Low Profile Load Cell Engineered For Success

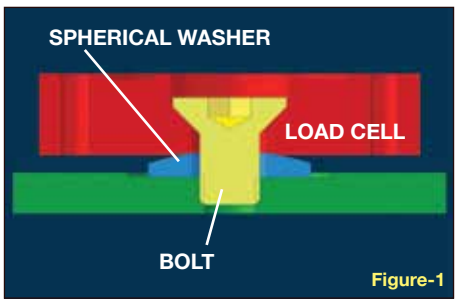
by Martin Gui, Gary Gui and Jay Visco

A few years ago, we received an inquiry from a scale company wondering if we had an interest in going above and beyond what the market was offering in a low profile, high capacity vessel, hopper, tank weigh module that does not need assembly before installation.

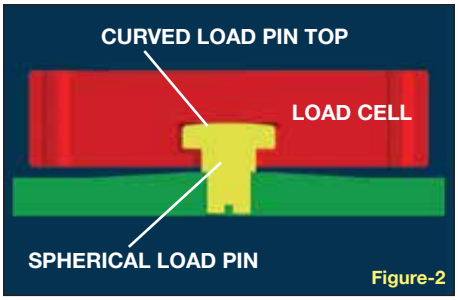
The challenge consisted of a 50,000-pound capacity compression weigh module with a declared accuracy of 0.05 percent and the desired profile lower than 2.2 inches. This size would be about a quarter of what was common in a weigh module height of ~8 inches. In the hopper and tank weighing sector of the process weighing industry, 0.1 percent is considered the high accuracy gold standard. Our Anyload engineers set out to improve the accuracy while remaining within the desired height constraint, or in this case, target.

Shrinking a conventional weigh module envelope design was not going to cut it. The Anyload team first sampled a few existing competitive contenders and identified key vulnerable areas needing improvement. One competing product fulfilling the low-profile requirement had only achieved an accuracy of 0.3 percent; hence, short of the target. Another key issue was repeatability (because of movement) of the load cell due to temperature or loading conditions during the actual weighing.

In Figure-1, a bolt (yellow) is utilized with a spherical washer (blue) as the point of contact in the applied load area for the load cell (red) was a significant step forward from existing approaches. However, the accuracy was vulnerable to weight distribution and off-center loads sensed by the weigh module. Any movement or indirectly applied load was detrimental to repeatability. Off-center loads are inevitable on-site realities.



This older design utilizes a bolt with a spherical washer as the point of contact in the applied load area of the load cell. However, the accuracy was vulnerable to weight distribution and off-center loads sensed by the weigh module.



Later designs abandoned the spherical washer, opting instead to internalize the applied force loading area with a spherical load pin. Accuracy was much improved, but not where it needed to be to meet the goals established.

Achieving a direct vertical applied load is only possible during production load cell calibration, utilizing precision-controlled hydraulic or deadweight test machines. The weight within a hopper tank is distributed amongst all the weigh modules in the vessel/hopper/tank system.

Repeatability was also prone to deterioration from gaps around the bolt underneath the load cell. This allows debris to build up and complicate any cleaning attempts, thus compromising long term reliability and rendering it less suitable for wash down applications.

With these challenges in mind and keeping with our Anyload design philosophy of delivering austere and reliable products, we developed our first prototype per the following concept sketch, see Figure-2.

Abandoning the spherical washer entirely, we internalized the applied force loading area with a spherical load pin (yellow). This allowed us to seal off the bottom of the load cell with a threaded and welded stainless steel ring, plus a rubber O-ring, thus improving the product's reliability for wash-down applications and keeping the uplift protection up to 50 percent of the capacity. Accuracy was much improved, even when there was a slight shift in the weight distribution or tilt to three degrees.

However, this design still faced the same

Continued on page 10

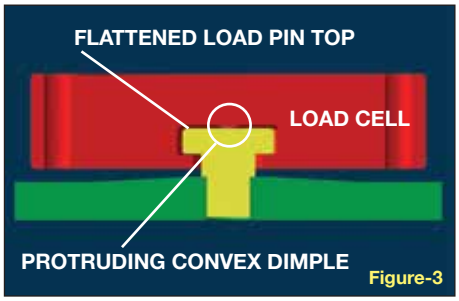
Low Profile and Open Mind Design . . .

Continued from page 8

challenge of achieving higher accuracy—although to a lesser degree. A fundamental weakness of our spherical load pin-load prototype (and that of our fellow manufacturer with their spherical washer load cell) was that any off-center load movement would still interfere with repeatability during weighing. It's the shifting of the point-of-contact in the load introduction area that causes the interference. Variable loading conditions and temperature variations made this challenge unavoidable. Our initial prototype did not solve the problem of horizontal movement, which lead to poor repeatability.

We decided to abandon this spherical load pin approach in favor of a more novel approach and design, see Figure-3. We flattened the top of the load pin. We implemented a protruding convex dimple with a concentrated radius centered on the load cell's underside as the ideally focused load introduction area.

Now, even with off-center applied loads, this elegant mechanical feature will better isolate the applied load to accommodate and provide a substantially more accurate reading. This design also reduced the overall size of the concentrated loading area, thus pinpointing precision. While our standard commercial model is promoted as having 0.1 percent accuracy, our extensive testing has found that this design is capable of 0.05 percent accuracy. At 50,000 pound capacity, we came below the ceiling of 2.2 inches with a total height of 2.09 inches. The Anyload solution has significantly improved accuracy and repeatability—all in all; it simply works better.



The final design did away with the spherical load pin approach in favor of a more novel approach and design. The top of the load pin was flattened and a protruding convex dimple with a concentrated radius centered on the load cell's underside became the focused load introduction area.

In two years of development, all of the capacities were created, and most of them are in stock at both our New Jersey and Vancouver warehouses, from 1,000 pounds to 200,000 pounds. For example, the total height of a 100,000-pound cell is 3.07 inches.

Also, for ease of installation, we offer a top plate option for the weigh module. This provides a symmetrical bolt mounting pattern for the top and bottom.

We rely on our customers and fellow competitors to provide the impetus for new products and improved designs. Rising to meet the challenge requires mutual inspiration and open minds. Our Anyload engineering team looks forward to continuing our industry-leading pioneering and forward-thinking. Patent pending for Europe and the USA.