

## Digital Scale Technology Increases Accuracy and Reduces Downtime and Repair Costs

*Accurate load cell measurement critical for valuable cargo and sensitive mixing operations*

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Accurate weighing of commercial goods has been the bedrock of trade for thousands of years, and questions about how to ensure accuracy have bedeviled merchants for just about that long. We've come a long way over the years, with electronic weighing technology largely taking the place of purely mechanical scales. Now, new digital technology has been developed that increases scale resolution, accuracy, and the speed of weighing communications. Along with these key benefits comes the ability to minimize downtime and reduce scale repair and calibration costs. What's more, the new technology achieves unprecedented lightning and surge protection, protecting the investment in weighing technology.

For truck weighing applications, especially those with valuable cargo, as well as tank mixing applications where product ratio is key (think of your favorite beer, wine, or perfume), the new technology is a good investment, often paying for itself in a matter of months.

### **Weighing basics – from analog to digital**

Most commercial scales use *load cells*, a device that is basically a piece of metal that deforms when weight is placed on it. A strain gage is affixed to the side of the metal, which measures change in electrical resistance as the metal deforms and translates this into a known weight. Load cell communication (LCC) technology takes the signal from the load cell strain gauge to a device called an 'indicator' that tells you its corresponding weight. **Figure 1** is a cutaway of a typical load cell.

Figure 1 – Load cell cutaway



In an analog solution, the dominant technology used today, there is a limited amount of signal strength that must be spread across multiple load cells. Further complicating matters is the fact that the signals from each load cell is combined and averaged – disguising performance (including abnormal or erroneous data) from any single cell. For example, there are only about 30 millivolts to work with for an average truck scale with a capacity of 200,000 pounds. By law this application is limited to 10,000 divisions, which equates to a mere .00003 volts per division. This means that scale accuracy is dependent upon

extremely minute changes in voltage or signal strength – so electromagnetic currents, radio frequency interferences, and even long cable runs, can have a negative impact on the scale reading.

Along comes digital LCC technology, including the Intalogix system developed by Fairbanks Scales, which allows the user to apply a whopping 5 volts for scale communication (as opposed to the 30 mV in a comparable analog system) – and that translates into a million times greater signal strength to the scale. Not only is the signal strength significantly stronger, it also allows for simultaneous communication to each individual load cell using its own dedicated data channel – without combining and averaging. And, because it is a digital signal, it does not suffer

from interference concerns like the old analog systems. This allows users to get more divisions from the same piece of equipment and enables significant features simply not available in older systems. There is a reason that telephones, TVs, and even your favorite album are only available in digital formats now-a-days.

The Intalogix system is comprised of:

- **Scale instrument** – Also called the “indicator” – The brains of the operation – used for operator interface, scale configuration, and technician troubleshooting.
- **Surge volt protector** – Special power strip that protect from power surges or inconsistencies in power supplied by the wall outlet.
- **Scale interface card** – Designed for both surge protection and communications.
- **Homerun cable** – Providing both power and data communications between the scale and the scale instrument
- **Pit power supply** – A critical component for power transmission and data transference.
- **Smart Sectional controllers** – Primary function is to convert weaker analog signals from the load cells to a stronger digital signal.
- **Weigh bridge** – Scale platform.
- **Non-proprietary analog load cells.**
- **Grounding rods** – Two separate rods, one for each major circuit in the system.

The system includes optic isolation, in which the communications signal is converted to pulses of light, which takes away a path for electricity to flow on the communications side of the system. Transformer coupling technology, which converts a power signal to a magnetic field and back again, takes away the path for electricity to flow on the system’s power side. These redundancies guarantee system reliability and offer scale owners an extremely affordable insurance policy.

The Intalogix technology digitizes analog load cell signals, letting users track what is happening in each load cell. The key benefits of such a system include increased resolution and accuracy, much easier problem isolation and troubleshooting, and unprecedented lightning and surge protection. The technology significantly minimizes downtime and reduces repair and calibration costs. And, because it works with virtually any analog load cell, no special proprietary load cells are required.

By tracking what is happening in each load cell, the Intalogix technology protects both buyers and sellers. An indicator can be set to alert users if a load cell begins to “misbehave.” For example, if the load cell is 5 percent outside of its calibrated range, the system could send an email alert to that effect. Such a failure might otherwise be invisible to an operator until days, perhaps weeks later, until the problem was so significant that weighing would be problematic or impossible. In other words, the system acts as an onsite technician, seeing things that an operator couldn’t readily see – and that no one would spot using an analog system.

### **Unique method of load cell communication benefits buyers and sellers**

Accurate measurement of commodities is always important, but the more valuable or critical the weighment, the more it matters. In some cases, the load cell could be failing at a fairly significant level, such that someone could be weighing for weeks or months and be off by 100 pounds or more for each weighment. What is that worth in terms of product purchased or sold?

**Table 1** provides some examples that illustrate the point. The examples assume a standard 70-foot x 10-foot truck scale appropriate for highway loads calibrated at 200,000# and 20# division size. And remember, a scale is considered “within legal limits” at 3 divisions (or 60#) on a normal truck scale application. That’s about three times the amount shown on the table!

Table 1 – Product Loss if off by One Division										
Commodity	Commodity price \$/ton	Tons per load	Value of each load	Number of trucks per day	Value of product per day	Value of product per week	Value of product per month	Value of product per year	Annual product loss if off by one division (20#) per truck (tons of product)	Annual product loss if off by one division (20#) per truck (value of product)
Pea Gravel	\$ 60	21	\$ 1,260	50	\$ 63,000	\$ 315,000	\$ 1,338,750	\$ 16,065,000	127.5	\$ 7,650
Corn	\$ 164	21	\$ 3,444	50	\$ 172,200	\$ 861,000	\$ 3,659,250	\$ 43,911,000	127.5	\$ 20,910
Soy Bean	\$ 435	21	\$ 9,135	50	\$ 456,750	\$ 2,283,750	\$ 9,705,938	\$ 116,471,250	127.5	\$ 55,463
Copper	\$ 5,500	21	\$ 115,500	10	\$ 1,155,000	\$ 5,775,000	\$ 24,543,750	\$ 294,525,000	25.5	\$ 140,250

For someone selling manure, being off 60 pounds is less critical than for the seller of pea gravel, and significantly more critical to someone selling copper. Scrap metal dealers who weigh 20 pounds light every load and handle 200 truckloads a day, are seeing 4000 pounds of scrap metal in their favor every day. In most applications, if the truck weighs 50-70,000 pounds, an inaccurate count of 20, 40, or 60 pounds in a load cell may not be detectable, especially using analog equipment. This could be worth thousands of dollars to the weigher or the weigher. Digital technology alerts owners to any possible inaccuracies, protecting consumers by constantly monitoring the condition of the scale – every load cell all the time – and at a level of accuracy well beyond the displayed weight. See **Figure 2** for a display on a digital scale.

And, let’s be honest, regardless of the business or material being weighed – no one can afford product loss or unrecognized revenue.

Figure 2 – Digital scale display



Another example is the use of tanks and hoppers for storing inventory or for mixing operations, in mainly non legal for trade applications. In these instances, load cells are usually placed under

a pre-existing piece of equipment and turned into a scale. This usually works fine for inventory purposes, but how about if it is used for mixing applications, like measuring the hops to water ratio for beer or the amount of flower essence for perfume? Making sure the mix ratio is precise could mean everything to the product quality.

The more divisions a user can get out of a scale, the better. For example, an analog solution might squeeze 20,000 divisions out of a 40,000 pound tank, which means they can weigh in 2-pound increments. With an Intalogix system, the stronger signal strength means they get a much higher number of divisions – easily double – allowing them to weigh in 1-pound or even half-pound increments.

Operators really need the highest possible scale resolution for quality control purposes. Scales that are off a couple of divisions can have a large impact on product quality – a small investment in an accurate scale ensures the highest possible quality control.

### **Digital load cell communication technology reduces down time and repair costs**

Communicating individually with each load cell provides, amongst other things, the ability to alert an owner of a possible problem prior to an actual failure. Also, the technology can identify errors quicker, so scale repairs can be done orders of magnitude faster than analog scales, saving on labor costs. The technician can go straight to work to isolate the problem, fix it, and recalibrate, rather than having to take time to open junction boxes and use a voltmeter to test each cell individually. (And, heaven forbid that the weather is bad! This work is hard enough even when you're not trying to hold an umbrella over your head at the same time.)

Even if the scale is using 8 different load cells from 8 different manufacturers, operators can still reap the benefits of being able to communicate individually, and allow each cell to behave at maximum performance. Repair cost savings increase the older the equipment gets, as the ground shifts, equipment gets dirty, and the scale is less straight and plumb.

If a problem does occur, the technology allows the user to replace a load cell without having to recalibrate the scale, which means the consumer can continue to weigh until proper repairs have been performed. Operators can “ghost” a cell while the service company is en route to a site with a new load cell, ignoring the misbehaving load cell and instead using the measurement of its companion load cell. (*Note that this is not applicable for legal for trade applications.*)

If operators have lost a load cell in a tank application, they have to reestablish zero (what an empty container looked like) before beginning to weigh again. With an analog system, this means you have to empty the tank completely so you can “tell” the instrument that you are at zero. With Intalogix, you can remove a cell, put in a new one, enter the manufacturer's nameplate output and sensitivity information and then you can be up and weighing accurately. No need to empty the container. Users can weigh with confidence until the tank is empty, and then hang weights and calibrate the tank or mixer.

This feature is as valuable to many tank weighing applications as is the smaller division size, because it allows you to get the most performance out of each load cell. The actual economic impact is based on how easy or difficult it is to fill or empty the tank. For some it's a nightmare. How much impact will it have if you can't weigh effectively or if it takes a few hours (or days) to empty and refill? What is the impact to your operation to be down for 4 hours for non-scheduled downtime? It depends on your operation and the commodity.

With its powerful signal, Intalogix technology stays in constant communication with a scale's individual load cells, instantly detecting any performance problems and alerting users to the location of trouble to a load cell or other electronic component. In addition, the stronger signal strength results in a higher number of divisions, enhancing a scale's usefulness. So yes, I'd say we've come a long way from those first weighing balances used for early barter systems.