Shunt Calibration of a Strain Gage Sensor

Definition

Shunt calibration is the known, electrical unbalancing of a strain gage bridge, by means of a fixed resistor that is placed, or "shunted", across a leg of the bridge. The "Wheatstone Bridge" is widely used in sensors such as load cells and torque sensors where shunt calibration is industry accepted method of in field calibration of strain gaged based sensors and instrumentation.

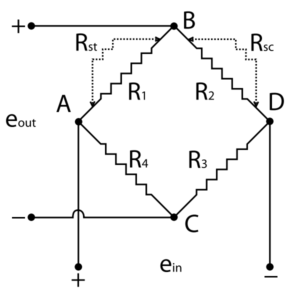
Purpose

Shunt calibration is a method of periodically checking the gain or span of a signal conditioner, which is used in conjunction with a strain gage based transducer, without exposing the transducer to known, traceable, physical input values. If required, adjustments can then be made to the signal conditioner to insure accurate measurement results.

Discussion

A strain gage bridge is "in balance" when the host mechanical structure is unloaded and unstressed. As the host structure (diaphragm, bending beam, shear beam, column, etc.) is loaded or stressed, the Wheatstone Bridge becomes unbalanced, resulting in an output signal that is proportional to the applied load.

Shunt calibration simulates the mechanical input to a transducer by unbalancing the bridge with a fixed resistor placed across, or in parallel with, one leg of the bridge. For tension shunt calibration, the shunt resistor (R_{st}) is shunted across the [+] excitation (A) and [+] signal (B) leg of the bridge. For compression shunt calibration, the shunt resistor (R_{sc}) is shunted across the [–] excitation (D) and [+] signal (B) leg of the bridge.



A Wheatstone Bridge circuit showing the location for connecting an appropriate shunt resistor for the purpose of simulating either a tension or compression input

Method

The typical method of collecting shunt calibration data is as follows:

1. Connect the transducer to an appropriate strain gage signal conditioner and allow adequate time for the system to stabilize.
2. Apply a full-scale, N.I.S.T. traceable, mechanical input (or load) to the transducer.
3. Adjust the signal conditioner's gain or span controls, as required, to obtain a full-scale electrical output signal, and/or numeric display that represents the applied, mechanical input quantity.
4 Remove the mechanical input (or load).
5. Place a shunt calibration resistor across an appropriate leg of the Wheatstone Bridge as discussed above.
6. Record the value of the signal conditioner's output signal and/or numeric display. This value is the shunt calibration value, or equivalent load.
7. It is important to note that the shunt calibration value is specific for the particular shunt resistor used. This value, and the particular resistor, are now matched to the transducer and form the basis of the transferable shunt calibration.

The following formula can be used to estimate the approximate value of shunt resistor required to simulate a mechanical load.

Rcal = (25000 * Rb) / (Output FS * Lcal)

Where:
Rcal = Shunt Resistor (ohms)
Rb = Bridge Resistance (ohms)
Output FS = Full Scale output of the load cell (mV/V)
Lcal = Load to be simulated, % of Load Cell Capacity

Summary

Shunt calibration is accepted throughout the industry as means of periodic calibration of a signal conditioner and transducer between calibrations of known, applied, traceable, mechanical, input values. Consequently, most all strain gage transducer manufacturers collect and supply shunt calibration data, along with a shunt calibration resistor, as a standard feature.

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