# Nemeth Code for Math and Science "Best of" Ask An Expert

presented by Kyle DeJute, *Committee Member* November 19, 2020 Online, Virtual Conference



NATIONAL BRAILLE ASSOCIATION

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# Introduction

In this workshop we will study seven questions from the more than 850 topics in the <u>Nemeth Code for</u> <u>Math and Science forum</u> of NBA's Ask an Expert service.

Our goals are 1) to display how instructive the Ask an Expert archive can be, 2) to use the examples here as gateways to discussions of key concepts for using the Nemeth Code, 3) to have fun working some puzzles from Ask an Expert questions.

This workshop has been prepared according to *Braille Formats: Principles of Print-to-Braille Transcription, 2016*; the *Braille Code for Chemical Notation, 1997*, including the *Provisional Guidance for Chemistry Notation Using Nemeth in UEB Contexts*; and *The Nemeth Braille Code for Mathematics and Science Notation, 1972 Revision, 2007-2015* Updates including the *Guidance for Transcription Using the Nemeth Code within UEB Contexts*.

In commentary, *The Nemeth Braille Code for Mathematics and Science Notation, 1972 Revision,* 2007-2015 Updates may be referred to as "NC," and the *Guidance for Transcription Using the Nemeth Code within UEB Contexts* (Approved April 2018) may be referred to as "the *Guidance*."

In this workshop, text taken from questions and responses posted to the Ask an Expert forum are not always quoted in full. This editing was done with the goal of making the question and response more clear.

This workshop does not replace or supersede any BANA publication.



# **Nemeth Code Switching**

# Can I use a single-word switch indicator for a word right after an opening grouping sign?

# Question – <u>UEB Single Word Switch Use</u>

Is this the correct use of single word switch indicator, or does Nemeth need to be terminated then reopened? I am unsure because of the opening parenthesis.

**Example:**  $\sqrt{25} = \pm 5$  (because  $5 \times 5 = 25$  and  $-5 \times -5 = 25$ )

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#### Response

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That is a correct transcription. I would do it the same way.

So, the answer to the question of "Can I use a single-word switch indicator for a word immediately following an opening grouping sign?" is "Yes." And, if you do use a single-word switch indicator for a word immediately following an opening grouping sign then the closing grouping sign should be preceded by Nemeth Code material and so also be in Nemeth Code (as it is in your attachment).

#### **Additional Commentary**

The questioner's transcription allowed the **pair of grouping symbols to be both in the same code**. A pair of grouping symbols should have both its opening and closing symbols in *either* Nemeth Code or UEB.

A single-word switch indicator may be placed between an opening Nemeth Code grouping symbol and a word (or hyphenated word).

**Additional Example** 

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Line 3: The single-word switch indicator is placed after the opening parenthesis that is in Nemeth Code.

Line 4: The closing parenthesis is transcribed in Nemeth Code, unspaced from the end of the material that it encloses. Then, Nemeth Code is terminated before the sentence-ending punctuation.



### **Opposite Example**

If the material enclosed in grouping symbols ends with word(s) that are transcribed in UEB, then the closing grouping symbol should be in UEB and the opening grouping symbol should be, too.

A single-word switch indicator cannot be placed immediately before an opening grouping symbol. This is because the single-word switch indicator is intended for use with a "word (or hyphenated word)," and an opening grouping symbol is not a word (or hyphenated word).

Thus, if a closing grouping symbol will be in UEB, then before its paired opening parenthesis, we must close Nemeth Code and reopen it where necessary. This puts both grouping symbols in UEB.

The upper incomplete gamma function is  $\Gamma(s,x) = \int_x^{\infty} t^{s-1} e^{-t} dt \text{ (whereas, } \gamma(s,x) = \int_0^x t^{s-1} e^{-t} dt \text{ is}$ the lower incomplete gamma function).

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Line 3: The opening parenthesis whose paired closing parenthesis must be in UEB is transcribed in UEB. This can only happen by using a Nemeth Code terminator before the opening parenthesis.

Lines 2 & 4: The whole equation and its Nemeth Code switch indicators fit all on one braille line, so they are all on one braille line.

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# Does a Nemeth Code switch indicator have to be on the same print page as its enclosed material?

# Question – Switch indicators at page turns

There is some confusion regarding the placement of Nemeth Code Switch indicators at **Print page** turns.

Question: Should the opening Nemeth Code indicator remain as is, or should it be moved to the **print page (816)** to which the mathematical material it applies to **and** where the Closing Nemeth Code indicator is located?

We use the volume formula to determine the amount of cubic feet added to the house.

\_ new print page \_\_\_\_\_

 $V = l \times w \times h$  $V = 15 \text{ ft} \times 12 \text{ ft} \times 10 \text{ ft}$ V = 1800 cu. ft

So we know ...

#### Response

**#11** under the heading **Additional Guideline**s in the *Guidance for Transcription Using the Nemeth Code within UEB Contexts* says, "The opening Nemeth Code indicator and the Nemeth Code terminator should be placed on the same page with part of the expression to which they apply."

The BANA Nemeth Code Technical Committee has discussed this particular wording, and they interpret the guideline to mean "The opening Nemeth Code indicator and the Nemeth Code terminator should be placed on the same **braille** page with part of the expression to which they apply."

So, in fact, the very last thing on a print page **could be** the opening Nemeth Code indicator. You do not have to move the opening Nemeth Code indicator to print page 816.

However, it would be alright to do so.

Thus, the answer to your question, "Should an opening Nemeth Code indicator be placed so that it is on the same print page as the material to which it applies?" is:

It is not required. I would recommend it.

In conclusion, the *Guidance* says that an opening Nemeth Code indicator *cannot* be the last thing on a *braille* page. As for print pages, it is not against the *Guidance* to say that an opening Nemeth Code indicator should not be the last thing on a print page.

**One Possible Transcription** 

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Line 2: Nemeth Code starts at the end of the text that precedes the mathematical material. This happens to be at the end of a print page.



**Recommended Transcription** 

We use the volume formula to determine the amount of cubic feet added to the house.

\_\_\_\_ new print page \_\_\_\_\_

 $V = l \times w \times h$  $V = 15 \text{ ft} \times 12 \text{ ft} \times 10 \text{ ft}$ V = 1800 cu. ft

So we know ...

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Line 4: Nemeth Code starts on the print page where the mathematical material starts.

Line 4: The I, w, and h are variables, not abbreviations.

Line 4: The transcriber chose to place the opening Nemeth Code indicator on the line with the first displayed equation instead of placing the opening Nemeth Code indicator on line 4 by itself, because the displayed equations are not aligned with one another. So, having the opening Nemeth Code indicator on a line with the first displayed equation does not put the braille reader at a disadvantage.

#### **Additional Example**

The *Guidance* says that a Nemeth Code switch indicator should be on a braille page with part of the material to which it applies.

# ... Finally, solve for x as shown in the following steps.

5(x+10) + 2x + 3(2x) = 700 5x + 50 + 2x + 6x = 700 13x + 50 = 700 13x + 50 - 50 = 700 - 50  $\frac{13x}{13} = \frac{650}{13}$ x = 50

A few notes about this problem:

#### 

\_\_\_\_\_ new braille page \_\_\_

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Line 1 of "braille page 104": Nemeth Code starts on the braille page where the mathematical material starts.

Line 1: The transcriber chose to place the opening Nemeth Code indicator on the line with the first displayed equation instead of placing it on line 1 by itself, because doing so does not put the braille reader at a disadvantage.



# **Nemeth Code Rules**

# How would I transcribe g/mol (an abbreviation in Chemistry)?

## Question – abbreviation in chemistry

For the following expression in chemistry

(Na = 23.0 g/mol; P = 31 g/mol; O = 16.0 g/mol)

would I consider the g/mol to be an abbreviation? If it is an abbreviation, and I am using the Chemistry code, would I use a punctuation indicator before the semicolon? And just to make sure, I would use the letter indicator before the g in g/mol?

### Response

g and mol are abbreviations so the g would require the letter indicator. In Chemistry Code, letters and abbreviations are both punctuated mathematically, so you would use a punctuation indicator before the semicolon that follows g/mol.

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Even though no contractions are used within Nemeth Code switch indicators, the English Letter Indicator is used before the abbreviation "g," in accordance with Nemeth Code §51.b, because we follow Nemeth Code rules for use of the English Letter Indicator, in accordance with **#14** under **Additional Guidelines** in the *Guidance*.

g and mol are abbreviations because they have a value associated with them (23.0, 31, and 16.0).

CHEMICAL abbreviations are punctuated in mathematical mode. (§9.1of the *Braille Code for Chemical Notation*)

A series of technical expressions along with the grouping symbols whose enclosed material is all technical material are within Nemeth Code switch indicators. (**#3.c** under **Basic Guidance on When to Switch** in the *Guidance*)

**Additional Examples** 

### **Mass Percentage Calculations**

Molar mass is also used to determine what percentage any given element in a compound contributes to the total mass of the compound. For example, consider a sample of 28.00 g of carbon monoxide. Because you know that the molar mass of carbon is 12.01 g/mol and the molar mass of oxygen is 16.00 g/mol, the carbon is responsible for 12.01/28.00 times 100 equal 42.89 percent of the total mass.

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Line 6: The abbreviated measurement unit "g" is included in the Nemeth Code switch indicators that are required for its associated decimal. (**#5** under **Additional Guidelines** in the *Guidance*) An English Letter Indicator is used with the one-letter abbreviation that has no period. (NC §51.b)

Line 9: The comma that follows g/mol is transcribed after the Nemeth Code terminator because it is followed by a string of UEB material and belongs to the sentence. (**#2** under **Basic Guidance on When to Switch** in the *Guidance*)

Lines 10-12: Nemeth Code is required for the decimals and for the slash meaning "per." The words (i.e., times & equal) are not included within that required Nemeth Code because the expression uses *only* words *instead of* technical symbols. This is different from a situation to which we should apply **#4** under **Additional Guidelines** in the *Guidance*, which says, "When words are part of an equation or math expression, they are as much a part of the technical notation as are the letter variables, numbers, signs of operation, etc. The whole expression is placed inside the Nemeth switches with no contractions and is spaced as defined in the Nemeth Code." The 100 can be transcribed in either code; the transcriber chose to place it in Nemeth Code to reduce the number of switch indicators.

Text taken from Sciencing.com, article "Why Is Molar Mass Important?" (https://sciencing.com/molar-mass-important-10061499.html)



Even when it is not paired with a number that includes a decimal, the abbreviation "g/mol" should be transcribed in Nemeth Code. This is because the slash in g/mol indicates division (i.e., it means "per"). (**#1** under **Basic Guidance on When to Switch** in the *Guidance*)

The mole was defined in such a way that the molar mass of a compound in g/mol is numerically equal (for all practical purposes) to the average mass of one molecule in daltons. Thus, for example, the average mass of a molecule of water is about 18.0153 daltons, and the molar mass of water is about 18.0153 g/mol.

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Line 1: In a UEB with Nemeth transcription, all paragraphs are indented, even if they are blocked in print. (**#3** under **Formatting** in the *Guidance*)

Line 2: The expression with a slash meaning "per" (i.e., g/mol) is transcribed within Nemeth Code switch indicators.

Line 7: The **un**abbreviated measurement unit "daltons" is not included in the Nemeth Code switch indicators that are required for its associated decimal. (**#5** under **Additional Guidelines** in the *Guidance*)

# Is there anything special about a left superscript?

# Question – Left subscripts and superscripts in Chemistry

Good evening. I have a question that the code book does not address specifically. It is possible that I am missing an essential element and I hope you can clarify that for me. Look at the attachment and help me to identify how to braille the material to the right of the yield sign. How do I show that the sub- and superscripts are left hand to the "n" instead of right hand to the "2"?

$${}^{2}_{1}H + {}^{97}_{42}Mo \rightarrow 2{}^{1}_{0}n + {}^{97}_{43}Tc$$

#### Response

Thank you for your question. There is no way to show that the sub- and superscripts are left hand to the "n" instead of right hand to the "2". Just as the print reader will understand from the context of the reaction, so will the braille reader.

#### 

#### **Additional Commentary**

In short: no, there is nothing special about a left superscript or a left subscript. Nemeth Code §75 says (in part), "A right or left superscript or subscript is represented as such merely by preserving the relative horizontal positions of the superscript or subscript symbol and the symbol to which it applies. Each must be preceded by its appropriate level indicator."

### Why do I get " instead of ??

"Smart quotes." That is probably the culprit. If you press Shift+" but instead of " you get " (or something similar), then the program in which you are typing probably has smart quotes "turned on" and automatically changes a nondirectional quotation mark to a directional one immediately after it is typed. These are two separate print characters, and only the nondirectional one corresponds to the dot 5 in simulated braille fonts.

Smart quotes are a favorite of the print publishing world, because they add visual appeal and a certain amount of visual clarity, but they can really muck up the process of creating simulated braille.



**Additional Example** 

The majority of heavy hydrogen isotopes decay directly to  ${}^{3}$ H, which then decays to the stable isotope  ${}^{3}$ He.

 $^{3}_{1}\text{H} \xrightarrow{12.32 \text{ y}} ^{3}_{2}\text{He} + e^{-}$ 

1 .... 2 3 4 5 6 7 8

Line 2: The "superscripted" 3 that applies to the H to its right is simply preceded by the superscript indicator. (NC §75)

Line 6: The subscript 1 and superscript 3 (indicating, respectively, the number of protons and the number of neutrons in the Hydrogen isotope Tritium) are preceded by their appropriate level indicators, and the H is preceded by the baseline indicator.

Lines 4-7: The arrow with a modifier directly over it is transcribed spatially. In chemistry transcriptions it is preferable to show a modified arrow spatially rather than as a modified arrow via the 5-step method for modifiers. (4.2.5 of the the *Braille Code for Chemical Notation, 1997* allows either method but says that "a spatial transcription is usually the best".) The y in the modifier is an abbreviation for years.

Lines 4 &7: A blank line in Nemeth Code precedes and follows the spatial material. (**#9.b** under **Additional Guidelines** in the *Guidance*)

Line 8: The Nemeth Code terminator appears on a line by itself in cell 1 after spatial material. (by extension of **#9.b** under **Additional Guidelines** in the *Guidance*)

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# How would I transcribe ${\mathbb R}$ and similar letters?

# Question – <u>Sets of numbers – R, N, Z</u>

How do you represent sets of numbers in braille - R, N, Z? I think it is what you called a double struck R.

We can also define Cartesian products of three or more sets by moving beyond ordered pairs. An **ordered triple** is a list (x, y, z). The Cartesian product of the three sets  $\mathbb{R}$ ,  $\mathbb{N}$  and  $\mathbb{Z}$  is  $\mathbb{R} \times \mathbb{N} \times \mathbb{Z} = \{(x, y, z): x \in \mathbb{R}, y \in \mathbb{N}, z \in \mathbb{Z}\}$ . Of course there is no reason to stop with ordered triples. In general, ...

#### Response

You are correct that your print is using the "double struck" or "blackboard bold" typeface for letters that refer to sets of numbers (e.g.  $\mathbb{R}$  for real numbers,  $\mathbb{Z}$  for integers,  $\mathbb{N}$  for natural numbers).

In a transcription using Nemeth within UEB, in instances like you describe, it is considered best practice to switch into Nemeth Code for double struck letters wherever they appear and to use the Nemeth Code script typeface for such double struck typeface (with the typeface substitution explained in a transcriber's note).

Please let me direct you to <u>Lesson 7</u> of the <u>Provisional Revised Nemeth Course Manual, posted by NFB</u> [especially 7.10 and Example 7.5-1, including the commentary before it] for more discussion and examples.

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Line 4: An enclosed list is brailled in Nemeth Code, because there are specific and explicit rules in the Nemeth Code for enclosed lists.

Line 4: No English Letter Indicators are used for single letters in an enclosed list. (NC §27.d)

Line 5: A double struck letter is transcribed in Nemeth Code even if it is not part of a math expression. This lets the letter have the same braille construction wherever it appears. In other words, a double struck letter should not have the UEB script typeform applied to it in some places and the Nemeth script type form applied to it in others.

Line 6: The colon in this expression, meaning "such that," is treated as a sign of comparison. A colon is unspaced from what precedes it. (This is touched on in 4.11.3 6.7.16.a of the <u>Provisional Revised</u> <u>Nemeth Course Manual</u>, posted by NFB.) So, in this very *specific* circumstance, the mathematical expression is divided *after* a symbol of comparison.



# **Formatting and Indentions**

# Should I align equals symbols as in print?

# Question – aligning steps to an equation

Under exercise 32, next to the word solution ... In Nemeth, do we align the problem like this in print (how the equal signs line up), or do we start each step of the problem in the same cell, different lines?

32. Mathematical Reasoning Justify each step in the solution

of the system of equations.

$$x + y = 19$$
$$x = 5 + y$$

Solution: 5 + y + y = 19 \_\_\_\_\_ 5 + 2y = 19 \_\_\_\_\_ 2y = 14 \_\_\_\_\_ y = 7 \_\_\_\_\_ x = 5 + 7 = 12 \_\_\_\_\_

# Response

Left justify each step of the demonstrated solution.

```
1
2
3
 4
 ....
  5
6
7
     8
  9
   10
 11
 12
 13
 14
 •••
 •••••
  15
```

Lines 11-15: Each step is a full equation, with material before *and* after the symbol of comparison, so this is not a linked expression requiring special margins. (NC §189.b.iii) That is why the equals symbols are not aligned in braille.

Lines 1-2: The question is formatted as a one-level item, so it starts in cell 1 with runovers in cell 3. (NC §191.a)

Lines 3 & 6: Spatial material is preceded and followed by a blank line, and the blank lines are within the Nemeth Code switch indicators. (**#9.b** under **Additional Guidelines** in the *Guidance*)

Line 11: "Solution" is treated as an additional paragraph and so is formatted in 5-3.

Lines 12-16: The transcriber chose to treat the equations that show the steps in solving for the variables as math expressions displayed to text that is formatted in 5-3, so they are formatted starting in cell 5. [If there were any runovers, they would be in cell 7.] (NC §191.a and **#7** under **Formatting** in the *Guidance*)



### **Opposite Example**

When the equals signs (or other comparison sign) are part of a layout that meets the Nemeth Code criteria for a "linked expression requiring special margins," then the required format makes it so the equals symbols are brailled aligned.

This example and the next are from Nemeth Code §189 and §190.

preceding text ...  $12\frac{1}{2}\% = 12.5\%$  = .125  $= \frac{125}{1000} = \frac{1}{8}$ text following ...

```
•• •• ••
1
 2
  3
  •••••
    4
    5
  •
    6
•• •• ••
7
```

Lines 3-6: Each link (material following a symbol of comparison, usually an equals sign) is brailled two cells to the right of where the anchor (very first thing *before* a sign of comparison) begins. [If there were runovers, they would go two cells to the right of where the symbols of comparison start.]

The criteria for a linked expression requiring special margins are:

- It includes at least one sign of comparison
- It is displayed (not embedded within text)
- Only its first sign of comparison has anything printed to its left (Okay, its last sign of comparison can have something printed to its left, too)

**Additional Opposite Example** 

 $8x^{3} + 125y^{3} \text{ can be factored in the following way:}$   $8x^{3} + 125y^{3} = (2x)^{3} + (5y)^{3}$   $= (2x + 5y)[(2x)^{2} - (2x)(5y) + (5y)^{2}]$   $= (2x + 5y)(4x^{2} - 10xy + 25y^{2}).$ 

1		••			•••	••	:•	ė	:•	· • · · ·	•	•••	•••	•• •• ••	:•	••			• . . •		••	•	•	•	•	•	•			•••	•	
2	•••			:• :: ••			•••	•• •• ••	••			••																				
3	- · ě	•••		- · ě	••	· •		••	••	••	- ÷ •	- · ě	••																			
4				• · • ·			••			· •		· •	· • • •		••	· •		· •														
5			• •	• · • · • ·			••			••	· •					••			· •	••	· •					•	•	· •				
6							••	· •		· •	••	· •																				
7				• · • ·			••			••	· •					· •	••	· •		••	· •			•	· · •		• •	••	· •	••	- · ě	••

That is how the example is transcribed in the Nemeth Code book.

Logical Division for Lines 5-6 of This Additional Opposite Example

1			- · •	••		- · .	• •	••	- · .		- •		• •	• •	• •	÷ •	- · •			- · •	• · · • · •		••		•••	- é		• •	• •	••	•	0 · 0 0 0 ·		· · • •		· • • · • •	
2	÷.	- i e	• · • · • ·	÷.	• •					• • • • • •			- · •	••																							
3			- · •	۰	••	- · .		- •		• •	• •	• •	- i 🔴	- · .																							
4						• · · · • ·			• •	••	••	- ÷ 🖷		- •			• •	- i 🔴	••	- · •																	
5					• •	• · • ·			••	••	• •	۰.	- ÷ •	••																							
6										••			· •	••	· •			••				••	· •				••	· •		· •	••	· •	 				
7						• · · · • ·			• •			• •	- • •					- • •		· • •		• •	- · •	••	· •			• •	· •	· •	••	- · •			• · · • · •	••	

This division of the next-to-last link keeps together on a braille line the "logical unit" that is the material enclosed in square brackets.



# How would I transcribe Pascal's triangle?

# Question – <u>Pascal's Triangle</u>

Can you please provide the provisional rule for transcribing the Pascal's Triangle for UEB with Nemeth, if there is NO provisional rule please provide past code reference with an example.

Pascal's triangle	If you arrange the values of <i>n</i> which each row corresponds to is called Pascal's triangle.	0 1
	$_{0}C_{0}$	1
	$_{1}C_{0}$ $_{1}C_{1}$	1 1
	${}_{2}C_{0}$ ${}_{2}C_{1}$ ${}_{2}C_{2}$	1 2 1
	$_{3}C_{0}  _{3}C_{1}  _{3}C_{2}  _{3}C_{3}$	1 3 3 1
	$_4C_0$ $_4C_1$ $_4C_2$ $_4C_3$ $_4C_4$	1 4 6 4 1

#### Response

We can point to no rules that specifically address Pascal's triangle.

If possible, it would be appropriate to follow print's triangular layout of a representation of Pascal's triangle. The content of the triangle determines which code (Nemeth or UEB) will be used.

Since we're talking about a transcription using Nemeth within UEB, in your sample of print, the triangle made up of C's with subscripts must be transcribed in Nemeth Code, and the triangle made up of whole unmodified numbers may be transcribed in Nemeth Code or in UEB.

Attached is a BRF with both triangles from your sample print transcribed, with the longest row (i.e., the base) of the triangle beginning in cell 1 and each smaller row centered relative to the row below it.

```
1
 2
 .
       .
3
•
     4
  5
6
    7
   8
  9
 10
      • • • • • • • • •
11
12
13
14
  15
  16
  17
  18
19
```

Lines 7-11 & 15-19: Two blank cells are inserted between the expressions or numbers so as to more closely reproduce the shape of the printed layout. Each line is centered based on the number of cells required for the line immediately below it.

Lines 15-19: The triangle made up of simple, unmodified numbers we chose to transcribe in UEB both because no part of it requires Nemeth Code and because we expect that UEB material follows after it. We chose to use individual numeric indicators (instead of a numeric passage) so as to make the single-digit numbers easier to read.

Line 12: A blank line follows a spatial arrangement, and that blank line is in Nemeth Code (i.e., it precedes the Nemeth Code terminator). (**#9.b** under **Additional Guidelines** of the *Guidance*)

Line 14: A blank line precedes the spatially arranged numbers.



# **Closing Words**

Thank you! Without your thoughtful questions, this collection could not exist.

As always, NBA's <u>Ask an Expert</u> is open 24/7. Here's to another decade of learning from and helping each other!

End of the material for "Best of" Ask An Expert (Nemeth Code)