Minebea intec

The true measure

providing measurable solutions

How Does Weight Distribution Affect your Weighing Accuracy?

In high school science trivia you may have been asked this age old question: Does a pound of lead weigh the same as a pound of feathers? Well, the mass is different but the weight is the same provided they are weighed in the identical gravitational field and atmospheric conditions.

How about this one: Does a horse weigh the same standing with one leg on each of four individual scales as he does with all legs on one single scale? Yes again, he does but in some multi-platform applications there are some physics and measurement precautions that must be taken to ensure the scales are summed properly. Truth is a scale with a single platform but four load cells acts the same as four individual scales when we only need the total weight. There are times, however where we need to know the total weight AND the distribution of weight.

In a recent application we were asked to weigh a 20 foot metal pipe to determine the raw metal weight (approximately 8 kg) and then re-weigh the pipe to calculate the amount of coating material added within a tolerance of +/- 0.2 gram. It was impractical with such a low capacity and long sample to use a single platform so the pipe was bridged between two 10" scale bases. We summed the two platform millivolt outputs and calibrated the scales as one. The results were terrible! We observed dramatic differences in displayed weight when the pipe was not PERFECTLY centered between the two scales.

The error was a result of dissimilar millivolt outputs from each scale at a given load, similar to the corner load error that occurs on four cell bases. Simply summing the scales produced an average output of the two combined scales but neither was actually correct. Matching the millivolt output of each scale improved this off center loading problem but not to the accuracy level required by our customer. It was not until we connected each scale with a separate A to D converter, calibrated the scales INDIVIDUALLY and summed the digital values mathematically that we got close to our required accuracy.

But it wasn't over...

Carefully and simultaneously loading the pipes on the two scale platforms in a precise vertical movement seemed to produce excellent numbers, even if not perfectly centered. Unfortunately, loading the pipe at an angle or sliding the pipe after loading caused non-repeatable readings. In this case, there appeared be some horizontal friction created between the platforms as the pipe settled into place. The "push/pull" friction of the pipe between platform surfaces was introducing a non-vertical force on the load cells. The answer was to reduce the contact area of the pipe with each platform. A quick trip to Home Depot for a round U-shaped pipe cradle reduced the contact point between pipe and scale to only a millimeter or two. Finally, regardless of our pipe loading precision, repeatable weight values were achieved.

As Colombo the famous TV detective used to say "but there's just one more thing..."

While our pipe suspension system was accurate and repeatable, it was slow. The pipes "wobbled" up and down between the two scales. It was not possible to get a stable reading for 30 seconds or more. We met customer accuracy specifications but not the speed they desired. Time filtering the display was ineffective and only served to display the instability in slow motion. The trick was to apply a frequency filter that examined the high and low weight values at peak pipe osculation and displayed only the mid-range values that represented the true weight. After some experimentation, we were able to produce a stable reading in less than ½ second with a reproducibility of 0.2 grams. So the moral of the story is simple: If you only need to weigh a calm horse a livestock scale is fine. If you need to weigh the thoroughbred just before a race AND determine if the saddle is on backwards (due to the saddle design the front is heavier than the back, but who doesn't know that?) you may need to rethink your scale design.