

# PREPARING FOR TAKEOFF

## *Conduit*



**W**hen it comes to preparing an estimate, every electrical estimator should be familiar with the *National Electrical Code* (NEC). Nearly all inspection authorities adopt the NEC with or without supplemental amendments. NEC standards require that materials be listed by a testing laboratory like Underwriters Laboratories, Inc. (UL); and typically all authorities will accept UL listed materials. As an estimator, you must be knowledgeable and familiar with local codes and also be aware of the NEC version the city or town has currently adopted. Not adhering to local requirements can result in expensive fines and costly do-overs!

Often job specifications state that all work must comply with the NEC but also include statements that override allowable NEC conditions. For example, a common practice by engineers is to limit the largest and smallest size conduit by conduit type and specify a job requirement for 3/4" conduit as the minimum size used on the job. This means that even if NEC standards would allow a smaller size conduit, the most stringent specification always applies. It is important to read the specifications carefully and completely before starting the estimate.

Job specification log-in sheets are used to track such requirements. It is good practice to list the systems within the job, along with references to page numbers and sections of the specifications, that support your entries. Be sure to make reference notes as to the type of fittings, hangers and wire type. Finding such information in the specifications can, at times, be a little cumbersome. Including this type of documentation with your estimate will expedite the review of an estimate by the chief estimator or owner. Computer estimating software that supports job specifications will allow you to preset the specifications by phase and systems...set it so you don't forget it.

Many experienced electrical estimators have developed short cuts that save time without sacrificing accuracy. One such practice is the use of assemblies. Assemblies produce results nearly as accurate as more exhaustive detailed estimating while dramatically cutting down on estimating time. Many assemblies, like fixtures and devices, include preset conduit lengths in the assembly. This requires calculating an average length per fixture or device. It is not a good practice to preset average lengths unless you consistently estimate the same type of job, as, for example in residential work with ceiling heights always within a reasonable average. Today's estimating programs allow you to preset defaults for particular assemblies by job and will also prompt you for specific values during takeoff. Of course, the ability to override previously entered data for special situations *must* always be allowed.

Averaging the installation works effectively with the right procedures. This process requires the estimator to sample one or two typical circuits. Roll the selected circuits and then divide the total length by the number of fixtures or devices served. Average the fixture and device circuits separately, and then apply these averages to all fixtures and devices supplied respectively.

Estimating software should have the ability to automatically calculate the required conduit size when multiple circuits of both equal or different size conductors are combined into one conduit run (in accordance with NEC standards). The variables utilized include NEC conduit fill Tables C1 thru C12, Tables 4, 5, Table 310-16 and Table 310.15(B)(2)(a) . Other considerations should include fault current, voltage drop, load calculations, motor calculations, conduit fill, box fill and wireway fill including multiple wire sizes. With these state-of-the-art tools built in to a software package the estimator can quickly and easily determine the optimal and most economical installation.

It is good practice to mark up the drawings when combining circuits in conduits or cable runs...for example, multiple home runs in one single conduit or cable (when specifications allow). Draw the pull or junction box on the drawings at the point where the circuits combine; and average the lengths to each fixture or device served, and then measure the combined run to the panel.

Remember, when applying the adjustment factors for more than three current-carrying conductors in a raceway or cable, the derating starts from 90°C column for conductors like THHN that are rated for ninety degrees. This means that ten (10) 2-wire circuits using number 12 THHN, where each has a calculated load of 15amps or less, can be installed in one conduit and meet the 50% adjustment rule.

Finally, it is ideal to be able to value engineer the estimate by comparing alternative specification choices such as aluminum versus copper wiring (including recalculation of conduit sizing), the use of set screw versus compression fittings, steel versus DC fittings or EMT versus a cable installation. While this is time consuming to do manually, the right estimating program can accomplish this in seconds providing the estimator with a detailed, accurate estimate of multiple alternatives allowing more competitive and profitable bids.

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