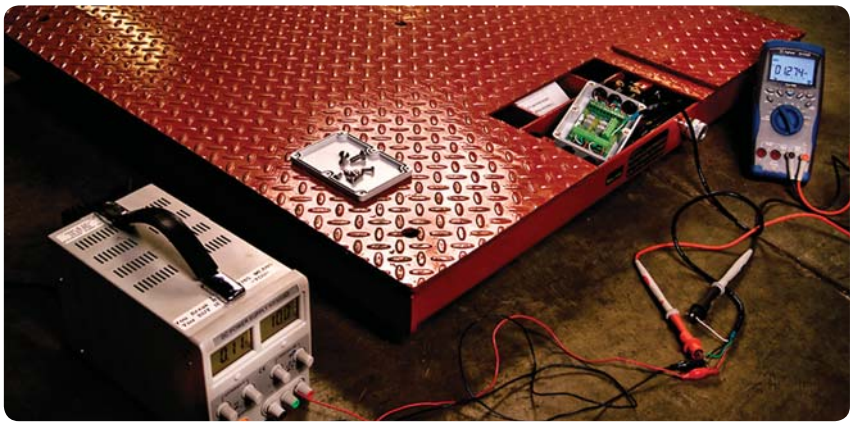
Troubleshooting Load Cell Applications with the Agilent Wireless Remote Connectivity Solution

Application Note



Introduction

Before the introduction of the electronic load cell, mechanical lever scales were widely used in many industrial and commercial applications. The accuracy of these mechanical scales depends on the scale calibration and maintenance. Today load cell-based weighing systems dominate the entire weighing industry and are the industry standard. Though load cells are reliable, they are subject to damage due to overloading, lightning strikes, chemical or moisture ingress, mishandling (such as damaging the cable, or dropping the cell). Troubleshooting a scale-fitted with more than one load cell to detect defective cells is always a tedious procedure. Multiple load cells also make troubleshooting harder. The larger the scale, the harder this can become. This application note explains how the Agilent wireless remote connectivity solution helps load cell application service technicians ease their troubleshooting task.

Basic Components of Load Cell-Based Weighing System

Weighing platform

This is a weighing platform to hold whatever is to be weighed allowing the force of gravity on the entire item to be transmitted to the load cells.

Load cell

A load cell is an electronic device (transducer) that is used to convert a force into an electrical signal. Load cells are wired to a weight indicator via a junction box.

Junction box

The junction box is where the load cell cables are terminated and summed. The weight indicator is also terminated here. The summing board is a passive circuit that joins the signals of the cells to the indicator as one signal. These boards normally have a trim potentiometer for each cell so that the signal of each cell can be adjusted so that no matter where a weight is placed on the scale, it will weigh the same. There are two types of summing methods. Adjusting the excitation voltage to the individual cells (excitation trim), or shunting signal of individual cells (signal trim). On larger scales such as vehicle scales, the cells are also able to be trimmed in groups of two in sections.

Weight indicator

The weight indicator digitizes the low-level signal voltage from the load cells and converts the voltage to a displayed weight. Normally the weight indicator is mounted away from the scale in an area where the weight can be easily viewed on the indicator's display. The indicator also supplies a regulated voltage known as "excitation" to power the load cells. This voltage is normally 10 or 5 VDC. The signal from the load cells will not exceed 30 mV with the maximum capacity applied to the cell.

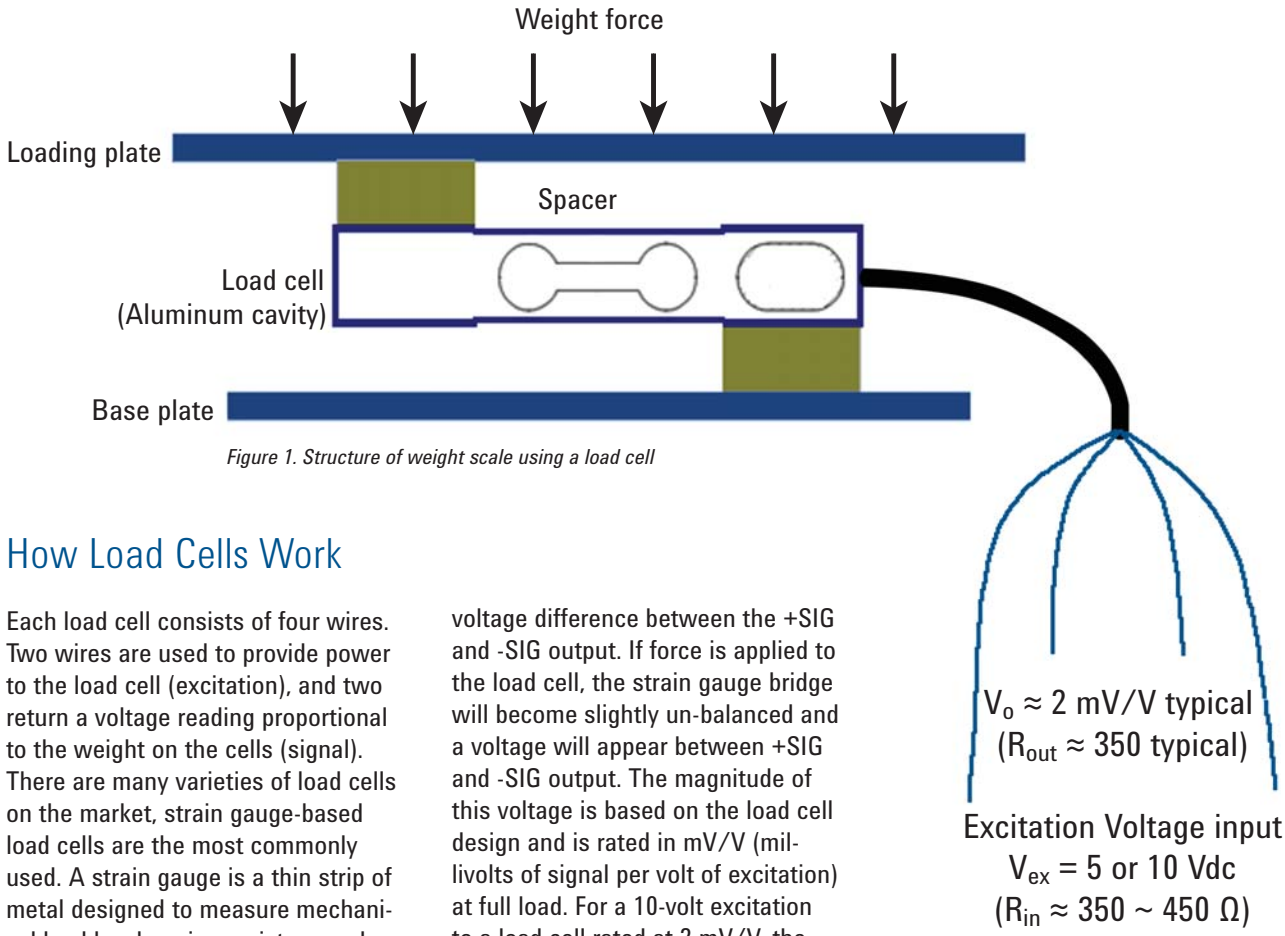


Figure 1. Structure of weight scale using a load cell

How Load Cells Work

Each load cell consists of four wires. Two wires are used to provide power to the load cell (excitation), and two return a voltage reading proportional to the weight on the cells (signal). There are many varieties of load cells on the market, strain gauge-based load cells are the most commonly used. A strain gauge is a thin strip of metal designed to measure mechanical load by changing resistance when stretched or compressed within its elastic limits.

There are four strain gauges bonded in the inner surface of load cell that form a Wheatstone Bridge configuration (refer to Figure 2). When stress is applied to the load cell, two strain gauges will be stretched, and the other two will be compressed. The stretched gauges will increase their resistance and the compressed gauges will decrease their resistance. If no stress is applied, there will be no voltage difference between the +SIG and -SIG output. If force is applied to the load cell, the strain gauge bridge will become slightly un-balanced and a voltage will appear between +SIG and -SIG output. The magnitude of this voltage is based on the load cell design and is rated in mV/V (millivolts of signal per volt of excitation) at full load. For a 10-volt excitation to a load cell rated at 2 mV/V, the maximum output with a force of full capacity would be only 20 mV.

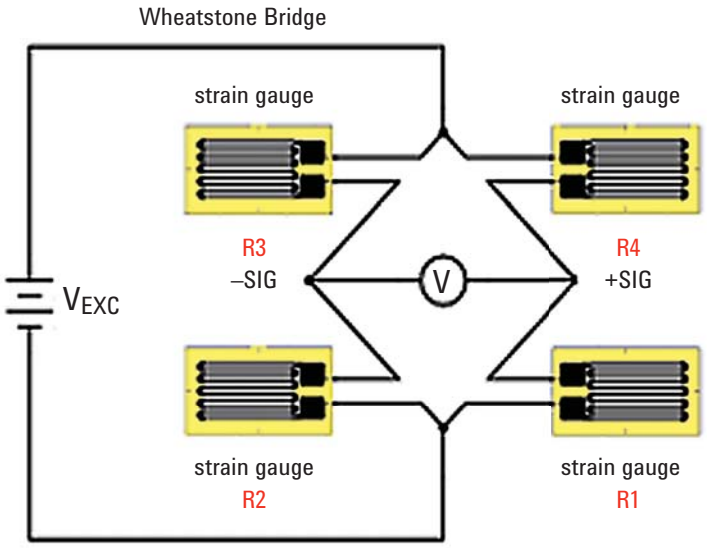


Figure 2: Wheatstone Bridge configuration

Troubleshooting Challenges When Servicing Strain Gauge Type Load Cell Based Scale

A scale not displaying weight correctly, drifting, not providing repeatable measurement, or one that is unstable, are indications that the scale needs service. Regular maintenance on the scale can improve the over-all reliability of the load cells, and provide an opportunity to discover such things as water leaks and spills running under the scale, allowing them be corrected before the cell goes bad.

To troubleshoot a load cell-based scale, technicians need to perform a cornering test to determine if the scale weighs the same no matter where the weight is placed (see Figure 3). Secondly, they need to perform a gross calibration test to determine if the scale is consistently weighing correctly with each application of weight. By measuring output from each load cell's output with a handheld multimeter, bad load cells can be identified.

When performing corner testing, technicians need to apply weight the on four corners of the platform. The signal to the weight indicator should read the same for each cell. On larger scales, such as a truck scale or a rail scale, one challenge technician's face is determining the multimeter reading without straining their eyes. Eye strain tends to be less of an issue when the technician is troubleshooting a small-size scale. On many scales it is possible to identify a cell using a meter and measuring the signal while standing above that cell. This can speed up the process of finding a bad cell.

If the resources allow, the technicians may also have to ask someone to read the multimeter reading. If not they have to move the multimeter each time they move. Sometimes, the scale troubleshooting task is not limited to just the workshop and requires technicians to perform scale troubleshooting outdoors, even if it is raining or snowing. This situation is worse if technicians need to view more than one meter reading at the same time. If the weight indicator is mounted in a control cabinet, viewing the weight indicator from the scale platform is completely impossible. Such conditions make troubleshooting tedious.

Figure 3. Identify a bad load cell with corner testing

Agilent Wireless Remote Connectivity Solution

Agilent Technologies' new U1177A IR-to-*Bluetooth*® adapter is an accessory that enables wireless remote connectivity via a *Bluetoot*h connection. By attaching the *Bluetooth* adapter to the IR port located at the back of Agilent handheld digital multimeter, users can establish *Bluetooth* communication with the Agilent handheld multimeter via an Android-based phone or tablet PC (see Figure 4). This phone or tablet PC must be preloaded with free Android-based application software called Agilent Mobile Meter or Agilent Mobile Logger.

Agilent Mobile Meter allows users to perform up to three multimeter measurements simultaneously and in real time (see Figure 5). With an Android device in hand, service technicians do not need to strain their eyes to view multimeter readings that are far away, or move the meter each time they move to identify bad load cell. This also makes it possible to monitor voltage readings within an industrial cabinet with the door closed.

The Agilent Mobile Meter solution also allows users to extend their reach to two or three places without the need to be physically present at various points. This solution allows technicians to make measurements from a safe distance, eliminates the need to walk back-and-forth between the measure target and control points, and monitors multiple measurements simultaneously.

For troubleshooting or identifying intermittent problems such as a power supply failure in the junction box, Agilent Mobile Logger (a free Android application) allows users to log data over a long period of time and provides trending graphs from Agilent handheld digital multimeters.

Both Agilent Mobile Meter and Agilent Mobile Meter Logger offer an array of extended functions such as the ability to automatically send e-mail or Short Message Service (SMS), and use pan and zoom functions via the Android device's touch screen. Alternatively, data logging and monitoring activities can be performed at a PC using downloadable Agilent GUI data logger software.

Figure 4: Attaching Agilent U1177A IR-to-Bluetooth adapter to the Handheld Multimter

Figure 5: Agilent Mobile Meter Application On Android Phone

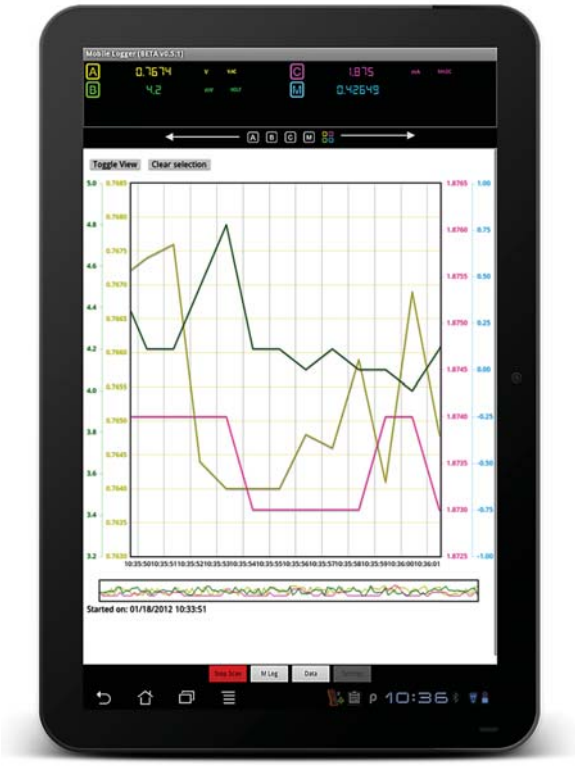
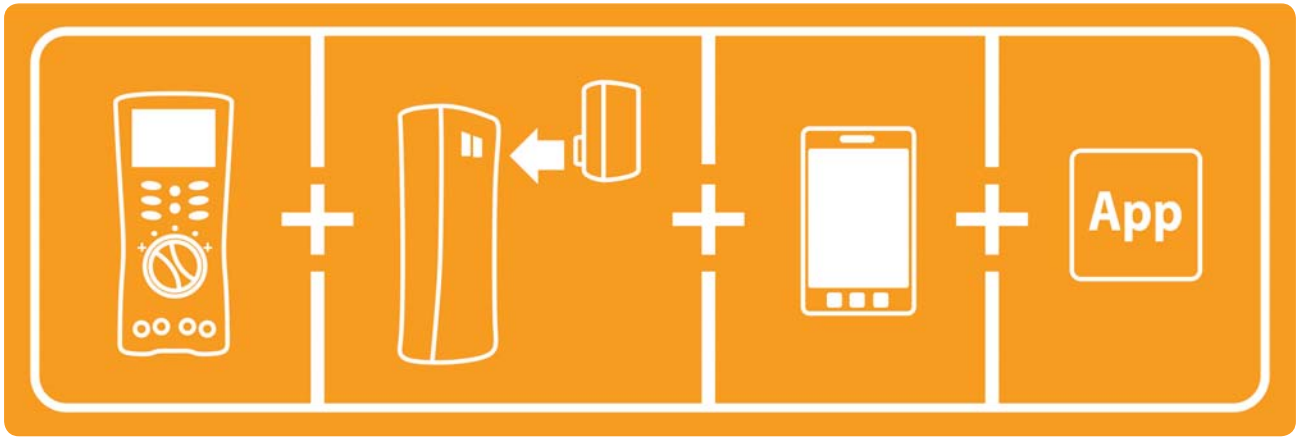


Figure 6. Agilent Mobile Logger Application on a tablet PC

Summary

Servicing technicians are constantly required to perform measurements in all sorts of hard-to-reach environments or to make multiple measurements simultaneously in order to identifying problems. In these environments, site conditions may necessitate using two service technicians. If a team is not available, the single service technician's efficiency is hampered by having to obtain readings by repeatedly walking back and forth, climbing up and down, or enduring physically strenuous demands to troubleshoot the load cell problems. Now higher work productivity can be achieved by using Agilent wireless remote connectivity which consists of a U1177 IR-to-*Bluetooth* adapter, an Agilent handheld digital mulitimeter, and Agilent Mobile Meter or Mobile Logger on your Android devices.



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