



Designation: D6621 – 21

Standard Practice for Performance Testing of Process Analyzers for Aromatic Hydrocarbon Materials¹

This standard is issued under the fixed designation D6621; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This practice serves as a practical guide for the performance testing of process stream analyzers specifically for measuring chemical or physical characteristics of liquid aromatic hydrocarbon materials for production or certification of these materials. The practice may be applicable to other hydrocarbon stream analyzers as well.

1.2 Only external methods (complete substitution of the process stream with a standard) of control sample introduction are included. Internal methods are beyond the scope of this practice.

1.3 Methods for resetting key operational parameters of analyzers to match predefined limits are provided by vendors and are not included in this practice.

1.4 Analyzer validation procedures are covered in Practices [D3764](#) and [D6122](#), not in this practice.

1.5 Procedures for statistically interpreting data from automatic sampling process stream analyzers are outlined.

1.6 The implementation of this practice requires that the analyzer be installed according to APIRP-550 ([1](#)),² and be in agreement with the analyzer supplier's recommendations. Also, it assumes that the analyzer is designed to monitor the specific material parameter of interest, and that at the time of initial or periodic validation, the analyzer was operating at the conditions specified by the manufacturer and consistently with the primary test method.

1.7 The units of measure used in this practice shall be the same as those applicable to the test primary method used for analyzer validation.

1.8 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appro-*

priate safety, health, and environmental practices, and determine the applicability of regulatory limitations prior to use.

1.9 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*³

[D3437 Practice for Sampling and Handling Liquid Cyclic Products](#)

[D3438 Practice for Sampling and Handling Naphthalene, Maleic Anhydride, and Phthalic Anhydride](#)

[D3764 Practice for Validation of the Performance of Process Stream Analyzer Systems](#)

[D3852 Practice for Sampling and Handling Phenol, Cresols, and Cresylic Acid](#)

[D6122 Practice for Validation of the Performance of Multivariate Online, At-Line, Field and Laboratory Infrared Spectrophotometer, and Raman Spectrometer Based Analyzer Systems](#)

[E456 Terminology Relating to Quality and Statistics](#)

[E1655 Practices for Infrared Multivariate Quantitative Analysis](#)

3. Terminology

3.1 *Definitions:*

3.1.1 *accuracy, n*—closeness of agreement between a test result and an accepted reference value.

3.1.2 *analyzer output, n*—signal that is proportional to the quality parameter being measured and suitable for input to readout instrumentation.

3.1.2.1 *Discussion*—It may be pneumatic, electrical, digital, etc., and expressed as psi, mv, sec., etc.

¹ This practice is under the jurisdiction of ASTM Committee [D16](#) on Aromatic, Industrial, Specialty and Related Chemicals and is the direct responsibility of Subcommittee [D16.09](#) on On-Line Analysis.

Current edition approved Nov. 1, 2021. Published December 2021. Originally approved in 2000. Last previous edition approved in 2017 as D6621 – 00 (2017). DOI: 10.1520/D6621-21.

² The boldface numbers in parentheses refer to the list of references at the end of this practice.

³ 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.

*A Summary of Changes section appears at the end of this standard

3.1.3 *analyzer result, n*—numerical estimate of a physical, chemical, or quality parameter produced by applying the calibration model to the analyzer output signal.

3.1.4 *bias, n*—the difference between the expectation of the results and an accepted reference value.

3.1.5 *control sample, n*—material similar to the process stream that is stable over long periods of time so that its parameters may be measured reproducibly in performance tests to characterize analyzer precision and accuracy.

3.1.5.1 *Discussion*—May be a pure compound, standard mixture, or a sample from the process stream. Its parameters are used to plot statistical process control charts to define analyzer precision in normal operation.

3.1.6 *external performance testing, n*—procedure involving complete substitution of the process/product stream measured by the analyzer with a control sample stream to measure the analyzer's precision and possibly accuracy (if the control sample's true value is known).

3.1.7 *internal performance testing, n*—procedure involving the addition of a known quantity of a standard material homogeneously into the process/product stream measured by the analyzer to measure the analyzer's precision and possibly accuracy (if the sample material's true value is known).

3.1.8 *linearity, n*—parameter ranges where the analyzer's results do and do not approximate a straight line.

3.1.9 *performance testing of an analyzer, n*—mechanical and statistical procedure for routinely checking the accuracy and precision of an analyzer's results against historical accuracy and precision for a control sample.

3.1.10 *precision, n*—closeness of agreement of independent test results of the same chemical or physical property of a given material obtained under stipulated conditions.

3.1.10.1 *Discussion*—Expressed in terms of dispersion of test results around the arithmetic mean, usually as variance, standard deviation, repeatability or reproducibility, or both.

3.1.11 *repeatability of an analyzer, n*—difference between two successive analyzer results measured in a short time interval that would be exceeded in the long run in only 1 case in 20 (5 % of the time) when the analyzer is operated on a flowing sample of uniform quality.

3.1.12 *reproducibility of an analyzer, n*—difference between a single result from each of two identical analyzer systems that would be exceeded in the long run in only 1 case in 20 (5 % of the time) when the two systems are operated at different sites by different operators, but on identical samples.

3.1.13 *rule violation, n*—condition when a point value or pattern of points in a statistical process control chart statistically exceeds the defined probability of its occurrence, as defined by the Western Electric rules (2) being used.

3.1.14 *spot sample, n*—representative material resembling the stream being monitored, an identical portion of which is analyzed both in a process analyzer and by a laboratory test on a non-scheduled basis for periodic validation testing.

3.1.14.1 *Discussion*—May be the same material as the control sample.

3.1.15 *validation of an analyzer, n*—process to identify how comparable an analyzer's results are statistically to results from the primary method, or to define how the analyzer's results compare to the primary method's results in precision and accuracy.

3.1.15.1 *Discussion*—Must be done when the analyzer is first configured or reconfigured (initial validation), and then on a periodic basis (periodic validation), as described in Practice D3764.

3.2 For additional definitions, see [Appendix X1](#).

4. Summary of Practice

4.1 This practice standardizes aromatic hydrocarbon process-analyzer performance testing practices, or processes for maintaining accurate and precise analyzer measurements. It is used with methods for the measurement and certification of aromatic hydrocarbon materials applied to continuous on-line analyzers. These methods are generally under the control of Committee D16 on Aromatic, Industrial, Specialty and Related Chemicals. It is meant as a practical guide for persons setting up and maintaining these analyzers in a process (non-laboratory) environment. They should apply it, with their knowledge of the analyzer's operation and of how the process analyzer results are to be used, to maintain and optimize analyzer operation.

5. Significance and Use

5.1 Performance testing of on-line analyzers is critical to their proper performance within predictable levels of precision and accuracy. This practice can affect production efficiency and certification of aromatic hydrocarbon materials.

6. System Components

6.1 Process analyzers for measuring the chemical composition of aromatic hydrocarbons, their purity, or physical properties often replace existing laboratory test methods, using the same or similar chemical measurement techniques. [Fig. 1](#) shows several possible analyzer configurations for on-line process testing of aromatic hydrocarbon materials. Aromatic hydrocarbon stream analyzers are often based on chromatography, but they may also perform physical measurements, wet chemistry, or other methods described in new or existing Committee D16 methods. This practice is intended to be generally applicable to any of them.

7. Performance Guidelines Before Calibration

7.1 At startup, validate any process analyzer against an existing analytical method, typically in this case, one overseen by Committee D16.

7.2 The capability measurement (c_m) for a given analyzer (3) shall be less than 0.2, as defined in [Eq 1](#):

$$c_m = \sigma_a^2 / \sigma_p^2 < 0.2 \quad (1)$$

where:

σ_a = standard deviation of the analyzer measurement, and
 σ_p = standard deviation of the process.

The variance (standard deviation squared) of the analyzer should be less than 20 % of the variance of the process, so that