

year period. For shallow burial conditions, under repeated traffic and in various bedding conditions, deflections were generally in the 2% range. Pea gravel was more effective in reducing deflection than lean clay. The report concluded the following: "A cover height of 12 in. is recommended for PVC pipe when subjected to highway loads (18-kip axle loads), 18 in. for pipe subjected to heavier highway loadings and light aircraft traffic (gross weight not to exceed 30,000 lbs) and 24 in. of cover is recommended for traffic of light to medium (320,000 lbs gross weight) aircraft."

The effort by the Ontario Ministry of Transportation, undertaken in 1992, included the testing of PVC profile pipes under shallow cover. One was a 30 in. (750mm) closed profile pipe while the other was a 24 in. (600mm) open profile pipe. The 30 in. pipe had a granular cover of 8 in. while the 24 in. pipe had 18 in. of granular cover. Mounted to the underside of a trailer, a hydraulic ram was used to apply the load. The footprint of the load pad was two 10 in. squares, simulating a dual truck tire. Four linear variable displacement transducers (LVDT) were used to monitor deflections in each pipe. The 30 in. pipe displayed a maximum deformation of 3.2% under a loading of 56,200 lbs (250 kN), with less than 1% residual deformation. The 24 in. pipe had a maximum deformation of 2% under the same loading. This study clearly highlighted the ability of PVC pipe to withstand large loads even under shallow cover.

As a general rule, when traffic loads are anticipated, the Uni-Bell PVC Pipe Handbook recommends the use of Class I (crushed rock), or Class II (clean sands and gravel) soils, compacted to 95% Proctor density, when burial within a depth of one to three feet is required.

We hope this article has been helpful in clarifying the engineering principles that govern the successful installation of PVC pipe in both deep and shallow burial conditions, and dispels doubts about PVC's capability to perform well under these adverse conditions.

References

1. Horn, W.J., "Field Tests of Plastic Pipe for Airport Drainage Systems," U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS, 1979.
2. Maheu, J.M., "Load Testing of PVC Profile Pipes Under Shallow Cover: Summary of Test Results," Ontario Ministry of Transportation, Canada, 1992.

Tapping PVC 101

by **Craig Fisher, P.E.**
Technical Director

"Those who cannot remember the past are condemned to repeat it."

While the author, George Santayana (1863-1952), may not have

had tapping PVC pipe in mind when he uttered this now famous quote, it certainly is applicable.

HONOR ROLE

The vast majority of those tapping PVC pipe have heeded Mr. Santayana's advice. By using the right tools and procedures, they successfully tap PVC pipe day-in and day-out. Their history lesson was a simple one. They took a few moments to review the experience-based educational material available on the topic.

Recommended viewing and reading for the good student are as follows:

- Uni-Bell tapping video, "Tapping of PVC Pressure Pipe"
- UNI-PUB-8, "Tapping Guide for AWWA C900 Pressure Pipe"
- Handbook of PVC Pipe, Chapter 10, Tapping Section
- UNI-B-8, "Recommended Practice for the Direct Tapping of Polyvinyl Chloride (PVC) Pressure Water Pipe"
- AWWA C605, "Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water"

Overall, the water industry continues to successfully tap PVC pipes. Most students receive an A in the course and the honor role is the size of a telephone directory. However, the importance of proper training and periodic review of procedures and equipment cannot be over-emphasized.

LESSON #1: OVERSIZED SADDLES

Problems can arise from selecting the wrong saddle when saddle tapping PVC pipe. In order to receive a passing grade, a tapping student can rely on any of the following:

"All service clamps or saddles shall provide full support around the circumfer-

Figure 1A

Oversized saddle does not conform to the OD of the pipe. Note the gap at 3 and 9 o'clock.

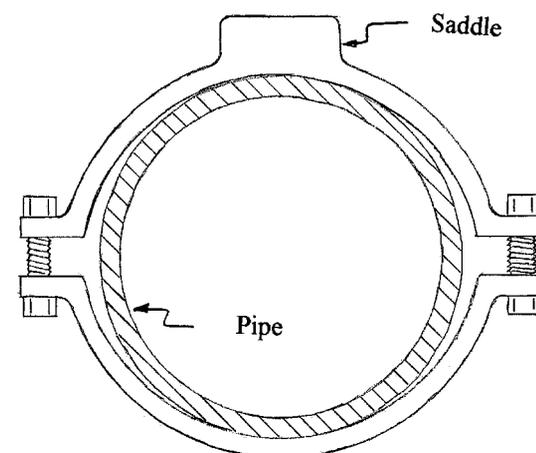
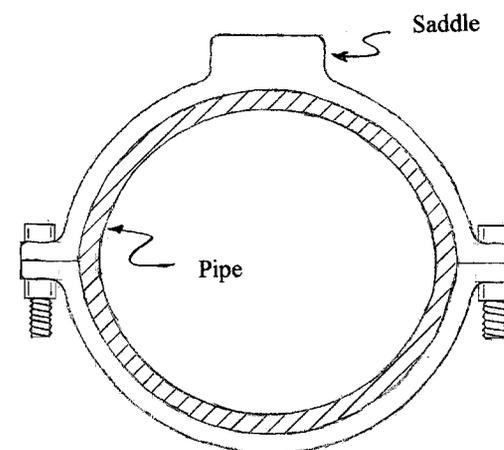


Figure 1B

Excessive distortions may result when the oversized saddle is tightened. Note, the point of ID penetration of the tapping bit at the 12 o'clock position is now in tension due to the distortion from the saddle.



ence of the pipe. Because the outside-diameter manufacturing tolerances for PVC pipes are tighter than those for compatible ductile-iron pipes, only tapping saddles manufactured specifically for PVC pipe shall be used." (Section 6.4.2.1 of AWWA C605)

or

"Service clamps or saddles used for attaching service connections to PVC water pipe should: Provide full support around the circumference of the pipe. Be designed for use with PVC pipe." (Handbook of PVC Pipe)

or

"Service clamps should not ... have a clamping arrangement that is not fully contoured to the outside diameter of the pipe." (UNI-PUB-8)

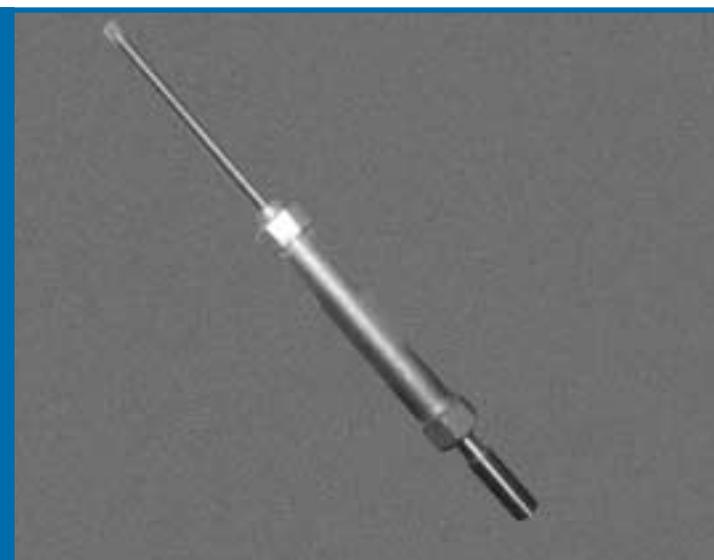
The scholars in the group may want to not only know the right answer, but also want to know why. Some saddles are manufactured to cover a range of outside diameters in order to accommodate more than one diameter regimen. Often times, the outside diameter of the PVC pipe falls on the low side of the range, and the bolts on the saddle take up the slack.

When an oversized saddle is used on PVC, the saddle contacts the pipe at six and twelve o'clock and leaves a gap at three and nine o'clock. (See Figure 1.) The uninformed student may not realize that the wrong saddle was purchased and tightens the bolts until the gap is gone. Unfortunately, by doing so, he will

SEE "TAPPING PVC 101" ON PAGE 14

**Figure 2A
INCORRECT**

The boring bar is threaded and automatically advances when the ratchet handle (not shown) is turned.



Tapping PVC 101

Continued from Page 13

induce additional stresses in the pipe. Using the correct saddle, one that conforms to the outside diameter of the pipe, such stresses can be avoided altogether.

The "A" student also checks to make sure the saddle provides sufficient bearing area. AWWA C605 recommends a strap width of two inches for taps up to one inch. A width of three inches is recommended for taps from 1.25 to 2.00 inches.

ple of a correct cutting / tapping tool for PVC and an incorrect one.

What are the recommended features of the correct tool? The second publication on the required reading list, UNI-PUB-8, recommends the following for direct tapping:

- "The machine must operate with a cutting/tapping tool suitable for PVC pipe. This tool should be of a shell-type design, have a minimum of two slots, and shall retain the cut coupon after penetrating the PVC pipe wall."

Using the correct cutting tool is probably the most important lesson of all. Do not drill a hole in PVC pipe with a twist drill, auger bit, or spade bit.

LESSON #2: SELF-FEEDING SADDLE TAPPING MACHINES

Like any other subject, there is some vocabulary to master. Those who understand the terminology will not have any difficulty with the following passage.

"The tapping machine shall provide a standard ratchet handle on the boring bar and be of a design such that cutting and tapping are controlled by a feed nut and yoke." (UNI-PUB-8)

Put another way, the boring bar should be advanced manually, instead of being advanced automatically by a threaded rod. Figure 2 shows an example of a machine that meets this recommendation and an example of a machine that does not.

LESSON #3: WRONG BIT

Using the correct cutting tool is probably the most important lesson of all. Do not drill a hole in PVC pipe with a twist drill, auger bit, or spade bit. These cutting tools were designed for iron pipe, not PVC pipe. Figure 3 shows an exam-

UNI-PUB-8 lists similar recommendations for saddle tapping:

- "This tool shall be of a shell-type design, have a minimum of two slots, shall retain the cut coupon after penetrating the PVC pipe wall, and be designed to accommodate walls as heavy as DR 14 (Pressure Class 200, AWWA C900)."

For extra credit, explain why two or more slots are recommended. Those who discussed eccentricity get ten points added to their final. If there is only one slot, there may be difficulty in initiating the cut. When the leading tooth of the cutting tool contacts the pipe, there are two possible outcomes:

- Possibility 1. The cutting tool does not 'walk' and there is no wobble when the boring bar is rotated.
- Possibility 2. There is some pivoting about the point where the tooth contacts the pipe surface, which results in some 'walking' of the tool and some wobble when the boring bar is rotated.

Having more than one slot eliminates the unbalanced forces and the creation of a pivot point. This makes it easier to initiate the cut. By following the recommendations, the scholar has made his

Figure 2B CORRECT

The boring bar is manually advanced by rotating the brass collar below the ratchet handle.



Figure 3A INCORRECT

This bit is intended for drilling and tapping iron pipe, and it should NOT be used with PVC.



Figure 3B CORRECT

This tool is intended for PVC— in this case, for direct tapping. A minimum of two slots are recommended, which is comfortably met here as three slots are provided. Also, this tool meets the recommendation that it be of the shell-type design.



job easier.

When it comes to tapping PVC, the Association's goal is to make the words of Nicholas Ling a reality: "Ignorance is a voluntary misfortune." The many graduates in the field have been of immense help with this goal. They share their knowledge and expertise with the new person on the crew. And in the final

analysis, it is they who are the real teachers.

We congratulate the many successful graduates. Class dismissed.



For all your educational tapping resources visit our website at:

www.uni-bell.org