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Felt Tips

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Toiling with Tolerances

If you have watched commercial television during that past twelve months, you have probably seen the commercial for a certain Japanese automobile touting the high degree of alignment tolerances between the many body components. [Some of you may remember a very similar advertisement by a certain German {I think} manufacturer about ten years ago. You've probably also seen the parodies involving a fast-food chain and a truck manufacturer.] For those of you who never saw any of the commercials, a ball bearing is placed in a body panel joint and allowed to smoothly roll around the car's body showing that the pieces are perfectly aligned implying a high degree of quality control in the design and manufacturing of the automobile.

You may have heard of a court case involving a home improvement contractor. The contractor was being sued by the homeowner because the contractor installed the ceiling 1/2-inch closer to the floor than dimensioned on the drawings. The judge dismissed the case at the conclusion of the presentation given by the homeowner's attorney [whew!].

What does the first thing have to do with the second? People who buy our (designers, manufacturers, and constructors) services expect the same level of perfection from the items we design and build as they get from the other stuff they buy. They are spending a lot of money [as they are concerned] for us to give them something. What to do, what to do? Educate, that's what!

Face it, people in the construction industry produce the largest machines in the world, and we aren't conscientious at explaining ourselves to outsiders in an understandable manner. People don't hold them in their hands—they live and work in them. Yet people expect the same quality from our big machines, as they are getting in their little machines (vehicles, appliances, and consumer goods). Explain to your clients that there are significant differences between the normal things they buy and buildings.

Most people believe that the Building Codes are the responsible for ensuring quality construction. [Stop chortling!] We in the construction industry know that the building codes only establish minimum criteria for obtaining structural integrity, life safety, and comfort. But clients usually don't know it. They expect codes to establish tolerances and acceptability criteria for buildings to be just as small and restrictive as the teeny tiny joints and tolerances in their microwave ovens and VCRs, even though their building/house is tens, hundreds, and sometimes thousands of times bigger than the appliance they use for the basis of their comparison. Enlighten your clients to not to expect building codes to be the final panacea when things are not as desired.

Following the analogy a little further, if a microwave oven has panel alignment tolerances in the hundredths of an inch, buildings should be expected to have tolerances in tenths of inches [and they have them, but clients are not necessarily aware of those tolerances]. A tenth of an inch is very obvious when compared to a barely perceptible hundredth of an inch. Educate your clients of the differences of size so they are prepared for the results they will receive.

Also tell clients that different parts of buildings have different degrees of acceptable tolerances. A steel column in the structural frame of a high rise building can be as much as 3-inches away from its desired position, and still be correctly positioned.[1] Yet a unit of custom cabinets in that same building can't have joints between pieces larger than 1/64th of an inch.[2] An item's size affects the allowable tolerances used to judge its acceptability.

If this isn't difficult enough to deal with, consider another misconception. When machines and appliances are marketed they are the result of numerous prototypes which have been designed, constructed, tested, broken, fixed, redesigned, and rebuilt, before they are mass-assembled on the factory floor for sale to the public. Only manufactured housing is constructed in a similar manner (with few options and variations available to purchasers), otherwise the vast majority of structures are designed, and built, one time. Yes, the pieces are manufactured thousands and millions of times with a high degree of quality, unfortunately it is not the same when all these pieces meet and are joined together on a construction site. Make sure your clients are aware that they are getting a one-of-a-kind machine that is not perfect, but within specified tolerances.

Okay, so now you have reasonable tolerances in your specifications and contracts, and have explained the ramifications to you clients. Feel comfortable and confident in yourself? There is a new kink slipping into the scheme of things: Metrication. Yes, the M-Word! Why? During the next ten years we'll be changing from inches and pounds to meters, grams, and newtons [no, not Fig Newtons®!] Thinking of simply just doing some math to convert your inch-pound tolerances into metric ones? Think again, and plan on spending some mental effort getting there. Inches, pounds, and their fractional parts, don't neatly converted to nice and tidy metric measurements. For example, should a 1/32" dimension or tolerance be convert to 0.8 millimeters or 1 millimeter? The 0.8 mm value is a convenient rounding of the 0.79375 mm exact conversion. But is 1 mm more reasonable? Also, do you have a "feel" for a millimeter? It's about the thickness of a penny. So when you start metricating, re-think the criteria for your dimensions and tolerances, and don't just blindly do the math. And if you get placed in the position of metricating a client's documents, educate the client in the "marvelous" world of tolerances and the need to re-evaluate the reasons used to establish the criteria.

Make sure you get those tolerances! When designers prepare specifications, they should include tolerances for acceptability of construction. [If the specifications are more than a list of materials; some clients and designers don't understand the need for complete specifications either, but that's another story.] Manufacturers and constructors should insist on tolerance limits in their contracts to protect themselves from misunderstanding clients, zealous designers, and antagonistic attorneys.

Sources:

1. American Institute of Steel Construction, Code of Standard Practice for Steel Buildings and Bridges, Paragraph 7.11.3.
2. American Woodwork Institute, Quality Standards.

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