$88.25

2017 NATIONAL PLUMBING & HVAC ESTIMATOR

By James A. Thomson

Craftsman Book Company
6058 Corte del Cedro, Carlsbad, CA 92011

Acknowledgments

The sample "Standard Form Subcontract" and "Subcontract Change Order" forms used in the final section of this book are reprinted with the permission of the publisher, the Associated General Contractors of America (National Office), 1957 E Street NW, Washington, District of Columbia 20006.

Cover design by: *Jennifer Johnson*
Photos*: iStock by Getty Images™*

ISBN 978-1-57218-329-2
Published September 2016 for the year 2017.

Contents

How to Use This Book

This 2017 National Plumbing & HVAC Estimator is a guide to estimating labor and material costs for plumbing, heating, ventilating and air conditioning systems in residential, commercial and industrial buildings.

Inside the back cover of this book you'll find a software download certificate. To access the download, follow the instructions printed there. The download includes an easy to-use estimating program with all the cost estimates in this book. The software will run on PCs using Windows XP, Vista, 7, 8, or 10 operating systems.

When the *National Estimator* program has been installed, click Help on the menu bar to see a list of topics that will get you up and running. Or, go online to www.craftsman-book.com and click on Support, then Tutorials, to view an interactive tutorial for *National Estimator*.

Costs in This Manual will apply within a few percent on a wide variety of projects. Using the information given on the pages that follow will explain how to use these costs and suggest procedures to follow when compiling estimates. Reading the remainder of this section will help you produce more reliable estimates for plumbing and HVAC work.

Manhour Estimates in This Book will be accurate for some jobs and inaccurate for others. No manhour estimate fits all jobs because every construction project is unique. Expect installation times to vary widely from job to job, from crew to crew, and even for the same crew from day to day.

There's no way to eliminate all errors when making manhour estimates. But you can minimize the risk of a major error by:

1. Understanding what's included in the manhour estimates in this book, and

2. Adjusting the manhour estimates in this book for unusual job conditions.

The Craft@Hrs Column. Manhour estimates in this book are listed in the column headed *Craft@Hr*s. For example, on page 19 you'll see an estimate for installing a 6 gallon hot water heater. In the *Craft@Hr*s column opposite 6 gallon you'll see:

P1@.500

To the left of the @ symbol you see an abbreviation for the recommended work crew.

Page 7 shows the wage rates and craft codes used in this book.

To the right of the @ symbol you see a number. The number is the estimated manhours (not crew hours) required to install each unit of material listed. In the case of a 6 gallon hot water heater, P1@.500 means that .500 manhours are required to install 1 hot water heater.

Costs in the Labor $ Column are based on manhour estimates in the *Craft@Hrs* column. Multiply the manhour estimate by the assumed hourly labor cost to find the installation cost in the *Labor $* column. For example, .500 manhours times $36.24 (the average wage for crew P1) is $18.12, or $18.10 rounded.

Quarterly price updates on the Web are free and automatic all during 2017. You'll be prompted by Craftsman Software Update when it's time to collect the next update. A connection to the Web is required**.**

Manhour Estimates include all productive labor normally associated with installing the materials described. These estimates assume normal conditions: experienced craftsmen working on reasonably well planned and managed new construction with fair to good productivity. Labor estimates also assume that materials are standard grade, appropriate tools are on hand, work done by other crafts is adequate, layout and installation are relatively uncomplicated, and working conditions don't slow progress.

All manhour estimates include tasks such as:

- Unloading and storing construction materials, tools and equipment on site.
- Working no more than two floors above or below ground level.
- Working no more than 10 feet above an uncluttered floor.
- Normal time lost due to work breaks.
- Moving tools and equipment from a storage area or truck not more than 200 feet from the work area.
- Returning tools and equipment to the storage area or truck at the end of the day.
- Planning and discussing the work to be performed.
- Normal handling, measuring, cutting and fitting.
- Regular cleanup of construction debris.
- Infrequent correction or repairs required because of faulty installation.

If the work you're estimating won't be done under these conditions, you need to apply a correction factor to adjust the manhour estimates in this book to fit your job.

Applying Correction Factors. Analyze your job carefully to determine whether a labor correction factor is needed. Failure to consider job conditions is probably the most common reason for inaccurate estimates.

Use one or more of the recommended correction factors in Table 1 to adjust for unusual job conditions. To make the adjustment, multiply the manhour estimate by the appropriate conversion factor. On some jobs, several correction factors may be needed. A correction factor less than 1.00 means that favorable working conditions will reduce the manhours required.

Supervision Expense to the installing contractor is not included in the labor cost. The cost of supervision and non-productive labor varies widely from job to job. Calculate the cost of supervision and non-productive labor and add this to the estimate.

Hourly Labor Costs also vary from job to job. This book assumes an average manhour labor cost of $42.65 for plumbers and $41.40 for sheet metal workers. If these hourly labor costs are not accurate for your jobs, adjust the labor costs up or down by an appropriate percentage. Instructions on the next page explain how to make these adjustments. If you're using the National Estimator disk, it's easy to set your own wage rates.

Hourly labor costs in this book include the basic wage, fringe benefits, the employer's contribution to welfare, pension, vacation and apprentice funds, and all tax and insurance charges based on wages. Table 2 at the top of the next page shows how hourly labor costs in this book were calculated. It's important that you understand what's included in the figures in each of the six columns in Table 2. Here's an explanation:

Column 1, the base wage per hour, is the craftsman's hourly wage. These figures are representative of what many contractors are paying plumbers, sheet metal workers and helpers in 2017.

Column 2, taxable fringe benefits, includes vacation pay, sick leave and other taxable benefits. These fringe benefits average about 5.48% of the base wage for many plumbing and HVAC contractors. This benefit is in addition to the base wage.

Condition	Correction Factor
Work in large open areas, no partitions	.85
Prefabrication under ideal conditions, bench work	.90
Large quantities of repetitive work	.90
Very capable tradesmen	.95
Work 300' from storage area	1.03
Work 400' from storage area	1.05
Work 500' from storage area	1.07
Work on 3rd through 5th floors	1.05
Work on 6th through 9th floors	1.10
Work on 10th through 13th floors	1.15
Work on 14th through 17th floors	1.20
Work on 18th through 21st floors	1.25
Work over 21 floors	1.35
Work in cramped shafts	1.30
Work in commercial kitchens	1.10
Work above a sloped floor	1.25
Work in attic space	1.50
Work in crawl space	1.20
Work in a congested equipment room	1.20
Work 15' above floor level	1.10
Work 20' above floor level	1.20
Work 25' above floor level	1.30
Work 30' above floor level	1.40
Work 35' to 40' above floor level	1.50

Table 1 Recommended Correction Factors

Column 3, insurance and employer-paid taxes in percent, shows the insurance and tax rate for the craft workers. The cost of insurance in this column includes workers' compensation and contractor's casualty and liability coverage. Insurance rates vary widely from state to state and depend on a contractor's loss experience. Note that taxes and insurance increase the hourly labor cost by approximately 30%. There is no legal way to avoid these costs.

Column 4, insurance and employer taxes in dollars, shows the hourly cost of taxes and insurance. Insurance and taxes are paid on the costs in both columns 1 and 2.

Column 5, non-taxable fringe benefits, includes employer paid non-taxable benefits such as medical coverage and tax-deferred pension and profit sharing plans. These fringe benefits average 4.84% of the base wage for many plumbing and HVAC contractors.

Column Number	1	2	3	4	5	6
Craft	Base wage per hour	Taxable fringe benefits (at 5.48% of base wage)	Insurance and employer taxes (%)	Insurance and employer taxes ($)	Non-taxable fringe benefits (at 4.84% of base wage)	Total hourly cost used in this book
Laborer	20.57	1.13	32.81%	7.12	1.00	29.82
Plumber	31.37	1.72	24.30%	8.04	1.52	42.65
Sheet Metal Worker	30.04	1.65	26.06%	8.26	1.45	41.40
Operating Engineer	30.61	1.68	25.27%	8.16	1.48	41.93
Sprinkler Fitter	30.82	1.69	25.12%	8.17	1.49	42.17
Electrician	30.35	1.66	19.86%	6.36	1.47	39.84
Cement Mason	25.87	1.42	23.18%	6.33	1.25	34.87

Craft Code	Crew Composition	Average Hourly Cost per Manhour
ER	4 building plumbers, 2 building laborers, 1 operating engineer	38.88
SN	4 building sheet metal workers, 2 building laborers, 1 operating engineer	38.17
P1	1 building plumber and 1 building laborer	36.24
ST	1 sprinkler fitter	42.17
SK	4 sprinkler fitters, 2 building laborers, 1 operating engineer	38.61
SL	1 sprinkler fitter and 1 laborer	36.00
S2	1 building sheet metal worker, 1 building laborer	35.61
BE	1 electrician	39.84
CF	1 cement mason	34.87
SW	1 sheet metal worker	41.40

Table 2 Labor Costs Used in This Book

The employer pays no taxes or insurance on these benefits.

Column 6, the total hourly cost in dollars, is the sum of columns 1, 2, 4, and 5. The labor costs in Column 6 were used to compute costs in the Labor $ column of this book.

Adjusting Costs in the Labor $ Column. The hourly labor costs used in this book may apply within a few percent on many of your jobs. But wage rates may be much higher or lower in some areas. If the hourly costs shown in Column 6 of Table 2 are not accurate for your work, adjust labor costs to fit your jobs.

For example, suppose your hourly labor costs are as follows:

Plumber	$19.00
Laborer	$16.00
Total hourly crew cost	$35.00

Your average cost per manhour would be $17.50 ($35.00 per crew hour divided by 2 because this is a crew of two).

A labor cost of $17.50 is about 48% of the $36.24 labor cost used for crew P1. Multiply costs in the Labor $ column by .483 to find your estimated cost.

For example, notice on page 19 that the labor cost for installing a 6 gallon hot water heater is $18.12 each. If installed by your plumbing crew working at an average cost of $17.50 per manhour, your estimated cost would be 48% of $18.12 or $8.74 per heater.

Adjusting the labor costs in this book will make your estimates much more accurate. Making adjustments to labor costs is both quick and easy if you use the National Estimator program.

Equipment Cost will vary according to need and application. It typically is $110 per hour for a 10-ton hydraulic truck-mounted crane.

Material Costs in this manual are intended to reflect what medium- to low-volume contractors will be paying in 2017 after applying normal discounts. These costs include charges for delivery to within 25 to 30 miles of the supplier.

Overhead and Profit for the installing contractor are not included in the costs in this manual unless specifically identified in the text. Markup can vary widely with local economic conditions, competition and the installing contractor's operating expenses. Add the markup that's appropriate for your company, the job and the competitive environment.

How Accurate Are These Figures? As accurate as possible considering that the editors don't know your material suppliers, haven't seen the plans or specifications, don't know what building code applies or where the job is, had to project material costs at least six months into the future, and had no record of how much work the crew that will be assigned to the job can handle.

You wouldn't bid a job under those conditions. And I don't claim that all plumbing and HVAC work is done at these prices.

Estimating Is an Art, not a science. There is no one price that applies on all jobs. On many jobs the range between high and low bid will be 10% or more. There's room for legitimate disagreement on what the correct costs are, even when complete plans and specifications are available, the date and site are established, and labor and material costs are identical for all bidders.

No estimate fits all jobs. Good estimates are custom made for a particular project and a single contractor through judgment, analysis and experience. This book is not intended as a substitute for judgment, analysis and sound estimating practice. It's an aid in developing an informed opinion of cost, not an answer book.

Additional Costs to Consider

Here's a checklist of additional costs to consider before submitting any bid.

1. Sales taxes
2. Mobilization costs
3. Payment and performance bond costs
4. Permits and fees
5. Storage container rental costs
6. Utility costs
7. Tool costs
8. Callback costs during warranty period
9. Demobilization costs

Exclusions and Clarifications

Neither the job specifications nor the contract may identify exactly what work should be included in the plumbing and HVAC bid. Obviously, you have to identify what work is included in the job.

The most efficient way to define the scope of the work is to prepare a list of tasks not normally performed by your company and attach that list to each bid submitted. Here's a good list of work that should be excluded from your bid.

Your Bid Should Exclude

Final cleaning of plumbing fixtures

Backings for plumbing fixtures

Toilet room accessories

Electrical work, including motor starters

Electrical wiring and conduit over 100 volts

Temporary utilities

Painting, priming and surface preparation

Structural cutting, patching or repairing

Fire protection and landscape sprinklers

Equipment supports

Surveying and layout of control lines

Removal or stockpiling of excess soil

Concrete work, including forming and rebar

Setting of equipment furnished by others

Equipment, unless shown, and personnel hoisting

Wall and floor blockouts

Pitch pockets

The costs of performance or payment bonds

Site utilities

Asbestos removal or disposal

Contaminated soil removal or disposal

Major increases in copper material prices

Fire dampers not shown on the plans

Your Bid Should Include

Trash sweep-up only. Others haul it away

Site utilities from building to property line only

Piping to 5 feet outside the building only

Plumbing & HVAC permits for your work only

Beware of Price Changes

There's no way to be sure what prices will be in three to six months. All labor, equipment, material and subcontract prices in a bid should be based on costs anticipated when the project is expected to be built, not when the estimate is compiled. That

presents a problem. Except for the installation of underground utilities, most plumbing and HVAC work is done six months to a year after the bid is submitted. When possible, get price protection in writing from your suppliers and subcontractors. If your suppliers and subs won't guarantee prices, include an escalation allowance in your bid to cover anticipated price increases.

Material Pricing Conditions

All equipment and material prices quoted by your vendors will be conditional. They usually don't include sales tax and are subject to specific payment and shipping terms. Every estimator should understand the meaning of common shipping terms. They define who pays the freight and who has responsibility for processing freight-damage claims. Here's a summary of important conditions you should understand.

F.O.B. Factory (Free On Board at the Factory): Title passes to the buyer when the goods are delivered by the seller to the freight carrier. The buyer pays the freight and is responsible for freight-damage claims.

F.O.B. Factory F.F.A. (Free On Board at the Factory, Full Freight Allowed): The title passes to the buyer when the goods are delivered by the seller to the freight carrier. The seller pays the freight charges, but the buyer is responsible for freight-damage claims.

F.O.B. (city of destination) (Free On Board to your city): The title passes to the buyer when the goods are delivered by the seller to the freight terminal in the city, or nearest city, of destination. The seller pays the freight and is responsible for freight-damage claims to the terminal. The buyer pays the freight charge and is responsible for freight-damage claims from the terminal to the final destination.

F.O.B. Job Site (Free On Board at job site, or contractor's shop): The title passes to the buyer when the goods are delivered to the job site (or shop). The seller pays the freight and is responsible for freight-damage claims.

F.A.S. Port [of a specific city] (Free Alongside Ship at the nearest port): The title passes to the buyer when goods are delivered to the ship dock or port terminal. The seller pays the freight and is responsible for freight-damage claims to the ship dock or port terminal only. The buyer pays the freight and is responsible for freight-damage claims from the ship dock or port terminal to the designated delivery point.

Obviously, it's to your advantage to instruct all vendors to quote costs F.O.B. the job site or your shop.

Reducing Costs

Most construction specifications allow the use of alternative equipment and materials. It's the estimator's responsibility to select the most cost-effective products. Research and compare your costs before making any decisions. Avoid selecting any material or equipment simply because that's what you've always done.

Don't recommend plastic products such as ABS, PVC, or polypropylene pipe or corrugated flexible ducts until you've checked local code requirements. Most building codes prohibit use of these materials inside public buildings such as schools, care centers and hospitals.

It's wise to select 100% factory-packaged equipment. Beware of equipment labeled "Some assembly required." Field labor costs for mounting loose coils, motors and similar equipment are very high.

Value Engineering

Let's suppose you've submitted a combined plumbing and HVAC bid for $233,000. Your cutthroat competitor put in a bid at $4,000 less, $229,000. Obviously there's no way you're going to get the job. Right?

Not so fast! Maybe value engineering can help you win that contract — while fattening your profit margin.

Suppose the proposal you submitted had two parts. Part I is the bid for $233,000, based entirely on job plans and specs, just the way they were written. But appended to your proposal is Part II, a list of suggestions for saving money without sacrificing any of the capacity or quality designed into the system. Here's an example of what might be in Part II:

1. Deduct for providing pipe hanger spacings per UPC in lieu of specified spacings: $1,750.00

2. Deduct for reducing heating hot water pipe sizes by using 40 degrees F Delta T in lieu of specified 20 degrees F Delta T: $4,600.00

3. Deduct for providing pressure/temperature taps at air handling units, pumps and chillers in lieu of specified thermometers and pressure gauges: $875.00

4. Deduct for eliminating water treatment in closed piping systems: $1,800.00

5. Deduct for piping chilled and heating hot water pumps in parallel in lieu of providing 100% standby pumps: $2,900.00

Total deductions: $11,925.00

Adopting these suggestions would make you low bidder by nearly $8,000. A saving like that will be tempting to most owners, especially if the owner understands that your suggestions result in a system that is every bit as good and maybe better than the system as originally designed.

You're not offering to undercut the competition. Far from it. You're using knowledge and experience to create better value for the owner. That's called value engineering and it's likely to win the respect of nearly all cost-conscious owners.

Notice that reducing costs is only part of what value engineering is all about. You don't cut costs at the expense of system quality, integrity, capacity or performance.

Don't waste your time, and your client's, by offering to substitute cheaper or lower-quality fixtures or equipment. Any cutthroat contractor with a price list can do that. Recommend the use of inferior materials and you'll be associated with the inferior goods you promote. Some owners consider even the suggestion to be insulting.

The recommendations you make (like most of those in the example) will require design changes. You can expect to be examined (or even challenged) on these points. Be ready to explain and defend each of your suggestions. Convince the client (or the design engineer) that your ideas are based on sound engineering principles and you're well on the way to winning the owner's confidence and the contract.

Now, let's go back to the list and see how we might justify the five value engineering recommendations.

1. **Pipe Hanger Spacing.** The pipe hanger spacings recommended in the Uniform Plumbing Code (UPC) are calculated by experienced, professional structural engineers. The safety factors used in these calculations are very conservative. They've been widely used for many years and have proved to be more than adequate. There's no need for more hangers than the UPC requires.

2. **Changing HHW Delta T.** In hydronic heating systems, heat measured in Btus is pumped to terminal units. The proposed change of the Delta T, from 20 degrees F to 40 degrees F, has no effect whatsoever on how many Btus the system delivers. You're not changing anything but the volume of water being pumped. At lower volume levels, the size of the pump, the pipe and the pipe insulation can all be reduced. Not one of these changes will affect the system's ability to transmit heat. Furthermore, operating costs will also drop, since less pump horsepower will be needed to run the smaller pump.

3. **Thermometers/Pressure Gauges.** Thermometers and pressure gauges installed on or near vibrating machinery have a very short life expectancy. Gauges quickly lose accuracy under harsh conditions. Readings will become less and less reliable. That's potentially dangerous. You can avoid this problem by using insertion-type pressure/temperature taps instead. Store these sensitive gauges in a desk drawer or a tool crib when not in use. Safely stored, they're protected from damage. They'll give accurate readings longer and won't need to be replaced as often. And they're simple to use. Just insert a gauge in one of the conveniently located taps. Make the reading, then remove the gauge and put it away.

4. **Water Treatment.** ITT Bell & Gossett has done studies on corrosion in closed hydronic systems that have a make-up water rate of no more than 5% per year. These studies show that corrosion virtually stops when entrained air is either removed or depleted. No water treatment is needed in this closed system.

5. **100% Standby Pumps.** Two pumps piped and operated in parallel are more economical. Even if one pump fails, the other pump can maintain delivery at 75 to 80% of the designed flow rate. That's usually adequate for emergency operation.

These cost-saving ideas are small, but could tip the balance in your favor. I hope they demonstrate the potential that value engineering has when bidding jobs. Any time you're compiling an estimate, keep an eye out for ways to save money or reduce the owner's cost. Jot a note to yourself about each potential saving you identify. Before submitting the bid, make a list of your alternate suggestions. Maybe best of all, markup on your value engineering suggestions can be higher than your normal markup. If value engineering can cut costs by $10,000, maybe as much as $4,000 of that should end up in your pocket!

Value Engineering: Surplus Materials

Value engineering doesn't begin and end with job plans and specs. Value engineering means getting the most value at the least cost, no matter whether it's value to the owner or value to the contractor. Smart mechanical contractors learn to build extra value into their jobs by controlling shrinkage of materials. Nearly every significant plumbing and HVAC job ends with at least some surplus material on hand. Material left over when the job is done tends to be discarded as waste or hauled off the job in the back of a truck that doesn't have your company name on the door. And why not? It's surplus — not needed. The owner didn't need it. So now it's up for grabs.

Not quite. Let's consider who actually owns that surplus material. When your company has been paid, every piece of material your crew installed belongs to the building owner. But what about those fittings, hangers and valves delivered to the job site but never actually used? Almost certainly, those materials were included in your bid. So aren't they the property of the owner? Not in my opinion. The owner contracted for a mechanical system and (presumably) has one. Unless it's a cost-plus job or a labor-only job, the owner didn't buy materials delivered to the job site. The owner bought a mechanical system and has one — completely separate and apart from any surplus materials. In my mind, the property owner has no more claim to left-over materials than the same owner would have claim to labor hours not expended or equipment not used on the same job.

Unless there's some provision in your contract to the contrary, surplus material belongs to the installing contractor. But your right to that material and the chance of actually getting it back to your shop are two very different propositions. I see recovery of surplus material as a training issue. As a matter of company policy, make it clear to your crews that surplus material belongs to your company. The supervisor on every job should be accountable for recovery of excess material. Every significant job will have at least some surplus. Accounting for that surplus should be part of your routine close-out procedure. Fortunately, it's not difficult. I'll explain.

Control of surplus materials begins with a good checklist, or form. I recommend the Materials, Equipment and Tool form, "MET" for short. A blank MET form appears following this section. Your MET should show both what's delivered to the job site (material, equipment and tools) and surplus "drops" returned to your shop at project close-out. A MET ensures that the estimator, the shop inventory manager and your field supervisor are on the same page. Your MET establishes accountability. Nothing falls through the cracks. Job input equals job output plus returns. Everything delivered to the job and not expended should be returned to your shop.

Here's how it works:

1. Based on the estimate that won you the job, the items needed are purchased for the job and staged for delivery to the job site.
2. As materials, equipment and tools are delivered to the job site, your supervisor completes the first three columns of the MET form: Description, Quantity and Date.
3. As work is completed, the same supervisor completes the four columns under Returned to Inventory: Quantity Returned, Date, Status Code and Value. The status code will be either "RS" (Returned and Salvaged) or "RN" (Returned New).
4. Back at your shop, both RS and RN materials should be restored to inventory.
5. If your company has an inventory manager, have that manager assign the return value to each item returned. If you're using QuickBooks Pro, the "Adjust Inventory" feature can handle this task quite easily. Add two new categories under "Inventory Stock on Hand by Vendor." The first new category is Returned Salvage. The second is Returned New. Be sure the value of RS materials includes the cost of any reconditioning done to restore salvaged materials (such as pumps and boilers) to serviceable condition.
6. Comparing MET deployed to the job site with MET returned to inventory yields MET actually used on the job. That's a very important number to every plumbing and HVAC estimator. Be sure actual usage gets entered on the Project Summary form.
7. When the take-off on your next estimate is complete, compare that materials list with a summary of RS and RN materials on hand from prior jobs.
8. Evaluate which returned materials can be redeployed on the new job.
9. It's a management decision to either (1) charge the new job for the cost of RS and RN materials already on hand, or (2) consider materials on hand as "free" and a competitive advantage in winning the new bid. Either way, RN and RS materials are an asset to your company.

Plumbing and HVAC materials are expensive. Every mechanical contractor has an interest in MET tracking. Everyone in your company should be aware of the need for good materials management. Used correctly, the MET form in this book can help engineer more value into your jobs.

Maximizing the Value of Old Estimates

There should be two profits in every job. The first is money in the bank — a return on time and expenses. The second is what you learn from the job — primarily by comparing the estimate you made with what turns out to be your actual cost. On some jobs, the value of lessons learned may outweigh net revenue.

Every plumbing and HVAC contractor has marginal jobs. That's normal. What *shouldn't* be normal is repeating mistakes. The best way to avoid trouble in your future is to keep track of your past. Keeping old estimates available for reference can help prevent errors on new estimates.

As your file of completed estimates grows, organization becomes more important. You need an easy way to find similar projects with the same components and comparable scope of work. If your estimating file is in QuickBooks Pro, searching by keyword may be enough. Otherwise, I recommend creating a short summary for each completed job, and an index that references all summaries available for comparison. You'll find a blank Project Summary form at the end of this section. To make reference easier, create an index by type of job and equipment used. You may choose to use an alphabetical index based on client name or project ID.

How to complete the Project Summary form is obvious. The many ways to use this form may not be so obvious, so here are a few pointers.

1. Use your index of Project Summary forms to find completed jobs most similar to the job you're bidding. Believe it or not, Project Summary forms with the widest margin of error will be most useful. Ask yourself: Who worked on those projects? Who was the field superintendent? Who were the vendors? Did the errors result from poor estimating or the poor performance of vendors, supervisors or crews? The most common estimating errors occur when (a) inspecting the job site, (b) examining the plans or (c) reading the specifications. What did you miss and why? Look for pitfalls to avoid in the job now being estimated. Identify the biggest two or three mistakes made when bidding that job. Make a notation about each on the Project Summary form.
2. Now look at your bid for the current job. Which mistakes made on a prior job might you expect on this job? Concentrate on the big three oversights to avoid: Inspecting the job site; examining the plans; and reading the specifications.
3. Unless there's a major error in take-off, your estimate of material costs should be within about 5 percent of the actual costs of materials. However, it's common for labor cost estimates to vary 20 percent or more from actual labor costs. This is precisely where data from old jobs comes in handy. If your Project Summary files show that some project types are consistent money-losers, either shift your company's focus to another class of work, factor more contingency into your bids, or find some way to wring inefficiencies out of the labor component. Poor staging, delivery and retrieval procedures drag down labor productivity on any job.
4. Use your file of Project Summary forms to spot any common thread that runs through either money-making jobs or money-losing jobs. For example, if the names of certain subcontractors or vendors are prominent on low-margin jobs, maybe there's a relationship between your profit margin and choice of subs and suppliers. Even the best and most reliable vendors can become complacent if not challenged occasionally.
5. Project Summary forms should note changes and extras identified after the contract was signed — both for which your company was paid and changes done without additional compensation. Projects with changes and extras that exceed about 4 percent of the contract price deserve special scrutiny. Jobs with changes beyond about 4 percent aren't good for business, at least in my opinion. Nearly all changes have a negative impact on your job schedule and require a disproportionate investment of management resources. Too many changes can antagonize the owner and design staff, even if they were responsible for the altered plans. You may know of a mechanical contractor with a reputation for capitalizing on change orders. But I've rarely seen a job plagued with changes that turned into a money-maker for anyone — except the attorneys. Your file of Project Summary forms will show job types that carry change order risk. Before finalizing and submitting any bid, consider whether the job will get mired in disputes over changes and extras. If similar jobs have ended on the courthouse steps, factor that risk into your estimate.

Utility of a Project Summary forms file is limited only by your ingenuity. The important point is to keep and organize the source of your second profit available on every job. What you learn can be more valuable than what you earn.

The Estimating Procedure

Every plumbing and HVAC estimator works under deadline pressure. You'll seldom have the luxury of spending as much time as you would like on an estimate. Estimators who aren't organized waste valuable time and tend to make careless errors. Try to be well-organized and consistent in your approach to estimating. For most projects, I recommend that you follow the procedures listed below and in the order listed:

1. Get a second set of project drawings and specifications for use by your suppliers and subcontractors. Remember that your subs and suppliers need access to the plans and specs and time to prepare their quotes.

2. Study the plans and specs carefully. Highlight important items. Make a list of specific tasks that require labor unit correction factors. The estimate is never complete until you're totally familiar with the project and the applicable construction codes.

3. Get the general contractor or owner to identify the proposed construction schedule and subcontractor lay-down (storage) area. Work schedule and site conditions always affect your costs.

4. Contact all potential suppliers and subcontractors as early as possible. Set a time when each can come to your office to make their take-offs from the spare set of contract documents.

When this important preliminary work is done, or in progress, it's time to begin your detailed take-off.

Guidelines for Good Estimating

You can compile estimates on a legal pad, a printed estimating form or on a computer. Regardless of the method, these guidelines will apply:

List Each Cost Separately on your take-off sheet. Don't combine system estimates, even if the materials are the same type. A combined system estimate may have to be completely redone if materials for one system are changed at a later date. Use the Estimate Detail Sheet on page 16 if you don't already have a good material take-off form.

Use Engineer's Identification Numbers when listing equipment. The word pump without any other description is ambiguous when there are several pumps included in the project.

Don't Forget Labor Adjustment factors if your labor costs are significantly higher or lower than the costs used in this book. See instructions on page 7 for adjusting labor costs.

Use Colored Pencils or highlighters to mark the items you've taken off and listed. Use a different color for each piping or ducting system.

Log Telephone Quotes and other important phone conversations on a telephone quote form. See the sample on page 18.

Project Estimated Costs for labor, material and equipment to the time when the work is expected to be done, not when the job is being estimated.

The only good estimate is a complete estimate. You've probably heard this saying, "He who makes the most mistakes is likely to be low bidder, and live to regret it."

Preparing the Proposal

It's both common courtesy and good business practice to deliver an unpriced copy of your bid or proposal letter to the general contractor three or four days before the bid deadline date. This gives the contractor time to study your proposal and obtain alternate pricing for items you may have excluded. To avoid misunderstandings, make sure your proposals include, as a minimum, the following elements:

1. The complete name and address of the proposed project.
2. Specification title and issue date.
3. A complete listing of drawings and their issue or revision date.
4. A complete list of addenda and their dates of issue.
5. A list of specification section numbers covered by your proposal.
6. A list of exclusions, clarifications and assumptions.

Your final bid can be phoned in or sent by fax, but it should reach the general contractor or owner no more than five or ten minutes before the bid deadline. Prices submitted too early may have to be revised because of last-minute price changes by subcontractors or suppliers.

MET Worksheet

Material, Equipment and Tool Delivery and Surplus Return Record

Project ID _____ Job Location _____

Supervisor _____ Start Date _____

Description of Material, Equipment or Tool Delivered or Returned	Delivered to Job Site		Returned to Inventory			
	Quantity Delivered	Date Delivered	Quantity Returned	Date Returned	Status Code RN or RS	Value at Return

PROJECT SUMMARY

Project ID _____ Job Location _____

Short description _____ _____

Supervisor _____ _____

Index ID _____ Start Date _____

Estimator _____ Client _____

Major vendors _____ Subcontractors _____

_____ _____

Sources of cost deviation _____ _____

_____ _____

_____ _____

Related Projects by ID Number _____ _____

Thumbnail Summary	Labor	Material	Equipment	Subcontract	Deployed RN/RS	Total
Actual cost						
Estimate Over/(Under)						
Full Summary						
Bid amount						
Estimated cost						
Projected profit						
Cost overrun						
Bid profit						
Change orders						
Cost of changes						
Total profit						
Total profit with RN/RS						
Redeployment						

Estimate Detail Sheet

Data carried forward from Take-Off Quantity Survey Sheet(s)

Company/Department _____ Estimator _____ Date _____

Project _____ Checked by _____ Date _____

Address _____ Notes: _____

Job description _____ Estimate # _____ _____

CSI Division/Account _____ Estimate due _____ _____

Item Description	Quantity	Unit	Crew @ MH/Unit	Manhours Ext.	Materials		Labor		Equipment		Subcontract		Total $
					Unit $	Ext. $	Unit $	Ext. $	Unit $	Ext. $	Unit $	Ext. $	
Totals This Sheet			**Manhours**		**Material $**		**Labor $**		**Equipment $**		**Subcontract $**		**Total $**

Carry totals forward to Estimate Summary Sheet Estimate #_____ Estimate Detail Sheet _____ of _____

Quotation Sheet

Job: _____

Supplier: _____

Salesperson: _____ **Phone No:** _____

Per Plans/Specs: _____ **Freight:** _____ **Terms:** _____

Description	Delivery Time	Price

By: _____

Record of Telephone Conversation

Date: _____ **Time:** _____ **Project:** _____

Telecon with: _____

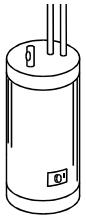
Company: _____ **Phone No:** _____

Subject: _____

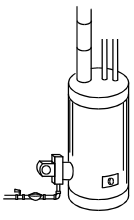
Details of Conversation: _____

By: _____

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Electric domestic hot water heater (residential). Set in place only (floor models). Make additional allowances for pipe and electrical connections. (See below)						
6 gallon						
1.5 KW/110V	P1@.500	Ea	410.00	18.10	—	428.10
10 gallon						
1.5 KW/110V	P1@.500	Ea	458.00	18.10	—	476.10
15 gallon						
1.5 KW/110V	P1@.750	Ea	483.00	27.20	—	510.20
20 gallon						
1.5 KW/110V	P1@.750	Ea	498.00	27.20	—	525.20
30 gallon						
1.5 KW/110V	P1@1.00	Ea	444.00	36.20	—	480.20
40 gallon						
1.5 KW/110V	P1@1.20	Ea	465.00	43.50	—	508.50
50 gallon						
3 KW/110V	P1@1.30	Ea	501.00	47.10	—	548.10
12 gallon						
3 KW/220V	P1@.500	Ea	404.00	18.10	—	422.10
20 gallon						
3 KW/220V	P1@.750	Ea	442.00	27.20	—	469.20
30 gallon						
3 KW/220V	P1@1.00	Ea	483.00	36.20	—	519.20
40 gallon						
3 KW/220V	P1@1.20	Ea	525.00	43.50	—	568.50
50 gallon						
3 KW/220V	P1@1.30	Ea	562.00	47.10	—	609.10

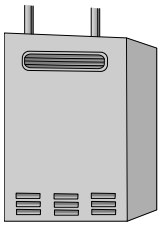


Electric domestic hot water heater (commercial), 208/240 volt. Set in place only. Make additional allowances for pipe and electrical connections. (See below)						
96 gallon, 12 kw	P1@1.50	Ea	2,240.00	54.40	—	2,294.40
96 gallon, 18 kw	P1@1.50	Ea	3,040.00	54.40	—	3,094.40
96 gallon, 36 kw	P1@1.50	Ea	3,150.00	54.40	—	3,204.40
120 gallon, 18 kw	P1@2.00	Ea	3,220.00	72.50	—	3,292.50
120 gallon, 36 kw	P1@2.00	Ea	3,330.00	72.50	—	3,402.50
120 gallon, 54 kw	P1@2.00	Ea	3,940.00	72.50	—	4,012.50
120 gallon, 63 kw	P1@2.00	Ea	4,250.00	72.50	—	4,322.50



Gas-fired domestic hot water heater (residential). Set in place only, Make additional allowances for pipe and combustion venting connections. (See below)						
30 gallon	P1@1.00	Ea	476.00	36.20	—	512.20
40 gallon	P1@1.00	Ea	769.00	36.20	—	805.20
50 gallon	P1@1.50	Ea	874.00	54.40	—	928.40

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Gas-fired domestic hot water heater (commercial), standard efficiency. Set in place only, Make additional allowances for pipe and combustion venting connections. (See below)						
50 gal./ 95 gph	P1@2.00	Ea	2,240.00	72.50	—	2,312.50
67 gal./106 gph	P1@2.00	Ea	2,650.00	72.50	—	2,722.50
76 gal./175 gph	P1@2.00	Ea	3,550.00	72.50	—	3,622.50
91 gal./291 gph	P1@2.00	Ea	4,280.00	72.50	—	4,352.50
Gas-fired domestic hot water heater (commercial), energy miser. Set in place only, Make additional allowances for pipe and combustion venting connections. (See below)						
50 gal./ 95 gph	P1@2.00	Ea	5,270.00	72.50	—	5,342.50
67 gal./106 gph	P1@2.00	Ea	5,510.00	72.50	—	5,582.50
76 gal./175 gph	P1@2.00	Ea	6,830.00	72.50	—	6,902.50
91 gal./291 gph	P1@2.00	Ea	8,120.00	72.50	—	8,192.50
Tankless natural gas water heaters. Ambient pressure. DOE and UL rated. For residential, multi-dwelling and light commercial potable water applications. Add the cost of piping, tempering valve, circulating pump, controls, and electrical connection, post-installation inspection by both the fire marshal and the mechanical inspector to validate federal, state and local energy tax credits or energy tax credit offsets. For larger arrays (laundries, institutional facilities, food processing plants), develop an estimate based on the required capacity and multiply these costs by the number of heaters required. Rated in Btus and gallons per minute capacity. (1 Mbh = 1,000 Btus)						
19.5-140 Mbh, .75-5.8 Gpm	P1@16.0	Ea	1,830.00	580.00	—	2,410.00
11-199 Mbh, .5-7 Gpm	P1@20.0	Ea	2,160.00	725.00	—	2,885.00
25-235 Mbh .75-9.6 Gpm	P1@20.0	Ea	2,160.00	725.00	—	2,885.00
Tankless electric point-of-use water heaters. Ambient pressure, DOE and UL rated. For residential, multi-dwelling and light commercial potable water applications. Cost does not include piping, tempering valve, circulating pump, controls, storage tank, electrical connection. Add the cost of post-installation inspection by the mechanical inspector to validate federal, state and local energy tax credits or energy tax credit offsets. In rated gallons per minute capacity.						
5.5 Kw/40 Amp, .75-2 Gpm	P1@4.00	Ea	461.00	145.00	—	606.00
9.5 Kw/50 Amp .75-2.5 Gpm	P1@4.25	Ea	547.00	154.00	—	701.00
19 Kw/100 Amp 1-3.5 Gpm	P1@4.50	Ea	909.00	163.00	—	1,072.00
28 Kw/120 Amp 1.5-5 Gpm	P1@4.75	Ea	1,660.00	172.00	—	1,832.00



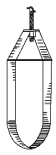
Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Domestic hot water heater connection assembly. Includes supply, return, recirculation and relief piping and fittings (copper), relief and isolation valves. Make additional allowances for gas and venting connections where applicable.						
¾" residential	P1@1.75	Ea	313.00	63.40	—	376.40
¾" commercial	P1@2.25	Ea	420.00	81.50	—	501.50
1" commercial	P1@2.75	Ea	736.00	99.70	—	835.70
1¼" commercial	P1@3.50	Ea	901.00	127.00	—	1,028.00
1½" commercial	P1@3.75	Ea	938.00	136.00	—	1,074.00
2" commercial	P1@4.50	Ea	1,000.00	163.00	—	1,163.00
2½" commercial	P1@5.75	Ea	2,080.00	208.00	—	2,288.00
3" commercial	P1@6.50	Ea	3,190.00	236.00	—	3,426.00
Domestic water heater combustion vent connection. Make additional allowances for piping distances greater than 25'.						
2" B-vent	P1@.090	LF	6.22	3.26	—	9.48
3" B-vent	P1@.100	LF	7.69	3.62	—	11.31
4" B-vent	P1@.110	LF	10.20	3.99	—	14.19
6" B-vent	P1@.130	LF	11.60	4.71	—	16.31
Tankless heater vent kit	P1@2.50	Ea	437.00	90.60	—	527.60
Power vent kit	P1@2.00	Ea	1,120.00	72.50	—	1,192.50

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Water softener, time clock controller. Including brine tank, brine well and pick-up tube. Labor includes setting in place, connecting the unit to an existing domestic water distribution system, start up and testing.						
20,000 grain water softener, TCC	P1@4.50	Ea	571.00	163.00	—	734.00
30,000 grain water softener, TCC	P1@4.50	Ea	609.00	163.00	—	772.00
45,000 grain water softener, TCC	P1@4.50	Ea	677.00	163.00	—	840.00
50,000 grain water softener, TCC	P1@4.75	Ea	764.00	172.00	—	936.00
60,000 grain water softener, TCC	P1@4.75	Ea	903.00	172.00	—	1,075.00
75,000 grain water softener, TCC	P1@5.00	Ea	969.00	181.00	—	1,150.00
90,000 grain water softener, TCC	P1@5.50	Ea	1,310.00	199.00	—	1,509.00
120,000 grain water softener, TCC	P1@5.75	Ea	1,410.00	208.00	—	1,618.00
Water softener, mechanically-metered controller. Including brine tank, brine well and pick up tube. Labor includes setting in place, connecting the unit to an existing domestic water distribution system, start up and testing.						
20,000 grain water softener, MMC	P1@4.50	Ea	742.00	163.00	—	905.00
30,000 grain water softener, MMC	P1@4.50	Ea	775.00	163.00	—	938.00
45,000 grain water softener, MMC	P1@4.50	Ea	843.00	163.00	—	1,006.00
50,000 grain water softener, MMC	P1@4.75	Ea	929.00	172.00	—	1,101.00
60,000 grain water softener, MMC	P1@4.75	Ea	1,090.00	172.00	—	1,262.00
75,000 grain water softener, MMC	P1@5.00	Ea	1,160.00	181.00	—	1,341.00
90,000 grain water softener, MMC	P1@5.50	Ea	1,490.00	199.00	—	1,689.00
120,000 grain water softener, MMC	P1@5.75	Ea	1,590.00	208.00	—	1,798.00

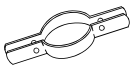
Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Water softener, electronically-metered controller. Including brine tank, brine well and pick up tube. Labor includes setting in place, connecting the unit to an existing domestic water distribution system, start up and testing.						
20,000 grain water softener, EMC	P1@4.50	Ea	787.00	163.00	—	950.00
30,000 grain water softener, EMC	P1@4.50	Ea	810.00	163.00	—	973.00
45,000 grain water softener, EMC	P1@4.50	Ea	889.00	163.00	—	1,052.00
50,000 grain water softener, EMC	P1@4.75	Ea	974.00	172.00	—	1,146.00
60,000 grain water softener, EMC	P1@4.75	Ea	1,140.00	172.00	—	1,312.00
75,000 grain water softener, EMC	P1@5.00	Ea	1,200.00	181.00	—	1,381.00
90,000 grain water softener, EMC	P1@5.50	Ea	1,530.00	199.00	—	1,729.00
120,000 grain water softener, EMC	P1@5.75	Ea	1,630.00	208.00	—	1,838.00
Water softener accessories						
By-pass valve	P1@.400	Ea	75.80	14.50	—	90.30
Manifold adapter kit	P1@.200	Ea	20.40	7.25	—	27.65
Turbulator	P1@.400	Ea	37.40	14.50	—	51.90
Iron filter, electronically-metered controller. Manganese green sand filter. Labor includes setting in place, connecting the unit to an existing domestic water distribution system, start-up and testing.						
42,000 iron filter (1.5 cf media), 5 gpm	P1@4.00	Ea	744.00	145.00	—	889.00
65,000 iron filter (2.0 cf media), 6 gpm	P1@4.50	Ea	880.00	163.00	—	1,043.00
84,000 iron filter (2.5 cf media), 8 gpm	P1@4.75	Ea	940.00	172.00	—	1,112.00
Replacement green sand media	P1@1.20	CF	43.10	43.50	—	86.60
Iron filter accessories						
By-pass valve	P1@.400	Ea	75.80	14.50	—	90.30
Air vent	P1@.200	Ea	60.10	7.25	—	67.35
Air controller	P1@.400	Ea	67.90	14.50	—	82.40

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Combination iron filter/water softener. Zeolite resins soften water and remove iron and manganese. Controller automatically controls PH level. Labor includes setting in place, connecting the unit to an existing domestic water distribution system, start-up and testing.						
40,000 iron filter, 1.3 cf media	P1@4.00	Ea	1,440.00	145.00	—	1,585.00
60,000 iron filter, 1.7 cf media	P1@4.50	Ea	1,560.00	163.00	—	1,723.00
80,000 iron filter, 2.5 cf media	P1@4.75	Ea	2,260.00	172.00	—	2,432.00
Hot water softener, time clock controller. Brass valve construction. Designed for 150 F. maximum operating temperature. Includes brine tank, brine well and pick-up tube. Labor includes setting in place, connecting the unit to an existing domestic water distribution system, start-up and testing.						
20,000 grain hot water softener	P1@4.50	Ea	1,810.00	163.00	—	1,973.00
30,000 grain hot water softener	P1@4.50	Ea	1,920.00	163.00	—	2,083.00
40,000 grain hot water softener	P1@4.50	Ea	2,000.00	163.00	—	2,163.00
60,000 grain hot water softener	P1@4.75	Ea	2,370.00	172.00	—	2,542.00
Pressure tank, fiberglass wound. Labor includes setting in place, connecting the tank to a domestic water distribution system and testing.						
Fiberglass pressure tank, 20 gallon	P1@2.00	Ea	240.00	72.50	—	312.50
Fiberglass pressure tank, 30 gallon	P1@2.00	Ea	270.00	72.50	—	342.50
Fiberglass pressure tank, 80 gallon	P1@2.75	Ea	438.00	99.70	—	537.70
Fiberglass pressure tank, 120 gallon	P1@3.50	Ea	578.00	127.00	—	705.00
Brass tank tee assembly, ¾"	P1@3.50	Ea	33.60	127.00	—	160.60
Brass tank tee assembly, 1"	P1@3.50	Ea	62.70	127.00	—	189.70
Brass tank tee assembly, 1¼"	P1@3.50	Ea	107.00	127.00	—	234.00

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Hanger with swivel assembly						
½"	P1@.250	Ea	3.84	9.06	—	12.90
¾"	P1@.250	Ea	4.25	9.06	—	13.31
1"	P1@.250	Ea	4.45	9.06	—	13.51
1¼"	P1@.300	Ea	4.56	10.90	—	15.46
1½"	P1@.300	Ea	4.90	10.90	—	15.80
2"	P1@.300	Ea	5.12	10.90	—	16.02
2½"	P1@.350	Ea	6.96	12.70	—	19.66
3"	P1@.350	Ea	8.61	12.70	—	21.31
4"	P1@.350	Ea	9.44	12.70	—	22.14



Riser clamp						
½"	P1@.100	Ea	2.48	3.62	—	6.10
¾"	P1@.100	Ea	3.65	3.62	—	7.27
1"	P1@.100	Ea	3.69	3.62	—	7.31
1¼"	P1@.105	Ea	4.45	3.81	—	8.26
1½"	P1@.110	Ea	4.70	3.99	—	8.69
2"	P1@.115	Ea	4.97	4.17	—	9.14
2½"	P1@.120	Ea	5.24	4.35	—	9.59
3"	P1@.120	Ea	5.67	4.35	—	10.02
4"	P1@.125	Ea	7.22	4.53	—	11.75



Copper, Type M with Soft-Soldered Joints

Type M hard-drawn copper pipe with wrought copper fittings and soft-soldered joints is used in a wide variety of plumbing and HVAC systems such as potable water, heating hot water, chilled water, and A.C. condensate.

Soft-soldered joints are those made with solders having melting points in the 350 degree F. to 500 degree F. range. Maximum working pressure/temperature relationships for soft-soldered joints are approximately as follows:

Maximum Working Pressures (PSIG)*				
Soft-solder Type	Water Temperature (degrees F.)	Nominal Pipe Size (inches)		
		Up to 1	1¼ to 2	2½ x 4
50-50 tin-lead**	100	200	175	150
	150	150	125	100
	200	100	90	75
	250	85	75	50
95-5 tin-antimony	100	500	400	300
	150	400	350	275
	200	300	250	200
	250	200	175	150

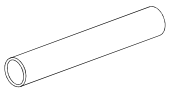
**For copper pipe and solder-type fittings using soft-solders melting at approximately 350 degrees F. to 500 degrees F.*

***The use of any solder containing lead is not allowed in potable water systems.*

This section has been arranged to save the estimator's time by including all normally-used system components such as pipe, fittings, valves, hanger assemblies, riser clamps and miscellaneous items under one heading. Additional items can be found under "Plumbing and Piping Specialties." The cost estimates in this section are based on the conditions, limitations and wage rates described in the section "How to Use This Book" beginning on page 5.

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Type M copper pipe with soft-soldered joints installed horizontally. Complete installation including six to twelve wrought copper tees and six to twelve wrought copper elbows every 100', and hangers spaced to meet plumbing code *(a tee & elbow every 8.3' for ½" dia., a tee and elbow every 16.6' for 4" dia.)*.						
½"	P1@.110	LF	2.02	3.99	—	6.01
¾"	P1@.120	LF	3.12	4.35	—	7.47
1"	P1@.140	LF	6.48	5.07	—	11.55
1¼"	P1@.160	LF	10.90	5.80	—	16.70
1½"	P1@.180	LF	12.90	6.52	—	19.42
2"	P1@.210	LF	27.10	7.61	—	34.71
2½"	P1@.240	LF	39.70	8.70	—	48.40
3"	P1@.270	LF	49.80	9.78	—	59.58
4"	P1@.312	LF	73.40	11.30	—	84.70

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Type M copper pipe with soft-soldered joints, installed risers. Complete installation including a wrought copper reducing tee every floor and a riser clamp every other floor.						
½"	P1@.060	LF	1.71	2.17	—	3.88
¾"	P1@.070	LF	2.77	2.54	—	5.31
1"	P1@.075	LF	5.42	2.72	—	8.14
1¼"	P1@.080	LF	8.00	2.90	—	10.90
1½"	P1@.100	LF	10.50	3.62	—	14.12
2"	P1@.130	LF	14.00	4.71	—	18.71
2½"	P1@.150	LF	30.40	5.44	—	35.84
3"	P1@.170	LF	37.20	6.16	—	43.36
4"	P1@.190	LF	55.30	6.89	—	62.19



Type M copper pipe with soft-soldered joints, pipe only						
½"	P1@.032	LF	1.21	1.16	—	2.37
¾"	P1@.035	LF	1.98	1.27	—	3.25
1"	P1@.038	LF	3.10	1.38	—	4.48
1¼"	P1@.042	LF	4.65	1.52	—	6.17
1½"	P1@.046	LF	6.51	1.67	—	8.18
2"	P1@.053	LF	12.00	1.92	—	13.92
2½"	P1@.060	LF	16.60	2.17	—	18.77
3"	P1@.066	LF	20.80	2.39	—	23.19
4"	P1@.080	LF	33.40	2.90	—	36.30

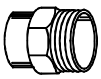
Type M copper 45-degree ell C x C with soft-soldered joints						
½"	P1@.107	Ea	1.01	3.88	—	4.89
¾"	P1@.150	Ea	1.73	5.44	—	7.17
1"	P1@.193	Ea	5.65	6.99	—	12.64
1¼"	P1@.236	Ea	6.37	8.55	—	14.92
1½"	P1@.278	Ea	11.40	10.10	—	21.50
2"	P1@.371	Ea	18.00	13.40	—	31.40
2½"	P1@.457	Ea	46.00	16.60	—	62.60
3"	P1@.543	Ea	60.90	19.70	—	80.60
4"	P1@.714	Ea	117.00	25.90	—	142.90

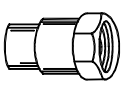
Type M copper 90-degree ell C x C with soft-soldered joints						
½"	P1@.107	Ea	.54	3.88	—	4.42
¾"	P1@.150	Ea	1.13	5.44	—	6.57
1"	P1@.193	Ea	4.30	6.99	—	11.29
1¼"	P1@.236	Ea	6.97	8.55	—	15.52
1½"	P1@.278	Ea	10.50	10.10	—	20.60
2"	P1@.371	Ea	18.30	13.40	—	31.70
2½"	P1@.457	Ea	38.10	16.60	—	54.70
3"	P1@.543	Ea	48.20	19.70	—	67.90
4"	P1@.714	Ea	102.00	25.90	—	127.90

Copper, Type M with Soft-Soldered Joints

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Type M copper 90-degree ell ftg. x C with soft-soldered joint						
½"	P1@.107	Ea	.94	3.88	—	4.82
¾"	P1@.150	Ea	2.04	5.44	—	7.48
1"	P1@.193	Ea	6.11	6.99	—	13.10
1¼"	P1@.236	Ea	8.50	8.55	—	17.05
1½"	P1@.278	Ea	12.60	10.10	—	22.70
2"	P1@.371	Ea	24.80	13.40	—	38.20
2½"	P1@.457	Ea	51.80	16.60	—	68.40
3"	P1@.543	Ea	58.30	19.70	—	78.00
4"	P1@.714	Ea	117.00	25.90	—	142.90
Type M copper tee C x C x C with soft-soldered joints						
½"	P1@.129	Ea	.91	4.67	—	5.58
¾"	P1@.181	Ea	2.45	6.56	—	9.01
1"	P1@.233	Ea	10.10	8.44	—	18.54
1¼"	P1@.285	Ea	16.10	10.30	—	26.40
1½"	P1@.337	Ea	23.50	12.20	—	35.70
2"	P1@.449	Ea	36.30	16.30	—	52.60
2½"	P1@.552	Ea	73.60	20.00	—	93.60
3"	P1@.656	Ea	114.00	23.80	—	137.80
4"	P1@.863	Ea	142.00	31.30	—	173.30
Type M copper branch reducing tee C x C x C with soft-soldered joints						
½" x 3/8"	P1@.129	Ea	2.02	4.67	—	6.69
¾" x ½"	P1@.182	Ea	4.29	6.60	—	10.89
1" x ½"	P1@.195	Ea	8.41	7.07	—	15.48
1" x ¾"	P1@.219	Ea	8.41	7.94	—	16.35
1¼" x ½"	P1@.225	Ea	12.70	8.15	—	20.85
1¼" x ¾"	P1@.247	Ea	12.70	8.95	—	21.65
1¼" x 1"	P1@.268	Ea	12.70	9.71	—	22.41
1½" x ½"	P1@.272	Ea	15.70	9.86	—	25.56
1½" x ¾"	P1@.287	Ea	15.70	10.40	—	26.10
1½" x 1"	P1@.302	Ea	15.70	10.90	—	26.60
1½" x 1¼"	P1@.317	Ea	15.70	11.50	—	27.20
2" x ½"	P1@.325	Ea	20.40	11.80	—	32.20
2" x ¾"	P1@.348	Ea	20.40	12.60	—	33.00
2" x 1"	P1@.373	Ea	20.40	13.50	—	33.90
2" x 1¼"	P1@.398	Ea	20.40	14.40	—	34.80
2" x 1½"	P1@.422	Ea	20.40	15.30	—	35.70
2½" x ½"	P1@.437	Ea	61.40	15.80	—	77.20
2½" x ¾"	P1@.453	Ea	61.40	16.40	—	77.80
2½" x 1"	P1@.469	Ea	61.40	17.00	—	78.40
2½" x 1½"	P1@.502	Ea	61.40	18.20	—	79.60
2½" x 2"	P1@.519	Ea	61.40	18.80	—	80.20
3" x 1¼"	P1@.525	Ea	69.40	19.00	—	88.40
3" x 2"	P1@.585	Ea	71.90	21.20	—	93.10
3" x 2½"	P1@.617	Ea	71.90	22.40	—	94.30
4" x 1¼"	P1@.625	Ea	125.00	22.70	—	147.70
4" x 1½"	P1@.671	Ea	125.00	24.30	—	149.30
4" x 2"	P1@.718	Ea	125.00	26.00	—	151.00
4" x 2½"	P1@.765	Ea	125.00	27.70	—	152.70
4" x 3"	P1@.811	Ea	125.00	29.40	—	154.40

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Type M copper reducer with soft-soldered joints						
½" x 3/8"	P1@.124	Ea	.73	4.49	—	5.22
¾" x ½"	P1@.129	Ea	1.37	4.67	—	6.04
1" x ¾"	P1@.172	Ea	2.46	6.23	—	8.69
1¼" x ½"	P1@.172	Ea	4.13	6.23	—	10.36
1¼" x ¾"	P1@.193	Ea	4.13	6.99	—	11.12
1¼" x 1"	P1@.215	Ea	4.13	7.79	—	11.92
1½" x ½"	P1@.193	Ea	6.32	6.99	—	13.31
1½" x ¾"	P1@.214	Ea	6.32	7.76	—	14.08
1½" x 1"	P1@.236	Ea	6.32	8.55	—	14.87
1½" x 1¼"	P1@.257	Ea	6.32	9.31	—	15.63
2" x ½"	P1@.239	Ea	9.50	8.66	—	18.16
2" x ¾"	P1@.261	Ea	9.50	9.46	—	18.96
2" x 1"	P1@.282	Ea	9.50	10.20	—	19.70
2" x 1¼"	P1@.304	Ea	9.50	11.00	—	20.50
2" x 1½"	P1@.325	Ea	9.50	11.80	—	21.30
2½" x 1"	P1@.325	Ea	25.90	11.80	—	37.70
2½" x 1¼"	P1@.347	Ea	25.90	12.60	—	38.50
2½" x 1½"	P1@.368	Ea	25.90	13.30	—	39.20
2½" x 2"	P1@.414	Ea	25.90	15.00	—	40.90
3" x 2"	P1@.457	Ea	30.20	16.60	—	46.80
3" x 2½"	P1@.500	Ea	30.20	18.10	—	48.30
4" x 2"	P1@.543	Ea	58.30	19.70	—	78.00
4" x 2½"	P1@.586	Ea	58.30	21.20	—	79.50
4" x 3"	P1@.629	Ea	58.30	22.80	—	81.10
Type M copper adapter C x MPT with soft-soldered joint						
½"	P1@.075	Ea	1.79	2.72	—	4.51
¾"	P1@.105	Ea	2.81	3.81	—	6.62
1"	P1@.134	Ea	6.97	4.86	—	11.83
1¼"	P1@.164	Ea	13.00	5.94	—	18.94
1½"	P1@.194	Ea	14.60	7.03	—	21.63
2"	P1@.259	Ea	18.30	9.39	—	27.69
2½"	P1@.319	Ea	59.30	11.60	—	70.90
3"	P1@.378	Ea	98.40	13.70	—	112.10
Type M copper adapter C x FPT with soft-soldered joint						
½"	P1@.075	Ea	2.99	2.72	—	5.71
¾"	P1@.105	Ea	5.41	3.81	—	9.22
1"	P1@.134	Ea	8.18	4.86	—	13.04
1¼"	P1@.164	Ea	17.20	5.94	—	23.14
1½"	P1@.194	Ea	20.70	7.03	—	27.73
2"	P1@.259	Ea	30.90	9.39	—	40.29
2½"	P1@.319	Ea	77.90	11.60	—	89.50
3"	P1@.378	Ea	107.00	13.70	—	120.70

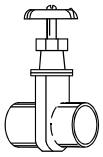


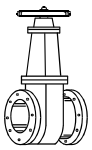


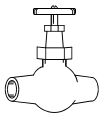
Copper, Type M with Soft-Soldered Joints

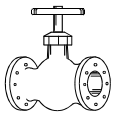
Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Type M copper flush bushing with soft-soldered joints						
½" x 3/8"	P1@.124	Ea	1.82	4.49	—	6.31
¾" x ½"	P1@.129	Ea	3.10	4.67	—	7.77
1" x ¾"	P1@.172	Ea	8.04	6.23	—	14.27
1" x ½"	P1@.172	Ea	9.17	6.23	—	15.40
1¼" x 1"	P1@.215	Ea	9.53	7.79	—	17.32
1½" x 1¼"	P1@.257	Ea	12.10	9.31	—	21.41
2" x 1½"	P1@.325	Ea	22.10	11.80	—	33.90
Type M copper union with soft-soldered joint						
½"	P1@.121	Ea	7.29	4.39	—	11.68
¾"	P1@.170	Ea	8.71	6.16	—	14.87
1"	P1@.218	Ea	19.50	7.90	—	27.40
1¼"	P1@.267	Ea	35.50	9.68	—	45.18
1½"	P1@.315	Ea	43.60	11.40	—	55.00
2"	P1@.421	Ea	63.00	15.30	—	78.30
Type M copper dielectric union with soft-soldered joint						
½"	P1@.121	Ea	6.83	4.39	—	11.22
¾"	P1@.170	Ea	6.83	6.16	—	12.99
1"	P1@.218	Ea	14.10	7.90	—	22.00
1¼"	P1@.267	Ea	24.10	9.68	—	33.78
1½"	P1@.315	Ea	33.20	11.40	—	44.60
2"	P1@.421	Ea	44.30	15.30	—	59.60
Type M copper cap with soft-soldered joint						
½"	P1@.069	Ea	.60	2.50	—	3.10
¾"	P1@.096	Ea	1.21	3.48	—	4.69
1"	P1@.124	Ea	2.74	4.49	—	7.23
1¼"	P1@.151	Ea	3.94	5.47	—	9.41
1½"	P1@.178	Ea	5.74	6.45	—	12.19
2"	P1@.237	Ea	10.00	8.59	—	18.59
2½"	P1@.292	Ea	25.40	10.60	—	36.00
3"	P1@.347	Ea	39.70	12.60	—	52.30
4"	P1@.457	Ea	61.00	16.60	—	77.60
Type M copper coupling with soft-soldered joints						
½"	P1@.107	Ea	.38	3.88	—	4.26
¾"	P1@.150	Ea	.96	5.44	—	6.40
1"	P1@.193	Ea	2.60	6.99	—	9.59
1¼"	P1@.236	Ea	4.54	8.55	—	13.09
1½"	P1@.278	Ea	6.56	10.10	—	16.66
2"	P1@.371	Ea	9.65	13.40	—	23.05
2½"	P1@.457	Ea	22.80	16.60	—	39.40
3"	P1@.543	Ea	34.70	19.70	—	54.40
4"	P1@.714	Ea	68.00	25.90	—	93.90

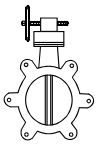
Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Class 125 bronze body gate valve with soft-soldered joints						
½"	P1@.200	Ea	18.10	7.25	—	25.35
¾"	P1@.249	Ea	22.60	9.02	—	31.62
1"	P1@.299	Ea	31.80	10.80	—	42.60
1¼"	P1@.398	Ea	40.00	14.40	—	54.40
1½"	P1@.448	Ea	53.90	16.20	—	70.10
2"	P1@.498	Ea	90.20	18.00	—	108.20
2½"	P1@.830	Ea	149.00	30.10	—	179.10
3"	P1@1.24	Ea	214.00	44.90	—	258.90
Class 125 iron body gate valve with flanged ends						
2"	P1@.500	Ea	345.00	18.10	—	363.10
2½"	P1@.600	Ea	466.00	21.70	—	487.70
3"	P1@.750	Ea	505.00	27.20	—	532.20
4"	P1@1.35	Ea	741.00	48.90	—	789.90
5"	P1@2.00	Ea	1,410.00	72.50	—	1,482.50
6"	P1@2.50	Ea	1,410.00	90.60	—	1,500.60
Class 125 bronze body globe valve with soft-soldered joints						
½"	P1@.200	Ea	33.50	7.25	—	40.75
¾"	P1@.249	Ea	44.60	9.02	—	53.62
1"	P1@.299	Ea	76.80	10.80	—	87.60
1¼"	P1@.398	Ea	108.00	14.40	—	122.40
1½"	P1@.448	Ea	146.00	16.20	—	162.20
2"	P1@.498	Ea	237.00	18.00	—	255.00
Class 125 iron body globe valve with flanged ends						
2½"	P1@.600	Ea	391.00	21.70	—	412.70
3"	P1@.750	Ea	469.00	27.20	—	496.20
4"	P1@1.35	Ea	629.00	48.90	—	677.90
200 PSIG iron body butterfly valve, lug-type, lever operated						
2"	P1@.450	Ea	152.00	16.30	—	168.30
2½"	P1@.450	Ea	157.00	16.30	—	173.30
3"	P1@.550	Ea	165.00	19.90	—	184.90
4"	P1@.550	Ea	206.00	19.90	—	225.90
200 PSIG iron body butterfly valve, wafer-type, lever operated						
2"	P1@.450	Ea	138.00	16.30	—	154.30
2½"	P1@.450	Ea	141.00	16.30	—	157.30
3"	P1@.550	Ea	152.00	19.90	—	171.90
4"	P1@.550	Ea	184.00	19.90	—	203.90

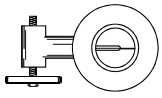








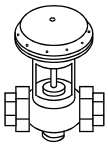


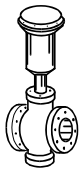


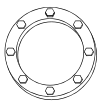
Copper, Type M with Soft-Soldered Joints

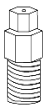
Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Class 125 bronze body 2-piece ball valve with soft-soldered joints						
½"	P1@.200	Ea	9.24	7.25	—	16.49
¾"	P1@.249	Ea	12.20	9.02	—	21.22
1"	P1@.299	Ea	21.30	10.80	—	32.10
1¼"	P1@.398	Ea	35.40	14.40	—	49.80
1½"	P1@.448	Ea	47.80	16.20	—	64.00
2"	P1@.498	Ea	60.70	18.00	—	78.70
3"	P1@1.24	Ea	415.00	44.90	—	459.90
4"	P1@1.45	Ea	543.00	52.50	—	595.50
Class 125 bronze body swing check valve with soft-soldered joints						
½"	P1@.200	Ea	19.40	7.25	—	26.65
¾"	P1@.249	Ea	27.80	9.02	—	36.82
1"	P1@.299	Ea	36.30	10.80	—	47.10
1¼"	P1@.398	Ea	51.80	14.40	—	66.20
1½"	P1@.448	Ea	73.00	16.20	—	89.20
2"	P1@.498	Ea	121.00	18.00	—	139.00
2½"	P1@.830	Ea	244.00	30.10	—	274.10
3"	P1@1.24	Ea	350.00	44.90	—	394.90
Class 125 iron body swing check valve, flanged ends						
2"	P1@.500	Ea	170.00	18.10	—	188.10
2½"	P1@.600	Ea	215.00	21.70	—	236.70
3"	P1@.750	Ea	268.00	27.20	—	295.20
4"	P1@1.35	Ea	394.00	48.90	—	442.90
Class 125 iron body silent check valve, wafer-type						
2"	P1@.500	Ea	124.00	18.10	—	142.10
2½"	P1@.600	Ea	138.00	21.70	—	159.70
3"	P1@.750	Ea	159.00	27.20	—	186.20
4"	P1@1.35	Ea	212.00	48.90	—	260.90
Class 125 bronze body strainer, threaded ends						
½"	P1@.230	Ea	29.80	8.34	—	38.14
¾"	P1@.260	Ea	39.30	9.42	—	48.72
1"	P1@.330	Ea	48.10	12.00	—	60.10
1¼"	P1@.440	Ea	67.30	15.90	—	83.20
1½"	P1@.495	Ea	101.00	17.90	—	118.90
2"	P1@.550	Ea	176.00	19.90	—	195.90
Class 125 iron body strainer, flanged ends						
2"	P1@.500	Ea	134.00	18.10	—	152.10
2½"	P1@.600	Ea	150.00	21.70	—	171.70
3"	P1@.750	Ea	174.00	27.20	—	201.20
4"	P1@1.35	Ea	294.00	48.90	—	342.90

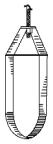
Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Installation of 2-way control valve, threaded joints						
½"	P1@.210	Ea	—	7.61	—	7.61
¾"	P1@.275	Ea	—	9.97	—	9.97
1"	P1@.350	Ea	—	12.70	—	12.70
1¼"	P1@.430	Ea	—	15.60	—	15.60
1½"	P1@.505	Ea	—	18.30	—	18.30
2"	P1@.675	Ea	—	24.50	—	24.50
2½"	P1@.830	Ea	—	30.10	—	30.10
3"	P1@.990	Ea	—	35.90	—	35.90
Installation of 3-way control valve, threaded joints						
½"	P1@.260	Ea	—	9.42	—	9.42
¾"	P1@.365	Ea	—	13.20	—	13.20
1"	P1@.475	Ea	—	17.20	—	17.20
1¼"	P1@.575	Ea	—	20.80	—	20.80
1½"	P1@.680	Ea	—	24.60	—	24.60
2"	P1@.910	Ea	—	33.00	—	33.00
2½"	P1@1.12	Ea	—	40.60	—	40.60
3"	P1@1.33	Ea	—	48.20	—	48.20
Companion flange, 150 pound cast brass						
2"	P1@.290	Ea	387.00	10.50	—	397.50
2½"	P1@.380	Ea	474.00	13.80	—	487.80
3"	P1@.460	Ea	474.00	16.70	—	490.70
4"	P1@.600	Ea	757.00	21.70	—	778.70
Bolt and gasket sets						
2"	P1@.500	Ea	4.23	18.10	—	22.33
2½"	P1@.650	Ea	4.71	23.60	—	28.31
3"	P1@.750	Ea	8.00	27.20	—	35.20
4"	P1@1.00	Ea	13.30	36.20	—	49.50
Thermometer with well						
7"	P1@.250	Ea	171.00	9.06	—	180.06
9"	P1@.250	Ea	176.00	9.06	—	185.06
Dial-type pressure gauge						
2½"	P1@.200	Ea	35.70	7.25	—	42.95
3½"	P1@.200	Ea	47.10	7.25	—	54.35
Pressure/temperature tap						
Tap	P1@.150	Ea	16.40	5.44	—	21.84





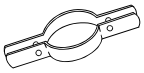






Hanger with swivel assembly

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
½"	P1@.250	Ea	3.84	9.06	—	12.90
¾"	P1@.250	Ea	4.25	9.06	—	13.31
1"	P1@.250	Ea	4.45	9.06	—	13.51
1¼"	P1@.300	Ea	4.56	10.90	—	15.46
1½"	P1@.300	Ea	4.90	10.90	—	15.80
2"	P1@.300	Ea	5.12	10.90	—	16.02
2½"	P1@.350	Ea	6.96	12.70	—	19.66
3"	P1@.350	Ea	8.61	12.70	—	21.31
4"	P1@.350	Ea	9.44	12.70	—	22.14



Riser clamp

½"	P1@.100	Ea	2.48	3.62	—	6.10
¾"	P1@.100	Ea	3.65	3.62	—	7.27
1"	P1@.100	Ea	3.69	3.62	—	7.31
1¼"	P1@.105	Ea	4.45	3.81	—	8.26
1½"	P1@.110	Ea	4.70	3.99	—	8.69
2"	P1@.115	Ea	4.97	4.17	—	9.14
2½"	P1@.120	Ea	5.24	4.35	—	9.59
3"	P1@.120	Ea	5.67	4.35	—	10.02
4"	P1@.125	Ea	7.22	4.53	—	11.75

Hard drawn rigid copper roll-grooved pipe with factory grooved copper fittings is commonly used for domestic or potable water distribution systems.

Maximum operating pressure for fittings is 300 psi (2065kPa). Operating temperature for fittings ranges from −30 F. to 250 F. (−34 C. – 121 C.).

Consult manufacturer for pipe pressure and temperature ratings and for the various combinations of pipe, fittings and system applications.

The cost estimates in this section are based on the conditions, limitations and wage rates described in the section “How to Use This Book” beginning on page 5.

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Type K Copper pipe only, roll-grooved, no hangers or fittings						
2"	P1@.080	LF	15.80	2.90	—	18.70
2½"	P1@.090	LF	23.00	3.26	—	26.26
3"	P1@.105	LF	31.20	3.81	—	35.01
4"	P1@.145	LF	48.70	5.25	—	53.95
6"	P1@.195	LF	74.50	7.07	—	81.57
Type L Copper pipe only, roll-grooved, no hangers or fittings						
2"	P1@.070	LF	14.30	2.54	—	16.84
2½"	P1@.070	LF	20.70	2.54	—	23.24
3"	P1@.090	LF	28.00	3.26	—	31.26
4"	P1@.130	LF	43.70	4.71	—	48.41
6"	P1@.180	LF	67.00	6.52	—	73.52
90-degree copper elbow, roll-grooved, style #610, (Victaulic)						
2"	P1@.410	Ea	84.90	14.90	—	99.80
2½"	P1@.430	Ea	93.40	15.60	—	109.00
3"	P1@.500	Ea	131.00	18.10	—	149.10
4"	P1@.690	Ea	281.00	25.00	—	306.00
6"	P1@1.19	Ea	1,660.00	43.10	—	1,703.10
45-degree copper elbow, roll-grooved, style #611, (Victaulic)						
2"	P1@.410	Ea	74.70	14.90	—	89.60
2½"	P1@.430	Ea	81.30	15.60	—	96.90
3"	P1@.500	Ea	111.00	18.10	—	129.10
4"	P1@.690	Ea	257.00	25.00	—	282.00
6"	P1@1.19	Ea	1,410.00	43.10	—	1,453.10
Tee, copper, roll-grooved, style #620, (Victaulic)						
2"	P1@.510	Ea	144.00	18.50	—	162.50
2½"	P1@.540	Ea	153.00	19.60	—	172.60
3"	P1@.630	Ea	230.00	22.80	—	252.80
4"	P1@.860	Ea	509.00	31.20	—	540.20
6"	P1@1.49	Ea	1,890.00	54.00	—	1,944.00

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Reducing tee, copper, roll-grooved, style #625, (Victaulic)						
2½" x 2"	P1@.540	Ea	236.00	19.60	—	255.60
3" x 2½"	P1@.630	Ea	253.00	22.80	—	275.80
4" x 3"	P1@.860	Ea	593.00	31.20	—	624.20
Reducing tee, copper, roll-grooved, style #626, (Victaulic)						
2½" x 1"	P1@.500	Ea	299.00	18.10	—	317.10
2½" x 1½"	P1@.520	Ea	299.00	18.80	—	317.80
3" x 1½"	P1@.600	Ea	316.00	21.70	—	337.70
Reducer, copper, roll-grooved, style #650, (Victaulic)						
2½" x 2"	P1@.430	Ea	126.00	15.60	—	141.60
3" x 2"	P1@.500	Ea	126.00	18.10	—	144.10
3" x 2½"	P1@.520	Ea	126.00	18.80	—	144.80
4" x 2"	P1@.690	Ea	248.00	25.00	—	273.00
4" x 3"	P1@.720	Ea	248.00	26.10	—	274.10
6" x 3"	P1@1.20	Ea	860.00	43.50	—	903.50
Roll-grooved copper coupling with gasket, style #650, (Victaulic)						
2"	P1@.300	Ea	41.70	10.90	—	52.60
2½"	P1@.350	Ea	47.10	12.70	—	59.80
3"	P1@.400	Ea	50.90	14.50	—	65.40
4"	P1@.500	Ea	65.50	18.10	—	83.60
5"	P1@.600	Ea	132.00	21.70	—	153.70
6"	P1@.700	Ea	151.00	25.40	—	176.40
8"	P1@.900	Ea	234.00	32.60	—	266.60
10"	P1@1.10	Ea	346.00	39.90	—	385.90
12"	P1@1.35	Ea	518.00	48.90	—	566.90
Flange adapter, copper, roll-grooved, style #641, (Victaulic)						
2½"	P1@.300	Ea	250.00	10.90	—	260.90
3"	P1@.400	Ea	267.00	14.50	—	281.50
4"	P1@.550	Ea	367.00	19.90	—	386.90
Butterfly valve, brass, roll-grooved, lever handle, style #608, (Victaulic)						
2½"	P1@.450	Ea	856.00	16.30	—	872.30
3"	P1@.450	Ea	1,100.00	16.30	—	1,116.30
4"	P1@.550	Ea	1,480.00	19.90	—	1,499.90

PVC (Polyvinyl Chloride) Schedule 40 pipe with Schedule 40 socket-type fittings and solvent-welded joints is widely used in process, chemical, A.C. condensate, potable water and irrigation piping systems. PVC is available in Type I (normal impact) and Type II (high impact). Type I has a maximum temperature rating of 150 degrees F., and Type II is rated at 140 degrees F.

Consult the manufacturers for maximum pressure ratings and recommended joint solvents for specific applications.

Because of the current unreliability of many plastic valves, most engineers specify standard bronze-body and iron-body valves for use in PVC water piping systems. Plastic valves, however, have to be used in systems conveying liquids that may be injurious to metallic valves.

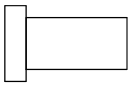
This section has been arranged to save the estimator's time by including all normally-used system components such as pipe, fittings, valves, hanger assemblies, riser clamps and miscellaneous items under one heading. Additional items can be found under "Plumbing and Piping Specialties." The cost estimates in this section are based on the conditions, limitations and wage rates described in the section "How to Use This Book" beginning on page 5.

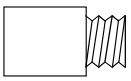
Equipment cost, where shown, is $110 per hour for a 10-ton hydraulic truck-mounted crane.

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Schedule 40 PVC pipe assembly with solvent-weld joints installed horizontally. Complete installation including three to eight tees and three to eight elbows every 100' and hangers spaced to meet plumbing code *(a tee and elbow every 12' for 1/2" dia., a tee and elbow every 40' for 8" dia.)*.						
½"	P1@.084	LF	1.55	3.04	—	4.59
¾"	P1@.091	LF	1.86	3.30	—	5.16
1"	P1@.099	LF	1.94	3.59	—	5.53
1¼"	P1@.114	LF	2.03	4.13	—	6.16
1½"	P1@.121	LF	2.31	4.39	—	6.70
2"	P1@.130	LF	2.84	4.71	—	7.55
2½"	P1@.134	LF	4.60	4.86	—	9.46
3"	P1@.146	LF	7.21	5.29	—	12.50
4"	P1@.177	LF	9.14	6.41	—	15.55
6"	P1@.231	LF	15.30	8.37	—	23.67
8"	P1@.236	LF	27.10	8.55	—	35.65
Schedule 40 PVC pipe assembly with solvent-weld joints, installed risers. Complete installation including a reducing tee every floor and a riser clamp every other.						
½"	P1@.040	LF	.75	1.45	—	2.20
¾"	P1@.047	LF	.99	1.70	—	2.69
1"	P1@.052	LF	1.25	1.88	—	3.13
1¼"	P1@.061	LF	1.58	2.21	—	3.79
1½"	P1@.069	LF	1.94	2.50	—	4.44
2"	P1@.077	LF	2.55	2.79	—	5.34
2½"	P1@.088	LF	4.05	3.19	—	7.24
3"	P1@.099	LF	6.15	3.59	—	9.74
4"	P1@.125	LF	7.91	4.53	—	12.44
6"	P1@.202	LF	16.60	7.32	—	23.92
8"	P1@.266	LF	30.60	9.64	—	40.24

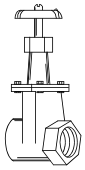
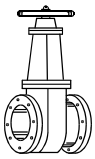
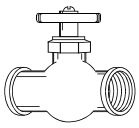
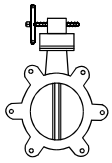
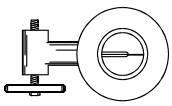
PVC, Schedule 80, with Solvent-Weld Joints

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Schedule 80 PVC reducing bushing SPIG x S with solvent-weld joints						
¾" x ½"	P1@.053	Ea	.91	1.92	—	2.83
1" x ½"	P1@.063	Ea	2.59	2.28	—	4.87
1" x ¾"	P1@.063	Ea	2.59	2.28	—	4.87
1¼" x ½"	P1@.084	Ea	4.15	3.04	—	7.19
1¼" x ¾"	P1@.084	Ea	4.15	3.04	—	7.19
1¼" x 1"	P1@.084	Ea	4.15	3.04	—	7.19
1½" x ½"	P1@.105	Ea	5.51	3.81	—	9.32
1½" x ¾"	P1@.105	Ea	5.51	3.81	—	9.32
1½" x 1"	P1@.105	Ea	5.51	3.81	—	9.32
1½" x 1¼"	P1@.105	Ea	5.51	3.81	—	9.32
2" x 1"	P1@.116	Ea	7.89	4.20	—	12.09
2" x 1¼"	P1@.116	Ea	7.89	4.20	—	12.09
2" x 1½"	P1@.116	Ea	7.89	4.20	—	12.09
3" x 2"	P1@.158	Ea	21.80	5.73	—	27.53
4" x 2½"	P1@.210	Ea	30.00	7.61	—	37.61
4" x 3"	P1@.210	Ea	30.00	7.61	—	37.61
6" x 3"	P1@.315	Ea	41.80	11.40	—	53.20
6" x 4"	P1@.315	Ea	41.80	11.40	—	53.20
8" x 4"	P1@.420	Ea	101.00	15.20	—	116.20
8" x 6"	P1@.420	Ea	101.00	15.20	—	116.20
Schedule 80 PVC adapter MPT x S with solvent-weld joints						
½"	P1@.063	Ea	3.30	2.28	—	5.58
¾"	P1@.068	Ea	3.60	2.46	—	6.06
1"	P1@.074	Ea	6.19	2.68	—	8.87
1¼"	P1@.105	Ea	7.32	3.81	—	11.13
1½"	P1@.116	Ea	10.50	4.20	—	14.70
2"	P1@.126	Ea	15.10	4.57	—	19.67
2½"	P1@.158	Ea	17.50	5.73	—	23.23
3"	P1@.189	Ea	19.20	6.85	—	26.05
4"	P1@.252	Ea	33.90	9.13	—	43.03
5"	P1@.385	Ea	47.30	14.00	—	61.30
6"	P1@.435	Ea	109.00	15.80	—	124.80
Schedule 80 PVC adapter FPT x S with solvent-weld joints						
½"	P1@.116	Ea	2.65	4.20	—	6.85
¾"	P1@.126	Ea	3.92	4.57	—	8.49
1"	P1@.137	Ea	5.73	4.96	—	10.69
1¼"	P1@.179	Ea	9.29	6.49	—	15.78
1½"	P1@.221	Ea	11.30	8.01	—	19.31
2"	P1@.305	Ea	19.80	11.10	—	30.90
2½"	P1@.345	Ea	31.30	12.50	—	43.80
3"	P1@.490	Ea	35.10	17.80	—	52.90
4"	P1@.655	Ea	60.50	23.70	—	84.20
5"	P1@.920	Ea	98.40	33.30	—	131.70
6"	P1@1.10	Ea	120.00	39.90	—	159.90

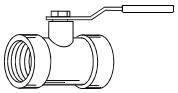




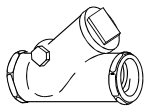
Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Schedule 80 PVC cap S with solvent-weld joints						
½"	P1@.063	Ea	2.76	2.28	—	5.04
¾"	P1@.070	Ea	2.86	2.54	—	5.40
1"	P1@.075	Ea	5.10	2.72	—	7.82
1¼"	P1@.105	Ea	6.19	3.81	—	10.00
1½"	P1@.115	Ea	6.19	4.17	—	10.36
2"	P1@.125	Ea	12.10	4.53	—	16.63
2½"	P1@.158	Ea	24.70	5.73	—	30.43
3"	P1@.189	Ea	29.30	6.85	—	36.15
4"	P1@.250	Ea	49.50	9.06	—	58.56
5"	P1@.390	Ea	102.00	14.10	—	116.10
6"	P1@.450	Ea	122.00	16.30	—	138.30
Schedule 80 PVC plug MPT with solvent-weld joints						
½"	P1@.155	Ea	2.68	5.62	—	8.30
¾"	P1@.165	Ea	2.76	5.98	—	8.74
1"	P1@.190	Ea	3.38	6.89	—	10.27
1¼"	P1@.220	Ea	4.97	7.97	—	12.94
1½"	P1@.240	Ea	6.00	8.70	—	14.70
2"	P1@.255	Ea	6.18	9.24	—	15.42
2½"	P1@.275	Ea	15.50	9.97	—	25.47
3"	P1@.320	Ea	20.10	11.60	—	31.70
4"	P1@.425	Ea	39.20	15.40	—	54.60
Schedule 80 PVC coupling S x S with solvent-weld joints						
½"	P1@.105	Ea	2.81	3.81	—	6.62
¾"	P1@.120	Ea	3.77	4.35	—	8.12
1"	P1@.125	Ea	3.91	4.53	—	8.44
1¼"	P1@.170	Ea	5.97	6.16	—	12.13
1½"	P1@.190	Ea	6.40	6.89	—	13.29
2"	P1@.210	Ea	6.85	7.61	—	14.46
2½"	P1@.262	Ea	16.80	9.49	—	26.29
3"	P1@.315	Ea	19.40	11.40	—	30.80
4"	P1@.520	Ea	24.50	18.80	—	43.30
6"	P1@.630	Ea	52.20	22.80	—	75.00
8"	P1@.840	Ea	71.90	30.40	—	102.30
Schedule 80 PVC union S x S with solvent-weld joints						
½"	P1@.125	Ea	5.65	4.53	—	10.18
¾"	P1@.140	Ea	7.77	5.07	—	12.84
1"	P1@.160	Ea	8.19	5.80	—	13.99
1¼"	P1@.200	Ea	16.30	7.25	—	23.55
1½"	P1@.225	Ea	18.50	8.15	—	26.65
2"	P1@.250	Ea	25.00	9.06	—	34.06
2½"	P1@.275	Ea	39.50	9.97	—	49.47
3"	P1@.300	Ea	46.60	10.90	—	57.50

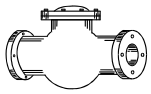
Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Class 125 bronze body gate valve, threaded ends						
						
½"	P1@.210	Ea	18.10	7.61	—	25.71
¾"	P1@.250	Ea	22.60	9.06	—	31.66
1"	P1@.300	Ea	31.80	10.90	—	42.70
1¼"	P1@.400	Ea	40.00	14.50	—	54.50
1½"	P1@.450	Ea	53.90	16.30	—	70.20
2"	P1@.500	Ea	90.20	18.10	—	108.30
2½"	P1@.750	Ea	149.00	27.20	—	176.20
3"	P1@.950	Ea	214.00	34.40	—	248.40
Class 125 iron body gate valve, flanged ends						
						
2"	P1@.500	Ea	345.00	18.10	—	363.10
2½"	P1@.600	Ea	466.00	21.70	—	487.70
3"	P1@.750	Ea	505.00	27.20	—	532.20
4"	P1@1.35	Ea	741.00	48.90	—	789.90
5"	ER@2.00	Ea	1,410.00	77.80	31.40	1,519.20
6"	ER@2.50	Ea	1,410.00	97.20	39.30	1,546.50
8"	ER@3.00	Ea	2,330.00	117.00	47.10	2,494.10
Class 125 bronze body globe valve, threaded ends						
						
½"	P1@.210	Ea	33.50	7.61	—	41.11
¾"	P1@.250	Ea	44.60	9.06	—	53.66
1"	P1@.300	Ea	63.90	10.90	—	74.80
1¼"	P1@.400	Ea	90.00	14.50	—	104.50
1½"	P1@.450	Ea	120.00	16.30	—	136.30
2"	P1@.500	Ea	196.00	18.10	—	214.10
200 PSIG iron body butterfly valve, lug-type, lever operated						
						
2"	P1@.450	Ea	152.00	16.30	—	168.30
2½"	P1@.450	Ea	157.00	16.30	—	173.30
3"	P1@.550	Ea	165.00	19.90	—	184.90
4"	P1@.550	Ea	206.00	19.90	—	225.90
5"	ER@.800	Ea	271.00	31.10	12.70	314.80
6"	ER@.800	Ea	331.00	31.10	12.70	374.80
8"	ER@.900	Ea	453.00	35.00	14.10	502.10
200 PSIG iron body butterfly valve, wafer-type, lever operated						
						
2"	P1@.450	Ea	138.00	16.30	—	154.30
2½"	P1@.450	Ea	141.00	16.30	—	157.30
3"	P1@.550	Ea	152.00	19.90	—	171.90
4"	P1@.550	Ea	184.00	19.90	—	203.90
5"	ER@.800	Ea	245.00	31.10	12.70	288.80
6"	ER@.800	Ea	307.00	31.10	12.70	350.80
8"	ER@.900	Ea	426.00	35.00	14.10	475.10

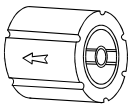
Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Class 125 bronze body 2-piece ball valve, threaded ends						
½"	P1@.210	Ea	9.27	7.61	—	16.88
¾"	P1@.250	Ea	12.20	9.06	—	21.26
1"	P1@.300	Ea	21.40	10.90	—	32.30
1¼"	P1@.400	Ea	35.60	14.50	—	50.10
1½"	P1@.450	Ea	48.00	16.30	—	64.30
2"	P1@.500	Ea	60.90	18.10	—	79.00
3"	P1@.625	Ea	416.00	22.70	—	438.70
4"	P1@.690	Ea	545.00	25.00	—	570.00
PVC ball valve, solid body, solvent-weld joints, EDPM (female socket)						
½"	P1@.170	Ea	5.60	6.16	—	11.76
¾"	P1@.200	Ea	6.33	7.25	—	13.58
1"	P1@.220	Ea	9.24	7.97	—	17.21
1¼"	P1@.280	Ea	10.60	10.10	—	20.70
1½"	P1@.315	Ea	17.80	11.40	—	29.20
2"	P1@.385	Ea	22.10	14.00	—	36.10
PVC ball valve, solid body, threaded joints, EDPM (female pipe thread)						
½"	P1@.200	Ea	5.60	7.25	—	12.85
¾"	P1@.240	Ea	6.33	8.70	—	15.03
1"	P1@.290	Ea	9.24	10.50	—	19.74
1¼"	P1@.390	Ea	10.60	14.10	—	24.70
1½"	P1@.420	Ea	17.80	15.20	—	33.00
2"	P1@.490	Ea	22.10	17.80	—	39.90
PVC ball valve, tru-union, threaded joints, EDPM (female pipe thread)						
2"	P1@.490	Ea	74.70	17.80	—	92.50
2½"	P1@.520	Ea	86.20	18.80	—	105.00
3"	P1@.590	Ea	199.00	21.40	—	220.40
4"	P1@.630	Ea	368.00	22.80	—	390.80
PVC ball valve, union-type body, solvent-weld joints (female socket)						
½"	P1@.185	Ea	5.60	6.70	—	12.30
¾"	P1@.225	Ea	6.33	8.15	—	14.48
1"	P1@.270	Ea	9.24	9.78	—	19.02
1¼"	P1@.360	Ea	10.60	13.00	—	23.60
1½"	P1@.400	Ea	17.80	14.50	—	32.30
2"	P1@.465	Ea	22.10	16.90	—	39.00
2½"	P1@.490	Ea	86.20	17.80	—	104.00
3"	P1@.540	Ea	199.00	19.60	—	218.60
4"	P1@.600	Ea	368.00	21.70	—	389.70

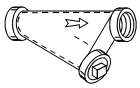


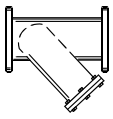
Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Class 125 bronze body swing check valve, threaded ends						
½"	P1@.210	Ea	19.40	7.61	—	27.01
¾"	P1@.250	Ea	27.80	9.06	—	36.86
1"	P1@.300	Ea	36.30	10.90	—	47.20
1¼"	P1@.400	Ea	51.80	14.50	—	66.30
1½"	P1@.450	Ea	73.00	16.30	—	89.30
2"	P1@.500	Ea	121.00	18.10	—	139.10
Class 125 iron body swing check valve, flanged ends						
2"	P1@.500	Ea	170.00	18.10	—	188.10
2½"	P1@.600	Ea	215.00	21.70	—	236.70
3"	P1@.750	Ea	268.00	27.20	—	295.20
4"	P1@1.35	Ea	394.00	48.90	—	442.90
5"	ER@2.00	Ea	758.00	77.80	31.40	867.20
6"	ER@2.50	Ea	758.00	97.20	39.30	894.50
8"	ER@3.00	Ea	1,370.00	117.00	47.10	1,534.10
Class 125 iron body silent check valve, wafer-type						
2"	P1@.500	Ea	124.00	18.10	—	142.10
2½"	P1@.600	Ea	138.00	21.70	—	159.70
3"	P1@.750	Ea	159.00	27.20	—	186.20
4"	P1@1.35	Ea	212.00	48.90	—	260.90
5"	ER@2.00	Ea	326.00	77.80	31.40	435.20
6"	ER@2.50	Ea	443.00	97.20	39.30	579.50
8"	ER@3.00	Ea	758.00	117.00	47.10	922.10
Class 125 bronze body strainer, threaded ends						
½"	P1@.210	Ea	29.80	7.61	—	37.41
¾"	P1@.250	Ea	39.30	9.06	—	48.36
1"	P1@.300	Ea	48.10	10.90	—	59.00
1¼"	P1@.400	Ea	67.30	14.50	—	81.80
1½"	P1@.450	Ea	101.00	16.30	—	117.30
2"	P1@.500	Ea	176.00	18.10	—	194.10
Class 125 iron body strainer, flanged ends						
2"	P1@.500	Ea	179.00	18.10	—	197.10
2½"	P1@.600	Ea	199.00	21.70	—	220.70
3"	P1@.750	Ea	230.00	27.20	—	257.20
4"	P1@1.35	Ea	393.00	48.90	—	441.90
5"	ER@2.00	Ea	797.00	77.80	31.40	906.20
6"	ER@2.50	Ea	797.00	97.20	39.30	933.50
8"	ER@3.00	Ea	1,350.00	117.00	47.10	1,514.10



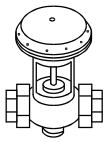


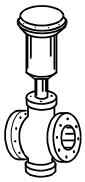


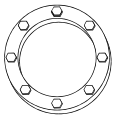


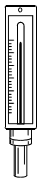


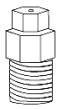
Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Installation of 2-way control valve, threaded joints						
½"	P1@.210	Ea	—	7.61	—	7.61
¾"	P1@.275	Ea	—	9.97	—	9.97
1"	P1@.350	Ea	—	12.70	—	12.70
1¼"	P1@.430	Ea	—	15.60	—	15.60
1½"	P1@.505	Ea	—	18.30	—	18.30
2"	P1@.675	Ea	—	24.50	—	24.50
2½"	P1@.830	Ea	—	30.10	—	30.10
3"	P1@.990	Ea	—	35.90	—	35.90
Installation of 3-way control valve, threaded joints						
½"	P1@.260	Ea	—	9.42	—	9.42
¾"	P1@.365	Ea	—	13.20	—	13.20
1"	P1@.475	Ea	—	17.20	—	17.20
1¼"	P1@.575	Ea	—	20.80	—	20.80
1½"	P1@.680	Ea	—	24.60	—	24.60
2"	P1@.910	Ea	—	33.00	—	33.00
2½"	P1@1.12	Ea	—	40.60	—	40.60
3"	P1@1.33	Ea	—	48.20	—	48.20
PVC companion flange						
2"	P1@.140	Ea	6.12	5.07	—	11.19
2½"	P1@.180	Ea	18.20	6.52	—	24.72
3"	P1@.210	Ea	19.00	7.61	—	26.61
4"	P1@.280	Ea	19.70	10.10	—	29.80
5"	P1@.310	Ea	43.60	11.20	—	54.80
6"	P1@.420	Ea	43.60	15.20	—	58.80
8"	P1@.560	Ea	65.20	20.30	—	85.50
Bolt and gasket set						
2"	P1@.500	Ea	4.00	18.10	—	22.10
2½"	P1@.650	Ea	4.68	23.60	—	28.28
3"	P1@.750	Ea	7.91	27.20	—	35.11
4"	P1@1.00	Ea	13.20	36.20	—	49.40
5"	P1@1.10	Ea	22.00	39.90	—	61.90
6"	P1@1.20	Ea	22.00	43.50	—	65.50
8"	P1@1.25	Ea	24.60	45.30	—	69.90
Thermometer with well						
7"	P1@.250	Ea	171.00	9.06	—	180.06
9"	P1@.250	Ea	176.00	9.06	—	185.06
Dial-type pressure gauge						
2½"	P1@.200	Ea	35.70	7.25	—	42.95
3½"	P1@.200	Ea	47.10	7.25	—	54.35





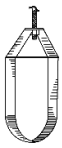






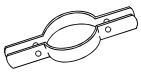
Pressure/temperature tap

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Tap	P1@.150	Ea	16.40	5.44	—	21.84



Hanger with swivel assembly

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
½"	P1@.250	Ea	3.84	9.06	—	12.90
¾"	P1@.250	Ea	4.25	9.06	—	13.31
1"	P1@.250	Ea	4.45	9.06	—	13.51
1¼"	P1@.300	Ea	4.56	10.90	—	15.46
1½"	P1@.300	Ea	4.90	10.90	—	15.80
2"	P1@.300	Ea	5.12	10.90	—	16.02
2½"	P1@.350	Ea	6.96	12.70	—	19.66
3"	P1@.350	Ea	8.61	12.70	—	21.31
4"	P1@.350	Ea	9.44	12.70	—	22.14
5"	P1@.450	Ea	13.80	16.30	—	30.10
6"	P1@.450	Ea	15.50	16.30	—	31.80
8"	P1@.450	Ea	19.50	16.30	—	35.80



Riser clamp

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
½"	P1@.100	Ea	2.48	3.62	—	6.10
¾"	P1@.100	Ea	3.65	3.62	—	7.27
1"	P1@.100	Ea	3.69	3.62	—	7.31
1¼"	P1@.105	Ea	4.45	3.81	—	8.26
1½"	P1@.110	Ea	4.70	3.99	—	8.69
2"	P1@.115	Ea	4.97	4.17	—	9.14
2½"	P1@.120	Ea	5.24	4.35	—	9.59
3"	P1@.120	Ea	5.67	4.35	—	10.02
4"	P1@.125	Ea	7.22	4.53	—	11.75
5"	P1@.180	Ea	10.40	6.52	—	16.92
6"	P1@.200	Ea	12.50	7.25	—	19.75
8"	P1@.200	Ea	20.30	7.25	—	27.55

Polyethylene-Aluminum Pipe with Crimped Joints

Composite pressure pipe is aluminum tube laminated between 2 layers of plastic pipe. It is manufactured and sold in various coiled lengths (200' to 1,000' rolls). The jointing method can be either crimped or compression connections. It will not rust or corrode and, because of its flexibility, installations require approximately 40% less fittings. Expansion rates are similar to copper, but its thermal coefficient (heat loss) is over 800 times less than copper. It is also chemically resistant to most acids, salt solutions, alkalis, fats and oils.

Common applications include ice or snow melting systems, radiant floor heating systems, water service tubing, hot & cold domestic water service, chilled water systems, compressed air systems, solar and process piping applications.

Maximum temperature	Maximum pressure	Pipe selection
73 degrees F	200 psi	PE-AL or PEX-AL
140 degrees F	160 psi	PE-AL or PEX-AL
180 degrees F	125 psi	PEX-AL
210 degrees F	115 psi	PEX-AL

PE-AL is the designation for polyethylene-aluminum composite pipe
PEX-AL is the designation for cross linked polyethylene-aluminum composite pipe

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Cross linked Polyethylene-Aluminum pipe with crimped joints (PEX-AL), pipe only						
3/8"	P1@.028	LF	.46	1.01	—	1.47
1/2"	P1@.028	LF	.67	1.01	—	1.68
5/8"	P1@.030	LF	.94	1.09	—	2.03
3/4"	P1@.030	LF	1.33	1.09	—	2.42
1"	P1@.034	LF	2.14	1.23	—	3.37
Polyethylene-Aluminum pipe with crimped joints (PE-AL), pipe only						
1/2"	P1@.028	LF	.51	1.01	—	1.52
5/8"	P1@.030	LF	.71	1.09	—	1.80
3/4"	P1@.030	LF	.94	1.09	—	2.03
1"	P1@.034	LF	1.50	1.23	—	2.73
90-degree brass ell with crimped joints (PEX-AL/PE-AL)						
1/2"	P1@.080	Ea	1.45	2.90	—	4.35
5/8"	P1@.085	Ea	1.75	3.08	—	4.83
3/4"	P1@.090	Ea	3.38	3.26	—	6.64
1"	P1@.105	Ea	3.69	3.81	—	7.50
90-degree brass ell with crimped joints x male pipe thread (PEX-AL x MPT/PE-AL x MPT)						
1/2" x 1/2"	P1@.085	Ea	1.59	3.08	—	4.67
1/2" x 3/8"	P1@.095	Ea	2.01	3.44	—	5.45

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
90-degree brass ell with crimped joints x copper socket (PEX-AL x C/PE-AL x C)						
1/2"	P1@.085	Ea	1.59	3.08	—	4.67
1/2" x 3/4"	P1@.090	Ea	2.01	3.26	—	5.27
5/8" x 3/4"	P1@.095	Ea	2.17	3.44	—	5.61
3/4"	P1@.095	Ea	1.77	3.44	—	5.21
90-degree brass wingback ell with crimped joints x female pipe thread (PEX-AL x FPT/PE-AL x FPT)						
1/2"	P1@.085	Ea	3.10	3.08	—	6.18
3/4"	P1@.095	Ea	3.69	3.44	—	7.13
Tee (brass) with crimped joints (PEX-AL/PE-AL)						
1/2"	P1@.095	Ea	1.55	3.44	—	4.99
5/8"	P1@.105	Ea	1.82	3.81	—	5.63
3/4"	P1@.110	Ea	3.69	3.99	—	7.68
1"	P1@.120	Ea	4.51	4.35	—	8.86
Reducing tee (brass) with crimped joints (PEX-AL/PE-AL)						
1/2" x 1/2" x 5/8"	P1@.110	Ea	1.82	3.99	—	5.81
1/2" x 1/2" x 3/4"	P1@.115	Ea	2.13	4.17	—	6.30
5/8" x 1/2" x 1/2"	P1@.115	Ea	1.82	4.17	—	5.99
5/8" x 1/2" x 5/8"	P1@.115	Ea	1.82	4.17	—	5.99
5/8" x 5/8" x 1/2"	P1@.115	Ea	1.82	4.17	—	5.99
3/4" x 1/2" x 1/2"	P1@.115	Ea	2.13	4.17	—	6.30
3/4" x 1/2" x 3/4"	P1@.115	Ea	2.27	4.17	—	6.44
3/4" x 3/4" x 1/2"	P1@.115	Ea	2.27	4.17	—	6.44
3/4" x 3/4" x 5/8"	P1@.115	Ea	2.27	4.17	—	6.44
3/4" x 3/4" x 1"	P1@.120	Ea	4.37	4.35	—	8.72
1" x 1/2" x 1/2"	P1@.120	Ea	4.24	4.35	—	8.59
1" x 1/2" x 3/4"	P1@.120	Ea	3.95	4.35	—	8.30
1" x 1/2" x 1"	P1@.120	Ea	4.37	4.35	—	8.72
1" x 3/4" x 1/2"	P1@.120	Ea	4.37	4.35	—	8.72
1" x 3/4" x 3/4"	P1@.120	Ea	4.37	4.35	—	8.72
1" x 3/4" x 1"	P1@.120	Ea	4.37	4.35	—	8.72
1" x 1" x 1/2"	P1@.120	Ea	3.93	4.35	—	8.28
1" x 1" x 3/4"	P1@.120	Ea	4.51	4.35	—	8.86
Coupling (brass) with crimped joints (PEX-AL/PE-AL)						
1/2"	P1@.080	Ea	.71	2.90	—	3.61
5/8"	P1@.085	Ea	.90	3.08	—	3.98
3/4"	P1@.090	Ea	1.99	3.26	—	5.25
1"	P1@.105	Ea	2.03	3.81	—	5.84

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Reducing coupling (brass) with crimped joints (PEX-AL/PE-AL)						
1/2"	P1@.080	Ea	.90	2.90	—	3.80
5/8"	P1@.085	Ea	1.28	3.08	—	4.36
3/4"	P1@.090	Ea	1.36	3.26	—	4.62
1"	P1@.105	Ea	1.66	3.81	—	5.47
Adapter (brass) with crimped joints x male pipe thread (PEX-AL x MPT/PE-AL x MPT)						
1/2" x 1/2"	P1@.080	Ea	1.07	2.90	—	3.97
1/2" x 3/4"	P1@.085	Ea	1.36	3.08	—	4.44
5/8" x 3/4"	P1@.085	Ea	1.34	3.08	—	4.42
3/4" x 1/2"	P1@.090	Ea	1.82	3.26	—	5.08
3/4" x 3/4"	P1@.090	Ea	1.93	3.26	—	5.19
3/4" x 1"	P1@.105	Ea	3.10	3.81	—	6.91
1" x 1"	P1@.105	Ea	3.38	3.81	—	7.19
Adapter (brass) with crimped joints x female pipe thread (PEX-AL x FPT/PE-AL x FPT)						
1/2" x 1/2"	P1@.080	Ea	1.11	2.90	—	4.01
1/2" x 3/4"	P1@.085	Ea	1.55	3.08	—	4.63
5/8" x 3/4"	P1@.085	Ea	1.55	3.08	—	4.63
3/4" x 1/2"	P1@.090	Ea	1.82	3.26	—	5.08
3/4" x 3/4"	P1@.090	Ea	2.01	3.26	—	5.27
3/4" x 1"	P1@.105	Ea	3.35	3.81	—	7.16
1" x 1"	P1@.105	Ea	3.69	3.81	—	7.50
Adapter (brass) with crimped joints x copper fitting (spigot) (PEX-AL x C ftg/PE-AL x C ftg)						
1/2" x 1/2"	P1@.080	Ea	1.28	2.90	—	4.18
1/2" x 3/4"	P1@.085	Ea	1.57	3.08	—	4.65
5/8" x 3/4"	P1@.085	Ea	1.55	3.08	—	4.63
3/4" x 3/4"	P1@.090	Ea	3.10	3.26	—	6.36
1" x 1"	P1@.105	Ea	3.69	3.81	—	7.50
Adapter (brass) with crimped joints x copper socket (PEX-AL x C/PE-AL x C)						
1/2" x 1/2"	P1@.080	Ea	1.07	2.90	—	3.97
1/2" x 3/4"	P1@.085	Ea	1.58	3.08	—	4.66
5/8" x 3/4"	P1@.085	Ea	1.64	3.08	—	4.72
3/4" x 1/2"	P1@.090	Ea	1.76	3.26	—	5.02
3/4" x 3/4"	P1@.090	Ea	2.54	3.26	—	5.80
3/4" x 1"	P1@.105	Ea	3.69	3.81	—	7.50
1" x 1"	P1@.105	Ea	4.24	3.81	—	8.05

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Cap (brass) with crimped joints (PEX-AL/PE-AL)						
1/2"	P1@.060	Ea	.48	2.17	—	2.65
5/8"	P1@.065	Ea	.68	2.36	—	3.04
3/4"	P1@.070	Ea	.90	2.54	—	3.44
1"	P1@.085	Ea	1.11	3.08	—	4.19
Mini ball valve (brass) with crimped joints (PEX-AL/PE-AL)						
1/2" x 3/8" straight	P1@.150	Ea	6.46	5.44	—	11.90
1/2" x 3/8" angle	P1@.150	Ea	5.94	5.44	—	11.38
1/2" x copper	P1@.150	Ea	6.81	5.44	—	12.25
1/2" x MPT	P1@.150	Ea	7.18	5.44	—	12.62
1/2"	P1@.150	Ea	7.58	5.44	—	13.02
1/2" x comp	P1@.150	Ea	7.69	5.44	—	13.13
5/8"	P1@.165	Ea	10.80	5.98	—	16.78
5/8" x 3/4" copper	P1@.170	Ea	8.61	6.16	—	14.77
5/8" x 3/4" MPT	P1@.170	Ea	9.45	6.16	—	15.61
3/4"	P1@.170	Ea	11.60	6.16	—	17.76
3/4" x copper	P1@.170	Ea	10.90	6.16	—	17.06
Balancing valve (brass) with crimped joints (PEX-AL/PE-AL)						
1/2" x copper	P1@.150	Ea	41.50	5.44	—	46.94
1/2" x MPT	P1@.150	Ea	47.90	5.44	—	53.34
Manifolds (headers) copper with crimped joints (PEX-AL)						
3 - 1/2" outlets	P1@.750	Ea	33.20	27.20	—	60.40
3 - 5/8" outlets	P1@.750	Ea	37.60	27.20	—	64.80
4 - 1/2" outlets	P1@.850	Ea	42.70	30.80	—	73.50
4 - 5/8" outlets	P1@.850	Ea	49.30	30.80	—	80.10
5 - 1/2" outlets	P1@1.00	Ea	54.60	36.20	—	90.80
6 - 1/2" outlets	P1@1.20	Ea	62.00	43.50	—	105.50
8 - 1/2" outlets	P1@1.45	Ea	88.30	52.50	—	140.80
10 - 1/2" outlets	P1@1.65	Ea	114.00	59.80	—	173.80
12 - 1/2" outlets	P1@1.85	Ea	138.00	67.00	—	205.00
Manifolds (headers) copper with mini ball valves and crimped joints (PEX-AL)						
3 - 1/2" outlets	P1@.750	Ea	124.00	27.20	—	151.20
3 - 5/8" outlets	P1@.750	Ea	150.00	27.20	—	177.20
4 - 1/2" outlets	P1@.850	Ea	162.00	30.80	—	192.80
4 - 5/8" outlets	P1@.850	Ea	197.00	30.80	—	227.80
5 - 1/2" outlets	P1@1.00	Ea	206.00	36.20	—	242.20
6 - 1/2" outlets	P1@1.20	Ea	235.00	43.50	—	278.50

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Crimp rings, nickel-plated soft copper						
1/2"	—	Ea	.18	—	—	.18
5/8"	—	Ea	.19	—	—	.19
3/4"	—	Ea	.22	—	—	.22
1"	—	Ea	.33	—	—	.33
Replacement O-rings						
1/2"	—	Ea	.12	—	—	.12
5/8"	—	Ea	.12	—	—	.12
3/4"	—	Ea	.18	—	—	.18
1"	—	Ea	.18	—	—	.18
Pipe hangers (polypropylene)						
1/2"	P1@.050	Ea	.06	1.81	—	1.87
5/8"	P1@.050	Ea	.06	1.81	—	1.87
3/4"	P1@.050	Ea	.06	1.81	—	1.87
1"	P1@.050	Ea	.08	1.81	—	1.89
Pipe clips (nail clips)						
1/2"	P1@.030	Ea	.13	1.09	—	1.22
5/8"	P1@.030	Ea	.21	1.09	—	1.30
1"	P1@.030	Ea	.47	1.09	—	1.56
Miscellaneous tools						
Crimp tool	—	Ea	275.00	—	—	275.00
Beveling tool	—	Ea	5.60	—	—	5.60
Reaming tool	—	Ea	33.50	—	—	33.50
Pipe bender kit	—	Ea	494.00	—	—	494.00
Bending spring	—	Ea	41.40	—	—	41.40
Pipe cutter	—	Ea	20.10	—	—	20.10

Polyethylene-Aluminum Pipe with Compression Joints

Composite pressure pipe is aluminum tube laminated between 2 layers of plastic pipe. It is manufactured and sold in various coiled lengths (200' to 1000' rolls). The jointing method can be either crimped or compression connections. It will not rust or corrode and, because of its flexibility, installations require approximately 40% less fittings. Installed like soft copper, it can be supported every 8.2 feet where applicable. Expansion rates are similar to copper, but its thermal coefficient (heat loss) is over 800 times less than copper. It is also chemically resistant to most acids, salt solutions, alkalis, fats and oils.

Common applications include ice or snow melting systems, radiant floor heating systems, water service tubing, hot & cold domestic water service, chilled water systems, compressed air systems, solar and process piping applications.

Maximum temperature	Maximum pressure	Pipe selection
73 degrees F	200 psi	PE-AL or PEX-AL
140 degrees F	160 psi	PE-AL or PEX-AL
180 degrees F	125 psi	PEX-AL
210 degrees F	115 psi	PEX-AL

PE-AL is the designation for polyethylene-aluminum composite pipe
PEX-AL is the designation for cross linked polyethylene-aluminum composite pipe

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Cross linked Polyethylene-Aluminum pipe with compression joints (PEX-AL), pipe only						
3/8"	P1@.028	LF	.42	1.01	—	1.43
1/2"	P1@.028	LF	.62	1.01	—	1.63
5/8"	P1@.030	LF	.85	1.09	—	1.94
3/4"	P1@.030	LF	1.19	1.09	—	2.28
1"	P1@.034	LF	1.91	1.23	—	3.14
Polyethylene-Aluminum pipe with compression joints (PE-AL), pipe only						
1/2"	P1@.028	LF	.50	1.01	—	1.51
5/8"	P1@.030	LF	.67	1.09	—	1.76
3/4"	P1@.030	LF	.91	1.09	—	2.00
1"	P1@.034	LF	1.45	1.23	—	2.68
90-degree brass ell with compression joints (PEX-AL/PE-AL)						
1/2"	P1@.092	Ea	3.31	3.33	—	6.64
5/8"	P1@.098	Ea	4.60	3.55	—	8.15
3/4"	P1@.104	Ea	6.71	3.77	—	10.48
1"	P1@.121	Ea	11.80	4.39	—	16.19
90-degree brass ell with compression joints x male pipe thread (PEX-AL x MPT/PE-AL x MPT)						
½" x ½"	P1@.098	Ea	5.18	3.55	—	8.73
½" x ¾"	P1@.105	Ea	6.28	3.81	—	10.09
¾" x ¾"	P1@.109	Ea	5.78	3.95	—	9.73

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
90-degree brass ell with compression joints x copper socket (PEX-AL x C/PE-AL x C)						
1/2"	P1@.098	Ea	2.83	3.55	—	6.38
1/2" x 3/4"	P1@.109	Ea	3.00	3.95	—	6.95
5/8" x 3/4"	P1@.112	Ea	3.59	4.06	—	7.65
3/4"	P1@.115	Ea	5.43	4.17	—	9.60
90-degree brass wingback ell with compression joints x female pipe thread (PEX-AL x FPT/PE-AL x FPT)						
1/2"	P1@.098	Ea	2.45	3.55	—	6.00
5/8"	P1@.105	Ea	4.21	3.81	—	8.02
3/4"	P1@.115	Ea	6.45	4.17	—	10.62
Tee (brass) with compression joints (PEX-AL/PE-AL)						
1/2"	P1@.109	Ea	4.04	3.95	—	7.99
5/8"	P1@.121	Ea	6.50	4.39	—	10.89
3/4"	P1@.127	Ea	9.61	4.60	—	14.21
1"	P1@.141	Ea	15.90	5.11	—	21.01
Reducing tee (brass) with compression joints (PEX-AL/PE-AL)						
5/8" x 5/8" x 1/2"	P1@.138	Ea	5.95	5.00	—	10.95
3/4" x 1/2" x 3/4"	P1@.138	Ea	8.45	5.00	—	13.45
3/4" x 3/4" x 1/2"	P1@.138	Ea	8.64	5.00	—	13.64
3/4" x 1/2" x 3/4"	P1@.138	Ea	7.66	5.00	—	12.66
3/4" x 3/4" x 5/8"	P1@.138	Ea	8.75	5.00	—	13.75
1" x 1/2" x 1/2"	P1@.142	Ea	13.00	5.15	—	18.15
1" x 1" x 1/2"	P1@.142	Ea	17.50	5.15	—	22.65
1" x 3/4" x 3/4"	P1@.142	Ea	9.84	5.15	—	14.99
1" x 1" x 3/4"	P1@.142	Ea	15.20	5.15	—	20.35
Coupling (brass) with compression joints (PEX-AL/PE-AL)						
3/8"	P1@.090	Ea	2.80	3.26	—	6.06
1/2"	P1@.092	Ea	3.04	3.33	—	6.37
5/8"	P1@.098	Ea	4.15	3.55	—	7.70
3/4"	P1@.104	Ea	6.16	3.77	—	9.93
1"	P1@.121	Ea	11.00	4.39	—	15.39
Reducing coupling (brass) with compression joints (PEX-AL/PE-AL)						
5/8" x 1/2"	P1@.092	Ea	3.66	3.33	—	6.99
3/4" x 1/2"	P1@.098	Ea	5.52	3.55	—	9.07
3/4" x 5/8"	P1@.104	Ea	5.34	3.77	—	9.11
1" x 3/4"	P1@.121	Ea	7.42	4.39	—	11.81
Cap (brass) with compression joints (PEX-AL/PE-AL)						
1/2"	P1@.069	Ea	2.05	2.50	—	4.55
5/8"	P1@.075	Ea	2.83	2.72	—	5.55
3/4"	P1@.081	Ea	3.71	2.94	—	6.65
1"	P1@.098	Ea	5.52	3.55	—	9.07

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Mini ball valve (brass) with compression joints (PEX-AL/PE-AL)						
1/2" x 3/8" straight	P1@.173	Ea	7.81	6.27	—	14.08
1/2" x 3/8" angle	P1@.173	Ea	7.36	6.27	—	13.63
1/2" x copper	P1@.173	Ea	7.32	6.27	—	13.59
1/2" x MPT	P1@.173	Ea	7.71	6.27	—	13.98
1/2"	P1@.173	Ea	8.61	6.27	—	14.88
5/8"	P1@.173	Ea	11.40	6.27	—	17.67
5/8" x 3/4" copper	P1@.196	Ea	8.87	7.10	—	15.97
5/8" x 3/4" MPT	P1@.196	Ea	9.51	7.10	—	16.61
3/4"	P1@.196	Ea	10.60	7.10	—	17.70
3/4" x copper	P1@.196	Ea	10.90	7.10	—	18.00
Balancing valve (brass) with compression joints (PEX-AL/PE-AL)						
1/2" x copper	P1@.173	Ea	45.90	6.27	—	52.17
1/2" x MPT	P1@.173	Ea	51.00	6.27	—	57.27
Crimp rings, nickel plated soft copper						
1/2"	—	Ea	.18	—	—	.18
5/8"	—	Ea	.20	—	—	.20
3/4"	—	Ea	.23	—	—	.23
1"	—	Ea	.34	—	—	.34
Replacement O-rings						
1/2"	—	Ea	.12	—	—	.12
5/8"	—	Ea	.12	—	—	.12
3/4"	—	Ea	.18	—	—	.18
1"	—	Ea	.18	—	—	.18
Pipe hangers (polypropylene)						
1/2"	P1@.050	Ea	.06	1.81	—	1.87
5/8"	P1@.050	Ea	.06	1.81	—	1.87
3/4"	P1@.050	Ea	.06	1.81	—	1.87
1"	P1@.050	Ea	.08	1.81	—	1.89
Pipe clips (nail clips)						
1/2"	P1@.030	Ea	.13	1.09	—	1.22
5/8"	P1@.030	Ea	.21	1.09	—	1.30
1"	P1@.030	Ea	.47	1.09	—	1.56
Miscellaneous tools						
Crimp tool	—	Ea	275.00	—	—	275.00
Beveling tool	—	Ea	5.60	—	—	5.60
Reaming tool	—	Ea	33.50	—	—	33.50
Pipe bender kit	—	Ea	494.00	—	—	494.00
Bending spring	—	Ea	41.40	—	—	41.40
Pipe cutter	—	Ea	20.10	—	—	20.10

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Water meters, turbine-type. Including brass connection unions						
½"	P1@.500	Ea	138.00	18.10	—	156.10
¾"	P1@.500	Ea	223.00	18.10	—	241.10
1"	P1@.650	Ea	299.00	23.60	—	322.60
1½"	P1@.700	Ea	803.00	25.40	—	828.40
2"	P1@.800	Ea	1,190.00	29.00	—	1,219.00
3"	P1@.900	Ea	1,850.00	32.60	—	1,882.60
4"	P1@.975	Ea	3,440.00	35.30	—	3,475.30
Water meters, compound-type. Including brass connection unions						
2"	P1@.800	Ea	2,920.00	29.00	—	2,949.00
3"	P1@.900	Ea	3,800.00	32.60	—	3,832.60
4"	P1@.975	Ea	6,230.00	35.30	—	6,265.30
Water meter by-pass and connection assembly. Includes three isolation ball valves, two tees, two 90-degree elbows, 10' of Type L copper pipe and standard support devices. Make additional allowances for the cost of the water meter.						
½"	P1@1.00	Ea	84.80	36.20	—	121.00
¾"	P1@1.50	Ea	128.00	54.40	—	182.40
1"	P1@1.95	Ea	222.00	70.70	—	292.70
1½"	P1@2.45	Ea	408.00	88.80	—	496.80
2"	P1@3.25	Ea	600.00	118.00	—	718.00
3"	P1@5.50	Ea	1,790.00	199.00	—	1,989.00
4"	P1@6.75	Ea	3,040.00	245.00	—	3,285.00
Backflow preventers – reduced pressure. Including valves and test ports						
¾"	P1@1.00	Ea	337.00	36.20	—	373.20
1"	P1@1.25	Ea	416.00	45.30	—	461.30
1½"	P1@2.00	Ea	670.00	72.50	—	742.50
2"	P1@2.15	Ea	832.00	77.90	—	909.90
2½"	P1@4.00	Ea	3,020.00	145.00	—	3,165.00
3"	P1@4.75	Ea	3,980.00	172.00	—	4,152.00
4"	P1@6.00	Ea	4,530.00	217.00	—	4,747.00
6"	P1@7.95	Ea	4,950.00	288.00	—	5,238.00
Backflow preventers – reduced pressure. Including integral ball valves and test ports						
½"	P1@.900	Ea	205.00	32.60	—	237.60
¾"	P1@1.00	Ea	242.00	36.20	—	278.20
1"	P1@1.25	Ea	303.00	45.30	—	348.30
1¼"	P1@1.50	Ea	444.00	54.40	—	498.40
1½"	P1@2.00	Ea	483.00	72.50	—	555.50
2"	P1@2.15	Ea	544.00	77.90	—	621.90

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Backflow preventers, double-check valve assembly. Including integral ball valves and test ports						
½"	P1@1.00	Ea	153.00	36.20	—	189.20
¾"	P1@1.00	Ea	170.00	36.20	—	206.20
1"	P1@1.25	Ea	205.00	45.30	—	250.30
1¼"	P1@1.95	Ea	344.00	70.70	—	414.70
1½"	P1@2.00	Ea	356.00	72.50	—	428.50
2"	P1@2.15	Ea	432.00	77.90	—	509.90
2½"	P1@2.95	Ea	1,780.00	107.00	—	1,887.00
3"	P1@3.45	Ea	2,270.00	125.00	—	2,395.00
4"	P1@3.95	Ea	3,070.00	143.00	—	3,213.00
6"	P1@5.75	Ea	5,180.00	208.00	—	5,388.00
Vacuum breakers, atmospheric. Female pipe thread						
¼"	P1@.350	Ea	51.30	12.70	—	64.00
½"	P1@.350	Ea	71.50	12.70	—	84.20
¾"	P1@.350	Ea	87.50	12.70	—	100.20
Vacuum breakers, hose connection. Male/female hose thread, polished brass						
½"	P1@.150	Ea	21.80	5.44	—	27.24
¾"	P1@.150	Ea	26.60	5.44	—	32.04
Suction diffusers						
2"	P1@1.25	Ea	301.00	45.30	—	346.30
3"	P1@2.50	Ea	505.00	90.60	—	595.60
4"	P1@3.25	Ea	643.00	118.00	—	761.00
6"	P1@4.80	Ea	910.00	174.00	—	1,084.00
8"	P1@5.95	Ea	1,710.00	216.00	—	1,926.00
10"	P1@6.75	Ea	2,310.00	245.00	—	2,555.00
Triple-duty valves						
2"	P1@1.25	Ea	416.00	45.30	—	461.30
3"	P1@2.50	Ea	564.00	90.60	—	654.60
4"	P1@3.25	Ea	1,020.00	118.00	—	1,138.00
6"	P1@4.80	Ea	1,680.00	174.00	—	1,854.00
8"	P1@5.95	Ea	2,460.00	216.00	—	2,676.00
10"	P1@6.75	Ea	3,620.00	245.00	—	3,865.00
In-line circulating pump, all bronze. 115 volt, including flange kit						
1/25 HP	P1@1.50	Ea	396.00	54.40	—	450.40
1/16 HP	P1@1.55	Ea	499.00	56.20	—	555.20
1/12 HP	P1@1.60	Ea	688.00	58.00	—	746.00
1/6 HP	P1@1.75	Ea	1,160.00	63.40	—	1,223.40
1/4 HP	P1@1.95	Ea	1,750.00	70.70	—	1,820.70
1 HP	P1@2.25	Ea	2,030.00	81.50	—	2,111.50
1½ HP	P1@2.85	Ea	2,450.00	103.00	—	2,553.00

Installation costs: An average crew can install approximately 25 pounds of duct and fittings per manhour under normal conditions. See “Applying Correction Factors” on page 6 for situations that do not conform to the definition of a standard labor unit.

EXAMPLE:

What is the cost to furnish and install 2,585 pounds of unlined duct and 560 pounds of unlined fittings? The ductwork will be purchased from an outside vendor. A 15% allowance for miscellaneous material is included in the weights.

Material:		
2,585 pounds of straight duct x $2.75/lb.	=	$7,108.75
560 pounds of fittings x $6.17/lb.	=	3,455.20
Delivery cost: (2,585 + 560) x $.15/lb.	=	471.75
Total material cost	=	$11,035.70*
Labor:		
$\frac{2,585 + 560}{25}$ =125.8 *MH*; 125.8 *MH* × $35.61	=	$4,479.74
Total installed cost: $11,035.70 + $4,479.74	=	$15,515.44*

**Sales tax not included.*

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Installed ductwork per lb. (under 1,000 lbs.). Duct purchased from an independent fabrication shop, installed by this contractor's shop. Material price includes scrap, cleats, hangers, sealant, miscellaneous hardware, delivery and fabrication shop markups.						
Straight duct	S2@.042	Lb	3.06	1.50	—	4.56
Duct fittings	S2@.042	Lb	6.17	1.50	—	7.67
Duct & fittings	S2@.042	Lb	4.08	1.50	—	5.58
Installed ductwork per lb. (over 1,000 lbs.). Duct purchased from an independent fabrication shop, installed by this contractor's shop. Material price includes scrap, cleats, hangers, sealant, miscellaneous hardware, delivery and subcontractor markups.						
Straight duct	S2@.039	Lb	2.75	1.39	—	4.14
Duct fittings	S2@.039	Lb	5.53	1.39	—	6.92
Duct & fittings	S2@.039	Lb	3.69	1.39	—	5.08
Installed lined ductwork per lb. (under 1,000 lbs.). Duct purchased from an independent fabrication shop, installed by this contractor's shop. Material price includes scrap, cleats, hangers, sealant, miscellaneous hardware, delivery and subcontractor markups.						
Straight duct	S2@.042	Lb	4.69	1.50	—	6.19
Duct fittings	S2@.042	Lb	7.77	1.50	—	9.27
Duct & fittings	S2@.042	Lb	5.72	1.50	—	7.22
Installed lined ductwork per lb. (over 1,000 lbs.). Duct purchased from an independent fabrication shop, installed by this contractor's shop. Material price includes scrap, cleats, hangers, sealant, miscellaneous hardware, delivery and subcontractor markups.						
Straight duct	S2@.039	Lb	4.41	1.39	—	5.80
Duct fittings	S2@.039	Lb	7.20	1.39	—	8.59
Duct & fittings	S2@.039	Lb	5.31	1.39	—	6.70
Installed ductwork per lb. (under 1,000 lbs.). Duct fabricated and installed by this contractor's shop. Material price includes scrap, cleats, hangers, sealant, miscellaneous hardware and delivery.						
Straight duct	S2@.051	Lb	1.88	1.82	—	3.70
Duct fittings	S2@.074	Lb	2.15	2.64	—	4.79
Duct & fittings	S2@.059	Lb	1.98	2.10	—	4.08
Installed ductwork per lb. (over 1,000 lbs.). Duct fabricated and installed by this contractor's shop. Material price includes scrap, cleats, hangers, sealant, miscellaneous hardware and delivery.						
Straight duct	S2@.046	Lb	1.73	1.64	—	3.37
Duct fittings	S2@.067	Lb	1.99	2.39	—	4.38
Duct & fittings	S2@.053	Lb	1.80	1.89	—	3.69

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Installed lined ductwork per lb. (under 1,000 lbs.). Duct fabricated and installed by this contractor's shop. Material price includes scrap, cleats, hangers, sealant, miscellaneous hardware and delivery.						
Straight duct	S2@.062	Lb	2.77	2.21	—	4.98
Duct fittings	S2@.085	Lb	3.06	3.03	—	6.09
Duct & fittings	S2@.070	Lb	2.88	2.49	—	5.37
Installed lined ductwork per lb. (over 1,000 lbs.). Duct fabricated and installed by this contractor's shop. Material price includes scrap, cleats, hangers, sealant, miscellaneous hardware and delivery. Use for preliminary estimates.						
Straight duct	S2@.057	Lb	2.63	2.03	—	4.66
Duct fittings	S2@.078	Lb	2.93	2.78	—	5.71
Duct & fittings	S2@.064	Lb	5.09	2.28	—	7.37

Weights of Galvanized Steel Spiral Duct (pounds per LF)					
Diameter (inches)	U.S. Standard Gauge				
	26	24	22	20	18
3	.76	1.01	1.23	1.46	—
4	1.02	1.35	1.64	1.94	—
5	1.28	1.69	2.06	2.42	—
6	1.54	2.03	2.47	2.91	3.88
7	1.79	2.37	2.88	3.40	4.52
8	2.05	2.71	3.29	3.86	5.17
9	2.31	3.05	3.71	4.37	5.82
10	2.57	3.39	4.12	4.86	6.47
12	3.08	4.07	4.95	5.83	7.75
14	3.59	4.74	5.77	6.81	9.05
16	4.11	5.42	6.60	7.78	10.34
18	4.63	6.10	7.43	8.76	11.64
20	5.15	6.78	8.25	9.73	12.93
22	5.65	7.46	9.08	10.71	14.93
24	6.16	8.14	9.91	11.68	15.52
26	6.67	8.82	10.73	12.66	16.82
28	7.18	9.50	11.56	13.63	18.11
30	7.71	10.18	12.38	14.60	19.41
32	8.22	10.84	13.21	15.58	20.71
34	—	11.52	14.05	16.55	22.00
36	—	12.20	14.90	17.53	23.29

Weights of Galvanized Steel Round Spiral Fittings (pounds per piece)				
Diameter (inches)	**90° elbow**	**45° elbow**	**Coupling**	**Reducer**
3	1.3	1.0	0.5	1.0
4	2.2	1.3	0.6	1.2
5	3.3	1.9	0.7	1.4
6	4.3	2.5	0.9	1.8
7	5.8	3.3	1.0	2.0
8	7.3	4.3	1.2	2.4
9	8.8	5.3	2.6	3.3
10	11.8	7.5	2.9	4.4
12	16.3	10.0	3.5	5.3
14	22.0	13.0	4.1	6.2
16	28.3	15.8	4.6	6.9
18	34.5	19.0	5.2	7.8
20	41.5	23.5	5.8	8.7
22	48.3	27.5	6.4	9.6
24	57.5	32.0	6.9	10.3
26	68.8	37.5	7.5	11.2
28	76.8	42.8	8.1	12.1
30	87.0	48.0	8.7	13.0
32	99.5	55.0	9.2	13.8
34	112.0	61.0	9.8	14.7
36	161.0	89.5	10.4	15.6

Largest run diam. (inches)	**Weights of Galvanized Steel Round Spiral Fittings (pounds per piece) Tee with reducing run and branch Branch diameter (inches)**													
	3	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**12**	**14**	**16**	**18**	**20**	**22**
4	2.3													
5	2.8	3.0												
6	3.2	3.5	3.7											
7	3.7	3.9	4.1	4.5										
8	4.1	4.4	4.7	5.0	5.3									
9	4.5	4.8	5.1	5.5	5.8	6.2								
10	6.4	6.7	7.1	7.5	7.8	8.2	8.6							
12	7.7	8.1	8.5	8.9	9.4	9.9	10.3	10.7						
14	8.9	9.4	10.0	10.5	11.0	11.5	12.1	12.6	13.6					
16	10.2	10.8	11.4	12.0	12.5	13.1	13.7	14.3	15.5	16.7				
18	11.5	12.1	12.7	13.5	14.1	14.8	15.5	16.1	17.5	18.8	19.2			
20	12.7	13.4	14.2	14.9	17.7	16.4	17.2	17.9	19.4	20.9	22.4	23.9		
22	14.0	14.8	15.6	16.4	17.2	18.1	18.9	19.7	21.3	23.0	24.6	26.2	27.9	
24	15.3	16.1	17.0	17.8	18.7	19.6	20.5	21.4	23.2	25.0	26.8	28.5	30.3	32.1
26	16.5	17.5	18.5	19.5	20.4	21.3	22.3	23.3	25.2	26.2	29.1	31.1	33.0	34.9
28	17.7	18.7	19.8	20.8	21.9	22.9	23.9	25.0	27.0	29.2	31.2	33.2	35.4	37.4
30	18.9	20.0	21.1	22.2	23.3	24.5	25.5	26.7	28.9	31.1	33.3	35.5	37.7	40.0
32	20.4	21.6	22.6	24.0	25.2	26.4	27.6	28.8	31.2	33.6	36.0	38.4	40.8	42.2
34	21.6	22.9	24.2	25.4	26.7	28.0	29.3	30.5	33.1	35.6	38.1	40.7	42.2	45.6
36	29.6	31.4	33.1	34.8	36.6	38.6	40.1	41.8	45.3	48.8	52.2	55.7	59.2	62.7

Galvanized Steel Round Spiral Fittings

Run diam. (inches)	Weights of Galvanized Steel Round Spiral Fittings (pounds per piece) Cross with reducing run and branch Branch diameter (inches)													
	3	4	5	6	7	8	9	10	12	14	16	18	20	22
4	2.6													
5	3.2	3.6												
6	3.8	4.2	4.6											
7	4.4	4.9	5.4	5.8										
8	4.9	5.4	6.0	6.5	7.0									
9	5.4	6.0	6.6	7.2	7.7	8.3								
10	7.6	8.2	8.9	9.5	10.2	10.8	11.4							
12	8.8	9.6	10.3	11.0	11.7	12.5	13.2	13.8						
14	10.1	10.9	11.7	12.6	13.4	14.2	15.1	15.9	17.5					
16	11.3	12.2	13.1	14.0	15.0	15.9	16.8	17.7	19.5	21.4				
18	12.5	13.5	14.5	15.5	16.5	17.5	18.5	19.5	21.5	23.5	25.5			
20	13.8	15.0	16.1	17.2	18.2	19.4	20.6	21.7	23.9	26.2	28.4	30.6		
22	15.2	16.4	17.7	18.9	20.1	21.4	22.6	23.8	26.2	28.7	31.2	33.6	36.1	
24	16.6	17.9	19.3	20.6	22.0	23.3	24.6	26.0	28.7	31.5	34.1	36.7	39.4	42.1
26	18.0	19.4	20.9	22.3	23.8	25.2	26.7	28.2	31.1	33.9	36.9	39.8	42.7	45.6
28	19.3	20.8	22.4	24.0	25.5	27.1	28.6	30.2	32.3	36.4	39.6	42.7	45.8	48.9
30	20.6	22.3	23.9	25.6	27.3	28.9	30.6	32.3	35.6	38.9	42.3	45.6	49.9	52.2
32	22.2	24.0	25.8	27.6	29.4	31.2	33.0	34.8	38.4	42.0	45.6	49.1	52.8	56.5
34	23.5	25.4	27.3	29.2	31.1	33.1	34.9	36.9	40.7	44.5	48.3	52.1	55.9	59.8
36	32.2	34.8	37.4	40.0	42.8	45.3	48.0	50.5	55.7	61.0	66.2	71.5	76.7	82.0

Weights of 26 Gauge Galvanized Steel Rectangular Duct (pounds per LF)									
Size (inches)	4	5	6	7	8	9	10	11	12
4	1.21								
5	1.36	1.51							
6	1.51	1.66	1.81						
7	1.66	1.81	1.96	2.11					
8	1.81	1.96	2.11	2.27	2.42				
9	1.96	2.11	2.27	2.42	2.57	2.72			
10	2.11	2.27	2.42	2.57	2.72	2.87	3.02		
11	2.27	2.42	2.57	2.72	2.87	3.02	3.17	3.32	
12	2.42	2.57	2.72	2.87	3.02	3.17	3.32	3.47	3.62

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Budget plumbing estimate, plastic DWV and plastic supply pipe						
Bathtubs	P1@12.0	Ea	1,850.00	435.00	—	2,285.00
Showers	P1@7.00	Ea	898.00	254.00	—	1,152.00
Lavatories	P1@9.00	Ea	1,720.00	326.00	—	2,046.00
Kitchen sinks	P1@10.0	Ea	1,910.00	362.00	—	2,272.00
Service sinks	P1@8.00	Ea	1,540.00	290.00	—	1,830.00
Bar sinks	P1@7.00	Ea	1,300.00	254.00	—	1,554.00
Floor sinks	P1@6.00	Ea	781.00	217.00	—	998.00
Water closets						
Tank-type	P1@8.00	Ea	1,200.00	290.00	—	1,490.00
Flush valve	P1@9.00	Ea	1,450.00	326.00	—	1,776.00
Urinals	P1@6.00	Ea	1,950.00	217.00	—	2,167.00
Drinking fountains						
(refrigerated)	P1@10.0	Ea	2,260.00	362.00	—	2,622.00
Wash fountains	P1@22.0	Ea	5,170.00	797.00	—	5,967.00
Can washers	P1@15.0	Ea	2,530.00	544.00	—	3,074.00
Floor drains	P1@7.00	Ea	646.00	254.00	—	900.00
Area drains	P1@5.00	Ea	528.00	181.00	—	709.00
Roof drains	P1@16.0	Ea	1,800.00	580.00	—	2,380.00
Overflow drains	P1@16.0	Ea	1,800.00	580.00	—	2,380.00
Deck drains	P1@3.00	Ea	449.00	109.00	—	558.00
Cleanouts	P1@4.00	Ea	548.00	145.00	—	693.00
Trap primers	P1@2.00	Ea	273.00	72.50	—	345.50
Sump pumps	P1@5.00	Ea	3,170.00	181.00	—	3,351.00
Water heaters						
Gas, 40 gal.	P1@15.0	Ea	3,830.00	544.00	—	4,374.00
Gas, 80 gal.	P1@16.0	Ea	4,190.00	580.00	—	4,770.00
Gas, 120 gal.	P1@17.0	Ea	4,860.00	616.00	—	5,476.00

Index

C

D

E

F

G

H

S

T

U

V

W - X- Y - Z