

## Drawing Details: Specifications and Tolerances

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Just about every few seconds, somewhere in the world, a designer or engineer places a specification or tolerance on a drawing. Intended to describe features of the component or system and how those features are to be built, specifications and tolerances are, without a doubt, controlling product functionality and quality. In other words, they control product reliability and cost.

Part tolerances are usually considered a means for controlling a specified size or feature. If a steel block is dimensioned to 5.0" x 6.0" x 7.0" with a tolerance of  $\pm 0.02$ ", a machinist knows to rough cut the block and to mill the sides using an end mill to get the final dimension within this size range. If a tolerance of  $\pm 0.001$ " is specified, the machinist knows to either use a different end mill or make a second pass using a different mill. Either way, the cost to produce the feature is higher at  $\pm 0.001$ " than at  $\pm 0.02$ ".

Engineers have considerable difficulties understanding the relationship between tight tolerances and cost. And, so, this article is devoted to them and their managers in an effort to reduce fabrication costs and the tensions between them and their fabricators.

### Open Tolerances = Lower Fabrication Costs

There is no rule book or program available to dictate the right tolerance for a part feature. There is, however, one rule of thumb every engineer should memorize: tight tolerances are expensive to fabricate and lead to higher scrap rates. Most companies have created standards drawings to dictate the tolerance to a dimension containing a particular number of decimal places or significant figures or certain size weld bead. The standards drawings are then used as guides or starting points for detailing drawings which are adjusted later by the design engineer. Only an understanding of the part functionality, required quality level and the costs associated with different fabrication methods can be used to truly set tolerances.

Engineers typically gain this experience by discussing proposed features with fabricators. In fact, every cognizant design engineer should discuss every design feature with the fabricators in a series of open and honest discussions focused on the reason for the tolerance, how much effort is required to arrive at it, and whether or not it could be opened. The fabricators welcome these opportunities for input because it provides them with the chance to be the successful bidder and to develop an open communication channel when fabrication problems and design changes occur.

Drafting designers also play a key role in opening the spread within tolerances. Because they know more fully how the part interacts with mating parts of the assembly, they can suggest fabrication techniques to open tolerances and still maintain part quality and functionality. Additionally, many older designers began their careers as machinists and welders, and know the costs involved with tight tolerances.

### Close Tolerances ? Perfection

Remember that no part, component, or system will be better, closer to perfection, or free of problems when small tolerances are used. No drawings full of tight specifications and difficult to make parts will make it easier to write and maintain quality processes for keeping the company's

ISO 9000 certification. Therefore, scrutinize tolerances and make it your mission to open them as large as possible to decrease fabrication costs and to improve your company's competitive position.

About the author:

JM Tarpoff, PE launched Tarpoff Moore Engineering, Inc. in 1999 after a successful ten year mechanical engineering design and analysis career with Bechtel Bettis (formerly Westinghouse Electric) in Pittsburgh and a successful two year career in manufacturing / mechanical engineering at P&G in Cincinnati gaining nearly \$2 million in savings from process improvements. The author has been an adjunct instructor of mechanical design courses through the University of Cincinnati's Applied Science College as well as having won numerous patent disclosure and design awards.