

Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonized System of Classification and Labelling of Chemicals

Sub-Committee of Experts on the Transport of Dangerous Goods

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Item 4 (f) of the provisional agenda

Electric storage systems

Miscellaneous

Use of the terms “rated capacity”, “nominal energy” and “watt-hour rating” in the English, French and Spanish versions of the Model Regulations and the Manual of Tests and Criteria

Note by the secretariat

I. Introduction

The main objective of this document is to discuss the terms “rated capacity”, “nominal energy” and “watt-hour rating” in the English, French and Spanish versions of the Model Regulations (MR) and the Manual of Tests and Criteria (MTC). However, during the preparation of the document we identified some other related issues, which we present here too.

II. Side note on the use of the SI

According to the International System of Units (SI)¹:

- (a) unit names start with a lower-case letter (even when the symbol for the unit begins with a capital letter);
- (b) when the name of a derived unit is formed from the names of individual units by juxtaposition, either a space or a hyphen is used to separate the names of the individual units;
- (c) multiplication of unit symbols must be indicated by a space or a half-high (centred) dot (·).

This means, for instance that one should write “watts”, “watt-hours” and “W·h”.

The secretariat proposes to review the texts of the MR and the MTC to ensure that these conventions are applied consistently throughout. As these amendments are purely editorial, we believe that there is no need to bring a detailed proposal to the Sub-Committee. The excerpts in this document have already been adjusted accordingly.

On a related note, the table in 1.2.2.1 of the MR showing the units which are applicable in the MR does not contain an entry for W·h, which is used multiple times in the regulations,

¹ <https://www.bipm.org/en/publications/si-brochure>

but contains an entry for kW·h, which is not used in the regulations and is just a multiple of W·h. We propose to replace the entry for kW·h by W·h.

Proposal 1 (MR, all languages)

- 1.2.2.1 In the table, in the row for “Work”, replace “KWh (kilowatt hour)” by “W·h (watt-hour)” and replace “1 kWh = 3.6 MJ” by “1 W·h = 3.6 kJ”.

II. Current situation in the English version

The term “rated capacity” is defined in 38.3.2.3 of the MTC as follows:

Rated capacity means the capacity, in ampere-hours or milliampere-hours, of a cell or battery as measured by subjecting it to a load, temperature and voltage cut-off point specified by the manufacturer.

This term is used in 38.3.2.3, 38.3.3, 38.3.4.8.2 of the MTC. The term also appears in special provision SP 339 and packing instruction P205 of the MR, but in different contexts (fuel cell cartridges and metal hydride storage systems) and with different meanings.

The terms “nominal energy” and “watt-hour rating” are synonyms and are jointly defined in 38.3.2.3 of the MTC as follows:

Nominal energy or watt-hour rating, expressed in watt-hours, means the energy value of a cell or battery determined under specified conditions and declared by the manufacturer. The nominal energy is calculated by multiplying nominal voltage by rated capacity expressed in ampere-hours.

Furthermore, in 38.3.2.3, there is a specific entry for watt-hour rating as follows:

Watt-hour rating, see *nominal energy*.

The term “nominal energy” is used in 38.3.2.2 and 38.3.2.3 of the MTC. On the other hand, the term “watt-hour rating” is used in SP 188, SP 348, P909 and 5.2.2.1.13.1 of the MR and in 38.3.2.3, 38.3.3 and 38.3.5 of MTC.

As discussed below, the French version uses only one term for “nominal energy” and “watt-hour rating” and although the Spanish version currently uses two terms, we are proposing that it is amended to use only one (see proposal 5). It is worth considering whether it might also be beneficial to use only one term in the English language throughout the text, improving consistency. To this end, we have prepared two options: proposal 2a to use only “nominal energy” and proposal 2b to use only “watt-hour rating”. In both cases we would retain a mention of the other term in the definition, but would not use it throughout the text. Proposal 2a would be better aligned with the French and Spanish versions and would use the term which is closer to the physical meaning of the quantity being described (nominal energy). On the other hand, proposal 2b would retain the term that is currently more used throughout the text (watt-hour rating). Both proposals also include a change in the second sentence to include the units of the physical quantities being mentioned.

Proposal 2a (MR, English)

3.3.1, SP 188 In (a), replace “Watt-hour rating” by “nominal energy”.

In (b), first sentence, replace “Watt-hour rating” by “nominal energy”.

In (b), second sentence, replace “Watt-hour rating” by “nominal energy in watt-hours”.

3.3.1, SP 348 Replace “Watt-hour rating” by “nominal energy in watt-hours”.

4.1.4.1, P909 In (2), first sentence, replace “Watt-hour rating” by “nominal energy” (two times).

5.2.2.1.13.1 In the second and third sentences, replace “Watt-hour rating” by “nominal energy”.

Proposal 2a (MTC, English)

38.3.2.2 In (b), delete “in Watt-hours”.

38.3.2.3 Amend the definition of “*Nominal energy or watt-hour rating*” to read:

“*Nominal energy*, expressed in watt-hours, means the energy value of a cell or battery determined under specified conditions and declared by the manufacturer. The nominal energy in watt-hours is calculated by multiplying the nominal voltage in volts by the rated capacity in ampere-hours. It is also known as watt-hour rating.”

38.3.3 In (f), replace “Watt-hour rating” by “nominal energy”.

In (g), replace “Watt-hour rating” by “nominal energy”.

38.3.5 In (f) (iii), replace “Watt-hour rating” by “nominal energy in watt-hours”.

Proposal 2b (MTC, English)

38.3.2.2 In (b), replace “nominal energy in Watt-hours” by “watt-hour rating”.

38.3.2.3 Amend the definition of “*Nominal energy or watt-hour rating*” to read:

“For *nominal energy*, see *watt-hour rating*.”

Amend the definition of “*Watt-hour rating*” to read:

“*Watt-hour rating*, expressed in watt-hours, means the energy value of a cell or battery determined under specified conditions and declared by the manufacturer. The watt-hour rating is calculated by multiplying the nominal voltage in volts by the rated capacity in ampere-hours. It is also known as nominal energy.”

III. Current situation in the French version

In French, the term used for “rated capacity” is “capacité nominale”, and it is used in the same places as in the English version.

However, in the French version, the term “capacité nominale” is used in two additional ways:

1. It is used in table 28.4 of the MTC, referring to the capacity in litres of IBCs and tanks, where the English version uses a different term (“normal capacity”). We believe that this use is not problematic.
2. It is also used in SP 361 and SP 372, where in English we have the term “nominal capacitance”. The usual term for capacitance in French is “capacité électrique”². We propose that the term “capacité électrique nominale” be used instead of “capacité nominale” (see proposal 3).

For the two synonymous terms used in the English version (“nominal energy” and “watt-hour rating”) the French version uses just one:

Énergie nominale exprimée en watt-heures, l'énergie d'une pile ou d'une batterie dont la valeur a été déterminée dans des conditions définies et qui a été déclarée par le

² See <https://www.bipm.org/en/publications/si-brochure/>

fabricant. L'énergie nominale est calculée en multipliant la tension nominale par la capacité nominale en ampères-heures ;

It is worth noting that the words “*exprimée en watt-heures*” are in italics, implying that they are an integral part of the defined term. However, all through the MR and MTC, the expression which is consistently used is “*énergie nominale en watt-heures*” (without “*exprimée*”).

We propose to add a coma after “*Énergie nominale*” and to remove the italics from the words “*exprimée en watt-heures*”, so that the term defined is just “*énergie nominale*”. As the expression “*exprimée en watt-heures*” will no longer be a part of the defined term, we propose to remove it in some places throughout the text, where the context makes it redundant. These changes are included in proposal 4 below.

Proposal 3 (MR, French)

3.3.1, SP 361 Dans la ligne sous la formule, remplacer « capacité nominale » par « capacité électrique nominale ».

3.3.1, SP 372 Dans la troisième phrase, remplacer « capacité nominale » par « capacité électrique nominale ».

Proposal 4 (MR, French)

3.3.1, SP 188 À l'alinéa a), après « l'énergie nominale », supprimer « en wattheures ».

À l'alinéa b), première phrase, après « l'énergie nominale », supprimer « en wattheures ».

4.1.4.1, P909 Dans 2), après « l'énergie nominale », supprimer « en wattheures ».

5.2.2.1.13.1 Dans la deuxième et troisième phrase, après « l'énergie nominale », supprimer « en wattheures ».

Proposal 4 (MTC, French)

38.3.2.2 À l'alinéa b), après « l'énergie nominale », supprimer « en wattheures ».

38.3.2.3 Modifier la définition d'énergie nominale pour lire comme suit :

« *Énergie nominale*, exprimée en watt-heures, l'énergie d'une pile ou d'une batterie dont la valeur a été déterminée dans des conditions définies et qui a été déclarée par le fabricant. L'énergie nominale en watt-heures est calculée en multipliant la tension nominale en volts par la capacité nominale en ampères-heures ;»

38.3.3 À l'alinéa f), après « énergie nominale », supprimer « en Watt heure ».

À l'alinéa g), après « énergie nominale », supprimer « en Watt heure ».

IV. Current situation in the Spanish version

The situation in Spanish is more complex. For “rated capacity” the Spanish version uses the term “capacidad nominal”, etymologically similar to the French term. However, for “nominal energy” and “watt-hour rating”, the Spanish version also uses two terms, as opposed to French: “energía nominal o capacidad nominal en vatios-hora”. Unfortunately, the second term coincides with the term used for “rated capacity”. This is further compounded by the fact that throughout the text, the expression “en vatios-hora” is not consistently used. All this could potentially lead to confusion over whether the concept of “rated capacity” or “watt-

hour rating” is being referred to when the expression “capacidad nominal” is encountered in the Spanish text.

To avoid this confusion, we propose to only use the term “energía nominal”, amending the definition and all other instances throughout the Spanish MR and MTC. This will have several advantages, as using only one term is clearer than using two different ones, the term “energía nominal” clearly conveys the physical quantity being described (an energy), it cannot be confused with the term used for “rated capacity” and it will better align the Spanish and French texts.

Proposal 5 below contains the amendments outlined above, except for the two instances appearing in 38.3.3 of the MTC, which have already been corrected in ST/SG/AC.10/11/Rev.7/Corr.2 together with other corrections to 38.3.3.

Finally, as with the French version, the Spanish version also uses “capacidad nominal” in table 28.4, but we do not believe this poses a problem.

Proposal 5 (MR, Spanish)

3.3.1, SP 188 En a), sustitúyase “capacidad nominal” por “energía nominal”.

En b), primera oración, sustitúyase “capacidad nominal” por “energía nominal”.

En b), segunda oración, sustitúyase “capacidad nominal” por “energía nominal en vatios-hora”.

3.3.1, SP 348 Sustitúyase “capacidad nominal” por “energía nominal en vatios-hora”.

4.1.4.1, P909 En 2), primera oración, sustitúyase “capacidad nominal en vatios hora” por “energía nominal” (2 veces).

5.2.2.1.13.1 En las oraciones segunda y tercera, sustitúyase “capacidad nominal” por “energía nominal”.

Proposal 5 (MTC, Spanish)

38.3.2.3 Suprímase la definición de “*Capacidad nominal en vatios-hora*”.

Modifíquese la definición de “*Energía nominal o capacidad nominal en vatios-hora*” para que quede como sigue:

“*Energía nominal*, expresada en vatios-hora, el valor de la energía que puede suministrar la pila o la batería en condiciones específicas y declarado por el fabricante. La energía nominal en vatios-hora se calcula multiplicando el voltaje nominal en vatios por la capacidad nominal en amperios-hora.”

38.3.3 En f), sustitúyase “capacidad nominal” por “energía nominal”.

En g), sustitúyase “capacidad nominal” por “energía nominal”.

V. Formula in SP 372

While reviewing the use of the term “capacité nominale” in SP 372, we realized that the formula in SP can be misleading. The formula is currently formatted as follows:

$$Wh = 1/2C_N(U_R^2 - U_L^2) \times (1/3600)$$

It is our understanding that the term “ $C_N(U_R^2 - U_L^2)$ ” should be part of the numerator of the fraction, whereas the current formatting seems to imply that it is part of the denominator.

This formula was introduced when SP 372 was created, in the 18th revised edition of the MR (see ST/SG/AC.10/40/Add.1), based on a proposal from Japan presented in the 42nd session of the Sub-Committee (ST/SG/AC.10/C.3/2012/84 and informal document INF.10). Referring to the standard formula for the capacity of a capacitor or simply performing a dimensional analysis confirms that “ $C_N(U_R^2-U_L^2)$ ” needs to be in the numerator for the formula to be coherent:

$$P \cdot t = V \cdot I \cdot t = V \cdot C = V^2 \cdot F$$

Where P = power, t = time, V = voltage, I = electric current, C = electric charge and F = capacitance.

Furthermore, in the left-hand side of the equation, the term should be “energy storage capacity”, not “Wh”, which are just the units.

Proposal 6 (MR, all languages)

3.3.1, SP 372 Amend the formula under the second paragraph to read as follows:

$$\text{energy storage capacity (W} \cdot \text{h)} = \frac{C_N \times (U_R^2 - U_L^2)}{2 \times 3600}$$
