

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

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Item 2 (i) of the provisional agenda

Explosives and related matters: miscellaneous

**Clarification of the classification of ammonium nitrate based
fertilizers – draft amendments to the Model Regulations and
the Manual of Tests and Criteria**

**Annex 3 of document ST/SG/AC.10/C.3/2016/29
(correspondence between the proposed flow chart and the
existing criteria for UN 2067 and UN 2071)**

Transmitted by the expert from Sweden

Document ST/SG/AC.10/C.3/2016/29 contains proposals for amendments to the United Nations Recommendations on the Transport of Dangerous goods, Model Regulations and Manual of Tests and Criteria, relating to the classification of ammonium nitrate fertilizers. Central to this document is a flow chart which is intended to replace many of the current provisions for classification of ammonium nitrate based fertilizers.

Annex 3 of the document explains in detail how the flow chart in particular corresponds to the existing provisions.

For editorial reasons, annex 3 is reproduced separately in this informal document.

Annex 3 - Correspondence between the proposed flow chart and the existing criteria for UN2067 and UN2071

UN2067 is the main UN-number for AN-based fertilizers. Transport under this UN-number is subject to three Special Provisions, namely SP186, 306 and 307.

- SP186 contains a description on how the AN-content should be calculated which is not a criterion but rather a definition. It has therefore been implemented through paragraph 39.3.4 in the proposed new Section 39 to the UN Manual of Tests and Criteria, see Annex 2.
- SP306 has been implemented as a condition on UN2067 through paragraph 39.4.2 in the proposed new Section 39 to the UN Manual of Tests and Criteria, see Annex 2.
- SP307 gives the detailed criteria in terms of composition that can be transported under UN2067. The corresponding criteria have been implemented in the flow chart, as explained in detail in the sections α , β and γ below, corresponding to the three sets of criteria (a), (b) and (c) of SP307. A fertilizer that does not fit the compositions given in SP307 cannot be transported under UN2067. If this is because the AN-content is too high, it is a dangerous good that should be transported under another UN-number. If the AN-content is too low, it may meet the conditions of another UN-number or it is not subject to the UN Model Regulations.

UN2071 applies to some compound fertilizers. Transport under this UN-number is subject to two Special Provisions, namely SP186 and 193. In addition, paragraph 38.3.2.2 of Section 38 of the UN Manual of Tests and Criteria applies to this UN-number.

- SP186 has been implemented in paragraph 39.3.4 of the proposed new Section 39 of the UN Manual of Tests and Criteria, as described above.
- SP193 contains the criteria in terms of composition that can be transported as UN2071, as well as a criterion on self-sustaining decomposition. These criteria have been implemented in the flow chart, as explained in detail in section δ below.
- Paragraph 38.3.2.2 of the UN Manual of Tests and Criteria contains an additional criterion for UN2071 on the content of additional nitrates. This has been implemented in the flow chart, see further in section δ below.

α . The conditions on UN2067 according to SP307(a)

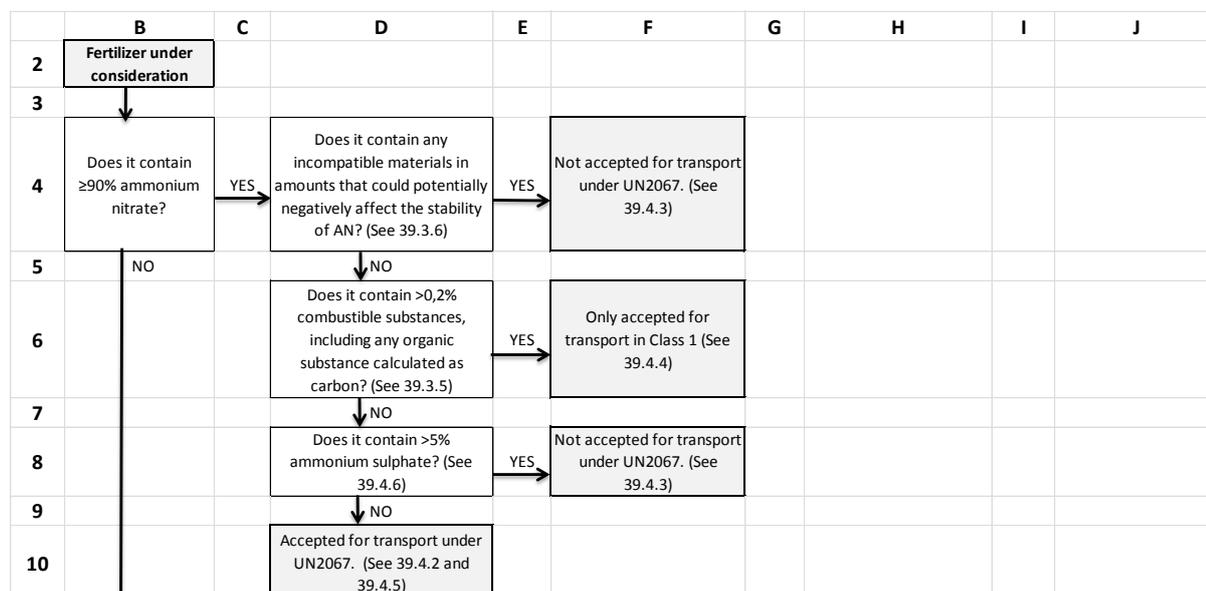
SP307(a) reads:

“Not less than 90% ammonium nitrate with not more than 0.2% total combustible/ organic material calculated as carbon and with added matter, if any, which is inorganic and inert towards ammonium nitrate”

Recast as a list, the conditions for a fertilizer to fit into SP307(a) are that:

- $\alpha 1$** It contains $\geq 90\%$ AN, and
- $\alpha 2$** it contains $\leq 0,2\%$ combustible/organic material, and
- $\alpha 3$** added matter is inorganic, and
- $\alpha 4$** added matter is inert towards AN.

Rows 4-10 in the flow chart correspond to SP307(a).



Condition α_1 is contained in Box B4 and condition α_2 is contained in Box D6. Condition α_3 is superfluous since condition α_2 already restricts the amount of organic material in the fertilizer, and hence there is no need for a corresponding box in the flow chart to cover condition α_3 .

Condition α_4 is contained in Box D4, but the wording has been altered. The reason for this is that the current condition is not very clear and also has a zero-tolerance towards material that is not inert, which is unrealistic considering e.g. naturally occurring contaminants. Box D4 set a tolerable limit to incompatible materials in that they are allowed as long as they cannot potentially negatively affect the stability of AN. In paragraph 39.3.6, to which Box D4 refers, it is exemplified what is meant by “incompatible materials”, and it is specified that such materials should not be added deliberately.

Box D8 contains what appears to be a new condition on the content of ammonium sulphate (AS). However, this condition is in fact already contained in SP307 since “nitrogen type” AN-based fertilizers that contain AS as a nutrient should adhere to the conditions of SP307(c), which is especially targeted at binary AN/AS-fertilizers and sets a limit of maximally 70% AN in such mixtures due to the effect of AS to enhance the explosive power of AN¹ (see also section γ below). What Box D8 does is not to create a new condition but rather to open up for a small addition of AS for quality reasons – something that is frequently done for fertilizers in practice but where it is not clear whether that is actually allowed within SP307 or not. The flow chart clarifies that it is allowed to add AS for quality reasons, by setting a limit of 5%.

The answer “YES” to the questions in Box D4 or D8 directs to the fertilizer being “Not accepted for transport under UN2067”. However, it may be transported under another suitable UN-number based on conditions as explained in paragraph 39.4.3 to which Box F4 and Box F8 refers. An answer “YES” to the question in Box D6 leads to “Only accepted for transport in Class 1”, because mixtures of ≥90% AN and combustibles are known to have explosive properties. Hence they should not be transported as anything else than under a suitable UN-number in Class 1, which is further emphasised in paragraph 39.4.4 to which Box F6 refers.

¹ See the review of several studies in “*Properties of Ammonium Nitrate based fertilizers*”, Ph.D. thesis by Harri Kiiski from Helsinki University, Faculty of science, Department of Chemistry, 2009 (Chapter 9, Section 9.3.3)

Rows 4-10 in the flow chart thus correspond to SP307(a). The flow chart clarifies that a small addition of AS is allowed for quality improvement, and that mixtures of $\geq 90\%$ AN and $>0,2\%$ combustibles shall be transported in Class 1.

β. The conditions on UN2067 according to SP307(b)

SP307(b) reads:

“Less than 90% but more than 70% ammonium nitrate with other inorganic materials or more than 80% but less than 90% ammonium nitrate mixed with calcium carbonate and/or dolomite and/or mineral calcium sulphate and not more than 0.4% total combustible/organic material calculated as carbon”

It actually contains two groups of conditions baked into one, and by splitting the groups up the conditions on each of them become clearer:

SP307(b) Alternative 1 is:

Less than 90% but more than 70% ammonium nitrate with other inorganic materials, and not more than 0.4% total combustible/organic material calculated as carbon

SP307(b) Alternative 2 is:

More than 80% but less than 90% ammonium nitrate mixed with calcium carbonate and/or dolomite and/or mineral calcium sulphate and not more than 0.4% total combustible/organic material calculated as carbon

Recast as a list, the conditions on a fertilizer to fit into UN2067 according to SP307(b) Alternative 1 are that:

- β1.1** It contains $>70\%$ AN, and
- β1.2** it contains $<90\%$ AN, and
- β1.3** it contains other inorganic materials, and
- β1.4** it contains $\leq 0,4\%$ combustible/organic material.

And the listed conditions on a fertilizer to fit into UN2067 according to SP307(b) Alternative 2 are that:

- β2.1** It contains $>80\%$ AN, and
- β2.2** it contains $<90\%$ AN, and
- β2.3** AN is mixed with calcium carbonate and/or dolomite and/or mineral calcium sulphate, and
- β2.4** it contains $\leq 0,4\%$ combustible/organic material.

Conditions β1.3 and β2.3 appear to be somewhat contradictory, since the listed substances in β2.3 are in fact also inorganic substances. The intention is, however, that fertilizers with $>70\%$ but $<90\%$ AN and inorganic material fulfil SP307(b) in general, with the exemption for when the AN-content is $\leq 80\%$ and the inorganic material is those listed in condition β2.3. Putting it another way, a fertilizer with $>70\%$ but $\leq 80\%$ AN where the added inorganic material is those listed in β2.3 escapes classification as UN2067, while those with other inorganic materials do not.

At this point in the flow chart, a distinction needs to be made for compound fertilizers and “straight N fertilizers”, because compound fertilizers contain inorganic materials providing the phosphate (P) and/or potassium (K), and may also contain AS as nutrient providing sulphur (S). Furthermore, UN2071 is only applicable to compound fertilizers (see section δ below).

Compound fertilizers

Compound fertilizers are never diluted with any of the materials of β2.3, and hence only the conditions relating to SP307(b) Alternative 1 need to be applied to those, i.e. conditions β1.1- β1.4.

Rows 12-16 in the flow chart correspond to SP307(b) for compound fertilizers.

	B	C	D	E	F	G	H	I	J
12	Is it a compound fertilizer containing ammonium nitrate? (See 39.3.2)	YES	Does it contain >70% ammonium nitrate?	YES	Does it contain >0,4% combustible substances, including any organic substance calculated as carbon? (See 39.3.5)	YES	Not accepted for transport under UN2067. (See 39.4.3)		
13	NO		NO		NO				
14					Does it contain >5% ammonium sulphate? (See 39.4.6)	YES	Does it contain \geq 10% inorganic materials providing the P and/or K?	YES	Accepted for transport under UN2067. (See 39.4.2 and 39.4.5)
15					NO		NO		
16					Accepted for transport under UN2067. (See 39.4.2 and 39.4.5)		Not accepted for transport under UN2067. (See 39.4.3)		

Condition β 1.2 is contained in Box B4, since fertilizers with \geq 90% AN can never reach Box B12. Condition β 1.1 is contained in Box D12. Condition β 1.4 is contained in Box F12, and since this puts a limit on the amount of organic materials, condition β 1.3 is superfluous because added material must then be inorganic.

Box F14 contains a limit on AS for the same reasons as explained for Box D8 above (see section α). This condition is placed also on compound fertilizers in order to prevent that AN/AS-fertilizers are disguised as compound fertilizers by adding a small amount of P or K so as to escape the limit of maximum 70% AN stipulated in SP307(c). However, for compound fertilizers, AS may be added as a nutrient and for these the allowable AS-content needs to be set a higher than at 5%. This is made possible through Box H14 which allows more than 5% AS provided that it contains at least 10% inorganic materials providing the nutrients phosphorus (P) and/or potassium (K), which means that the AN-content must be less than 85%. This limit on the AN-content is set with regard to the effect of AS to enhance the explosive power of AN as explained above (see section α).

Non-compound fertilizers (“straight N-fertilizers”)

Rows 34-40 in the flow chart correspond to SP307(b) for non-compound fertilizers.

	B	C	D	E	F	G	H	I	J
34	Does it contain >70% ammonium nitrate?	YES	Does it contain >0,4% combustible substances, including any organic substance calculated as carbon? (See 39.3.5)	YES	Not accepted for transport under UN2067. (See 39.4.3)				
35	NO		NO						
36			Does it contain >5% ammonium sulphate? (See 39.4.6)	YES	Not accepted for transport under UN2067. (See 39.4.3)				
37			NO						
38			Does it contain \geq 20% calcium carbonate and/or dolomite and/or mineral calcium sulfate?	YES	Not subject to these regulations				
39			NO						
40			Accepted for transport under UN2067. (See 39.4.2 and 39.4.5)						

Condition β 1.2/ β 2.2 is contained in Box B4, since fertilizers with \geq 90% AN can never reach Box B34. Condition β 1.1 is contained in Box B34. Condition β 1.4/ β 2.4 is contained in Box D34, which also puts a limit on the amount of organic materials making condition β 1.3 superfluous. Box D36 puts a limit on the AS-content for the same reasons as argued above for Box D8 (see section α).

Box D38 poses a question that implements conditions β2.1 and β2.3 simultaneously. If at least 20% of the material in the fertilizer is those listed in condition β2.3, this simultaneously means that the AN-content cannot be higher than 80%. Consequently, such a fertilizer is directed to Box 38 stating it is “Not subject to these regulations”, because it does not fit within SP307(b) due to a too low AN-content. If on the other hand there is less than 20% of those materials it fits within SP307(b), since it then either meets condition β2.1 or β1.3 (or both).

γ. The conditions on UN2067 according to SP307(c)

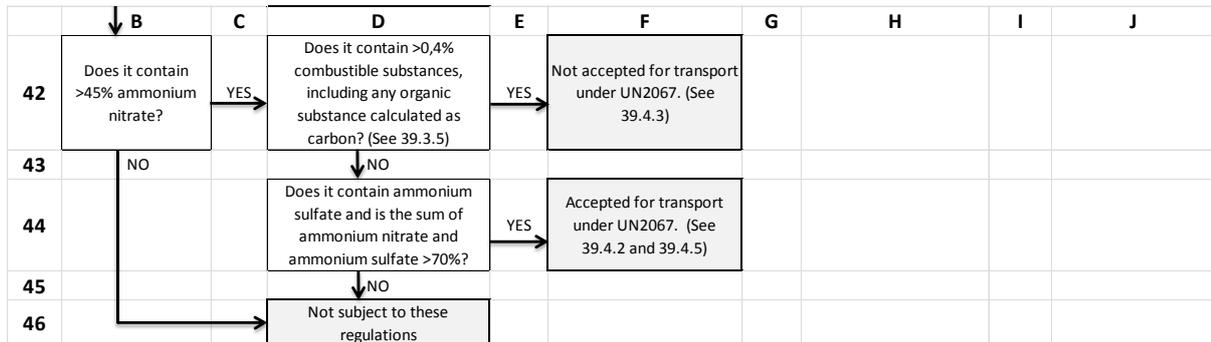
SP307(c) reads:

“Nitrogen type ammonium nitrate based fertilizers containing mixtures of ammonium nitrate and ammonium sulphate with more than 45% but less than 70% ammonium nitrate and not more than 0.4% total combustible/organic material calculated as carbon such that the sum of the percentage compositions of ammonium nitrate and ammonium sulphate exceeds 70%.”

Recast as a list, the conditions for a fertilizer to fit into UN2067 according to SP307(c) are that:

- γ1 It is “nitrogen type ammonium nitrate based”, and
- γ2 it contains >45% AN, and
- γ3 it contains <70% AN, and
- γ4 it contains <0,4% combustibles, and
- γ5 the sum of AN and AS is >70%.

Rows 42-46 in the flow chart correspond to SP307(c).



Condition γ1 is already covered, since fertilizers that are not of the “nitrogen type” are compound fertilizers that are already directed away by Box B12. Condition γ3 is contained in Box B34, where fertilizers with >70% AN are directed away. Condition γ2 is contained in Box B42, condition γ4 in Box D42 and condition γ5 in Box D44.

δ. The conditions on UN2071 according to SP193 and Section 38 of the UN Manual

SP193 reads:

“This entry may only be used for uniform ammonium nitrate based fertilizer mixtures of the nitrogen, phosphate or potash type, containing not more than 70% ammonium nitrate and not more than 0.4% total combustible/organic material calculated as carbon or with not more than 45% ammonium nitrate and unrestricted combustible material. Fertilizers within these composition limits are only subject to these Regulations when transported by air or sea and are not subject to these Regulations if shown by a Trough test (see Manual of Tests and Criteria, Part III, sub-section 38.2) not to be liable to self-sustaining decomposition.”

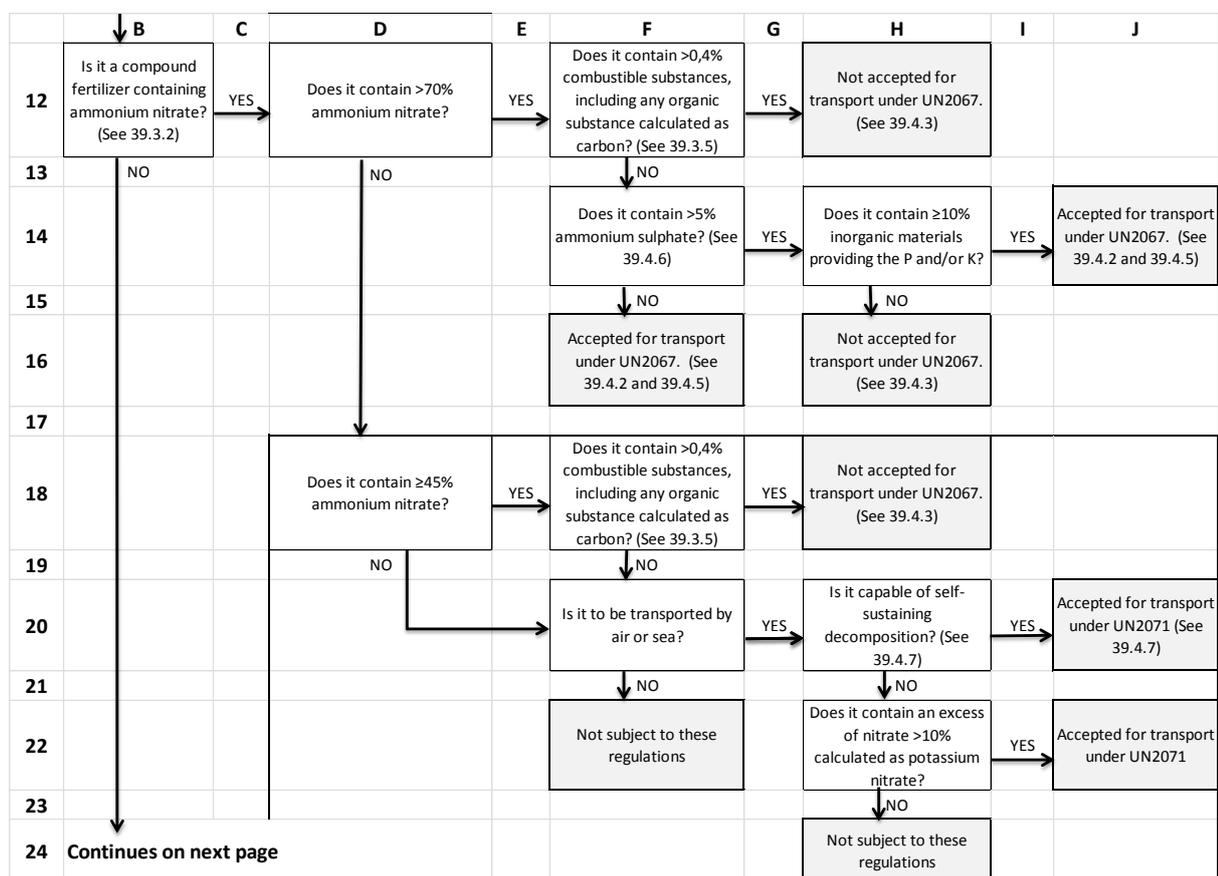
Apart from the conditions of SP193, there is another condition on fertilizers to fit into UN2071 in Section 38, paragraph 38.2.3.3 of the UN Manual of Tests and Criteria:

“Ammonium nitrate fertilizers with the composition given for UN 2071 may be regarded as not subject to the Model Regulations if shown not to be liable to self-sustaining decomposition and provided that they do not contain an excess of nitrate greater than 10% by mass (calculated as potassium nitrate).”

Recast as a list, the conditions on the fertilizer to fit into UN2071 according to SP193 and Section 38 are:

- δ1 It is a uniform AN-based fertilizer mixtures of the nitrogen, phosphate or potash type, and
- δ2 it contains $\leq 70\%$ AN, and
- δ3 if it contains $>45\%$ AN it contains $<0,4\%$ combustibles, and
- δ4 it is transported by air or sea, and
- δ5 it is either liable to self-sustaining decomposition, or it contains an excess of nitrate $>10\%$ calculated as potassium nitrate.

Rows 18-22 in the flow chart correspond to SP 193 and paragraph 38.2.3.3.



Condition δ1 is contained by the fact that this, through Box B12, only applies to compound fertilizers. Condition δ2 is in Box D12. By Box D18 and F18 condition δ3 on the amount of combustibles is implemented only for fertilizers with $>45\%$ AN. Condition δ4 is in Box F20, and the condition δ5, which is actually two conditions (“either ... or ...”), is implemented through Boxes H20 and H22.

An answer “YES” to either Box H20 or H22 directs to “Accepted for transport under UN2071”, while if the answer is “NO” to both of these boxes the fertilizer is “Not subject to these regulations”, which is in accordance with SP193 and paragraph 38.2.3.3 of the UN Manual, respectively. If the fertilizer is not to be transported by air or sea, the answer “NO” to Box F20 also directs to “Not subject to these regulations”, in line with SP193.
