NORTHSTAR Load Cell & Scale

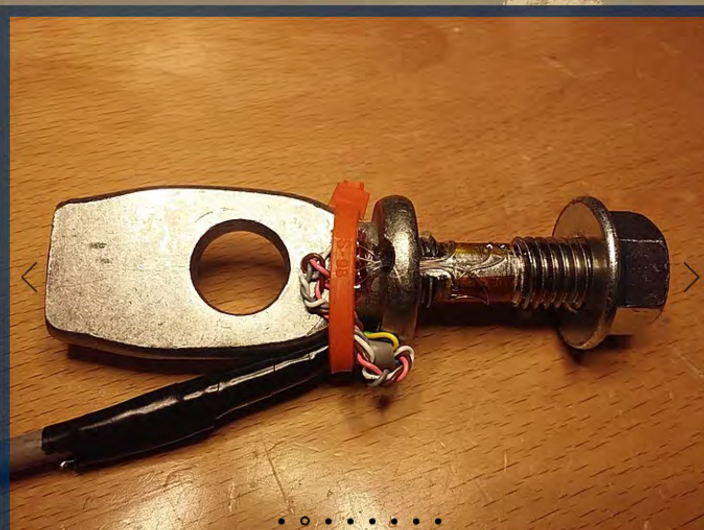
Find Your Weigh

SEE OUR SOLUTIONS

WHO WE WORK WITH

Northstar Load Cell & Scale typically works with OEM equipment manufacturers and R&D departments.

LEARN MORE



ABOUT US

I'm Dan, owner and operator of Northstar Load Cell & Scale. I have a natural aptitude for the art and science of load cells and a personal interest in helping customers find the best solutions. I have over 20 years of experience in manufacturing and engineering in various disciplines. In my career trajectory, I have learned both the "why" and the "how" of load cell design and I use that knowledge to meet the needs of my customers in a timely, cost-effective manner.

OUR PROMISE TO YOU

Northstar was started to address the need for low-volume load cell solutions for manufacturers and R&D departments. In this endeavor, we will strive to be reliable and true in guiding you to the answers you seek.

LET'S DISCUSS YOUR PROJECT

With our engineering and testing experience, we can help find the solution that works for you.

CONTACT US

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P.O. Box 730
Three Lakes, WI. 54562
715-972-3557
(715-97-CELLS)

contact@northstarloadcell.com

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OUR SOLUTIONS

We specialize in unique scale projects and one-of-a-kind custom load cells.

We are the epitome of a lean manufacturing operation. We are able to draw upon years of engineering and testing experience to help customers answer vital questions about their equipment. Whether that means building a one-of-a-kind load cell or networking with contacts and suppliers to source off-the-shelf solutions, we are here to help.

Load cell diagnosis and repair
Evaluating, repairing and replacing load cells
Do you have a malfunctioning load cell with an expired warranty? Send it to us! We'll evaluate and then repair or replace it, as needed.

Low-volume, customized load cells
Creating specialized load cells
Do you have a research and design project or new prototype that requires specialized load cells? We can help you with that!

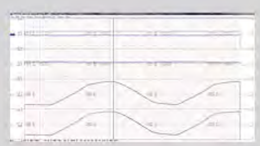
Freelance load cell and scale design
Working with manufacturers on a freelance basis
Are you a load cell and scale manufacturer who has more projects than you can handle? Let us help you get caught up!

Custom strain gage application
Creating custom design-for-life testing
Do you have your design-for-life test up and running? We have the tools and experience to help!

OUR EQUIPMENT & CAPABILITIES

Some of the tools and equipment we use include:

- SolidWorks 3D CAD modelling with FEA analysis capability.
- Calibration machinery and fixturing with 40,000lbs capacity.
- Calibration load cell standard with an accuracy rating of <0.002% full scale.
- Temperature chamber with 8 cu. ft. working volume, and temperature range of -34.6 to +356 degF.
- Mobile data acquisition system cable of measuring temperature, load cell output and RPM's, 8 channels maximum.
- Light fabrication capabilities, including turning and milling of small parts, and welding.



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Dual-Axis Load Cell

This cell was designed and built for field research and development testing. It's capable of measuring vertical and horizontal loads in excess of 20,000lbs simultaneously to evaluate the forces that may impact a machine during use.

PDF **NSTB000010**

This Northstar Technical Bulletin discusses the Dual-Axis Load Cells and the criteria that they were designed to meet.

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Tri-Axial Hitch Load Cell

This cell has a 3-3/4" diameter body, and was designed and built for field research and development testing. It's capable of measuring vertical, horizontal and pulling loads simultaneously to evaluate the forces that may impact a machine during use.

Revised Design

The latest tri-axial hitch load cell design features a 3D printed cover with threads incorporated for strain relief cable glands. This greatly improves the durability and environmental protection of the cell so that it will perform reliably, even during the harshest field testing conditions.

Photo: "While the Sun Shines" Taken by Patricia Stafford in Ohio. www.patriciastaffordart.com

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NORTHSTAR
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Load Cells

100017

Cell - 2.125DBND-21
Contact Seller

100104

Cell - 10klbs Shear Beam
$265.00
Add to Cart

100126

Cell - 1.5DB-16
$300.00
Out of Stock

100127

Cell - 0.75DB-16
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100128

Cell - 10klbs Shear Beam
$245.00
Add to Cart

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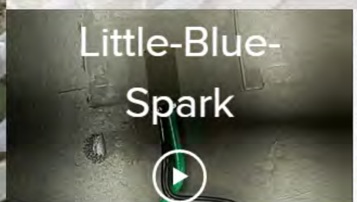
NORTHSTAR Load Cell & Scale

PDF **What is a Load Cell?**
A brief explanation of what a load cell is and how we use them in our every day lives.

PDF **Load Cell Error Per Degrees of Rotation**
How is a load cell measurement affected when it is out of alignment?



Little-Blue-Spark
Captured on film - the moment that a voltage is applied to a circuit to expose a very high resistance short between the strain gage and the steel bar. Also, a much milder version of what happens when you weld next to a load cell!

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PDF **Multi-Point Scale Systems**

Examples and calculations of how the load cells in a simple scale system interact with each other to produce a signal.

PDF **How A TMR Mixer Scale Is Made**

There are a lot of different ways to build load cells and scale systems, and the attached document from the Hoard's Dairyman archives describes one of them in very nice detail!

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Home / Load Cells / Cell - 2.125DBND-21

< Prev | Next >

Cell - 2.125DBND-21

SKU: 100017

Quantity

1

Contact Us to Purchase

Click Here for Specification Drawing

A versatile load cell most often used on seed tenders and TMR mixers.
This load cell is a one-for-one replacement of a Digi-Star part# 143989.
See the drawings for specifications and dimensions.

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Northstar Technical Bulletin
NSTB000007
D. Folmer
6-30-19

Title:

What is a Load Cell?

Overview:

I'm often asked, "What exactly is a load cell, and what does it do?" The simplest answer is that a load cell is a sensor that tells you how much things weigh, similar to how a thermometer is a sensor that tells you how hot or cold something is.

The next most common questions is, "How does it work?" To fully answer that requires a much more complicated answer, which is beyond the scope of this Technical Bulletin - I would have to write an entire book to really explain it! Thankfully, others have already done that. In a nutshell, however, a load cell is built in such a way that it can take a 'physical event', such as a weight being loaded on to it, and convert it into an 'electrical signal' that can be processed by an indicator or computer to be displayed as a number on a screen.

Sometimes a load cell is misnamed as a 'strain gage' or 'scale', so just to help clear up the confusion in terminology - a strain gage is used to build a load cell, and a load cell is used to build a scale. Think of it like this:

One of the coolest aspects of a load cell is that it is truly an electro-mechanical device - it acts as a 'bridge', or translator, between the worlds of Electrical Engineering and Mechanical Engineering. That means in order to be a Load Cell Engineer or Designer, you must have an understanding of both types of Engineering disciplines. Another really cool aspect of load cells is that they're not just confined to planet earth. Load cells are used by the aerospace industry in satellites in orbit - there's even a load cell on the Curiosity Mars Rover that is used to measure force and torque on its robotic arm!

Like a lot of things, load cells are tools that we almost all use every day and don't even realize it. If you stepped on a bathroom scale this morning, bought a pound of potato salad at the grocery store, or picked up a prescription at the pharmacy, then you used a load cell. Many industries around the world use load cells as part of their operations, such as seaports, over-the-road trucking, manufacturing, and especially, agriculture. So more likely than not, almost every product or material you used today was weighed with a load cell at some point in its lifecycle.

References:

www.northstarloadcell.com
http://www.futek.com/application/aerospace-defense/MSL-Mars-Rover

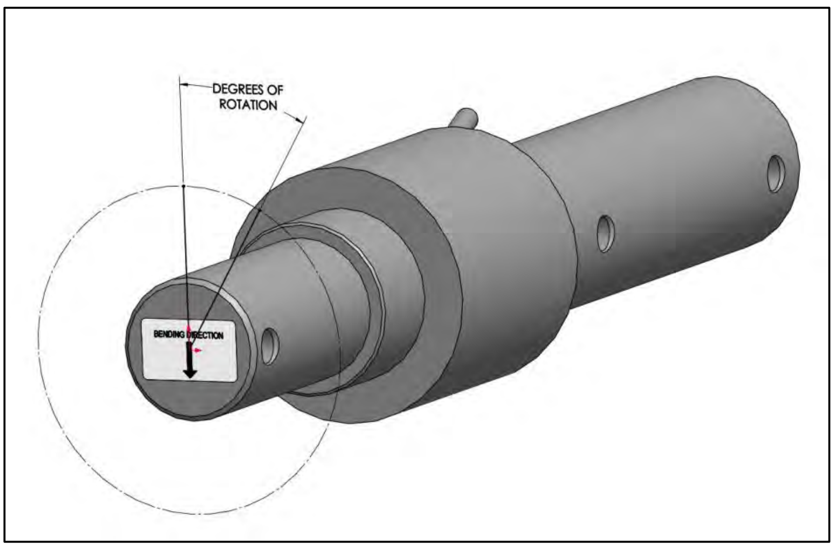
Northstar Technical Bulletin
NSTB000001
D. Folmer
02-16-19

Title:
Load Cell Error Per Degrees of Rotation.

Overview:
Most users of load cells understand that the load applied should be straight up-and-down in almost all cases. But sometimes the application calls for a non-vertical load, or perhaps there's something not quite right about the installation that makes the load angle suspect. In those situations, how does one answer the question, "How far off am I?"

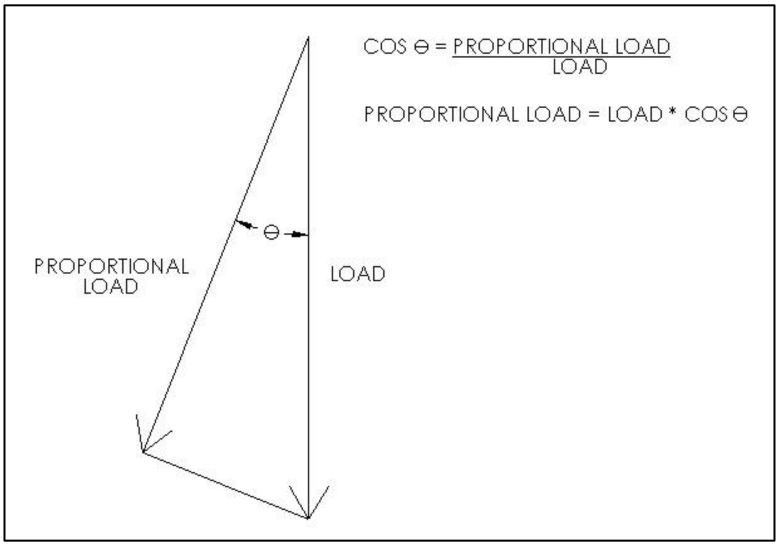
The following example will focus on a round, differential-bending load cell, often referred to as a DB cell. However, all load cells are susceptible to error caused by loads that are out of alignment.

Let's say for example that you have a DB cell with 10,000lbs capacity. It might look something like this, with an arrow sticker or engraving on the end where the load is applied. The other end is the 'fixed' or mount end, and the large diameter section in the middle is the 'can' or cover.



Underneath the cover is where all of the load cell circuitry is hidden away and protected from the elements. Without going into a lot of detail about how it all works, it's enough to say that the circuit is made of strain gages and other resistors wired into a Wheatstone bridge. The strain gages are positioned exactly on the top and bottom of the cell - that's how they are able to measure 100% of the load that is applied.

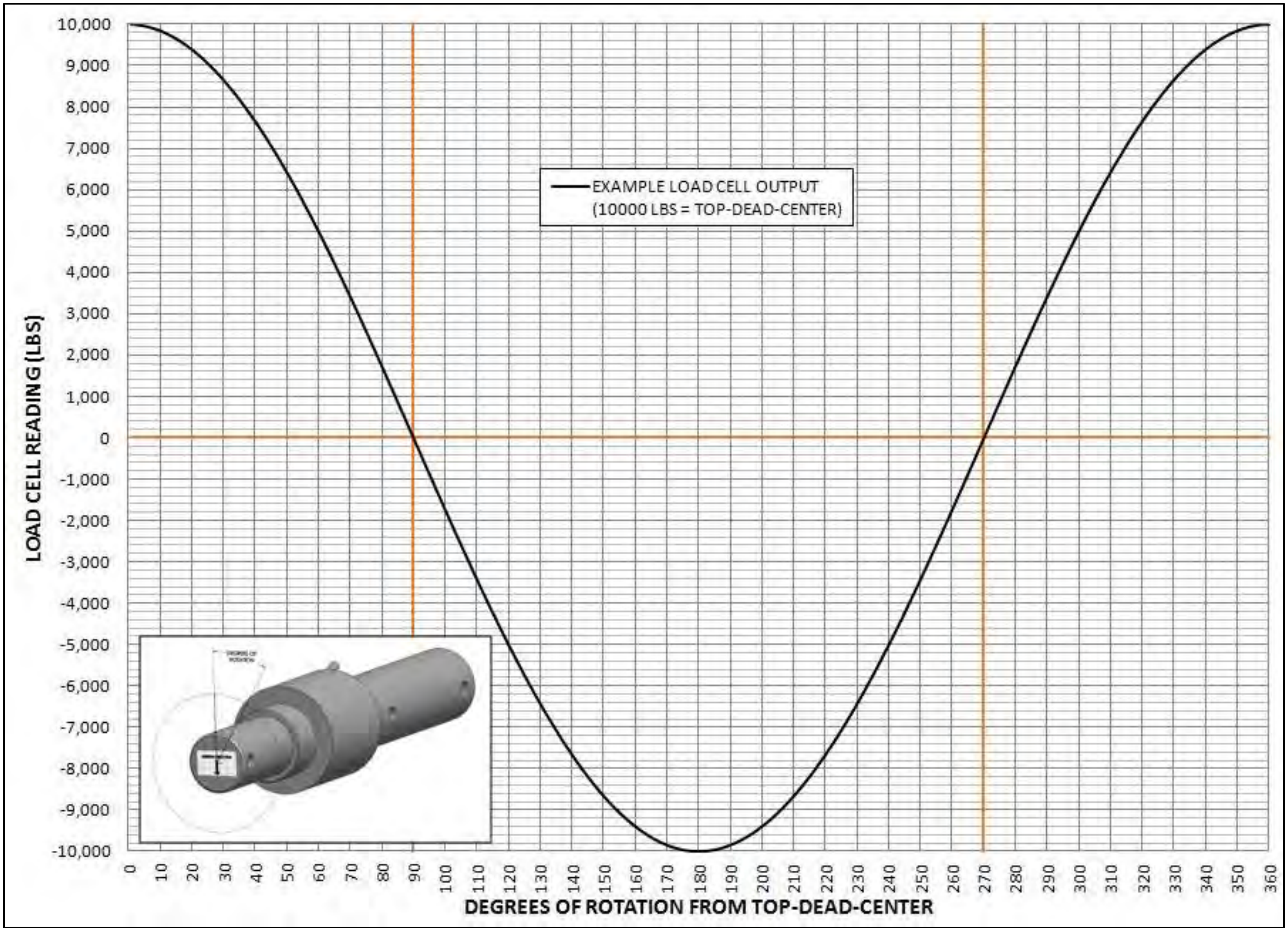
If the bar were to be rotated away from top-dead-center while the load stayed vertical, the strain gages would no longer be exactly on the top and bottom anymore. As a result, they would only be able to sense a smaller proportion of the total load. That proportion is calculated by using the formula:



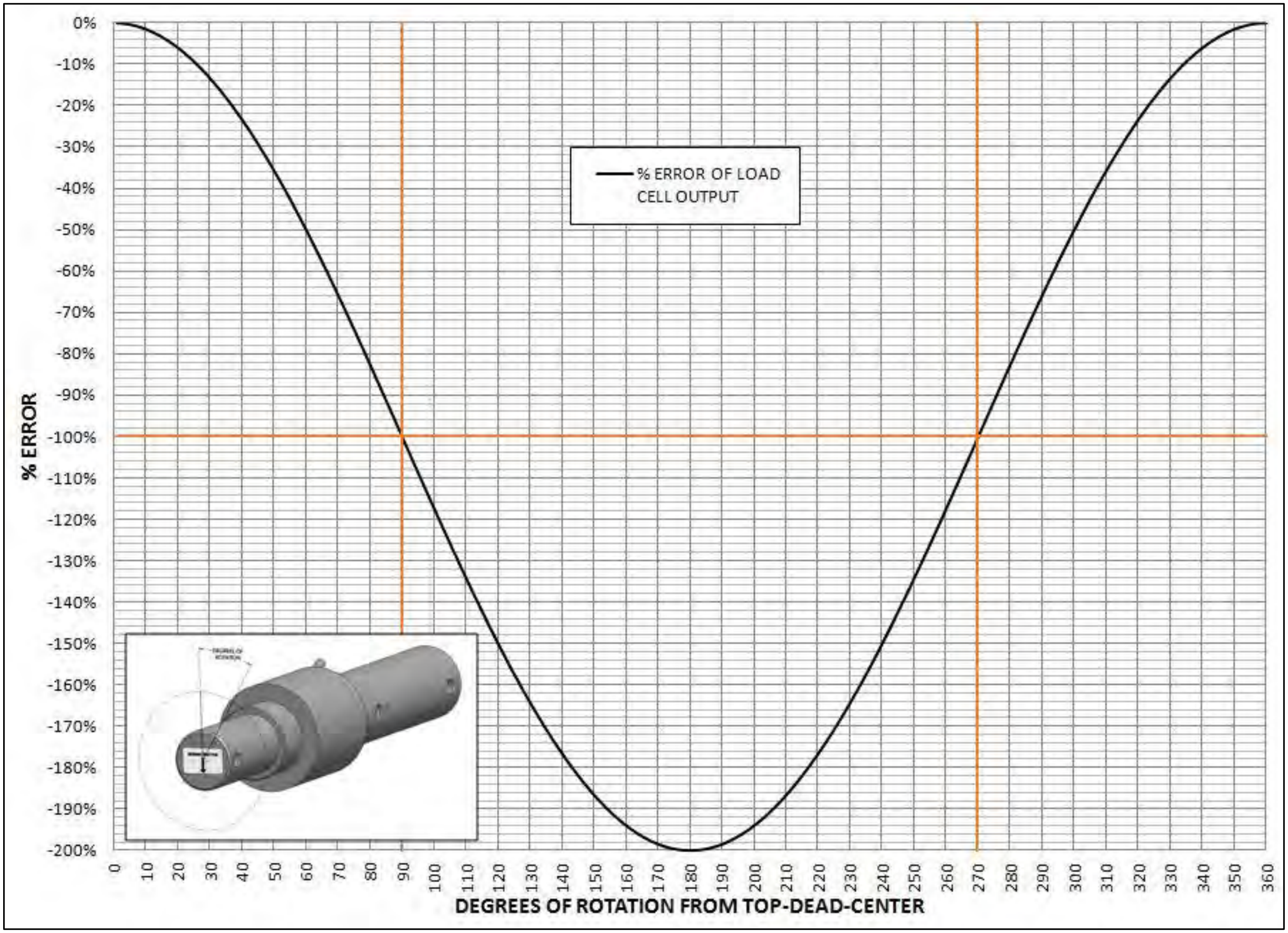
The percent error is then calculated by using this formula:

$$\% \text{ Error} = \frac{(\text{PROPORTIONAL LOAD} - \text{LOAD})}{\text{LOAD}} \times 100$$

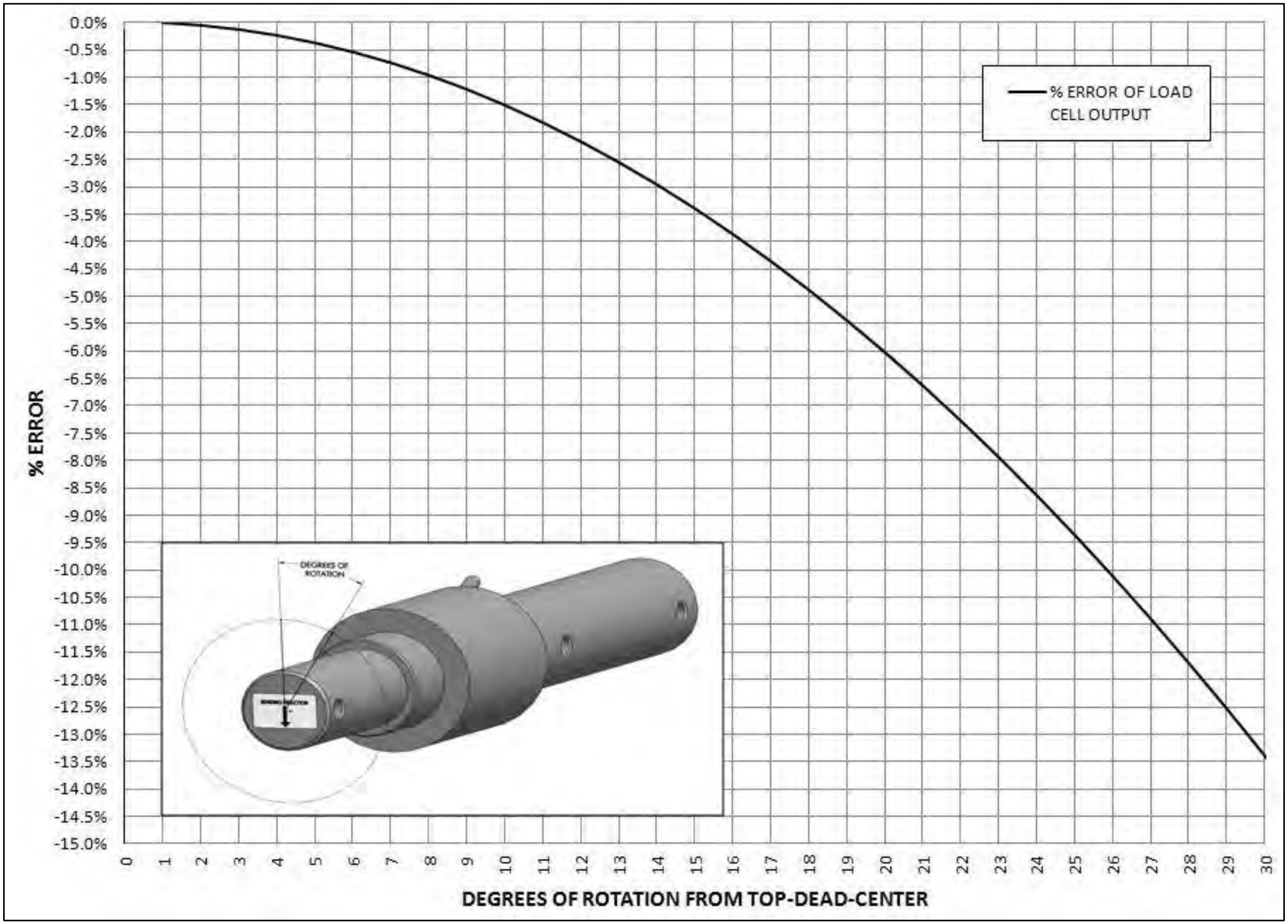
To bring it all together, the error per degrees of rotation for a 10,000lbs capacity load cell is summarized in a graph on the following page. Then, the next graphs show a generalized application of the percent error, including a close-up of the 0° to 30° degree range.


EXAMPLE LOAD CELL OUTPUT
(10000 LBS = TOP-DEAD-CENTER)
LOAD CELL READING (LBS)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
-1,000
-2,000
-3,000
-4,000
-5,000
-6,000
-7,000
-8,000
-9,000
-10,000
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310 320 330 340 350 360
DEGREES OF ROTATION FROM TOP-DEAD-CENTER

NORTHSTAR Load Cell & Scale



Northstar Technical Bulletin
NSFT000001
D. Folmer
02-16-19



Summary:

As can be seen in the graphs, load cell misalignment can quickly lead to significant errors in the weight reading of a scale system. In real-world applications, there will likely be some angular deviation from top-dead-center in almost any application, but the more care that is taken to keep this deviation to a minimum the better the scale system will perform.

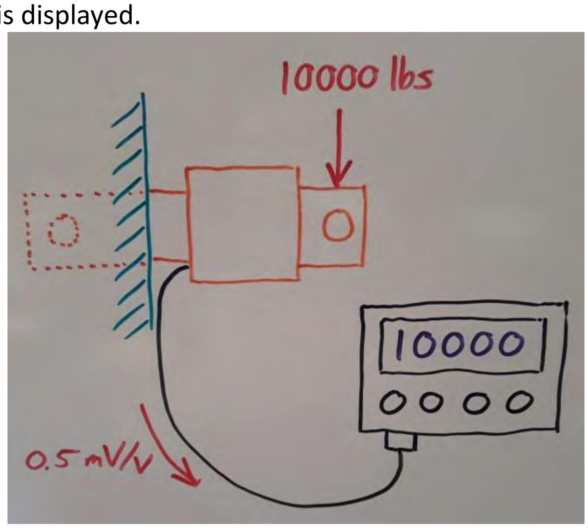
References:

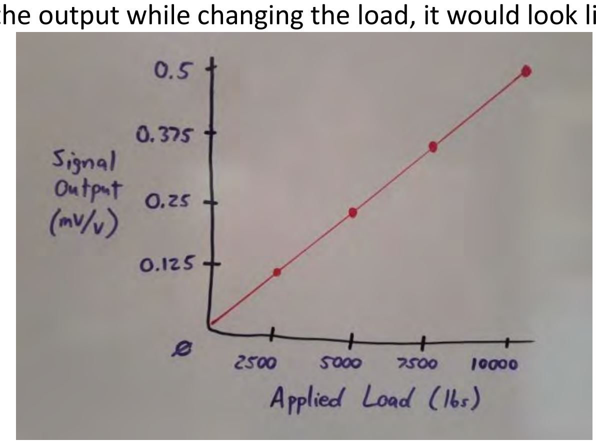
www.northstarloadcell.com

Northstar Technical Bulletin
NSTB000005
D. Folmer
7-7-19

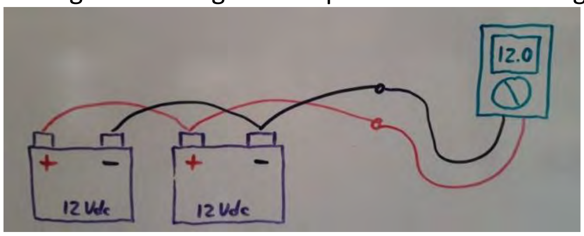
Title:
Multi-Point Scale System Signals

Overview:
- The questions often arise: "How do load cells 'add' together in a scale system?" or, "How does 'negative' load affect a scale?" This Technical Bulletin will use simple diagrams and mathematics as examples to answer these questions.

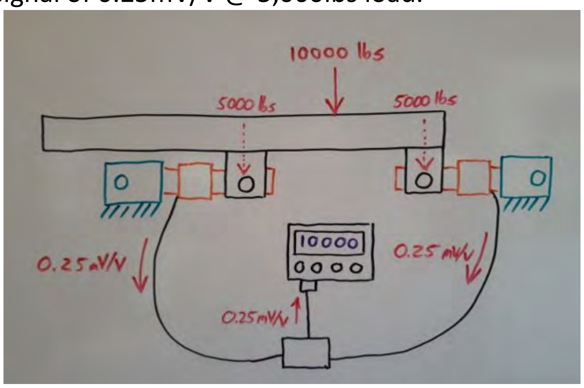
Load Cell Basic Concepts:
- Consider the output of a single load cell. In this example, the cell will have a calibration value of 0.5 mV/V @ 10,000lbs. In other words, when 10,000lbs of load is placed on the cell, it will produce an electrical signal of 0.5 mV/V. The load cell is designed and built to have this amount of signal output at this load, and it is permanently 'set', or calibrated, at the time of its construction. An indicator, or scale head, is used to process the load cell signal so that the weight is displayed.
    - 

- The output of a properly designed load cell is linear, which simply means that if you were to graph the output while changing the load, it would look like a straight line.
    - 

- In a multiple load cell scale system, the cables of the load cells are joined together in a junction box. Another cable exits the junction box and is connected to the indicator. The terminology used to describe this setup is to say that the cells are 'summed' together in the junction box, but that's misleading. The load cell signals are not being added together, they are being averaged, because the cables are connected together in parallel. Think of it as being similar to two 12Vdc batteries being hooked together in parallel - the resulting voltage reading is 12, not 24.

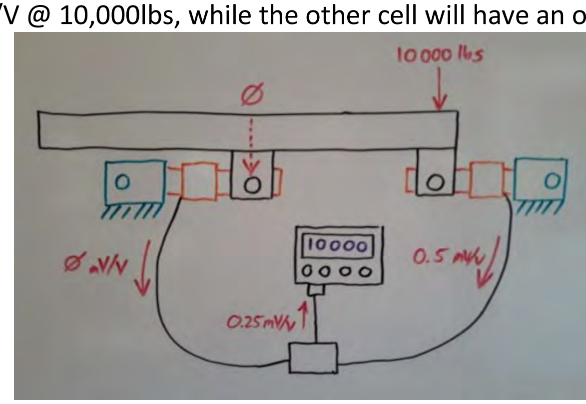
- 

2-Point Scale System - Even Load:

- Consider the example of a 10,000lb load placed on a platform in such a way that it is evenly distributed on two load cells. Based on the graph above, we know that each cell will produce an output signal of 0.25mV/V @ 5,000lbs load.
  - 

- The load cell cables are joined together in a junction box, where the signals are averaged:
  - $\text{Averaged Load Cell Output} = \frac{(0.25+0.25)}{2} = 0.25 \text{ mV/V}$
- The calibration value of the indicator is adjusted so that when it sees an input signal of 0.25mV/V it will display 10,000lbs.

2-Point Scale System - Offset Load:

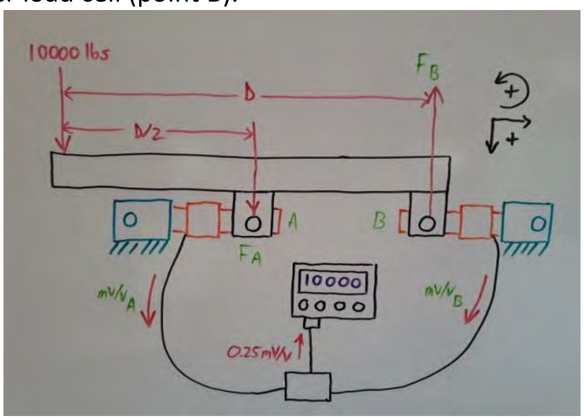
- Next, consider the example of 10,000lbs load placed exactly on top of one of the cells so that the other cell sees no load at all. The cell supporting all of the load will have an output signal of 0.5mV/V @ 10,000lbs, while the other cell will have an output of 0.0mV/V @ 0lbs.
  - 

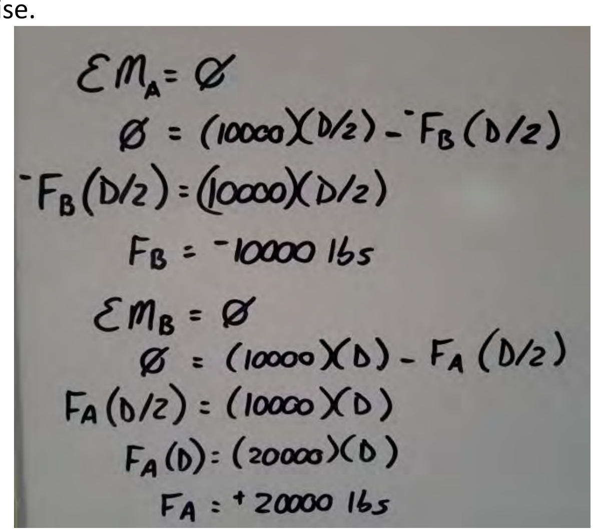
- The signals are averaged, and the resultant signal is sent to the indicator:

- Averaged Load Cell Output $= \frac{(0.0 + 0.5)}{2} = 0.25\ \text{mV/V}$

- The setup of the indicator doesn't change because the resultant signal being produced is still 0.25mV/V @ 10,000lbs.

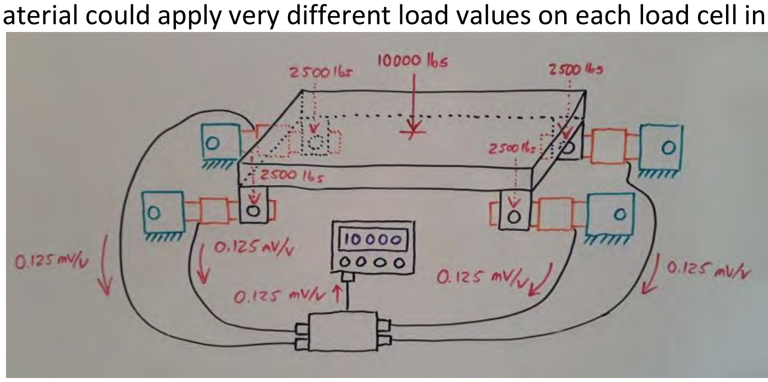
2-Point Scale System - Negative Load:

- Finally, consider the example of 10,000lbs load placed in a cantilevered position on the platform so that it is not above either load cell. Intuitively, one can see that the platform wants to tip or pivot counterclockwise around one of the load cells (point A), and that it is going to pull up on the other load cell (point B).
  - 

- In order to determine the output signal of each load cell, we first must calculate the load being applied to them (F_A and F_B). Because the platform is being held firmly in place and kept from rotating, we say that it is 'static', which makes the mathematics much easier. A rotating or moving platform is 'dynamic', and would be a more difficult problem to solve.
- The first step in determining the loads being applied to the cells is to calculate the 'Sum of the Moments' at points A and B. A moment is nothing more than a torque, which is a force being applied some distance away from the point in question. Because the platform is static, the sum of the moments is equal to zero - in other words, the torque trying to make the platform rotate counterclockwise is being balanced by an equal-and-opposite torque trying to make it rotate clockwise.
  - 

- From the calculations above, we can see that the load being applied to load cell A is 20,000lbs, and the load applied to B is -10,000lbs (down is positive). That means that the output of load cell A is 1.0mV/V @ 20,000lbs, and the output of B is -0.5mV/V @ 10,000lbs (being analog devices load cells are capable of producing negative output).
- It should be noted that load cell A is being 'crunched' like a nut in a nutcracker, and is overloaded by twice its calibration value. This would be called '100% overload' - the percentage refers to the load above and beyond the acceptable maximum capacity.
- Once again, the signals are averaged in the junction box and sent to the indicator:
  - $\text{Averaged Load Cell Output} = \frac{(1.0 + (-0.5))}{2} = 0.25\ \text{mV/V}$
- Even in this cantilevered loading condition, the indicator will still display 10,000lbs. This works out well 'theoretically' on paper, but given the numerous factors that come into play in a scale system, it's hard to say how such a system would behave in real life.

4-Point Scale System - Even Load:

- A four point load cell scale system would behave exactly the same way as the two point system, with the exception that the load position has another degree of freedom that must be taken into account to determine the distribution. One can see how a hopper full of grain or other 'fluid' material could apply very different load values on each load cell in the system.
  - 

- The load cells signals are also averaged in the junction box and sent to the indicator in the same manner:
  - $\text{Averaged Load Cell Output} = \frac{(0.125 + 0.125 + 0.125 + 0.125)}{4} = 0.125\ \text{mV/V}$
- What does change is the calibration value of the indicator, because now it needs to display 10,000lbs when it sees a smaller 0.125mV/V signal.

Summary:

Understanding the natural characteristics of a single load cell can help one determine the correct behavior of a multi-point scale system.

References:

www.northstarloadcell.com