Temperature Controls
Estimating Procedure
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Introduction

This document describes the process of estimating temperature controls for mechanical (HVAC) systems. In order to generate a complete, accurate estimation of labor and materials for the control systems portion of a mechanical project, certain prerequisites must be met. First and foremost, the mechanical systems must be clearly depicted, conceptually, diagrammatically, and physically. Such depictions should be found in the form of a mechanical plan, showing all systems and equipment, schedules, details, and control descriptions. In addition to the mechanical plans, there is often an accompanying written specification, which details the guidelines that are to be followed by the installing contractor(s), and includes acceptable practices and equipment, division of responsibilities, and often a rough Sequence of Operation. With these plans and specifications, an accurate temperature controls estimate can be generated.

For negotiated work, design/build work, and work done directly with building owners, the mechanical system designs are not always as clear-cut. Generally there will be no specification document, and any mechanical plans will often be conceptual in nature, at least during the initial design stages. For projects such as these, generating an accurate estimate up front is more challenging, yet at the same time perhaps less critical, since there are ideally no competitors. For this type of work, it is more important to account for everything, and be more conservative with the estimate, to cover any gray areas that will need to be worked out down the road.

The estimating procedure outlined herein is geared toward projects that *do* have plans and specifications. In essence it is a two-part process. The first part is to generate an initial "ballpark" estimate, by accounting for everything and attaching a number to each item, without too much regard for what each item actually entails. The second part of the process is to "fine tune" the estimate, by insightfully addressing each item and applying "practical analysis" to come up with a more accurate, more realistic number for what's involved with each item.

A detailed, accurate temperature controls estimate can provide an invaluable service to a mechanical project, not only up front, but also after the job is sold and booked. The document serves as the "first step" for the control systems engineer, as it clearly defines the scope of work, in terms of what was sold and what was not sold. It should also provide insight into how the systems should be designed to operate, as the estimator has embedded "clues" in the manner of how he detailed his estimate. Finally, a well put together estimate serves as a tracking tool for the project, and can aid in cost control, in the determination of responsibilities, and in the generation of change orders.

Part One – Generate a "Ballpark" Estimate

Perhaps the single most important thing in generating an accurate temperature controls estimate is to account for every piece of mechanical equipment, from the largest air handler right down to the smallest exhaust fan! It is the first step toward the final goal. An estimate can be precisely detailed down to the nuts and bolts, wire and cable, and conduit and fittings. Yet if something is missed or left out, then even the most detailed estimate will not accurately represent the project, and hence will not serve the very purpose that it was generated to serve.

Highlight the Mechanical Plans, and Account for all HVAC Equipment

Take a set of different colored highlighters, and color the plans! Color the equipment tags first with one color, and then the actual equipment with another color. Color any miscellaneous controls devices shown (smoke detectors, control valves and damper actuators, sensors and thermostats, etc.) with yet another color. If you'd like, color the major pipe and duct runs, to help better visualize the mechanical systems.

By coloring the plans, a familiarity with the project is subconsciously gained, and is a good first step. Also important is the review of the equipment schedules. Highlight information in each schedule relevant to equipment operation and control. Notes and remarks included in these schedules provide pertinent information related to controls and control system requirements.

If a Sequence of Operation is included on the plans, then read it and highlight any important parts of it, parts that imply costs or components that might not be explicitly spelled out. For instance, if the Sequence of an air handler states that the system is to shut down if supply temperatures fall below 40 degrees, then a freezestat, though not explicitly asked for, is required.

Finally, review all details and mechanical system schematics. These diagrams provide additional insight into intended system operation, and might indicate controls components that aren't necessarily shown on the actual mechanical layout.

Read the Specification and Highlight Important Details

The written specification provides guidelines that will steer the estimator in the proper direction. First off, the spec will define responsibilities, i.e., who's responsible for what. The temperature controls portion of a project specification will be found as part of the mechanical contractor's scope of work, under Division 15 (section 15900). Division 15 (mechanical) and Division 16 (electrical) generally draw the line between work to be provided by the mechanical (HVAC) contractor and work to be provided by the electrical contractor. Certain items, such as motor starters and smoke detectors, can fall under either division, so it's important to review the spec for these types of issues.

The spec will also list out acceptable manufacturers of controls, from digital controllers and control systems down to valve and damper actuators. The spec will often define acceptable types of other miscellaneous items, such as sensors and transmitters, without necessarily demanding a specific brand or manufacturer. It is important to note these issues, and account for them in the estimate.

The spec will outline acceptable practices and will stipulate other general responsibilities, such as commissioning and user training. Finally, the Sequence of Operation, if not found on the mechanical plans, will likely be included in the specification.

Break the Entire Project into Meaningful Portions

Rooftop Units, Make Up Air Units, Fan Coil Units, Air Handlers, VAV and Fan Powered Boxes, Reheat Coils, Exhaust Fans, Pumps, Boilers, Chillers, Unitary Heating Equipment, Miscellaneous. Or more generally, Airside Systems and Equipment, Waterside Systems and Equipment, and Miscellaneous. For each category, itemize the mechanical assemblies that make up the category.

For Each Portion, Estimate the Mechanical Assemblies

Using an estimating manual, an estimating spreadsheet, and rules of thumb, generate a ballpark estimate for each assembly, for both labor and materials. Use a separate worksheet for each portion, with the spreadsheet tallying all worksheets and generating an overall summary sheet. On each worksheet, itemize only as much as necessary. For instance, for a constant volume rooftop unit, all that is typically required is a thermostat and perhaps a smoke detector. Lump both items together as one. A built up air handler, on the other hand, requires more of a breakdown. Break out the control valves and enter them as separate line items, break out the main control panel as well, and lump everything else (damper actuators, sensors, freezestats, etc.) together as a single line item. Some people will find that the more they itemize things, the more detailed they can get. This is generally a matter of preference, but it does take more time.

For other project requirements, such as starters, CO detection systems, networking, and Building Automation System items, handle on separate worksheets.

On each worksheet, include any pertinent notes, inclusions, exclusions, etc. For instance, if figuring in control valves for fan powered box heating coils, note this, so that the box provider doesn't include these in his quote. On the flipside of that, if you know that the box provider is including these items, then note that they are excluded in your estimate. If the spec calls for something out of the ordinary and you are including it in the estimate, then make note of it. Note exclusions and why. For example, if an exhaust fan is controlled by a wall switch and the electrical contractor is responsible for this work, then note this. Note any assumptions or uncertainties as well. For example, "Unit ventilators line item assumes factory packaged controls with integral thermostats".

Part Two – Fine Tune the Estimate

Now that all mechanical equipment has been accounted for and the rough estimate has been generated, it's time for some introspect! Take a step back from the estimate, and put yourself in the installer's shoes. Also, take a real good look at the material costs, and find where there may be opportunities for less expensive alternatives. The following guidelines will help to "dial in" the estimate and arrive at a well-defined scope of work and an accurate budget number.

Conduit – Labor and Material

The use of conduit is generally mandated by the municipality and the code that they follow, or may simply be preferred and specified by the engineer. For controls and control systems, much of the wiring is low voltage. Nevertheless, much of this must be run in conduit, regardless, unless it can be categorized as "not required to be in conduit", such as communication and network wiring "might" be. For most installations where conduit is required, the size of the conduit will be small (1/2" to ¾"), and the additional cost for conduit and fittings can be figured in as a percentage of the project.

Now is the time to take another look at the mechanical plans, and determine the amount of conduit required to be run. Note the length of runs, and ceiling heights as well. If the ceiling height is 20 feet, and a lift is required for the work, then account for this by adjusting the appropriate labor factors. Likewise, if runs are generally short, then the initial labor factors may be slightly heavy.

Control Panel Labor

For every major system and major piece of equipment that's not packaged, a control panel will likely need to be built. The estimate for control panel labor (and material, for that matter) can be fine tuned. For instance, "Will it really take that many hours to build and install that control panel, or is that number rather high? What is the number originally based on? Is physical size a factor? Will there be more than one panel built?"

Ideal Conditions

The initial estimate is typically based on "ideal conditions", which can mean a lot of things. For a built up air handling unit, ideal conditions would mean indoors, a nice clean equipment room with plenty of room to work, wall space for the control panel, and a condensing unit in close proximity and easily reachable. Each portion of the project should be looked at. If the conditions of certain tasks are somewhat less than ideal, then the labor factors for these tasks should be adjusted accordingly.

Repetition and Overlap

When a task is to be repeated many times, the time required for the task will generally come down, as compared to having to perform the task just once or twice. This is because a familiarity with the task is gained from the first few times the task is performed, and the installer learns how to perform the task quicker and more easily. This is true for tasks such as thermostat wiring, unitary equipment wiring, communication link wiring, etc. If a task must be performed dozens and dozens of times, and your labor estimate for the task is based upon the task being performed only once or twice, then there may be an opportunity to decrease the labor factors for the task.

Are there any areas of overlap in your estimate? Overlap can be defined as labor (and material also) that is accounted for more than once. Are you expecting the control systems installer to perform tasks that might possibly be covered elsewhere in the project estimate? What about components? Are you picking up something in your estimate that might already be included in an equipment vendor's quote? It's important to find these things out, so that labor and materials aren't accounted for twice.

Material and Component Prices

How accurate are your component prices? Is that big-ticket item really that much money? How about that 5" three-way control valve? Can it be purchased any cheaper? Is it worth the time to get a quote on it? For items with large associated costs, it's a good idea to take a closer look at what those costs are, and see if they somehow can be reduced.

For items of which there are many of required, like thermostats and reheat coil control valves, are the component prices for such items accurate? If you have four dozen ¾" control valves, a price reduction of ten dollars per valve results in an adjustment to the components cost of close to $500.00. For items of which there are many required for the project, this is an area that merits a second look.

Uncertainties and Gray Areas

No project is completely clear-cut. There will always be gray areas to watch out for, and always things that are unclear up front. Be aware of these types of things, and cover them by qualifying them and associating a cost to what's been qualified, or simply exclude them. Remember that excluding something from your estimate does not relieve responsibility of it. If something is specified to be the responsibility of the mechanical or temperature controls contractor, then it must be covered somewhere, if not in your estimate.

Opportunities and Value Engineering

Are there any opportunities to do anything any less costly than what has been figured? Can substitutions be made, that won't lessen the value of what's ultimately installed? Is the specification asking for something that is overkill, or are the mechanical plans specifying something that works "on paper", but won't necessarily work in the real world? There are opportunities to lessen costs and still provide a value-added product. To find these opportunities is challenging, and one must be sure that the original design intentions aren't compromised in the process. A bidding contractor can always offer alternative solutions, as an "alternate" to the main scope of work. If the alternative is valid, the engineer approves of it, and there is money to be saved, then the alternate just might be attractive enough to win the project!