Verification of LOD and LOQ according to the NELAC and TNI Standards

The first part of this document investigates and describes the minimum requirements for Limit of Detection (LOD) and Limit of Quantitation (LOQ) in the 2003 NELAC and 2009 TNI standards.

The second part of the document describes a protocol for t=verification of LOD and LOQ that the committee determined to be technically sound and reasonable to implement. In other words, a “Good Practice” for LOD and LOQ verification. It must be emphasized that this suggested practice is not required, and that other practices in use at some laboratories may be equally valid or even superior, and also that the only requirements for NELAC/TNI certification are those discussed in Section 1.

Section 1 – Requirements for Verification of LOD and LOQ

When is a LOD required?

2003 NELAC standard	2009 TNI standard
An LOD is not required for a test method when test results are not reported outside of the calibration range	1.5.2.1 If the laboratory is not reporting a value below the Limit of Quantitation, a Limit of Detection Study is not required

The TNI standard also requires that the lowest calibration standard be at or below the LOQ. Therefore the NELAC and TNI requirements are equivalent – LOD determination and verification is required if results are reported below the lowest calibration standard, otherwise there is no requirement for a LOD study.

2003 NELAC standard	2009 TNI standard
The laboratory shall determine the LOD for the method for each target analyte of concern in the quality system matrices. All sample processing steps of the analytical method shall be included in the determination of the LOD	All sample-processing and analysis steps of the analytical method shall be included in the determination or validation of the LOD. When required, the laboratory shall determine or verify the LOD for the method for each target analyte of concern in the quality system matrices.

If the lab is reporting below the LOQ, then the LOD determination is required for each analyte and for each of the quality system matrices. The statement that all steps in the method must be included implies that separate LOD determinations are required for different preparation techniques. For example the combination of Method 3510 (Separatory funnel extraction) with method 8270 (GC/MS) would require a separate LOD determination from the combination of method 3520 (Continuous liquid-liquid extraction) with method 8270.

2003 NELAC standard	2009 TNI standard
An LOD study is not required for any component or property for which spiking solutions or quality control samples are not commercially available, or otherwise inappropriate (e.g., pH)	An LOD study is not required for any component for which spiking solutions or quality control samples are not available, such as temperature

Other examples of methods where LOD determinations are not required are

Need list of example methods

How should a LOD be determined?

2003 NELAC standard	2009 TNI standard
All sample processing steps of the analytical method shall be included in the determination of the LOD	All sample-processing and analysis steps of the analytical method shall be included in the determination or validation of the LOD.
LODs shall be determined by the protocol in the mandated test method or applicable regulation. If the protocol for determining LODs is not specified, the selection of the procedure must reflect instrument limitations and the intended application of the test method.	If a mandated test method or applicable regulation includes protocols for determining detection limits, these shall be followed. The laboratory shall document how LODs were derived from the determinations. If the protocol for determining the LOD is not specified, the selection of the procedure shall reflect instrument limitations and the intended application of the test method.

The language in the two standards is essentially equivalent. Both are clear that all steps of the method must be included in the development of the LOD, and both are very open regarding the method to be used to determine LOD.

How may a LOD be verified?

2003 NELAC standard	2009 TNI standard
The validity of the LOD shall be confirmed by qualitative identification of the analytes in a QC sample in each quality system matrix containing the analyte at no more than 2-3X the LOD for single analyte tests and 1-4X the LOD for multiple analyte tests. This verification must be performed on every instrument that is to be used for the analysis and reporting of data.	The validity of the LOD shall be verified by detection (a value above zero) of the analyte(S) in a QC sample in each quality system matrix. This QC sample shall contain the analyte at no more than 3X the LOD for single analyte tests and 4X the LOD for multiple analyte tests. This verification shall be performed on every instrument that is to be used for analysis of samples and reporting of data. The validity of the LOD shall be verified as part of the LOD determination process. This verification shall be done prior to the use of the LOD for sample analysis.

The NELAC and TNI standards have subtle differences. The NELAC standard requires a spiking range of 2-3 times the LOD for single analyte tests, while the TNI standard allows 1-3X (or even < 1X, although that would be an unusual choice).

The NELAC standard requires that the result must be capable of "qualitative identification" while the TNI standard requires that the result shall be above zero. The TNI requirement is clear, but unfortunately the NELAC standard does not define "qualitative identification". Certainly it means that there is no quantitative requirement, but the question of what would constitute qualitative identification is complex and open to various interpretations, especially for tests such as ICP and ICPMS. In general, a reasonable interpretation could be that an analyte result that is qualitatively identified is one that would have been detected and potentially reported by the routine data processing steps in use at the laboratory. This could mean that a GC/MS result missing qualifier ions, or an ICP or ICP/MS result below the LOD, would not constitute an acceptable verification.

It should be noted that a strict reading of the TNI standard indicates that qualitative identification in the sense described above is not needed to verify the LOD, i.e. any result that is above zero is acceptable, even if it is indistinguishable from the result from a blank. However, if qualitative identification criteria are defined in the laboratory SOP, then these must be met, because otherwise the result would be ND, i.e., not above zero.

When is a LOQ required?

How should a LOQ be determined?

How may a LOQ be verified?