturer, the last thing you want to hear is that your product failed – especially if it's already underground. Your frustration level would plunge even further after realizing that it could have been easily prevented. That's how many precasters learn – the hard way – about restraining pipe stubs. Consider this scenario:

Your field engineer calls to report that a manhole he installed recently is full of mud and the city inspector wants you to dig it up. At the work site, you find your engineer staring into an open manhole along a muddy run that is supposed to be blacktopped next week. A pump outside the manhole is discharging muddy water.

You discover that the connector blew in and took the pipe and the fill with it. Now you'll have to dig up the manhole just to replace the connector.

The city inspector reminds you that the lines will have to be cleaned, and that he will return to check the other manholes before accepting the work. The next day, the inspectors discover three more manholes that must be repaired.

Each manhole had an 8-inch throughline and a 6-inch stub inlet. The 8-inch lines were fine, but each of the stubs



HYDROSTATIC PRESSURE AND VACUUM TESTING CAN CAUSE TREMENDOUS FORCES ON PIPE STUBS.

had been forced back into the manhole, and one of the three was leaking. In all, four manholes have to be excavated and fixed, which will cost an extra two days for equipment and crew.

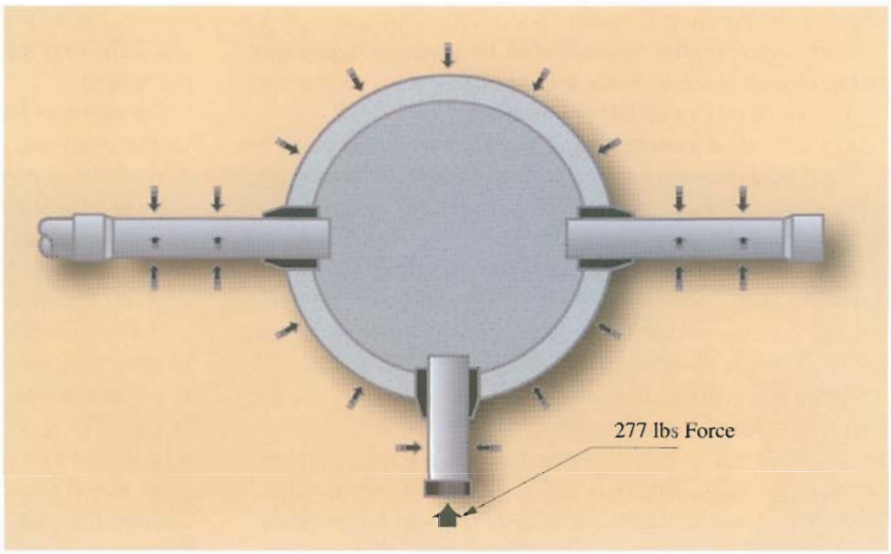
What could have been done to prevent this? A simple restraint holding each pipe stub in place would have made sure that everybody could concentrate on doing the next job, rather than going back to fix the last job. So why wasn't this done? Many people don't know that they have to restrain stubs and pipes or why they have to do it.

Restraining pipe stubs

ASTM C 923, "Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals," paragraph 5.3 states, "Purchaser shall require that all stubs installed, to allow for future connection to the manhole or wastewater structure, be mechanically restrained from movement by means of, and in addition to, the resilient connectors." The same requirement is included in ASTM C 1478, for connections to storm structures. Why?

When a pipe stub is installed in a manhole, it may look like the other installed pipes, but it is subjected to an entirely different range of forces. Under the right conditions, these forces can push the pipe stub all the way back into the manhole, destroying the seal of the connector and allowing water and soil surrounding the manhole base to come flooding in. Once this happens, there are few real alternatives to digging it up and installing it correctly.

Let's take the example of a pipe running from one manhole to another. Assume the manhole is 15 feet deep and the ground is very wet, and there are 12 feet of head at both manholes. Where the pipe enters the connector, it is subject to hydrostatic pressure (in this case about 5 psi) all around its circumference. The pressure is more or less uniform and is directed toward the center of the pipe.



WITH 5 PSI OF HYDROSTATIC PRESSURE, THE END OF AN 8-INCH PIPE STUB WILL EXPERIENCE ABOUT 277 POUNDS OF FORCE.

The connector is also affected by the hydrostatic pressure, and it is also pushed inward, just as it was designed and tested to do. Everything holds up and nothing leaks.

But in the case of a pipe stub, the hydrostatic pressure is not only even around the pipe, it also pushes on the capped end. Because the other open end of the stub is in the dry manhole, a pressure differential is created on the outside end of the pipe stub. For an 8-inch pipe with an outside diameter of 8.4 inches, this 5 psid (differential) pressure places a force of 277 pounds against the end of the pipe stub. Add to this the force against the connector and it can amount to hundreds of pounds of force pushing the pipe stub back into the manhole.

In order to resist this force, an unrestrained stub has to rely only on friction between the pipe and the soil and between the pipe and the connector. If this friction is low, or if the stub is short, it's easy to see how the stub can be pushed back into the manhole. And most stubs are short. Why waste a whole stick of pipe and a bunch of extra time digging when it's just a stub, right?

Relying on friction alone to secure pipe stubs becomes a calculation of hydrostatic pressure, soil friction, pipe length, etc. Expecting this to be worked out accurately and consistently during installation is asking too much of an installation crew. The solution is simple: Block the stub across the manhole and secure the blocking. Simple 2x4 bracing works very well and is easily removed later when the connection is made, resisting the thrust force on the pipe stub. Just be sure to keep the bracing out of the flow channel. Many other methods can be used as long as they positively restrain the stub from movement. For long-term situations, special consideration for material selection is required, given the possibility of wood rot or steel corrosion.

Although pipe stubs are the most common reason for restraining pipes, other situations also call for restraint. Usually, these come about as a result of testing, and they can teach some very nasty – and expensive – lessons.

Pipe restraint during vacuum and low-pressure air testing

ASTM C1244, "Standard Test Method for Concrete Sewer Manholes by

Negative Air Pressure (Vacuum) Test," states in paragraph 6.2, "All pipes entering the manhole shall be temporarily plugged, taking care to securely brace the pipes and plugs to prevent them from being drawn into the manhole."

Let's look at vacuum testing. Typically, air-inflated plugs are installed in all lines to seal them. The manhole is capped and, if following ASTM C 1244, a vacuum equivalent to 10 inches of mercury is drawn on the manhole. This is equivalent to a 5 psi pressure differential between the inside of the manhole and the outside. Because of the plugs, the pipes are pulled into the manhole with a force of 277 pounds (for 8-inch pipe). This situation is identical to that of the pipe stub above.

Most pipes installed in manholes are long lengths, meaning they will encounter significant friction with the soil. This is usually sufficient to keep the pipe from being drawn into the manhole. But what if there is a short length of pipe on one side? The answer is that the pipe is drawn into the manhole until the pressure differential is relieved. This relief typically happens when the pipe joint nearest the manhole is pulled apart and a flood of water and mud enters the line.

If the pipe plug isn't restrained and is pulled into the manhole, the operator can tell because the vacuum tester suddenly loses its vacuum. If this happens quickly enough, it can cause the vacuum tester to lift off the manhole and fly into the air. The solution is proper mechanical restraint of all pipes entering the manhole being tested and all plugs used in the testing.

The situation for low air pressure testing is the same. Unless pipes and plugs are properly restrained, they can be pushed out of position, resulting in test failure and possible opening of pipe joints nearest the test plug. Extreme failures can result in damage to equipment and danger to personnel.

Pipe restraint during flow blocking

The last condition under which a pipe should be restrained is when flow through the pipe is closed off. For some repairs or measurements, flow may be stopped by installation of an inflatable plug or installation of a weir. Usually, this is done on the upstream pipe of the manhole. The effect of this is the same as the situations above. The pipe accumulates pressure through the water column that forms behind the plug. Depending upon the height of this column, this can result in substantial force pushing the pipe into the downstream manhole. As in the examples above, pipe and plugs without positive mechanical restraint depend solely on friction to keep from being pushed into the manhole. A short length of pipe can create a disaster by being dislocated enough to open a joint. Restraining the pipe and plug will prevent its dislocation and subsequent opening of the pipe joint.

Anytime a plug, cap, weir or other method is used to reduce flow or block the pipe completely, both the pipe and the plug should be positively restrained. It's safe to say that the simple step of making sure parts stay put will save time, money and reputation.

Now we know that we should restrain pipe stubs, and test plugs and pipe sections, but how to do it?

There is no one answer that will meet the requirements of every situation. The amount of hydrostatic head, any applied vacuum, any applied air pressure, pipe section length, soil friction and many other factors contribute to determining what methods of restraint should be used. The design of the system where the restraint will be needed will also help determine how the restraint should be designed and constructed.

The best bet for information is to ask the test equipment manufacturer for recommendations for the specific test application. Where a stub is to be restrained, the local engineering or specifying body should provide guidance as to design(s) that will be acceptable. In the end, the contractor must become educated about these requirements, as they are the ones who will bear the responsibility for ensuring that proper restraints are used where they are needed.

As a precaster, what can you do?

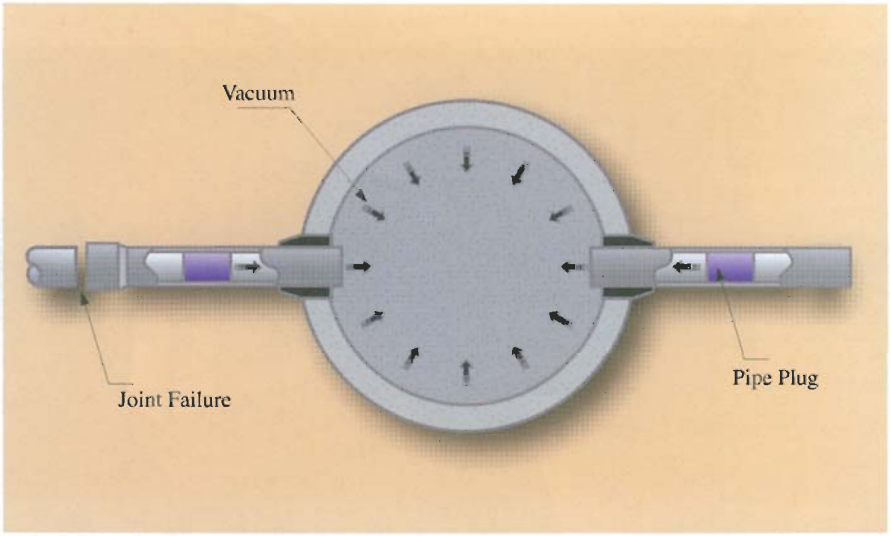
First, talk to your customers. Make sure they know why and how to properly restrain pipes and plugs. Help them understand that you rely on them to do this and that you don't

want either company to suffer loss of money or reputation because somebody didn't take these simple steps.

Make a copy of this article and give it to each customer. Discuss it with them and with their crews. This creates not only a better understanding, but also gives you an extra chance to show how you provide service as well as products.

Finally, make sure that local inspection authorities are aware of the need for restraint. Talk to the local engineers and municipalities so they can include specifications for, and methods of, restraint in their plans. This will help make sure that nobody will have to make the kind of call that none of us wants to get. mc

Mike R. Miller is systems director and quality manager with Press-Seal Gasket Corp.



A VACUUM OF 10 INCHES Hg MAY CREATE ENOUGH FORCE TO OVERCOME THE FORCE OF FRICTION ON SMALLER PIPE SECTIONS, CAUSING PIPE JOINTS TO SEPARATE.