BLÜCHER®

A WATTS Brand

Installation Comparison of Pipework Drainage Systems

PREPARED FOR WATTS WATER CORPORATION

July 2021

A research document comparing the installation times of Watts Water BLÜCHER drain pipe system to Cast Iron and PVC drain pipe systems.

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EXECUTIVE SUMMARY

BLÜCHER EuroPipe, founded in Denmark in 1965, specializes in stainless steel drainage products. *BLÜCHER EuroPipe* stainless steel drainage products are used for residential, commercial, industrial, and marine applications. The *BLÜCHER EuroPipe* product offering consists of pipes and pipe fittings for drainage systems, domestic and industrial drain systems, and channels for linear drainage solutions. These *BLÜCHER EuroPipe* stainless steel products are chemically descaled and passivated to enhance the natural corrosion resistance and provide a sleek looking matt silver surface finish. Primary customers of *BLÜCHER EuroPipe* products include consultant engineers, plumbers and pipefitters, hospital networks, and companies in the food and pharmaceutical industries.

RSMeans (Gordian), the most trusted source of construction cost data for over 70 years, was selected by Watts Water to conduct a time and motion study to compare the differences in productivity between their *BLÜCHER EuroPipe* drainage pipework system to that of two alternative drainage pipework systems – PVC and cast iron. The objective was to conduct an independent time and motion study to both validate efficiencies in installation methods of one product over the other, but also to identify areas of the installation that specifically contribute to one product being more ineffectual than the other in terms of productivity variances. The products featured in this study research were installed in the same exact location following the same layout that was designed for each of the installations with the same crew working the same daily schedule.

RSMeans Engineers reviewed the installation processes for each of the products featured in the study to assess and define productivity metrics that would be evaluated and tracked. A study control guide was developed to measure each discrete work element. The work sampling methodology used to time and record the activities being performed by the selected crew for each of the product installations was the Group Timing Technique (GTT). The GTT method of work sampling provides important data about the characteristics of each of the products featured in the study and the advantages and disadvantages associated with each.

The crew selected by RSMeans to perform the installations of the selected drainage pipework systems consisted of two workers each with extensive experience installing various types of piping used in a wide range of applications for both new construction and renovation of existing facilities. The qualified crew maintained a consistent work pattern across all three product installations and demonstrated a distinct level of knowledge and proficiency.

RSMeans Engineers took care to ensure that each product installed was done so in accordance with each of their respective manufacturer's installation instructions and requirements.

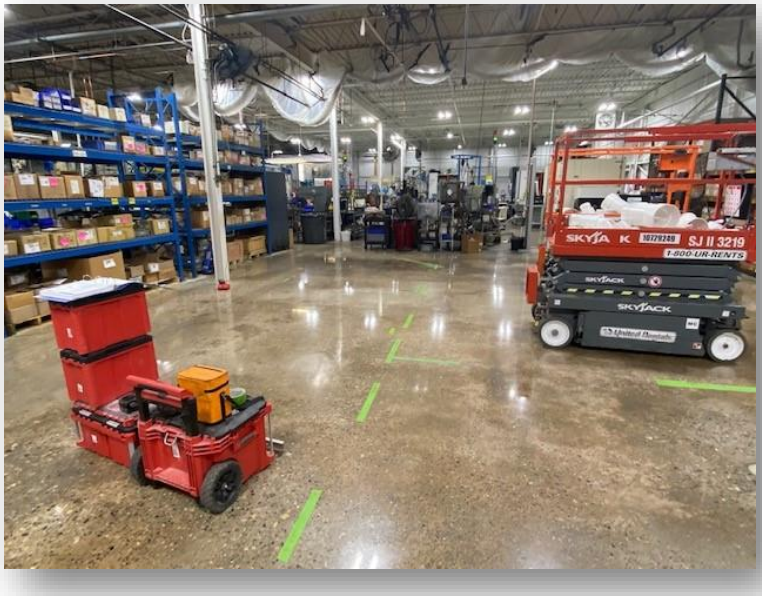
The data collected from the time and motion study indicated that the *BLÜCHER EuroPipe* system installed significantly faster than both the cast iron and PVC drainage pipework systems. When comparing total crew hours required to install each of the three products, the *BLÜCHER EuroPipe* system installed 62% faster than the PVC pipework and about 71% faster than the cast iron pipework across identical installation layouts. It is important to note that the layout time and the time to fabricate and install hangers has been excluded from these calculations.

STUDY DESIGN AND APPROACH

The goal of this time and motion study was to identify and report on differences in productivity between various installations of drain waste and vent piping systems. The proposed piping layout was reviewed and approved, by both RSMeans Engineers and the crew that would be performing the installations, prior to arriving onsite for observation and data collection. Three different drainage pipework systems were selected to compare during this study – (1.) schedule 40 PVC pipe, (2.) regular service/no hub cast iron pipe, and (3.) *BLÜCHER EuroPipe* stainless steel drain waste and vent piping.

(A copy of the design layout for each of the pipework product installation are included in the supporting documentation section of this report.)

The location selected to conduct the time and motion study was the Watts Water valve factory located in Franklin, New Hampshire. The factory provided an open area roughly 30’ by 60’ where the study was conducted. This was an active production facility which provided a real-world scenario to conduct the study. The construction of the facility was open web joist on a concrete slab.



RSMeans utilized the Group Timing Technique (GTT) in conducting the time and motion study and in measuring the work being observed. The GTT is an industry accepted methodology for work sampling and allows an observer to accurately record the installation time of several workers and distinguish between multiple activities. For purposes of performing this research study, the activities/tasks were recorded in 5-minute time intervals.

It is important to note that the work measurement method used to conduct the time and motion study is used to accurately determine, from a very limited sample size, the time required to carry out a particular activity related to, in this case, the installation of a drain, waste and vent piping system. A chronological record of activities was also noted as a reference. This record also included notes and other relevant information that would prove helpful in producing this report and analyzing the results of the research study. The time needed to conduct the layout and to build the hangers and struts needed was captured here in these additional notes. There are a number of variables that were possible regarding hanger spacing and location. Therefore, it was decided to use the same layout for all three products. Site conditions and installer preference all play a critical role in determining the overall time required for a proper installation. We felt that eliminating the hanger variance would be indicative of a more equitable installation sample for this study. That being said, RSMeans engineers did record the time associated with building, assembling and placing the hangers in position for the pipe.

A study control guide was prepared by RSMeans Engineers prior to arriving onsite to the facility to conduct the research study. The study control guide is a defined list of tasks required to perform the data collection for the given work being measured. A copy of the study control guide is included in the supporting documents section.

Most importantly, RSMeans verified and insured that the three installation procedures and the overall process/layout remained as consistent and unchanged as much as reasonably possible throughout the entire time and motion study. RSMeans took care to ensure that each product installed was done so in accordance with manufacturers' instructions and requirements. It is important to note that the PVC product has specific cure times for the solvent cement relative to the various sizes of pipe. It is recommended by the manufacture that the joints remain undisturbed until the cure time has passed. Specifically, 4-8 inch pipe requires 1 hour of cure time before the pipe should be disturbed. The way this cure time was handled in this study was, we added one hour to the total install time for the PVC product. This would ensure that the last fixture made up would have the full amount of time required for the solvent cement to fully set up. The utmost care was taken to ensure the comparisons were fair and balanced as to maintain both the independence and credibility of the research study. There was no influence nor direction from any outside sources.

As previously mentioned, each material used in the time and motion study followed the same piping layout and hanger placement as much as reasonably possible. An actual detailed breakdown of the diameter size and length, linear feet of pipe, included in each of the installations can be found in the description of Crew, Tasks and Materials section. Slight variations in lengths can be attributed to the different fitting size and insertion depths for the various products.

Description of Crew, Tasks, and Materials

The crew selected to perform the installations consisted of two (2) plumbers with similar experience (20 years each). They are employed by the same company and paid by the hour (in contrast to lump sum). Both installers had substantial experience working together as a crew during routine work assignments over the last 90 days. Crew members had personal protective gear including hard hats, glasses, steel toe boots and gloves, the crew also observed safe practices in compliance with OSHA for the term of the study. The crew maintained a consistent work pattern across each installation trial and demonstrated a proficient level of knowledge and experience. Furthermore, the crew was encouraged to perform each installation as they normally would on a typical project of this size and scope. The crew used standard equipment and tools that included the following: scissors lift, tape measures, add additional tools.

A study control guide was compiled to define the tasks. Tasks performed by the crew and tracked by RSMeans Engineers included the following: (actual copies of the study control guides are provided in the supporting documents section.)

- Connection of fittings
- Measuring of pipe
- Cutting of pipe
- Prep cut pipe (removing burs, bevel tap, etc.)
- Material handling
- Non-productive

The test site was well lit and there was no interference from other trades. Sufficient quantities of all materials were delivered and mobilized within the facility as needed for easy access to and from the install area. All materials were located just outside the install area. Product data for each manufacturers' product is provided in the supporting documents section.

The materials selected to perform this study were schedule 40 solvent weld PVC, regular service/no hub cast iron pipe and *BLÜCHER EuroPipe* drainage pipework systems. The layout consisted of 3", 4", 6" and 8" pipe along with the associated fittings. The overall layout drawing for each of the systems being installed are provided in the Appendix section of this report.

The following quantities of pipe were installed:

- PVC 3-inch diameter 12 feet, 5 and 7/8 inches
- PVC 4-inch diameter 102 feet, 1 and ¼ inches
- PVC 6-inch diameter 1 foot
- PVC 8-inch diameter 11 feet, 11 and 1/8 inches

- Cast iron 3-inch diameter 10 feet, and 11/12 of an inch
- Cast iron 4-inch diameter 105 feet, 2 and ½ inches
- Cast iron 6-inch diameter 1 foot
- Cast iron 8-inch diameter 13 feet, 6 and 1/8 inches

- BLÜCHER 3-inch diameter 12 feet, 9 and 7/8 inches
- BLÜCHER 4-inch diameter 92 feet, and 7/16 of an inch
- BLÜCHER 6-inch diameter 1 foot
- BLÜCHER 8-inch diameter 12 feet, and ¾ of an inch

Slight variations in lengths can be attributed to the various manufactures' fitting design and insertion depths of the respective products.

CONDUCT OF THE STUDY

At the beginning of the first day the team met to discuss means and methods of installation, safety, security check in and review what the expectations were going to be for the course of the study. At this point the layout of the piping was discussed and slightly modified to allow the layout to fit within the allocated space and not interfere with any active assembly stations of the plant. These changes were consistent with all the installations.

It was noted that the installation crew had previously never worked with the *BLÜCHER* product. It was decided that before the install started, the *BLÜCHER* representative on site would provide a tutorial on how to join and install the BLÜCHER product. During this tutorial it was clear that the install crew was not going to have a difficult time installing and the install crew quickly understood the *BLÜCHER* process. It was also decided that we would record and monitor the layout and hanger installation independently from the piping installation. This was done to ensure that all products had a level playing field to start. Because the materials were different and each had slightly different hanger spacing, per manufactures recommendations, we wanted to be able to identify how long it would take to create and install each hanger assembly independent of the piping installation.

At the beginning of each installation day, RMeans Engineers and the installation crew met to discuss the plan for the day and to review expectations and answer any questions that anyone had for that specific day. The crew broke for lunch at roughly the same time each day. At the end of each installation, the same crew carefully removed the previously installed piping system but left all the strut and hangers to be utilized by the next installation. The install area was left clean and neat for the next day's installation. Any debris was loaded to the proper area daily by the crew. The time for this demolition and clean up tasks was not included within the data collected as these tasks were outside of the scope of the study.

RSMeans Engineers observed, timed, and recorded the work using the Group Timing Technique (GTT). This methodology is an industry accepted work sampling procedure that allows an observer to accurately record the installation time of multiple workers and distinguish between multiple activities. In this study, the activities were recorded in 5-minute increments. A smart phone, stopwatch was used to time specific activities and the overall time for each manufacturer's product as well as time for each of the 5-minute time intervals.

Time such as instruction, clean up, mobilization/demobilization, demolition (removal) of piping, scheduled breaks, etc. was recorded but isolated from the install time to measure actual gains or losses in productivity. RSMeans Engineers verified that procedures and the overall process remained the same throughout the study. Care was taken to ensure the comparisons were fair and balanced as to maintain the independence of the study. There was no influence from outside sources.

Time and Motion Study Results

The following tables reflect the installation results for each pipework system that was featured during the course of the multi-day time and motion research study. The layout for each of the piping products installed was identical and a consistent work pattern was maintained.

It is important to note that the "Non-Productive" category seen within each of the data results tables below account for activities that include but are not limited to the following:

- waiting for instructions/receiving instructions
- discussions amongst crew members
- waiting to receive material/standing idle
- retrieving a dropped tool/locating a tool
- relocating power cords/plugging into power source
- operating/relocating scissor lift (w/out material)
- receiving measurements and instructions
- using restroom (outside of scheduled break times)

Also, please note that if a "0" is included in any of the task fields within the data results tables that does not conclude that the worker did not perform that particular task during the entire duration of the installation. Rather the "0" indicates the worker was not seen performing that particular task at that given 5-minute time interval.

The data results below do not represent the actual time it took to perform each of the discrete tasks; rather they represent the number of occurrences in which that specific task was being performed at each 5-minute time interval in which data was recorded.

Each recorded "tick mark" (or number) represents data collected at a 5-minute time interval. The data collected indicates a particular task that is included on the study control guide was being performed at that 5-minute mark. The stopwatch is then restarted, and a data point (or tick mark) is recorded again at the next 5-minute time interval. In other words, 1 "tick mark" represents a specific activity being performed at that given 5-minute time interval.

Please note the following when reviewing the result tables and charts below - the data collected in this study and presented here does not include hanger time or layout time.

Installation #1: Schedule 40 PVC Piping System

PVC INSTALLATION				
Task Description	**Worker #1**	**Worker #2**		**Total Minutes**
Connection of fittings *(primer + glue)*	23	23		230
Measuring of pipe	4	2		30
Cutting of pipe *(w/ snap cutter or grinder)*	3	3		30
Prep cut pipe *(w/ grinder, file, or hand router to remove burs, chamfer ends, etc.)*	5	4		45
Material handling	11	8		95
Non-productive	9	15		120
Total	55	55		550
		Total Crew Minutes		550
		Total Crew Hours		9.167

Note: a value of "1" represents a time interval of 5-minutes

Installation #2: Regular Service/No Hub Cast Iron Piping System

CAST IRON INSTALLATION				
Task Description	**Worker #1**	**Worker #2**		**Total Minutes**
Connection of fittings	28	25		265
Measuring of pipe	15	7		110
Cutting of pipe *(w/ snap cutter or grinder)*	11	12		115
Prep cut pipe	0	1		5
Material handling	15	19		170
Non-productive	10	15		125
Total	79	79		790
		Total Crew Minutes		790
		Total Crew Hours		13.167

Note: a value of "1" represents a time interval of 5-minutes

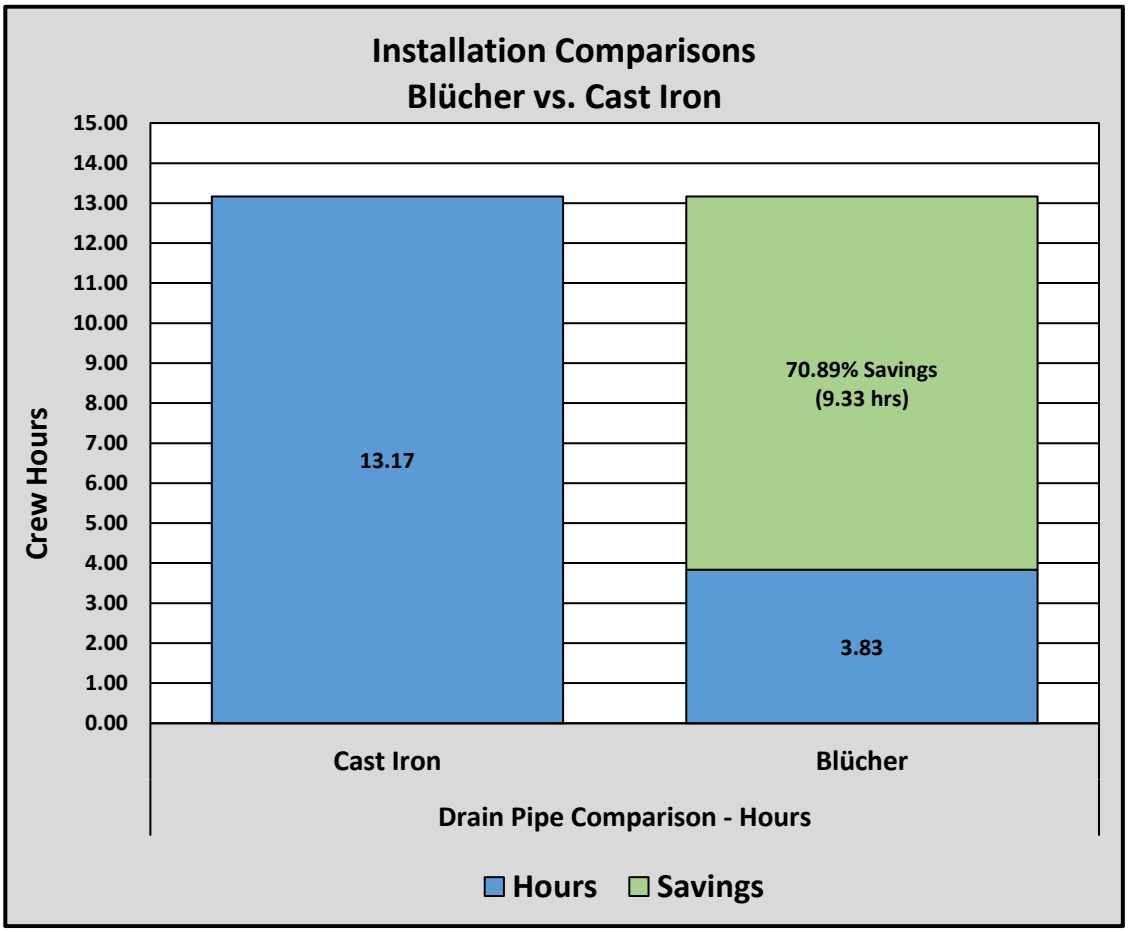
Installation #3: BLÜCHER® EuroPipe System

BLÜCHER EUROPIPE/STAINLESS STEEL INSTALLATION				
Task Description	**Worker #1**	**Worker #2**		**Total Minutes**
Connection of fittings *(spray/wipe lube hubs)*	9	7		80
Measuring of pipe	2	1		15
Cutting of pipe *(w/ electric cutting tool)*	0	1		5
Prep cut pipe *(not needed w/ BLÜCHER)*	0	0		0
Material handling	6	7		65
Non-productive	6	7		65
Total	23	23		230
		Total Crew Minutes		230
		Total Crew Hours		3.833

Note: a value of "1" represents a time interval of 5-minutes

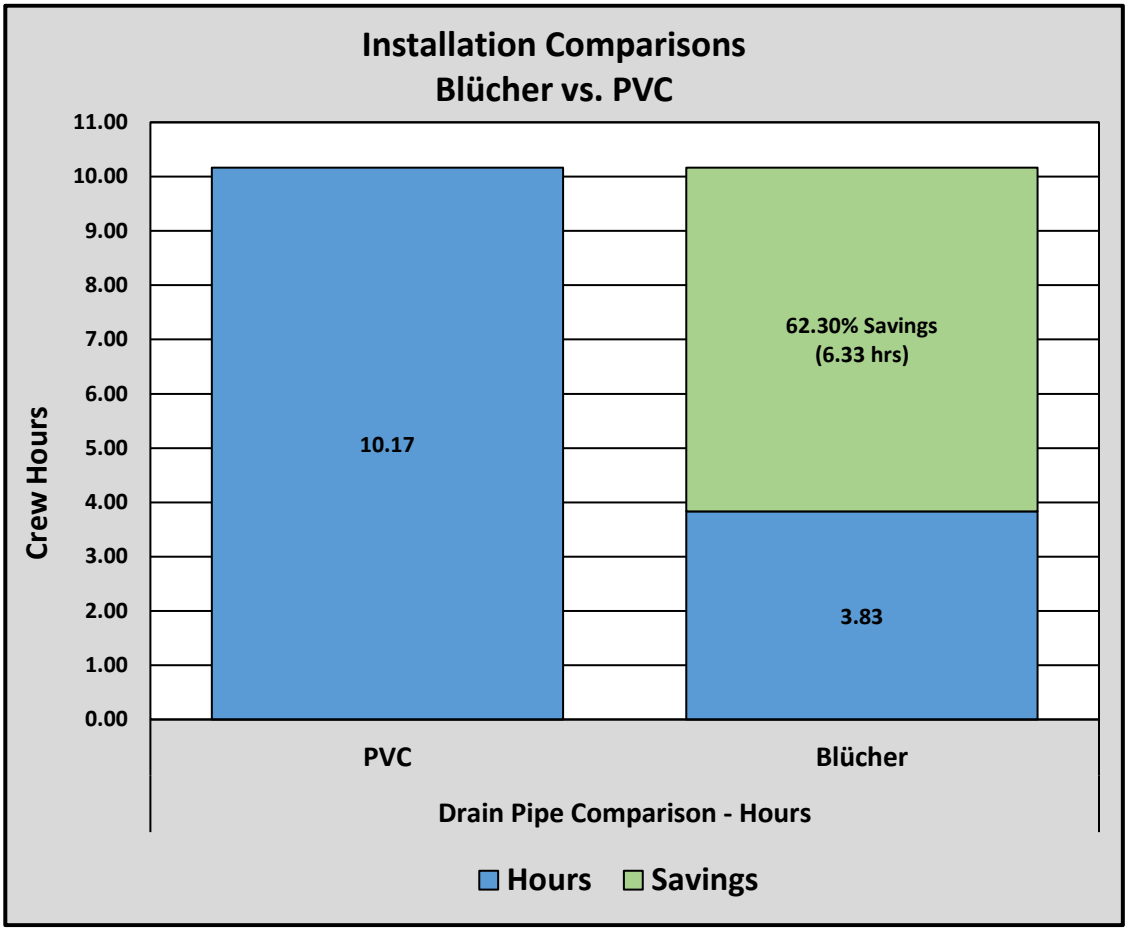
Comparison of Total Crew Hours for Installations		
BLÜCHER	**PVC**	**%**
3.833 Hours	9.167 Hours + 1.00 Hour for Cure Time	BLÜCHER *62.30% Faster*
BLÜCHER	**Cast Iron**	**%**
3.833 Hours	13.167 Hours	BLÜCHER *70.89% Faster*

Bar Charts Comparing Installation Times



Comparison #1: BLÜCHER Stainless Steel vs. Cast Iron (Crew productivity)

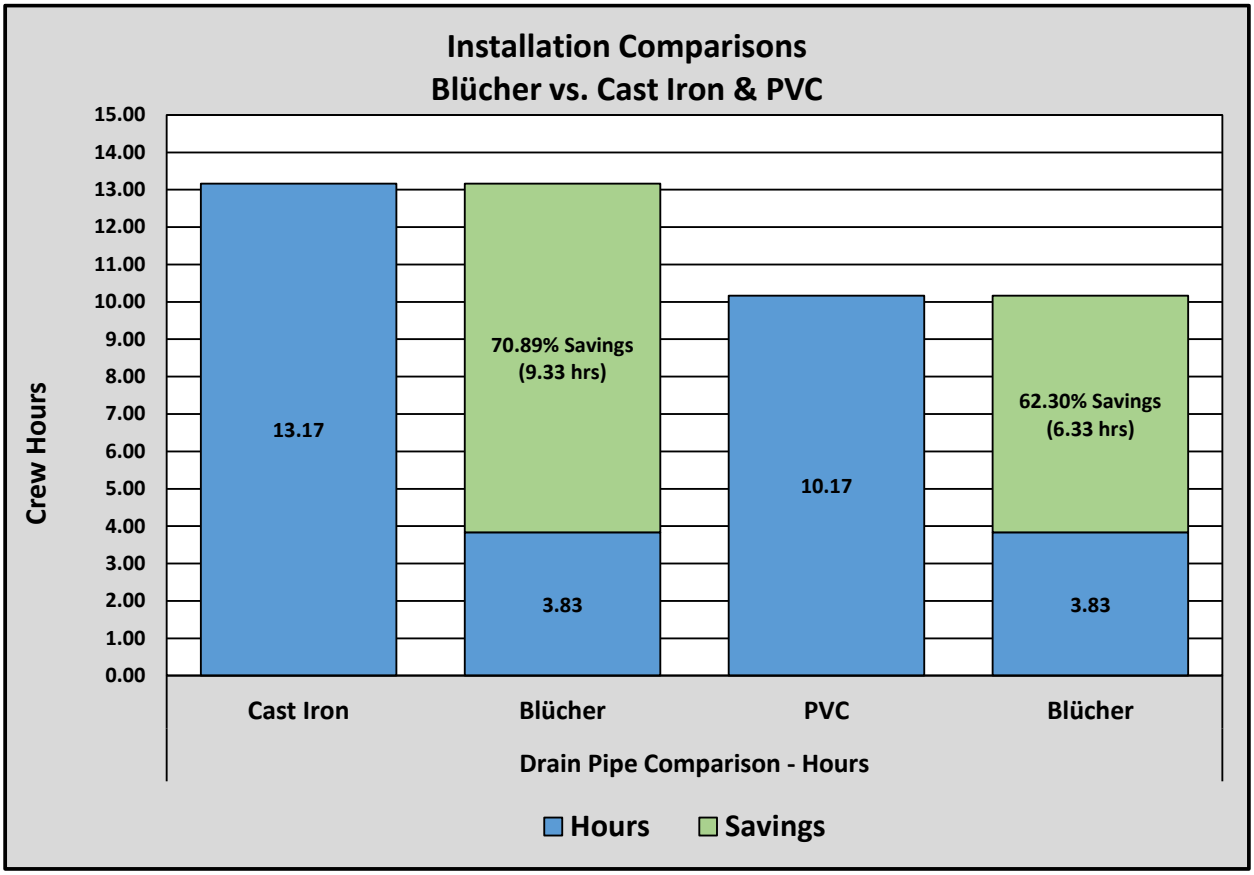
The total of all crew hours necessary to complete the installation with the BLÜCHER stainless steel drain pipe was 3.83 hours. The same installation using cast iron drain pipe required 13.17 total crew hours to complete. These results indicate that the BLÜCHER system installed 9.33 hours or 70.89% faster than the cast iron system.



*1 hour was added to the PVC installation time to account for the pipe cement curing time

Comparison #2: BLÜCHER Stainless Steel vs. PVC (Crew productivity)

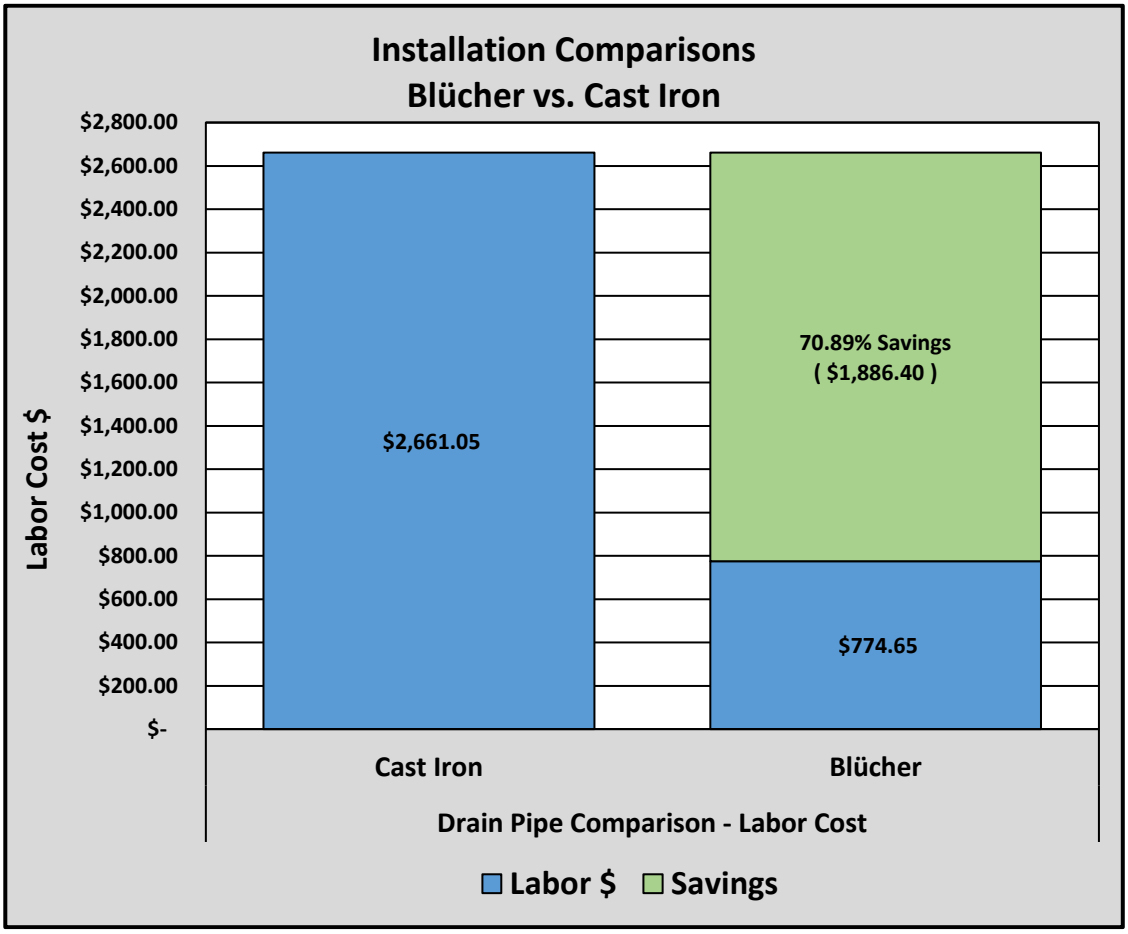
The total of all crew hours necessary to complete the installation with the BLÜCHER stainless steel drain pipe was 3.83 hours. The same installation using PVC drain pipe required 10.17 total crew hours to complete. The PVC installation time includes 1 hour for pipe cement curing time. These results indicate that the BLÜCHER system installed 6.33 hours or 62.30% faster than the PVC system.



*1 hour was added to the PVC installation time to account for the pipe cement curing time

Comparison #3: BLÜCHER Stainless Steel vs. Cast Iron & PVC (Crew productivity)

This chart is a summary comparison of productivity time savings for BLÜCHER stainless steel drain pipe against both cast iron and PVC pipe systems (See results in comparisons #1 & #2).



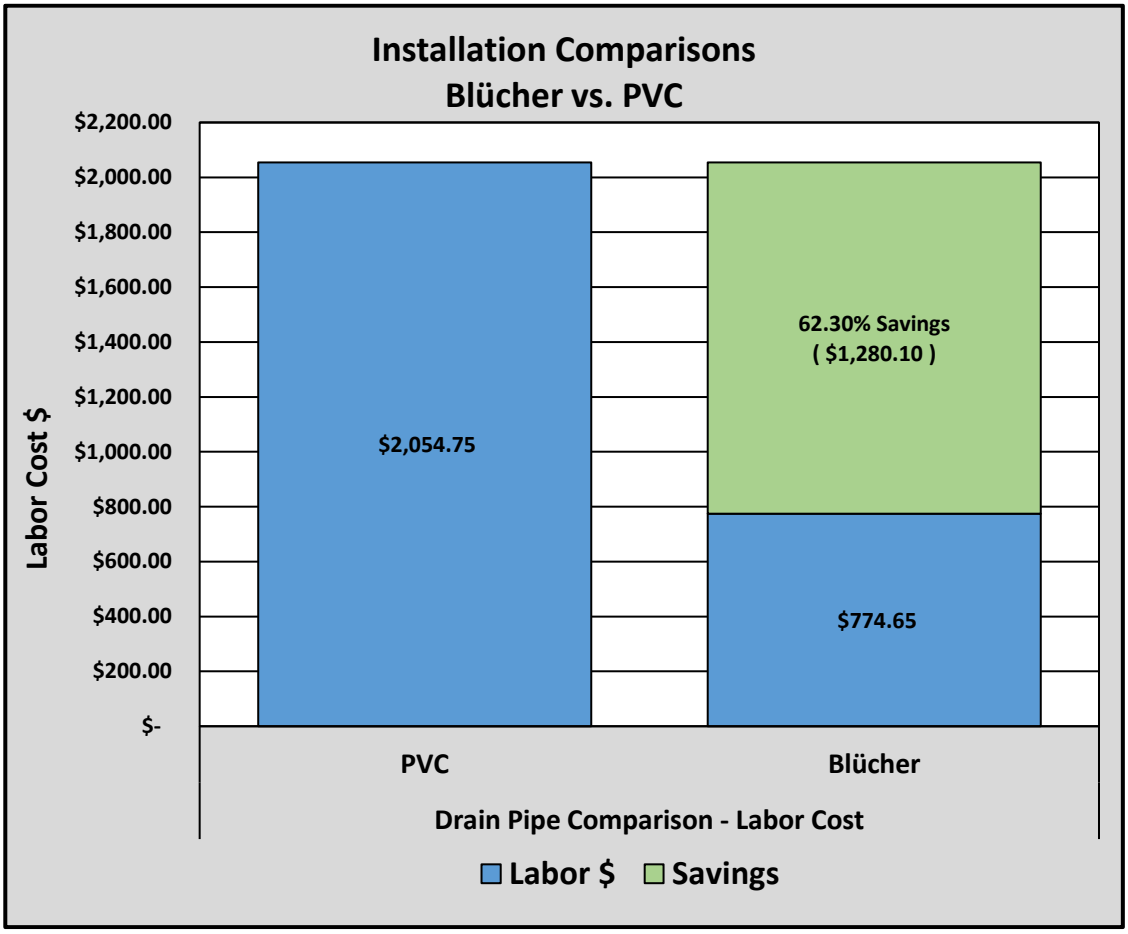
Comparison #4: BLÜCHER Stainless Steel vs. Cast Iron (Crew labor cost)

Labor cost savings were determined using the crew productivity times and calculating them against the labor cost of the installation crew which consisted of 2 plumbers. Using 2021 RSMeans standard union labor rate for one plumber at $101.05 per hour, the following labor cost savings were established.

BLÜCHER: (3.833 hours X $202.10 crew cost per hour) = $774.65

Cast Iron: (13.167 hours X $202.10 crew cost per hour) = $2,661.05

This translates into $1,886.40 or 70.89% labor cost savings using the BLÜCHER pipe system over the cast iron alternative.



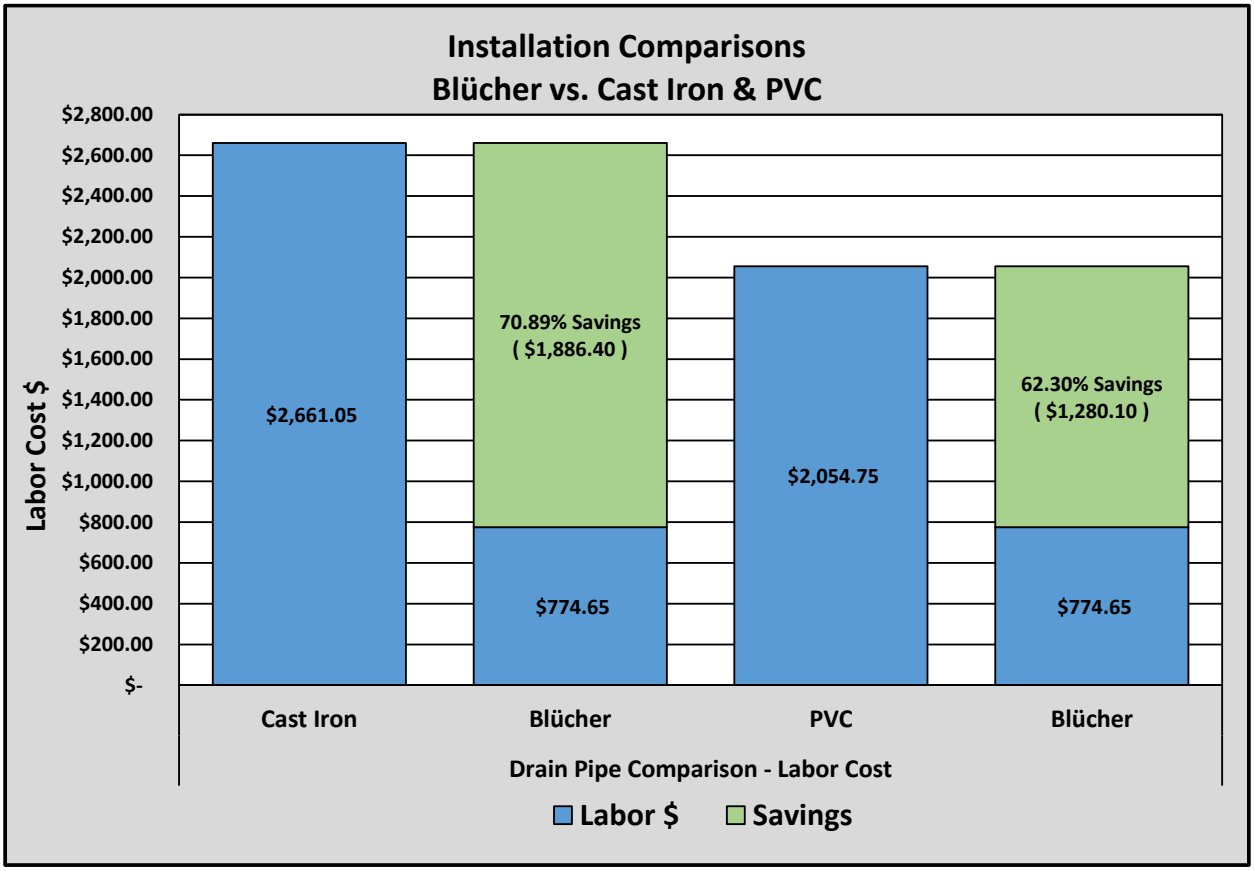
Comparison #5: BLÜCHER Stainless Steel vs. PVC (Crew labor cost)

Labor cost savings were determined using the crew productivity times and calculating them against the labor cost of the installation crew which consisted of 2 plumbers. Using 2021 RSMeans standard union labor rate for one plumber at $101.05 per hour, the following labor cost savings were established.

BLÜCHER: (3.833 hours X $202.10 crew cost per hour) = $774.65

PVC: (10.167 hours X $202.10 crew cost per hour) = $2,054.75

This translates into $1,280.10 or 62.30% labor cost savings using the BLÜCHER pipe system over the PVC alternative.



Comparison #6: BLÜCHER Stainless Steel vs. Cast Iron & PVC (Crew labor cost)

This chart is a summary comparison of labor cost savings for BLÜCHER stainless steel drain pipe against both cast iron and PVC pipe systems (See results in comparisons #4 & #5).

OBSERVATION AND ANALYSIS

A general observation was that any learning curve in using the *BLÜCHER EuroPipe* drainage pipework systems was overcome immediately. This crew was comfortable with handling and installing the product at the conclusion of the tutorial provided by a knowledgeable technical representative from Watts Water. It was apparent to that the crew members mobilizing and joining the lengths of *BLÜCHER* pipe required much less effort to pick up and maneuver the product because of how lightweight the pipe material is. It was also observed and noted that the section of 8" pipe and associated fittings was assembled on the floor and then lifted into the air at one time. This proved to be a much faster install than the other 8" product because of the sheer weight of the fully assembled section. While this may be difficult to quantify in cost savings, the *BLÜCHER* product has the distinct advantage of less physical fatigue on the installer after long hours of installing.

Speed typically equates to improved productivity, which has been validated by the data collected from conducting this time and motion study. *BLÜCHER* piping products did install quicker overall compared to the PVC and Cast-Iron products featured in this research study, but it's important to ask "why?" The PVC and Cast-Iron products are much heavier materials and

therefore require much more effort to mobilize around a jobsite. Mobilization around a jobsite would include actions such as moving individual lengths of pipe from the stack of material to the cutting station, or from the cutting station to the lift where it would then be handed up to another crew member to receive it, and then place it in location. Another answer to the question "why?" is the speed of the connection. With the *BLÜCHER* product you simply push the two sections together, no glue to set up or tightening of bands to make the connection.

There are important details to consider when comparing the installation design and therefore productivity differences between the *BLÜCHER* products and the other piping products featured in this research study. One important distinction is the lengths of the piping being installed. The *BLÜCHER* piping needed minimal cuts to make the correct lengths required. This provided a distinct time savings compared to the other two piping systems being installed and is illustrated in the amount, or lack of cutting recorded in the raw data columns "cutting of pipe" and "prep cut pipe".

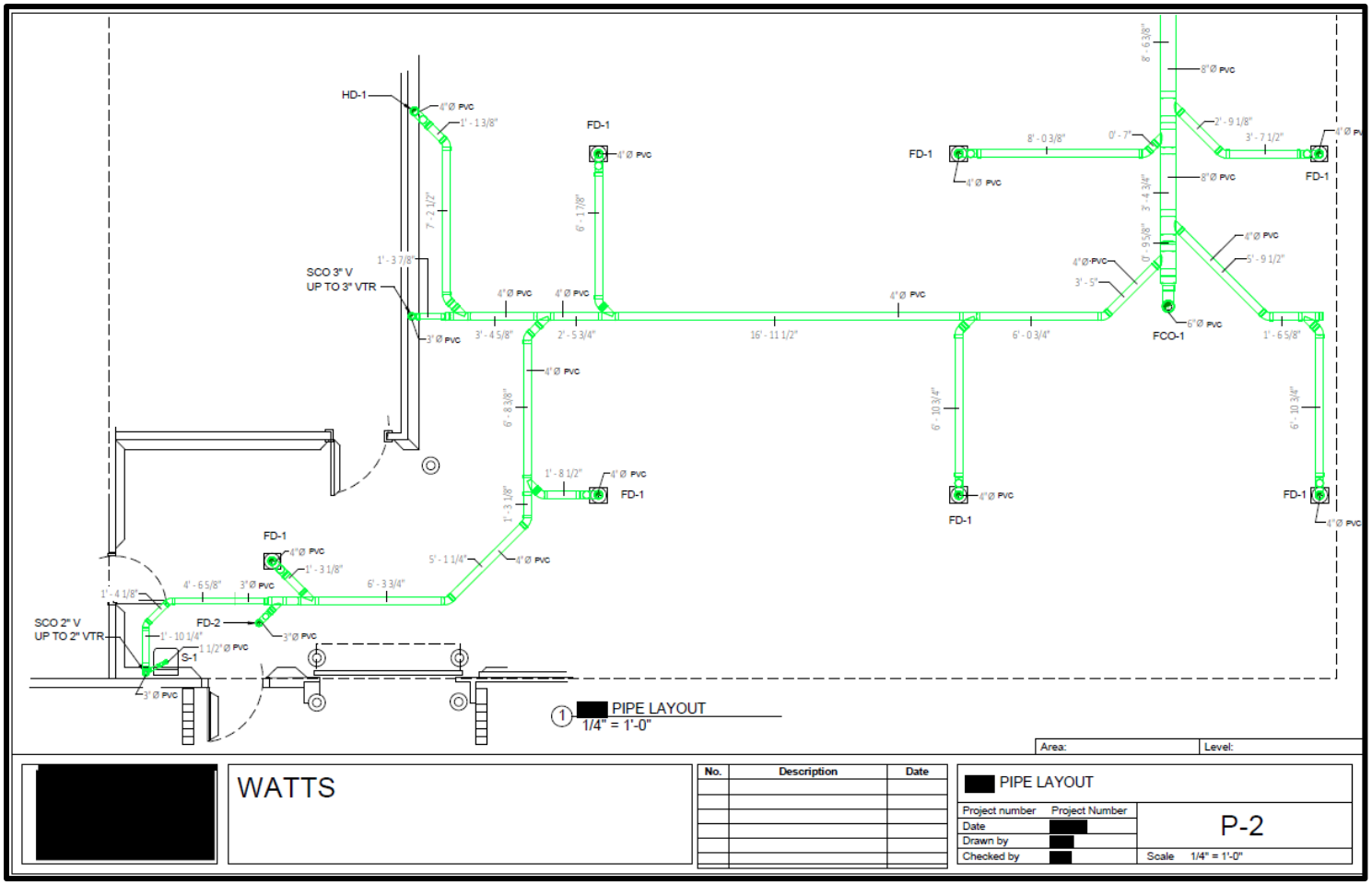
Finally, it is important to note that the percentage of fittings to length of pipe installed was rather high and we would expect to see the savings increase even further if a larger volume of piping was installed as would be seen in a real world installation.

POST-INSTALLATION CREW INTERVIEW AND FEEDBACK

General comments from the installing crew included mentioning that the *BLÜCHER EuroPipe* material was much lighter than the other two products installed, and the stainless-steel pipe system was much more facile to maneuver around the site during the course of the installation. The crew also mentioned how simple and fast the fittings were to join. The crew specifically asked if this product could be used for boiler venting because that is a job that they often perform. They were hoping that if the *BLÜCHER EuroPipe* product could be used in this application (i.e., boiler venting), it would clearly result in a much more expeditious installation process, which in turn would allow them to complete more jobs. The *BLÜCHER* technical representative who was present onsite explained that the rubber gasket feature associated with the *BLÜCHER* pipe fittings were a limiting factor in it being used for boiler venting.

The crew also made a statement related to the replacement of cast iron pipework and how difficult it can be to replace because it often becomes brittle and breaks apart over time the older the piping is. They went on to say that the *BLÜCHER* piping system appears to be much easier to replace and/or rework fittings and append additional lengths of piping if necessary.

APPENDIX A – INSTALLATION SCHEMATIC



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