



# 2025 NATIONAL PLUMBING & HVAC ESTIMATOR

**Edited by James A. Thomson**

33rd Edition



**The National  
Estimator Cloud**



This manual is also available as an internet-based estimating service, *National Estimator Cloud*, that makes it easy to compile and print estimates, bids and invoices for nearly any type of construction project.

Generate professional estimates from your internet browser. Includes 10 Craftsman cost databases. It's never been easier. No disk and no download needed!



- Turn your estimate into a bid.
- Turn your bid into a contract.
- [ConstructionContractWriter.com](http://ConstructionContractWriter.com)



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.*

**Looking for other construction reference manuals?**

Craftsman has the books to fill your needs. **Call toll-free 1-800-829-8123**

Visit our Web site: <http://www.craftsman-book.com>

Cover design by: *Jennifer Johnson*

Photos: *iStock by Getty Images™*

© 2024 Craftsman Book Company

ISBN 978-1-57218-404-6

Published October 2024 for the year 2025.

# Contents

<b>How to Use This Book</b> .....	<b>5</b>	<b>Fire Protection</b>	
<b>Plumbing Equipment</b>		Fire Protection Sprinklers .....	172
Domestic Hot Water Heaters .....	19	Fire Protection Equipment .....	175
Water Softeners .....	22	Fire Protection Sprinkler Pipe and Fittings (Roll Grooved) .....	177
Kitchen Equipment .....	25	Fire Protection Branch Pipe & Fittings .....	181
Kitchen Equipment Connections .....	26	Fire Protection Sprinkler Pipe and Fittings (CPVC) .....	184
Plumbing Fixtures .....	27		
Plumbing Fixture Rough-In .....	31	<b>HVAC Equipment</b>	
<b>Piping Systems</b>		Commercial Boilers .....	186
Copper Pipe, Type K with Brazed Joints .....	33	Commercial Boiler Connections .....	191
Copper Pipe, Type K with Soft-Soldered Joints .....	43	Commercial Boiler Components and Accessories .....	193
Copper Pipe, Type L with Brazed Joints .....	53	Centrifugal Pumps and Pump Connections .....	207
Copper Pipe, Type L with Soft-Soldered Joints .....	61	Heat Exchangers and Connections .....	208
Copper Pipe, Type M with Brazed Joints .....	70	Fan Coil Units and Connections .....	209
Copper Pipe, Type M with Soft-Soldered Joints .....	78	Reheat Coils and Connections .....	210
Copper, Pressfit .....	86	Unit Heaters and Connections .....	211
Copper Pipe, Type K & L with Roll Grooved Joints .....	89	Chillers and Chiller Connections .....	212
Soft Copper Pipe .....	91	Condensing Units and Cooling Towers .....	213
Corrugated Stainless Steel Tubing .....	92	Cooling Towers and Cooling Tower Connections .....	214
PVC, Schedule 40, with Solvent-Weld Joints .....	93		
PVC, Schedule 80, with Solvent-Weld Joints .....	103	<b>Steel Piping Systems</b>	
Polyethylene-Aluminum Pipe with Crimped Joints .....	113	Carbon Steel, Schedule 40 with 150# Fittings & Butt-Welded Joints .....	215
Polyethylene-Aluminum Pipe with Compression Joints .....	118	Carbon Steel, Schedule 40 with 150# M.I. Fittings & Threaded Joints .....	224
Plumbing and Piping Specialties .....	121	Carbon Steel, Schedule 5 with Pressfit Fittings .....	235
Cast Iron, DWV, Service Weight, No-Hub with Coupled Joints .....	137	Carbon Steel, Schedule 80 with 300# Fittings & Butt-Welded Joints .....	238
Cast Iron, DWV, Service Weight, Hub & Spigot with Gasketed Joints .....	143	Carbon Steel, Schedule 80 with 300# M.I. Fittings & Threaded Joints .....	248
Copper, DWV, with Soft-Soldered Joints .....	148	Carbon Steel, Schedule 160 with 3,000-6,000# Fittings .....	256
ABS, DWV with Solvent-Weld Joints .....	152	Carbon Steel, Schedule 40 with Roll-Grooved Joints .....	267
PVC, DWV with Solvent-Weld Joints .....	156	Carbon Steel, Schedule 10 with Roll-Grooved Joints .....	274
PVC, DWV with Gasketed Bell and Spigot Joints .....	161	Carbon Steel, Schedule 40 with Cut-Grooved Joints .....	281
Polypropylene, Schedule 40, with Heat-Fused Joints .....	166		
<b>Floor, Area, Roof and Planter Drains</b> .....	<b>170</b>		
<b>Cleanouts</b> .....	<b>171</b>		

<b>Residential HVAC Assemblies</b> .....	<b>287</b>	Galvanized Steel Round Ductwork .....	395
<b>Air Handling Unit Accessories</b> .....	<b>291</b>	Fiberglass Ductwork.....	396
<b>Heat Recovery Ventilators - Commercial</b> .....	<b>292</b>	<b>Fiberglass Pipe Insulation</b> .....	<b>398</b>
<b>Heat Recovery Ventilators - Residential</b> .....	<b>293</b>	<b>Calcium Silicate Pipe Insulation with</b>	
<b>Water Coil Piping</b> .....	<b>295</b>	<b>Aluminum Jacket</b> .....	<b>400</b>
<b>Air Handling Unit Coil Connections</b> .....	<b>298</b>	<b>Closed Cell Elastomeric Pipe Insulation</b> .....	<b>401</b>
<b>Gas-Fired Furnaces</b> .....	<b>300</b>	<b>Thermal Duct Insulation</b> .....	<b>402</b>
<b>Energy Recovery Systems, Enthalpy</b> .....	<b>302</b>	<b>Balancing of HVAC Systems</b> .....	<b>403</b>
<b>Unit Heaters</b> .....	<b>303</b>	<b>Temperature Controls</b> .....	<b>406</b>
<b>Infrared Heaters</b> .....	<b>305</b>	<b>Ductile Iron Pipe Systems</b>	
<b>Heat Pump Systems</b> .....	<b>306</b>	Ductile Iron, Class 153, Cement-Lined with	
<b>Water Pump Systems</b> .....	<b>314</b>	Mechanical Joints.....	408
<b>Geothermal/Domestic Water Wells</b> .....	<b>317</b>	Ductile Iron, Class 153, Double Cement-Lined	
<b>Biomass-Fired Boilers</b> .....	<b>320</b>	with Mechanical Joints .....	410
<b>Fans and Blowers</b> .....	<b>325</b>	Ductile Iron, Class 110, Cement-Lined with	
<b>Ventilators &amp; Residential Exhaust Fans</b> .....	<b>327</b>	Mechanical Joints.....	412
<b>Apparatus Housing</b> .....	<b>332</b>	<b>Cast Iron, Class 150 with Mechanical Joints</b> ....	<b>413</b>
<b>Air Devices, Registers &amp; Grilles</b> .....	<b>334</b>	<b>Asbestos-Cement, Class 2400 or 3000 with</b>	
<b>Air Devices, Diffusers &amp; Grilles</b> .....	<b>335</b>	<b>Mechanical Joints</b> .....	<b>414</b>
<b>Terminal Units (VAV)</b> .....	<b>338</b>	<b>Fiberglass Tanks</b> .....	<b>415</b>
<b>Ducting Systems</b>		<b>Plastic Tanks</b> .....	<b>416</b>
Ductwork Specialties.....	340	<b>Trenching</b> .....	<b>418</b>
Galvanized Steel Ductwork .....	345	<b>Equipment Rental</b> .....	<b>420</b>
Installed Ductwork Per Pound.....	347	<b>Close-Out Items</b> .....	<b>421</b>
Galvanized Steel Spiral Ductwork.....	349	<b>HVAC &amp; Plumbing Demolition</b> .....	<b>422</b>
Galvanized Steel Round Spiral Fittings .....	350	<b>Budget Estimating</b> .....	<b>435</b>
Galvanized Steel Rectangular Ductwork.....	352	<b>Forms and Letters</b>	
Galvanized Steel Rectangular		Change Estimates .....	438
90 Degree Elbows.....	354	Subcontract Forms.....	447
Galvanized Steel Spiral Duct .....	357	Purchase Orders .....	451
Galvanized Steel Spiral Duct Fittings.....	359	Construction Schedules .....	453
Galvanized Steel Spiral Tees.....	361	Letter of Intent.....	456
Galvanized Steel Spiral Crosses.....	367	Submittal Data.....	458
Galvanized Steel Rectangular Ductwork.....	370	Billing Breakdown Worksheet .....	461
Galvanized Steel Rectangular Elbows.....	382	<b>Index</b> .....	<b>463</b>
Galvanized Steel Drops and Tees .....	392		

# How to Use This Book

This 2025 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.

This manual is also available by subscription on the Web as part of *National Estimator Cloud*. For only a few dollars a month, you get all ten of Craftsman's 2025 construction cost estimating guides. Each has about 400 pages of current labor and material costs for construction – all neatly organized and indexed. Use these costs to build estimates, bids and invoices for nearly any type of project.

## *National Estimator Cloud:*

- Prints estimates, bids and invoices as Word, Excel or PDF documents.
- Supports progress billing. National Estimator remembers what work has been billed and what hasn't.
- Runs as a secure app on the Web so you can write estimates anywhere you have a Web connection.
- Exports invoices to QuickBooks, either desktop or online.
- Bids and invoices can show as much or as little detail as you want.
- Material costs are updated regularly as prices change.
- Costs only a few dollars a month. Cancel any time you want.

**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@Hrs*. For example, on page 19 you'll see an estimate for installing a 6 gallon hot water heater. In the *Craft@Hrs* 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 \$42.54 (the average wage for crew P1) is \$21.30.

**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.

**National Plumbing & HVAC Estimator**

- 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 \$49.43 for plumbers and \$47.79 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 National Estimator Cloud, 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

<b>Condition</b>	<b>Correction Factor</b>
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**

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 2025.

**Column 2**, taxable fringe benefits, includes vacation pay, sick leave and other taxable benefits. These fringe benefits average about 5.68% of the base wage for many plumbing and HVAC contractors. This benefit is in addition to the base wage.

**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



Column Number	1	2	3	4	5	6
	Base wage per hour	Taxable fringe benefits (at 5.68% of base wage)	Insurance and employer taxes (%)	Insurance and employer taxes (\$)	Non-taxable fringe benefits (at 5.02% of base wage)	Total hourly cost used in this book
Craft						
Laborer	24.94	1.42	30.46%	8.03	1.25	35.64
Plumber	36.51	2.07	23.37%	9.02	1.83	49.43
Sheet Metal Worker	34.94	1.99	24.68%	9.11	1.75	47.79
Operating Engineer	35.49	2.02	23.90%	8.96	1.78	48.25
Sprinkler Fitter	35.88	2.04	23.97%	9.09	1.80	48.81
Electrician	35.57	2.02	19.19%	7.21	1.79	46.59
Cement Mason	31.14	1.77	22.26%	7.33	1.56	41.80

Craft Code	Crew Composition	Average Hourly Cost per Manhour
ER	4 building plumbers, 2 building laborers, 1 operating engineer	45.32
SN	4 building sheet metal workers, 2 building laborers, 1 operating engineer	44.38
P1	1 building plumber and 1 building laborer	42.54
ST	1 sprinkler fitter	48.81
SK	4 sprinkler fitters, 2 building laborers, 1 operating engineer	44.97
SL	1 sprinkler fitter and 1 laborer	42.23
S2	1 building sheet metal worker, 1 building laborer	41.72
BE	1 electrician	46.59
CF	1 cement mason	41.80
SW	1 sheet metal worker	47.79

**Table 2 Labor Costs Used in This Book**

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 5.02% of the base wage for many plumbing and HVAC contractors. 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	\$29.00
Laborer	\$19.00
Total hourly crew cost	\$48.00

Your average cost per manhour would be \$24.00 (\$48.00 per crew hour divided by 2 because this is a crew of two).

A labor cost of \$24.00 is about 56.4% of the \$42.54 labor cost used for crew P1. Multiply costs in the Labor \$ column by .564 to find your estimated cost.

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 National Estimator Cloud.

**Equipment Cost** will vary according to need and application. It is typically \$33.30 per day for a 2-ton chain hoist.

**Material Costs** in this manual are intended to reflect what medium- to low-volume contractors will be paying in 2025 after applying normal discounts. These costs include charges for delivery to within 25 to 30 miles of the supplier.

## National Plumbing & HVAC Estimator

**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

## National Plumbing & HVAC Estimator

- |  |            |
|--|------------|
| 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% stand-by 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.

## National Plumbing & HVAC Estimator

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

### **Maximizing the Value of Old Estimates**

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

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

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

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

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

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

## **The Estimating Procedure**

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

1. Get a second set of project drawings and specifications for use by your suppliers and subcontractors. Remember that your subs and suppliers need access to the plans and specs and time to prepare their quotes.
2. Study the plans and specs carefully. Highlight important items. Make a list of specific tasks that require labor unit correction factors. The estimate is never complete until you're totally familiar with the project and the applicable construction codes.
3. Get the general contractor or owner to identify the proposed construction schedule and subcontractor lay-down (storage) area. Work schedule and site conditions always affect your costs.
4. Contact all potential suppliers and subcontractors as early as possible. Set a time when each can come to your office to make their take-offs from the spare set of contract documents.

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

## **Guidelines for Good Estimating**

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

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

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

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

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

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

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

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

## **Preparing the Proposal**

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

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

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

## MET Worksheet

### Material, Equipment and Tool Delivery and Surplus Return Record

Project ID \_\_\_\_\_

Job Location \_\_\_\_\_

Supervisor \_\_\_\_\_

Start Date \_\_\_\_\_

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

## PROJECT SUMMARY

Project ID \_\_\_\_\_ Job Location \_\_\_\_\_

Short description \_\_\_\_\_

Supervisor \_\_\_\_\_

Index ID \_\_\_\_\_ Start Date \_\_\_\_\_

Estimator \_\_\_\_\_ Client \_\_\_\_\_

Major vendors \_\_\_\_\_ Subcontractors \_\_\_\_\_

\_\_\_\_\_

Sources of cost deviation \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Related Projects by ID Number \_\_\_\_\_

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

# Estimate Detail Sheet

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

Company/Department \_\_\_\_\_ Estimator \_\_\_\_\_ Date \_\_\_\_\_  
 Project \_\_\_\_\_ Checked by \_\_\_\_\_ Date \_\_\_\_\_  
 Address \_\_\_\_\_ Notes: \_\_\_\_\_  
 Job description \_\_\_\_\_ Estimate # \_\_\_\_\_  
 CSI Division/Account \_\_\_\_\_ Estimate due \_\_\_\_\_

Item Description	Quantity	Unit	Crew @ MH/Unit	Manhours		Materials		Labor		Equipment		Subcontract		Total \$
				Unit	Ext.	Unit \$	Ext. \$	Unit \$	Ext. \$	Unit \$	Ext. \$	Unit \$	Ext. \$	
<b>Totals This Sheet</b>														

Carry totals forward to Estimate Summary Sheet Estimate # \_\_\_\_\_ Estimate Detail Sheet \_\_\_\_\_ of \_\_\_\_\_





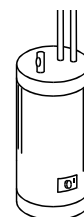


## Domestic Hot Water Heaters

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

**Electric domestic hot water heater (residential).** Set in place only (floor models). Make additional allowances for pipe and electrical connections. (See below)

6 gallon						
1.5 KW/110V	P1@.500	Ea	490.00	21.30	—	511.30
10 gallon						
1.5 KW/110V	P1@.500	Ea	548.00	21.30	—	569.30
15 gallon						
1.5 KW/110V	P1@.750	Ea	576.00	31.90	—	607.90
20 gallon						
1.5 KW/110V	P1@.750	Ea	542.00	31.90	—	573.90
30 gallon						
1.5 KW/110V	P1@1.00	Ea	556.00	42.50	—	598.50
40 gallon						
1.5 KW/110V	P1@1.20	Ea	582.00	51.00	—	633.00
50 gallon						
3 KW/110V	P1@1.30	Ea	627.00	55.30	—	682.30
12 gallon						
3 KW/220V	P1@.500	Ea	483.00	21.30	—	504.30
20 gallon						
3 KW/220V	P1@.750	Ea	529.00	31.90	—	560.90
30 gallon						
3 KW/220V	P1@1.00	Ea	603.00	42.50	—	645.50
40 gallon						
3 KW/220V	P1@1.20	Ea	656.00	51.00	—	707.00
50 gallon						
3 KW/220V	P1@1.30	Ea	703.00	55.30	—	758.30

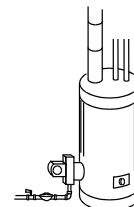


**Electric domestic hot water heater (commercial), 208/240 volt.** Set in place only. Make additional allowances for pipe and electrical connections. (See below)

96 gallon, 12 kw	P1@1.50	Ea	2,720.00	63.80	—	2,783.80
96 gallon, 18 kw	P1@1.50	Ea	3,690.00	63.80	—	3,753.80
96 gallon, 36 kw	P1@1.50	Ea	3,830.00	63.80	—	3,893.80
120 gallon, 18 kw	P1@2.00	Ea	3,920.00	85.10	—	4,005.10
120 gallon, 36 kw	P1@2.00	Ea	4,040.00	85.10	—	4,125.10
120 gallon, 54 kw	P1@2.00	Ea	4,780.00	85.10	—	4,865.10
120 gallon, 63 kw	P1@2.00	Ea	5,160.00	85.10	—	5,245.10

**Gas-fired domestic hot water heater (residential).** Set in place only, Make additional allowances for pipe and combustion venting connections. (See below)

30 gallon	P1@1.00	Ea	559.00	42.50	—	601.50
40 gallon	P1@1.00	Ea	904.00	42.50	—	946.50
50 gallon	P1@1.50	Ea	1,030.00	63.80	—	1,093.80



## Domestic Hot Water Heaters

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

**Gas-fired domestic hot water heater (commercial), standard efficiency.** Set in place only, Make additional allowances for pipe and combustion venting connections. (See below)

50 gal./ 95 gph	P1@2.00	Ea	2,710.00	85.10	—	2,795.10
67 gal./106 gph	P1@2.00	Ea	3,210.00	85.10	—	3,295.10
76 gal./175 gph	P1@2.00	Ea	4,290.00	85.10	—	4,375.10
91 gal./291 gph	P1@2.00	Ea	5,190.00	85.10	—	5,275.10

**Gas-fired domestic hot water heater (commercial), energy miser.** Set in place only, Make additional allowances for pipe and combustion venting connections. (See below)

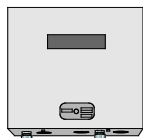
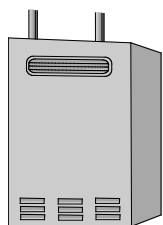
50 gal./ 95 gph	P1@2.00	Ea	6,690.00	85.10	—	6,775.10
67 gal./106 gph	P1@2.00	Ea	6,990.00	85.10	—	7,075.10
76 gal./175 gph	P1@2.00	Ea	8,660.00	85.10	—	8,745.10
91 gal./291 gph	P1@2.00	Ea	10,300.00	85.10	—	10,385.10

**Tankless natural gas water heaters.** Ambient pressure. DOE and UL rated. For residential, multi-dwelling and light commercial potable water applications. Add the cost of piping, tempering valve, circulating pump, controls, and electrical connection, post-installation inspection by both the fire marshal and the mechanical inspector to validate federal, state and local energy tax credits or energy tax credit offsets. For larger arrays (laundries, institutional facilities, food processing plants), develop an estimate based on the required capacity and multiply these costs by the number of heaters required. Rated in Btus and gallons per minute capacity. (1 Mbh = 1,000 Btus)

19.5-140 Mbh, .75-5.8 Gpm	P1@16.0	Ea	1,950.00	681.00	—	2,631.00
11-199 Mbh, .5-7 Gpm	P1@20.0	Ea	2,310.00	851.00	—	3,161.00
25-235 Mbh, .75-9.6 Gpm	P1@20.0	Ea	3,000.00	851.00	—	3,851.00

**Tankless electric point-of-use water heaters.** Ambient pressure, DOE and UL rated. For residential, multi-dwelling and light commercial potable water applications. Cost does not include piping, tempering valve, circulating pump, controls, storage tank, electrical connection. Add the cost of post-installation inspection by the mechanical inspector to validate federal, state and local energy tax credits or energy tax credit offsets. In rated gallons per minute capacity.

5.5 Kw/40 Amp, .75-2 Gpm	P1@4.00	Ea	492.00	170.00	—	662.00
9.5 Kw/50 Amp, .75-2.5 Gpm	P1@4.25	Ea	582.00	181.00	—	763.00
19 Kw/100 Amp, 1-3.5 Gpm	P1@4.50	Ea	969.00	191.00	—	1,160.00
28 Kw/120 Amp, 1.5-5 Gpm	P1@4.75	Ea	1,770.00	202.00	—	1,972.00



## Domestic Hot Water Heater Connections

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

**Domestic hot water heater connection assembly.** Includes supply, return, recirculation and relief piping and fittings (copper), relief and isolation valves. Make additional allowances for gas and venting connections where applicable.

¾" residential	P1@1.75	Ea	342.00	74.40	—	416.40
¾" commercial	P1@2.25	Ea	459.00	95.70	—	554.70
1" commercial	P1@2.75	Ea	804.00	117.00	—	921.00
1¼" commercial	P1@3.50	Ea	985.00	149.00	—	1,134.00
1½" commercial	P1@3.75	Ea	1,020.00	160.00	—	1,180.00
2" commercial	P1@4.50	Ea	1,090.00	191.00	—	1,281.00
2½" commercial	P1@5.75	Ea	2,270.00	245.00	—	2,515.00
3" commercial	P1@6.50	Ea	3,480.00	277.00	—	3,757.00

**Domestic water heater combustion vent connection.** Make additional allowances for piping distances greater than 25'.

2" B-vent	P1@.090	LF	7.18	3.83	—	11.01
3" B-vent	P1@.100	LF	8.88	4.25	—	13.13
4" B-vent	P1@.110	LF	11.80	4.68	—	16.48
6" B-vent	P1@.130	LF	14.40	5.53	—	19.93
Tankless heater vent kit	P1@2.50	Ea	681.00	106.00	—	787.00
Power vent kit	P1@2.00	Ea	1,670.00	85.10	—	1,755.10

## Water Softeners and Controllers

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

**Water softener, time clock controller.** Including brine tank, brine well and pick-up tube. Labor includes setting in place, connecting the unit to an existing domestic water distribution system, start up and testing.

20,000 grain water softener, TCC	P1@4.50	Ea	634.00	191.00	—	825.00
30,000 grain water softener, TCC	P1@4.50	Ea	676.00	191.00	—	867.00
45,000 grain water softener, TCC	P1@4.50	Ea	752.00	191.00	—	943.00
50,000 grain water softener, TCC	P1@4.75	Ea	848.00	202.00	—	1,050.00
60,000 grain water softener, TCC	P1@4.75	Ea	1,000.00	202.00	—	1,202.00
75,000 grain water softener, TCC	P1@5.00	Ea	1,080.00	213.00	—	1,293.00
90,000 grain water softener, TCC	P1@5.50	Ea	1,460.00	234.00	—	1,694.00
120,000 grain water softener, TCC	P1@5.75	Ea	1,570.00	245.00	—	1,815.00

**Water softener, mechanically-metered controller.** Including brine tank, brine well and pick up tube. Labor includes setting in place, connecting the unit to an existing domestic water distribution system, start up and testing.

20,000 grain water softener, MMC	P1@4.50	Ea	824.00	191.00	—	1,015.00
30,000 grain water softener, MMC	P1@4.50	Ea	860.00	191.00	—	1,051.00
45,000 grain water softener, MMC	P1@4.50	Ea	936.00	191.00	—	1,127.00
50,000 grain water softener, MMC	P1@4.75	Ea	1,030.00	202.00	—	1,232.00
60,000 grain water softener, MMC	P1@4.75	Ea	1,200.00	202.00	—	1,402.00
75,000 grain water softener, MMC	P1@5.00	Ea	1,290.00	213.00	—	1,503.00
90,000 grain water softener, MMC	P1@5.50	Ea	1,650.00	234.00	—	1,884.00
120,000 grain water softener, MMC	P1@5.75	Ea	1,760.00	245.00	—	2,005.00

## Water Softeners and Controllers

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

**Water softener, electronically-metered controller.** Including brine tank, brine well and pick up tube. Labor includes setting in place, connecting the unit to an existing domestic water distribution system, start up and testing.

20,000 grain water softener, EMC	P1@4.50	Ea	874.00	191.00	—	1,065.00
30,000 grain water softener, EMC	P1@4.50	Ea	900.00	191.00	—	1,091.00
45,000 grain water softener, EMC	P1@4.50	Ea	987.00	191.00	—	1,178.00
50,000 grain water softener, EMC	P1@4.75	Ea	1,080.00	202.00	—	1,282.00
60,000 grain water softener, EMC	P1@4.75	Ea	1,270.00	202.00	—	1,472.00
75,000 grain water softener, EMC	P1@5.00	Ea	1,330.00	213.00	—	1,543.00
90,000 grain water softener, EMC	P1@5.50	Ea	1,700.00	234.00	—	1,934.00
120,000 grain water softener, EMC	P1@5.75	Ea	1,810.00	245.00	—	2,055.00

### Water softener accessories

By-pass valve Manifold	P1@.400	Ea	83.10	17.00	—	100.10
adapter kit	P1@.200	Ea	22.40	8.51	—	30.91
Turbulator	P1@.400	Ea	40.90	17.00	—	57.90

**Iron filter, electronically-metered controller.** Manganese green sand filter. Labor includes setting in place, connecting the unit to an existing domestic water distribution system, start-up and testing.

42,000 iron filter (1.5 cf media), 5 gpm	P1@4.00	Ea	826.00	170.00	—	996.00
65,000 iron filter (2.0 cf media), 6 gpm	P1@4.50	Ea	978.00	191.00	—	1,169.00
84,000 iron filter (2.5 cf media), 8 gpm	P1@4.75	Ea	1,040.00	202.00	—	1,242.00
Replacement green sand media	P1@1.20	CF	47.90	51.00	—	98.90

### Iron filter accessories

By-pass valve	P1@.400	Ea	84.10	17.00	—	101.10
Air vent	P1@.200	Ea	66.70	8.51	—	75.21
Air controller	P1@.400	Ea	75.40	17.00	—	92.40

## Water Softener Accessories

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

**Combination iron filter/water softener.** Zeolite resins soften water and remove iron and manganese. Controller automatically controls PH level. Labor includes setting in place, connecting the unit to an existing domestic water distribution system, start-up and testing.

40,000 iron filter, 1.3 cf media	P1@4.00	Ea	1,600.00	170.00	—	1,770.00
60,000 iron filter, 1.7 cf media	P1@4.50	Ea	1,730.00	191.00	—	1,921.00
80,000 iron filter, 2.5 cf media	P1@4.75	Ea	2,510.00	202.00	—	2,712.00

**Hot water softener, time clock controller.** Brass valve construction. Designed for 150 F. maximum operating temperature. Includes brine tank, brine well and pick-up tube. Labor includes setting in place, connecting the unit to an existing domestic water distribution system, start-up and testing.

20,000 grain hot water softener	P1@4.50	Ea	2,000.00	191.00	—	2,191.00
30,000 grain hot water softener	P1@4.50	Ea	2,130.00	191.00	—	2,321.00
40,000 grain hot water softener	P1@4.50	Ea	2,230.00	191.00	—	2,421.00
60,000 grain hot water softener	P1@4.75	Ea	2,630.00	202.00	—	2,832.00

**Pressure tank, fiberglass wound.** Labor includes setting in place, connecting the tank to a domestic water distribution system and testing.

Fiberglass pressure tank, 20 gallon	P1@2.00	Ea	295.00	85.10	—	380.10
Fiberglass pressure tank, 30 gallon	P1@2.00	Ea	333.00	85.10	—	418.10
Fiberglass pressure tank, 80 gallon	P1@2.75	Ea	539.00	117.00	—	656.00
Fiberglass pressure tank, 120 gallon	P1@3.50	Ea	711.00	149.00	—	860.00
Brass tank tee assembly, ¾"	P1@3.50	Ea	45.00	149.00	—	194.00
Brass tank tee assembly, 1"	P1@3.50	Ea	83.80	149.00	—	232.80
Brass tank tee assembly, 1¼"	P1@3.50	Ea	143.00	149.00	—	292.00



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

**Ultra-violet water disinfection unit.** Stainless steel reactor, audible and visible alarm, lamp end-of-life indicator and 7-day override. Gpm rating at 30,000 mj/m2 output. Labor includes setting in place, connecting to the water system and testing.

UV system, 1 gpm, ¼" in/out	P1@3.00	Ea	276.00	128.00	—	404.00
UV system, 6 gpm, ½" in/out	P1@3.00	Ea	537.00	128.00	—	665.00
UV system, 8 gpm, ¾" in/out	P1@4.00	Ea	621.00	170.00	—	791.00
UV system, 12 gpm, ¾" in/out	P1@4.00	Ea	796.00	170.00	—	966.00
UV replacement lamp, 20W, 1 gpm	P1@.750	Ea	61.80	31.90	—	93.70
UV replacement lamp, 32W, 6 gpm	P1@.750	Ea	70.10	31.90	—	102.00
UV replacement lamp, 39W, 8-12 gpm	P1@.750	Ea	89.70	31.90	—	121.60
UV replacement ballast, 420 Mv/110V	P1@1.00	Ea	270.00	42.50	—	312.50

**Kitchen equipment booster heater**

1,000 watt	P1@4.00	Ea	859.00	170.00	—	1,029.00
------------	---------	----	--------	--------	---	----------

**Dishwasher**

Built-in	P1@5.00	Ea	949.00	213.00	—	1,162.00
----------	---------	----	--------	--------	---	----------

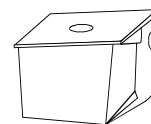
**Garbage disposal**

½ HP	P1@2.00	Ea	197.00	85.10	—	282.10
¾ HP	P1@2.00	Ea	329.00	85.10	—	414.10



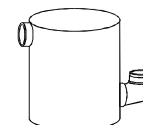
**Grease and oil interceptor**

4 GPM	P1@4.00	Ea	395.00	170.00	—	565.00
10 GPM	P1@5.00	Ea	643.00	213.00	—	856.00
15 GPM	P1@7.00	Ea	959.00	298.00	—	1,257.00
20 GPM	P1@8.00	Ea	1,160.00	340.00	—	1,500.00



**Hair and lint interceptor**

1½"	P1@.650	Ea	225.00	27.70	—	252.70
2"	P1@.750	Ea	320.00	31.90	—	351.90



**All bronze ¾" to 1½" in-line NPT pump**

1/12 HP	P1@1.50	Ea	648.00	63.80	—	711.80
1/6 HP	P1@1.50	Ea	968.00	63.80	—	1,031.80
1/4 HP	P1@1.50	Ea	1,130.00	63.80	—	1,193.80

## Kitchen Equipment Connections

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

### Kitchen appliance gas trim

1/2"	P1@1.15	Ea	48.10	48.90	—	97.00
3/4"	P1@1.30	Ea	87.90	55.30	—	143.20
1"	P1@1.60	Ea	102.00	68.10	—	170.10
1 1/4"	P1@2.10	Ea	168.00	89.30	—	257.30
1 1/2"	P1@2.50	Ea	213.00	106.00	—	319.00
2"	P1@3.00	Ea	284.00	128.00	—	412.00

### Hot and cold water supply

1/2"	P1@1.10	Ea	56.10	46.80	—	102.90
3/4"	P1@1.55	Ea	79.60	65.90	—	145.50
1"	P1@1.90	Ea	108.00	80.80	—	188.80
1 1/4"	P1@2.50	Ea	152.00	106.00	—	258.00
1 1/2"	P1@3.00	Ea	191.00	128.00	—	319.00

### Continuous waste

2-part	P1@.250	Ea	68.20	10.60	—	78.80
3-part	P1@.350	Ea	116.00	14.90	—	130.90
4-part	P1@.450	Ea	148.00	19.10	—	167.10

### Indirect waste

1/2"	P1@1.05	Ea	17.80	44.70	—	62.50
3/4"	P1@1.50	Ea	30.20	63.80	—	94.00
1"	P1@1.90	Ea	48.50	80.80	—	129.30
1 1/4"	P1@2.15	Ea	71.50	91.50	—	163.00
1 1/2"	P1@2.60	Ea	94.20	111.00	—	205.20
2"	P1@3.00	Ea	144.00	128.00	—	272.00

### Kitchen fixture waste tailpiece

1 1/2"	P1@.100	Ea	17.10	4.25	—	21.35
--------	---------	----	-------	------	---	-------

### Kitchen fixture trap with solder bushing

1 1/2"	P1@.250	Ea	57.50	10.60	—	68.10
2"	P1@.300	Ea	79.70	12.80	—	92.50

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

**Water closet, floor-mounted, flush tank, white vitreous china, lined tank.** Complete with trim. Make additional allowances for rough-in. Based on American Standard Cadet series. ADA means American Disabilities Act compliant. (Wheelchair accessible)

Round bowl	P1@2.10	Ea	300.00	89.30	—	389.30
Elongated bowl	P1@2.10	Ea	362.00	89.30	—	451.30
ADA, 18" high	P1@2.10	Ea	493.00	89.30	—	582.30



**Water closet, floor-mounted, flush valve, white vitreous china.**

Complete with trim. Make additional allowances for rough-in. Based on American Standard. ADA means American Disabilities Act compliant. (Wheelchair accessible)

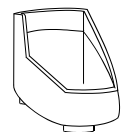
Elongated bowl	P1@2.60	Ea	470.00	111.00	—	581.00
Elongated bowl, ADA 18" high	P1@2.60	Ea	558.00	111.00	—	669.00
Elongated bowl with a bedpan cleanser	P1@4.10	Ea	810.00	174.00	—	984.00
Elongated bowl, ADA 18" high with a bedpan cleanser	P1@4.10	Ea	878.00	174.00	—	1,052.00

**Water closet, wall-hung, flush valve, white vitreous china.** Complete with fixture carrier and all trim. Make additional allowances for rough-in. Based on American Standard AFWall series.

Elongated bowl	P1@3.55	Ea	743.00	151.00	—	894.00
Elongated bowl with electronic flush valve	P1@3.80	Ea	1,330.00	162.00	—	1,492.00
Elongated bowl with bedpan cleanser	P1@5.05	Ea	1,080.00	215.00	—	1,295.00
Electronic flush valve, add	P1@.600	Ea	588.00	25.50	—	613.50

**Urinal, wall-hung, flush valve, white vitreous china.** Complete with trim. Make additional allowances for rough-in.

Siphon-jet type	P1@3.15	Ea	743.00	134.00	—	877.00
Wash-out type	P1@3.10	Ea	607.00	132.00	—	739.00
Wash-down type	P1@3.00	Ea	428.00	128.00	—	556.00
Urinal carrier, add	P1@.600	Ea	130.00	25.50	—	155.50
Electronic flush valve, add	P1@.600	Ea	475.00	25.50	—	500.50



**Urinal, stall-type, flush valve, white vitreous china.** Complete with trim. Make additional allowances for rough-in.

Stall urinal	P1@5.00	Ea	1,410.00	213.00	—	1,623.00
--------------	---------	----	----------	--------	---	----------

## Plumbing Fixtures

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

**Lavatory, wall-hung, white vitreous china.** Complete with trim and fixture carrier. Make additional allowances for rough-in. ADA means American Disabilities Act compliant. (Wheelchair accessible)



Wall-hung lav	P1@2.70	Ea	598.00	115.00	—	713.00
Wall-hung, ADA	P1@2.70	Ea	871.00	115.00	—	986.00
Fixture carrier	P1@.500	Ea	121.00	21.30	—	142.30

**Countertop lavatory, white.** Complete with trim. Make additional allowances for rough-in.



Vitreous china	P1@2.00	Ea	435.00	85.10	—	520.10
Enameled steel	P1@2.00	Ea	360.00	85.10	—	445.10
Acrylic	P1@2.00	Ea	262.00	85.10	—	347.10

**Bathtub, white, 60" x 32".** Complete with trim, including shower head. Make additional allowances for rough-in.



Enameled steel	P1@2.50	Ea	611.00	106.00	—	717.00
Cast iron	P1@3.50	Ea	1,150.00	149.00	—	1,299.00
Fiberglass	P1@2.50	Ea	592.00	106.00	—	698.00
Acrylic	P1@2.50	Ea	633.00	106.00	—	739.00

**Tub and shower combination, fiberglass, white.** Complete with trim. Make additional allowances for rough-in.

One-piece	P1@4.50	Ea	1,330.00	191.00	—	1,521.00
Two-piece (reno)	P1@5.50	Ea	1,710.00	234.00	—	1,944.00
Four-piece (reno)	P1@6.25	Ea	1,810.00	266.00	—	2,076.00

**Shower stall, white, 36" x 36".** Complete with trim. Make additional allowances for rough-in.



Fiberglass one-piece	P1@3.50	Ea	844.00	149.00	—	993.00
Fiberglass three-piece	P1@4.25	Ea	1,090.00	181.00	—	1,271.00
Acrylic one-piece	P1@3.50	Ea	1,270.00	149.00	—	1,419.00
Acrylic three-piece	P1@4.25	Ea	1,660.00	181.00	—	1,841.00

**Shower basin, 36" x 36".** Complete with trim (faucet, shower head and strainer). Make additional allowances for rough-in.

Fiberglass	P1@2.50	Ea	543.00	106.00	—	649.00
Acrylic	P1@2.50	Ea	584.00	106.00	—	690.00
Molded stone	P1@2.65	Ea	565.00	113.00	—	678.00

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

**Kitchen sink, double compartment.** Complete with trim. Make additional allowances for rough-in.

Stainless steel	P1@2.15	Ea	448.00	91.50	—	539.50
Cast iron	P1@2.50	Ea	1,400.00	106.00	—	1,506.00
Acrylic	P1@2.15	Ea	530.00	91.50	—	621.50



**Kitchen sink, single compartment.** Complete with trim. Make additional allowances for rough-in.

Stainless steel	P1@2.00	Ea	378.00	85.10	—	463.10
Cast iron	P1@2.10	Ea	873.00	89.30	—	962.30
Acrylic	P1@2.00	Ea	394.00	85.10	—	479.10

**Bar sink.** Complete with trim. Make additional allowances for rough-in.

Stainless steel	P1@2.00	Ea	321.00	85.10	—	406.10
Acrylic	P1@2.00	Ea	216.00	85.10	—	301.10



**Exam room sink.** Complete with trim. Make additional allowances for rough-in.

Stainless steel	P1@2.10	Ea	467.00	89.30	—	556.30
Acrylic	P1@2.10	Ea	399.00	89.30	—	488.30

**Laboratory sink.** Complete with trim. Make additional allowances for rough-in.

Stainless steel	P1@2.25	Ea	536.00	95.70	—	631.70
Acrylic	P1@2.25	Ea	467.00	95.70	—	562.70

**Laundry sink, double compartment.** Complete with trim. Make additional allowances for rough-in.

Cast iron	P1@3.50	Ea	626.00	149.00	—	775.00
Acrylic	P1@2.25	Ea	275.00	95.70	—	370.70

**Laundry sink, single compartment.** Complete with trim. Make additional allowances for rough-in.

Cast iron	P1@2.75	Ea	1,080.00	117.00	—	1,197.00
Acrylic	P1@2.00	Ea	190.00	85.10	—	275.10



**Mop sink, floor-mounted, 36" x 24".** Complete with trim. Make additional allowances for rough-in.

Molded stone	P1@2.65	Ea	762.00	113.00	—	875.00
Terrazzo	P1@2.65	Ea	908.00	113.00	—	1,021.00
Acrylic	P1@2.35	Ea	588.00	100.00	—	688.00

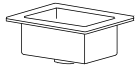
## Plumbing Fixtures

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



**Slop sink, enameled cast iron with P-trap, standard.** Complete with trim. Make additional allowances for rough-in.

Slop sink with P-trap, std.	P1@3.50	Ea	1,380.00	149.00	—	1,529.00
-----------------------------	---------	----	----------	--------	---	----------



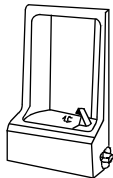
**Floor sink, recessed, enameled steel, white.** Add 40% to material prices for acid-resisting finish. Complete with strainer. Make additional allowances for rough-in.

9" x 9"	P1@1.00	Ea	112.00	42.50	—	154.50
12" x 12"	P1@1.00	Ea	131.00	42.50	—	173.50
15" x 15"	P1@1.15	Ea	143.00	48.90	—	191.90
18" x 18"	P1@1.25	Ea	164.00	53.20	—	217.20
24" x 24"	P1@1.50	Ea	215.00	63.80	—	278.80



**Drinking fountain, refrigerated, stainless steel.** Complete with trim. Make additional allowances for rough-in. ADA means American Disabilities Act compliant. (Wheelchair accessible)

Free-standing	P1@2.00	Ea	1,770.00	85.10	—	1,855.10
Semi-recessed	P1@2.50	Ea	2,360.00	106.00	—	2,466.00
Fully-recessed	P1@2.50	Ea	4,080.00	106.00	—	4,186.00
Wall-hung	P1@2.00	Ea	1,660.00	85.10	—	1,745.10
Wall-hung, ADA	P1@2.50	Ea	4,080.00	106.00	—	4,186.00



**Drinking fountain, non-refrigerated.** Complete with trim. Make additional allowances for rough-in. ADA means American Disabilities Act compliant. (Wheelchair accessible) S.S. means stainless steel.

Recessed, china	P1@2.50	Ea	1,400.00	106.00	—	1,506.00
Wall-hung, china	P1@2.00	Ea	797.00	85.10	—	882.10
Recessed, S.S.	P1@2.50	Ea	1,600.00	106.00	—	1,706.00
Wall-hung, S.S.	P1@2.00	Ea	850.00	85.10	—	935.10
ADA, S.S.	P1@2.50	Ea	1,450.00	106.00	—	1,556.00

## Plumbing Fixtures Rough-in

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

**Commercial plumbing fixture rough-in.** Includes type L copper supply pipe and DWV copper (to 2½") or cast iron (MJ) DWV (over 2½") drain and vent piping. Make additional allowances for plumbing fixtures and trim. Use these costs for preliminary estimates.

Water closet, wall-hung, flush valve, with carrier	P1@2.25	Ea	1,030.00	95.70	—	1,125.70
Water closet, wall-hung, flush valve, no carrier	P1@1.95	Ea	945.00	83.00	—	1,028.00
Water closet, floor-mounted, flush valve	P1@2.75	Ea	835.00	117.00	—	952.00
Water closet, floor-mounted, tank type	P1@2.25	Ea	640.00	95.70	—	735.70
Bidet	P1@2.00	Ea	445.00	85.10	—	530.10
Urinal, wall-hung, flush valve, with carrier	P1@3.10	Ea	1,120.00	132.00	—	1,252.00
Urinal, wall-hung, flush valve, without carrier	P1@2.35	Ea	640.00	100.00	—	740.00
Lavatory, wall-hung, with carrier	P1@2.40	Ea	928.00	102.00	—	1,030.00
Lavatory	P1@1.90	Ea	445.00	80.80	—	525.80
Sink	P1@1.90	Ea	480.00	80.80	—	560.80
Bath tub	P1@2.35	Ea	686.00	100.00	—	786.00
Shower	P1@2.60	Ea	804.00	111.00	—	915.00
Mop sink	P1@2.40	Ea	570.00	102.00	—	672.00
Slop sink	P1@2.60	Ea	408.00	111.00	—	519.00
Laundry tub	P1@1.95	Ea	484.00	83.00	—	567.00
Wash fountain	P1@2.10	Ea	522.00	89.30	—	611.30
Lab sink, glass drainage	P1@3.80	Ea	2,060.00	162.00	—	2,222.00
Lab sink, acid resistant plastic drainage	P1@2.65	Ea	327.00	113.00	—	440.00
Drinking fountain	P1@2.20	Ea	355.00	93.60	—	448.60
Emergency eyewash and shower	P1@1.75	Ea	135.00	74.40	—	209.40
Washing machine	P1@2.25	Ea	521.00	95.70	—	616.70

## Plumbing Fixtures Rough-in

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

**Commercial plumbing fixture group rough-in.** Includes Type L copper supply pipe and DWV copper (to 2½") or cast iron (MJ) DWV (over 2½") drain and vent piping. Make additional allowances for plumbing fixtures and trim. Use these costs for preliminary estimates.

3-piece washroom group	P1@5.50	Ea	1,230.00	234.00	—	1,464.00
3-piece washroom group back to back	P1@9.75	Ea	2,270.00	415.00	—	2,685.00
Kitchen sink, back to back	P1@2.15	Ea	662.00	91.50	—	753.50
Battery of water closets, floor-mounted, tank type, per water closet	P1@1.75	Ea	516.00	74.40	—	590.40
Battery of water closets, floor-mounted, flush valve, per water closet	P1@2.20	Ea	674.00	93.60	—	767.60
Battery of water closets, wall-hung, flush valve, with carrier, per water closet	P1@1.80	Ea	885.00	76.60	—	961.60
Battery of water closets, wall-hung, flush valve, without carrier, per water closet	P1@1.50	Ea	259.00	63.80	—	322.80
Battery of urinals, wall-hung, flush valve with carrier, per urinal	P1@2.45	Ea	1,060.00	104.00	—	1,164.00
Battery of urinals, wall-hung, flush valve without carrier, per urinal	P1@1.90	Ea	549.00	80.80	—	629.80
Battery of lavatory basins, wall-hung, with carrier, per lavatory	P1@2.00	Ea	829.00	85.10	—	914.10
Battery of lavatory basins, without carrier, per lavatory	P1@1.50	Ea	374.00	63.80	—	437.80

**Residential plumbing fixture rough-in.** Includes polyethylene (PE) supply pipe and ABS DWV drain and vent piping. Make additional allowances for plumbing fixtures and trim. Use these costs for preliminary estimates.

Water closet, floor-mounted, tank type	P1@2.00	Ea	139.00	85.10	—	224.10
Bidet	P1@1.85	Ea	104.00	78.70	—	182.70
Lavatory	P1@1.75	Ea	104.00	74.40	—	178.40
Counter sink	P1@1.75	Ea	115.00	74.40	—	189.40
Bathtub	P1@2.10	Ea	104.00	89.30	—	193.30
Shower	P1@2.45	Ea	153.00	104.00	—	257.00
Laundry tub	P1@1.75	Ea	95.00	74.40	—	169.40
Washing machine	P1@2.00	Ea	118.00	85.10	—	203.10



# Index

<b>A</b>		
A/C systems .....	287	
ABS, DWV		
test cap .....	154	
ABS, DWV pipe .....	152	
1/4 bend .....	152	
1/8 bend .....	152	
adapters .....	154	
bushings .....	154	
cleanouts .....	154	
closet bend .....	153	
closet flanges .....	153	
combinations .....	153	
couplings .....	155	
hanger assemblies .....	155	
P-traps .....	153	
reducers .....	155	
riser clamps .....	155	
solvent-weld joints .....	154-155	
tees .....	153	
wyes .....	153-154	
Access doors, steel .....	123	
Accessories		
iron filter .....	23	
water softener .....	23	
Acid DWV systems .....	166	
Actuator, damper .....	405	
Adapters		
copper, DWV, soldered .....	150	
copper, pressfit .....	88	
CPVC sprinkler pipe .....	185	
F.I.P., ABS .....	154	
PE-AL pipe .....	115	
PEX-AL pipe .....	115	
polypropylene pipe .....	168	
PVC sewer, bell & spigot .....	165	
PVC, DWV .....	158	
PVC, Schedule 40 .....	96	
PVC, Schedule 80 .....	106	
Schedule 10 steel, roll-grooved .....	276	
Schedule 40 steel, cut-grooved .....	282	
Schedule 40 steel, roll-grooved .....	269	
Schedule 5 steel, pressfit .....	237	
Type K copper, brazed .....	37	
Type K copper, soldered .....	47-48	
Type L copper, brazed .....	56	
Type L copper, soldered .....	64	
Type M copper, brazed .....	73	
Type M copper, soldered .....	81	
Additional costs .....	8	
Adjusting costs .....	7	
Air admittance valve .....	329	
Air balance software .....	339	
Air balancing		
air handling units .....	403	
centrifugal fans .....	404	
diffusers .....	403	
fan coil units .....	404	
fume hoods .....	404	
grilles .....	404	
terminal boxes .....	403	
Air compressor .....	407	
rental .....	420	
Air conditioning		
budget estimates .....	435	
residential .....	287	
Air conditioning condensate systems		
PVC, Schedule 40 .....	93	
PVC, Schedule 80 .....	103	
Type K copper, brazed .....	33	
Type K copper, soldered .....	43	
Type L copper, brazed .....	53	
Type L copper, soldered .....	61	
Type M copper, brazed .....	70	
Type M copper, soldered .....	78	
Air conditioning units .....	289	
Air cooled condenser		
demolition .....	426	
removal .....	426	
Air cooled condensing unit .....	213	
Air grilles, return .....	334	
Air handling equipment		
air conditioner .....	289	
exhaust fans .....	327	
housings .....	332	
ventilators .....	327	
Air handling units .....	290	
accessories .....	291	
air balancing .....	403	
coil connection .....	298-299	
removal .....	424	
Air mixing box		
removal .....	423	
Air separators, Rolaitrol type .....	202	
Air vents .....	123	
Alarm valves .....	173	
Apartments, HVAC estimates .....	437	
Area drains .....	170	
installation costs .....	435	
Arresters, water hammer .....	135	
As-built drawings .....	421	
Assemblies		
air conditioning .....	287	
forced air heating .....	288	
Auditoriums, HVAC estimates .....	437	
<b>B</b>		
Backfill costs, trenching .....	418	
Backflow preventers		
double check .....	122	
reduced pressure .....	121	
Backhoes, rental .....	420	
Balancing valves		
PEX-AL pipe .....	116, 120	
Ball valves		
copper, pressfit .....	88	
PEX-AL pipe .....	116, 120	
pipe and plumbing specialty .....	128-129	
PVC, Schedule 40 .....	99	
PVC, Schedule 80 .....	109	
PVC, Solid body, EDPM .....	99, 109	
PVC, Solid body, threaded .....	99, 109	
PVC, Tru-union, threaded .....	99, 109	
PVC, Union type, Solvent weld .....	100, 109	
Schedule 40 steel, threaded .....	231	
Schedule 80 steel, threaded .....	253	
Type K copper, brazed .....	40	
Type K copper, soldered .....	50	
Type L copper, brazed .....	59	
Type L copper, soldered .....	67	
Type M copper, brazed .....	76	
Type M copper, soldered .....	84	
Banks, HVAC estimates .....	437	
Bar sinks .....	29	
estimating .....	435	
Barber shops, HVAC estimates .....	437	
Base wage .....	6	
Baseboard fins .....	205	
bath		
fan .....	330	
Bathroom		
fans .....	327-328	
fixtures .....	28	
Bathroom fans .....	328-329	
Bathroom heaters .....	329	
Bathroom sink		
disconnect .....	433	
Bathtubs .....	28	
disconnect .....	433	
estimating .....	435	
Beauty shops, HVAC estimates .....	437	
Bell & spigot pipe, PVC .....	161	
Benders, hydraulic, rental .....	420	
Bends		
ABS, DWV pipe .....	152	
cast iron, no-hub .....	138-140	
class 110 DI, cement lined .....	412	
class 150 cast iron .....	413	
class 153 DI, cement lined .....	408	
class 153 DI, double cement lined .....	410	
class 2400 or 3000 asbestos cement .....	414	
copper, DWV, soldered .....	149	
polypropylene pipe .....	166	
PVC sewer, bell & spigot .....	162	
PVC, DWV .....	161-162	
Bevel machines, rental .....	420	
Billing breakdown worksheet .....	461-462	
Biomass fired		
boilers .....	320-321	
central airspace heater .....	322	

Black steel pipe .....	178	Bowling alleys, HVAC estimates .....	437	Schedule 160 steel, welded .....	262
assemblies.....	177	Branch pipe and fittings, sprinkler...183		Schedule 40 steel, cut-grooved....283	
Blowers, centrifugal .....	325	Brass Corporation		Schedule 40 steel, roll-grooved....270	
Boiler		Adapter .....	91	Schedule 40 steel, threaded.....227	
blowdown.....	204	Coupling Copper Pipe .....	91	Schedule 40 steel, welded .....	218
burners .....	196	Brazed joint pipe		Schedule 80 steel, threaded.....251	
connections .....	191	Type K copper .....	33	Schedule 80 steel, welded .....	242
controls .....	201	Type L copper .....	53	Type K copper, brazed .....	38
pumps.....	206	Type M copper .....	70	Type K copper, soldered .....	48
stack .....	204	Bucket steam trap .....	128	Type L copper, brazed .....	57
trim.....	205	Budget estimating.....	435	Type L copper, soldered.....65	
Boilers		Buildings		Type M copper, brazed .....	74
biomass fired .....	320-321	HVAC estimates .....	437	Type M copper, soldered.....82	
pulse type .....	323	bulb heater.....	330	Carbon steel fittings.....	215-266
removal.....	425	Burner controls .....	201	Carbon steel pipe	
steam heating .....	190	Burners, dual fuel .....	196	Schedule 40.....	181
Boilers, commercial		Bushings		Schedule 80.....	239
accessories.....	205	ABS .....	154	Cast iron class 150.....	413
adjusting .....	199	PVC, DWV.....	158	Cast iron DWV pipe, hub & spigot...143	
cast iron .....	186	PVC, Schedule 40 .....	96	1/16 bend.....	144
chemical feed pump .....	203	PVC, Schedule 80 .....	106	1/4 bend.....	143
combustion controls.....	198-199	Type K copper, brazed .....	38	1/8 bend.....	143
combustion train .....	193	Type K copper, soldered .....	48	bends .....	144
components .....	205	Type L copper, brazed .....	57	closet flanges.....	144
deaerator/condenser .....	202	Type L copper, soldered.....65		combinations .....	145
electrical service .....	197	Type M copper, brazed .....	74	gaskets .....	147
feedwater pumps .....	198	Type M copper, soldered.....82		hanger assemblies .....	147
firebox.....	188	Butterfly valves		P-traps .....	144
firetube.....	187-188	pipe and plumbing specialty .....	129	reducers.....	146
fuel train piping.....	194-195	PVC, Schedule 40 .....	98	riser clamps .....	147
packaged, feedwater systems.....203		PVC, Schedule 80 .....	108	sanitary tees .....	144
pumping unit.....	202	Schedule 10 steel, roll-grooved....278		tees .....	144
refractory .....	198	Schedule 40 steel, cut-grooved....284		wyes .....	145-146
stacks .....	204	Schedule 40 steel, roll-grooved....271		Cast iron DWV pipe, mechanical	
water softening systems.....	199	Schedule 40 steel, threaded.....231		joint.....	137
watertube.....	189	Schedule 40 steel, welded .. 220-221		Cast iron DWV pipe, no-hub .....	137
Boilers, gas fired		Schedule 80 steel, threaded... 252-253		1/4 bend.....	138
cast iron .....	190	Schedule 80 steel, welded .....	244	1/8 bend.....	137-138
steel.....	189	Type K & L copper, roll grooved ....90		caps .....	141
Bolt and gasket sets		Type K copper, brazed .....	39	closet bends .....	138
pipe and plumbing specialty .....	124	Type K copper, soldered .....	50	closet flanges.....	138
polypropylene pipe .....	169	Type L copper, brazed .....	58	combinations .....	140
PVC, Schedule 40 .....	101	Type L copper, soldered.....66		couplings .....	141
PVC, Schedule 80 .....	111	Type M copper, brazed .....	75	crosses .....	141
Schedule 10 steel, roll-grooved....280		Type M copper, soldered.....83		hanger assemblies .....	142
Schedule 160 steel, full face .....	265			horizontal assembly.....	137
Schedule 160 steel, ring face.....265				P-traps .....	138
Schedule 40 steel, cut-grooved....285				reducers.....	141
Schedule 40 steel, roll-grooved....272				riser clamps .....	142
Schedule 40 steel, threaded.....233				tees .....	140-141
Schedule 40 steel, welded .....	223			wyes .....	138-140
Schedule 80 steel, threaded.....254				Cast iron sprinkler pipe fittings	
Schedule 80 steel, welded .....	246			cap.....	182
Type K copper, brazed.....	41			couplings .....	182
Type K copper, soldered .....	52			cross .....	182
Type L copper, brazed .....	60			ells .....	181
Type L copper, soldered.....68				plugs.....	182
Type M copper, brazed .....	77			reducers.....	181
Type M copper, soldered.....85				reducing tee.....	181
Boom lifts, rental.....	420			Ceiling diffusers.....	335-336
Booster heaters .....	25			Central air space heater	
Bore holes, geothermal .....	318			biomass fired .....	322

## C

Calcium silicate pipe insulation .....	400
Can washers, installation costs.....	435
Caps	
cast iron, no-hub.....	141
cast iron, threaded.....	182
CPVC sprinkler pipe .....	185
PE-AL pipe .....	116, 119
PEX-AL pipe .....	116, 119
PVC sewer, bell & spigot.....	165
PVC, Schedule 40 .....	97
PVC, Schedule 80 .....	107
roll grooved, Victaulic .....	179
Schedule 10 steel, roll-grooved....277	

Central dehumidification.....	301	copper, DWV, soldered.....	149	Connections	
Centrifugal blowers.....	325	PVC, DWV.....	157-158	air handling unit, HVAC.....	298-299
Centrifugal fans, air balancing.....	404	Clothes dryers, exhaust.....	328	continuous waste.....	26
Centrifugal pumps, HVAC.....	207	Cocktail lounges, HVAC estimates...	437	fire department.....	176
Centrifugal water-cooled chiller.....	212	Coil connection,		flexible duct.....	344
Ceramic heater.....	305	air handling unit.....	298-299	hot and cold water supply.....	26
Chain hoists, rental.....	420	Coil, duct mounted, removal.....	429	indirect waste.....	26
Change estimates.....	438-448	Coils, reheat, HVAC.....	210	kitchen equipment.....	26
change order log.....	443	Cold water connections.....	26	Siamese.....	176
example.....	439	Collars, galvanized steel.....	344	water heaters.....	21
summary.....	442, 446	Combinations		Connectors, pipe.....	125
take-off.....	440, 444	ABS.....	153	flexible.....	126
worksheet.....	441, 445	cast iron, hub & spigot.....	145	Construction schedule.....	453-455
Check valves.....	173	cast iron, no-hub.....	140	Contents.....	3
Chemical feed pump, boiler.....	203	copper, DWV, soldered.....	149	Continuous waste connections.....	26
Chemical feed system.....	203	polypropylene pipe.....	167	control modules	
Chemical systems		Combustion controls, boiler.....	198-199	pollution.....	200
polypropylene, DWV.....	166	Combustion monitoring.....	206	Control valves	
PVC, Schedule 40.....	93	Combustion train, boiler.....	193	2-way.....	406-407
PVC, Schedule 80.....	103	Come-alongs, rental.....	420	3-way.....	406-407
Chilled water systems		Commercial boilers.....	187-190	electric.....	406
Schedule 10 steel, roll-grooved....	274	combustion trains.....	193	pipe and plumbing specialty...	134-135
Schedule 40 steel, cut-grooved....	281	components and accessories.....	205	pneumatic.....	407
Schedule 40 steel, roll-grooved....	267	connections.....	191	PVC, Schedule 40.....	101
Schedule 40 steel, threaded.....	224	Commercial fans and blowers.....	325	PVC, Schedule 80.....	111
Schedule 80 steel, threaded.....	248	Commercial fixture rough-ins.....	31	Schedule 10 steel, roll-grooved....	279
Type K copper, brazed.....	33	group.....	32	Schedule 160 steel, flanged...	264-265
Type K copper, soldered.....	43	Commercial water heaters.....	19-20	Schedule 160 steel, threaded.....	264
Type L copper, brazed.....	53	Compaction, trenching.....	418	Schedule 40 steel, cut-grooved....	285
Type L copper, soldered.....	61	Compactors, rental.....	420	Schedule 40 steel, roll-grooved....	272
Type M copper, brazed.....	70	Companion flanges		Schedule 40 steel, threaded.....	232
Type M copper, soldered.....	78	150 pound, threaded.....	124	Schedule 40 steel, welded.....	222
Chillers		300 pound, threaded.....	124	Schedule 80 steel, threaded.....	254
centrifugal.....	212	PVC.....	124	Schedule 80 steel, welded...	245-246
drinking fountain.....	30	PVC, Schedule 40.....	101	Type K copper, brazed.....	41
reciprocating.....	212	PVC, Schedule 80.....	111	Type K copper, soldered.....	51
removal.....	426	Schedule 40 steel, threaded.....	233	Type L copper, brazed.....	60
water cooled, connection.....	212	Type K copper, brazed.....	41	Type L copper, soldered.....	68
Chlorinated polyvinyl chloride pipe...	184	Type K copper, soldered.....	51	Type M copper, brazed.....	77
Churches, HVAC estimates.....	437	Type L copper, brazed.....	60	Type M copper, soldered.....	85
Circuit balance valves.....	129	Type L copper, soldered.....	68	Controllers.....	339
Circulating pumps		Type M copper, brazed.....	77	Controls	
all bronze.....	122	Type M copper, soldered.....	85	boiler.....	201, 204
iron body.....	123	welding type.....	123	HVAC.....	405
Clarifications.....	8	Composite pipe.....	113	Cooling systems, residential.....	287
Classrooms, HVAC estimates.....	437	compression fittings.....	118	Cooling towers	
Cleanouts		compression joint fittings.....	119	connection assembly.....	214
ABS.....	154	compression joints.....	118	demolition.....	427
ABS/PVC.....	171	crimped joint.....	113	forced draft.....	214
copper, DWV, soldered.....	149	crimped joint fittings.....	113-114	galvanized steel.....	213
end-of-line.....	171	Compressed air systems		induced draft.....	213
floor.....	171	Type K copper, brazed.....	33	removal.....	427
installation costs.....	435	Type L copper, brazed.....	53	Cooling units, variable volume.....	338
PVC, DWV.....	159	Computer rooms, HVAC estimates...	437	Copper, pressfit fittings.....	86
wall.....	171	Condenser units.....	206	Copper fittings, roll grooved.....	89
Closed loop heat pump.....	307	Condenser water systems		Copper pipe	
Close-out items.....	421	Schedule 40 steel, cut-grooved....	281	ball valve, pressfit.....	88
Closet bends, ABS, DWV pipe.....	152	Schedule 40 steel, roll-grooved....	267	coupling, pressfit.....	86
Closet flanges		Condensing units, air cooled.....	213	ells, pressfit.....	86
ABS, DWV pipe.....	152	Condominiums, HVAC estimates...	437	female adapter, pressfit.....	88
cast iron, hub & spigot.....	144	Configurable controller.....	339	male adapter, pressfit.....	88
cast iron, no-hub.....	138			roll grooved.....	89

tee, pressfit.....	87	roll grooved.....	89	reducers.....	81
tee, reducing, pressfit.....	87	tees.....	89	strainers.....	84
type K & L.....	89	valves.....	90	tees.....	80
union, pressfit.....	87	Copper pipe, Type L brazed.....	53-54	thermometers with wells.....	85
Copper pipe, DWV, soldered.....	148	adapters.....	56	unions.....	82
1/4 bend.....	149	bolt and gasket sets.....	60	valves.....	83-85
1/8 bend.....	148	bushings.....	57	Copper piping, removal.....	430
adapters.....	150	caps.....	57	Correction factors.....	6
assembly with riser.....	148	companion flanges.....	60	Countertop sinks/lavatories.....	28
cleanouts.....	149	couplings.....	57	Couplings	
closet flanges.....	149	ells.....	54-55	ABS.....	155
combinations.....	149	pressure gauges.....	60	cast iron, no-hub.....	141
couplings.....	150	reducers.....	56	cast iron, threaded.....	182
crosses.....	149	strainers.....	59	copper, DWV, soldered.....	150
hanger assemblies.....	151	tees.....	55	copper, pressfit.....	86
horizontal assemblies.....	148	thermometers with wells.....	60	CPVC sprinkler pipe.....	184
P-traps.....	149	unions.....	57	galvanized steel spiral duct.....	360
reducers.....	150	valves.....	58-60	PE-AL pipe.....	114-115, 119
riser clamps.....	151	Copper pipe, Type L soldered.....	61-62	PEX-AL pipe.....	115, 119
tees.....	149	adapters.....	64	polypropylene pipe.....	168
test caps.....	150	bolt and gasket sets.....	68	PVC sewer, bell & spigot.....	162
test tees.....	150	bushings.....	65	PVC, DWV.....	158
wyes.....	149	caps.....	65	PVC, Schedule 40.....	97
Copper pipe, Type K brazed.....	33-34	companion flanges.....	68	PVC, Schedule 80.....	107
adapters.....	37	couplings.....	65	roll grooved, Victaulic.....	180
bolt and gasket sets.....	41	ells.....	62-63	roll-grooved, Victaulic.....	180
bushings.....	38	hanger assemblies.....	69	Schedule 10 steel, roll-grooved.....	277
caps.....	38	maximum working pressure.....	61	Schedule 40 steel, cut-grooved.....	283
companion flanges.....	41	pressure gauges.....	68	Schedule 40 steel, roll-grooved.....	270
couplings.....	38	reducers.....	64	Schedule 40 steel, threaded.....	227
ells.....	34-35	riser clamps.....	69	Schedule 5 steel, pressfit.....	236-237
hanger assemblies.....	42	strainers.....	67	Schedule 80 steel, threaded.....	252
pressure gauges.....	41	tees.....	63	Type K copper, brazed.....	38
reducers.....	37	thermometers with wells.....	68	Type K copper, soldered.....	49
riser clamp.....	42	unions.....	65	Type K & L copper, roll grooved.....	90
strainers.....	40	valves.....	66-68	Type L copper, brazed.....	57
tees.....	35-36	Copper pipe, Type M brazed.....	70-71	Type L copper, soldered.....	65
thermometers with wells.....	41	adapters.....	73	Type M copper, brazed.....	74
unions.....	38	bolt and gasket sets.....	77	Type M copper, soldered.....	82
valves.....	39-41	bushings.....	74	CPVC sprinkler pipe.....	184
Copper pipe, Type K soldered.....	43-44	caps.....	74	adapters.....	185
adapters.....	47-48	companion flanges.....	77	cap.....	185
bolt and gasket sets.....	52	couplings.....	74	coupling.....	184
bushings.....	48	ells.....	71	elbows.....	184
caps.....	48	maximum working pressure.....	70	fittings.....	185
companion flanges.....	51	pressure gauges.....	77	flange.....	185
couplings.....	49	reducers.....	73	head adapter.....	185
ells.....	44-45	strainers.....	76	reducing tees.....	184
hanger assemblies.....	52	tees.....	72	tees.....	184
pressure gauges.....	52	thermometers with wells.....	77	Craft codes.....	7
reducers.....	47	unions.....	74	Craft@hrs.....	5
riser clamps.....	52	valves.....	75-77	Cranes, rental.....	420
strainers.....	51	Copper pipe, Type M soldered.....	78-79	Crew composition.....	7
tees.....	45-46	adapters.....	81	Crimp rings	
thermometers with wells.....	52	bolt and gasket sets.....	85	PE-AL pipe.....	117, 120
unions.....	48	bushings.....	82	PEX-AL pipe.....	117, 120
valves.....	49-51	caps.....	82	Croll-Reynolds.....	200
Copper pipe, Type K & L.....	89-90	companion flanges.....	85	Cross linked PEX-AL.....	113
coupling.....	90	couplings.....	82	Cross linked Polyethylene-	
ells.....	89	ells.....	79-80	Aluminum pipe.....	118
flange adapter.....	90	maximum working pressure.....	78	Crosses	
reducers.....	90	pressure gauges.....	85	cast iron, no-hub.....	141

cast iron, threaded.....	182	Duct lining		Schedule 160 steel, threaded... 258-259	
copper, DWV, soldered .....	149	calcium silicate .....	400	Schedule 160 steel, welded ... 258-259	
Schedule 40 steel, threaded.....	226	fiberglass .....	402	Schedule 40 steel, cut-grooved....281	
Schedule 80 steel, threaded.....	251	Duct markers .....	421	Schedule 40 steel, roll-grooved....268	
<hr/>					
<b>D</b>		Ductwork		Schedule 40 steel, threaded.....225	
Daily rental, equipment.....	420	correction factors .....	341	Schedule 40 steel, welded .....	
Dampers		demolition .....	422	Schedule 40 steel, welded .....	
actuator.....	405	removal.....	422	Schedule 5 steel, pressfit .... 235-236	
correction factors .....	341	Ductwork specialties		Schedule 80 steel, threaded.....249	
dampers		collars .....	344	Schedule 80 steel, welded .....	
fire.....	341	connections .....	344	Type K & L copper, roll grooved ... 89	
fusible plug .....	342	dampers.....	340-341	Type K copper, brazed .....	
rectangular.....	340	flexible connections .....	344	Type K copper, soldered .....	
round .....	340	turning vanes .....	343	Type L copper, brazed .....	
Deaerator/condenser, boiler.....	202	Ductwork, fiberglass		Type L copper, soldered..... 62-63	
Deck drains, installation costs.....	435	fabrication labor .....	396	Type M copper, brazed .....	
Deep well jet pump.....	314	installation costs .....	397	Type M copper, soldered..... 79-80	
dehumidification.....	301	vinyl cover.....	397	emissions reduction module.....200	
Dehumidifiers.....	292-293	Ductwork, galvanized steel		Emissions sensing.....	
Demolition.....	422	per pound installed .....	347-348	Energy recovery ventilators..... 292-293	
Department stores,		rectangular.....	381	Energy recovery wheel.....	
HVAC estimates .....	437	rectangular 20 gauge .....	379-381	Engraved nameplates .....	
Dielectric unions .....	38, 124	rectangular 22 gauge .....	374-378	Enthalpy	
Diffusers		rectangular 24 gauge .....	372-374	energy recovery.....	
air balancing .....	403	rectangular 26 gauge .....	370-371	heat recovery.....	
ceiling .....	335-336	rectangular fittings .....	382-394	Equipment	
removal.....	423	round fittings.....	395	nameplates .....	
Dishwasher connections .....	25	spiral .....	357-358	plumbing .....	
Dishwashers, built-in .....	25	spiral fittings.....	359-369	rental costs .....	
Disinfection unit.....	25	DWV pipe		Equipment costs.....	
Disposals, garbage.....	25	ABS .....	152	Estimate detail sheet.....	
Domestic hot water softener .....	24	cast iron.....	137	Estimates	
Domestic water iron filter.....	23	cast iron, hub & spigot.....	143	budget.....	
Domestic water softener.....	22-23	copper.....	148	Estimating	
Doors.....	123	polypropylene .....	166	accuracy .....	
Double check detector valves .....	173	polypropylene heat-fused .....	166	guidelines .....	
Downblast ventilation .....	330	PVC .....	156	Exclusions .....	
Drain, waste, vent pipe		<hr/>			
cast iron, hub & spigot.....	143	<b>E</b>		Exhaust.....	
cast iron, no-hub.....	137	EDPM valves.....	99, 109	clothes dryer.....	
copper.....	148	Elastomeric gaskets .....	161	fans.....	
polypropylene .....	166	Elastomeric pipe insulation.....	401	326-328	
PVC .....	156	Elbows, ductwork		wall hood .....	
Drains .....	170	galvanized steel spiral duct .....	359	328	
Drawings, as-built.....	421	rectangular, galvanized steel... 382-391		exhaust fan .....	
Drilling wells .....	317	round, galvanized steel .....	395	329-330	
Drinking fountains.....	30	Elbows, pipe		exhauster arrays.....	
disconnect .....	433	black steel pipe.....	178-179	exhausters .....	
refrigerated .....	30	CPVC sprinkler pipe .....	184	330	
removal.....	432	Electric water heaters.....	19	Expansion tank fittings .....	
Drinking water tank.....	415-416	Electrical service for boilers .....	197	125	
Drops and tees, ductwork .....	392-394	Eills		Expansion tanks, galvanized..... 125	
Dry valves.....	173	cast iron, threaded.....	181	<hr/>	
Dryers, exhaust .....	328	copper, pressfit.....	86	<b>F</b>	
Dual-fuel burners.....	196	PE-AL pipe .....	113-114, 118-119	F.O.B. ....	
Duct insulation		PEX-AL pipe.....	113-114, 118-119	9	
calcium silicate .....	400	PVC, DWV.....	156	Fabrication, fiberglass ductwork.....396	
fiberglass .....	402	PVC, Schedule 40 .....	94	Fan coils .....	
removal.....	434	PVC, Schedule 80 .....	104-105	427	
		Schedule 10 steel, roll-grooved....275		Fan coil units	
				air balancing .....	
				404	
				HVAC equipment.....	
				209	
				Fans	
				attic .....	
				327	
				bathroom .....	
				327-329	
				ceiling exhaust.....	
				327-328	
				ceiling mounted .....	
				327	
				centrifugal air foil .....	
				325	
				centrifugal utility.....	
				325	

commercial .....	327	PVC, Schedule 80 .....	103-104	wall .....	301
controls .....	328	Schedule 10 steel, roll-grooved .....	275	with A/C .....	300
exhaust .....	329-330	Schedule 40 steel, cut-grooved .....	281	Fusible plug dampers .....	342
exhaust, roof .....	326	Schedule 40 steel, roll-grooved .....	268		
humidistat .....	328	Schedule 40 steel, threaded .....	225		
kitchen .....	328	Schedule 40 steel, welded .....	216		
roof .....	327	Schedule 80 steel, threaded .....	249		
room ventilation .....	327	Type K copper, brazed .....	42	<b>G</b>	
speed controller .....	328	Type L copper, brazed .....	54	Galvanized steel collars .....	344
thru-wall .....	327	Type L copper, soldered .....	62	Galvanized steel cooling tower .....	213
timer .....	328	Type M copper, brazed .....	71	Galvanized steel ductwork	
tube-axial .....	326	Type M copper, soldered .....	79	installation costs .....	346
vane-axial .....	325	Fixtures		per pound installed .....	347-348
ventilation .....	327-328	bathroom .....	28	rectangular .....	370-371
wall exhaust .....	327	disconnect .....	433	rectangular 20 gauge .....	379-381
wall mounted .....	327	estimating costs .....	435	rectangular 22 gauge .....	374-378
washroom .....	327-328	removal .....	432	rectangular 24 gauge .....	372-374
Feedwater pumps, boiler .....	198	Flange adapter		rectangular fittings .....	382-394
feedwater systems .....	206	Type K & L copper, roll grooved .....	90	round .....	395
Fiberglass		Flanges		round elbow .....	395
blanket .....	402	CPVC sprinkler pipe .....	185	round snap-lock .....	395
rigid board .....	402	polypropylene pipe .....	169	spiral .....	357-358
ductwork .....	370	roll-grooved, Victaulic .....	180	spiral coupling .....	360
flexible .....	397	Schedule 10 steel, roll-grooved .....	277	spiral crosses .....	367-369
installation costs .....	397	Schedule 160 steel, slip on .....	263	spiral elbows .....	359
pipe insulation .....	398-399	Schedule 160 steel, weld neck .....	263	spiral tees .....	361-366
pressure tank .....	23	Schedule 40 steel, cut-grooved .....	283	Galvanized steel pipe	
tank .....	24, 415	Schedule 40 steel, roll-grooved .....	270	sleeves .....	155
Filter, iron .....	24	Schedule 40 steel, threaded .....	233	Garbage disposals .....	25
Fire dampers .....	341	Schedule 40 steel, welded .....	219	Gas furnaces	
Fire department connection .....	176	Schedule 80 steel, threaded .....	254	high efficiency .....	300
Fire extinguisher .....	176	Schedule 80 steel, welded .....	243	residential .....	300
Fire extinguishing systems .....	323	Flanges, companion		wall .....	301
Fire hose cabinet .....	175	150 pound, threaded .....	124	with A/C .....	300
Fire hydrant .....	176	150 pound, welding type .....	123	Gas heaters .....	304
Fire protection		300 pound, threaded .....	124	Gas trim connections .....	26
CPVC sprinkler pipe .....	184	PVC .....	124	Gas valves .....	135
fire hose cabinets .....	175	Flashing		Gas water heaters .....	19-20
plastic sprinkler pipe .....	184	pipe .....	169	tankless .....	20
pumps .....	175-176	roof .....	125, 155, 160	Gaskets	
Siamese connections .....	176	Flat panel water heater .....	324	cast iron, hub & spigot .....	147
sprinkler fittings .....	178-182	Flexible connections, ductwork .....	344	elastomeric .....	161
sprinkler heads .....	174	Flexible fiberglass duct .....	397	Gate valves	
sprinkler pipe .....	177-178	Flexible pipe connectors .....	126	pipe and plumbing specialty ...	131-132
steel pipe nipples .....	183	Floor drains .....	170	PVC, Schedule 40 .....	98
switches .....	174	estimating .....	435	PVC, Schedule 80 .....	108
valves .....	173	Floor sinks .....	30, 170	Schedule 10 steel, roll-grooved .....	277
Fire pumps .....	175	estimating .....	435	Schedule 160 steel, flanged .....	263-264
Firebox boilers .....	188	Flues, water heater .....	21	Schedule 40 steel, cut-grooved .....	284
Fire-rated doors .....	123	Foot valve .....	315	Schedule 40 steel, roll-grooved .....	270
Firetube boilers .....	187-188	Forced air heating		Schedule 40 steel, threaded .....	230-231
Fittings		residential .....	288	Schedule 40 steel, welded .....	220
ductwork .....	360	Forced-draft cooling tower .....	214	Schedule 80 steel, threaded .....	252
roll grooved .....	89	Forklifts, rental .....	420	Schedule 80 steel, welded .....	243
Fittings, pipe		Forms and letters .....	438	Type K copper, brazed .....	39
copper, DWV, soldered .....	148	Fringe benefits .....	6	Type K copper, soldered .....	49
expansion tank .....	125	Front-end loaders, rental .....	420	Type L copper, brazed .....	58
M.I., 150 pound .....	225	Fuel train piping .....	194-195	Type L copper, soldered .....	66
malleable iron, Schedule 40 .....	267	Fume hoods, air balancing .....	404	Type M copper, brazed .....	75
polypropylene .....	166	Furnace removal .....	425	Type M copper, soldered .....	83
PVC sewer, bell & spigot .....	161	Furnaces, residential .....	300	Geothermal	
PVC, DWV .....	156	high efficiency .....	300	bore holes .....	318
PVC, Schedule 40 .....	94				

heat pump.....	307-309	Heat cool thermostat.....	406	Schedule 40 steel, cut-grooved....	281
wells.....	317	Heat exchanger		Schedule 40 steel, roll-grooved....	267
Globe valves		demolition.....	429	Type K copper, brazed.....	33
pipe and plumbing specialty ...	132-133	removal.....	429	Type K copper, soldered.....	43
PVC, Schedule 40.....	98	Heat exchangers, HVAC.....	208	Type L copper, brazed.....	53
PVC, Schedule 80.....	108	assembly.....	208	Type L copper, soldered.....	61
Schedule 10 steel, roll-grooved....	278	connections.....	208	Type M copper, brazed.....	70
Schedule 160 steel, flanged.....	264	Heat pumps.....	308-312	Type M copper, soldered.....	78
Schedule 40 steel, cut-grooved....	284	accessories.....	313	Hot water tank	
Schedule 40 steel, roll-grooved....	271	air to air.....	310	disconnect.....	433
Schedule 40 steel, threaded.....	231	demolition.....	428	removal.....	432
Schedule 40 steel, welded.....	220	geothermal.....	307	Hourly labor costs.....	6
Schedule 80 steel, threaded.....	252	removal.....	428	How to use this book.....	5
Schedule 80 steel, welded ...	243-244	split system.....	310	HRV (heat recovery ventilators).....	292-293
Type K copper, brazed.....	39	supplemental electric		Hub & spigot C.I. pipe, DWV.....	143
Type K copper, soldered.....	49	heating coil.....	313	Humidistat control.....	328
Type L copper, brazed.....	58	thermostats.....	313	HVAC	
Type L copper, soldered.....	66	Heat reclaimer.....	205	boiler connections.....	191
Type M copper, brazed.....	75	Heat recovery.....	204, 206, 302	controls.....	405
Type M copper, soldered.....	83	Heat recovery systems		demolition.....	422
Grease and oil interceptors.....	25	continuous blowdown.....	203	HVAC balancing	
Green sand filter.....	23	stack waste.....	200	air.....	404
Greywater tank.....	417	Heat recovery ventilators.....	293	wet.....	405
Grilles		Heat transfer equipment.....	211	HVAC equipment	
air balancing.....	404	Heat-A-Lamp®.....	330	air conditioning units.....	289
removal.....	423	Heaters		air handling equipment.....	332
return air.....	334	bathroom.....	329	air handling units.....	290-291
Ground source heat pump.....	307	biomass fired.....	322	boilers.....	186-190
		ceramic.....	305	centrifugal blowers.....	325
		commercial.....	305	connections, air handling unit ...	298-299
		gas fired.....	305	fan coil units.....	209
		heat pumps.....	311-312	heat exchanger connections.....	208
		infrared.....	305	heat exchangers.....	208
		infrared bulb.....	329	heat transfer equipment.....	211
		infrared tube.....	305	pumps.....	207
		residential furnaces.....	300	reheat coils.....	210
		resistance.....	330	unit heaters.....	211
		unit.....	304	variable-air volume units.....	338
		Heat-fused joint pipe,		HVAC systems	
		polypropylene.....	166	Type K copper, brazed.....	33
		Heating systems.....	288	Type K copper, soldered.....	43
		estimating.....	435	Type L copper, brazed.....	53
		residential.....	288	Type L copper, soldered.....	61
		Help.....	5	Type M copper, brazed.....	70
		High rise offices, HVAC estimates ...	437	Type M copper, soldered.....	78
		Holding tank.....	415-416	Hydrant, fire.....	176
		Hood, duct kit.....	328	Hydraulic benders, rental.....	420
		Hooks, pipe.....	127		
		Hose bibbs.....	135		
		Hot and cold water connections.....	26		
		Hot water boilers			
		biomass fired.....	320-321		
		connections, HVAC.....	191		
		gas fired.....	186, 188		
		gas fired, cast iron.....	190		
		gas fired, steel.....	189		
		high pressure.....	189		
		oil fired.....	188		
		Hot water reheat coils.....	210		
		Hot water softener.....	24		
		Hot water systems			
		piping.....	215		

## H

Hair and lint interceptors.....	25
Hanger assemblies	
ABS.....	155
cast iron, hub & spigot.....	147
cast iron, no-hub.....	142
copper, DWV, soldered.....	151
polypropylene pipe.....	169
PVC, DWV.....	159
PVC, Schedule 40.....	102
PVC, Schedule 80.....	112
Schedule 10 steel, roll-grooved....	280
Schedule 160 steel.....	266
Schedule 40 steel, cut-grooved....	286
Schedule 40 steel, roll-grooved....	273
Schedule 40 steel, threaded.....	233
Schedule 40 steel, welded.....	223
Schedule 80 steel, threaded.....	255
Schedule 80 steel, welded.....	247
Type K copper, brazed.....	42
Type K copper, soldered.....	52
Type L copper, soldered.....	69
Hangers, pipe.....	126
PE-AL.....	117, 120
PEX-AL.....	117, 120
steel band.....	126
Hard water softener.....	22-24
Head adapter, CPVC.....	185
Headers	
PEX-AL pipe.....	116
Heads, sprinkler.....	174

## I

Indicator post.....	176
Indirect waste connections.....	26
Indirect water heater.....	204
Induced-draft cooling tower.....	213
Infrared	
heater.....	305
tube heater.....	305
Infrared bulb heater.....	329
Injector.....	315
Installation costs, ductwork.....	397

Instructing, operating personnel.....421	Schedule 40 steel, roll-grooved....267	Old estimates .....12
Instructions for this book .....5	Manganese filters	Open loop heat pump..... 308-309
Insulation, pipe	green sand.....23	O-rings
calcium silicate .....400	iron.....23	PE-AL pipe .....117, 120
elastomeric .....401	Manhours.....5	PEX-AL pipe.....117, 120
fiberglass ..... 398-399	Manifolds, PEX-AL pipe .....116	Overflow drains .....170
Insulation, removal .....434	Manufacturing plants,	estimating .....435
Insurance.....6	HVAC estimates .....437	Overhead and profit.....7
Interceptors	Markers, pipe and duct.....421	
grease and oil.....25	Markets, HVAC estimates .....437	
hair and lint.....25	Material costs .....7	
Iron filter ..... 23-24	Material pricing conditions.....9	
accessories.....23	Materials, equipment, and tool form...10	
Iron removal .....23	Maximum working pressures	
Irrigation systems	Type K copper, brazed .....33	
PVC, Schedule 40 .....93	Type K copper, soldered .....43	
PVC, Schedule 80 .....103	Type L copper, brazed .....53	
	Type L copper, soldered.....61	
	Type M copper, brazed .....70	
	Type M copper, soldered.....78	
	Mechanical joint coupling .....141	
	Mechanical tee	
	roll-grooved, Victaulic .....180	
	Medical buildings,	
	HVAC estimates .....437	
	MET .....10	
	worksheet .....14	
	Miscellaneous tools	
	PE-AL pipe .....117, 120	
	PEX-AL pipe .....117, 120	
	MJ coupling .....141	
	Molded stone	
	mop sinks .....29	
	shower basins.....28	
	Monthly rental, equipment .....420	
	Mop sink	
	disconnect .....433	
	Motels, HVAC estimates .....437	
	Museums, HVAC estimates .....437	
	<b>N</b>	
	Nail clips	
	PE-AL pipe .....117, 120	
	PEX-AL pipe.....117, 120	
	Nameplates, equipment .....421	
	Nipples	
	Schedule 40 steel, threaded... 228-230	
	steel pipe, fire protection .....183	
	Non-taxable fringe benefits .....6	
	NPT pump, in-line..... 25, 122-123	
	Nursing homes, HVAC estimates....437	
	<b>O</b>	
	Office buildings	
	HVAC estimates .....437	
	Office trailers, rental .....420	
	oil fuel train piping .....206	
	<b>P</b>	
	Packaged boiler	
	feedwater systems .....203	
	PE-AL pipe ..... 113-120	
	adapters.....115	
	brass fittings .....113	
	caps .....116, 119	
	compression brass fittings.....118	
	couplings ..... 114-115, 119	
	crimp rings .....117, 120	
	crimped brass fittings .....113	
	ells ..... 113-114, 118-119	
	hangers.....117, 120	
	miscellaneous tools .....117, 120	
	nail clips.....117, 120	
	O-rings rings.....117, 120	
	tees .....114, 119	
	valves .....116, 120	
	PEX-AL pipe..... 113-118, 120	
	adapters.....115	
	brass fittings .....113	
	caps .....116, 119	
	compression brass fittings.....118	
	couplings ..... 114-115, 119	
	crimp rings .....117, 120	
	crimped brass fittings .....113	
	ells ..... 113-114, 118-119	
	hangers.....117, 120	
	manifolds .....116	
	miscellaneous tools .....117, 120	
	nail clips.....117, 120	
	O-rings.....117, 120	
	tees .....114, 119	
	valves .....116, 120	
	Pipe	
	connector..... 125-126	
	flashing ..... 125, 155, 160, 169	
	hangers.....126	
	hooks.....127	
	markers.....421	
	sleeves ..... 127, 155, 160, 169	
	sleeves, cut-grooved .....286	
	Pipe insulation	
	calcium silicate .....400	
	elastomeric .....401	
	fiberglass ..... 398-399, 415	
	removal.....434	
	Pipe machines, rental.....420	
	Pipe sizes	
	Type K copper, brazed .....33	



Type K copper, soldered .....	43	removal .....	432	Schedule 80 steel, welded .....	246
Type L copper, brazed .....	53	Pollution control modules .....	200	Type K copper, brazed .....	41
Type L copper, soldered .....	61	Pollution control stack		Type K copper, soldered .....	52
Type M copper, brazed .....	70	retrofit .....	320, 322	Type L copper, brazed .....	60
Type M copper, soldered .....	78	Polyethylene sewage pit .....	417	Type L copper, soldered .....	68
Piping		Polyethylene sump pit .....	417	Type M copper, brazed .....	77
air handling unit coil .....	298-299	Polyethylene-aluminum		Type M copper, soldered .....	85
cast iron .....	143	pipe .....	113-118, 120	Pressure pump .....	176
class 110 DI, cement lined .....	412	Polypropylene DWV pipe .....	166	Pressure reducing valves .....	135
class 150 cast iron .....	413	adapters .....	168	Pressure switches .....	174, 315
class 153 DI, cement lined .....	408	bends .....	166	Pressure tank .....	23-24, 315
class 153 DI, double		bolt and gasket sets .....	169	Pressure/temperature taps	
cement lined .....	410	combinations .....	167	Schedule 10 steel, roll-grooved .....	280
class 2400 or 3000 asbestos		couplings .....	168	Schedule 160 steel .....	265
cement .....	414	fittings .....	166	Schedule 40 steel, cut-grooved .....	286
copper .....	148	flanges .....	169	Schedule 40 steel, roll-grooved .....	273
CPVC sprinkler .....	184	hanger assemblies .....	169	Schedule 40 steel, threaded .....	233
polypropylene .....	166	heat-fused joint pipe .....	166	Schedule 40 steel, welded .....	223
PVC .....	156	plugs .....	168	Schedule 80 steel, threaded .....	255
PVC, DWV .....	156	P-traps .....	166	Schedule 80 steel, welded .....	246
Schedule 10 steel,		reducers .....	169	Price updates .....	5
roll-grooved .....	274-275	riser clamps .....	169	Pricing, HVAC systems .....	435
Schedule 40 steel, cut-grooved .....	281	tees .....	167	Process systems	
Schedule 40 steel, roll-grooved .....	267	wyes .....	167-168	PVC, Schedule 40 .....	93-94
Schedule 40 steel, threaded .....	224	Polyvinyl chloride pipe		PVC, Schedule 80 .....	103-104
Schedule 40 steel, welded .....	215	Schedule 40 .....	93	Project summary .....	12
schedule 80 steel, threaded .....	249	Schedule 80 .....	103	Project summary worksheet .....	15
Schedule 80 steel, welded .....	238-239	Potable water storage tank .....	416	Proposal, preparing .....	13
Piping specialties .....	136	Potable water systems		P-traps	
Piping systems		PVC, Schedule 40 .....	93	ABS .....	153
chilled water .....	215	PVC, Schedule 80 .....	103	cast iron, hub & spigot .....	144
hot water .....	215	Type K copper, brazed .....	33	cast iron, no-hub .....	138
recirculating water .....	247	Type K copper, soldered .....	43	copper, DWV, soldered .....	149
Piping removal		Type L copper, brazed .....	53	polypropylene pipe .....	166
copper .....	430	Type L copper, soldered .....	61	PVC, DWV .....	158
plastic .....	430	Type M copper, brazed .....	70	Pulse type boilers .....	323
steel .....	430	Type M copper, soldered .....	78	Pumping unit for boilers .....	202
Planter drains .....	170	Pressfit		pumps	
Plastic piping		ball valve, copper .....	88	boiler .....	206
removal .....	430	copper fittings .....	86	Pumps .....	314
Plastic sewage pit .....	417	coupling, copper .....	86	centrifugal .....	207
Plastic sprinkler pipe .....	184	ells, copper .....	86	heat .....	307-309
Plastic sump pit .....	417	female adapter, copper .....	88	in-line .....	25
Plastic tank .....	416	fittings .....	235	in-line circulating .....	122-123
plug dampers		male adapter, copper .....	88	removal .....	431
fusible .....	342	tee, copper .....	87	submersible .....	314
Plugs		tee, reducing, copper .....	87	sump, installation costs .....	435
cast iron, threaded .....	182	Type O o-rings .....	235	well water .....	314
polypropylene pipe .....	168	union, copper .....	87	Purchase order .....	451-452
PVC, Schedule 40 .....	97	Pressure controller .....	339	PVC	
PVC, Schedule 80 .....	107	Pressure fiberglass tank .....	24	valves, EDPM .....	99, 109
Schedule 40 steel, threaded .....	227	Pressure gauges		valves, threaded .....	99, 109
Schedule 80 steel, threaded .....	251	dial-type .....	127	valves, Tru-union .....	99, 109
Plumbing		PVC, Schedule 40 .....	102	valves, Union type, Solvent	
budget estimates .....	435	PVC, Schedule 80 .....	111	weld .....	100, 109
equipment .....	26	Schedule 10 steel, roll-grooved .....	280	PVC sewer pipe, bell & spigot .....	161
fixture costs .....	435	Schedule 160 steel .....	265	1/16 bend .....	161
fixture rough-in .....	31-32	Schedule 40 steel, cut-grooved .....	286	1/4 bend .....	162
fixtures .....	32	Schedule 40 steel, roll-grooved .....	272	1/8 bend .....	161, 162
specialties .....	136	Schedule 40 steel, threaded .....	233	adapters .....	165
Plumbing fixture		Schedule 40 steel, welded .....	223	caps .....	165
disconnect .....	433	Schedule 80 steel, threaded .....	255	couplings .....	162

gasket joints.....161  
 reducers.....165  
 tees.....164  
 test plugs.....165  
 wyes.....162-164  
 PVC, DWV pipe.....156  
 adapters.....158  
 bushings.....158  
 cleanouts.....159  
 closet flanges.....157-158  
 couplings.....158  
 ells.....156  
 fittings.....156  
 hanger assemblies.....159  
 P-traps.....158  
 reducers.....159  
 riser clamps.....159  
 solvent-weld joints.....156  
 tees.....157  
 wyes.....157  
 PVC, Schedule 40 pipe.....94  
 adapters.....96  
 assembly.....93  
 bolt and gasket sets.....101  
 bushings.....96  
 caps.....97  
 companion flange.....101  
 control valves.....101  
 couplings.....97  
 ells.....94  
 hanger assemblies.....102  
 plugs.....97  
 pressure gauges.....102  
 pressure/temperature taps.....102  
 riser clamps.....102  
 solvent-weld joints.....93  
 strainers.....100-101  
 tees.....95  
 thermometers with wells.....102  
 unions.....97  
 valves.....98-101  
 PVC, Schedule 80 pipe.....103-104  
 adapters.....106  
 assembly.....103-104  
 bolt and gasket sets.....111  
 bushings.....106  
 caps.....107  
 companion flanges.....111  
 couplings.....107  
 ells.....104-105  
 hanger assemblies.....112  
 plugs.....107  
 pressure gauges.....111  
 pressure/temperature taps.....112  
 riser clamps.....112  
 solvent-weld joints.....103  
 strainers.....110  
 tees.....105  
 thermometers with wells.....111  
 unions.....107  
 valves.....108-111

**Q**

Quotation sheet.....17

**R**

Rainwater systems, PVC.....161  
 Reciprocating water-cooled chiller.....212  
 Recirculating water systems.....247  
 Record of telephone conversation.....18  
 Recorder, digital.....406  
 recording equipment.....206  
 Rectangular duct,  
 galvanized steel.....346, 381  
 Rectangular elbow,  
 galvanized steel.....391  
 Reducers  
 ABS.....155  
 cast iron, hub & spigot.....146  
 cast iron, no-hub.....141  
 cast iron, threaded.....181  
 class 110 DI, cement lined.....412  
 class 150 cast iron.....413  
 class 153 DI, cement lined.....409  
 class 153 DI, double cement  
 lined.....411  
 class 2400 or 3000 asbestos  
 cement.....414  
 copper, DWV, soldered.....150  
 galvanized steel spiral duct.....360  
 polypropylene pipe.....169  
 PVC.....165  
 PVC, DWV.....159  
 roll-grooved, Victaulic.....179  
 Schedule 10 steel, roll-grooved.....276  
 Schedule 160 steel, welded... 261-262  
 Schedule 40 steel, cut-grooved.....283  
 Schedule 40 steel, roll-grooved.....269  
 Schedule 40 steel, threaded.....226  
 Schedule 40 steel, welded.....218  
 Schedule 80 steel, threaded.....250  
 Schedule 80 steel, welded... 241-242  
 Type K & L copper, roll grooved....90  
 Type K copper, brazed.....37  
 Type K copper, soldered.....47  
 Type L copper, brazed.....56  
 Type L copper, soldered.....64  
 Type M copper, brazed.....73  
 Type M copper, soldered.....81  
 Reducing costs.....9  
 Reducing ells  
 Schedule 5 steel, pressfit.....236  
 Reducing tees  
 cast iron.....181  
 CPVC sprinkler pipe.....184  
 roll-grooved, Victaulic.....179  
 Schedule 10 steel, roll-grooved.....276  
 Schedule 40 steel, cut-grooved.....282  
 Schedule 40 steel, roll-grooved.....269  
 Schedule 40 steel, threaded.....226  
 Schedule 5 steel, pressfit.....237  
 Schedule 80 steel, threaded.....250

Reducing valves, pressure.....135  
 Refractory, boiler.....198  
 Refrigeration systems  
 Type K copper, brazed.....33  
 Type L copper, brazed.....53  
 Registers  
 return.....335  
 supply.....334  
 Reheat coils  
 electric.....210  
 hot water.....210  
 HVAC.....210  
 Reheat units  
 variable volume.....338  
 Removal costs  
 air cooled condensers.....426  
 air handling units.....424  
 air mixing box.....423  
 boilers.....425  
 chillers.....426  
 cooling towers.....427  
 copper piping.....430  
 diffusers.....423  
 duct insulation.....434  
 duct mounted coils.....429  
 ductwork.....422-423  
 fan coils.....427  
 furnaces.....425  
 grilles.....423  
 heat exchangers.....429  
 heat pumps.....428  
 hot water tank.....432  
 pipe insulation.....434  
 plastic piping.....430  
 plumbing fixtures.....432  
 pumps.....431  
 roof top unit.....424  
 steel piping.....430  
 unit heaters.....428  
 valves.....431  
 Rental costs, equipment.....420  
 Residences  
 HVAC estimates.....437  
 Residential fixture rough-ins.....32  
 Residential furnaces.....300-301  
 Residential water heaters.....19-20  
 resistance heater.....330  
 Retail shops, HVAC estimates.....437  
 Retrofit pollution control stack...320, 322  
 Return air grilles.....334  
 Return registers.....335  
 Riser clamps  
 ABS.....155  
 cast iron, hub & spigot.....147  
 cast iron, no-hub.....142  
 copper, DWV, soldered.....151  
 pipe and plumbing specialty.....127  
 polypropylene pipe.....169  
 PVC, DWV.....159  
 PVC, Schedule 40.....102  
 PVC, Schedule 80.....112  
 Schedule 10 steel, roll-grooved....280

Schedule 160 steel.....	266	reducers.....	276	hanger assemblies.....	233
Schedule 40 steel, cut-grooved....	286	reducing tees.....	276	horizontal assembly.....	224
Schedule 40 steel, roll-grooved....	273	riser clamps.....	280	nipples.....	228-230
Schedule 40 steel, threaded.....	234	strainers.....	279	plugs.....	227
Schedule 40 steel, welded.....	223	tees.....	275	pressure gauges.....	233
Schedule 80 steel, threaded.....	255	thermometers with wells.....	280	pressure/temperature taps.....	233
Schedule 80 steel, welded.....	247	valves.....	277-279	reducers.....	226
Type K copper, brazed.....	42	vertical assembly.....	274	reducing tees.....	226
Type K copper, soldered.....	52	Schedule 40		riser clamps.....	234
Type L copper, soldered.....	69	threadolet.....	136	strainers.....	232
Rollairtrol type air separators.....	202	weldolet.....	136	tees.....	225
Roll-grooved fittings.....	180	Schedule 40 carbon steel pipe.....	216	thermometers with wells.....	233
Roll-grooved joint		Schedule 40 carbon steel pipe,		unions.....	227
Schedule 40 carbon steel.....	267	cut grooved.....	281	valves.....	228, 230-232
Roof		adapters.....	282	vertical assembly.....	224
drains.....	170	bolt and gasket sets.....	285	Schedule 40 carbon steel pipe,	
exhaust fan.....	326	caps.....	283	welded.....	215
fans.....	327	couplings.....	283	bolt and gasket sets.....	223
flashing.....	125, 155, 160	ells.....	281	caps.....	218-219
Roof exhauster.....	327	flanges.....	283	companion flanges.....	219
Roof flashing, lead.....	125, 155, 160	hanger assemblies.....	286	ells.....	216
Roof top unit, removal.....	424	pipe sleeves.....	286	pressure gauges.....	223
Rough-ins		pressure gauges.....	286	pressure/hanger assemblies.....	223
commercial fixture.....	31	pressure/temperature taps.....	286	pressure/temperature tap.....	223
commercial group.....	32	reducers.....	283	reducers.....	218
residential.....	32	reducing tees.....	282	riser clamp.....	223
Round galvanized steel ductwork...	395	riser clamps.....	286	strainers.....	221-222
Roustabouts, rental.....	420	strainers.....	285	tees.....	217
Run and branch, tees,		tees.....	282	thermometers with wells.....	223
galvanized steel.....	366	thermometers with wells.....	286	threadolets.....	219
		valves.....	284-285	valves.....	220-222
		Schedule 40 carbon steel pipe,		vertical assembly.....	215
		roll-grooved.....	267-268	weldolets.....	219
		adapters.....	269	Schedule 40 polypropylene pipe.....	166
		bolt and gasket sets.....	272	Schedule 40 PVC pipe.....	93-94
		caps.....	270	assembly.....	93
		couplings.....	270	Schedule 80	
		ells.....	268	PVC pipe.....	103
		flanges.....	270	threadolet.....	136
		hanger assemblies.....	273	weldolet.....	136
		horizontal assembly.....	267	Schedule 80 carbon steel pipe,	
		pressure gauges.....	272	threaded.....	248-249
		pressure/temperature taps.....	273	bolt and gasket sets.....	254
		reducers.....	269	caps.....	251
		reducing tees.....	269	couplings.....	252
		riser clamps.....	273	crosses.....	251
		strainers.....	272	ells.....	249
		tees.....	268	flanges.....	254
		thermometers with wells.....	272	hanger assemblies.....	255
		valves.....	270-272	horizontal assembly.....	248
		vertical assembly.....	267	plugs.....	251
		Schedule 40 carbon steel pipe,		pressure gauges.....	255
		threaded.....	225	pressure/temperature taps.....	255
		bolt and gasket sets.....	233	reducers.....	250
		caps.....	227	reducing tees.....	250
		companion flanges.....	233	riser clamps.....	255
		control valves.....	232-233	strainers.....	253-254
		couplings.....	227	tees.....	250
		crosses.....	226	thermometers with wells.....	255
		ells.....	225	unions.....	251
		fire protection.....	181	valves.....	252-254
				vertical assembly.....	248

## S

Saddle tee, roll-grooved, Victaulic...	180
Safety, trenching.....	418
Sandstone, trenching.....	418
Sanitary tee, cast iron DWV pipe.....	144
Sanitary tees	
cast iron DWV pipe.....	144
polypropylene pipe.....	167
Schedule construction.....	453-455
Schedule 5 carbon steel pipe,	
pressfit.....	235
adapters.....	237
couplings.....	236, 237
ells.....	235, 236
reducing ells.....	236
reducing tees.....	237
tees.....	237
Schedule 10 carbon steel pipe,	
roll-grooved.....	274-275
adapters.....	276
bolt and gasket sets.....	280
caps.....	277
couplings.....	277
ells.....	275
flanges.....	277
hanger assemblies.....	280
horizontal assembly.....	274
pressure gauges.....	280
pressure/temperature taps.....	280

Schedule 80 carbon steel pipe, welded.....	239	Shoring, trench.....	418	Solvent-weld joint pipe PVC, DWV.....	156
bolt and gasket sets.....	246	Shower stall disconnect.....	433	PVC, Schedule 40.....	93
caps.....	242	removal.....	432	PVC, Schedule 80.....	103
ells.....	239	Showers.....	28	Specialties, piping and plumbing.....	136
flanges.....	243	estimating.....	435	Speed controller, fan.....	328
hanger assemblies.....	247	Siamese connection.....	176	Spin-ins, plain.....	344
horizontal assembly.....	238	Silent check valves pipe and plumbing specialty.....	131	Spiral crosses, galvanized steel.....	367-369
pressure gauges.....	246	PVC, Schedule 40.....	100	Spiral duct, galvanized steel.....	357-358, 367-369
pressure/temperature tap.....	246	PVC, Schedule 80.....	110	Spiral tees, galvanized steel...364, 366	
reducers.....	241-242	Schedule 10 steel, roll-grooved....	279	Sprinkler fittings.....	178-182
riser clamps.....	247	Schedule 40 steel, cut-grooved....	285	Sprinkler heads.....	174
strainers.....	245	Schedule 40 steel, roll-grooved....	271	Sprinkler systems black steel pipe.....	177-178
tees.....	240-241	Schedule 40 steel, threaded.....	232	branch pipe and fittings.....	183
thermometers with wells.....	246	Schedule 40 steel, welded.....	221	heads.....	174
threadolets.....	243	Schedule 80 steel, threaded.....	253	per head costs.....	172
unions.....	242	Schedule 80 steel, welded.....	245	square foot costs.....	172
valves.....	243-246	Type K copper, brazed.....	40	switches.....	174
vertical assembly.....	238	Type K copper, soldered.....	50	valves.....	173
weldolets.....	242	Type L copper, brazed.....	59	Square-foot costs, HVAC.....	435
Schedule 80 PVC pipe.....	104	Type L copper, soldered.....	67	Stack waste, heat recovery.....	200
Schedule 160 carbon steel pipe, plain end.....	257	Type M copper, brazed.....	76	Stainless steel doors.....	123
Schedule 160 carbon steel pipe, threaded.....	256-258	Type M copper, soldered.....	84	sinks.....	29
ells.....	258-259	Sinks.....	28-30	Standard form subcontract.....	448
horizontal assembly.....	256	acrylic.....	29	Steam boiler connections, HVAC....	191
tees.....	260	bar.....	29	Steam boilers biomass fired.....	321
unions.....	261	cast iron.....	29	connections.....	191
vertical assembly.....	257	countertop.....	28	gas fired.....	186
Schedule 160 carbon steel pipe, welded.....	256-257	disconnect.....	433	Steam heating boilers.....	190
bolt and gasket sets.....	265	exam room.....	29	Steam systems, piping.....	239
caps.....	262	kitchen.....	29	Steam traps.....	127, 205
ells.....	258-259	laboratory.....	29	Steel collars.....	344
flanges.....	263	laundry.....	29	Steel doors.....	123
hanger assemblies.....	266	medical.....	29	Steel ductwork, galvanized.....	357-358, 360
horizontal assembly.....	256	molded stone.....	29	fittings.....	359
pressure gauges.....	265	mop.....	29	Steel pipe black.....	178
pressure/temperature taps.....	265	removal.....	432	cooling systems.....	235
reducers.....	261-262	slop.....	30	heating systems.....	235
riser clamps.....	266	stainless steel.....	29	nipples, threaded.....	183, 230
tees.....	260	Skip loaders, rental.....	420	pressfit system.....	235
thermometers with wells.....	265	Sleeves galvanized steel pipe.....	155, 160	process applications.....	235
threadolets.....	263	polypropylene pipe.....	169	Steel pipe fittings, Schedule 40 steel, roll-grooved.....	267
unions.....	261	Slop sink disconnect.....	433	Steel pipe nipples, threaded....	228-230
valves.....	263-265	Slope, trench.....	418	Steel pipe, black.....	177-178
weldolets.....	262	Softener water.....	22	Steel pipe, Schedule 5 pressfit.....	235
Scissors-lifts, rental.....	420	software.....	339	adapters.....	237
Scotch marine firetube boilers... 187-188		air balance.....	339	couplings.....	236-237
Self-sticking markers.....	421	Solar water heater.....	324	ells.....	235-236
Sensor CO2.....	406	Solder, soft.....	33, 43	reducing ells.....	236
HVAC controls.....	405	Soldered joint fittings Type K copper.....	43	reducing tees.....	237
Septic tank.....	415	Type L copper.....	61	tees.....	237
Service sinks.....	29	Soldered joint pipe.....	43, 78	Steel pipe, Schedule 10 roll-grooved.....	274-275
estimating.....	435	copper, DMV.....	148	adapters.....	276
Sewage lift tank.....	417	Type K copper.....	43	bolt and gasket sets.....	280
Sewage tank.....	415	Type L copper.....	61		
Sewer pipe, PVC bell & spigot.....	161	Type M copper.....	78		
Shale, trenching.....	418	Solenoid valves.....	205		
Shallow well water pump.....	314				
Sheet metal.....	347-348				

caps .....	277	couplings .....	227	thermometers with wells .....	255
control valves .....	279	crosses .....	226	unions .....	251
couplings .....	277	ells .....	225	valves .....	254
ells .....	275	hanger assemblies .....	233	Steel pipe, Schedule 80	
flanges .....	277	horizontal assembly .....	224	welded .....	238, 239
hanger assemblies .....	280	nipples .....	228-230	bolt and gasket sets .....	246
horizontal assembly .....	274	plugs .....	227	butterfly valves .....	244
pressure gauges .....	280	pressure gauges .....	233	caps .....	242
pressure/temperature taps .....	280	pressure/temperature taps .....	233	control valves .....	245-246
reducers .....	276	reducers .....	226	ells .....	239
reducing tees .....	276	riser clamps .....	234	flanges .....	243
riser clamps .....	280	silent check valves .....	232	gate valves .....	243
strainers .....	279	strainers .....	232	globe valves .....	243-244
tees .....	275	swing check valves .....	232	hanger assemblies .....	247
thermometers with wells .....	280	tees .....	225-226	pressure gauges .....	246
valves .....	277-279	thermometers with wells .....	233	pressure/temperature tap .....	246
vertical assembly .....	274	unions .....	227	reducers .....	241-242
Steel pipe, Schedule 40		valves .....	230-231, 233	riser clamps .....	247
cut-grooved .....	281	vertical assembly .....	224	silent check valves .....	245
adapters .....	282	Steel pipe, Schedule 40		strainers .....	245
bolt and gasket sets .....	285	welded .....	215-216	swing check valves .....	244
caps .....	283	bolt and gasket sets .....	223	tees .....	240-241
couplings .....	283	caps .....	218	thermometers with wells .....	246
ells .....	281	control valves .....	222	threadolets .....	243
flanges .....	283	ells .....	216	unions .....	242
hanger assemblies .....	286	flanges .....	219	valves .....	246
pipe sleeves .....	286	hanger assemblies .....	223	weldolets .....	242
pressure gauges .....	286	pressure gauges .....	223	Steel pipe, Schedule 160	257
pressure/temperature taps .....	286	pressure/temperature tap .....	223	bolt and gasket sets .....	265
reducers .....	283	reducers .....	218	ells .....	259
reducing tees .....	282	riser clamp .....	223	hanger assemblies .....	266
riser clamps .....	286	strainers .....	221-222	pressure gauges .....	265
strainers .....	285	tees .....	217	pressure/temperature taps .....	265
tees .....	282	thermometers .....	223	riser clamps .....	266
thermometers with wells .....	286	threadolets .....	219	thermometers with wells .....	265
valves .....	284-285	unions .....	219	Steel pipe, Schedule 160	
Steel pipe, Schedule 40		valves .....	220-222	plain end .....	257
roll-grooved .....	267	weldolets .....	219	Steel pipe, Schedule 160	
adapters .....	269	Steel pipe, Schedule 80		threaded .....	257, 261
bolt and gasket sets .....	272	threaded .....	248-249	ells .....	258-259
caps .....	270	ball valves .....	253	horizontal assembly .....	256
couplings .....	270	bolt and gasket sets .....	254	tees .....	260
ells .....	268	butterfly valves .....	252-253	unions .....	261
flanges .....	270	caps .....	251	vertical assembly .....	257
hanger assemblies .....	273	control valves .....	254	Steel pipe, Schedule 160 welded	257
pressure gauges .....	272	couplings .....	252	caps .....	262
pressure/temperature taps .....	273	crosses .....	251	ells .....	258-259
reducers .....	269	ells .....	249	flanges .....	263
reducing tees .....	269	flanges .....	254	horizontal assembly .....	256
riser clamps .....	273	gate valves .....	252	reducers .....	261-262
strainers .....	272	globe valves .....	252	tees .....	260
tees .....	268	hanger assemblies .....	255	threadolets .....	263
thermometers with wells .....	272	plugs .....	251	unions .....	261
valves .....	270-272	pressure gauges .....	255	valves .....	263-265
Steel pipe, Schedule 40		pressure/temperature taps .....	255	vertical assembly .....	257
threaded .....	225	reducers .....	250	weldolets .....	262
ball valves .....	231	reducing tees .....	250	Steel piping	
bolt and gasket sets .....	233	riser clamps .....	255	removal .....	430
butterfly valves .....	231	silent check valves .....	253	Storage vans, rental .....	420
caps .....	227	strainers .....	253-254	Stores, HVAC estimates .....	437
companion flanges .....	233	swing check valves .....	253	Strainers	
control valves .....	232	tees .....	250	pipe and plumbing specialty ...	133-134

PVC, Schedule 40.....	100-101	Tank tee .....	315	Type K copper, brazed.....	35-36
PVC, Schedule 80.....	110	Tankless water heaters .....	20, 204	Type K copper, soldered.....	45, 46
Schedule 10 steel, roll-grooved....	279	Tanks		Type L copper, brazed .....	55
Schedule 40 steel, cut-grooved....	285	above ground.....	416	Type L copper, soldered.....	63
Schedule 40 steel, roll-grooved....	272	buried.....	415-416	Type M copper, brazed .....	72
Schedule 40 steel, threaded.....	232	deep burial.....	415-416	Type M copper, soldered.....	80
Schedule 40 steel, welded ...	221-222	drinking water .....	415-416	with run and branch,	
Schedule 80 steel, threaded...	253-254	expansion .....	125	galvanized steel.....	366
Schedule 80 steel, welded .....	245	fiberglass .....	415	Terminal box controller.....	339
Type K copper, brazed.....	40	greywater.....	417	Terminal boxes, air balancing .....	403
Type K copper, soldered .....	51	heat/cool .....	406	Test caps	
Type L copper, brazed .....	59	holding .....	415-416	ABS DWV .....	154
Type L copper, soldered.....	67	line voltage .....	406	copper, DWV, soldered .....	150
Type M copper, brazed .....	76	low voltage.....	406	Test plugs, PVC sewer, bell	
Type M copper, soldered.....	84	plastic .....	416-417	& spigot .....	165
Subcontract		polyethylene .....	416	Test tees, copper, DWV, soldered ...	150
change order .....	450	septic .....	415-416	Theaters	
forms.....	447	sewage .....	415	HVAC estimates .....	437
Submersible pump .....	314	sewage lift.....	417	Thermometers with wells	
Submittal data .....	458-459	sewer .....	416	pipe and plumbing specialty.....	128
Submittal index.....	460	shallow burial.....	415-416	PVC, Schedule 40 .....	102
Suction diffusers.....	122	sump.....	417	PVC, Schedule 80 .....	111
Sump pit .....	417	swimming pool.....	292	Schedule 10 steel, roll-grooved....	280
Sump pumps, installation costs.....	435	water.....	416	Schedule 160 steel.....	265
Supermarkets, HVAC estimates.....	437	Taxable fringe benefits.....	6	Schedule 40 steel, cut-grooved....	286
Supervision expense .....	6	Taxes.....	6	Schedule 40 steel, roll-grooved....	272
Supervision valves		Tee, reducing		Schedule 40 steel, threaded.....	233
flanged.....	172	copper, pressfit.....	87	Schedule 40 steel, welded .....	223
grooved.....	173	Tees		Schedule 80 steel, threaded.....	255
Supply registers.....	334	ABS .....	153-154	Schedule 80 steel, welded .....	246
Supports, wall bracket.....	126	cast iron, hub & spigot.....	144	Type K copper, brazed.....	41
Surplus materials.....	10	cast iron, no-hub.....	140-141	Type K copper, soldered .....	52
Swimming pool heat recovery		cast iron, threaded.....	181	Type L copper, brazed .....	60
ventilators.....	292	class 110 DI, cement lined .....	412	Type L copper, soldered.....	68
Swing check valves		class 150 cast iron.....	413	Type M copper, brazed .....	77
pipe and plumbing specialty ...	129-130	class 153 DI, cement lined .....	408	Type M copper, soldered.....	85
PVC, Schedule 40 .....	100	class 153 DI, double cement		Thermostats, heat pump .....	313
PVC, Schedule 80.....	110	lined.....	411	Threadolets	
Schedule 10 steel, roll-grooved....	278	class 2400 or 3000 asbestos		pipe and plumbing specialty .....	136
Schedule 160 steel, flanged.....	264	cement.....	414	Schedule 160 steel, welded .....	263
Schedule 40 steel, cut-grooved....	284	copper, DWV, soldered .....	149	Schedule 40 steel, welded .....	219
Schedule 40 steel, roll-grooved....	271	CPVC sprinkler pipe .....	184	Schedule 80 steel, welded .....	243
Schedule 40 steel, threaded.....	232	PE-AL pipe .....	114, 119	Tier IV .....	200
Schedule 40 steel, welded .....	221	PEX-AL pipe .....	114, 119	Timer, fan .....	328
Schedule 80 steel, threaded.....	253	polypropylene pipe .....	167	Tin solder.....	33, 43, 61, 78
Schedule 80 steel, welded .....	244	PVC sewer, bell & spigot.....	164	Toilet	
Type K copper, brazed.....	40	PVC, DWV.....	157	disconnect .....	433
Type K copper, soldered.....	50	PVC, Schedule 40 .....	95	removal.....	432
Type L copper, brazed .....	59	PVC, Schedule 80 .....	105	Tools.....	117, 120
Type L copper, soldered.....	67	roll-grooved, Victaulic .....	179-180	Trailers, office, rental.....	420
Type M copper, brazed .....	76	Schedule 10 steel, roll-grooved....	275	Transceiver.....	339
Type M copper, soldered.....	84	Schedule 160 steel, threaded.....	260	Trap primers, installation costs .....	435
Switches, sprinkler system.....	174	Schedule 160 steel, welded .....	260	Traps with bushing connections.....	26
		Schedule 40 steel, cut-grooved....	282	Traps, steam .....	127
		Schedule 40 steel, roll-grooved....	268	Treatment tank .....	417
		Schedule 40 steel, threaded.....	225	Triple duty valves .....	122
		Schedule 40 steel, welded .....	217	Trucks, rental.....	420
		Schedule 5 steel, pressfit.....	237	Tub	
		Schedule 80 steel, threaded.....	250	disconnect .....	433
		Schedule 80 steel, welded ...	240-241	removal.....	432
		spiral, galvanized steel .....	361-366	Tub and shower combinations .....	28
		Type K & L copper, roll grooved ...	89	Tube-axial fan.....	326

## T

Table of contents.....	3
Tables	
budget estimates .....	435
trenching costs .....	418-419
Tailpiece connections.....	26

Turning vanes.....	343	Type L copper pipe, soldered.....	61-62	PVC, Schedule 40.....	97
Tutorial.....	5	adapters.....	64	PVC, Schedule 80.....	107
Type I and II PVC		bolt and gasket sets.....	68	Schedule 160 steel, threaded.....	261
pipe.....	93-94, 103-104	bushings.....	65	Schedule 160 steel, welded.....	261
Type K copper pipe, brazed.....	33-34	caps.....	65	Schedule 40 steel, threaded.....	227
adapters.....	37	companion flanges.....	68	Schedule 40 steel, welded.....	219
bolt and gasket sets.....	41	couplings.....	65	Schedule 80 steel, threaded.....	251
bushings.....	38	ells.....	62-63	Schedule 80 steel, welded.....	242
caps.....	38	hanger assemblies.....	69	Type K copper, brazed.....	38
companion flanges.....	41	pressure gauges.....	68	Type K copper, soldered.....	48
couplings.....	38	pressure/temperature taps.....	68	Type L copper, brazed.....	57
ells.....	34	reducers.....	64	Type L copper, soldered.....	65
hanger assemblies.....	42	riser clamps.....	69	Type M copper, brazed.....	74
pressure gauges.....	41	strainers.....	67	Type M copper, soldered.....	82
pressure/temperature taps.....	42	tees.....	63	Unit heaters.....	211, 304
reducers.....	37	thermometers with wells.....	68	connections.....	211
riser clamps.....	42	unions.....	65	demolition.....	428
strainers.....	40	valves.....	66-68	gas fired.....	211
tees.....	35-36	Type L soft copper pipe.....	91	hot water.....	302
thermometers with wells.....	41	Type M copper pipe, brazed.....	70-71	HVAC connections.....	211
unions.....	38	adapters.....	73	removal.....	428
valves.....	39-41	bolt and gasket sets.....	77	steam.....	303
Type K copper pipe, soldered.....	43-44	bushings.....	74	Upblast ventilation.....	331
adapters.....	47-48	caps.....	74	Updates.....	5
bolt and gasket sets.....	52	couplings.....	74	Urinals.....	27
bushings.....	48	ells.....	71	disconnect.....	433
caps.....	48	pressure gauges.....	77	estimating.....	435
companion flanges.....	51	pressure/temperature taps.....	77	Using this book.....	5
couplings.....	49	reducers.....	73	Utility fan.....	325
ells.....	44-45	strainers.....	76	UV disinfection unit.....	25
hanger assemblies.....	52	tees.....	72		
pressure gauges.....	52	thermometers with wells.....	77		
pressure/temperature taps.....	52	unions.....	74		
reducers.....	47	valves.....	75-77	<b>V</b>	
riser clamps.....	52	Type M copper pipe, soldered.....	78-79	Vacuum breakers.....	122, 205
strainers.....	51	adapters.....	81	atmospheric.....	122
tees.....	45-46	bolt and gasket sets.....	85	hose connection.....	122
thermometers with wells.....	52	bushings.....	82	Value engineering.....	9
unions.....	48	caps.....	82	Valves	
valves.....	49-51	companion flanges.....	85	air admittance.....	329
Type K & L copper pipe, roll grooved		couplings.....	82	alarm.....	173
coupling.....	90	ells.....	79-80	check, flanged.....	173
ells.....	89	pressure gauges.....	85	check, grooved.....	173
flange adapter.....	90	pressure/temperature taps.....	85	control.....	222
reducers.....	90	reducers.....	81	double check detector.....	173
tees.....	89	strainers.....	84	dry.....	173
valves.....	90	tees.....	80	fire protection.....	173
Type L copper pipe, brazed.....	53-54	thermometers with wells.....	85	PE-AL pipe.....	116, 120
adapters.....	56	unions.....	82	PEX-AL pipe.....	116, 120
bolt and gasket sets.....	60	valves.....	83-85	pipe and plumbing	
bushings.....	57			specialty.....	128-130, 135
cap.....	57			PVC, Schedule 40.....	98-101
companion flanges.....	60			PVC, Schedule 80.....	108-111
couplings.....	57			PVC, threaded.....	99, 109
ells.....	54			PVC, Tru-union.....	99, 109
pressure gauges.....	60			PVC, Union type,	
reducers.....	56			Solvent weld.....	100, 109
strainers.....	59			removal.....	431
tees.....	55			Schedule 40 steel,	
thermometers with wells.....	60			cut-grooved.....	284-285
unions.....	57			Schedule 40 steel, roll-grooved....	272
valves.....	58-60			Schedule 40 steel, threaded.....	233
		<b>U</b>			
		U-bolts, galvanized.....	126		
		Ultra-violet			
		disinfection.....	25		
		water treatment.....	25		
		Underground piping, PVC.....	161		
		Unions			
		copper, pressfit.....	87		
		dielectric.....	124		

Schedule 40, welded.....	222	<b>W - X - Y - Z</b>	
Schedule 80 steel, threaded.....	254	Wall exhauster.....	327
Schedule 80 steel, welded.....	246	Wall fan.....	327
Schedule 160 steel, flanged.....	264	Wash fountains, installation costs...	435
solenoid.....	205	Waste heat controls.....	204
solvent weld.....	99, 109	Waste systems	
sprinkler system.....	173	cast iron, hub & spigot.....	143
supervision, flanged.....	172	cast iron, no-hub.....	143
supervision, grooved.....	173	copper.....	148
tags.....	421	PVC.....	156
triple duty.....	122	PVC, DWV.....	156
Type K copper, brazed.....	40	Water closets.....	27
Type K copper, soldered.....	50	disconnect.....	433
Type L copper, brazed.....	60	estimating.....	435
Type L copper, soldered.....	66-68	Water coil piping.....	295
Type M copper, brazed.....	75-77	Water connections, hot and cold.....	26
Type M copper, soldered.....	83-85	Water cooled chiller connection.....	212
Vane-axial fan.....	325	Water hammer arresters.....	135
Vans, storage, rental.....	420	Water heaters	
Variable-air volume		commercial.....	19-20
cooling units.....	338	connections.....	21
reheat units.....	338	estimating.....	435
Vent systems.....	435	residential.....	19-20
cast iron, hub & spigot.....	143	solar.....	324
cast iron, no-hub.....	143	tankless.....	20
copper.....	148	tankless indirect.....	204
PVC, DWV.....	156	Water meters	
Ventilation		by-pass and connection	
ductwork.....	347-348	assembly.....	121
exhausters.....	330	compound type.....	121
fans.....	328	turbine type.....	121
Ventilator		Water motor gong.....	176
heat recovery.....	302	Water pump.....	314
fans.....	327	jet.....	314
Vents, air.....	123	well.....	314
Verantis.....	200	Water softener.....	22-24
Victaulic roll-grooved fittings.....	178-180	accessories.....	23
		Water softening systems, boiler.....	199
		Water source heat pump.....	308-309
		Water storage tank.....	416
		Water wells	
		drilling.....	317
		Watertube boilers.....	189
		Weekly rental, equipment.....	420
		Welding machines, rental.....	420
		Weldolets	
		pipe and plumbing specialty.....	136
		Schedule 160 steel, welded.....	262
		Schedule 40 steel, welded.....	219
		Schedule 80 steel, welded.....	242
		Wells	
		drilling.....	317
		geothermal.....	317
		pipe.....	315
		water pump.....	314
		Well-to-well heat pump.....	308-309
		Wheel	
		heat recovery.....	302
		Wireless transceiver.....	339
		Wyes	
		ABS.....	153-154
		cast iron, hub & spigot.....	145-146
		cast iron, no-hub.....	138-140
		class 150 cast iron.....	413
		class 153 DI, cement lined.....	409
		class 153 DI, double cement	
		lined.....	411
		class 2400 or 3000 asbestos	
		cement.....	414
		copper, DWV, soldered.....	149
		polypropylene pipe.....	167-168
		PVC sewer, bell & spigot.....	162-164
		PVC, DWV.....	157



# Practical References for Builders

## National Estimator Cloud



Generate professional construction estimates for all residential and commercial construction from your internet browser. Includes 10 Craftsman construction cost databases, over 40,000 labor and material costs for construction, in an easy-to-use format. Cost estimates are well-organized and thoroughly indexed to speed and simplify writing estimates for nearly any residential or light commercial construction project – new construction, improvement or repair. Convert the bid to an invoice – in either QuickBooks Desktop or QuickBooks Online. Access your estimates from anywhere and on any device with a Web browser. Monthly and one-time billing options available. Visit <https://craftsman-book.com/national-estimator-cloud> for more details.

## Construction Contract Writer



Relying on a “one-size-fits-all” boilerplate construction contract to fit your jobs can be dangerous — almost as dangerous as a handshake agreement. *Construction Contract Writer* lets you draft a contract in minutes that precisely fits your needs and the particular job, and meets both state and federal requirements. You just answer a series of questions — like an interview — to construct a legal contract for each project you take on. Anticipate where disputes could arise and settle them in the contract before they happen. Include the warranty protection you intend, the payment schedule, and create subcontracts from the prime contract by just clicking a box. Includes a feedback button to an attorney on the Craftsman staff to help should you get stumped — *No extra charge.* **\$199.95.** Download the *Construction Contract Writer* at <http://www.constructioncontractwriter.com>

## Plumber's Handbook Revised, 6th Edition



This new edition explains simply and clearly, in non-technical, everyday language, how to install all components of a plumbing system to comply not only with recent changes in the *International Plumbing Code* and the *Uniform Plumbing Code*, but with the requirements of the Americans with Disabilities Act. Originally written for working plumbers to assure safe, reliable, code-compliant plumbing installations that pass inspection the first time, *Plumber's Handbook*, because of its readability, accuracy and clear, simple diagrams, has become the textbook of choice for numerous schools preparing plumbing students for the plumber's exams. Now, with a set of questions for each chapter, full explanations for the answers, and with a 200-question sample exam in the back, this handbook is one of the best tools available for preparing for almost any plumbing journeyman, master or state-required plumbing contracting exam.

**384 pages, 8 1/2 x 11, \$67.00**

**eBook (PDF) also available; \$33.50** at [www.craftsman-book.com](http://www.craftsman-book.com)

## Paper Contracting: The How-To of Construction Management Contracting

Risk, and the headaches that go with it, have always been a major part of any construction project — risk of loss, negative cash flow, construction claims, regulations, excessive changes, disputes, slow pay — sometimes you'll make money, and often you won't. But many contractors today are avoiding almost all of that risk by working under a construction management contract, where they are simply a paid consultant to the owner, running the job, but leaving him the risk. This manual is the how-to of construction management contracting. You'll learn how the process works, how to get started as a CM contractor, what the job entails, how to deal with the issues that come up, when to step back, and how to get the job completed on time and on budget. Includes a link to free downloads of CM contracts legal in each state.

**272 pages, 8 1/2 x 11, \$55.50**

**eBook (PDF) also available; \$27.75** at [www.craftsman-book.com](http://www.craftsman-book.com)

## Building Code Compliance for Contractors & Inspectors

Have you ever failed a construction inspection? Have you ever dealt with an inspector who has his own interpretation of the Code and forces you to comply with it? This new book explains what it takes to pass inspections under the 2009 *International Residential Code*. It includes a Code checklist — with explanations and the Code section number — for every trade, covering some of the most common reasons why inspectors reject residential work. The author uses his 30 years' experience as a building code official to provide you with little-known information on what code officials look for during inspections. **232 pages, 8 1/2 x 11, \$32.50**  
**eBook (PDF) also available; \$16.25** at [www.craftsman-book.com](http://www.craftsman-book.com)

## Commercial Metal Stud Framing

Master the transition from wood to metal stud framing with this comprehensive guide. Written by industry expert Ray Clark, this book offers step-by-step instructions, essential tools, and proven techniques to excel in commercial metal stud framing. Ideal for experienced wood framers, it includes hundreds of job site photos and valuable tips to help you work quickly, accurately, and safely on commercial projects.

**208 pages, 8 1/2 x 11, \$65.50**

**Also available as eBook PDF, \$32.75** at [www.craftsman-book.com](http://www.craftsman-book.com)

## Plumbing & HVAC Manhour Estimates

Hundreds of tested and proven manhours for installing just about any plumbing and HVAC component you're likely to use in residential, commercial, and industrial work. You'll find manhours for installing piping systems, specialties, fixtures and accessories, ducting systems, and HVAC equipment. If you estimate the price of plumbing, you shouldn't be without the reliable, proven manhours in this unique book.

**224 pages, 5 1/2 x 8 1/2, \$28.25**

## Planning Drain, Waste & Vent Systems

How to design plumbing systems in residential, commercial, and industrial buildings. Covers designing systems that meet code requirements for homes, commercial buildings, private sewage disposal systems, and even mobile home parks. Includes relevant code sections and many illustrations to guide you through what the code requires in designing drainage, waste, and vent systems. **192 pages, 8 1/2 x 11, \$39.95**

## Construction Forms for Contractors

This practical guide contains 78 practical forms, letters and checklists, guaranteed to help you streamline your office, organize your jobsites, gather and organize records and documents, keep a handle on your subs, reduce estimating errors, administer change orders and lien issues, monitor crew productivity, track your equipment use, and more. Includes accounting forms, change order forms, forms for customers, estimating forms, field work forms, HR forms, lien forms, office forms, bids and proposals, subcontracts, and more. All are also on the CD-ROM included, in Excel spreadsheets, as formatted Rich Text that you can fill out on your computer, and as PDFs. **360 pages, 8 1/2 x 11, \$48.50**

**eBook (PDF) also available; \$24.25** at [www.craftsman-book.com](http://www.craftsman-book.com)

## Roofing Construction & Estimating, Revised

Detailed, step-by-step instructions, with photographs and diagrams, for installing, repairing and estimating nearly every type of roof covering available today for residential and commercial structures: asphalt shingles, roll roofing, wood shingles and shakes, clay tile, slate, metal, built-up, elastomeric, TPO and more. Provides guidance on sheathing, synthetic and felt underlayment, as well as tips and tricks from an experienced pro for dealing with those difficult points on a roof that are prone to leaks, such as valleys and roof penetrations. For each roofing type, instructions are provided for estimating material quantities and labor costs, with formulas, easy-to-follow examples and sample estimates for you to test your skill. Use these methods to create reliable estimates that will help insure a profit on every job you take. **448 pages, 8 1/2 x 11, \$62.50**

**eBook (PDF) also available; \$31.25** at [www.craftsman-book.com](http://www.craftsman-book.com)

### National Construction Estimator

Current building costs for residential, commercial, and industrial construction. Estimated prices for every common building material. Provides man-hours, recommended crew, and gives the labor cost for installation. **672 pages, 8 1/2 x 11, \$117.50. Revised annually**  
**eBook (PDF) also available; \$58.75** at [www.craftsman-book.com](http://www.craftsman-book.com)

### National Appraisal Estimator



An Online Appraisal Estimating Service. Produce credible single-family residence appraisals – in as little as five minutes. A smart resource for appraisers using the cost approach. Reports consider all significant cost variables and both physical and functional depreciation. For more information, visit [www.craftsman-book.com/national-appraisal-estimator-online-software](http://www.craftsman-book.com/national-appraisal-estimator-online-software)

### Home Building Mistakes & Fixes

This is an encyclopedia of practical fixes for real-world home building and repair problems. There's never an end to "surprises" when you're in the business of building and fixing homes, yet there's little published on how to deal with construction that went wrong - where out-of-square or non-standard or jerry-rigged turns what should be a simple job into a nightmare. This manual describes jaw-dropping building mistakes that actually occurred, from disastrous misunderstandings over property lines, through basement floors leveled with an out-of-level instrument, to a house collapse when a siding crew removed the old siding. You'll learn the pitfalls the painless way, and real-world working solutions for the problems every contractor finds in a home building or repair jobsite. Includes dozens of those "surprises" and the author's step-by-step, clearly illustrated tips, tricks and workarounds for dealing with them.

**384 pages, 8 1/2 x 11, \$52.50**  
**eBook (PDF) also available; \$26.25** at [www.craftsman-book.com](http://www.craftsman-book.com)

### Insurance Restoration Contracting: Startup to Success

Insurance restoration — the repair of buildings damaged by water, fire, smoke, storms, vandalism and other disasters — is an exciting field of construction that provides lucrative work that's immune to economic downturns. And, with insurance companies funding the repairs, your payment is virtually guaranteed. But this type of work requires special knowledge and equipment, and that's what you'll learn about in this book. It covers fire repairs and smoke damage, water losses and specialized drying methods, mold remediation, content restoration, even damage to mobile and manufactured homes. You'll also find information on equipment needs, training classes, estimating books and software, and how restoration leads to lucrative remodeling jobs. It covers all you need to know to start and succeed as the restoration contractor that both homeowners and insurance companies call on first for the best jobs.



**640 pages, 8 1/2 x 11, \$69.00**  
**eBook (PDF) also available; \$34.50** at [www.craftsman-book.com](http://www.craftsman-book.com)

### Craftsman eLibrary

Craftsman's eLibrary license gives you immediate access to 60+ PDF eBooks in our bookstore for 12 full months!

**You pay only one low price. \$129.99.**

**Visit [www.craftsman-book.com](http://www.craftsman-book.com) for more details.**



### Plumber's Exam Preparation Guide eBook

Hundreds of questions and answers to help you pass the apprentice, journeyman, or master plumber's exam. Questions are in the style of the actual exam. Gives answers for both the Standard and Uniform plumbing codes. Includes tips on studying for the exam and the best way to prepare yourself for examination day. **\$19.00**



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

Call me  
**1-800-829-8123**  
 Fax (760) 438-0398

Name \_\_\_\_\_

e-mail address (for order tracking and special offers) \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City/State/Zip \_\_\_\_\_  This is a residence

Total enclosed \_\_\_\_\_ (In California add 7.5% tax)  
*Free Media Mail shipping, within the US,  
 when your check covers your order in full.*

### In A Hurry?

We accept phone orders charged to your

Visa,  MasterCard,  Discover or  American Express

Card# \_\_\_\_\_

Exp. date \_\_\_\_\_ CVV# \_\_\_\_\_ Initials \_\_\_\_\_

**Tax Deductible:** Treasury regulations make these references tax deductible when used in your work. Save the canceled check or charge card statement as your receipt.

**Order online: [www.craftsman-book.com](http://www.craftsman-book.com)**

**Writing contracts that comply with law in your state isn't easy. A contract that doesn't comply could leave you with no way to collect.**

**Construction Contract Writer has you covered. Download a trial today:**

**[www.constructioncontractwriter.com](http://www.constructioncontractwriter.com)**

#### 10-Day Money Back Guarantee

#### Prices subject to change without notice

- |   |  |
|---|--|
| <input type="radio"/> 32.50 Building Code Compliance for Contractors & Inspectors | <input type="radio"/> 55.50 Paper Contracting: The How-To of Construction Management Contracting |
| <input type="radio"/> 65.50 Commercial Metal Stud Framing                         | <input type="radio"/> 39.95 Planning Drain, Waste & Vent Systems                                 |
| <input type="radio"/> 48.50 Construction Forms for Contractors                    | <input type="radio"/> 67.00 Plumber's Handbook Revised, 6th Edition                              |
| <input type="radio"/> 52.50 Home Building Mistakes & Fixes                        | <input type="radio"/> 28.25 Plumbing & HVAC Manhour Estimates                                    |
| <input type="radio"/> 69.00 Insurance Restoration Contracting: Startup to Success | <input type="radio"/> 62.50 Roofing Construction & Estimating, Revised                           |
| <input type="radio"/> 117.50 National Construction Estimator                      | <input type="radio"/> 118.25 National Plumbing & HVAC Estimator                                  |