CROSSTALK & EXTRANEOUS LOAD LIMITS

Crosstalk

Crosstalk occurs in all multi-axis force sensors and is expressed as a ratio of the output of any unloaded axis that occurs to the output of the one axis that is loaded to its full rated capacity. Manufacturers are usually able to keep the effects of crosstalk to less than 2% through experience, design and special processes developed by the manufacturer. SensorData has been able to keep the effects of crosstalk to <1%. Method employed by the user to load the multi-axis sensor will usually determine how the sensor will be calibrated by the manufacturer.

Crosstalk is typcally characterized at the face fkange of the active transducer surface. Using this as the base line, the sensor can be suppllied with a repeatable set of values that can be mathematically accomodated for during testing. In some cases, such as tire testing, this is not the case. An elaborate fixturing scheme, dictated by the specific test requirements, shiftts the point of load applicaation from the center of the active flange, where the sensor has been characterized by the manufacturer, to a point in space. This shift in load application causes the crosstalk values to suffer most, since it is moment dependent, and this shift usually increases the moment arm length. If this point is identified by the user, then the manufacturer can characterize the transducer for this crosstalk point is space by using calibration fixtures which simulate the actual test conditions. Assuming a linear behavior of crosstalk values obtained in this manner would be considered maximum, the values for nonlinearity, hysteresis, and nonrepeatability will continue to be determined at the face flange of the sensor.

Static extraneous load limits are the maximum loads that can be applied to the sensor structure without causing it to fail. They are calculated such that only one extraneous load can be applied simultaneously with half the normal load limit capacity.

The governing equation for this is:

$$\sigma = a\,(F_x) + b\,(F_y) + c\,(F_z) + d\,(M_x) + e\,(M_y) + f\,(M_z) \leq \sigma \text{ allowable}$$

Where: σ allowable;

= 80,000 psi for 4340 alloy steel - static test
= 40,000 psi for 4340 alloy steel - fatigue test

In a finished transducer, the above small case alpha letters would be calculated from finished design dimensions, and would be provided with the finished transducer. The values in parentheses are variable force and moment values applied to the transducer at actual (maximum) expected values.

The forces, F_x, F_y, and F_z, and M_x, M_y, and M_z in this governing equation are related by the equation that follow. From these equations the variable quantities, R and L, in different tests, can be used to establish the correct moments to be used in the above equation. These bending moment equations are:

$$M_x = (F_x \bullet L) + (F_y \bullet R)$$
$$M_y = F_x \bullet R$$
$$M_z = F_x \bullet L$$

where L = Maximum moment arm, and R = Maximum radius from the primary axis.

We want to emphasize the theoretical nature of these equations in the application. However, just as long as the design criteria for loading to full scale in each of the individual bridges is maintained, and simultaneously, the total stress is kept within the safe region, you may alter the individual parameters to suit each test. The benefits of this formula is that it allows the test engineer to precisely know the maximum stress limits the sensor can safely endure, before testing, and thereby use only the combination of loads which will not fail the sensor.

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LOAD GEOMETRY AND AXIS DEFINITIONS