APPENDIX A

GENERAL DEFINITIONS

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ABSOLUTE VALUE	-	The absolute value of a number is the magnitude of that number without considering the positive or negative sign.
AMBIENT CONDITIONS	-	The conditions (humidity, pressure, temperature, etc.) of the medium surrounding the installation.
ANGULAR LOAD, ECCENTRIC	-	A load applied eccentric with the primary axis at the point of application and at some angle with respect to the primary axis.
ANGULAR LOAD, CONCENTRIC	-	A load applied concentric with the primary axis at the point of application and at some angle with respect to the primary axis.
AXIAL LOAD	-	A load applied along or parallel to and concentric with the primary axis.
BEAM	-	The indicating device of a lever scale.
CALIBRATION	-	The comparison of load cell outputs against standard test loads.
CALIBRATION CURVE	-	A record (graph) of the comparison of load cell outputs against standard test loads.
CLOSED RANGE	-	A condition that exists when the edges of load and power pivots are above the edge of the fulcrum pivot.
COMBINED ERROR (Nonlinearity and Hysteresis)	-	The maximum deviation from the straight line drawn between the original no-load and rated load outputs expressed as a percentage of the rated output and measured on both increasing and decreasing loads.
COMPENSATION	-	The utilization of supplementary devices, materials, or processes to minimize known sources of error.
COUNTERBALANCE	-	An offsetting weight.
CREEP	-	The change in load cell output occurring with time while under load and with all environmental conditions and other variables remaining constant.

NOTE

Usually measured with rated load applied and expressed as a percent of rated output over a specified period of time.

CREEP RECOVERY - The change in no-load output occurring with time after a removal of a load which had been applied for a specific period of time.

NOTE

Usually measured over a specified time period immediately following removal of rated load and expressed as a percent of rated output.

DASHPOT - A dampening device used to reduce scale oscillations.

DEAD LOAD - The fixed force of the weighbridge, platform, and other load supporting structures of the scale, the value of which is to be permanently balanced or cancelled out in the weight or measuring system.

DEFLECTION - The change in length along the primary axis of the load cell between no-load and related load conditions.

DIAL SCALE - A desensitized beam scale where the travel is mechanically enlarged by projection on a chart or dial.

DORMANT SCALE - A built-in scale but with a self contained understructure.

DRIFT - A random change in output under constant load conditions.

ECCENTRIC LOAD - Any load applied parallel to but not concentric with the primary axis.

ERROR - The algebraic difference between the indicated and true value of the load being measured.

EXCITATION, ELECTRICAL - The voltage or current applied to the input terminals of the load cell.

FREQUENCY RESPONSE - The range of frequencies over which the load cell output will follow the sinusoidally varying mechanical input within specified limits.

NOTE

Normally expressed as "within ...percent from...to...Hz"

FULCRUM - A pivot point for a lever.

GRAVITY BALL - A mass or weight required to stabilize an otherwise neutral lever.

HYSTERESIS - The maximum difference between load cell output readings for the same applied load; one reading obtained by increasing the load from zero and the other by decreasing the load from rated output.

NOTE

Usually measured at half rated output and expressed in percent of rated output. Measurements should be taken as rapidly as possible to minimize creep.

INSULATION RESISTANCE - The dc resistance measured between the load cell circuit and the load cell structures.

NOTE

Normally measured at fifty volts dc and under standard test conditions.

LEVER - A tool that transfers a force, equally, with reduction, or with multiplication.

LOAD - The weight or force applied to the load cell.

LOAD CELL - A device which produces an output signal proportional to the applied weight or force.

NATURAL FREQUENCY - The frequency of free oscillation under no-load conditions.

NONLINEARITY - The maximum deviation of the calibration curve from a straight line drawn between the no-load and rated load outputs, expressed as a percentage of the rated output and measured on increasing load only.

NOSE IRON - Short coupling (shackle) between the end of one lever (power pivot) and the load pivot of another lever.

OPEN RANGE - A condition that exists when the edges of the load and power pivots are below the edge of the fulcrum pivot point. This will cause sluggish action in a scale.

OUTPUT - The signal (voltage, current, pressure, etc.) produced by load cell.

NOTE

Where the output is directly proportional to excitation, the signal must be expressed in terms of volts per volt, volts per ampere, etc. of excitation.

OUTPUT, RATED - The algebraic difference between the outputs at no-load and at rated load.

OVERLOAD RATING, SAFE - The maximum load in percent of rated capacity which can be applied without producing a permanent shift in performance characteristics beyond those specified.

OVERLOAD RATING, ULTIMATE - The maximum load in percent of rated capacity which can be applied without producing a structural failure.

POISE - A moveable weight that counterbalances the load on a scale. At the point of equal balance the weight indicated by the position of the poise on the beam.

POISE RUN - The distance a poise travels on a beam from zero to full capacity position.

PRIMARY AXIS - The axis along which the load cell is designed to be loaded; normally its geometric centerline.

RADIO FREQUENCY INTERFERENCE (RFI) - Radio frequency interference is a type of electrical disturbance which, when introduced into electronic and electrical circuits, may cause deviations from the normally expected performance.

RATED CAPACITY (RATED LOAD) - The maximum axial load the load cell is designed to measure within its specifications.

RATIO - Relationship of the amount of power required to balance a load using a lever.

REFERENCE STANDARD - A force measuring device whose characteristics are precisely known in relation to a primary standard.

REPEATABILITY - The maximum difference between load cell output readings for repeated loadings under identical loading and environmental conditions.

RESOLUTION	-	The smallest change in mechanical input which produces a detectable change in the output signal.
SCALE	-	A device for weighing, comparing and determining a weight or mass.
SCALE SENSITIVITY	-	The distance the beam or indicator travels when a certain unit of weight is placed on the platform of the scale.
SENSITIVITY	-	Amount of structural displacement caused by the addition of weight to a portion of a balanced structure. This amount depends on the distribution of mass above and below the fulcrum.
SENSITIVITY REQUIREMENT (SR)	-	The amount of weight necessary to move the weight indicating beam from the center to the top or bottom of its travel of its travel limits.
SHADOWGRAPH	-	An even arm scale that uses an optical system and projector bulb to magnify the scale travel.
SHIFT TEST	-	A test intended to disclose the weighing performance of a scale under off-center loading.
SHUNT CALIBRATION	-	Electrical simulation of load cell output by insertion of known shunt resistors between appropriate points within the circuitry.
SHUNT-TO-LOAD CALIBRATION	-	The difference in output readings obtained through electrically simulated and actual applied loads.
SIDE LOAD	-	Any load acting 90° to the primary axis at the point of axial load applications.
SPRING SCALE	-	A device that balances a weight against the force of a spring to determine a weight.
STABILIZATION PERIOD	-	The time required to insure that any further change in the parameter being measured is tolerable.
STANDARD TEST CONDITIONS	-	The environmental conditions under which measurements should be made when measurements under any other conditions may result in disagreement between various observers at different times and places. These conditions are as follows:

Temperature - $23^{\circ} \pm 2^{\circ}C (72^{\circ} \pm 3.6^{\circ}F)$

Barometric Pressure - 28 to 32 inches Hg

STEELYARD - A first class multiplying lever with a graduated power arm.

TARE - The weight of an empty container or vehicle, or of spools, cores or wrappings, or the allowance or deduction from gross weight made on account thereof. Sometimes also called light weight, with respect to a container or vehicle.

TARE BARS - Unit weights that replace the beam in a dial scale.

TEMPERATURE EFFECT ON RATED OUTPUT - The change in rated output due to a change in ambient temperature.

NOTE

Usually expressed as the percentage change in rated output per 100° change in ambient temperature.

TEMPERATURE EFFECT ON ZERO BALANCE - The change in zero balance due to a change in ambient temperature.

NOTE

Usually expressed as the change in zero balance in percent of rated output per 100°F change in ambient temperature.

TEMPERATURE RANGE, COMPENSATION - The range of temperature over which the load cell is compensated to maintain rated output and zero balance within specific limits.

TEMPERATURE RANGE, SAFE - The extremes of temperature within which the load cell will operate without permanent adverse change to any of its performance characteristics.

TERMINAL RESISTANCE, CORNER TO CORNER - The resistance of the load cell circuit measured at specific adjacent bridge terminals at standard temperature, with no load applied, and with the excitation and output terminals open-circuited.

TERMINAL RESISTANCE, INPUT - The resistance of the load cell circuit measured at the excitation terminals at standard temperature, with no load applied, and with the output terminals open-circuited.

TERMINAL RESISTANCE - OUTPUT - The resistance of the load cell circuit measured at the output signal terminals at standard temperature, with no load applied, and with the excitation terminals open-circuited.

TIP MULTIPLE	-	Total multiple or ratio of the whole scale including the balance beam at its power (tip) pivot.
TOLERANCE	-	A magnitude fixing the limit of allowable error or departure from true performance or value.
TRACEABILITY	-	The step-by-step transfer process by which the load cell calibration can be related to primary standards.
TRIG LOOP	-	An oval iron loop limiting the travel of the balance beam.
UNIT WEIGHT	-	Counterbalance weights used to increase the capacity of a dial scale.
WEIGHTOGRAPH	-	Type of dial scale where increments of weight or lever travel are optically magnified and projected on a ground glass screen.
ZERO BALANCE	-	The output signal of the load cell with rated excitation and with no load applied, usually expressed in percent of rated output.

APPENDIX B

CONVERSION FACTORS

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CONVERSION FACTORS

WEIGHTS AND MEASURES

The abbreviations and symbols shown below are generally accepted and used by the National Bureau of Standards. No period is used after metric symbols and customary unit abbreviations. (Reference NBS Handbook 44)

PART I - U. S. CUSTOMARY

AVOIRDUPOIS (avdp) WEIGHT (Commercial)

1 pound (lb)	= 16 ounces	= 7000 grains
1 ounce (oz)	= 16 drams (dr)	= 437.5 grains, exactly
1 short hundred weight (cwt)		= 100 pounds
1 long hundred weight (gross cwt)		= 112 pounds
1 short ton (tn)		= 2000 pounds
1 long ton (gross in)		= 2240 pounds

APOTHECARIES WEIGHT

1 scruple	(s ap) =	20 grains	
1 dram	(dr ap) =	3 scruples	= 60 grains
1 ounce	(oz ap) =	8 drams	= 480 grains
1 pound	(lb ap) =	12 ounces	=5760 grains

TROY WEIGHT

1 pennyweight	(dwt) =	24 grains	
1 ounce	(oz t) =	20 pennyweight	= 480 grains
1 pound	(lb t) =	12 ounces	= 5760 grains

LENGTH MEASURES

1 foot (ft)	= 12 inches (in)	
1 yard (yd)	= 3 feet	= 36 inches
1 mile (mi)	= 5280 feet	
1 chain (ch) (Gunter's or surveyor's)		= 66 feet

AREA OR SURFACE

1 square foot (ft^2)	=	144 square inches (in^2)
1 square yard (yd^2)	=	1,296 square inches
1 acre	=	43,560 square feet

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CAPACITIES OR VOLUMES

LIQUID MEASURE

1 U.S. gallon (gal)	=	231 cubic inches, exactly
1 British Imperial gallon	=	1.201 U.S. gallons)
60 minims	=	1 fluid dram
8 fluid drams (fl dr)	=	1 fluid ounce
4 fluid ounces (fl oz)	=	1 gill
4 gills (gi)	=	1 pint = 16 fluid ounces
2 pints (pt)	=	1 quart = 32 fluid ounces
4 quarts (qt)	=	1 gallon

DRY MEASURE

1 U. S. bushel (bu)	=	2150.42 cubic inches (in^3)
British Imperial bushel	=	1.0321 U.S. bushels
1 U. S. bushel	=	4 pecks
1 peck (pk)	=	4 quarts = 16 pints (pt)
1 quart (qt)	=	2 pints

CUBIC MEASURE

1 cubic yard (yd^3)	=	27 cubic feet
1 cubic foot (ft^3)	=	1728 cubic inches (in^3)
1 board foot	=	144 cubic inches - 1/12 cubic foot
1 cord (cd)	=	128 cubic feet

AVOIRDUPOIS - METRIC WEIGHT EQUIVALENTS

AVOIRDUPOIS (Commercial)				METRIC
1 grain	=	0.0648 gram (g)	=	64.8 milligrams (mg)
1 ounce (oz)	=	38.35 grams		
1 pound (lb)	=	0.454 kilogram (kg)	=	454 grams
1 short ton	=	0.907 metric ton (t)	=	907 kilograms
1 long ton	=	1.016 metric ton	=	1016 kilograms

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METRIC - AVOIRDUPOIS - WEIGHT EQUIVALENTS

METRIC		AVOIRDUPOIS (Commercial)
1 gram (g)	=	15.432 grains
1 gram	=	0.035 ounces (oz)
1 Newton	=	0.225 pounds (lb)
1 kilogram (kg)	=	2.205 pounds = 35.274 ounces
1 metric ton (t)	=	1.102 short ton (tn) = 2205 pounds (lb)
1 metric ton	=	0.984 long ton (gross tn) = 2205 pounds

TROY - APOTHECARIES - AVOIRDUPOIS - METRIC WEIGHT EQUIVALENTS

1 pound troy or apothecaries	=	0.823 pounds avoirdupois
	=	373.2 grams
1 ounce troy or apothecaries	=	1.097 ounce avoirdupois
	=	31.103 grams
1 grain troy	=	1 grain apothecaries = 1 grain avdp
	=	0.065 gram
1 pound avoirdupois	=	1.2153 pound troy or apothecaries
1 ounce avoirdupois	=	0.9115 ounce troy or apothecaries
1 kilogram (kg)	=	2.6792 pounds troy or apothecaries
1 gram (g)	=	0.0322 ounce troy or apothecaries

METRIC - U. S. CUSTOMARY LENGTH EQUIVALENTS
(1 inch = 25.4 millimeters, exactly)

METRIC				CUSTOMARY
1 millimeter (mm)	=	0.001 meter	=	0.03937 inch
1 centimeter (cm)	=	10 millimeters	=	0.3937 inch
1 decimeter (dm)	=	10 centimeters	=	3.937 inches
1 meter (m)	=	10 decimeters	=	39.37 inches
1 dekameter (dam)	=	10 meters	=	32.808 feet
1 kilometer (km)	=	1000 meters	=	0.6 mile

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CONVERSION FACTORS

PART II - METRIC (SI) SYSTEM

MULTIPLICATION FACTOR	PREFIX	SYMBOL	MEANS
1,000,000 = 10^6	mega	M	one million times
1,000 = 10^3	kilo	k	one thousand times
100 = 10^2	hecto	h*	one hundred times
10 = 10	deka	da*	ten times
0.1 = 10^{-1}	deci	d*	one tenth of
0.01 = 10^{-2}	centi	c*	one hundredth of
0.001 = 10^{-3}	milli	m	one thousandth of
0.000001 = 10^{-6}	micro	μ	one millionth of

(* While hecto, deka, deci, and centi are SI prefixes, their use should generally be avoided except for measurement of area and volume).

METRIC UNITS OF MASS (WEIGHT)

1 milligram (mg)	=	0.001 gram
1 gram (g)	=	1000 milligrams
	=	0.001 kilogram
1 kilogram[1] (kg)	=	1000 grams
1 metric ton (t)	=	1000 kilograms

METRIC CAPABILITIES OR VOLUMES

1 cubic centimeter (cm^3)	= 1 milliliter
1000 milliliters (ml)	= 1 liter
1 liter (l)	= 1 cubic decimeter
1 cubic decimeter (cm^3)	= 0.001 cubic meter
1 cubic meter (m^3)	= 1000 cubic decimeters

METRIC UNITS OF LENGTH

1 micrometer (μ)	=	0.000001 meter
1 millimeter (mm)	=	0.001 meter
1 centimeter (cm)	=	0.01 meter
1 decimeter (dm)	=	0.1 meter
1 meter[2] (m)	=	10 decimeters
1 kilometer (km)	=	1000 meters

METRIC AREA OR SURFACE MEASURES

1 square centimeter (cm^2)	=	0.0001 square meter
1 square decimeter (dm^2)	=	0.01 square meter
1 square meter (m^2)	=	100 square decimeters
10,000 square meters	=	1 hectare (ha)

[1] Footnote: The kilogram is the SI base unit of mass.
[2] Footnote: The meter is the SI base unit of length. Other base units include: kilogram(kg), second(s), ampere (A), kelvin (K), mole (mol), candela (cd).