



**Home Innovation**  
RESEARCH LABS™

# RESIDENTIAL WATER PIPING INSTALLATION

## *TIME STUDY*

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### ■ INTRODUCTION

With housing construction rebounding and labor shortages threatening home builders' construction timelines, it is important for builders and contractors to understand the effect that building material choices have on installation speed.

In the area of potable water piping, there are many competing, and sometimes contradictory, marketing claims made by both product manufacturers and contractors about the required installation time associated with leading piping materials such as CPVC and PEX.

In an effort to better understand the effect of piping material choice on installation time, Home Innovation Research Labs was approached by Lubrizol to conduct a study of their FlowGuard Gold® CPVC plumbing piping system against market leading PEX plumbing products.

## ■ STUDY DESIGN

Home Innovation Research Labs designed and conducted a time and motion study of complete new home installations of FlowGuard Gold CPVC and a market leading PEX hot and cold water piping systems. The piping systems were installed on two full-scale study homes in Home Innovation’s Upper Marlboro, Md., location, using local plumbing contractors<sup>1</sup>.

### Study Home Specs.

The study homes were built using typical home construction practices, including lumber floor joists, 2 x 4 wall framing at 8’ and 9’ wall heights, HVAC main and run-out ducts installed, and DWV piping installed. The number and type of plumbing fixtures, their locations, and layouts were typical of 2.5 bathroom, 2-story homes with a concrete slab foundation<sup>2</sup>. Hose bibbs, ice maker box, washing machine box, and water heater supply were located in each house.

### Description of Plumbing Systems and Materials.

The three piping systems were 1) FlowGuard Gold CPVC with a trunk and branch configuration, 2) PEX-a with trunk and branch configuration, and 3) PEX-a with remote manifolds. Each of the three systems was installed twice – once on each of the two homes by a different installer - to capture a range of experience

#### System 1:

FlowGuard Gold CPVC piping, supplied in 10’ lengths, CPVC fittings, one-step cement joining, installed in a trunk and branch configuration.



FlowGuard Gold CPVC in Trunk and Branch Configuration

#### System 2:

PEX piping in a trunk and branch configuration using straight pipes in 20’ lengths, ASTM F1960 plastic cold-expansion fittings installed using a battery-powered, auto-rotating expanding tool. Site-assembled stub-outs were used at fixtures.



PEX in Trunk and Branch Configuration

#### System 3:

PEX piping supplied in coils, installed in a remote manifold configuration using a ASTM F1960 plastic cold-expansion fittings installed using a battery-powered, auto-rotating expanding tool. Pre-assembled turnout “kits” with pipe supports and brackets.



PEX in Remote Manifold Configuration

Each completed system was pressure test-ready. In the trunk and branch systems, an average of 336 linear feet of total piping was installed on the two homes. In the remote manifold systems, 408 linear feet of piping, on average, was installed. One-inch pipe was used to attach to the water supply, ¾-inch diameter as trunks, and ½-inch diameter pipe to the fixtures.

When each installation was complete, a plumbing contractor supervisor inspected the homes to determine whether the installations would pass a local plumbing inspection. When a deficiency was noted, the installer corrected it and the additional installation time was added.

Five different plumbing installers from two separate companies participated in the study – the installers were evaluated and determined to be highly proficient with the materials and methods they were asked to install. Combined, the two plumbing companies reported installing water piping on more than 6,000 new production homes and apartments in the past year.



One of the Study Homes

## ■ STUDY RESULTS

This study found that the average installation time for the FlowGuard Gold CPVC system using a one man crew, from arrival at the jobsite to departure, was about 6.75 hours.

Installation Time (in minutes)	House 1	House 2	Average
CPVC Trunk & Branch	408	401	405
PEX Trunk & Branch	457	488	472
<b>PEX Remote Manifold</b>	<b>376</b>	<b>350</b>	<b>363</b>

PEX installed in a remote manifold system by a one man crew was installed in an average of 6.05 hours – about 10% faster than FlowGuard Gold CPVC. These results appear to contradict competitive marketing claims of a 50% speed advantage for PEX. The PEX with a trunk and branch configuration was installed in about 7.87 hours – 17% more time than FlowGuard Gold CPVC.

	CPVC	PEX Trunk & Branch	PEX Remote Manifold
Total Fitting Install Time/House (mins.)	150.3	201.5	135
Total Fittings/House	154	109.5	43.5
<b>Average Minutes per Fitting</b>	<b>0.98</b>	<b>1.84</b>	<b>3.1</b>

The 2015 Annual Builder Practices Survey shows that the majority of PEX systems (58%) use a trunk and branch configuration. It is noteworthy that CPVC installed about 15% faster than PEX in its most common configuration.

In addition to length of piping, the installation time for fittings and number of fittings varied by plumbing system. The PEX remote manifold system reported the fewest fittings and least amount of time installing fittings. While the PEX Trunk and Branch system used fewer fittings than the CPVC system, the reduction was insufficient to offset the higher installation time per fitting.

Total length of piping used in this study varied primarily by piping system configuration. Including scrap generated, the trunk and branch systems used an average of 336 linear feet of pipe: about 6 feet of 1-inch pipe, 50 feet of ¾-inch pipe, and 280 linear feet of ½-inch pipe. The PEX remote manifold configuration used an average of 408 linear feet of pipe; 6 feet of 1-inch pipe, 30 feet of ¾-inch pipe, and 372 feet of ½-inch pipe.

### **Applying the Time Study Data and Future Areas of Research.**

Given that the most common plumbing installation method today for PEX (trunk and branch configuration) has the slowest installation time in our study, this study suggests that builders and plumbers may be able to realize time and cost savings through the use of other plastic materials and system designs.

Since the focus of this study was installation time, a complete cost comparison requires that appropriate labor rates should be applied to these installation times, as well as adding materials and overhead costs.

While the results of this study are generally reflective of overall installation productivity for the three piping systems installations studied, actual installation times may vary widely based on factors specific to the home features or characteristics, the plumbing system, materials chosen and joining method, the geographic area of installation and the skill level of the installer. Examples of such variables may include: the use of pre-assembled kits for turnouts at fixtures; use of open-web joists and wood I-joists instead of lumber joists; the addition of pipe insulation; or, using a different joining system than that used in the study (e.g., crimping).

<sup>1</sup> Plumbing contractors specialized in the plumbing piping type they installed in the study. Their primary job was to install hot and cold water distribution piping in typical new home environments.

<sup>2</sup> Number and type of bath fixtures in the study homes were based on Annual Builder Practices Data for SFD homes: 1 stand-alone shower; 1 stand-alone bath; and 1 bath-shower combination.

