

Hydrostatic Load Cells —

Who's Using Them And Why?

by Jim Romeo

Scales and weighing equipment are only valuable to a plant manager when the scale is operating accurately. The following article takes a look at hydrostatic technology and the advantages it offers to keep scales operating even in extremely harsh environments.



This above ground, steel deck Flat Top Truck Scale uses hydrostatic load cells. It is located at a quarry operation in North Carolina, and replaced a scale that was frequently damaged by lightning.



A hydrostatic load cell under a floor scale takes a direct blast from a high-pressure hose at a meat processing plant.

When SeaWorld wanted a scale to weigh the marine theme park's whales and marine creatures, one of the largest electronic load cell suppliers referred them to Emery Winslow, the leading manufacturer of hydrostatic load cell scales. An end user that purchases a scale wants a scale to give them accurate weight information forever, without interruption, and without expending too much extra. Unfortunately, just like computers, automobiles, houses and just about everything else, such scale products don't exist. Hydraulic load cell technology may come closer to this ideal than any other load cell scale on the market.

Although there are a few companies that make hydraulic load cells of one kind or another, we could find only one company, Emery Winslow, that has developed this technology into a broad line of scale products and achieved NTEP certification. Founded in 1868, Emery Winslow created hydrostatic technology for force measurement.

The word "hydraulic" when used in a load cell description is really a misnomer. Although it's a term that has been used for many years, a more accurate word is "hydrostatic," since there is no movement of fluid. A hydrostatic load cell is a closed loop system with no pumps or reservoirs as is often associated with other hydraulic devices. Therefore, we will use the word hydrostatic in



The close-up view of one of the Emery Winslow Model 136, 75,000-pound hydrostatic load cells used in the Bocker Grain installation. (Photo courtesy of Midwest Scale Company, Rockford, Ill.)

place of hydraulic throughout this article.

The hydrostatic load cell is a relatively simple device. In essence, a thin film of fluid is held between the base and head of the load cell. Even in a 200,000-pound capacity cell, this film of oil is only .030 inch thick. The weight applied to a hydrostatic load cell is transmitted as a precise signal to a summing device via capillary tubing. This summing totalizer has a millivolt output for operation of standard digital weight indicators, computer interfaces and printers.

These types of load cells are non-electronic, electrically inert and are risk-free of damage by many of the elements that cause electronic load cell failures. With hydrostatics, all vulnerable components, cables and summing devices are located away from the scale in a protected environment. This utilization makes for a scale that performs and weighs accurately, day after day. However, electronic load cell technology is popular and certainly has a long standing place in the weighing and measuring community.

When should you consider hydrostatic scales?

"Whenever we come across a hostile environment where they will use steam or high pressure wash-down it will immedi-

ately bring the hydrostatic cell into play," said Roger Sladek, Norris Scale Company, Sullivan, Ind. "Also any kind of heavy usage such as in truck scales. These cells will take a beating."

Jack Cheney, president of Abacus Scale in Chicago, says he likes these cells for tank scales because of the usual welding done on site. He says the hydrostatic cells simplify the installation because "we simply bolt them down and put the tank on top of them and do our welding with the cells in place. You can't do that with electronic cells."

If there is one major reason we heard about why people choose hydrostatic scales, it was lightning. "We did a conversion on a truck scale at C.E. Duff & Sons, an aggregate/stone company near here," said Jim Day of Fies Scale, Dayton, Ohio. "The company was spending about \$12,000 per year on load cell replacements due to lightning that would take two or three cells at a time. We converted the scale to hydrostatic last year, and after a summer of electrical storms, they haven't spent a dime on load cells."

Joe Ruland of Action Scale in Toledo, Ohio, agrees that those who have lightning problems are looking for alternative devices. "We sell a lot of hydrostatic load

cells in this area to people who have had bad experiences with full electronic systems being hit with lightning," he said.

"We probably have over 200 hydrostatic truck scales out there and we're in a lightning belt," said Sladek. "If we figure about eight load cells in each of those scales, that's 1600 cells. In five years we've replaced only four hydrostatic cells (which were covered under warranty) and two electronic load cells in the totalizers. I won't tell you how many load cells we've replaced in electronic scales."

John DeBo, general manager of Midwest Scale Company, Rockford, Ill., has a similar experience. "Our workhorse is the 75K hydrostatic load cell," he said. "In the five years we've been using these, we haven't replaced a single one."

Ideal Applications for Hydrostatic Cells

So what are the applications where hydrostatic load cell technology is most useful? Because of the immunity of hydrostatic load cells to damage from certain elements, there are many applications where only hydrostatic load cells have a chance of providing long term performance.

Take the meat packing industry, for example, where equipment must be hosed with high pressure water or steam to maintain USDA sanitation requirements. Floor scales, bench scales, hopper and blender scales are all subject to intense wash down. This water will eventually destroy electronic load cells.

Gary Gobel, plant engineer at Great Bend Packing in Great Bend, Kan., told us he was introduced to these devices when he installed a hydrostatic track scale a couple years earlier. He liked the technology so well that he converted one of his weigh hoppers inside the plant to hydrostatic. "We do extensive wash down on this scale," he said. "It will be washed down with hot water at least once a day. In spite of that, we haven't had any problems with the system. These scales have lived up to my expectations, and I will more than likely change out all my analog load cell systems to hydrostatic."

Outdoor applications, where the load cells can experience rain, flooding, humidity, ice, snow and of course lightning, are also prime areas for using hydrostatic scales. This includes most truck scales, railroad track scales and outdoor tanks. Electronic load cells will work in



A pitless hydrostatic railroad track scale at a scrap company.



This load cell, under a hydrostatic truck scale, gets a direct blast from a high pressure hose.

these applications but are very susceptible to damage. "All load cell manufacturers can talk about waterproof cables, waterproof connections, hermetically sealed units, but the answer is they don't hold up to steam and they don't hold up to any kind of forced water pressure washings," said Sladek.

Truck and railroad track scales located in aggregate stone and mining applications are noted for building up debris under the scale. A spokesman for a large aggregate company in the southwest told us he really likes the hydrostatic truck scales because they can use a firehose to wash out from under them without hurting the load cells.

Gary Gilmore, plant engineer at Exxon Chemical, Mt. Belview, Texas, says he really likes their hydrostatic railroad track scale that they've had since 1989. This scale operates under extreme corrosive conditions, yet it has been the most reliable scale they have. Hydrostatic load cells are available in materials that will not corrode in corrosive applications where chemicals, salts, acids and oils are present.

Accuracy Matches Electronic Cells

The number of hydrostatic load cells that constitute a scale varies. A bench scale will typically have one load cell, while a floor scale will typically have four. A tank will have one load cell under each

leg or gusset, and a standard truck scale will have eight or more. Special axle weighing truck scales with multiple platforms can have 20 or more load cells.

The accuracy of hydrostatic load cell scales matches that of electronic scales. Accuracy of one-tenth of one percent is



A scrap bucket at a steel mill is filled as it sets on a large 18- by 18-foot, 300,000-pound capacity pit scale.

standard in the industry, but in many cases, actual scale performance is far better, with some being accurate to one part in 5,000 and some at one part in 10,000.

What really separates the hydrostatic load cell from electronic ones is its ability to set at zero. "With the hydrostatic load cell you have one 2mV/V electronic load

cell," according to Sladek. "So obviously, at zero it doesn't drift at all. When we leave a truck scale installation, I've got three techs that will look you right in the eye and say it (scale) will be perfect and will stay set on zero." Sladek also explains that electronic scales require the marriage of eight or 10 load cells with millivolt outputs and trimmed at a junction box. These multiple points mean multiple signals which generate some drift from zero. Hydrostatic load cells are spared this.

Scales range from small bench scales at 20-pound capacity, reading in 0.01 pound increments to a 12 million-pound load cell found at the National Institute of Standards and Technology in their testing laboratory. Hydrostatic truck scales use 75,000 pound load cells, while railroad track scales use 100,000- and 200,000-pound cells. Because tanks come in all sizes, load cells for them range from 3,000 to 300,000 pounds.

When Florida Rock Industries, a producer of crushed stone products, was seeking scales for loading its truck haulers, they were looking for a scale to improve its operation of weighing precise loads of crushed stone quickly and accurately; it found the hydrostatic load scales ideal for the application. The rugged environment of a stone quarry warrants a durable scale. The rigor of a hydrostatic load cell scale meant that a truck could stay on the scale, be topped off or lightened without moving the vehicle to another location for stone

loading or off loading.

One of Norris Scale's customers, the Rogers Group, had a similar positive experience with hydrostatic load cell scales. The company is the sixth largest stone quarry in the country and runs up to 1300 trucks per day for eight months during their busy season. It uses two hydrostatic scales to weigh these trucks. Amazingly, the company has worn the decking off their scales twice, yet have never had to replace a cell. Similarly, another customer, Vulcan Materials, won't use anything but a hydrostatic cell

This heavy duty hydrostatic truck scale weighs off-road vehicles with axle loads exceeding 150,000 pounds.



arrangement. They run up to 800 trucks per day across their hydrostatic scale and haven't had any problems.

Very Little Fluid Required

Before you have any visions of sloppy and messy hydrostatic oil surrounding one of these scales, keep in mind one important fact: a 75,000-pound capacity truck scale load cell uses only a few teaspoons of fluid (one cubic inch). Tubing is heavywall capillary tubing, 1/8-inch outside diameter and 1/32-inch inside diameter and is made of either copper or grade 316 stainless steel. **An entire truck scale with eight load cells and perhaps 500 feet of tubing uses less than a pint of fluid.**

Light machine oil, with low viscosity, is the most common oil used. It contains a blue dye to make it more visible. Though this fluid has the properties that are best suited for hydrostatic scales, special custom applications have used water and even soybean oil.

Other fluids may be sought for exceptionally cold or exceptionally hot applications as well. Standard fluid is suitable for a temperature range from -30 degrees F to +250 degrees F. Beyond this range other fluids are used up to 500 degrees F. Air bubbles are not a function of the fluid, but of purging. Just as you purge the air out of your automobile brakes, so too

should the air be purged out of load cells and tubing lines. Large amounts of air can cause scale inaccuracies or slow response. The purging method is very simple, and excess air is rarely a problem.

An often unmentioned advantage of the hydrostatic load cell scale is that there is ordinarily no life limit to the fluid used. It does not deteriorate over time, and there is no recommendation for routine fluid change.

A significant advantage is in the hydrostatic cell's lack of moving parts -- and its simplicity is bliss. The more moving parts one has, the more frictional losses, wear and ultimately failure or a need for maintenance. The total deflection of a typical hydrostatic load cell, under full load, is about .001 inch.

Is it Price or Cost of Ownership?

While hydrostatic load cell scales are high on durability with no sacrifice in accuracy and maintenance, it is price that most object to when purchasing a hydrostatic load cell scale, without paying enough attention to total or lifecycle costs -- the cost of the equipment over long term. **Hydrostatic scales have a very low cost of ownership. Perhaps lower than any scale on the market.** These lifecycle costs should be of paramount importance if the environment in which the scale

operates poses threat of deterioration and failure.

Hydrostatic load cells are more expensive; however, the discerning buyer knows that cost assessment isn't just about price. "It's quality that sells," says Cheney, "if you can convince them to spend the money." Cheney mentions this because a hydrostatic truck scale may run \$3,000 to \$4,000 higher than an electronic scale. The difference is justified, according to Sladek. "Anybody who has owned a truck scale knows that the extra cost can be like one or two electronic load cells and a service call."

For some applications the hydrostatic cell isn't much more expensive. "In a pit truck scale it's not much higher priced at all," says DeBo. "That's because of the I-beam structure and the use of 75K load cells. This allows us to use fewer load cells and helps the scale dealer be more competitive for this type of scale."

A large soup company on the East Coast has well over 100 Emery Winslow scales in their processing plant, perhaps more than any other single location. When they asked Emery Winslow for a quote on two truck scales some eight years ago, the scale company lost the order to a lower bidder. Two years later, the company received a call from the customer, asking them to put hydrostatic load cells under their truck scale. Apparently they had been devastated by lightning, losing more than two dozen load cells. They spent thousands of dollars on a special grounding system to no avail. Emery Winslow retrofitted their scale with its cells, and one year later they repeated this for a second scale. In the six years since, they have not lost a single load cell. **It is easy to see why more companies are focusing on cost of ownership, rather than price, in buying decisions.**

Corporations continue to seek ways to increase efficiency and reduce costs. Scales and weighing equipment are only valuable to a plant manager when the scale is operating accurately, day after day. Scale failures interrupt production and down-time costs money. Hydrostatic technology offers advantages that should be considered, especially in harsh environments.

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Brochure # WM2/00/Rev.1/03

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