

PVC PRESSURE PIPE TAPPING GUIDE

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TAPPING GUIDE: PVC PRESSURE PIPE

FOREWORD

The PVC Pipe Association (PVCPA) was formed in 1971 as the Uni-Bell PVC Pipe Association. The organization's mission includes:

- ▶ Conducting research
- ▶ Providing technical service and support
- ▶ Developing recommended standards
- ▶ Promoting proper use of PVC pipe

This document has been developed by the PVCPA for use as a field tapping guide. Detailed recommendations for equipment and procedures are included for tapping polyvinyl chloride (PVC) pressure pipe and molecularly oriented polyvinyl chloride (PVCO) pressure pipe.

INTRODUCTION

GENERAL

In the pipe industry, “tapping” is the process of connecting a branch line to a main line by cutting a hole into the main. For tapping of PVC pressure pipe, branch lines can range in size from small service lines which supply individual homes to large outlets for industrial users. Service connections to PVC water mains are accomplished in the field via:

- ▶ Direct tapping into the pipe wall
- ▶ Tapping through service saddles
- ▶ Tapping large service connections through tapping sleeves
- ▶ Using fabricated or injection-molded couplings with threaded outlets

Fabricated or injection-molded tapped couplings are in-line fittings that are installed during original construction. This type of connection is not included in this guide – the coupling manufacturer should be consulted for information.

This guide provides recommendations for tools, procedures, and acceptable pipe products for adding branch lines to existing mains using these types of taps:

Direct taps – the branch line is connected to the main by a corporation stop that is screwed directly into the pipe wall. Maximum branch line size is 1-inch.



Corporation Stop

Saddle taps – the branch line is connected to a main by a corporation stop that is screwed into a metal saddle that wraps around the pipe. Maximum branch line size is 2-inch.



Brass Tapping Saddle

Sleeve taps – the branch line is joined to the main via a connection at a metal sleeve that wraps around the pipe. Maximum branch size is the same as the main.



Tapping Sleeve

TAPPING GUIDE: PVC PRESSURE PIPE

INTRODUCTION

GUIDANCE FOR OUTLET SIZES

TAPPING: AWWA PIPE						
Pipe Material	Pipe Standard	Size (in.)	DR	TAPPING TYPE		
				Direct Tap	Saddle Tap	Sleeve Tap
PVC	C900	4	All	<i>Not Recommended</i>	≤ 2" diameter	Up to size-on-size
		6	25	<i>Not Recommended</i>	≤ 2" diameter	Up to size-on-size
		6	18	≤ 1" diameter	≤ 2" diameter	Up to size-on-size
		6	14	≤ 1" diameter	≤ 2" diameter	Up to size-on-size
		8	25	<i>Not recommended</i>	≤ 2" diameter	Up to size-on-size
		8	18	≤ 1" diameter	≤ 2" diameter	Up to size-on-size
		8	14	≤ 1" diameter	≤ 2" diameter	Up to size-on-size
		10	All	≤ 1" diameter	≤ 2" diameter	Up to size-on-size
		12	All	≤ 1" diameter	≤ 2" diameter	Up to size-on-size
		14	≥ 41	<i>Not recommended</i>	≤ 2" diameter	Up to size-on-size
		14	≤ 32.5	≤ 1" diameter	≤ 2" diameter	Up to size-on-size
		16	≥ 51	<i>Not recommended</i>	≤ 2" diameter	Up to size-on-size
		16	≤ 41	≤ 1" diameter	≤ 2" diameter	Up to size-on-size
		≥ 18	All	<i>Not recommended</i>	≤ 2" diameter	Up to size-on-size
PVCO	C909	All	All	<i>Not recommended</i>	≤ 2" diameter	Up to size-on-size

TAPPING: ASTM PIPE						
Pipe Material	Pipe Standard	Size (in.)	DR	TAPPING TYPE		
				Direct Tap	Saddle Tap	Sleeve Tap
PVC	D2241	4	All	<i>Not recommended</i>	≤ 2" diameter	Up to size-on-size
		6	≥ 21	<i>Not recommended</i>	≤ 2" diameter	Up to size-on-size
		6	≤ 17	≤ 1" diameter	≤ 2" diameter	Up to size-on-size
		8	≥ 26	<i>Not recommended</i>	≤ 2" diameter	Up to size-on-size
		8	≤ 21	≤ 1" diameter	≤ 2" diameter	Up to size-on-size
		10	≥ 32.5	<i>Not recommended</i>	≤ 2" diameter	Up to size-on-size
		10	≤ 26	≤ 1" diameter	≤ 2" diameter	Up to size-on-size
		12	≥ 41	<i>Not recommended</i>	≤ 2" diameter	Up to size-on-size
		12	≤ 32.5	≤ 1" diameter	≤ 2" diameter	Up to size-on-size
		14	≥ 41	<i>Not recommended</i>	≤ 2" diameter	Up to size-on-size
		14	≤ 32.5	≤ 1" diameter	≤ 2" diameter	Up to size-on-size
		16	≥ 51	<i>Not recommended</i>	≤ 2" diameter	Up to size-on-size
		16	≤ 41	≤ 1" diameter	≤ 2" diameter	Up to size-on-size
		≥ 18	All	<i>Generally not allowed</i>	≤ 2" diameter	Up to size-on-size
PVCO	F1483	All	All	<i>Not recommended</i>	≤ 2" diameter	Up to size-on-size

Notes:

1. Direct tapping is typically not performed on 18-inch and larger PVC pipe.
2. The values in this table are recommendations only and the pipe manufacturer should be consulted for guidance.

INTRODUCTION

SAFETY CONSIDERATIONS

During the drilling or tapping of any pressurized pipe, basic safety precautions should be taken to assure personal safety of workers in the event of a sudden pipe failure. Although such situations are extremely infrequent, the following safety precautions are recommended:

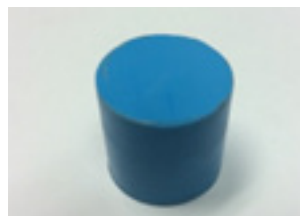
- ▶ When a worker is drilling or tapping pipe under pressure, a second worker should be in the immediate vicinity.
- ▶ In addition to normal protective clothing, goggles or face shields should be worn.
- ▶ Ladders should be provided in the work area for quick exit.
- ▶ A protective blanket with a hole at its center to permit installation and operation of the tapping and drilling machine should be provided to cover the exposed area of the pipe.
- ▶ The tapping crew should be familiar with the location of valves and their proper operation in case depressurization of the line is needed.
- ▶ Air should be removed from pipes before tapping. Failure to vent entrapped air can create a hazardous condition.

COUPON

The cylindrical piece of plastic removed during tapping is known as a “coupon.”

The coupon cut from the pipe wall should be examined after removal from the cutter head.

- ▶ Smooth coupon: a smooth, clean cut indicates the feed rate was correct and the cutter was functioning properly.

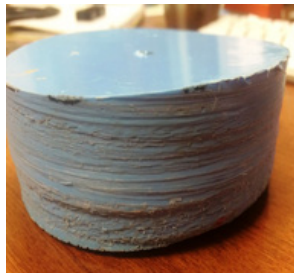


Smooth Coupons

TAPPING GUIDE: PVC PRESSURE PIPE

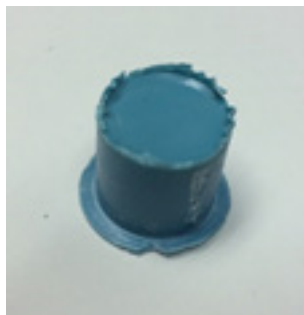
INTRODUCTION

- ▶ **Striations:** melted plastic or rough striations on the cut surface of the coupon indicate a dull cutter, too rapid a feed rate, or lack of lubrication of the cutting tool.



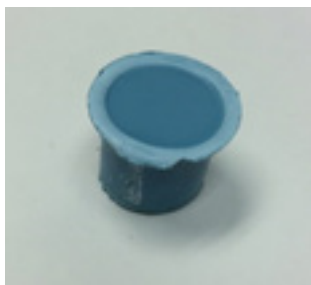
Coupon with Striations

- ▶ **Crown:** a raised edge, or “crown” on the edge of the coupon where the cutter first contacted the pipe wall indicates that the feed rate was excessive. Under this condition, the cutter cannot efficiently remove the material being cut. The cutter is forced away from the cut resulting in plastic deformation, creating the crown effect.



Coupons Showing “Crown” at Outer Surface

- ▶ **Punch-through:** if the cutter is being forced through the pipe wall (excessive feed rate), if a dull cutter is used, or if the cutter is of insufficient depth for the pipe wall thickness a plug of material can be displaced from the inside surface of the pipe as the cutter approaches the interior pipe surface. This is often referred to as “punch-through.” Punch-through can result in a failure of the pipe wall.



Coupons Showing “Punch-Through” at Inner Wall

INTRODUCTION

- ▶ Problem correction: if striations, raised edges, or melted plastic are observed on a coupon, the tapping procedure and the condition of the tools should be re-examined and corrected before additional taps are attempted.
- ▶ Lubrication: before tapping, the cutter should be lubricated with a cutting grease recommended by the cutter manufacturer.
- ▶ Threads: various corporation stop threads are available. For a leak-free connection, it is important that the thread type match and be compatible with the pipe, saddle, or sleeve. The corporation stop thread type is typically an ANSI/AWWA C800 tapered thread also referred to as a “CC” thread. IPS/NPT threaded corporation stops are also available and may be used.

TEMPERATURE CONSIDERATIONS

The equipment and methods recommended in this guide are also applicable for tapping in cold temperatures and in hot temperatures. No special considerations are necessary.

LITERATURE

The literature listed below provides additional information and recommendations. Tapping crews should be familiar with:

- ▶ Uni-Bell tapping video, “Tapping of PVC Pressure Pipe”
- ▶ AWWA Standard C605, “Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings”
- ▶ AWWA Manual M23, “PVC Pipe – Design and Installation”
- ▶ AWWA Field Guide: “Pipe Tapping”

General Notes:

- 1) This tapping guide is not intended to take the place of the designer’s judgment.
- 2) Illustrations used in this guide depict specific tooling for the sake of clarity. Illustrations are not intended to promote specific types of equipment or the equipment of a particular manufacturer. Other equipment meeting the guide’s requirements may be equally satisfactory.

TAPPING GUIDE: PVC PRESSURE PIPE

DIRECT TAPPING

GENERAL

When a pipe is direct-tapped, a hole is drilled into the pipe wall and threads are cut. The same machine that drills the hole is also used to cut the threads and to screw the corporation stop into the hole and tighten it securely.

The maximum outlet size for direct tapping is 1-inch.

GUIDANCE FOR DIRECT TAPPING

The tables below provide guidance on which products are recommended for direct tapping:

DIRECT TAPPING: AWWA PIPE				
Pipe Material	Pipe Standard	Size (in.)	DR	Comment
PVC	C900	4	All	<i>Not Recommended</i>
		6	25	<i>Not Recommended</i>
		6	18	≤ 1" diameter
		6	14	≤ 1" diameter
		8	25	<i>Not Recommended</i>
		8	18	≤ 1" diameter
		8	14	≤ 1" diameter
		10	All	≤ 1" diameter
		12	All	≤ 1" diameter
		14	≥ 41	<i>Not Recommended</i>
		14	≤ 32.5	≤ 1" diameter
		16	≥ 51	<i>Not Recommended</i>
		16	≤ 41	≤ 1" diameter
		≥ 18	All	<i>Generally not allowed</i>
PVCO	C909	All	All	<i>Not Recommended</i>

DIRECT TAPPING

DIRECT TAPPING: ASTM PIPE				
Pipe Material	Pipe Standard	Size (in.)	DR	Comment
PVC	D2241	4	All	<i>Not Recommended</i>
		6	≥ 21	<i>Not Recommended</i>
		6	≤ 17	≤ 1" diameter
		8	≥ 26	<i>Not Recommended</i>
		8	≤ 21	≤ 1" diameter
		10	≥ 32.5	<i>Not Recommended</i>
		10	≤ 26	≤ 1" diameter
		12	≥ 41	<i>Not Recommended</i>
		12	≥ 32.5	≤ 1" diameter
		14	≥ 41	<i>Not Recommended</i>
		14	≥ 32.5	≤ 1" diameter
		16	≥ 51	<i>Not Recommended</i>
		18	≤ 41	≤ 1" diameter
		≥18	All	<i>Not Recommended</i>
PVCO	F1483	All	All	<i>Not Recommended</i>

Note: direct tapping is typically not performed on 18-inch and larger PVC pipe.

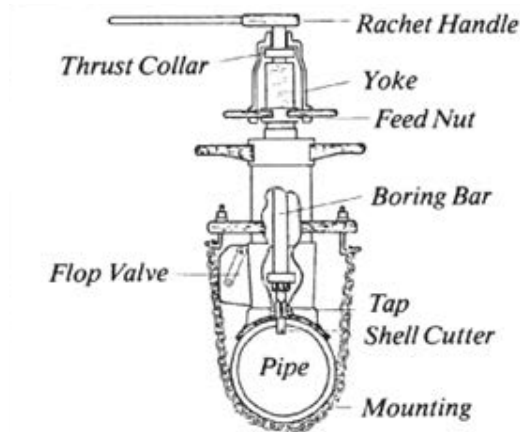
EQUIPMENT

Tapping Machine

- ▶ Several tapping machines are available to make direct service taps. The machines vary in design and operation depending on the manufacturer.
- ▶ The machine chosen should provide the following features:
 - ▷ Adapter base: the machine's adapter base should be properly sized to seal securely against the PVC pipe.
 - ▷ Cutting tool: the machine should operate with a shell-design cutting tool suitable for PVC pipe.
 - ▷ Hand rotation: the tapping machine should operate using a standard ratchet handle on the boring bar to rotate the boring bar by hand.
 - ▷ Manual advance: the machine should be capable of manually advancing the boring bar independently from the rotation (i.e., no "automatic" advance). Typically this is controlled by a feed nut and yoke or similar device.

TAPPING GUIDE: PVC PRESSURE PIPE

DIRECT TAPPING



Components of a Direct Tapping Machine

CAUTION

- ▶ Hand-held drill: a hand-held drill should never be used to tap PVC pipe.



Cordless Drill



Brace and Bit

Cutting/Tapping Tool

- ▶ A tool used to direct-tap PVC is a specialized device that bores a hole in the pipe wall and cuts threads to match those on the corporation stop that will be installed.
- ▶ The cutting/threading tool used to direct-tap PVC pipe should:
 - ▷ Have a minimum of 1 slot for taps $\frac{5}{8}$ -inch or smaller
 - ▷ Have a minimum of 2 slots for taps $\frac{3}{4}$ -inch or larger
 - ▷ Retain the coupon
 - ▷ Provide a simple means of removing the retained coupon
 - ▷ Have sufficient depth to accommodate the thickness of the wall being tapped
 - ▷ Thread the hole with a thread pattern that matches the corporation stop that will be installed (typically AWWA C800 tapered threads)

DIRECT TAPPING

- ▷ Have a shank compatible with the cutting machine being used
- ▷ Direct the shavings from the cut surface into the throat of the shell cutter



Slotted Core Cutters With Threads for Direct Tapping

CAUTION

- ▶ Many shell cutters are designed to cut through smaller-diameter pipes with less wall thickness than found in larger-diameter PVC pipes. Consequently, some cutters do not have sufficient throat depth to handle the heavier-walled pipe (e.g., AWWA C900 12-inch DR 14 with average wall thickness 0.97 inch; AWWA C905 16-inch DR 14 with average wall thickness 1.28 inch).
- ▶ Use of a twist drill, spade bit, auger bit, wood bit, hole saw, or similar cutting device is not recommended and may cause the pipe to crack.



Improper Tapping Bits

Corporation Stop (“Corp Stop”): Corp stops should be AWWA-tapered with thread complying with AWWA C800 in sizes $\frac{5}{8}$ ”, $\frac{3}{4}$ ” and 1”. When a tap larger than 1 inch is required, the pipe should not be direct-tapped:

- ▶ For taps up to 2-inch diameter, see “Saddle Tapping”
- ▶ For taps greater than 2-inch diameter, see “Sleeve Tapping”

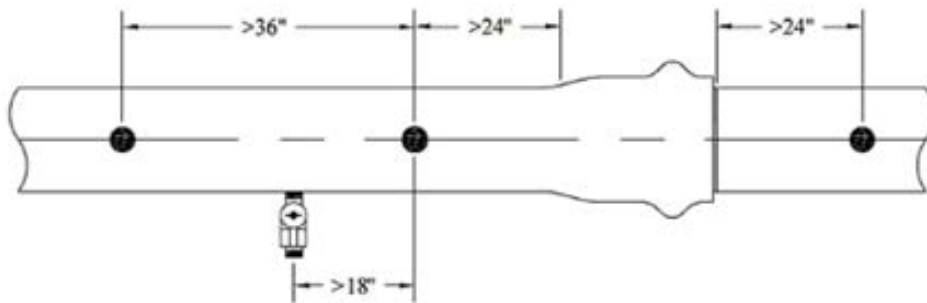
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DIRECT TAPPING

PROCEDURES

Planning a Direct Tap

- ▶ Outlet size: up to 1-inch diameter maximum
- ▶ Pipe product: see tables on pages 9 & 10
- ▶ Wet/dry taps: wet taps (pipe filled) and dry taps (pipe empty) are allowed. Wet taps can be made on pipe pressurized up to the full pressure class/rating of the pipe. However, the system operator may choose to lower the system pressure prior to tapping.
- ▶ Position of the tap
 - ▷ For 12-inch pipe or smaller, the tap should not be located closer than 24" from:
 - > The back of the bell (where the bell transitions to the barrel of the pipe)
 - > The spigot insertion line
 - > Joint-restraint hardware



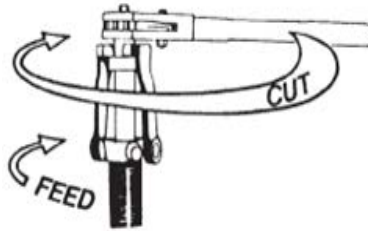
Proper Tap Spacing for 12-inch Pipe or Smaller

- ▷ For 14-inch pipe or larger, the tap should not be located closer than 36 inches from:
 - > The back of the bell (where the bell transitions to the barrel of the pipe)
 - > The spigot insertion line
 - > Joint-restraint hardware
- ▷ For all pipe, stagger multiple taps and keep them at least 18 inches apart lengthwise. Thus, the minimum spacing along the same line is 36 inches.

Considerations for Direct Tapping

- ▶ Reduced flow: some operators choose to partially operate the control valves to reduce flow in the section being tapped. However, reducing the flow does not reduce system pressure.
- ▶ Manufacturer's instructions: for direct taps, the installation procedures may vary by machine manufacturer. It is important to comply with the manufacturer's recommended procedures when installing the required devices.
 - ▷ To minimize pipe distortion, the tapping machine should be installed on the pipe in accordance with the manufacturer's directions.

DIRECT TAPPING



Feed Lightly – Just Enough to Keep the Cutter Engaged

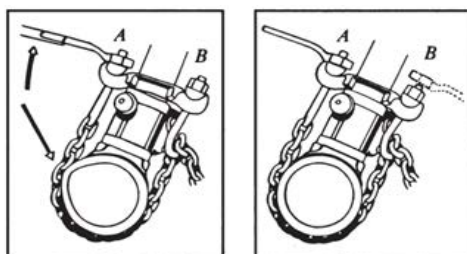
- ▶ Ease of cutting: PVC is relatively easy to cut when compared to metal. When PVC is properly tapped, the cutter turns easily with light pressure.
 - ▷ The force required to maintain a correct feed rate can be judged by “finger pull” – the effort required should be similar to opening a desk drawer.
 - ▷ The temptation to over-feed the cutter into the pipe wall should be resisted.
- ▶ Boring bar: when a pressurized pipe is tapped, system pressure will create an upward force on the boring bar. A 1-inch tap will result in about 0.8 pounds of force per 1 psi of pressure in the system. This force will act to push the boring bar back toward the operator. It is very important to follow the machine manufacturer’s instructions to safely control this effect.
- ▶ Reference marks: the hole must extend through the entire pipe wall. If the machine being used does not provide reference marks for tapping PVC, bench tests must be performed to develop these reference points and to mark the machine appropriately. “Cast iron” reference marks that may be provided by the machine manufacturer should not be used when tapping PVC pipes.

Making a Direct Tap

- ▶ Control valves: before tapping pressurized pipes, the crew should have a clear understanding of the valve operations necessary to isolate the tapping site and should ensure that the appropriate control valves are operational.
- ▶ Air: before a pipe is tapped, air should be removed from the pipeline. Failure to vent entrapped air can create a hazardous condition.
- ▶ Mounting the machine
 - ▷ A correctly sized adapter should be mounted on the drilling machine. The adapter should match the pipe OD to provide a satisfactory seal.
 - ▷ The drilling machine should sit firmly on the pipe but should not distort the pipe.
 - ▷ The machine manufacturer’s procedures for positioning and securing the drilling machine should be followed.

TAPPING GUIDE: PVC PRESSURE PIPE

DIRECT TAPPING



WRONG

CORRECT

Wrong: over-tightening one side may distort the pipe wall and stress the pipe. A wrench extension should not be used.

Correct: both sides are evenly tightened using only the wrench supplied.

- ▷ When direct tapping a pressurized line, an improperly matched chamber and cutter can block the valve, making it unusable. The operator should verify that the control valve can be closed by fully retracting the boring bar with the cutter installed and closing the valve on the chamber after the drilling machine is installed.
- ▶ Cutting the Hole and Tapping the Threads
 - ▷ When making a direct tap in PVC pipe, the tapping machine manufacturer's operating procedures should be followed.
 - ▷ The cutter should be lubricated per the manufacturer's instructions.
 - ▷ PVC is relatively easy to cut when compared to metal. When PVC is properly tapped, the cutter turns easily with a light pressure. Feeding the cutter into the pipe wall too quickly should be avoided.
 - ▷ An accepted "rule of thumb" is to rotate the boring bar one complete turn for every one-eighth turn of the feed yoke. This allows the cutter to work as a cutter.
 - ▷ The force required to maintain a correct feed rate can be judged by "finger pull" – the effort required should be similar to opening a desk drawer.
 - ▷ When the "finger pull" criterion is applied in cold weather, the rate of feed will be reduced due to the properties of PVC.
 - ▷ The feed yoke is used to engage the tapping tool in the bored hole. After the threads are established in the bore, the tool becomes self-feeding and the feed yoke is typically disengaged from the boring bar. The machine manufacturer's operating instructions should be followed to complete the tap.
 - ▷ The pipe wall should be tapped to the correct depth. If the machine being used does not provide reference marks for tapping PVC, bench tests should be performed to develop these reference points and to mark the machine appropriately. "Cast iron" reference points provided by the machine manufacturer should not be used for tapping PVC pipes.
 - ▷ After the threads are properly completed, the tapping tool should be removed from the hole. To disengage the cutter and safely retract the boring bar, the machine manufacturer's instructions should be followed.
 - ▷ The coupon should be removed from the cutter and inspected per the "Coupon" section on pages 6 and 7.

DIRECT TAPPING

CAUTION

- ▶ Wrench extenders (“cheater bars”) should never be used when tapping PVC pipes.
- ▶ When a pressurized pipe is tapped, system pressure will create an upward force on the boring bar. A 1-inch-diameter tap will result in about 0.8 lbs. of force per 1 psi of pressure in the system. This force will act to push the boring bar back toward the operator. To prevent injury, it is important to follow the machine manufacturer’s instructions to safely control this effect.

▶ Inserting the Corporation Stop

- ▷ A direct tap is completed by using the drilling machine to install a corporation stop into the drilled and threaded hole that has been prepared in the pipe wall. Again, the machine manufacturer’s operating procedures should be followed.
- ▷ The threads of the stop should be properly lubricated by applying two clockwise spiral wraps of “Teflon®” tape. Other thread lubricants are not recommended. Liquid sealants (even though they may contain Teflon) should not be used.
- ▷ The corporation stop is attached to the boring bar. The stop should be in the closed position to prevent flow when the machine is removed after the installation is completed.
- ▷ The tapping machine is reattached to the tapping chamber, the valve is opened, and the stop is inserted into the prepared tap hole.
- ▷ The machine’s operating procedures should be followed to tighten the corporation stop, disengage the boring bar, and remove the machine from the main.
- ▷ After the machine is removed, the tap should be inspected. At correct insertion depth, 2 to 3 threads should be visible on the corporation stop.
- ▷ If leakage is occurring around the threads, the stop can be tightened. Exceeding 35 foot pounds of torque to stop any leakage around the threads is not recommended.
- ▷ If leaking past the threads persists, it may be necessary to remove the pressure from the line, remove the corporation stop, and clean the threads. When reinstalling the stop, “Teflon®” tape should be reapplied to the threads and the manufacturer’s torque recommendations should be followed.
- ▷ When making a direct tap on PVC pipe that is empty, not in service, or not yet under pressure, some of the procedures can be modified. For example, if the machine manufacturer’s operating instructions allow, the tapping machine can be removed after the tap is completed and the corporation stop can be installed by hand.

SAFETY CONSIDERATIONS

Before any tapping activities are performed, it is recommended that the tapping crew review the “Safety Considerations” section on page 6 of this document.

TAPPING GUIDE: PVC PRESSURE PIPE

SADDLE TAPPING

GENERAL

When a pipe is saddle-tapped, equipment is attached to the corporation stop that permits a cutting tool to be fed through the stop to cut a hole in the pipe. No threading of the pipe wall is required, since the corporation stop is screwed into the service saddle.

The use of saddles to make taps is recommended for all sizes and classes of PVC and PVCO pressure pipe. Service connections up to 2-inch size may be made using a service saddle.

Another term for “tapping saddle” is “service saddle.”

Note: in this section, “PVC” applies to both polyvinyl chloride (PVC) pipe and oriented polyvinyl chloride (PVCO) pipe.

GUIDANCE FOR SADDLE TAPPING

SADDLE TAPPING: AWWA PIPE				
Pipe Material	Pipe Standard	Pipe Size	DR	Comment
PVC	C900	All	All	≤ 2” diameter
PVCO	C909	All	All	≤ 2” diameter

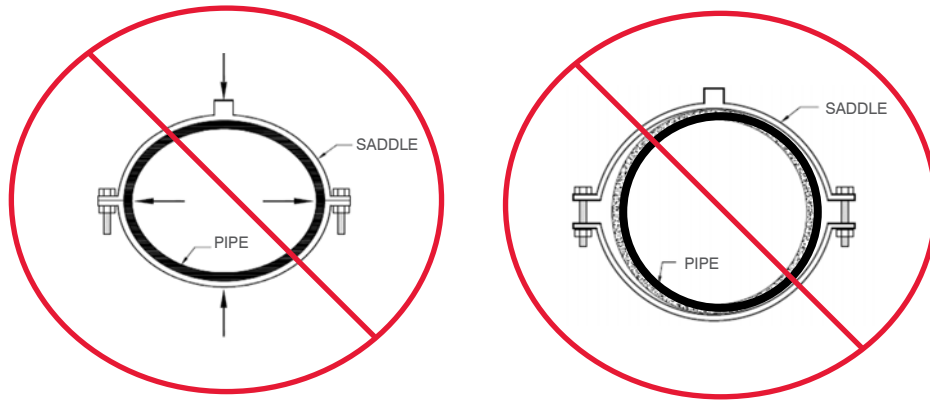
SADDLE TAPPING: ASTM PIPE				
Pipe Material	Pipe Standard	Pipe Size	DR	Comment
PVC	D2241	All	All	≤ 2” diameter
PVCO	F1483	All	All	≤ 2” diameter

SADDLE TAPPING

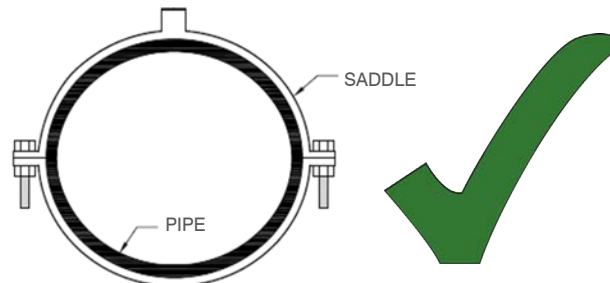
EQUIPMENT

Tapping Saddles

- ▶ When a tapping saddle is used, the tapping machine attaches to a corporation stop that is screwed into the saddle outlet. This allows a cutting tool to be fed through the corporation stop to cut a hole in the pipe. No threading of the pipe wall is required, since the corporation stop is threaded into the saddle.
- ▶ Many saddles are manufactured to accommodate multiple piping materials. As a result, despite the stated nominal diameter, the typical dimensional tolerances are very broad. Since the outside diameter of PVC pipe is controlled to strict tolerances, these “wide-range” saddles should not be used for PVC pipe.
- ▶ The saddle chosen should:
 - ▷ Be designed and sized for use on PVC pipe
 - ▷ Provide full support around the circumference of the pipe



Improper Saddle Sizing

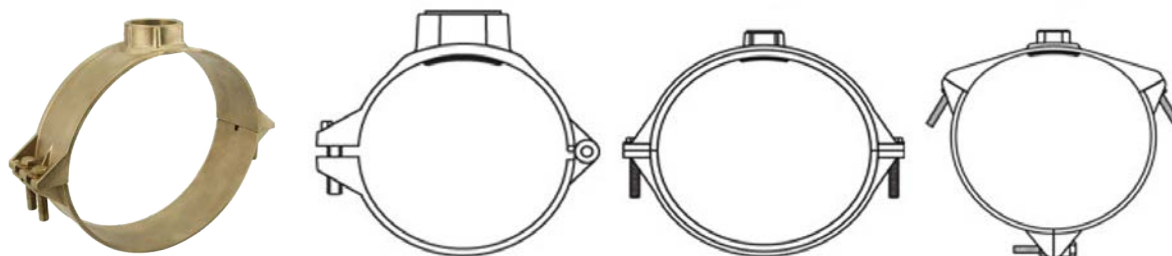


Proper Saddle Sizing

TAPPING GUIDE: PVC PRESSURE PIPE

SADDLE TAPPING

- ▷ Provide a bearing area of sufficient width along the longitudinal axis of the pipe to minimize pipe distortion when the saddle is properly tightened.
 - > For taps up to 1 inch diameter, a minimum of 2 inches total width along the pipe axis
 - > For taps from 1¼ inch through 2 inches, a minimum of 3 inches total width
 - > Minimum width of any individual band not less than 1 inch
- ▶ Service saddles should not:
 - ▷ Have lugs that will dig into the pipe when the saddle is tightened
 - ▷ Have U-bolt type straps that do not provide sufficient bearing area
- ▶ The service saddle manufacturer should be consulted for recommended pressure capacity.



Brass Tapping Saddles

Corporation Stop (“Corp Stop”)

- ▶ The threads on the corp stop must match the threads on the outlet of the saddle.
- ▶ The maximum size of corp stop used with a service saddle is 2 inches. When a tap larger than 2 inch is required, the pipe should not be saddle-tapped:
 - ▷ For taps greater than 2-inch diameter, see “Sleeve Tapping”



Tapping Saddle with Corporation Stop

Tapping Machine

- ▶ Several tapping machines are available that will cut through a corp stop. Tapping machines vary in design and operation depending on the specific machine manufacturer.

SADDLE TAPPING



Tapping Machines with Feed Nut and Yoke



Hand-Held Drill



Threading Boring Bar Without Ratchet Feed

- ▶ Tapping machines should:
 - ▷ Use a shell-design cutting tool suitable for PVC pipe.
 - ▷ Operate using a standard ratchet handle on the boring bar to rotate the boring bar by hand.
 - ▷ Be capable of manually advancing the boring bar independently from the rotation (i.e., no “automatic” advance). Typically this is controlled by a feed nut and yoke or similar device.

CAUTION

- ▶ Hand-held drill: a hand-held drill should never be used to tap PVC pipe.

Cutting Tool

- ▶ The cutting tool used to saddle-tap PVC pipe should:
 - ▷ Have a minimum of 1 slot for taps $\frac{5}{8}$ -inch or smaller
 - ▷ Have a minimum of 2 slots for taps $\frac{3}{4}$ -inch or larger
 - ▷ Retain the coupon
 - ▷ Provide a simple means of removing the retained coupon
 - ▷ Have sufficient depth to accommodate the thickness of the wall being tapped
 - ▷ Have a shank compatible with the cutting machine being used
 - ▷ Direct the shavings from the cut surface into the throat of the shell cutter

TAPPING GUIDE: PVC PRESSURE PIPE

SADDLE TAPPING

CAUTION

- ▶ Many shell cutters are designed to cut through smaller-diameter pipes with less wall thickness than found in larger-diameter PVC pipes. Consequently, some cutters do not have sufficient throat depth to handle the heavier-walled pipe (e.g., AWWA C900 12-inch DR 14 with average wall thickness 0.97 inch; AWWA C905 16-inch DR 14 with average wall thickness 1.28 inch).
- ▶ Use of a twist drill, spade bit, auger bit, wood bit, hole saw, or similar cutting device is **not recommended** and may cause the pipe to fail.

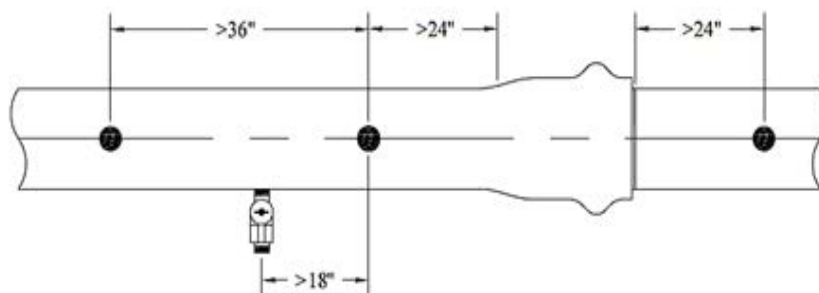


Improper Cutters

PROCEDURES

Planning a Saddle Tap

- ▶ Tapping hole size: taps up to 2-inch diameter can be made through a service saddle.
- ▶ Wet/dry taps: wet taps (pipe filled) or dry taps (pipe empty) are acceptable. Wet taps can be made on pipe pressurized up to the full pressure class/rating of the pipe.
- ▶ Position of the tap
 - ▷ For 12-inch pipe or smaller, the tap should not be located closer than 24 inches from:
 - > The back of the bell (where the bell transitions to the barrel of the pipe)
 - > The spigot insertion line
 - > Joint-restraint hardware



Proper Tap Spacing for 12-inch Pipe or Smaller

SADDLE TAPPING

- ▷ For 14-inch pipe or larger, the tap should not be located closer than 36 inches from:
 - > The back of the bell (where the bell transitions to the barrel of the pipe)
 - > The spigot insertion line
 - > Joint-restraint hardware
- ▷ For all pipe, multiple taps should be staggered and kept at least 18 inches apart lengthwise. Thus, the minimum spacing along the same line is 36 inches.

Considerations for Saddle Tapping

- ▶ Reduced flow: some operators choose to partially operate the control valves to reduce flow in the section being tapped. However, reducing the flow does not reduce system pressure.
- ▶ Manufacturer's instructions: for saddle taps, the installation procedures may vary by manufacturer. It is important to comply with the manufacturer's recommended procedures when installing the required devices.
 - ▷ To minimize pipe distortion, the tapping saddles should be assembled on the pipe in accordance with the manufacturer's directions.
 - ▷ Some distortion may occur in thinner-walled PVC and PVCO pipes. This condition is acceptable as long as the saddle manufacturer has qualified the saddle by testing with the pipe product used.
- ▶ Ease of cutting: PVC is relatively easy to cut when compared to metal. When PVC is properly tapped, the cutter turns easily with light pressure.
 - ▷ The force required to maintain a correct feed rate can be judged by "finger pull" – the effort required should be similar to opening a desk drawer.
 - ▷ The temptation to over-feed the cutter into the pipe wall should be resisted.
- ▶ Boring bar: when a pressurized pipe is tapped, system pressure will create an upward force on the boring bar. A 1-inch tap will result in about 0.8 pounds of force per 1 psi of pressure in the system. This force will act to push the boring bar back toward the operator. It is very important to follow the machine manufacturer's instructions to safely control this effect.
- ▶ Reference marks: the hole must extend through the entire pipe wall. If the machine being used does not provide reference marks for tapping PVC, bench tests should be performed to develop these reference points and to mark the machine appropriately. "Cast iron" reference marks that may be provided by the machine manufacturer should not be used when tapping PVC pipes.

TAPPING GUIDE: PVC PRESSURE PIPE

SADDLE TAPPING

Making a Saddle Tap

- ▶ The saddle should be installed on the pipe following the manufacturer's instructions.
 - ▷ Recommended torque values should not be exceeded.
- ▶ The inlet side of the corporation stop is then screwed into the saddle threads. The stop hardware should be retained.
- ▶ The corporation stop should be opened.
- ▶ The cutter should be lubricated per the manufacturer's instructions.
- ▶ Using the correct adapter and gasket, the tapping machine is attached to the corporation stop's outlet threads.
- ▶ Before the tap is begun, the boring bar and cutter should be fully retracted and the corporation stop opened and reclosed to ensure that there is no interference.
- ▶ The machine should have an operator-controlled feed rate. The use of a shell cutter is essential. The machine manufacturer's instructions should be followed.
- ▶ The operator should lower the boring bar to the main and rotate the cutter while exerting finger-pull on the feed handle. The ratchet handle should be rotated one complete turn for every one-eighth ($\frac{1}{8}$) turn of the feed yoke to allow the cutter to work as a cutter.
- ▶ When the tap is completed, the cutter should be retracted, the corp stop closed, and the tapping machine removed.
- ▶ When retracting the boring bar and cutter from the tapped pipe, the machine manufacturer's operating instructions should be followed. Failure to do so may create a situation that endangers the personnel making the tap and may result in serious injuries.
- ▶ The coupon should be removed from the cutter and inspected per the "Coupon" section on pages 6 and 7.

SAFETY CONSIDERATIONS

Before any tapping activities are performed, it is recommended that the tapping crew review the "Safety Considerations" section on page 6 of this document.

SLEEVE TAPPING

GENERAL

Large-diameter taps are greater than 2 inches nominal diameter in size. Tapping sleeves are recommended for these large-diameter connections.

The lateral or branch being connected may be any diameter up to the diameter of the pipe main (size-on-size connection). When making a sleeve tap, the drilling equipment attaches to a valve that allows a cutting tool to be fed through the valve to cut a hole in the pipe. The actual diameter of the hole to be cut is less than the inside diameter of the pipe used for the branch and should never exceed the inside diameter of the main being tapped.

Note: In this section, “PVC” applies to both polyvinyl chloride (PVC) pipe and oriented polyvinyl chloride (PVCO) pipe.

GUIDANCE FOR SLEEVE TAPPING

SLEEVE TAPPING: AWWA PIPE				
Pipe Material	Pipe Standard	Size (in.)	DR	Comment
PVC	C900	All	All	Up to size-on-size
PVCO	C909	All	All	Up to size-on-size

SLEEVE TAPPING: AWWA PIPE				
Pipe Material	Pipe Standard	Size (in.)	DR	Comment
PVC	D2241	All	All	Up to size-on-size
PVCO	F1483	All	All	Up to size-on-size

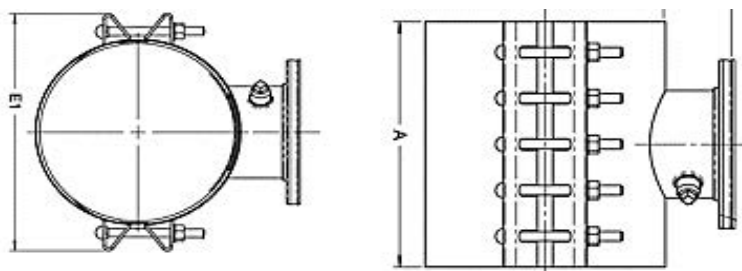
TAPPING GUIDE: PVC PRESSURE PIPE

SLEEVE TAPPING

EQUIPMENT

Tapping Sleeve

- ▶ The following information should be provided to the sleeve manufacturer and verified by the engineer/installer when specifying tapping sleeves:
 - ▷ Outside diameter of the pipe being tapped
 - ▷ Dimension ratio (DR) of pipe being tapped
 - ▷ Size of the outlet desired
 - ▷ System working pressure
- ▶ Tapping sleeves should:
 - ▷ Provide full support around the circumference of the pipe
 - ▷ Provide sufficient length to:
 - > Furnish satisfactory sealing
 - > Prevent potential movements of the pipe
 - ▷ Be independently supported to minimize loading on the pipe being tapped
 - ▷ Be compatible with the tapping valves and/or attaching mechanisms of the drilling machine that will be used



Tapping Sleeve

- ▶ Tapping sleeves should not:
 - ▷ Distort the pipe when properly tightened
 - ▷ Have lugs or other protrusions that will dig into the pipe when the sleeve is tightened

Tapping Valve

- ▶ A tapping valve is used to control flow into the newly installed lateral line after the tap is completed. Tapping valves are typically gate valves.
- ▶ The valve opening must be of sufficient diameter to allow the cutter to pass through the valve to complete the tap.

SLEEVE TAPPING

- ▶ When tapping “dry” pipes, it is possible to tap without using a tapping valve by selecting an appropriate adapter for the drilling machine. However, this would not be a typical installation.
- ▶ A tapping valve should:
 - ▷ Match the connectors on both the tapping sleeve and the drilling machine
 - ▷ Allow the cutter to pass through without interference
 - ▷ Comply with the system operator’s criteria if it will be used as a permanent control valve

Tapping Machine

- ▶ Several manufacturers produce tapping machines designed to make large-diameter taps. These machines vary in design and operation depending on the specific machine. For all taps, the machine and the valve used must mate properly.
- ▶ Most large-diameter tapping machines use power units that operate at very low rotation speeds. The tapping crew should ensure that the manufacturer of the machine being used recommends it for tapping PVC pipe. The crew should also follow the machine manufacturer’s instructions.



Tapping Machine

- ▶ Large-diameter tapping equipment is available for rental or purchase from many vendors. In addition, in many areas, contractors who specialize in this type of work are available. Due to the expertise required to perform large diameter taps, the use of experienced personnel is recommended.

Cutting Tool

- ▶ Because of the wide ranges of pipe size and pipe thickness encountered, several different types of cutting tools are used.
- ▶ The cutting tool should:
 - ▷ Have the capability to retain the coupon
 - ▷ Have sufficient depth to accommodate the thickness of the wall being drilled
 - ▷ Have a shank compatible with the cutting machine being used

TAPPING GUIDE: PVC PRESSURE PIPE

SLEEVE TAPPING

PROCEDURES

Planning a Tap through a Sleeve and Valve

- ▶ Tapping hole size
 - ▷ Connections up to size-on-size can be made through a tapping sleeve and valve.
 - ▷ To prevent damage to the main, the diameter of the hole being cut should never exceed the inside diameter of the main.
 - ▷ Several tapping-sleeve manufacturers recommend that the hole cut in the main line be smaller than size-on-size. The recommendations of the sleeve manufacturer regarding hole size should be followed.
- ▶ Wet/dry taps: both wet taps (pipe filled) and dry taps (pipe empty) can be made.
- ▶ Non-pressurized pipe: When tapping non pressurized pipes, a valve may not be required.
- ▶ Position of the tap
 - ▷ For 12-inch pipe or smaller, the end of the tapping sleeve should not be located closer than 24 inches from:
 - > The back of the bell (where the bell transitions to the barrel of the pipe)
 - > The spigot insertion line
 - > Joint-restraint hardware
 - ▷ For 14-inch pipe or larger, the end of the tapping sleeve should not be located closer than 36 inches from:
 - > The back of the bell (where the bell transitions to the barrel of the pipe)
 - > The spigot insertion line
 - > Joint-restraint hardware
 - ▷ For spacing criteria for multiple sleeve taps, the sleeve manufacturer should be consulted.

Considerations for Large-Diameter Tapping

- ▶ Reduced flow: some operators choose to partially operate the control valves to reduce flow in the section being tapped. However, reducing the flow does not reduce system pressure.
- ▶ Manufacturer's instructions: for large-diameter taps, the installation and operating procedures of the items required may vary by manufacturer. It is important to comply with the manufacturer's recommended procedures when installing and operating the required devices.
 - ▷ To ensure that the gasket will seal properly, the pipe should be cleaned and the gasket should be lubricated and assembled in accordance with the sleeve manufacturer's directions.

SLEEVE TAPPING

- ▷ To minimize pipe distortion, the tapping sleeve should be assembled on the pipe in accordance with the manufacturer's directions.
- ▷ Some distortion may occur in thinner-walled PVC and PVCO pipes. This condition is acceptable as long as the sleeve manufacturer has qualified the sleeve by testing with the pipe product used.
- ▶ **Structural support:** tapping sleeves should be well-supported independently from the pipe during tapping. Support should be left in place after tapping. It is important to realize that tapping sleeves are designed for sealing purposes only, not for structural support.
- ▶ **Joint restraint:** thrust blocks or joint-restraint devices should be used as with any other fitting or appurtenance. If the tapping valve will be used as a permanent control valve, adequate blocking designed to accommodate the torque associated with valve operations should be included.
- ▶ **Alignment of cutting tool:** the larger the tapping hole size, the more important it is to ensure that the cutting tool is perpendicular to the axis of the pipe. This will prevent stresses caused by misaligned penetration of the ID.

Making a Large-Diameter Tap

- ▶ The tapping sleeve should be assembled on the pipe in accordance with the manufacturer's directions, ensuring that minimal pipe distortion occurs.
- ▶ The tapping valve is then connected to the sleeve.
- ▶ Support blocks are positioned under the valve.
- ▶ The tapping machine and adaptor are then attached to the valve outlet flange.
- ▶ The tapping valve is opened, the cutter advanced, and the hole cut into the main through the sleeve.
- ▶ After the hole is cut, the cutter is retracted from the tapped pipe. The machine manufacturer's operating instructions should be followed. Failure to do so will create a dangerous situation that may result in serious injuries.
- ▶ The tapping valve is then closed and the tapping machine removed.
- ▶ The coupon should be removed from the cutter and inspected per the "Coupon" section on pages 6 and 7.

SAFETY CONSIDERATIONS

Before any tapping activities are performed, it is recommended that the tapping crew review the "Safety Considerations" section on page 6 of this document.

TAPPING GUIDE: PVC PRESSURE PIPE

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