



Standard Practice for Reporting Results from Methods of Chemical Analysis¹

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1. Scope

1.1 This practice covers the approximate number of digits required to express the expected precision of results reported from standard methods of chemical analysis. This practice provides selection criteria and proper form and symbols for coding results when necessary to indicate the relative reliability of results having small values.

1.2 Specifically excluded is consideration of report forms and the associated informational content of reports in which results are tabulated or transmitted. It is assumed that the reporting laboratory has established a report format to ensure proper identification of the materials tested, the nature and conditions of the test, the responsible personnel, and other related information in accordance with existing regulations and good laboratory practices.

2. Referenced Documents

2.1 ASTM Standards:²

- E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
- E135 Terminology Relating to Analytical Chemistry for Metals, Ores, and Related Materials
- E1601 Practice for Conducting an Interlaboratory Study to Evaluate the Performance of an Analytical Method
- E1763 Guide for Interpretation and Use of Results from Interlaboratory Testing of Chemical Analysis Methods

3. Terminology

3.1 Definitions:

3.1.1 For definitions of terms, refer to Terminology E135.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *lower limit, L, n*—the lower limit of the quantitative analyte concentration range (see Annex A1).

3.2.2 *low-level reproducibility index, K_R , n*—the reproducibility index constant (for low analyte levels) determined in accordance with Guide E1763.

3.2.3 *null limit, NL, n*—the analyte content below which results are so near zero that averaging is unlikely to yield a value significantly different from zero.

3.2.4 *quantitative, adj—relating to results*, having a numerical value that includes at least one significant digit (see Practice E29).

4. Significance and Use

4.1 A result must be stated to a sufficient number of digits so that a user receives both quantitative information and a measure of the variability of the value reported.

4.2 The range of application of most methods of chemical analysis is based upon the presumption that the quantitative results produced are to be used to compare the analyte content of the test material with specified limiting values. However, analytical results may be used legitimately for other purposes. If the same material is analyzed a number of times or a product is analyzed periodically during an interval of production, each set of results may be averaged to yield an average result having improved reliability, provided nothing has been done between analyses to modify the composition of the analyzed material. Results that fall below the lower limit, although not quantitative individually, contain compositional information and may be reported. The reporting system in this practice permits the analyst to indicate which values are likely to be rendered quantitative by averaging and which are not.

4.3 The system is simple enough to be used routinely in reporting results from standard methods and assists those untrained in statistics to apply results appropriately.

5. Rounding Calculated Values

5.1 Use information from the precision section of the method to determine the appropriate number of digits to report as follows:

5.1.1 Estimate the reproducibility index, R , at the analyte level of the result, C , from an equation of R as a function of concentration or from the table of statistical information.

5.1.2 Calculate the percent relative reproducibility index:

$$R_{rel\%} = 100 \times R/C \quad (1)$$

¹ This practice is under the jurisdiction of ASTM Committee E01 on Analytical Chemistry for Metals, Ores, and Related Materials and is the direct responsibility of Subcommittee E01.22 on Laboratory Quality.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.