Load Cell Terms and Definitions

This document defines the terminology and performance parameters pertaining to engineering specifications of load cell products. The objective of this terminology standard is to promote effective communication of specifications and to constitute a reference for uniformity. The definitions herein are generally compatible with common understanding in the load cell community and are an expansion of those found in "Load Cell Terminology and Test Procedure Recommendations", Third Edition, 1985, Scale Manufacturers Association, and in OIML International Recommendation R60, 1991 Edition. This document includes modifications to the definitions in the above referenced standards to correct some of their inconsistencies and inadequacies.

For convenience, terms which are defined in this standard are printed in ***italics*** when used in the definition of another term.==========

AMBIENT TEMPERATURE

The temperature of the medium surrounding the ***load cell***.

AXIAL LOAD

A load applied along the ***primary axis***.

BAROMETRIC SENSITIVITY

The change in ***zero balance*** due to a change in ambient barometric pressure. Normally expressed in units of %RO/atm.

CALIBRATION

The comparison of ***load cell output*** against standard test loads.

CAPACITY

The maximum ***axial load*** a ***load cell*** is designed to measure within its specifications.

COMBINED ERROR

The maximum deviation of the ***calibration*** curve from the straight line drawn between ***minimum load output*** and ***maximum load output***, normally expressed in units of %FS. Both ascending and descending curves are considered.

CREEP

The change in ***load cell signal*** occurring with time while under load and with all environmental conditions and other variables remaining constant. Normally expressed in units of % of applied load over a specified time interval. It is common for characterization to be measured with a constant load at or near ***capacity***.

CREEP RECOVERY

The change in ***load cell signal*** occurring with time immediately after removal of a load which had been applied for a specified time interval, environmental conditions and other variables remaining constant during the loaded and unloaded intervals. Normally expressed in units of % of applied load over a specified time interval. Normally the applied interval and the recovery interval are equal. It is common for characterization to be measured with a constant load at or near ***capacity***.

CREEP RETURN

The difference between ***load cell signal*** immediately after removal of a load which had been applied for a specified time interval, environmental conditions and other variables remaining constant during the loaded interval, and the ***signal*** before application of the load. Normally expressed in units of % of applied load over a specified time interval. It is common for characterization to be measured with a constant load at or near ***capacity***.

DEFLECTION

The displacement of the point of ***axial load*** application in the ***primary axis*** between the ***MDL*** and ***MDL+capacity*** load conditions.

ECCENTRIC LOAD

Any load applied parallel to but not concentric with the ***primary axis***.

FULL SCALE or FS

The ***output*** corresponding to ***maximum load*** in any specific test or application .

HYSTERESIS

The algebraic difference between ***output*** at a given load descending from ***maximum load*** and ***output*** at the same load ascending from ***minimum load***. Normally expressed in units of %FS. It is common for characterization to be measured at 40-60 %FS.

INPUT RESISTANCE

The resistance of the ***load cell*** circuit measured at the excitation terminals with no load applied and with the output terminals open-circuited.

INSULATION RESISTANCE

The DC resistance measured between the bridge

circuit and the case. Normally measured at 50 VDC.

LOAD CELL

A device which produces an ***output*** proportional to an applied force load.

MAXIMUM AXIAL LOAD, SAFE

The maximum ***axial load*** which can be applied without producing a permanent shift in performance characteristics beyond those specified. Normally expressed in units of % ***capacity***.

MAXIMUM LOAD

The highest load in a specific test or application, which may be any load up to and including (***capacity*** + ***minimum load***), but may not exceed ***capacity*** significantly.

MAXIMUM AXIAL LOAD, ULTIMATE

The maximum ***axial load*** which can be applied without producing a structural failure. Normally expressed in units of % ***capacity***.

MAXIMUM LOAD AXIS MOMENT, SAFE

The maximum moment with respect to the ***primary axis*** which can be applied without producing a permanent shift in performance characteristics beyond those specified.

MAXIMUM MOUNTING TORQUE, SAFE

The maximum torque which can be applied concentric with the ***primary axis*** without producing a permanent shift in performance characteristics beyond those specified.

MAXIMUM SIDE LOAD, SAFE

The maximum ***side load*** which can be applied without producing a permanent shift in performance characteristics beyond those specified.

MEASURING RANGE

The difference between ***maximum load*** and ***minimum load*** in a specific test or application. It may not exceed ***capacity***.

MINIMUM DEAD LOAD or MDL

The smallest load for which specified performance will be met. It is normally equal to or near ***no load*** in single mode applications and is of necessity equal to ***no load*** in double mode applications.

MINIMUM LOAD

The lowest load in a specific test or application, differing from ***no load*** by the weight of fixtures and load receptors which are attached plus any intentional pre-load which is applied.

MODE

The direction of load. Tension and Compression are each one mode.

NATURAL FREQUENCY

The frequency of free oscillations under conditions of ***no load***.

NO LOAD

The condition of the ***load cell*** when in its normal physical orientation, with no force input applied, and with no fixtures or load receptors attached.

NONLINEARITY

The algebraic difference between ***output*** at a specific load and the corresponding point on the straight line drawn between ***minimum load*** and ***maximum load***. Normally expressed in units of %FS. It is common for characterization to be measured at 40-60 %FS.

NONREPEATABILITY

The maximum difference between ***output*** readings for repeated loadings under identical loading and environmental conditions. Normally expressed in units of %RO.

OUTPUT

The algebraic difference between the ***signal*** at applied load and the ***signal*** at ***minimum load***.

OUTPUT RESISTANCE

The resistance of the ***load cell*** circuit measured at the ***signal*** terminals with no load applied and with the excitation terminals open-circuited.

PRIMARY AXIS

The axis along which the ***load cell*** is designed to be loaded.

RATED OUTPUT or RO

The ***output*** corresponding to ***capacity***, equal to the algebraic difference between the ***signal*** at (***minimum load*** + ***capacity***) and the ***signal*** at ***minimum load***.

RESOLUTION

The smallest change in load which produces a detectable change in the ***signal***.

SHUNT CALIBRATION

Electrical simulation of ***output*** by connection of shunt resistors of known values at appropriate points in the circuitry.

SIDE LOAD

Any load at the point of ***axial load*** application acting at 90 ° to the ***primary axis***.

SIGNAL

The absolute level of the measurable quantity into which a force input is converted.

SPAN

Another name for ***rated output***.

STATIC ERROR BAND or SEB

The band of maximum deviations of the ascending and descending calibration points from a best fit line through zero ***output***. It includes the effects of ***nonlinearity***, ***hysteresis***, and nonreturn to ***minimum load***. Normally expressed in units of %FS.

SEB OUTPUT

A computed value for ***output*** at ***capacity*** derived from a line best fit to the actual ascending and descending calibration points and through zero ***output***.

SYMMETRY ERROR

The algebraic difference between the ***rated output*** in tension and the average of the absolute values of ***rated output*** in tension and ***rated output*** in compression. Normally expressed in units of %RO.

TEMPERATURE EFFECT ON OUTPUT

The change in ***output*** due to a change in ***ambient temperature***. Normally expressed as the slope of a chord spanning the ***compensated temperature range*** and in units of %/°F or %/100°F.

TEMPERATURE EFFECT ON ZERO

The change in ***zero balance*** due to a change in ***ambient temperature***. Normally expressed as the slope of a chord spanning the ***compensated temperature range*** and in units of %RO/°F or %RO/100°F.

TEMPERATURE RANGE, COMPENSATED

The range of temperature over which the ***load cell*** is compensated to maintain ***output*** and ***zero balance*** within specified limits.

TEMPERATURE RANGE, OPERATING

The extremes of ***ambient temperature*** within which the ***load cell*** will operate without permanent adverse change to any of its performance characteristics.

TOGGLE

Another name for ***zero float***.

ZERO BALANCE

The ***signal*** of the ***load cell*** in the ***no load*** condition.

ZERO DEAD BAND

Another name for ***zero float***.

ZERO FLOAT

The shift in ***zero balance*** resulting from a complete cycle of equal tension and compression loads. Normally expressed in units of %FS and usually characterized at FS = ***capacity***.

ZERO STABILITY

The degree to which ***zero balance*** is maintained over a specified period of time with all environmental conditions, loading history, and other variables remaining constant.

ABBREVIATIONS

(All abbreviations are case-specific, are not to be pluralized, and do not use trailing periods)

ampere	A
combined error	CE
degree Celsius	°C
degree Fahrenheit	°F
degree Kelvin	°K
foot	ft
foot-pound	ft-lb
full scale	FS
gram	g
hertz	Hz
inch	in
inch-pound	in-lb
kilogram	kg
kilogram force	kgf
kilonewton	kN
kilopound (kip)	K
kilopound force	Klbf
meganewton	MN
meter	m
milliampere	mA
millimeter	mm
millivolt	mV
millivolt/volt	mV/V
minimum dead load	MDL
newton	N
newton-meter	Nm
pound	lb
pound force	lbf
pound per square inch	psi
rated output	RO
static error band	SEB
ton, metric	t
volt	V
volt direct current	VDC
volt alternating current	VAC
watt	W

Conversion Table

TO CONVERT FROM	MULTIPLY BY	TO CONVERT TO
Centimeters (cm)	0.3937	inches (in)
Cubic centimeters (cm^3)	0.061	cubic inches (in^3)
Cubic feet (ft^3)	7.481	US gallons
Cubic inches (in^3)	16.39	cubic centimeters (cm^3)
Feet (ft)	0.305	meters (m)
Grams (gm)		pounds weight (lb)
Inches (in)	25.4	millimeters (mm)
Inches (in)	2.54	centimeters (cm)
Kilograms (kg)	2.2046	pounds weight (lb)
Kilometers (km)	0.6214	miles (mi)
Kilometers per hour (km/h)	0.6215	miles per hour (mph)
Kilopascals (kPa)		pounds-force per sq. in (psi)
Meters (m)	3.281	feet (ft)
Meters (m)	39.37	inches (in)
Miles per hour (mph)	1.609	kilometers per hour (km/h)
Millimeters (mm)	0.03937	inches (in)
Newton-meters (N-m)		pounds-force foot (lbf-ft)
Newtons (N)		pounds-force (lbf)
Ounces (oz)	28.35	grams (gm)
Pounds weight (lb)	0.4536	kilograms (kg)
Pounds weight (lb)	453.6	grams (gm)
Pounds-force (lbf)	4.44822	newtons (N)
Pounds-force foot (lbf-ft)	1.35582	newton-meters (N-m)
Pounds-force per sq. in (psi)	6.8948	kilopascals (kPa)
Ton, US (Ton)	2000	pounds weight (lb)
Tonne, metric (t)	2204.6	pounds weight (lb)
US gallons	0.1337	cubic feet (ft^3)

Ref: *The Economist DESK COMPANION*, John Wiley & Sons, Inc. 1998