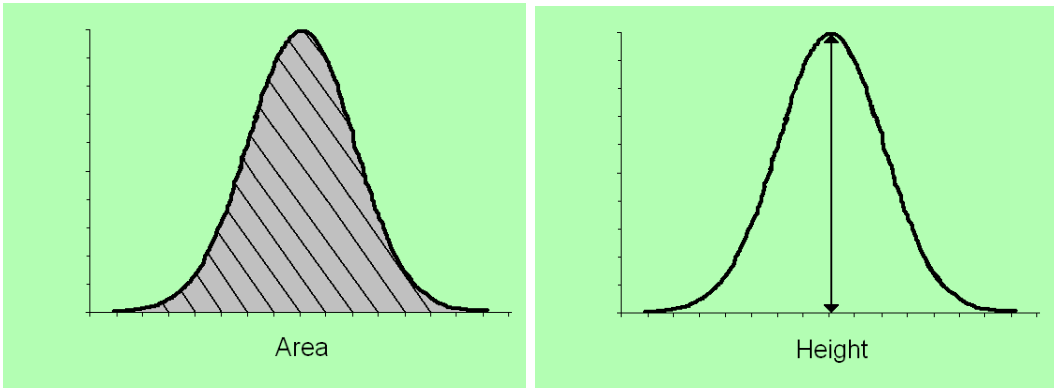
Division of Consolidated Laboratory Services (DCLS)
Virginia Environmental Laboratory Accreditation Program (VELAP)

Technical Assistance Document

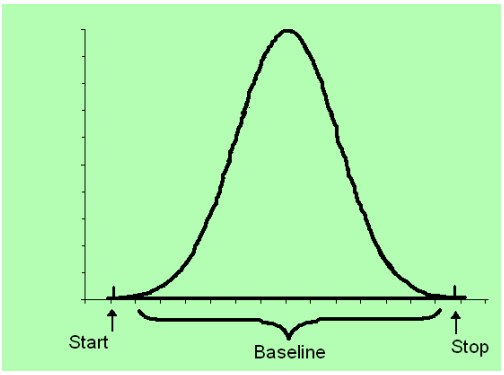
Procedures for Ensuring Defensibility of Manual Integrations

This is a Technical Assistance Document prepared by the Laboratory Certification Group of the Virginia Division of Consolidated Laboratory Services. Whenever possible, references to the regulation or standard are included, and the full context of the citation should be read by the user of this document for the greatest understanding of the regulation. This document was prepared to provide laboratories with technical assistance in achieving compliance with required regulations, either by providing explanation or examples.

1. What is Integration?
   1.1. Integration is the result of chromatographic software used in determining peak area or height for quantitative purposes.



   1.2. The chromatographic software is configured to perform integrations using defined integration parameters.
   1.3. Manual Integration is the process of manually setting the baseline when the chromatographic software fails to integrate a peak in a manner that is consistent with previous peak integrations, i.e., when a peak is integrated with error.

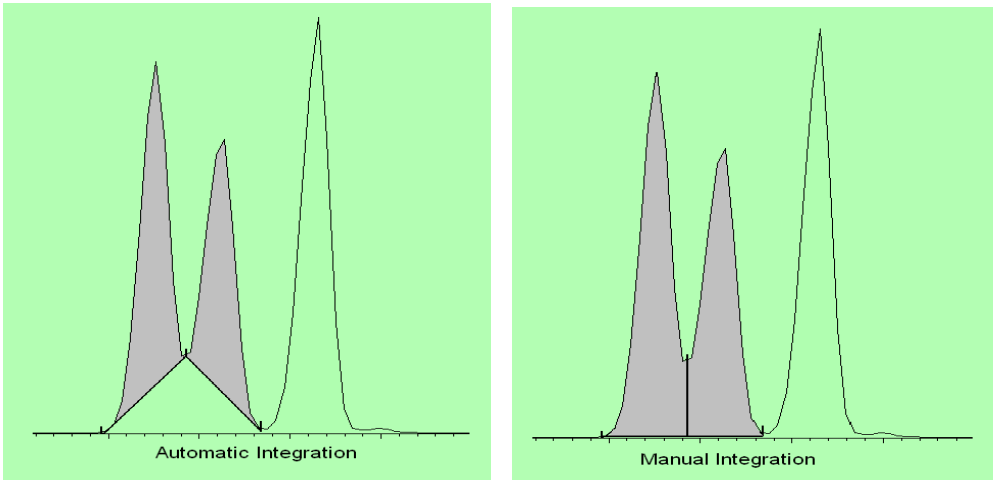


2. Why do we need Manual Integration?

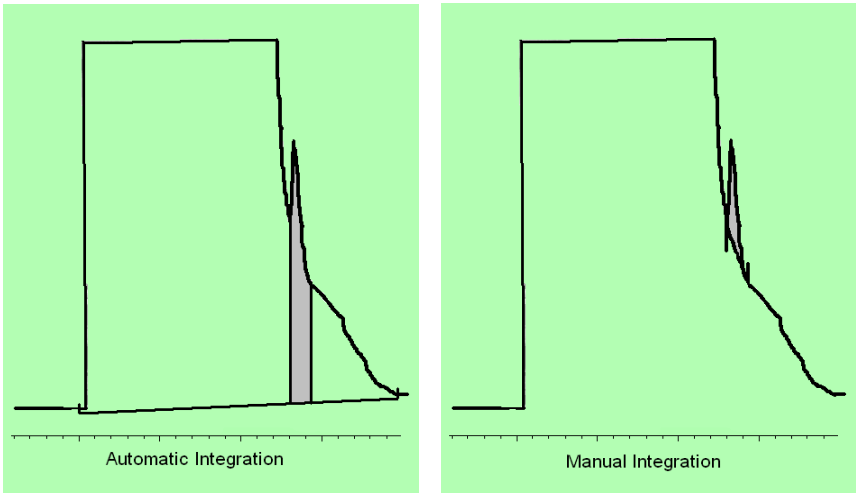
2.1. Manual Integration must be performed when the chromatographic software does not identify and integrate the peak of interest, integrates the peak of interest in an inconsistent manner, or identifies and integrates a peak other than the peak of interest.

2.2. Other reasons for manual integration can result from incorrect software integrations of:

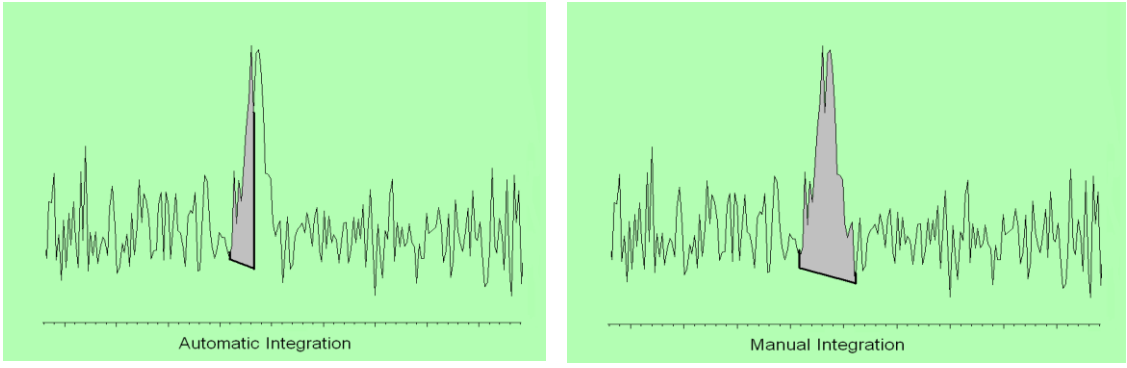
2.2.1. Split peaks



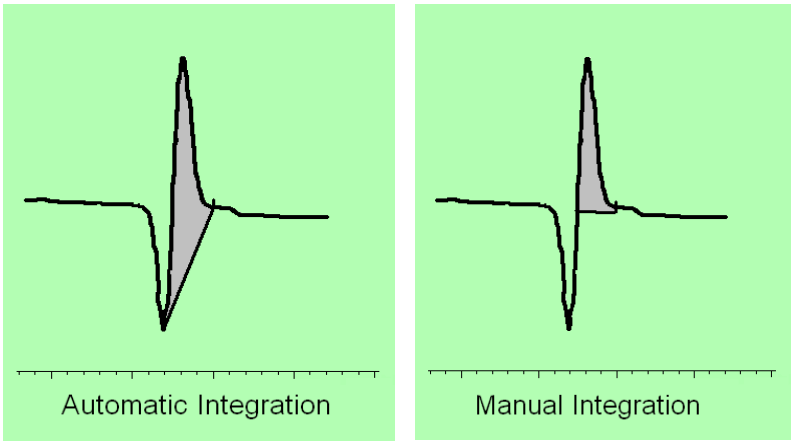
2.2.2. Co-elution of target compounds/shoulders



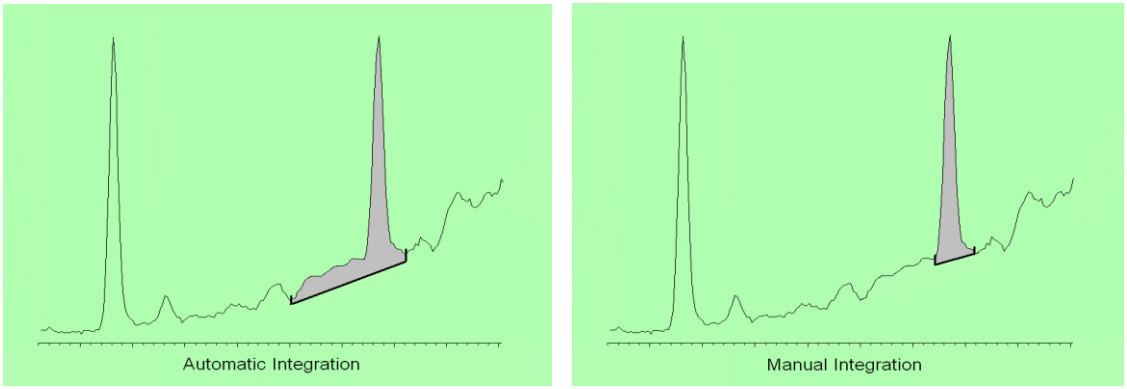
2.2.3. Baseline noise



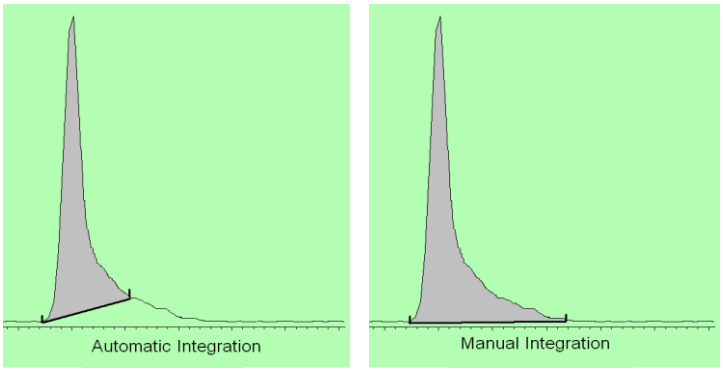
2.2.4. Negative peaks



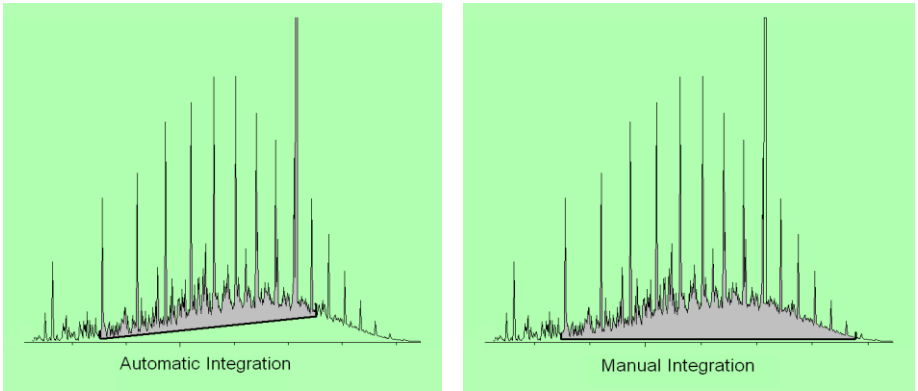
2.2.5. Rising or falling baselines



2.2.6. Excessive peak tailing



2.2.7. Integration of summed areas (typically hydrocarbons).



3. <u>Manual integration</u> is an acceptable and expected process that must be performed on chromatographic data when the chromatographic software produces an incorrect automatic integration of the data.

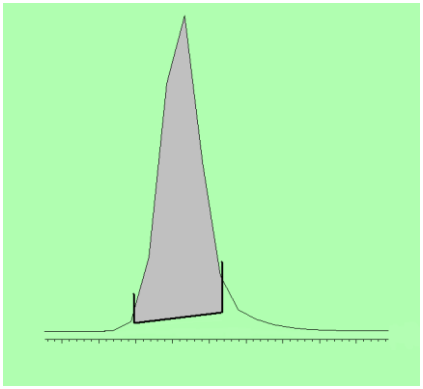
3.1. A manual integration policy is necessary since chromatographic software automated integrations are not always correct. Having a manual integration policy helps the laboratory protect the defensibility of the data produced.

3.2. All standards, samples, and QC peaks must be integrated in a consistent and appropriate manner which will result in data that is more likely to be scientifically defensible.

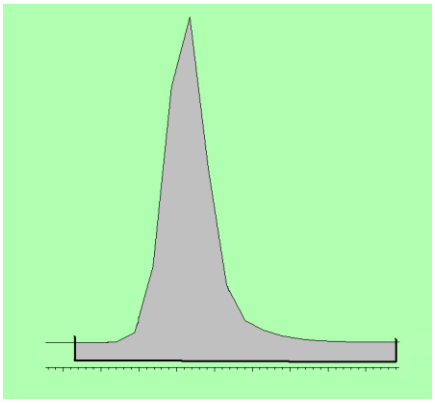
3.3. Manual integration should never be performed to make quality control samples meet method acceptance criteria.

3.4. Some types of improper manual integration include:

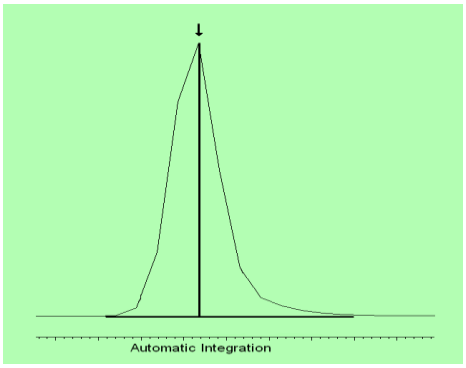
3.4.1. "Peak Shaving" - manual integration that removes some peak area from an acceptable auto integration of the peak.

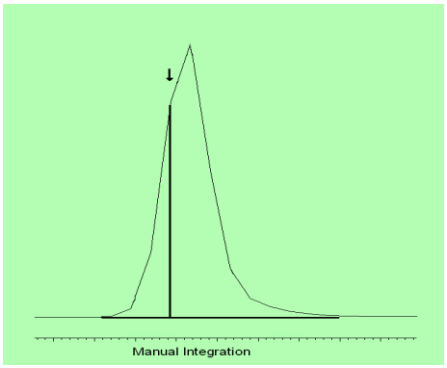


3.4.2. "Peak Juicing" - manual integration that adds some peak area to an acceptable auto integration of the peak.



3.4.3. "Changing Peak Height" - setting the peak height to a height other than the highest point of the peak.





3.5. Some tips that strengthen the defensibility of integrated data:

3.5.1. When poor resolution or response is a problem, instrument maintenance, and/or other corrective or preventive actions (not manual integration) should be pursued as the correction to the problem.

3.5.2. Use enlarged printouts of chromatograms so that baseline can be discerned.

3.5.3. Incorporate a periodic verification of hard copy data against the electronically saved version of the data into the laboratory's data review procedures.

4. What do the regulations require for defensible data with regard to manual integration?

4.1. For Commercial Laboratories accredited under 1VAC30-46 (TNI 2009 Standard):

4.1.1. Documented procedures for manual integration

- (V1M2 4.2.8.5.a) *Laboratories shall maintain SOPs that accurately reflect all phases of current laboratory activities, such as assessing data integrity, corrective actions, handling customer complaints, and all methods. The laboratory's SOPs, for example, may be equipment manuals provided by the manufacturer, or internally written documents with adequate detail to allow someone similarly qualified, other than the analyst, to reproduce the procedures used to generate the test result*.
- (V1M2 5.4.1) *The laboratory shall have instructions on the use and operation of all relevant equipment, and on the handling and preparation of items for testing and/or calibration, or both, where the absence of such instructions could jeopardize the results of tests and/or calibrations.*
- (V1M2 5.4.7.2 b) *Procedures are established and implemented for protecting the data; such procedures shall include, but not be limited to, integrity and confidentiality of data entry or collection, data storage, data transmission and data processing*.
- (V1M4 1.7.3.4) *The procedures used for data reduction, such as use of linear regression, shall be documented.*

4.1.2. Recordkeeping that allows historical reconstruction

- (V1M2 4.13.2.2) *Observations, data and calculations shall be recorded at the time they are made and shall be identifiable to the specific task.*
- (V1M2 4.13.3 a) *The laboratory shall establish a record keeping system that allows the history of the sample and associated data to be readily understood through the documentation. This system shall produce unequivocal, accurate records that document all laboratory activities…*
- (V1M2 4.13.3 f) *All information necessary for the historical reconstruction of data must be maintained by the laboratory.*

  vii) all manual calculations

  (V1M2 4.13.3 g) *All generated data, except those that are generated by automated data collection systems, shall be recorded legibly in permanent ink.*

  i) An individual making corrections to records shall date and initial the correction.

  ii) Corrections due to reasons other than transcription errors shall specify the reason for the correction.

4.1.3. Data review

- (V1M2 5.4.7.1) *Calculations and data transfers shall be subject to appropriate checks in a systematic manner.*

4.1.4. Data integrity training that addresses manual integration

- (V1M2 5.2.7 e) *At a minimum, the following topics and activities shall be included: specific examples of breaches of ethical behavior such as improper data manipulations…*

4.2. For Non-commercial Laboratories certified under 1-VAC30-45:

4.2.1. Documented procedures for manual integration

- (1VAC30-45-730 B 1) *Laboratories shall maintain SOPs that accurately reflect all phases of current laboratory activities such as assessing data integrity, corrective actions, handling customer complaints, and all test methods.*
- (1VAC30-45-730 A 1) *The laboratory shall have documented instructions on the use and operation of all relevant equipment, on the handling and preparation of samples, and for calibration or testing, where the absence of such instructions could jeopardize the calibrations or tests.*
- (1VAC30-45-730 K 2) *Procedures are established and implemented for protecting the integrity of data, such as integrity of data entry or capture, data storage, data transmission and data processing.*
- (1VAC30-45-772) *The procedures for data reduction, such as use of linear regression, shall be documented.*

4.2.2. Recordkeeping that allows historical reconstruction

- (1VAC30-45-330 8) *[The specific areas evaluated in an on-site assessment shall include but not be limited to:] Data reduction procedures, including an examination of raw data and confirmation that the final reported results can be traced to the raw data/original observations.*
- (1VAC30-45-630) *The laboratory shall maintain a record system to suit its particular circumstances and comply with any applicable regulations. This system shall produce unequivocal, accurate records that document all laboratory activities*.
- (1VAC30-45-640 A) *The laboratory shall have a recordkeeping system that allows historical reconstruction of all laboratory activities that produced the analytical data. The history of the sample shall be readily understood through the documentation.*
- (1VAC30-45-650 B) *The laboratory shall maintain all information necessary for the historical reconstruction of data, including all original observations, calculations and derived data, calibration records and a copy of the test report.*
- (1VAC30-45-640 F) *All generated data except those that are generated by automated data collection systems, shall be recorded directly, promptly, and legibly in permanent ink.*
- (1VAC30-45-660 C) *Analytical records. The laboratory shall retain essential information associated with analytical documents, such as strip charts, tabular printouts, computer data files, analytical notebooks, and run logs. This information includes, but is not limited to, all manual calculations (e.g., manual integrations); sample preparation; standard and reagent origin, receipt, preparation, and use; quality control protocols and assessment; and method performance criteria.*

4.2.3. Data review

- (1VAC30-45-610 C) *The quality manual shall include or reference but not be limited to… 7. Procedures for audits and data review.*
- (1VAC30-45-730 I) *Data verification. Calculations and data transfers shall be subject to appropriate checks. The laboratory shall establish standard operating procedures to ensure*

that (i) the reported data are free from transcription and calculation errors and (ii) all quality control measures are reviewed and evaluated before data are reported. The laboratory also shall establish standard operating procedures addressing manual calculations including manual integrations.

NOTE: A manual integration is considered a manual calculation and a correction.

5. How can my laboratory ensure that its manual integration policy will be compliant with the regulations?
   5.1. A comprehensive policy addressing all aspects of manual integrations includes the following procedures and training:
      - The laboratory's policies on when manual integration is acceptable; for examples refer to illustrations in section 2.2;
      - The laboratory's policies on how manual integration is to be performed and documented;
      - The laboratory's policies on the review process for manual integrations;
      - Data Integrity training that addresses manual integrations.
   5.2. Documentation of manually integrated data includes, at a at a minimum:
      - A copy of the original (incorrect) automated integration with the analyst's initials, date and reason for the manual integration, and the initials and date of the person that performed the review of the need for manual integration.
      - A copy of the corrected manual integration with the analyst's initials and date, and the initials and date of the person that performed the review of the manual integration.

6. Things to remember
   6.1. Manual integrations may be necessary for the generation of data of known and documented quality.
   6.2. Just because a manual integration has been documented does not mean it is acceptable and/or appropriate.

References

EPA Region 9 SOP #835, "Chromatographic Integration Procedures"

Florida Department of Health SOP CM-018-1.5, "Laboratory Policy Regarding Manual Chromatographic Peak Integration"

EPA OIG Report No. 2006-P-00036, "Promising Techniques Identified to Improve Drinking Water Laboratory Integrity and Reduce Public Health Risks"

The NELAC Institute, "Manual Integration Assessment Forum" January, 2008 [source for chromatographic illustrations in this document]

Chromatographic Integration Methods", Second Edition, Norman Dyson, 1996