

Determining the Property Value of a Material or Product

One cannot determine the TRUE average property of a batch of material or products unless all of the material is tested. This is not economically feasible even if the tests are non-destructive. Therefore, the best one can do is to get an estimate of the true average by testing a sample of the lot or batch. The average of the sample will not generally coincide with the true average of the batch; at best, it may be close, but the sample average would vary around the true average of the batch.

Let's say we have 1000 items, and we randomly sample 5 items from the batch and test those items and determine the average property of the sample. Now, if we do this 200 times, and determine the averages of the 200 samples – effectively we've evaluated the complete lot, and from this data we can determine the true average value. We would find that nearly none (possibly one or two by chance) of the samples would have an average property identical to the true average. The sample averages, for the most part, would vary all around the true average, usually with about half of the samples above the true average, and half below the true average.

Each time one produces a lot of these items, even though they're produced in an identical manner, their true average values will be slightly different, with a slightly different range. So how do we establish a reasonable property value for the product? Obviously we can't publish the average value, because, on average, half of the product would fall below the published value. One way would be to publish a minimum average sample value, above which one could reasonably presume that the product is similar to the expected product; and below which one could reasonably expect a significantly different, presumably lower, product performance. One could use the lowest average sample value determined from all the samples – but, there is a likelihood that a sample's average value could be slightly lower than the minimum value, yet the product is still the same. In this case, one would be rejecting a perfectly good product lot. However, as one reduces the minimum sample average one also increases the likelihood of accepting a significantly lower performing batch of product.

These two risks must be balanced. Usually the risk is balanced in favor of the entity making the property determination – the manufacturer. A lower value is set to ensure that the property can generally be satisfied, while the user of the product must bear the risk that the product may, in fact, be a poor performer.