
The Metrology Handbook

Errata

Front Matter

P. xi, Preface, line 34: "American Society of Quality" should read "American Society for Quality."

Chap. 1

P. 10, line 24: "These units are the meter (M), . . ." should read "These units are the meter (m), . . ."
P. 14, line 25: "Good laboratory practices become effective.[3]" should read "Good laboratory practices become effective."

Chap. 2

P. 20, line 3: "This is the basic foundation of a quality system.[6]" should read "This is the basic foundation of a quality system."

Chap. 3

P. 29, line 28: "As explained by Stanley Marash.[13]" should read "As explained by Stanley Marash[13]:"

Chap. 5

P. 43, paragraph 4.2: "IM&TE – Inspection, Measurement, and Test Instrument" should read "IM&TE – Inspection, Measurement, and Test Equipment."

Chap. 11

P. 86, Table 11.3, "Primary" row, end of "Definition" column: "primary standard." should be moved to the end of the sentence in the "Example" column.
P. 87, line 37: ". . . physical property.[1]" should read ". . . physical property." (Superscript and corresponding endnote deleted.)

Chap. 17

P. 117, line 10 (fifth bullet item): "Perform a software validation" should read "Perform a software validation (pages 143–44)."

P. 123, line 20: "There is a statement showing traceability to back to a national . . ." should read "There is a statement showing traceability back to a national . . ."

Chap. 19

P. 150, Table 19.1: Replace with following table.

Table 19.1 Frequently used constants

Physical Constant	Value	Standard Uncertainty
atomic mass constant	$1.660\ 538\ 86 \times 10^{-27}$ kg	$0.000\ 000\ 28 \times 10^{-27}$ kg
Avogadro constant	$6.022\ 1415 \times 10^{23}$ mol^{-1}	$0.000\ 0010 \times 10^{23}$ mol^{-1}
Boltzmann constant	$1.380\ 6505 \times 10^{-23}$ J K^{-1}	$0.000\ 0024 \times 10^{-23}$ J K^{-1}
conductance quantum	$7.748\ 091\ 733 \times 10^{-5}$ S	$0.000\ 000\ 026 \times 10^{-5}$ S
electric constant	$8.854\ 187\ 817... \times 10^{-12}$ F m^{-1}	
electron mass	$9.109\ 3826 \times 10^{-31}$ kg	$0.000\ 0016 \times 10^{-31}$ kg
electron volt	$1.602\ 176\ 53 \times 10^{-19}$ J	$0.000\ 000\ 14 \times 10^{-19}$ J
elementary charge	$1.602\ 176\ 53 \times 10^{-19}$ C	$0.000\ 000\ 14 \times 10^{-19}$ C
Faraday constant	96 485.3383 C mol^{-1}	0.0083 C mol^{-1}
fine-structure constant	$7.297\ 352\ 568 \times 10^{-3}$	$0.000\ 000\ 024 \times 10^{-3}$
inverse fine-structure constant	137.035 999 11	0.000 000 46
magnetic constant	$4\pi \times 10^{-7} = 12.566\ 370\ 614... \times 10^{-7}$ N A^{-2}	
magnetic flux quantum	$2.067\ 833\ 72 \times 10^{-15}$ Wb	$0.000\ 000\ 18 \times 10^{-15}$ Wb
molar gas constant	8.314 472 J mol^{-1} K^{-1}	0.000 015 J mol^{-1} K^{-1}
Newtonian constant of gravitation	6.6742×10^{-11} m^3 kg^{-1} s^{-2}	0.0010×10^{-11} m^3 kg^{-1} s^{-2}
Planck constant	$6.626\ 0693 \times 10^{-34}$ J s	$0.000\ 0011 \times 10^{-34}$ J s
Planck constant over 2 pi	$1.054\ 571\ 68 \times 10^{-34}$ J s	$0.000\ 000\ 18 \times 10^{-34}$ J s
proton mass	$1.672\ 621\ 71 \times 10^{-27}$ kg	$0.000\ 000\ 29 \times 10^{-27}$ kg
proton-electron mass ratio	1836.152 672 61	0.000 000 85
Rydberg constant	10 973 731.568 525 m^{-1}	0.000 073 m^{-1}
speed of light in vacuum	299 792 458 m s^{-1}	
Stefan-Boltzmann constant	$5.670\ 400 \times 10^{-8}$ W m^{-2} K^{-4}	$0.000\ 040 \times 10^{-8}$ W m^{-2} K^{-4}

P. 154, Table 19.4: "Power – Pdbm" should read "Power – P_{dbm}" and "Temperature – Rt" should read "Temperature – R_t."

Chap. 20

P. 166, Table 20.1, X-Bar Control Chart and R-Bar Control Chart: All references of "X-bar" should read "Xbar" and all references of "R-bar" should read "Rbar."

P. 167, Figure 20.2: “X-bar” should read “Xbar”; and Figure 20.3: “R-bar” should read “Rbar.”
P. 170, Table 20.3, Computations: “K1” should read “K_1,” “K2” should read “K_2,” and “K3” should read “K_3.”

Chap. 21

P. 182, line 11: The specification stated is "±(0.0005% output + 5 mV)". Should be: "±(0.0005% output + 5 µV)
P. 183, line 6: “Many bench or system digital multimeter” should read “Many bench or system digital multimeters.”
P. 187, Example 3, row 1: "Sensitivity is 5 mV / division to 50 mV / division..." should read "Sensitivity is 5mV / division to 50 V / division..."
P. 188, rows 1 and 2: "...can be set to 5 mV, 10 mV, 30 mV, 0.5 V, 10 V, 30 V, or 50 V per division." should read "...can be set to 5 mV, 10 mV, 30 mV, 50 mV, 100 mV, 300 mV, 500 mV, 1 V, 3 V, 5 V, 10 V, 30 V, or 50 V per division."

Chap. 22

P. 198, line 10 through P. 199, line 10: Delete entire block. It is a repeat of the previous four paragraphs.
P. 199, line 15: “. . . performance verification is will have to be revised . . .” should read “. . . performance verification it will have to be revised . . .”

Chap. 23

P. 205, Table 23.1, row 24: “K=2” should read “k = 2.”
P. 206, Table 23.2, row 25: “En” should read “E_n.”
P. 216, line 5: After the first set of equations, add the following clarifying note.

UCL_{IX} =Individuals Upper Control Limit
LCL_{IX} =Individuals Lower Control Limit
UCL_{MR} =Moving Range Upper Control Limit
LCL_{MR} = Moving Range Lower Control Limit

lines 6–12: The formula for calculating control limits for Xbar, Range chart should be:

$$UCL_{\bar{x}} = \bar{\bar{x}} + A_2 \bar{R}$$

$$LCL_{\bar{x}} = \bar{\bar{x}} - A_2 \bar{R}$$

$$CL_{\bar{x}} = \bar{\bar{x}}$$

$$UCL_R = \bar{R} D_4$$

$$LCL_R = \bar{R} D_3$$

$$CL_R = \bar{R}$$

After this set of equations, add the following clarifying note.

$UCL_{\bar{X}}$ = Xbar Upper Control Limit

$LCL_{\bar{X}}$ = Xbar Lower Control Limit

UCL_R = Range Upper Control Limit

LCL_R = Range Lower Control Limit

Chap. 24

P. 232, line 17: ". . . like raising to integral posers, . . ." should be ". . . like raising to integral powers, . . ."

Chap. 25

P. 244, Table 25.3, "specific heat capacity, specific entropy" row: "m2" should read "m^2."
P. 254, Table 25.9, all (14) exponents listed under the "Units" column should be corrected to be superscripted.

Chap. 27

P. 268, lines 13–22: Replace with the following text:

ROOT MEAN SQUARE

The root mean square (RMS) statistic is most often associated with continuous variables, such as time. There are occasions where RMS is associated with discrete variables as well, such as specific measurements of a variable, for example, weight. Basically, as the name implies, RMS involves squaring the values of data, finding the mean (average) of these values, followed by taking a (square) root of this mean. As such, the unit of the calculation is the same as that of the data. For instance, if the RMS value of a set of data in feet is taken, the RMS result also has the unit, feet.

The unit of RMS is the same as the measurement unit. Root mean square (RMS) is given by the following equation:

$$RMS_{XX} = \sqrt{\frac{\sum_{i=1}^{n} Y^2}{n}}$$

For instance, in the data series of amperage measurements,

13, 14, 23, 23, 32, 33, 45, 99, and 105 A

the RMS value is 54.15 A, rounded to two decimal places.

P. 269, lines 1–18: Replace with the following text:

SUM OF SQUARES

Sum of squares (SS) is often used as one step in ANOVA calculations. The unit of SS is the measurement unit squared. The sum of squares (SS) is given by the following equation(s):

$$SS_{XX} = \sum_{i=1}^{n} Y^2$$

or… $SS = X_1^2 + X_2^2 + X_3^2 + \ldots + X_n^2$

For instance in the data series of amperage measurements,

13, 14, 23, 23, 32, 33, 45, 99 and 105 A

the SS value is 26,387 A^2, rounded to two decimal places.

ROOT SUM OF SQUARES

The unit of RSS is the same as the measurement unit. The root sum of squares (RSS) is given by the following equation(s):

$$RSS_{XX} = \sqrt{\sum_{i=1}^{n} Y^2}$$

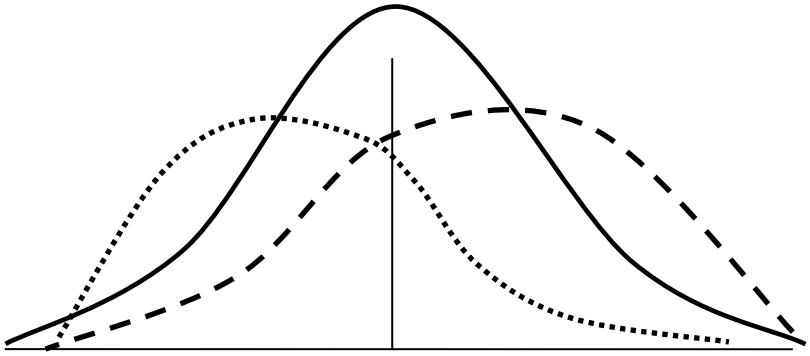
or… $$RSS = \sqrt{X_1^{\,2} + X_2^{\,2} + X_3^{\,2} + \ldots + X_n^{\,2}}$$

For instance in the data series of amperage measurements,

13, 14, 23, 23, 32, 33, 45, 99 and 105 A

the RSS value is 162.44 A, rounded to two decimal places.

P. 271, line 21 (skewness illustration): Replace with following graphic:



…… Positive Skewness – – – Negative Skewness

P. 274, line 17: "=INTERCEPT (DATA1)" should read "=INTERCEPT (DATA1, DATA2)." line 31, intercept equation: "b =" should read "m =."
P. 279, line 1: "the interpolated value . . ." should read "the 4-point Interpolation, Cubic, 3rd Order Exponential interpolated value . . ."
P. 282, line 1: "uj" should read "u_j."
P. 282, line 12: "For an assumed triangular distribution . . ." should read "'For an assumed u-shaped distribution . . ."
P. 282, line 25: ". . . U_r then is xx, dimensionless" should read ". . . U_r then is 0.00667, dimensionless."

Chap. 29

P. 306, line 27: "For more information on statistical control and control charts, refer to

Part IV" should read "For more information on statistical process control and control charts, refer to Part III—Chapter 20."

P. 308, lines 8 and 10: "where: _ = population standard deviation" should read "where: σ = population standard deviation" and "S_x = standard deviation of the mean" should read "$S_{\bar{x}}$ = standard deviation of the mean."

P. 311, line 12: Insert paragraph return after first sentence.

P. 313, line 6 (first formula): "0.01^2" should read "0.001^2"; and "0.001503" should read "0.005103."

Line 26 (last computation): "0.33228" should read "0.033228."

P. 318, line 18: Replace Welch-Satterthwaite formula as shown:

$$V_{eff} = \frac{u_c^{\,4}(y)}{\sum_{i=1}^{N} \frac{u^4{}_i(y_i)}{v_i}}$$

Chap. 30

P. 324, Table 30.1, fourth column head: "Dimensional and Mechanic" should read "Dimensional and Mechanical."

Chap. 31

P. 332, Table 31.5, rows 5 and 6: Move "thermal converter" and "calibrators, ratio transformers" to the second column.

P. 333, line 6: "form the other" should read "from the other."

P. 334, Table 31.6, row 5: Move "thermal converter" to the second column.

P. 358, line 12: Delete the infinity symbol.

Appendix C

P. 466: Add "IAS" to table of Acronyms and Abbreviations as shown:

Acronym	Meaning	More Information
IAS	International Accreditation Service, Inc.	www.iasonline.org

Appendix E

Throughout: Add subheadings to "FROM" and "TO" columns as shown:

TO CONVERT	FROM		TO		MULTIPLY BY
	SYMBOL	NAME	SYMBOL	NAME	

P. 487, prior to table add: "Note: Table is alphabetical within 'FROM/Name' column."