$88.25

2018 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 978-1-57218-338-4
Published November 2017 for the year 2018.

Contents

How to Use This Book

This 2018 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.

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 $36.39 (the average wage for crew P1) is $18.195, or $18.20 rounded.

Quarterly price updates on the Web are free and automatic all during 2018. 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 $42.85 for plumbers and $41.59 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 2018.

Column 2, taxable fringe benefits, includes vacation pay, sick leave and other taxable benefits. These fringe benefits average about 5.50% 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 4.86% 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 5.50% of base wage)	Insurance and employer taxes (%)	Insurance and employer taxes ($)	Non-taxable fringe benefits (at 4.86% of base wage)	Total hourly cost used in this book
Laborer	20.67	1.14	32.66%	7.12	1.00	29.93
Plumber	31.53	1.73	24.24%	8.06	1.53	42.85
Sheet Metal Worker	30.19	1.66	25.97%	8.27	1.47	41.59
Operating Engineer	30.77	1.69	25.18%	8.17	1.50	42.13
Sprinkler Fitter	30.98	1.70	25.05%	8.19	1.51	42.38
Electrician	30.50	1.68	19.82%	6.38	1.48	40.04
Cement Mason	26.00	1.43	23.12%	6.34	1.26	35.03

Craft Code	Crew Composition	Average Hourly Cost per Manhour
ER	4 building plumbers, 2 building laborers, 1 operating engineer	39.06
SN	4 building sheet metal workers, 2 building laborers, 1 operating engineer	38.34
P1	1 building plumber and 1 building laborer	36.39
ST	1 sprinkler fitter	42.38
SK	4 sprinkler fitters, 2 building laborers, 1 operating engineer	38.79
SL	1 sprinkler fitter and 1 laborer	36.16
S2	1 building sheet metal worker, 1 building laborer	35.76
BE	1 electrician	40.04
CF	1 cement mason	35.03
SW	1 sheet metal worker	41.59

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 $36.39 labor cost used for crew P1. Multiply costs in the Labor $ column by .481 to find your estimated cost.

For example, notice on page 19 that the labor cost for installing a 6 gallon hot water heater is $18.20 each. If installed by your plumbing crew working at an average cost of $17.50 per manhour, your estimated cost would be 48% of $18.20 or $8.75 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 2018 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

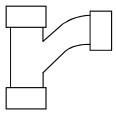
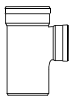
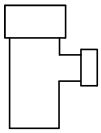
Material, Equipment and Tool Delivery and Surplus Return Record

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

PVC, DWV with Gasketed Bell and Spigot Joints

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
PVC sewer pipe tee-wye B x B x B with bell and spigot gasketed joints						
						
4"	P1@.480	Ea	33.70	17.50	—	51.20
6"	P1@.600	Ea	85.30	21.80	—	107.10
6" x 4"	P1@.560	Ea	72.80	20.40	—	93.20
8" x 4"	P1@.640	Ea	91.90	23.30	—	115.20
8" x 6"	P1@.680	Ea	106.00	24.70	—	130.70
PVC sewer pipe tee B x S x B with bell and spigot gasketed joints						
						
10"	P1@1.20	Ea	465.00	43.70	—	508.70
12"	P1@1.59	Ea	644.00	57.90	—	701.90
15"	P1@2.01	Ea	1,030.00	73.10	—	1,103.10
18"	P1@2.40	Ea	1,930.00	87.30	—	2,017.30
PVC sewer pipe reducing tee B x S x B with bell and spigot gasketed joints						
						
10" x 4"	P1@.960	Ea	295.00	34.90	—	329.90
10" x 6"	P1@1.00	Ea	307.00	36.40	—	343.40
10" x 8"	P1@1.04	Ea	481.00	37.80	—	518.80
12" x 4"	P1@1.22	Ea	362.00	44.40	—	406.40
12" x 6"	P1@1.26	Ea	370.00	45.90	—	415.90
12" x 8"	P1@1.30	Ea	508.00	47.30	—	555.30
12" x 10"	P1@1.46	Ea	608.00	53.10	—	661.10
15" x 4"	P1@1.50	Ea	587.00	54.60	—	641.60
15" x 6"	P1@1.54	Ea	616.00	56.00	—	672.00
15" x 8"	P1@1.58	Ea	631.00	57.50	—	688.50
15" x 10"	P1@1.74	Ea	739.00	63.30	—	802.30
15" x 12"	P1@1.87	Ea	810.00	68.00	—	878.00
18" x 4"	P1@1.76	Ea	1,490.00	64.00	—	1,554.00
18" x 6"	P1@1.80	Ea	1,520.00	65.50	—	1,585.50
18" x 8"	P1@1.84	Ea	1,610.00	67.00	—	1,677.00
18" x 10"	P1@2.00	Ea	1,650.00	72.80	—	1,722.80
18" x 12"	P1@2.13	Ea	1,710.00	77.50	—	1,787.50
18" x 15"	P1@2.27	Ea	1,820.00	82.60	—	1,902.60

PVC sewer pipe reducer S x B with bell and spigot gasketed joints

6" x 4"	P1@.360	Ea	32.50	13.10	—	45.60
8" x 4"	P1@.400	Ea	89.10	14.60	—	103.70
8" x 6"	P1@.440	Ea	99.80	16.00	—	115.80
10" x 4"	P1@.560	Ea	234.00	20.40	—	254.40
10" x 6"	P1@.600	Ea	238.00	21.80	—	259.80
10" x 8"	P1@.640	Ea	286.00	23.30	—	309.30
12" x 4"	P1@.690	Ea	307.00	25.10	—	332.10
12" x 6"	P1@.730	Ea	314.00	26.60	—	340.60
12" x 8"	P1@.770	Ea	362.00	28.00	—	390.00
12" x 10"	P1@.930	Ea	402.00	33.80	—	435.80
15" x 4"	P1@.830	Ea	517.00	30.20	—	547.20
15" x 6"	P1@.870	Ea	536.00	31.70	—	567.70
15" x 8"	P1@.910	Ea	608.00	33.10	—	641.10
15" x 10"	P1@1.07	Ea	608.00	38.90	—	646.90
15" x 12"	P1@1.20	Ea	700.00	43.70	—	743.70
18" x 8"	P1@1.04	Ea	751.00	37.80	—	788.80
18" x 10"	P1@1.20	Ea	760.00	43.70	—	803.70
18" x 12"	P1@1.33	Ea	764.00	48.40	—	812.40
18" x 15"	P1@1.47	Ea	782.00	53.50	—	835.50

PVC sewer pipe adapter B x S with bell and spigot gasketed joints

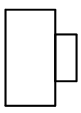
4"	P1@.320	Ea	19.10	11.60	—	30.70
6"	P1@.400	Ea	35.30	14.60	—	49.90
8"	P1@.480	Ea	90.90	17.50	—	108.40
10"	P1@.800	Ea	112.00	29.10	—	141.10
12"	P1@1.06	Ea	171.00	38.60	—	209.60
15"	P1@1.34	Ea	259.00	48.80	—	307.80
18"	P1@1.60	Ea	568.00	58.20	—	626.20

PVC sewer pipe cap with bell and spigot gasketed joints

4"	P1@.160	Ea	11.60	5.82	—	17.42
6"	P1@.200	Ea	21.70	7.28	—	28.98
8"	P1@.240	Ea	58.70	8.73	—	67.43
10"	P1@.400	Ea	183.00	14.60	—	197.60
12"	P1@.530	Ea	277.00	19.30	—	296.30
15"	P1@.670	Ea	447.00	24.40	—	471.40
18"	P1@.800	Ea	644.00	29.10	—	673.10

PVC sewer pipe test plug with bell and spigot gasketed joints

4"	P1@.160	Ea	8.77	5.82	—	14.59
6"	P1@.200	Ea	13.40	7.28	—	20.68
8"	P1@.240	Ea	48.10	8.73	—	56.83
10"	P1@.400	Ea	160.00	14.60	—	174.60
12"	P1@.530	Ea	191.00	19.30	—	210.30
15"	P1@.670	Ea	377.00	24.40	—	401.40
18"	P1@.800	Ea	523.00	29.10	—	552.10

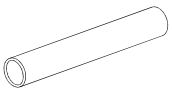
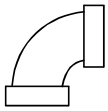
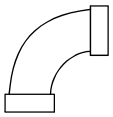
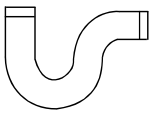


Polypropylene, Schedule 40, with Heat-Fusioned Joints

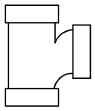
Polypropylene is used almost exclusively for acid and laboratory drain, waste and vent (DWV) systems.

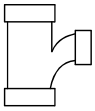
Joints are made by applying low-voltage current to electrical resistance coils imbedded in propylene collars, which are slipped over the ends of the pipe, then inserted into the hubs of the fittings. Compression clamps are placed around the assemblies and tightened to compress the joints prior to applying electrical current from the power unit to fuse the joint.

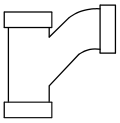
This section has been arranged to save the estimator's time by including all normally-used system components such as pipe, fittings, hanger assemblies, and riser clamps under one heading. The cost estimates in this section are based on the conditions, limitations and wage rates described in the section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

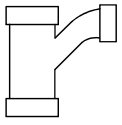
Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Schedule 40 DWV polypropylene pipe with heat-fusioned joints						
						
1½"	P1@.050	LF	5.47	1.82	—	7.29
2"	P1@.055	LF	7.42	2.00	—	9.42
3"	P1@.060	LF	13.20	2.18	—	15.38
4"	P1@.080	LF	19.00	2.91	—	21.91
6"	P1@.110	LF	34.20	4.00	—	38.20
Schedule 40 DWV polypropylene 1/8 bend with heat-fusioned joints						
						
1½"	P1@.350	Ea	22.40	12.70	—	35.10
2"	P1@.400	Ea	27.20	14.60	—	41.80
3"	P1@.450	Ea	49.70	16.40	—	66.10
4"	P1@.500	Ea	56.30	18.20	—	74.50
6"	P1@.750	Ea	155.00	27.30	—	182.30
Schedule 40 DWV polypropylene ¼ bend with heat-fusioned joints						
						
1½"	P1@.350	Ea	22.50	12.70	—	35.20
2"	P1@.400	Ea	27.70	14.60	—	42.30
3"	P1@.450	Ea	47.70	16.40	—	64.10
4"	P1@.500	Ea	75.60	18.20	—	93.80
6"	P1@.750	Ea	186.00	27.30	—	213.30
Schedule 40 DWV polypropylene long sweep ¼ bend with heat-fusioned joints						
						
1½"	P1@.350	Ea	22.90	12.70	—	35.60
2"	P1@.400	Ea	32.10	14.60	—	46.70
3"	P1@.450	Ea	54.60	16.40	—	71.00
4"	P1@.500	Ea	78.00	18.20	—	96.20
Schedule 40 DWV polypropylene P-trap with heat-fusioned joints						
						
1½"	P1@.500	Ea	44.10	18.20	—	62.30
2"	P1@.560	Ea	61.50	20.40	—	81.90
3"	P1@.630	Ea	111.00	22.90	—	133.90
4"	P1@.700	Ea	200.00	25.50	—	225.50

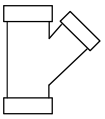
Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Schedule 40 DWV polypropylene sanitary tee (TY) with heat-fusioned joints						
1½"	P1@.500	Ea	27.70	18.20	—	45.90
2"	P1@.560	Ea	33.70	20.40	—	54.10
3"	P1@.630	Ea	56.00	22.90	—	78.90
4"	P1@.700	Ea	100.00	25.50	—	125.50
Schedule 40 DWV polypropylene reducing sanitary tee (TY) with heat-fusioned joints						
2" x 1½"	P1@.510	Ea	37.00	18.60	—	55.60
3" x 1½"	P1@.530	Ea	64.20	19.30	—	83.50
3" x 2"	P1@.580	Ea	68.50	21.10	—	89.60
4" x 2"	P1@.650	Ea	98.80	23.70	—	122.50
4" x 3"	P1@.700	Ea	103.00	25.50	—	128.50
6" x 4"	P1@.850	Ea	186.00	30.90	—	216.90
Schedule 40 DWV polypropylene combination wye and 1/8 bend with heat-fusioned joints						
1½"	P1@.500	Ea	41.00	18.20	—	59.20
2"	P1@.560	Ea	54.90	20.40	—	75.30
3"	P1@.630	Ea	87.30	22.90	—	110.20
4"	P1@.700	Ea	123.00	25.50	—	148.50
Schedule 40 DWV polypropylene combination reducing wye and 1/8 bend with heat-fusioned joints						
2" x 1½"	P1@.500	Ea	49.10	18.20	—	67.30
3" x 1½"	P1@.520	Ea	72.50	18.90	—	91.40
3" x 2"	P1@.570	Ea	78.50	20.70	—	99.20
4" x 2"	P1@.580	Ea	108.00	21.10	—	129.10
4" x 3"	P1@.630	Ea	115.00	22.90	—	137.90
Schedule 40 DWV polypropylene wye with heat-fusioned joints						
1½"	P1@.500	Ea	31.50	18.20	—	49.70
2"	P1@.560	Ea	44.70	20.40	—	65.10
3"	P1@.630	Ea	78.50	22.90	—	101.40
4"	P1@.700	Ea	115.00	25.50	—	140.50
6"	P1@1.05	Ea	289.00	38.20	—	327.20







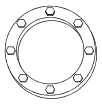


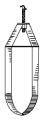


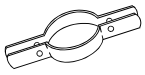
Polypropylene, Schedule 40, with Heat-Fusioned Joints

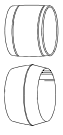
Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Schedule 40 DWV polypropylene reducing wye with heat-fusioned joints						
2" x 1½"	P1@.510	Ea	43.70	18.60	—	62.30
3" x 2"	P1@.580	Ea	73.00	21.10	—	94.10
4" x 2"	P1@.600	Ea	105.00	21.80	—	126.80
4" x 3"	P1@.650	Ea	109.00	23.70	—	132.70
6" x 2"	P1@.900	Ea	184.00	32.80	—	216.80
6" x 3"	P1@.900	Ea	186.00	32.80	—	218.80
6" x 4"	P1@.950	Ea	189.00	34.60	—	223.60
Schedule 40 DWV polypropylene female adapter with heat-fusioned joints						
1½"	P1@.280	Ea	15.30	10.20	—	25.50
2"	P1@.330	Ea	20.50	12.00	—	32.50
3"	P1@.350	Ea	34.40	12.70	—	47.10
4"	P1@.400	Ea	65.80	14.60	—	80.40
Schedule 40 DWV polypropylene male adapter with heat-fusioned joints						
1½"	P1@.280	Ea	15.00	10.20	—	25.20
2"	P1@.330	Ea	18.20	12.00	—	30.20
3"	P1@.350	Ea	30.10	12.70	—	42.80
4"	P1@.400	Ea	62.40	14.60	—	77.00
Schedule 40 DWV polypropylene cleanout adapter with heat-fusioned joints						
1½"	P1@.210	Ea	16.00	7.64	—	23.64
2"	P1@.280	Ea	18.90	10.20	—	29.10
3"	P1@.430	Ea	35.00	15.60	—	50.60
4"	P1@.640	Ea	60.10	23.30	—	83.40
6"	P1@.850	Ea	104.00	30.90	—	134.90
Schedule 40 DWV polypropylene plug with heat-fusioned joints						
1½"	P1@.060	Ea	5.53	2.18	—	7.71
2"	P1@.065	Ea	6.04	2.37	—	8.41
3"	P1@.070	Ea	10.60	2.55	—	13.15
4"	P1@.090	Ea	11.90	3.28	—	15.18
Schedule 40 DWV polypropylene coupling with heat-fusioned joints						
1½"	P1@.350	Ea	19.50	12.70	—	32.20
2"	P1@.400	Ea	24.00	14.60	—	38.60
3"	P1@.450	Ea	30.70	16.40	—	47.10
4"	P1@.500	Ea	43.70	18.20	—	61.90
6"	P1@.750	Ea	69.90	27.30	—	97.20

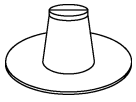
Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Schedule 40 DWV polypropylene reducer with heat-fusioned joints						
2" x 1½"	P1@.360	Ea	20.50	13.10	—	33.60
3" x 2"	P1@.410	Ea	23.50	14.90	—	38.40
4" x 2"	P1@.430	Ea	52.50	15.60	—	68.10
4" x 3"	P1@.450	Ea	54.00	16.40	—	70.40
Schedule 40 DWV polypropylene flange with heat-fusioned joints						
2"	P1@.350	Ea	67.60	12.70	—	80.30
3"	P1@.380	Ea	140.00	13.80	—	153.80
4"	P1@.430	Ea	182.00	15.60	—	197.60
6"	P1@.630	Ea	239.00	22.90	—	261.90
Schedule 40 DWV polypropylene bolt and gasket set						
2"	P1@.500	Ea	6.66	18.20	—	24.86
2½"	P1@.650	Ea	7.05	23.70	—	30.75
3"	P1@.750	Ea	7.40	27.30	—	34.70
4"	P1@1.00	Ea	13.30	36.40	—	49.70
Hanger with swivel assembly						
1½"	P1@.300	Ea	5.15	10.90	—	16.05
2"	P1@.300	Ea	5.38	10.90	—	16.28
3"	P1@.350	Ea	9.04	12.70	—	21.74
4"	P1@.350	Ea	9.91	12.70	—	22.61
6"	P1@.450	Ea	16.30	16.40	—	32.70
Riser clamp						
1½"	P1@.110	Ea	4.94	4.00	—	8.94
2"	P1@.115	Ea	5.22	4.18	—	9.40
3"	P1@.120	Ea	5.95	4.37	—	10.32
4"	P1@.125	Ea	7.58	4.55	—	12.13
6"	P1@.200	Ea	13.10	7.28	—	20.38
Pipe sleeve						
2"	P1@.130	Ea	7.59	4.73	—	12.32
2½"	P1@.150	Ea	7.70	5.46	—	13.16
3"	P1@.180	Ea	7.90	6.55	—	14.45
4"	P1@.220	Ea	8.97	8.01	—	16.98
5"	P1@.250	Ea	11.10	9.10	—	20.20
6"	P1@.270	Ea	12.10	9.83	—	21.93
8"	P1@.270	Ea	13.90	9.83	—	23.73
Lead roof pipe flashing						
1½"	P1@.250	Ea	32.30	9.10	—	41.40
2"	P1@.250	Ea	42.90	9.10	—	52.00
3"	P1@.250	Ea	49.30	9.10	—	58.40
4"	P1@.250	Ea	54.60	9.10	—	63.70



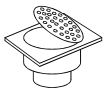




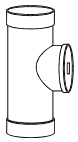




Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Floor drain, cast iron or plastic body, nickel-bronze grate. Add for rough-in (P-trap, fittings, hangers, etc.).						
3" x 2"	P1@.500	Ea	151.00	18.20	—	169.20
5" x 3"	P1@.500	Ea	187.00	18.20	—	205.20
6" x 4"	P1@.500	Ea	241.00	18.20	—	259.20
8" x 6"	P1@.500	Ea	319.00	18.20	—	337.20
Area drain, cast iron or plastic body, cast iron grate. Add for rough-in (P-trap, fittings, hangers, etc.).						
10" x 3"	P1@.650	Ea	319.00	23.70	—	342.70
12" x 4"	P1@.650	Ea	349.00	23.70	—	372.70
14" x 6"	P1@.700	Ea	376.00	25.50	—	401.50
Roof and overflow drain, cast iron or plastic body, with plastic dome, flow control weir and deck clamp. Add for rough-in (pipe, fittings, hangers, etc.).						
8" x 3"	P1@1.50	Ea	430.00	54.60	—	484.60
10" x 4"	P1@1.50	Ea	454.00	54.60	—	508.60
12" x 6"	P1@1.65	Ea	454.00	60.00	—	514.00
Planter drain, cast iron. Add for rough-in (pipe, fittings, hangers, etc.).						
2"	P1@1.00	Ea	82.50	36.40	—	118.90
3"	P1@1.10	Ea	95.10	40.00	—	135.10
4"	P1@1.15	Ea	115.00	41.80	—	156.80
6"	P1@1.25	Ea	168.00	45.50	—	213.50
Planter drain, plastic. Add for rough-in (pipe, fittings, hangers, etc.).						
4"	P1@.800	Ea	25.20	29.10	—	54.30
5"	P1@1.00	Ea	26.70	36.40	—	63.10
6"	P1@1.05	Ea	43.80	38.20	—	82.00
8"	P1@1.10	Ea	66.80	40.00	—	106.80



Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Cleanout, in-line, (Barrett) cast iron, (MJ) brass plug. Add for MJ couplings.						
2"	P1@.350	Ea	72.80	12.70	—	85.50
3"	P1@.350	Ea	93.20	12.70	—	105.90
4"	P1@.400	Ea	132.00	14.60	—	146.60
6"	P1@.400	Ea	463.00	14.60	—	477.60
Cleanout, in-line (Barrett), ABS/PVC						
2"	P1@.300	Ea	21.30	10.90	—	32.20
3"	P1@.300	Ea	34.30	10.90	—	45.20
4"	P1@.350	Ea	62.20	12.70	—	74.90
6"	P1@.350	Ea	242.00	12.70	—	254.70
8"	P1@.400	Ea	470.00	14.60	—	484.60
10"	P1@.550	Ea	580.00	20.00	—	600.00
Cleanout, end of line (Malcolm), cast iron body, brass top. Add for MJ coupling.						
2" raised	P1@.250	Ea	26.20	9.10	—	35.30
2" recessed	P1@.250	Ea	65.40	9.10	—	74.50
3" raised	P1@.250	Ea	30.50	9.10	—	39.60
3" recessed	P1@.300	Ea	96.00	10.90	—	106.90
4" raised	P1@.300	Ea	40.80	10.90	—	51.70
4" recessed	P1@.350	Ea	125.00	12.70	—	137.70
6" raised	P1@.350	Ea	129.00	12.70	—	141.70
6" recessed	P1@.400	Ea	239.00	14.60	—	253.60
8" raised	P1@.450	Ea	278.00	16.40	—	294.40
Cleanout, end-of-line (Malcolm), ABS/PVC						
2"	P1@.250	Ea	11.30	9.10	—	20.40
3"	P1@.250	Ea	19.00	9.10	—	28.10
4"	P1@.300	Ea	34.30	10.90	—	45.20
6"	P1@.300	Ea	144.00	10.90	—	154.90
8"	P1@.400	Ea	261.00	14.60	—	275.60
10"	P1@.450	Ea	297.00	16.40	—	313.40
12"	P1@.550	Ea	347.00	20.00	—	367.00



Description	Unit	Material $	Labor $	Equipment $	Total $
Complete wet sprinkler system (square foot costs). System includes subcontractors' overhead and profit. Cost includes design drawings, zone and supervision valves, sprinkler heads, pipe, and connection to water supply service. Make additional allowances if a fire pump is required. Costs are based on ordinary hazard coverage (110 sf per head). Coverage density can vary depending on room sizes and/or hazard rating. Use these costs for preliminary estimates.					
Exposed piping to 5,000	SF	—	—	—	4.54
Exposed piping 5,000-15,000	SF	—	—	—	3.82
Exposed piping over 15,000	SF	—	—	—	3.42
Concealed piping to 5,000	SF	—	—	—	4.23
Concealed piping 5,000-15,000	SF	—	—	—	3.65
Concealed piping over 15,000	SF	—	—	—	2.85
Add for dry system	%	—	—	—	20.0
Complete wet sprinkler system (per head costs). Cost includes sprinkler heads, sprinkler mains, branch piping, and supports. Make additional allowances for zone and supervision valves, alarms, connection to water service and fire pump when required. Costs are based on ordinary hazard 155 degree heads. Use these costs for preliminary estimates.					
Upright heads to 5,000 SF	Ea	—	—	—	317.00
Upright heads 5,000 to 15,000 SF	Ea	—	—	—	303.00
Upright heads over 15,000 SF	Ea	—	—	—	287.00
Pendent heads to 5,000 SF	Ea	—	—	—	480.00
Pendent heads 5,000 to 15,000 SF	Ea	—	—	—	400.00
Pendent heads over 15,000 SF	Ea	—	—	—	339.00

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Supervision (zone) valves, flanged. Add for alarm trim if required.						
2½" OS&Y gate valve	SL@1.70	Ea	351.00	61.50	—	412.50
3" OS&Y gate vlv	SL@1.80	Ea	371.00	65.10	—	436.10
4" OS&Y gate vlv	SL@2.20	Ea	428.00	79.60	—	507.60
6" OS&Y gate vlv	SL@2.80	Ea	658.00	101.00	—	759.00
8" OS&Y gate vlv	SL@3.50	Ea	1,040.00	127.00	—	1,167.00
2½" butterfly valve (lug)	SL@.600	Ea	533.00	21.70	—	554.70
3" butterfly vlv	SL@.700	Ea	538.00	25.30	—	563.30
4" butterfly vlv	SL@.850	Ea	552.00	30.70	—	582.70
6" butterfly vlv	SL@1.15	Ea	765.00	41.60	—	806.60
8" butterfly vlv	SL@1.85	Ea	1,150.00	66.90	—	1,216.90

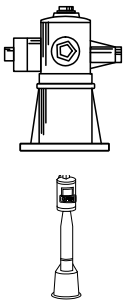
Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Supervision (zone) valves, grooved. Add for alarm trim if required						
4" butterfly valve	SL@.550	Ea	412.00	19.90	—	431.90
6" butterfly valve	SL@.850	Ea	535.00	30.70	—	565.70
8" butterfly valve	SL@1.25	Ea	810.00	45.20	—	855.20
Alarm valves (flanged or grooved)						
4" alarm valve	SL@3.50	Ea	563.00	127.00	—	690.00
6" alarm valve	SL@4.00	Ea	693.00	145.00	—	838.00
8" alarm valve	SL@4.75	Ea	1,010.00	172.00	—	1,182.00
4" alarm vlv trim	SL@1.25	Ea	377.00	45.20	—	422.20
6" alarm vlv trim	SL@1.25	Ea	377.00	45.20	—	422.20
8" alarm vlv trim	SL@1.25	Ea	377.00	45.20	—	422.20
4" alarm vlv pkg	SL@4.75	Ea	1,770.00	172.00	—	1,942.00
6" alarm vlv pkg	SL@5.50	Ea	1,950.00	199.00	—	2,149.00
8" alarm vlv pkg	SL@6.00	Ea	2,380.00	217.00	—	2,597.00
Dry valves and trim (deluge/pre-action system)						
2" dry valve	SL@2.25	Ea	1,050.00	81.40	—	1,131.40
3" dry valve	SL@2.75	Ea	1,090.00	99.40	—	1,189.40
4" dry valve	SL@3.05	Ea	1,230.00	110.00	—	1,340.00
6" dry valve	SL@3.65	Ea	1,580.00	132.00	—	1,712.00
2" dry valve trim	SL@1.25	Ea	515.00	45.20	—	560.20
3" dry valve trim	SL@1.25	Ea	515.00	45.20	—	560.20
4" dry valve trim	SL@1.25	Ea	515.00	45.20	—	560.20
6" dry valve trim	SL@1.25	Ea	515.00	45.20	—	560.20
Check valves, grooved						
2½"	SL@.450	Ea	201.00	16.30	—	217.30
3"	SL@.500	Ea	221.00	18.10	—	239.10
4"	SL@.550	Ea	198.00	19.90	—	217.90
6"	SL@.850	Ea	391.00	30.70	—	421.70
Check valves, wafer-type, flanged						
2½"	SL@1.65	Ea	250.00	59.70	—	309.70
3"	SL@1.70	Ea	260.00	61.50	—	321.50
4"	SL@2.10	Ea	281.00	75.90	—	356.90
6"	SL@2.60	Ea	459.00	94.00	—	553.00
8"	SL@3.20	Ea	654.00	116.00	—	770.00
Double-check detector valve assembly (flanged)						
2½"	SL@4.00	Ea	2,610.00	145.00	—	2,755.00
3"	SL@4.35	Ea	2,800.00	157.00	—	2,957.00
4"	SL@4.95	Ea	3,050.00	179.00	—	3,229.00
6"	SL@6.25	Ea	4,780.00	226.00	—	5,006.00
8"	SL@6.95	Ea	8,610.00	251.00	—	8,861.00

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Switches: flow, pressure, monitor, supervisory						
Flow switch	SL@1.00	Ea	178.00	36.20	—	214.20
Pressure switch	SL@1.00	Ea	133.00	36.20	—	169.20
Monitor switch	SL@1.00	Ea	129.00	36.20	—	165.20
Supervisory sw.	SL@1.00	Ea	119.00	36.20	—	155.20
Sprinkler heads, 155 degree						
Pendent, brass	SL@.350	Ea	7.76	12.70	—	20.46
Pendent, chrome	SL@.350	Ea	8.31	12.70	—	21.01
Upright, brass	SL@.350	Ea	7.76	12.70	—	20.46
Upright, chrome	SL@.350	Ea	19.50	12.70	—	32.20
Sidewall, brass	SL@.350	Ea	10.10	12.70	—	22.80
Sidewall, chrome	SL@.350	Ea	10.80	12.70	—	23.50
Sprinkler heads, dry, 165 degree						
Dry pendent	SL@.450	Ea	77.40	16.30	—	93.70
Dry sidewall	SL@.450	Ea	108.00	16.30	—	124.30
Sprinkler heads, 200 degree						
Pendent, brass	SL@.350	Ea	7.76	12.70	—	20.46
Pendent, chrome	SL@.350	Ea	8.31	12.70	—	21.01
Upright, brass	SL@.350	Ea	7.76	12.70	—	20.46
Upright, chrome	SL@.350	Ea	19.50	12.70	—	32.20
Sidewall, brass	SL@.350	Ea	10.10	12.70	—	22.80
Sidewall, chrome	SL@.350	Ea	10.80	12.70	—	23.50
Sprinkler heads, 286 degree						
Pendent, brass	SL@.350	Ea	7.76	12.70	—	20.46
Pendent, chrome	SL@.350	Ea	8.31	12.70	—	21.01
Upright, brass	SL@.350	Ea	7.76	12.70	—	20.46
Upright, chrome	SL@.350	Ea	19.50	12.70	—	32.20
Sidewall, brass	SL@.350	Ea	10.10	12.70	—	22.80
Sidewall, chrome	SL@.350	Ea	10.80	12.70	—	23.50
Sprinkler heads, 360 degree						
Pendent, brass	SL@.350	Ea	5.23	12.70	—	17.93
Upright, brass	SL@.350	Ea	5.23	12.70	—	17.93
Sprinkler heads, 400 degree						
Pendent, brass	SL@.350	Ea	23.10	12.70	—	35.80
Upright, brass	SL@.350	Ea	23.10	12.70	—	35.80

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Fire hose cabinet, complete assembly. Includes recessed steel cabinet, 2½" and 1½" angle valves, 100' fire hose, hose rack and fog nozzle.						
FHC, chrome trim	SL@1.95	Ea	372.00	70.50	—	442.50
FHC, brass trim	SL@1.95	Ea	363.00	70.50	—	433.50
FHC, plastic trim	SL@1.95	Ea	353.00	70.50	—	423.50
Fire hose cabinet components						
Recessed cabinet	SL@1.00	Ea	167.00	36.20	—	203.20
Surface cabinet	SL@.850	Ea	193.00	30.70	—	223.70
Cabinet glass	SL@.350	Ea	12.30	12.70	—	25.00
100' fire hose	SL@.250	Ea	157.00	9.04	—	166.04
75' hose rack	SL@.350	Ea	48.50	12.70	—	61.20
100' hose rack	SL@.350	Ea	65.70	12.70	—	78.40
1½" brass fire hose angle valve	SL@.350	Ea	78.80	12.70	—	91.50
1½" chrome fire hose angle valve	SL@.350	Ea	131.00	12.70	—	143.70
2½" brass fire hose angle valve	SL@.450	Ea	151.00	16.30	—	167.30
2½" chrome fire hose angle valve	SL@.450	Ea	59.70	16.30	—	76.00
Brass fog nozzle	SL@.150	Ea	58.80	5.42	—	64.22
Plastic fog nozzle	SL@.150	Ea	16.20	5.42	—	21.62
Chrome fog nozzle	SL@.150	Ea	60.30	5.42	—	65.72

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Electric fire pump, skid-mounted with controller and jockey pump						
15 KW, 500 gpm	—	Ea	—	—	—	45,500.00
22 KW, 500 gpm	—	Ea	—	—	—	48,800.00
30 KW, 750 gpm	—	Ea	—	—	—	51,500.00
38 KW, 1,000 gpm	—	Ea	—	—	—	57,100.00
56 KW, 1,000 gpm	—	Ea	—	—	—	57,900.00
Diesel fire pump, skid-mounted with controller and jockey pump						
250 gpm	—	Ea	—	—	—	67,900.00
500 gpm	—	Ea	—	—	—	70,900.00
750 gpm	—	Ea	—	—	—	71,900.00
1,000 gpm	—	Ea	—	—	—	73,500.00
Excess pressure pump						
1/4 hp	SL@1.35	Ea	506.00	48.80	—	554.80
1/3 hp	SL@1.35	Ea	508.00	48.80	—	556.80
1/2 hp	SL@1.50	Ea	528.00	54.20	—	582.20
Siamese connection, flush, fire dept. connection						
4" brass	SL@4.00	Ea	728.00	145.00	—	873.00
4" chrome	SL@4.00	Ea	785.00	145.00	—	930.00
6" brass	SL@4.50	Ea	845.00	163.00	—	1,008.00
6" chrome	SL@4.50	Ea	860.00	163.00	—	1,023.00
Siamese connection, surface, fire dept. connection						
4" brass	SL@2.85	Ea	173.00	103.00	—	276.00
6" brass	SL@3.25	Ea	326.00	118.00	—	444.00
Siamese connection, sidewalk, fire dept. connection						
4" brass	SL@3.25	Ea	658.00	118.00	—	776.00
6" brass	SL@3.75	Ea	930.00	136.00	—	1,066.00

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Water motor gong						
Gong	SL@1.50	Ea	310.00	54.20	—	364.20
Multi-purpose fire extinguisher						
2 lb.	SL@.500	Ea	37.00	18.10	—	55.10
5 lb.	SL@.500	Ea	51.90	18.10	—	70.00
10 lb.	SL@.500	Ea	74.30	18.10	—	92.40
20 lb.	SL@.500	Ea	156.00	18.10	—	174.10
Fire hydrant with spool						
6"	P1@5.00	Ea	1,430.00	182.00	—	1,612.00
Indicator post						
6"	P1@6.50	Ea	826.00	237.00	—	1,063.00



Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Black steel pipe (A53), installed horizontal, roll-grooved, Schedule 40. Standard weight, including hangers every 10' and a fitting every 33'. Use these figures for preliminary estimates.						
2" (50mm)	SL@.160	LF	7.17	5.79	—	12.96
2½" (65mm)	SL@.180	LF	11.50	6.51	—	18.01
3" (75mm)	SL@.210	LF	14.80	7.59	—	22.39
4" (10cm)	SL@.300	LF	20.00	10.80	—	30.80
6" (15cm)	SK@.450	LF	39.80	17.50	4.20	61.50
8" (20cm)	SK@.630	LF	59.20	24.40	5.90	89.50
10" (25cm)	SK@.750	LF	115.00	29.10	7.10	151.20
12" (30cm)	SK@.800	LF	150.00	31.00	7.50	188.50
Black steel pipe (A53), installed riser, roll-grooved, Schedule 40. Standard weight, including a riser clamp every other floor and a tee at every floor. Make additional allowances for sleeving or coring as required. Use these figures for preliminary estimates.						
2" (50mm)	SL@.110	LF	7.42	3.98	—	11.40
2½" (65mm)	SL@.120	LF	11.90	4.34	—	16.24
3" (75mm)	SL@.150	LF	14.20	5.42	—	19.62
4" (10cm)	SL@.190	LF	20.30	6.87	—	27.17
6" (15cm)	SK@.300	LF	38.50	11.60	2.90	53.00
8" (20cm)	SK@.400	LF	59.90	15.50	3.80	79.20
10" (25cm)	SK@.510	LF	93.70	19.80	4.80	118.30
12" (30cm)	SK@.560	LF	135.00	21.70	5.30	162.00
Black steel pipe (A53), installed horizontal, roll-grooved, thin wall, Schedule 10. Light weight, including hangers every 10' and a fitting every 33'. Use these figures for preliminary estimates.						
2" (50mm)	SL@.160	LF	5.96	5.79	—	11.75
2½" (65mm)	SL@.180	LF	8.70	6.51	—	15.21
3" (75mm)	SL@.210	LF	10.20	7.59	—	17.79
4" (10cm)	SL@.300	LF	14.70	10.80	—	25.50
6" (15cm)	SK@.450	LF	28.30	17.50	4.20	50.00
8" (20cm)	SK@.630	LF	52.40	24.40	5.90	82.70
Black steel pipe (A53), installed riser, roll-grooved, thin wall, Schedule 10. Light weight, including a riser clamp every other floor and a tee at every floor. Make additional allowances for sleeving or coring as required. Use these figures for preliminary estimates.						
2" (50mm)	SL@.110	LF	6.70	3.98	—	10.68
2½" (65mm)	SL@.120	LF	9.67	4.34	—	14.01
3" (75mm)	SL@.150	LF	11.30	5.42	—	16.72
4" (10cm)	SL@.190	LF	15.80	6.87	—	22.67
6" (15cm)	SK@.300	LF	30.40	11.60	2.90	44.90
8" (20cm)	SK@.400	LF	59.20	15.50	3.80	78.50

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Black steel pipe only (A53), roll-grooved, Schedule 40. Standard weight, no hangers or fittings.						
2" (50mm)	SL@.070	LF	3.17	2.53	—	5.70
2½" (65mm)	SL@.070	LF	6.78	2.53	—	9.31
3" (75mm)	SL@.090	LF	7.54	3.25	—	10.79
4" (10cm)	SL@.130	LF	10.70	4.70	—	15.40
6" (15cm)	SK@.160	LF	15.60	6.21	1.50	23.31
8" (20cm)	SK@.210	LF	23.60	8.15	2.00	33.75
10" (25cm)	SK@.280	LF	34.20	10.90	2.60	47.70
12" (30cm)	SK@.340	LF	57.70	13.20	3.20	74.10
14" (36cm)	SK@.400	LF	66.60	15.50	3.80	85.90
16" (41cm)	SK@.550	LF	77.30	21.30	5.20	103.80
Black steel pipe only, (A53) roll-grooved, thin wall, Schedule 10. Light weight, no hangers or fittings.						
2" (50mm)	SL@.070	LF	2.40	2.53	—	4.93
2½" (65mm)	SL@.070	LF	5.07	2.53	—	7.60
3" (75mm)	SL@.090	LF	5.62	3.25	—	8.87
4" (10cm)	SL@.130	LF	8.06	4.70	—	12.76
6" (15cm)	SK@.160	LF	11.60	6.21	1.50	19.31
8" (20cm)	SK@.210	LF	20.00	8.15	2.00	30.15
10" (25cm)	SK@.280	LF	28.90	10.90	2.60	42.40
12" (30cm)	SK@.340	LF	49.00	13.20	3.20	65.40
14" (36cm)	SK@.400	LF	56.70	15.50	3.80	76.00
16" (41cm)	SK@.550	LF	66.00	21.30	5.20	92.50
90-degree elbow, roll-grooved, Style #10 (Victaulic)						
2"	SL@.410	Ea	27.00	14.80	—	41.80
2½"	SL@.430	Ea	27.00	15.50	—	42.50
3"	SL@.500	Ea	35.70	18.10	—	53.80
4"	SL@.690	Ea	55.70	25.00	—	80.70
6"	SL@1.19	Ea	121.00	43.00	—	164.00
8"	SL@1.69	Ea	207.00	61.10	—	268.10
10"	SL@2.23	Ea	398.00	80.60	—	478.60
12"	SL@2.48	Ea	629.00	89.70	—	718.70
45-degree elbow, roll-grooved, Style #11 (Victaulic)						
2"	SL@.410	Ea	27.00	14.80	—	41.80
2½"	SL@.430	Ea	27.00	15.50	—	42.50
3"	SL@.500	Ea	35.70	18.10	—	53.80
4"	SL@.690	Ea	55.70	25.00	—	80.70
6"	SL@1.19	Ea	121.00	43.00	—	164.00
8"	SL@1.69	Ea	207.00	61.10	—	268.10
10"	SL@2.23	Ea	398.00	80.60	—	478.60
12"	SL@2.48	Ea	629.00	89.70	—	718.70

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
22½-degree elbow, roll-grooved, Style #12 (Victaulic)						
2"	SL@.410	Ea	32.20	14.80	—	47.00
2½"	SL@.430	Ea	32.20	15.50	—	47.70
3"	SL@.500	Ea	33.70	18.10	—	51.80
4"	SL@.690	Ea	63.50	25.00	—	88.50
6"	SL@1.19	Ea	138.00	43.00	—	181.00
8"	SL@1.69	Ea	283.00	61.10	—	344.10
10"	SL@2.23	Ea	400.00	80.60	—	480.60
12"	SL@2.48	Ea	428.00	89.70	—	517.70
Tee, roll-grooved, Style #20 (Victaulic)						
2"	SL@.510	Ea	52.20	18.40	—	70.60
2½"	SL@.540	Ea	52.20	19.50	—	71.70
3"	SL@.630	Ea	63.00	22.80	—	85.80
4"	SL@.860	Ea	87.90	31.10	—	119.00
6"	SL@1.49	Ea	203.00	53.90	—	256.90
8"	SL@2.11	Ea	343.00	76.30	—	419.30
10"	SL@2.79	Ea	606.00	101.00	—	707.00
12"	SL@3.10	Ea	710.00	112.00	—	822.00
Reducing tee, roll-grooved, Style #25 (Victaulic)						
2"	SL@.510	Ea	52.20	18.40	—	70.60
2½"	SL@.540	Ea	68.60	19.50	—	88.10
3"	SL@.630	Ea	62.00	22.80	—	84.80
4"	SL@.860	Ea	106.00	31.10	—	137.10
6"	SL@1.49	Ea	196.00	53.90	—	249.90
8"	SL@2.11	Ea	356.00	76.30	—	432.30
10"	SL@2.79	Ea	471.00	101.00	—	572.00
12"	SL@3.10	Ea	519.00	112.00	—	631.00
Reducer, roll-grooved, Style #50 (Victaulic)						
2"	SL@.410	Ea	17.30	14.80	—	32.10
2½"	SL@.430	Ea	17.30	15.50	—	32.80
3"	SL@.500	Ea	24.20	18.10	—	42.30
4"	SL@.690	Ea	40.50	25.00	—	65.50
6"	SL@1.19	Ea	58.80	43.00	—	101.80
8"	SL@1.69	Ea	104.00	61.10	—	165.10
10"	SL@2.23	Ea	216.00	80.60	—	296.60
Cap, roll-grooved, Style #60 (Victaulic)						
2"	SL@.270	Ea	15.20	9.76	—	24.96
2½"	SL@.280	Ea	15.20	10.10	—	25.30
3"	SL@.330	Ea	19.20	11.90	—	31.10
4"	SL@.450	Ea	22.20	16.30	—	38.50
6"	SL@.770	Ea	43.30	27.80	—	71.10
8"	SL@1.10	Ea	69.90	39.80	—	109.70
10"	SL@1.61	Ea	299.00	58.20	—	357.20

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Mechanical tee (saddle tee), roll-grooved, Style #920 (Victaulic)						
3"	SL@.750	Ea	52.70	27.10	—	79.80
4"	SL@1.00	Ea	59.80	36.20	—	96.00
6"	SL@1.30	Ea	71.10	47.00	—	118.10
8"	SL@1.50	Ea	112.00	54.20	—	166.20
Coupling, roll-grooved, 800 PSI, Style #77 (Victaulic). Labor included with fittings.						
3"	—	Ea	26.60	—	—	26.60
4"	—	Ea	44.10	—	—	44.10
6"	—	Ea	72.30	—	—	72.30
8"	—	Ea	98.60	—	—	98.60
10"	—	Ea	133.00	—	—	133.00
12"	—	Ea	177.00	—	—	177.00
Coupling, roll-grooved, light weight, Style #75 (Victaulic). Labor included with fittings.						
3"	—	Ea	21.50	—	—	21.50
4"	—	Ea	23.20	—	—	23.20
6"	—	Ea	41.40	—	—	41.40
8"	—	Ea	63.50	—	—	63.50
Coupling, roll-grooved, zeroflex, Style #07 (Victaulic). Labor included with fittings.						
3"	—	Ea	24.80	—	—	24.80
4"	—	Ea	32.60	—	—	32.60
6"	—	Ea	47.90	—	—	47.90
8"	—	Ea	72.90	—	—	72.90
10"	—	Ea	107.00	—	—	107.00
12"	—	Ea	148.00	—	—	148.00
Flange, roll-grooved, Style #741 (Victaulic)						
3"	SL@.500	Ea	84.00	18.10	—	102.10
4"	SL@.690	Ea	114.00	25.00	—	139.00
6"	SL@1.19	Ea	139.00	43.00	—	182.00
8"	SL@1.69	Ea	161.00	61.10	—	222.10
10"	SL@2.23	Ea	240.00	80.60	—	320.60
12"	SL@2.48	Ea	326.00	89.70	—	415.70

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Schedule 40 carbon steel pipe, threaded and coupled, pipe only. Add for hangers, fittings etc.						
1"	P1@.090	LF	2.48	3.28	—	5.76
1¼"	P1@.100	LF	3.24	3.64	—	6.88
1½"	P1@.110	LF	3.85	4.00	—	7.85
2"	P1@.120	LF	5.20	4.37	—	9.57
125# cast iron 90-degree ell, threaded joints						
1" x ¾"	P1@.130	Ea	4.39	4.73	—	9.12
1"	P1@.180	Ea	4.08	6.55	—	10.63
1¼"	P1@.240	Ea	5.76	8.73	—	14.49
1½"	P1@.300	Ea	8.03	10.90	—	18.93
2"	P1@.380	Ea	12.20	13.80	—	26.00
125# cast iron 45-degree ell, threaded joints						
1"	P1@.180	Ea	5.34	6.55	—	11.89
1¼"	P1@.240	Ea	7.61	8.73	—	16.34
1½"	P1@.300	Ea	9.77	10.90	—	20.67
2"	P1@.380	Ea	13.20	13.80	—	27.00
125# cast iron tee, threaded joints						
1"	P1@.230	Ea	5.61	8.37	—	13.98
1¼"	P1@.310	Ea	10.20	11.30	—	21.50
1½"	P1@.390	Ea	13.00	14.20	—	27.20
2"	P1@.490	Ea	17.90	17.80	—	35.70
125# cast iron reducing tee, threaded joints						
1" x ¾"	P1@.220	Ea	7.16	8.01	—	15.17
1¼" x ¾"	P1@.290	Ea	9.13	10.60	—	19.73
1¼" x 1"	P1@.290	Ea	10.00	10.60	—	20.60
1½" x ¾"	P1@.370	Ea	12.60	13.50	—	26.10
1½" x 1"	P1@.370	Ea	13.90	13.50	—	27.40
1½" x 1¼"	P1@.370	Ea	15.20	13.50	—	28.70
2" x 1"	P1@.460	Ea	19.90	16.70	—	36.60
2" x 1¼"	P1@.460	Ea	21.30	16.70	—	38.00
2" x 1½"	P1@.460	Ea	22.90	16.70	—	39.60
125# cast iron reducer, threaded joints						
1" x ¾"	P1@.200	Ea	5.61	7.28	—	12.89
1¼" x 1"	P1@.210	Ea	6.75	7.64	—	14.39
1½" x 1"	P1@.270	Ea	8.28	9.83	—	18.11
1½" x 1¼"	P1@.270	Ea	8.76	9.83	—	18.59
2" x 1¼"	P1@.340	Ea	13.10	12.40	—	25.50
2" x 1½"	P1@.340	Ea	13.80	12.40	—	26.20

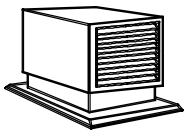
Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
125# cast iron cross, threaded joints						
1"	P1@.360	Ea	13.10	13.10	—	26.20
1¼"	P1@.480	Ea	21.60	17.50	—	39.10
1½"	P1@.600	Ea	26.20	21.80	—	48.00
2"	P1@.700	Ea	43.30	25.50	—	68.80
125# cast iron cap, threaded joint						
¾"	P1@.100	Ea	2.76	3.64	—	6.40
1"	P1@.140	Ea	3.34	5.09	—	8.43
1¼"	P1@.180	Ea	4.26	6.55	—	10.81
1½"	P1@.230	Ea	5.41	8.37	—	13.78
2"	P1@.290	Ea	8.50	10.60	—	19.10
125# cast iron plug, threaded joint						
¾"	P1@.100	Ea	1.80	3.64	—	5.44
1"	P1@.140	Ea	2.38	5.09	—	7.47
1¼"	P1@.180	Ea	3.70	6.55	—	10.25
1½"	P1@.230	Ea	4.70	8.37	—	13.07
2"	P1@.290	Ea	5.82	10.60	—	16.42
125# cast iron coupling, threaded joints						
1"	P1@.180	Ea	4.86	6.55	—	11.41
1¼"	P1@.240	Ea	6.00	8.73	—	14.73
1½"	P1@.300	Ea	7.54	10.90	—	18.44
2"	P1@.380	Ea	10.20	13.80	—	24.00

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Steel pipe nipples — 3" long, standard right-hand thread						
1"	P1@.025	Ea	1.88	.91	—	2.79
1¼"	P1@.025	Ea	2.42	.91	—	3.33
1½"	P1@.025	Ea	2.87	.91	—	3.78
2"	P1@.030	Ea	3.58	1.09	—	4.67
Steel pipe nipples — 4" long, standard right-hand thread						
1"	P1@.025	Ea	2.24	.91	—	3.15
1¼"	P1@.030	Ea	2.81	1.09	—	3.90
1½"	P1@.030	Ea	3.46	1.09	—	4.55
2"	P1@.030	Ea	4.46	1.09	—	5.55
Steel pipe nipples — 6" long, standard right-hand thread						
1"	P1@.030	Ea	2.87	1.09	—	3.96
1¼"	P1@.030	Ea	3.60	1.09	—	4.69
1½"	P1@.030	Ea	4.39	1.09	—	5.48
2"	P1@.035	Ea	5.90	1.27	—	7.17

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Chlorinated Polyvinyl Chloride pipe (CPVC), CPVC pipe only, solvent weld. No hangers or fittings.						
¾"	SL@.055	LF	1.01	1.99	—	3.00
1"	SL@.055	LF	1.46	1.99	—	3.45
1¼"	SL@.065	LF	2.30	2.35	—	4.65
1½"	SL@.075	LF	3.22	2.71	—	5.93
2"	SL@.085	LF	4.76	3.07	—	7.83
2½"	SL@.110	LF	7.39	3.98	—	11.37
3"	SL@.125	LF	11.20	4.52	—	15.72
CPVC 90-degree elbow, solvent weld						
¾"	SL@.100	Ea	2.79	3.62	—	6.41
1"	SL@.120	Ea	4.19	4.34	—	8.53
1¼"	SL@.170	Ea	5.37	6.15	—	11.52
1½"	SL@.180	Ea	8.09	6.51	—	14.60
2"	SL@.200	Ea	9.39	7.23	—	16.62
CPVC 45-degree elbow, solvent weld						
¾"	SL@.100	Ea	2.88	3.62	—	6.50
1"	SL@.120	Ea	3.77	4.34	—	8.11
1¼"	SL@.170	Ea	4.95	6.15	—	11.10
1½"	SL@.180	Ea	6.66	6.51	—	13.17
2"	SL@.200	Ea	8.31	7.23	—	15.54
CPVC tee, solvent weld						
¾"	SL@.150	Ea	3.07	5.42	—	8.49
1"	SL@.170	Ea	5.24	6.15	—	11.39
1¼"	SL@.230	Ea	8.25	8.32	—	16.57
1½"	SL@.250	Ea	10.80	9.04	—	19.84
2"	SL@.280	Ea	17.10	10.10	—	27.20
CPVC reducing tee, solvent weld						
1"	SL@.170	Ea	4.51	6.15	—	10.66
1¼"	SL@.230	Ea	8.19	8.32	—	16.51
1½"	SL@.250	Ea	10.90	9.04	—	19.94
2"	SL@.280	Ea	17.50	10.10	—	27.60
3"	SL@.350	Ea	27.60	12.70	—	40.30
CPVC coupling, solvent weld						
¾"	SL@.100	Ea	2.03	3.62	—	5.65
1"	SL@.120	Ea	2.74	4.34	—	7.08
1¼"	SL@.170	Ea	4.33	6.15	—	10.48
1½"	SL@.180	Ea	5.46	6.51	—	11.97
2"	SL@.200	Ea	6.89	7.23	—	14.12
3"	SL@.280	Ea	14.10	10.10	—	24.20

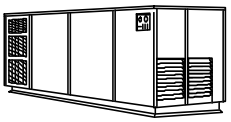
Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $

Packaged self-contained rooftop DX air conditioning units. EnergySmart certified, ASHRAE, U.S. Green Building Council and Underwriters Laboratories approved. Includes cooling coils, compressor, heat rejection coils, regulator valves, refrigerant tank and remote digital single-zone control package. Set in place with a 13,000 lb. truck crane. Add installation costs from the section that follows.



2-T, 800 CFM	SN@5.00	Ea	3,810.00	192.00	78.70	4,080.70
2½-T, 1,000 CFM	SN@6.00	Ea	4,560.00	230.00	94.20	4,884.20
3-T, 1,200 CFM	SN@7.00	Ea	5,450.00	268.00	110.00	5,828.00
4-T, 1,600 CFM	SN@8.00	Ea	6,670.00	307.00	157.00	7,134.00
5-T, 2,000 CFM	SN@9.00	Ea	8,340.00	345.00	157.00	8,842.00
7½-T, 3,000 CFM	SN@10.0	Ea	11,500.00	383.00	314.00	12,197.00
10-T, 4,000 CFM	SN@12.0	Ea	14,400.00	460.00	314.00	15,174.00
12-T, 5,000 CFM	SN@14.0	Ea	17,200.00	537.00	377.00	18,114.00
15-T, 6,000 CFM	SN@15.0	Ea	21,000.00	575.00	377.00	21,952.00
20-T, 8,000 CFM	SN@16.0	Ea	27,900.00	613.00	550.00	29,063.00
25-T, 10,000 CFM	SN@17.0	Ea	34,000.00	652.00	550.00	35,202.00
30-T, 12,000 CFM	SN@19.0	Ea	38,800.00	728.00	707.00	40,235.00
40-T, 16,000 CFM	SN@22.0	Ea	48,500.00	843.00	707.00	50,050.00

Rooftop DX air conditioning unit, hot water coil. EnergySmart certified, ASHRAE, U.S. Green Building Council, and Underwriters Laboratories approved. Add for the hot water coil. Single zone controls. Add installation costs from the section that follows.

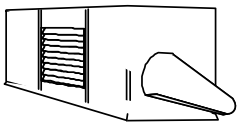


2-T, 800 CFM	SN@5.00	Ea	3,710.00	192.00	79.00	3,981.00
2½-T, 1,000 CFM	SN@6.00	Ea	4,460.00	230.00	94.00	4,784.00
3-T, 1,200 CFM	SN@7.00	Ea	5,330.00	268.00	110.00	5,708.00
4-T, 1,600 CFM	SN@8.00	Ea	6,510.00	307.00	157.00	6,974.00
5-T, 2,000 CFM	SN@9.00	Ea	8,150.00	345.00	157.00	8,652.00
7½-T, 3,000 CFM	SN@10.0	Ea	12,300.00	383.00	314.00	12,997.00
10-T, 4,000 CFM	SN@12.0	Ea	14,100.00	460.00	314.00	14,874.00
12-T, 5,000 CFM	SN@14.0	Ea	16,700.00	537.00	377.00	17,614.00
15-T, 6,000 CFM	SN@15.0	Ea	20,500.00	575.00	377.00	21,452.00
20-T, 8,000 CFM	SN@16.0	Ea	27,300.00	613.00	550.00	28,463.00
25-T, 10,000 CFM	SN@17.0	Ea	33,000.00	652.00	550.00	34,202.00
30-T, 12,000 CFM	SN@19.0	Ea	38,800.00	728.00	707.00	40,235.00
40-T, 16,000 CFM	SN@22.0	Ea	48,500.00	843.00	707.00	50,050.00

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Installation costs for packaged rooftop cooling						
Cut, frame and gasket downcomer hole in roof	S2@1.00	Ea	39.40	35.80	—	75.20
Mount duct hangers	S2@.250	Ea	3.94	8.94	—	12.88
Cut and mount sheet metal duct	S2@.350	LF	6.17	12.50	—	18.67
Apply and coat duct insulation	S2@.150	LF	2.69	5.36	—	8.05
Install piping for gas line	P1@.100	LF	4.21	3.64	—	7.85
Install piping for chilled or hot water/steam line	P1@.100	LF	3.19	3.64	—	6.83
Install electrical wiring	BE@.150	LF	1.96	6.01	—	7.97
Install HVAC controls	BE@.500	Ea	—	20.00	—	20.00
Commission and test	P1@4.00	Ea	—	146.00	—	146.00
Air balance and fine-tune	P1@4.00	Ea	—	146.00	—	146.00

Packaged air handler with chilled water and hot water/steam coil.
Costs shown based on 400 CFM per ton cooling. Unit includes insulated single wall casing, fan section, cooling coil section, heating coil section, mixing plenum section, bag filter section, fan motor, variable pitch drive, vibration isolators and drain pan. Set in place only. Make additional allowances for coil connections, controls, motor starters and power wiring. (12,000 BTUs equals 1 ton cooling.) Use these costs for preliminary estimates.

3-T,	1,200 CFM	SN@4.00	Ea	3,060.00	153.00	63.00	3,276.00
4-T,	1,600 CFM	SN@5.50	Ea	4,230.00	211.00	157.00	4,598.00
5-T,	2,000 CFM	SN@7.00	Ea	5,030.00	268.00	157.00	5,455.00
7½-T,	3,000 CFM	SN@9.00	Ea	7,090.00	345.00	314.00	7,749.00
10-T,	4,000 CFM	SN@11.0	Ea	8,990.00	422.00	314.00	9,726.00
12-T,	5,000 CFM	SN@13.0	Ea	10,700.00	498.00	377.00	11,575.00
15-T,	6,000 CFM	SN@14.0	Ea	12,000.00	537.00	377.00	12,914.00
20-T,	8,000 CFM	SN@15.0	Ea	14,300.00	575.00	550.00	15,425.00
25-T,	10,000 CFM	SN@16.0	Ea	14,200.00	613.00	550.00	15,363.00
30-T,	12,000 CFM	SN@18.0	Ea	17,800.00	690.00	707.00	19,197.00
40-T,	16,000 CFM	SN@21.0	Ea	21,900.00	805.00	707.00	23,412.00



Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Air handling unit accessories and options. Use these costs for preliminary estimates.						
DDC controls per zone complete	SN@2.75	Ea	997.00	105.00	43.30	1,145.30
Electric controls per zone complete	SN@2.75	Ea	533.00	105.00	43.30	681.30
Pneumatic controls per zone complete	SN@2.75	Ea	502.00	105.00	43.30	650.30
Variable speed drive 5 HP	SN@4.00	Ea	4,020.00	153.00	62.90	4,235.90
Variable speed drive 7.5HP	SN@4.00	Ea	4,690.00	153.00	62.90	4,905.90
Variable speed drive 10 HP	SN@6.00	Ea	5,330.00	230.00	94.20	5,654.20
Variable speed drive 15 HP	SN@8.00	Ea	6,020.00	307.00	94.20	6,421.20
Variable speed drive 20 HP	SN@12.0	Ea	6,700.00	460.00	189.00	7,349.00
Variable speed drive 25 HP	SN@16.0	Ea	7,370.00	613.00	251.00	8,234.00
Variable speed drive 30 HP	SN@18.0	Ea	8,690.00	690.00	282.00	9,662.00
Variable speed drive 40 HP	SN@22.0	Ea	10,800.00	843.00	347.00	11,990.00
Variable speed drive 50 HP	SN@26.0	Ea	12,800.00	997.00	409.00	14,206.00
Variable inlet vanes 1,000-1,500 CFM	SN@4.00	Ea	201.00	153.00	62.90	416.90
Variable inlet vanes 1,600-2,500 CFM	SN@4.00	Ea	435.00	153.00	62.90	650.90
Variable inlet vanes 2,600-5,000 CFM	SN@6.00	Ea	1,220.00	230.00	94.20	1,544.20
Variable inlet vanes 6,000-10,000 CFM	SN@8.00	Ea	2,010.00	307.00	126.00	2,443.00
Variable inlet vanes 11,000-20,000 CFM	SN@10.0	Ea	3,340.00	383.00	157.00	3,880.00

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $

Heat Recovery Ventilators provide a fresh air supply to tightly sealed building envelopes. An HRV extracts heat from the stale indoor air being exhausted and transfers the heat to the fresh air being drawn into the building through the HRV. Heat recovery ventilators are also excellent dehumidifiers.

HRV unit features include energy-efficient defrost cycle, cross-flow polypropylene heat exchanger, acoustically lined cabinet, outdoor air filter.

Allow 15-30 cfm per person or .04 to.05 cfm per square foot when sizing HRV unit. (ASHRAE62-19890) (cfm = cubic feet per minute)

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Commercial heat recovery ventilator. Set/hang in place only. Make additional allowances for duct, diffusers, controls, air balancing, electrical connections and condensate drain.						
HRV 700 cfm	SN@4.75	Ea	5,830.00	182.00	74.60	6,086.60
HRV 1,200 cfm	SN@5.25	Ea	6,280.00	201.00	82.50	6,563.50
HRV 2,500 cfm	SN@6.75	Ea	25,800.00	259.00	106.20	26,165.20
Swimming pool heat recovery ventilator. Set/hang in place only. Make additional allowances for duct, diffusers, controls, air balancing, electrical connections and condensate drain.						
HRV 700 cfm	SN@5.00	Ea	6,760.00	192.00	78.70	7,030.70
HRV 1,200 cfm	SN@5.75	Ea	7,660.00	220.00	90.40	7,970.40

Conventional heat recovery ventilator. Hang in place only. Make additional allowances for duct, diffusers, controls, air balancing, electrical connections and condensate drain.

HRV 65–150 cfm	S2@2.45	Ea	1,080.00	87.60	—	1,167.60
HRV 115–200 cfm	S2@2.65	Ea	1,300.00	94.80	1,370.00	2,764.80

Compact heat recovery ventilator. Hang in place only. Make additional allowances for duct, diffusers, controls, air balancing, electrical connections and condensate drain.

HRV 65–127 cfm	S2@2.45	Ea	1,140.00	87.60	—	1,227.60
HRV 115–195 cfm	S2@2.65	Ea	1,280.00	94.80	1,370.00	2,744.80

High-efficiency heat recovery ventilator. Hang in place only. Make additional allowances for duct, diffusers, controls, air balancing, electrical connections and condensate drain.

HRV 65–127 cfm	S2@2.65	Ea	1,260.00	94.80	—	1,354.80
HRV 115–180cfm	S2@2.90	Ea	1,930.00	104.00	—	2,034.00
HRV 180–265cfm	S2@3.25	Ea	2,010.00	116.00	—	2,126.00

Heat recovery ventilator controls

HRV basic control	S2@1.00	Ea	99.50	35.80	133.00	268.30
HRV std. control	S2@1.00	Ea	156.00	35.80	—	191.80
HRV auto control	S2@1.00	Ea	210.00	35.80	—	245.80
60 minute timer	S2@.600	Ea	65.40	21.50	—	86.90
Interlock relay	S2@.600	Ea	77.70	21.50	—	99.20

Heat recovery ventilator accessories

6" diffusers	S2@.500	Ea	16.60	17.90	—	34.50
6" wall hoods	S2@1.50	Ea	28.70	53.60	—	82.30
6" tee fittings	S2@.350	Ea	3.84	12.50	—	16.34
6" flex duct	S2@.025	LF	.91	.89	—	1.80
6" flex insul duct	S2@.025	LF	1.75	.89	—	2.64
HRV filters	S2@.450	Ea	23.50	16.10	—	39.60

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Installation costs for heat recovery ventilators						
Hang heat recovery ventilator, 150 CFM	S2@2.00	Ea	5.00	71.50	—	76.50
Hang heat recovery ventilator, 250 CMF	S2@2.25	LF	7.50	80.50	—	88.00
Heat recovery ventilator ducting, 150 CFM	S2@4.00	LF	335.00	143.00	—	478.00
Heat recovery ventilator ducting, 250 CFM	S2@4.75	LF	375.00	170.00	—	545.00
Heat recovery ventilator drain line, gravity	P1@1.50	LF	25.00	54.60	—	79.60
Heat recovery ventilator drain line, pumped	P1@2.00	LF	225.00	72.80	—	297.80
Heat recovery ventilator power wiring, 115 volt	BE@2.00	Ea	85.00	80.10	—	165.10
Heat recovery ventilator power wiring, 24 volt	BE@2.00	Ea	20.00	80.10	—	100.10
Commission and test	P1@1.50	Ea	—	54.60	—	54.60
Run air balance and fine tune system	P1@1.75	Ea	—	63.70	—	63.70

Water Coil Piping

Engineering drawings of coil piping details have a bad reputation among HVAC contractors and estimators. They're notorious for what they leave out. They'll rarely show more than one coil bank, no matter how big the system. Furthermore, the drawings hardly ever call out sizes for either the piping or the control valves. Don't be taken in by the apparent simplicity of the system as shown in these drawings. It's likely to be only the tip of the iceberg. For example, unless the air handling capacity of the system is less than 16,000 CFM, the single coil bank shown won't be adequate. Add one or two more coil banks and you're looking at a lot more piping — and a more complex system that takes longer to install.

You probably haven't even decided which equipment supplier to use. This is hardly the time for you to start researching heating and cooling coils. Nevertheless, you need better, more complete and realistic data to come up with a competitive estimate.

I'll tell you how and where to track down the hard data that you need, and also pass along a few tips on estimating water coil piping. They'll help you avoid leaving something out of your estimates — a real pitfall for any beginner. It's those little (but essential) items, so easily overlooked, that are so deadly to a profit margin. Finally, check the next two pages of diagrams with tables. The data given there, combined with the data you collected earlier, forms the basis for informed guesswork.

The Hard Data

There are two things you absolutely must know to estimate water coil piping. First, the size of the branch piping to the coils; second, the CFM rating of the air handling units for the system.

To find the pipe sizes, look at either the floor plans or the details for the equipment room. They'll list the sizes of the branch run-out pipes. Once you know them, you can make a good guess at the right size for the control valves. (See the diagrams and tables on pages 295 and 296.) The only information you need is the CFM ratings of the air handling units and the branch piping sizes to the coils. If the system's capacity is over 16,000 CFM, you need two or three coil banks.

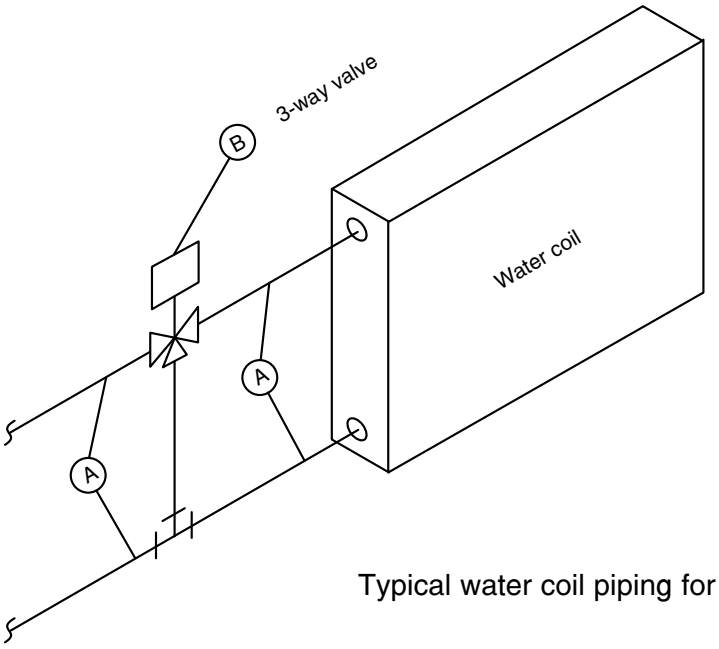
A Few Tips on Estimating Water Coil Piping

1) Coil connection sizes seldom match branch pipe sizes. Be sure to include the reducing fittings you'll need in any estimate.

2) Two-way and three-way control valves are both usually one pipe size smaller than the pipe where they're installed. That means you'll need either two or three reducing fittings per control valve. Be sure you include their cost in your estimates.

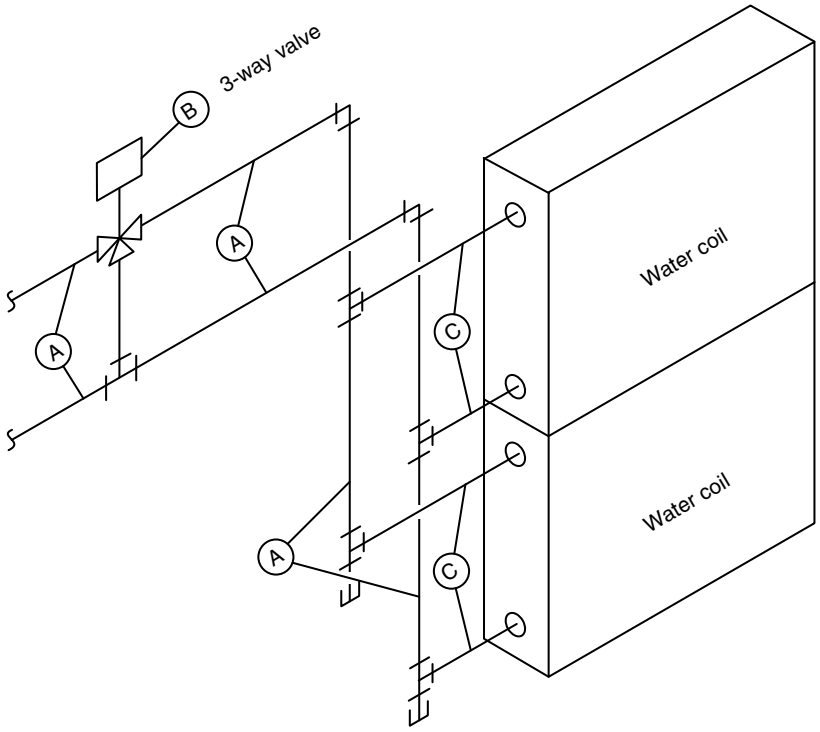
Using the Diagrams

In the following diagrams, for clarity, some items aren't included. These items are: balance valves, shut-off valves, reducers, strainers, gauges and gauge taps. Any details you need about these items for your estimate are in the engineer's coil piping details.



If (A) is:	Then (B) is:
1"	¾"
1¼"	1"
1½"	1¼"
2"	1½"
2½"	2"
3"	2½"

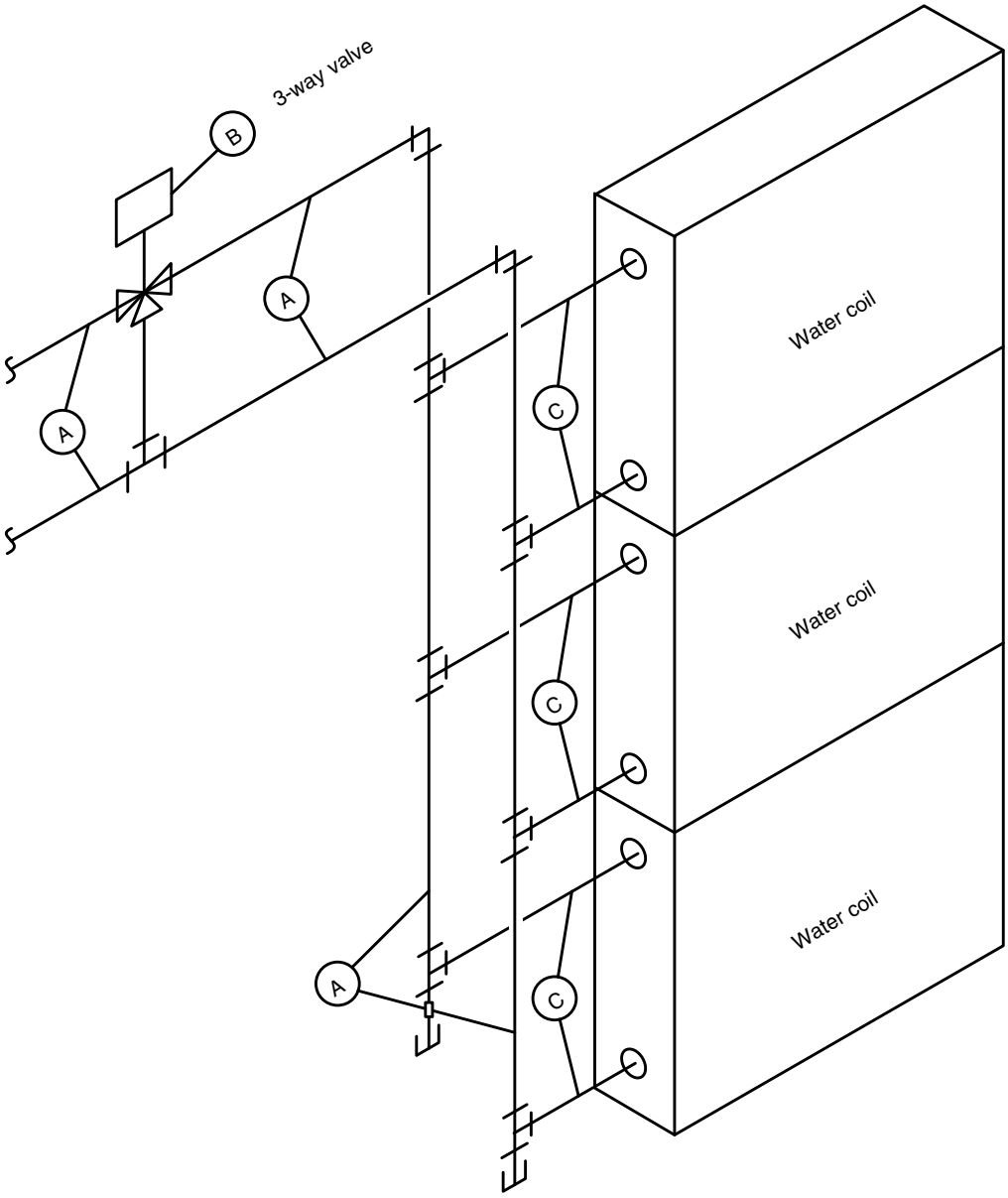
Typical water coil piping for A.H. units up to 16,000 CFM



If (A) is:	Then (B) is:	And (C) is:
2½"	2"	2"
3"	2½"	2½"
4"	3"	3"

Typical water coil piping for A.H. units from 16,000 to 26,000 CFM

Water Coil Piping



If (A) is:	Then (B) is:	And (C) is:
4"	3"	2½"
6"	4"	3"
8"	6"	4"
10"	8"	6"

Typical water coil piping for A.H. units over 26,000 CFM

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Air handling unit coil connection, one row coil bank, non-regulated flow. Connection assembly includes pipe, fittings, pipe insulation, valves, gauges, thermometers and vents.						
1½" supply	SN@14.0	Ea	1,780.00	537.00	220.00	2,537.00
2" supply	SN@18.0	Ea	2,190.00	690.00	282.00	3,162.00
2½" supply	SN@28.0	Ea	2,930.00	1,070.00	440.00	4,440.00
3" supply	SN@31.5	Ea	3,210.00	1,210.00	495.00	4,915.00
4" supply	SN@34.0	Ea	3,440.00	1,300.00	534.00	5,274.00
6" supply	SN@41.0	Ea	4,980.00	1,570.00	644.00	7,194.00
Air handling unit coil connection, one row coil bank, 2-way control valve design. Connection assembly includes pipe and fittings, pipe insulation, valves, gauges, thermometers and vents.						
1½" supply	SN@16.5	Ea	2,010.00	633.00	259.00	2,902.00
2" supply	SN@21.0	Ea	2,590.00	805.00	330.00	3,725.00
2½" supply	SN@33.6	Ea	3,150.00	1,290.00	528.00	4,968.00
3" supply	SN@36.0	Ea	3,390.00	1,380.00	567.00	5,337.00
4" supply	SN@43.8	Ea	4,110.00	1,680.00	688.00	6,478.00
6" supply	SN@54.0	Ea	6,590.00	2,070.00	849.00	9,509.00
Air handling unit coil connection, one row coil bank, 3-way control valve design. Connection assembly includes pipe and fittings, pipe insulation, valves, gauges, thermometers and vents.						
1½" supply	SN@18.0	Ea	2,320.00	690.00	282.00	3,292.00
2" supply	SN@26.0	Ea	2,900.00	997.00	409.00	4,306.00
2½" supply	SN@41.5	Ea	3,630.00	1,590.00	653.00	5,873.00
3" supply	SN@43.8	Ea	4,000.00	1,680.00	688.00	6,368.00
4" supply	SN@54.6	Ea	5,160.00	2,090.00	858.00	8,108.00
6" supply	SN@61.4	Ea	7,340.00	2,350.00	965.00	10,655.00
Air handling unit coil connection, two row coil bank, non-regulated flow. Connection assembly includes pipe and fittings, pipe insulation, valves, gauges, thermometers and vents.						
2½" supply	SN@48.0	Ea	4,390.00	1,840.00	754.00	6,984.00
3" supply	SN@51.5	Ea	5,340.00	1,970.00	809.00	8,119.00
4" supply	SN@63.6	Ea	7,070.00	2,440.00	999.00	10,509.00
6" supply	SN@79.2	Ea	10,400.00	3,040.00	1,250.00	14,690.00
Air handling unit coil connection, two row coil bank, 2-way control valve design. Connection assembly includes pipe and fittings, pipe insulation, valves, gauges, thermometers and vents.						
2½" supply	SN@54.0	Ea	4,920.00	2,070.00	849.00	7,839.00
3" supply	SN@58.5	Ea	6,180.00	2,240.00	919.00	9,339.00
4" supply	SN@67.0	Ea	7,600.00	2,570.00	1,050.00	11,220.00
6" supply	SN@83.5	Ea	10,600.00	3,200.00	1,310.00	15,110.00

Description	Craft@Hrs	Unit	Material $	Labor $	Equipment $	Total $
Air handling unit coil connection, two row coil bank, 3-way control valve design. Connection assembly includes pipe and fittings, pipe insulation, valves, gauges, thermometers and vents.						
2½" supply	SN@58.8	Ea	5,160.00	2,250.00	924.00	8,334.00
3" supply	SN@64.0	Ea	6,500.00	2,450.00	1,010.00	9,960.00
4" supply	SN@72.0	Ea	8,230.00	2,760.00	1,130.00	12,120.00
6" supply	SN@87.0	Ea	11,000.00	3,340.00	1,370.00	15,710.00
Air handling unit coil connection, three-row coil bank, non-regulated flow. Connection assembly includes pipe and fittings, pipe insulation, valves, gauges, thermometers and vents.						
4" supply	SN@72.0	Ea	7,450.00	2,760.00	1,130.00	11,340.00
6" supply	SN@94.0	Ea	13,000.00	3,600.00	1,480.00	18,080.00
8" supply	SN@120.	Ea	17,400.00	4,600.00	1,890.00	23,890.00
Air handling unit coil connection, three-row coil bank, 2-way control valve design. Connection assembly includes pipe and fittings, pipe insulation, valves, gauges, thermometers and vents.						
4" supply	SN@78.0	Ea	7,920.00	2,990.00	1,230.00	12,140.00
6" supply	SN@105.	Ea	14,300.00	4,030.00	1,650.00	19,980.00
8" supply	SN@132.	Ea	19,500.00	5,060.00	2,070.00	26,630.00
Air handling unit coil connection, three-row coil bank, 3-way control valve design. Connection assembly includes pipe and fittings, pipe insulation, valves, gauges, thermometers and vents.						
4" supply	SN@82.0	Ea	9,170.00	3,140.00	1,290.00	13,600.00
6" supply	SN@112.	Ea	14,700.00	4,290.00	1,760.00	20,750.00
8" supply	SN@140.	Ea	21,900.00	5,370.00	2,200.00	29,470.00

For contracts that comply with your state's regulations, please visit www.constructioncontractwriter.com

Standard Form Subcontract

Subcontract No. 7777-1

THIS AGREEMENT, made and entered into at Smallville, CA. this 3rd day of May, 2018, by and between Acme Mechanical Contractors hereinafter called **CONTRACTOR,** with principal office at 7600 Oak Avenue, Smallville, California, and Quikrap Insulation Co., 320 Maple Blvd., Smallville, CA hereinafter called a **SUBCONTRACTOR**.

RECITALS

On or about the 2nd day of January, 20 18, CONTRACTOR entered into a prime contract with

ABC General Contractors, Inc. hereinafter called OWNER, whose address is 380 First Street, Smallville, California to perform the following construction work: The installation of all mechanical and plumbing systems for the proposed Mile-Hi office building to be located at 2600 Second, North, Smallville, California.

Said work is to be performed in accordance with the prime contract and the plans and specifications. Said plans and specifications have been prepared by or on behalf of Quik-Draw and Associates, Smallville, California, **ARCHITECT**

SECTION 1 - ENTIRE CONTRACT

SUBCONTRACTOR certifies and agrees that he is fully familiar with all of the terms, conditions and obligations of the Contract Documents, as hereinafter defined, the location of the job site, and the conditions under which the work is to be performed, and that he enters into this Agreement based upon his investigation of all of such matters and is in no way relying upon any opinions or representations of CONTRACTOR. It is agreed that this Agreement represents the entire agreement. It is further agreed that the Contract Documents are incorporated in this Agreement by this reference, with the same force and effect as if the same were set forth at length herein, and that SUBCONTRACTOR and his subcontractors will be and are bound by any and all of said Contract Documents insofar as they relate in any part or in any way, directly or indirectly to the work covered by this Agreement. SUBCONTRACTOR agrees to be bound to CONTRACTOR in the same manner and to the same extent as CONTRACTOR is bound to OWNER under the Contract Documents, to the extent of the work provided for in this Agreement, and that where, in the Contract Documents, reference is made to CONTRACTOR and the work or specification therein pertains to SUBCONTRACTOR'S trade, craft, or type of work, then such work or specification shall be interpreted to apply to SUBCONTRACTOR instead of CONTRACTOR. The phrase "Contract Documents" is defined to mean and include:

Drawing Nos. A-1 thru A-17, C-1 thru C-4, S-1 thru S-7, E-1 thru E-6 and M-1 thru M-7, all dated
10-4-2017, Specifications dated 10-2-16 and Addendum No. 1 dated 10-18-17.

SECTION 2 - SCOPE

SUBCONTRACTOR agrees to furnish all labor, services, materials, installation, cartage, hoisting, supplies, insurance, equipment, scaffolding, tools and other facilities of every kind and description required for the prompt and efficient execution of the work described herein and to perform the work necessary or incidental to complete thermal insulation for all plumbing, HHW, CHW and condensate piping systems, including pumps P-1, P-2 and P-3 for the project in strict accordance with the Contract Documents and as more particularly, though not exclusively, specified in:

Division 15, Section 400 entitled "Thermal Insulation systems" and General Conditions, as applicable.

SECTION 3 - CONTRACT PRICE

CONTRACTOR agrees to pay SUBCONTRACTOR for the strict performance of his work, the sum of:

Forty-two thousand, three hundred dollars ($42,300.00), subject to additions and deductions for changes in the work as may be agreed upon, and to make payment in accordance with the Payment Schedule, Section 4.

SECTION 4 - PAYMENT SCHEDULE

CONTRACTOR agrees to pay SUBCONTRACTOR in monthly payments of 90 % of labor and materials which have been placed in position and for which payment has been made by OWNER to CONTRACTOR. The remaining 10 % shall be retained by CONTRACTOR until he receives final payment from OWNER, but not less than thirty-five days after the entire work required by the prime contract has been fully completed in conformity with the Contract Documents and has been delivered and accepted by OWNER, ARCHITECT, and CONTRACTOR. Subject to the provisions of the next sentence, the retained percentage shall be paid SUBCONTRACTOR promptly after CONTRACTOR receives his final payment from OWNER. SUBCONTRACTOR agrees to furnish, if and when required by CONTRACTOR, payroll affidavits, receipts, vouchers, release of claims for labor, material and subcontractors performing work or furnishing materials under this Agreement, all in form satisfactory to CONTRACTOR, and it is agreed that no payment hereunder shall be made, except at CONTRACTOR'S option, until and unless such payroll affidavits, receipts, vouchers or release; or any or all of them, have been furnished. And payment made hereunder prior to completion and acceptance of the work, as referred to above, shall not be construed as evidence of acceptance of any part of SUBCONTRACTOR'S work.

SECTION 5 - GENERAL SUBCONTRACT PROVISIONS

General Subcontract Provisions on back of Pages 1 and 2 are an integral part of this Agreement.

SECTION 6 - GENERAL PROVISIONS

1. *SUBCONTRACTOR* agrees to begin work as soon as instructed by the CONTRACTOR, and shall carry on said work promptly, efficiently and at a speed that will not cause delay in the progress of the CONTRACTOR'S work or work of other subcontractors. If, in the opinion of the CONTRACTOR, the SUBCONTRACTOR falls behind in the progress of the work, the CONTRACTOR may direct the SUBCONTRACTOR to take such steps as the CONTRACTOR deems necessary to improve the rate of progress, including, without limitation, requiring the SUBCONTRACTOR to increase the number of shifts, personnel, overtime operations, days of work, equipment, amount of plant, or other remedies and to submit to CONTRACTOR for CONTRACTOR'S approval an outline schedule demonstrating the manner in which the required rate of progress will be regained, without additional cost to the CONTRACTOR. CONTRACTOR may require SUBCONTRACTOR to prosecute, in preference to other parts of the work, such part or parts of the work as CONTRACTOR may specify.

The SUBCONTRACTOR shall complete the work as required by the progress schedule prepared by the CONTRACTOR, which may be amended from time to time. The progress schedule may be reviewed in the office of the CONTRACTOR and sequence of construction will be as directed by the CONTRACTOR.

The SUBCONTRACTOR agrees to have an acceptable representative (an officer of SUBCONTRACTOR if requested by the CONTRACTOR) present at all job meetings and to submit weekly progress reports in writing if requested by the CONTRACTOR. Any job progress schedules are hereby made a part of and incorporated herein by reference.

2. ***Reserved Gate Usage***

SUBCONTRACTOR shall notify in writing, and assign its employees, material men and suppliers, to such gates or entrances as may be established for their use by CONTRACTOR and in accordance with such conditions and at such times as may be imposed by CONTRACTOR. Strict compliance with CONTRACTOR'S gate usage procedures shall be required by the SUBCONTRACTOR who shall be responsible for such gate usage by its employees, material men, suppliers, subcontractors, and their material men and suppliers.

3. ***Staggered Days and Hours of Work and for Deliveries***

SUBCONTRACTOR shall schedule the work and the presence of its employees at the jobsite and any deliveries of supplies or materials by its material men and suppliers to the jobsite on such days, and at such times and during such hours, as may be directed by CONTRACTOR. SUBCONTRACTOR shall assume responsibility for such schedule compliance not only for its employees but for all its material men, suppliers and subcontractors, and their material men and suppliers.

SECTION 7 - SPECIAL PROVISIONS

1. Pipe hanger inserts will be furnished and installed by Contractor.
2. All trash pickup by Subcontractor; haul-away will be by General Contractor.

Contractors are required by law to be licensed and regulated by the Contractors' State License Board. Any questions concerning a contractor may be referred to the registrar of the board whose address is:

Contractors' State License Board -- P. O. Box 26000, Sacramento, California 95826

IN WITNESS WHEREOF: The parties hereto have executed this Agreement for themselves, their heirs, executors, successors, administrators, and assignees on the day and year first above written.

SUBCONTRACTOR	**CONTRACTOR**
Quikrap Insulation Company	Acme Mechanical Contractors
By _____	By _____
Name Title	Name Title
☐ Corporation ☐ Partnership ☐ Proprietorship	
(Seal)	
Contractor's State License No. _____	Contractor's State License No. _____

Subcontract Change Order

Number One

Date 6-11-18

To Quickrap Insulation Co.

Subcontract Number 7777-1

Our Job Number

Our Proposal Number

Architect's C.O. Number

Effective Date of Charge 6-17-18

Subject to all the provisions of this Change Order, you are hereby directed to make the following change(s)

Delete HHW and CHW piping insulation located above Room No. 322 per ABC General Contractor's Change Order No. 18, dated 6-5-18.

The following change(s) will alter the price provided in your subcontract by the deduction ***of $*** 465.00

*Surety Consent		
This Change is Approved **Date**	Adjusted Subcontract Price Through C.O. Number 0	$ 42,300.00
Name:	Amount this C.O. Number:	$ (465.00)
By:	Current Adjusted Subcontract Price:	$ 41,835.00
Title:		

When this Change Order is signed by both parties (and by Subcontractor's surety is subcontract is bonded), it constitutes their agreement:

(A) That the subcontract price is adjusted as shown above and that no further adjustment in that price by reason of the change(s) provided herein shall be made; and (B) That all the terms and conditions of the subcontract, except as modified by this and any previous changes, shall remain in full force and effect and apply to the work as so changed.

Accepted and Agreed:	**Date:**
By	**By**
Authorized Signature – Subcontractor	Authorized Signature – Contractor
Title	**Title**

* Subcontractor: Sign pink copy and return immediately. If subcontract is bonded, obtain consent of surety endorsed thereon. No payments on account of this Change Order will be made until you have complied with the foregoing.

Published by San Diego Chapter A.G.C.

A purchase order is a legal document used to order equipment and materials from a vendor, with the implied promise to pay for these goods within a specified time after receipt of the items. Purchase orders are sometimes used to write subcontracts whose value does not exceed one or two thousand dollars. Refer to the sample purchase order on page 452.

While most of the purchase order is self-explanatory, certain items need to be emphasized:

“Description” should include all pertinent data such as model numbers, arrangements, performance requirements, applicable standards, electrical characteristics and so on.

“Tag” is used to identify a particular piece of equipment to facilitate unloading it at the proper location at the jobsite. Tag numbers for all major equipment can usually be found on the contract drawings.

“48 hour delivery notice”: This can be very important if the material or equipment being delivered is too heavy to be unloaded by hand. Time will be required to arrange for a crane or forklift to unload the truck.

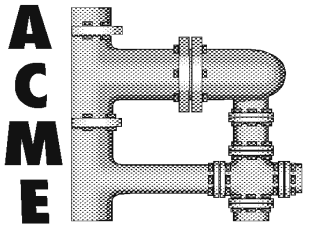
“Sales tax” is the current state sales tax which must be included unless the goods are to be delivered and installed at a project located out-of-state.

“Terms”: The usual payment terms are “Net 30” which means the entire amount of the purchase order must be paid within thirty days after receipt of all goods, undamaged. If items are received damaged, payment should be withheld until satisfactory repair or replacement is made.

ACME

Mechanical Contractors

7600 Oak Avenue - Smallville, U.S.A. 12345-6789
Voice 1-234-5678 / FAX 1-234-5680



Purchase Order

P.O. Number: 7777-36 **Date:** 1-6-18

Job: CBC Bank Building

Job No: 7777

Seller: Smallville Industrial Sales Co. 3657 Third Avenue Northwest Smallville, CA 63876	**Ship to:** Acme Mechanical Contractors c/o CBC Bank Building 465 Commercial Street Smallville, CA 63876

Attn: Mr. L.H. Seller By: RJS

Delivery date: 2-28-18 **24 Hr. Delivery Notice Required** **Payment terms:** Net 30

Quantity	Description	Unit	Total
Two	Big-Blo Model No. 1JN 86-13 centrifugal	$443.00	$886.00
	fans with 480/3/60 one-half H.P., O.D.P.		
	motor. 3250 CFM @ 0.50 T.S.P.		
	Tag one EF-13 and one EF-23		

Number of copies of operation and maintenance manuals required 2.

All shipments are to be F.O.B. jobsite or shop unless otherwise noted.

Total before tax	$886.00
Sales tax	$62.02
Freight	Included
Total Order	$948.02

Buyer: RJS

Acceptance by seller _____ Date _____

The general contractor's construction schedule may range from a simple bar chart to a complicated computer-generated CPM (Critical Path Method) diagram. More complex jobs require more complete and detailed schedules. On larger jobs, lower-tier subcontractors may be required to prepare a bar chart showing their construction schedule.

If you have to prepare a construction schedule, make conservative estimates of the time required to complete each part of the job. A slower schedule makes it possible to use smaller crews which are usually more efficient.

You can't schedule your own work until the general contractor has supplied a schedule for the balance of the project. When you have that schedule, prepare a list of tasks your crews will perform. Show this list to the general contractor to be certain there are no conflicts with the master schedule.

When the list of tasks to be performed has been approved, begin recording the manhours required for each task. Take these manhours from your estimate. When the duration for each task has been determined, figure the crew sizes required.

For example, suppose the estimate shows that it will take 1,040 manhours to install the underground plumbing for a project. The work must be completed in two months. Assuming one worker averages 173 hours of work in one month, how many workers will be required to meet the schedule? Here's the solution:

$$\frac{\text{1,040 manhours}}{\text{173 MH / Mo. x 2 months}} = \text{3 workers}$$

The first of the two bar charts on the following pages shows the schedule a general contractor might expect to receive from a plumbing and HVAC subcontractor. The chart on page 454 is intended for use by the subcontractor. It includes information a mechanical subcontractor needs to determine proper crew sizes for each task. The *Cumulative Manhours* line shows the budgeted manhours for each month of the project. If labor costs are to be kept within budget, actual hours should not exceed estimated hours. Monitor labor costs each month by comparing the line *Actual MH Used* (actual manhours used) with the line *Cumulative MH* (estimated cumulative manhours).

Construction Schedule

Company: Acme Mechanical Contractors **Project:** Mile-Hi Office Bldg **Job Number:** 7777 **Date:** 6/8/18

	2018						2019					
Activity	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Crew Sizes**
Submittals												
Purchasing												
U/G Plumbing												
A/G Plumbing												
Fin. Plumbing												
HVAC Piping												
HVAC Ducting												
Equipment												
Insulation												
Temp. Controls												
Start-up												

Construction Schedule

Company: Acme Mechanical Contractors **Project:** Mile-Hi Office Bldg **Job Number:** 7777 **Date:** 6/8/18

	2018						2019					
Activity	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Crew Sizes**
Submittals												N/A
Purchasing												N/A
U/G Plumbing												1040 MH ÷(173 x 2) = 3
A/G Plumbing												2075 MH ÷ (173 x 4) = 3
Fin. Plumbing												130 MH ÷ (173 x .5) = 1.5
HVAC Piping												2760 MH ÷ (173 x 4) = 4
HVAC Ducting												2790 MH ÷ (173 x 4) = 4
Equipment												690 MH ÷ (173 x 2) = 2
Insulation												Subcontract
Temp. Controls												Subcontract
Start-up												85 MH ÷ (173 x .5) = 1
Crew size/month			3	6	11	11	11	11.5	2	1		
Cumulative MH*			520	1159	3466	5373	7280	9143	9448	9573		MH Estimated = 9573
Actual MH used												
*Per estimate												
*Rounded												

Letter of Intent

On most large projects the contractor is required to submit drawings and technical data to the owner's representative for approval before work actually begins. Most of these submittals will be prepared by your suppliers and third-tier subs. Vendors and subs may be reluctant to prepare these documents without some assurance that they've been selected to do the work. That's the purpose of a letter of intent. It notifies a proposed vendor or subcontractor that you plan to contract with them when the owner approves the information submitted.

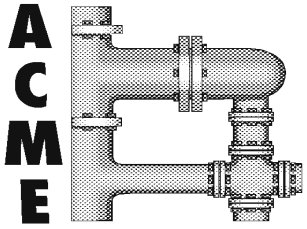
A letter of intent isn't a contract. It's an expressed intention to make a contract, which isn't a contract at all. But a vendor who gets your letter of intent and supplies all the information requested should get the contract. If you place the order with a different vendor, obviously, your letter of intent was worthless. That first vendor may be very reluctant to cooperate in the future.

A sample letter of intent follows this page.

ACME

Mechanical Contractors

7600 Oak Avenue - Smallville, U.S.A. 12345-6789
Voice 1-234-5678 / FAX 1-234-5680



December 20, 2017

Quikrap Insulation Company
320 Maple Boulevard
Smallville, U.S.A. 12345-6789

Attn: Mr. R. S. Quikrap

Dear Mr. Quikrap:

Acme Mechanical Contractors has been issued a subcontract to furnish and install the mechanical and plumbing systems for the proposed Mile-Hi Office Building to be located at 2600 Second Street in Smallville.

It is my intention to award your firm a subcontract to provide the thermal insulation for these systems in accordance with your proposal dated 12-13-17 in the amount of $42,300.00.

Please prepare ten copies of your submittal data and forward them to me no later than January 15, 2018. Upon approval of your submittal, I will mail you the subcontract for your review and signature.

Thank you,

Bobby Thompson
Project Manager

CC: Project file

Submittal Data

The construction specifications may require that you submit manufacturer's technical data on certain equipment you plan to install. You may have to submit six to ten copies of this technical data for approval before buying the equipment or contracting with third-tier subcontractors.

First, find out how many submittal copies will be required. Request that number of copies plus at least two additional sets for your use. A subcontractor who provides only services (no materials) may have to submit a detailed written explanation of the work to be done.

The second step is to label each submittal with the paragraph number of the specification where that equipment, material or service is described. Type or write this number in the upper right corner of each submittal sheet. From this set of numbered submittals, prepare a submittal index, a list of submittals identified by title and paragraph number. This index should be arranged in specification paragraph order. A blank submittal index form follows this section.

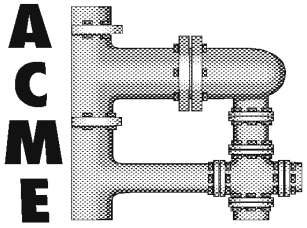
I prefer to use a three-ring binder to hold submittals. That makes it easier to add and delete sections as needed. Be sure to include a cover sheet, usually on company letterhead, which identifies the project, job number and scope of work being submitted. A sample submittal cover sheet follows this section.

Purchase orders and subcontracts should not be written until an approved copy of the submittal brochure has been received.

ACME

Mechanical Contractors

7600 Oak Avenue - Smallville, U.S.A. 12345-6789
Voice 1-234-5678 / FAX 1-234-5680



Division 15

Heating, Ventilating, Air Conditioning and Plumbing Systems

Submittal Data for

Mile-Hi Office Building
2600 Second Street
Smallville, U.S.A.

Submittal Index

Specification Section	Specification Paragraph	Item Description	Proposed Vendor or Sub	As Specified	See Submittal Data Page

The format to be used for monthly progress billings is seldom specified in the contract documents. In any case, your bill has to include enough detail to satisfy the owner and the lender.

Before preparing your bill, ask the general contractor how much detail is required. Some general contractors will want detailed cost breakdowns showing costs for each system on each building floor. Others will require much less detail.

Find out if billings can include the cost of equipment and materials delivered and stored either on site or off site but not yet installed. If billings can include materials stored off site, do these materials have to be stored in a bonded warehouse? Do vendor's invoices have to accompany progress billings?

When you understand what's required for monthly progress billings, prepare a billing breakdown worksheet. A sample worksheet follows this section.

Column one, Activity Lists each work item in the order work will be performed. The first item listed will usually be mobilization. This includes the cost of the job site trailer, electrical and telephone hookups, office furniture and supplies and initial labor costs. Billings for mobilization costs are sometimes denied by the lender. Many contractors minimize these costs to increase the chance of approval. It's better to receive partial payment for these costs than none at all.

Column two, Cost ($) Lists the actual contractor's costs for each activity, including labor, material, equipment and sales taxes. Markup for overhead and profit are not included.

Column three, Factor This column shows the markup assigned to each activity. Activities scheduled to be completed first are usually assigned the highest markups. This is called front loading and is common in the construction industry. Most bills won't be paid for 30 to 60 days. When the bill is paid, the amount received probably won't include the percentage allowed for retention. Generally, retention is 10 percent and isn't released until the project is complete and accepted by the owner.

Front loading helps contractors carry the financial burden of work in progress. Few subcontractors have enough cash to pay all their bills when due and still wait months to collect for work that's been completed. Employees have to be paid in full and on time. Assigning a higher markup to work completed first accelerates the payment schedule and helps spread payments more evenly over the entire project. Front loading is routine with subcontractors and unpopular with owners and lenders. In practice, subcontractors have no choice but to place a higher price or higher markup on work completed first.

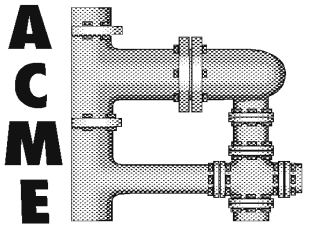
Note that figures in the Factor column are less than 1.0 for work done near the end of the project. That's because front loading doesn't change the contract price. It changes only when that money is received.

Column four, Sell ($) Values for this column are the product of the cost and factor columns. Use the figures in this column when submitting monthly progress invoices.

ACME

Mechanical Contractors

7600 Oak Avenue - Smallville, U.S.A. 12345-6789
Voice 1-234-5678 / FAX 1-234-5680



Billing Breakdown Worksheet

(CBC Bank Building - Job No. 7777)

Activity	Cost ($)	Factor	Sell ($)
Mobilization	2,000	1.50	3,000
Underground chilled and heated water piping	120,000	1.35	162,000
Underground plumbing & piping	87,000	1.35	117,450
Above ground chilled and heating water piping	115,000	1.20	138,000
Above ground plumbing & piping	87,000	1.20	104,400
HVAC ducting	96,000	1.20	115,200
Equipment	312,000	1.10	343,200
Duct and pipe insulation	119,000	1.00	119,000
Temperature controls	53,000	.90	47,700
Plumbing fixtures	43,000	.65	27,950
Water treatment	1,800	.55	990
Test and balance	13,000	.55	7,150
Validation	500	.50	250
	1,049,300		1,186,290

$$\text{Estimated gross profit} = \frac{\$1{,}186{,}290 - \$1{,}049{,}300}{\$1{,}049{,}300} = 13\%$$

Index

C

D

E

F

G

Q

R

S

T

U

V

W - X- Y - Z