



U.S. Department
of Transportation

**Pipeline and Hazardous
Materials Safety
Administration**

1200 New Jersey Avenue, SE
Washington, DC 20590

May 28, 2020

P. Shelley BEng (Hons), MISEE, MIExpE
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Reference No. 20-0015

Dear Mr. Shelley:

This letter is in response to your January 27, 2020, letter requesting clarification of the Hazardous Materials Regulations (HMR; 49 CFR Parts 171-180) applicable to the classification of explosives. Your letter relates to a previously issued Letter of Interpretation (LOI) Reference No. 18-0141.

We have paraphrased and answered your questions as follows:

- Q1: You note that LOI 18-0141 states that thermites and thermates provide a “practical pyrotechnic effect” as defined in the United Nations (UN) Manual of Test and Criteria. Your understanding is that any thermite-based substance is potentially an explosive as defined in § 173.50. You ask whether the manufacturer must obtain an approval from the Pipeline and Hazardous Materials Safety Administration (PHMSA) for the shipment of any thermite-based substance or article(s).
- A1: The answer is yes. Materials designed with pyrotechnic intent are required to be tested in accordance with the HMR. As specified in § 173.56, classification of Class 1 (explosive) materials is the responsibility of the person who offers a new explosive for transportation in commerce and is subject to PHMSA's approval. Section 173.56 specifies that the person requesting approval of the new explosive must submit to the Associate Administrator of the Office of Hazardous Materials Safety a report from a DOT-approved explosives test laboratory on the examination and recommended classification of the explosive, which includes a recommended shipping description, division, and compatibility group. If PHMSA finds that the approval request meets the regulatory criteria, the explosive will be approved in writing and assigned an EX number.
- Q2: You ask whether the HMR provide any specific exemptions for the shipment of thermites, thermates, or articles containing thermite or thermate substances without obtaining a competent authority approval.

- A2: The answer is no. Thermites, thermates, or articles containing thermites or thermates that have a pyrotechnic intent are required to undergo explosives testing in accordance with the HMR. See A1.
- Q3: You ask about a thermite substance or thermite containing article that was developed before the current format of Department of Transportation (DOT)-approved test laboratories came into existence. These thermites or thermite containing articles were self-classified as “Not Class 1” materials. You ask whether there are cases where modifications or replacements of older thermite or thermate products could be “grandfathered” in and not be required to undergo the same examination or testing for approval as a totally new product.
- A3: The answer is no. The materials you describe would need to be examined to determine if a competent authority approval is required. See A1.
- Q4: You have a thermite substance that was developed prior to the current format of DOT approved test laboratories came into existence. This thermite substance was later mixed with additional substances. You ask whether this is a clear trigger point for the manufacturer to undertake examination of the new substance and containing article(s) under § 173.56.
- A4: The answer is yes. Under § 173.56(a)(2), any change to an explosive in the formulation, design, or process so as to alter any of the properties of the explosive would require examination and meet the definition of a “new” explosive unless an agency listed in § 173.56(b) has determined, and confirmed in writing to the Associate Administrator, that there are no significant differences in hazard characteristics from the explosive previously approved.
- Q5: You note that in LOI 18-0141, PHMSA stated that “extensive discussions” have taken place surrounding the transport classification of thermites and thermite derivatives. You ask PHMSA to clarify the discussions that have taken place and whether these discussions have led to any exception, conclusion, or recommendation other than determination that thermites provide a “practical pyrotechnic effect.”
- A5: PHMSA continues to have regular and ongoing discussions with our explosive test labs, foreign competent authorities, and our regulated stakeholders, but does not have additional information at this time. However, it should be noted that PHMSA has initiated a long-term study on thermite and thermate materials to determine the hazards and risks in transportation. Additional information on thermite research conducted by PHMSA can be found at <https://www.phmsa.dot.gov/hazmat/reports/energetic-properties-thermite>.
- Q6: When conducting Test Series 6 of the UN Manual of Test and Criteria, you ask whether it is required that any substance and/or article testing of the packaged product include other energetic articles that are being shipped within the same box.

- A6: Test Series 6 requires explosives to be examined in the configuration as intended for transport. For approved substances and articles, limited changes to the configuration may then be authorized as mixed packagings under § 173.61(e).
- Q7: If a manufacturer, company, or individual makes changes to a thermite substance or thermite containing article that a DOT test laboratory determined to be “not Class 1,” you ask whether such changes render any prior approval or determination as “not Class 1” to be invalid.
- A7: The answer is yes. Any modified material that exceeds the parameters authorized by a prior approval meets the definition of a “new” explosive under § 173.56(a). See A4.
- Q8: You describe a manufacturer that has self-classified a substance as Class 4.1 either by carrying out Test Series 1 and 2 of the UN Manual of Test and Criteria, or by defining the substance as already listed in the Hazardous Materials Table (HMT) as a “Flammable Solid.” You ask whether this allows the manufacturer to avoid Test Series 3, 4, and 6 of the UN Manual of Test and Criteria and the need to seek DOT approval prior to shipping the substance or articles.
- A8: The answer is no. Manufacturers may not self-classify substances that are provisionally classified as a Class 1 explosive materials. The DOT-approved laboratories will determine which UN Test Series need to be conducted to make a hazard class recommendation in accordance with the UN Manual of Test and Criteria.
- Q9: You ask whether you may self-classify a new or modified thermite as a Class 4.1, “Flammable Solid” or must a DOT-approved Test Laboratory commence examination of the substance, article, or packaged substance with Test Series 3, 4 and 6 of the UN manual test and criteria.
- A9: The answer is no. All Class 1 explosives require a competent authority approval and are not eligible for self-classification. The explosives test lab would determine the appropriate test configuration. See A1 and A8.
- Q10: You note that a manufacturer has previously self-classified a thermite related substance as Class 4.1 either by carrying out Test Series 1 and 2 of UN Manual of Test and Criteria on the substance only, and thereby self-determining exclusion from Class 1, or by defining the substance as already listed on the Dangerous Goods List as a Flammable Solid. You ask whether there is a time limit that would allow the manufacturer to permanently avoid Test Series 3, 4 and 6 of the UN manual test and criteria and the need to seek DOT approval for the substance or articles prior to shipment.
- A10: The answer is no. See A8 and A9.
- Q11: You ask whether an explosives approval of a “not Class 1” material is only relevant to the entity or person to whom it is addressed. That is, if another entity manufactures the same

substance or article, does the substance or article still meet the definition of a “new explosive” and therefore require its own approval under § 173.56.

- A11: The answer is yes. Under § 173.56(a)(1), the new manufacturer is producing a new explosive and requires its own competent authority approval.
- Q12: It is your understanding of the HMR that explosives approved and manufactured by different entities must seek their own EX number approval. You describe a scenario when an employee (particularly a senior employee such as a president or CEO) of an entity manufactures a substance and has received a “not Class 1” determination from DOT. You ask whether that employee can subsequently take that “not Class 1” determination to another entity and allow the second entity to manufacture and self-classify the substance using the previous determination.
- A12: The answer is no. See A11.
- Q13: You cite the definition for “igniters” and “ignition, means of” in § 173.59 of the HMR. You ask, when classifying an article designed to initiate a thermite or thermate substance, whether PHMSA would expect the device article initiating another device article containing a thermite or thermate substance to be called an igniter and thus require testing by a DOT-approved laboratory. You also ask whether the initiating article would meet the description of a Class 1 Igniter as listed in the § 172.101 Hazardous Materials Table.
- A13: Any article used to initiate a thermite article or substance would need to be evaluated to determine whether it meets any hazard class definition in accordance with the HMR. If the initiating article contains any explosive or pyrotechnic substance, meets the definition of an igniter as described in such as an igniter as defined in § 173.59, or otherwise meets the definition of an explosive in § 173.50, then it must be approved in accordance with § 173.56.
- Q14: You describe an article that contains a mixture of substances which are determined to meet a hazard class other than Class 1. You note that when combined the substances can produce a pyrotechnic effect. You ask whether such an article is automatically excluded from the hazardous materials regulations as an explosive.
- A14: The answer is no. The definition of an explosive or pyrotechnic substance in § 173.50(a) is not based upon the properties of its individual ingredients, but the formulation as a whole. Any article containing an explosive substance is provisionally in Class 1 and must be approved in accordance with § 173.56. See A1.
- Q15: You state that you have a substance contained within an article that is described by a manufacturer as a “propellant.” You ask whether PHMSA expects the substance and any article containing the substance to undergo explosives testing in the UN Manual of Tests and Criteria (i.e. test series 3 and 6 for the substance and test series 4 and 6 for the article).

A15: The answer is yes, provided that the substance meets the definition of an explosive material as described in § 173.50. If any article contains an explosive substance, it must be approved in accordance with § 173.56. See A1.

Q16: You describe a situation where a hazard class recommendation for a substance or article is submitted by a DOT-approved laboratory to PHMSA. You ask whether an “EX” number will be assigned by PHMSA, regardless of whether the approval is issued for Class 1 or Class 4.1.

A16: The answer is yes. PHMSA will issue an approval with an EX number in accordance with § 173.56. The EX number must then be utilized for hazard communication (e.g., markings, labels, or shipping papers) as required by the HMR.

I hope this information is helpful. Please contact us if we can be of further assistance.

Sincerely,

A handwritten signature in blue ink that reads "T. Glenn Foster". The signature is fluid and cursive, with a long horizontal flourish extending to the right.

T. Glenn Foster
Chief, Regulatory Review and Reinvention Branch
Standards and Rulemaking Division

JAN 27 2020

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20th January 2020

Our ref: Technical Note 200120-DOT

Supplemental Questions for the US Department of Transport, Pipeline and Hazardous Materials Safety Administration

References:

1. US Department of Transport, Pipeline and Hazardous Materials Safety Administration, 18-0141, dated May 09 2019.
2. Explosives, Sixth, Completely Revised Edition, Meyer et al 2007.
3. Military and Civilian Pyrotechnics, Dr. Herbert Ellern, 1968.
4. Encyclopedia of Explosives and Related Items, Volume 9, U.S. Army Research and Development Command, Picatinny Arsenal, New Jersey, USA, 1980

Definitions:

1. Thermite, An incendiary composition consisting of 2.75 parts of black iron oxide (ferrosoferric oxide) and 1.0 part of granular aluminum². A mixture that produces very high temperature; derived from the coined and proprietary word Thermit, [through the] reduction of the oxides or respective salts with Aluminum, both in more-or-less finely dispersed state³.
2. Thermate, an incendiary filler consisting of Thermite with additives³; the general name given to a number of mixtures of Thermite and pyrotechnic additives, several of which were developed before and during WWII⁴.

Dear Dirk Der Kinderen,

Firstly let me thank you for your reply, referenced¹ above, to my earlier letter, the response is much appreciated. It was most helpful in increasing my understanding of the US approvals system and the appropriate legislation. Upon discussing your responses, I have some supplementary questions as listed below which I hope you can help me with.

As DOT will be well aware, extractive industries make wide use of explosives and associated energetic products. I write to you to further understand how Thermites and Thermates are required to be classified for transport which is of interest to clients in the oil and gas sector. I am specifically interested in those substances which are classified as Thermite but which then are modified to include gas generating substances such as Teflon (PTFE) and accelerants such as Magnesium, regardless of their quantity, as shown below in Table 1 Thermate Formulations.

Table 1 Thermate Formulations

Ingredient Name	CAS No.	Mixture 1	Mixture 2
Iron Oxide	1309-37-1	>55%	<35%
Aluminum	7429-90-5	<35%	<35%
Polytetrafluoroethylene (PTFE)	9002-84-0	<35%	<15%
Magnesium	7439-95-4	<10%	<5%
Magnesium Sulfate	7487-88-9	-	<25%
Polyethylene Terephthalate	25038-59-9	-	>15%
Acetal Plastic	24969-26-4	-	<30%

I would also like to understand if a Thermite or Thermate substance and a containing device/article can automatically be excluded from testing under the HMR, §173.57 and §173.58 (specifically UN "Class 1" Test Series 3, 4 and 6).

The questions are specifically made with reference to the DOT recent Letter¹, accordingly:

Q1 Reference 1 states that 'Thermite and Thermate would both provide a "practical pyrotechnic effect" as defined by the UN Manual'. As a result my understanding is that any Thermite-based substance is deemed an explosive by definition under HMR, §173.50 ("The term includes pyrotechnic substance or article") and therefore the manufacturer cannot avoid the tests in HMR, §173.57 and §173.58 and submission to the DOT for an approval of the substance and any article(s) which may contain the substance as shipped. Is this correct?

Q2 Are there any exclusions relating to Thermites, Thermates or articles containing Thermite or Thermate substances that would not require such products to receive Competent Authority Approval prior to shipment?

Q3 Are there cases where modifications or replacements of older Thermite or Thermate products could be "grand fathered" or read-across and not be required to undergo the same examination or testing for approval as a totally new product?

For instance, could a substance and/or containing article, having been initially developed before the current format of DOT approved Test Laboratories came into existence, be "grand fathered" as "Not Class 1" thereby allowing the original entity to self-classify modifications to the substance and articles in which it is used if the original classification was that of a non-explosive (e.g. Class 4.1 Flammable Solid)?

If yes, can you provide further insight or information into these cases?

Q4 If a Thermite substance was initially developed prior to the current format of DOT approved test laboratories coming into existence, and, if other substances have since been mixed with this Thermite substance (as mixture 1 in Table 1, which increases the energetic, pyrotechnic and gaseous effect of the substance and article). In your view is this a clear trigger point for the manufacturer to undertake examination of the new substance and containing article(s) per the HMR, §173.56 and test criteria set out in HMR, §173.57 and §173.58 (UN Tests Series 3, 4 and 6)?

Presuming that the addition of substances such as those shown in Table 1 for mixtures 1 and 2 are made to a Thermite composition, or if the percentages of the original or additional substances are later varied, does each set of modifications to the original and approved Thermite composition require a new examination? Are there any exceptions that would remove any or all requirements for retesting under the HMR for this scenario?

Q5 As stated in reference 1, can you clarify the "extensive discussions" that have taken place surrounding the transport classification of Thermites (broadly defined) and Thermite derivatives and whether these discussions have led to any exception, conclusion or recommendation other than that as you state, "Thermite would provide a "practical pyrotechnic effect"?

Q6 During Test Series 6, the UN Test Regulations require that any substance and/or containing article must be packaged as it will be for shipment. Does this require that testing of the

packaged product include any other energetic articles that are being shipped within the same box?

Q7 If the manufacturer or any other company or individual makes any changes to a substance or containing article (as per Q4 and Q6) previously determined by the DOT to be “not Class 1”; do such changes deem any prior approval or determination as “not Class 1” meaningless?

Q8 Conversely if a manufacturer has self-classified a substance as Class 4.1 (either by carrying out Test Series 1 and 2 on the substance only, and thereby allowing exclusion from Class 1, or by defining the substance as already listed on the Dangerous Goods List, as a Flammable Solid), would this allow the manufacturer to avoid Test Series 3, 4 and 6 and the need to seek DOT approval prior to shipping the substance or articles that utilize it?

Q9 Is it true that a manufacturer cannot legally self-classify any new or modified Thermite to be Class 4.1, Flammable Solid, but rather must select a DOT approved Test Laboratory and commence examination of the substance, article or packaged substance or article with Test Series 3, 4 and 6 as per HMR, §173.57 and §173.58?

Q10 If a manufacturer has previously self-classified a Thermite related substance as Class 4.1 (either by carrying out Test Series 1 and 2 on the substance only, and thereby self-determining exclusion from Class 1, or by defining the substance as already listed on the Dangerous Goods List, most likely as a Flammable Solid), and has been shipping it as such for some period of time, is there a time limit that would allow the manufacturer to permanently avoid Test Series 3, 4 and 6 and the need to seek DOT approval for the substance or articles that utilize it?

Q11 Can you clarify whether an explosives approval or a determination as “not Class 1” given by DOT is only relevant to the entity or person it is addressed to? That is, if another entity or person (“Second Individual”) manufactures the same substance or article that has been previously examined and approved for shipment by DOT for a different entity. Does it still meet the definition of a “new explosive”, and are they therefore required to obtain their own testing and approval under §173.56?

Q12 I understand from the HMR that even if an explosive is approved and manufactured by other entities, any new entity choosing to manufacture that same explosive, must seek their own DOT EX approval. However, if an employee (particularly a senior employee e.g. President, CEO) of an entity manufactures a substance and has a “not Class 1” determination for that substance confirmed by the DOT to that employee, can the employee subsequently take that “not Class 1” determination to another entity and allow the second entity to manufacture and self-classify the substance using this determination?

Q13 To quote HMR, §173.59:

- *Igniters.* Articles containing one or more explosive substance used to start deflagration of an explosive train. They may be actuated chemically, electrically, or mechanically. The term excludes: cord, igniter; fuse, igniter; fuse, instantaneous, non-detonating; fuze, igniting; lighters, fuse, instantaneous, non-detonating; fuzes, igniting; lighters, fuse; primers, cap type; and primers, tubular.

- *Ignition, means of.* A general term used in connection with the method employed to ignite a deflagrating train of explosive or pyrotechnic substances (for example: a primer for propelling charge, an igniter for a rocket motor or an igniting fuze).

When classifying an article designed to initiate a Thermite or Thermate substance, would you expect the device initiating another device containing a Thermite or Thermate substance to be called an ignitor?

Can such a device be self-classified or should it be examined by an approved laboratory?

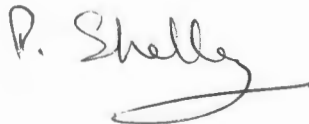
Does it fall under the classification identified for ignitors (all Class 1) in the Hazardous Materials Table in HMR, §172.101?

Q14 If an article only contains a mixture of substances, which by themselves are determined to be classed as something other than Class 1, but when combined produce a practical pyrotechnic effect. Is the containing article automatically excluded from the explosives or hazardous materials regulations? Or does the article require testing and analysis to prove the article is safe to transport?

Q15 If a substance contained within an article is described by a manufacturer as a "propellant", would you expect the substance and any article containing the substance to be UN Class 1 tested (i.e. test series 3 and 6 for the substance and 4 and 6 for the article)?

Q16 If any test reports/recommendations were submitted to the DOT that were obtained through a DOT approved Test Laboratory on a substance or containing article which had gone through Class 1 testing, would an "EX" number be assigned by the DOT for the substance and any device (article) containing the substance, regardless of whether the result of the testing was Class 1 or Class 4.1?

Yours sincerely,



Mr P Shelley BEng (Hons), MISEE, MIExpE

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