WISCONSIN DEPARTMENT OF NATURAL RESOURCES
NOTICE OF FINAL GUIDANCE & CERTIFICATION

Pursuant to ch. 227, Wis. Stats., the Wisconsin Department of Natural Resources has finalized and hereby certifies the following guidance document.

DOCUMENT ID

AM-19-0038

DOCUMENT TITLE

Standards for Mathematical Computations

PROGRAM/BUREAU

Air Management

STATUTORY AUTHORITY OR LEGAL CITATION

Chapter NR 439, Wisconsin Administrative Code

DATE SENT TO LEGISLATIVE REFERENCE BUREAU (FOR PUBLIC COMMENTS)

October 28, 2019

DATE FINALIZED

November 25, 2019

No comments were received during the comment period 28OCT2019 to 18NOV2019

DNR CERTIFICATION

I have reviewed this guidance document or proposed guidance document and I certify that it complies with sections 227.10 and 227.11 of the Wisconsin Statutes. I further certify that the guidance document or proposed guidance document contains no standard, requirement, or threshold that is not explicitly required or explicitly permitted by a statute or a rule that has been lawfully promulgated. I further certify that the guidance document or proposed guidance document contains no standard, requirement, or threshold that is more restrictive than a standard, requirement, or threshold contained in the Wisconsin Statutes.

Jail E. Good

November 20, 2019

Signature

Date

DNR GUIDANCE DISCLAIMER

This document is intended solely as guidance and does not contain any mandatory requirements except where requirements found in statute or administrative rule are referenced. Any regulatory decisions made by the Department of Natural Resources in any matter addressed by this guidance will be made by applying the governing statutes and administrative rules to the relevant facts.

CORRESPONDENCE/MEMORANDUM

State of Wisconsin

DATE: October 10, 2003

TO: Air Staff

FROM: Compliance Core & Enforcement Team

SUBJECT: Standards for Mathematical Computations

The use of significant figures has been touched upon a few times in our history but a consistent means on how to conduct our math does not exist. This memo sets forth the standards by which the Core Team recommends the Air Program should utilize to conduct mathematical computations and will replace any previous memos relating to the use of significant figures.

⇒ Unless the calculations within a given Code or Test Method are specifically addressed, the Air Program should follow the most recent versions developed of what currently is known as ASTM Method IEEE/ASTM SI 10 - 2002, "The American National Standard for Use of the International System of Units (SI): The Modern Metric System".

⇒ This memo supercedes memo G4-88001.ENF from Don Theiler, i.e., "Interpretation of Significant Digits on Emission Limitations", dated September 2, 1988.

⇒ In 1973, EPA began promulgating all standards in ***metric units*** and establishing limits with two (2) significant figures. When using an english approximation of the metric value the EPA suggested that not more than three (3) significant figures would be used in the approximation. EPA referenced the ASTM methods of that time to be used in conducting mathematical computations. One thing EPA did convey in its earlier findings is that while the significant figures be set at two (2), the interim computations be carried out to five (5) significant figures. There is no basis for what appears to be a subjective observation. How to carry out interim computations would be bound by the ASTM method for your computations. The ASTM method would remove any contemplation on how to conduct interim computations.

⇒ **Air Program consistency can only be achieved through the use of the Federal mathematical conventions on limits and use of the ASTM method of conducting computations**. Limits, and compliance with limits, should be calculated to two (2) significant figures in metric units, and can be approximated in english units to three (3) significant figures.

The Compliance Team believes that if the math is conducted in this consistent manner, application of limits and associated enforcement actions will also be consistent. The following examples have been provided to illustrate the ASTM method computations:

Example 1: Coating Analysis

VOC content	=	3.53 pounds VOC per gallon
Emission limit	=	3.5 pounds VOC per gallon of coating (0.42 kg/liter) : NR 422.15(2)(b)

If we accept the value of 3.53 pounds per gallon we are changing the accuracy by which the limit of 3.5 pounds VOC per gallon reflects. It makes a difference in making a referral of a case. Following the ASTM standard for the math may indeed yield that the 3.53 cannot be reported more accurately and would require the computation to yield a rounded result of 3.5 pounds VOC per gallon. Another person may be at liberty to round the value to 4 pounds VOC per gallon. But this again reduces the accuracy by which the limit was set. By following the rules of the ASTM method, everyone within the program and within industry would compute a value of 3.5 pounds VOC per gallon.

The value to which the source is required to comply is expressed in 2 significant figures. The accuracy of the limit is to the nearest hundredth of a kilogram per liter. 3.53 pounds per gallon is converted by multiplying by the conversion factor of 0.1198264 (page 28, SI10) yielding 0.42298 kilograms per liter (precisely) which rounds (2 sig figs) to 0.42 kilograms per liter (accurately). The company is in compliance.

The above example illustrates the english and metric conventions. The only anomaly occurs in rounding. When the first digit discarded is exactly 5, followed by only zeros, round the last digit upward if it is an odd number, but make no adjustment if it is an even number. For example, 3.550 would round up to 3.6 and 3.450 would round down to 3.4.

Example 2: Synthetic minor condition

22.83 pounds of VOC per hour

The company measures their paint consumption by dip-sticking the tote. One inch equals 4 gallons of paint consumed. The graduations provide a reading accuracy of +/- 1/4 inch. The company reports using 6.5 gallons of paint per hour.

First thing to notice is the accuracy called for by the limit of 22.83 is to the hundredth of a pound. The value is derived by dividing 100 tons per year by 8760 hours per year. The greatest number of significant figures when considering these values is arguably 3 (100 tons as written could be 1 sig fig, but we can assume 100 tons written in law text is a whole number representing 3 sig figs). As we start our compliance determination, we determine for this phase that 22.83 pounds is converted to metric to be 10.4 kilograms (3 sig figs)(accurately). However, there is another problem. The precision of our measurements using the dipstick is +/- 1/4 inch which is plus or minus 1 gallon. 1 gallon is just under 4 liters when converted (3.785412 to be precise). Readings cannot be reliably measured or reported to a precision greater than 4 liters. 6.5 estimated gallons is therefore multiplied by the conversion factor yielding a value of 24.60518 liters (precisely), the closest 4 liter increment being 24 liters (accurately). In this case 0.42 kilograms per liter multiplied by 24 liters yields 10.08 kilograms per hour (precisely) but our reported results would simply be 10 kilograms per hour (2 sig figs)(accurately). They are in compliance.

Example 3: Pressure Drop

Pressure drop across the paint filter shall be between 1.0 and 8.0 inches of water: NR 407.09(1)(a) & NR 439.055(1)(b).

Since the Department required the use of instruments to monitor pressure drop, NR 439.055(3)(b) requires the device to be accurate to within 5% of the measurement of +/- 1 inch of water column, whichever is greater. 8.0 inches x 5% equals 0.4 inches, less than 1 inch. The required accuracy is therefore +/- 1 inch. 0.7 (precisely) is therefore rounded to 1 (accurately) and 8.2 (precisely) is rounded to 8 (accurately). The limits of 1.0 and 8.0 are not in agreement with the requirements of the Code. Compliance to their implied precision cannot be demonstrated.

There may be cases where the english convention could round up and the metric convention rounds down. I'm bringing this back to the team because I wanted to make sure everybody has thorough understanding of the ASTM method regarding rounding and metric units.

DATE: September 10, 2003

TO: Compliance Core Team

FROM: Andy Seeber - AM/7

SUBJECT: NR 439.055(3), Wis, Adm. Code, Accuracy Requirements

Parameter	***Accuracy Requirement***
Temperature	±0.5% or ±5°F or ±3°C, whichever is greater
Pressure Drop	±5% or ±1" H_2O, whichever is greater
Current	±5%, typically ampere
Voltage	±5%, typically volts
Flow (liquid)	±5%, typically gallons/minute
pH	±5%, typically 0 to 14

NR 439.055, Wis. Adm. Code, requires the installation and operation of instrumentation to monitor an operational process or air pollution control equipment. NR 439.055(3), Wis. Adm. Code, lists the minimum accuracy requirements for the specific monitoring instrumentation. The above table was created to remind permit writers and compliance inspectors we cannot require greater precision at a facility than the code dictates.

Example: Permit lists a required scrubber operating range of 0.5 - 7.5" H_2O

Maximum pressure drop readings are rarely above 10" H_2O. If we take 5% of 10 we get 0.5" H_2O, which is less than the second option of ±1" H_2O. The facility would be required to accurately measure the pressure drop to ±1" H_2O, but the permit required an operating range of 0.5 - 7.5" H_2O.

We cannot, legally require greater precision than the code allows. As a reminder we need to be cognizant of our code flexibility before we establish requirements in permits.