

(D) Self-reactive, solid, type C, temperature controlled, 4.1, UN3234.

[Amdt. 173-241, 59 FR 67511, Dec. 29, 1994, as amended by Amdt. 173-242, 60 FR 26806, May 18, 1995; Amdt. 173-246, 60 FR 49110, Sept. 21, 1995; Amdt. 173-256, 61 FR 51338, Oct. 1, 1996; Amdt. 173-261, 62 FR 24734, 24735, May 6, 1997; 62 FR 45702, Aug. 28, 1997; 64 FR 10779, Mar. 5, 1999; 65 FR 58630, Sept. 29, 2000; 66 FR 33431, June 21, 2001; 66 FR 45379, Aug. 28, 2001; 68 FR 45035, July 31, 2003]

§ 173.225 Packaging requirements and other provisions for organic peroxides.

(a) *General.* When the §172.101 table specifies that an organic peroxide be packaged under this section, the organic peroxide must be packaged and offered for transportation in accordance with the provisions of this section. Each packaging must conform to the general requirements of subpart B of part 173 and to the applicable requirements of part 178 of this subchapter. Non-bulk packagings must meet Packing Group II performance levels. To avoid unnecessary confinement, metallic non-bulk packagings meeting Packing Group I are not authorized. No used material, other than production residues or regrind from the same production process, may be used in plastic packagings. Organic peroxides which require temperature control are subject to the provisions of §173.21(f).

(b) *Organic peroxides table.* The following Organic Peroxides Table specifies, by technical name, those organic peroxides that are authorized for transportation and not subject to the approval provisions of §173.128 of this part. An organic peroxide identified by technical name in the following table is authorized for transportation only if it conforms to all applicable provisions of the table. For an organic peroxide not identified in the table by technical name or a formulation of identified organic peroxides, the provisions of paragraph (c) of §173.128 apply. The column headings of the Organic Peroxides Table are as follows:

(1) *Technical name.* The first column specifies the technical name.

(2) *ID number.* The second column specifies the identification (ID) number which is used to identify the proper shipping name in the §172.101 table.

The word "EXEMPT" appearing in the column denotes that the material is not regulated as an organic peroxide.

(3) *Concentration of organic peroxide.* The third column specifies concentration (mass percent) limitations, if any, in mixtures or solutions for the organic peroxide. Limitations are given as minimums, maximums, or a range, as appropriate. A range includes the lower and upper limits (i.e., "53-100" means from, and including, 53 percent to, and including 100 percent). See introductory paragraph of §172.203(k) of this subchapter for additional description requirements for an organic peroxide that may qualify for more than one generic listing, depending on its concentration.

(4) *Concentration of diluents.* The fourth column specifies the type and concentration (mass percent) of diluent or inert solid, when required. Other types and concentrations of diluents may be authorized if approved by the Associate Administrator.

(i) The required mass percent of "Diluent type A" is specified in column 4a. A diluent type A is an organic liquid that does not detrimentally affect the thermal stability or increase the hazard of the organic peroxide and with a boiling point not less than 150 °C at atmospheric pressure. Type A diluents may be used for desensitizing all organic peroxides.

(ii) The required mass percent of "Diluent type B" is specified in column 4b. A diluent type B is an organic liquid which is compatible with the organic peroxide and which has a boiling point, at atmospheric pressure, of less than 150 °C (302 °F) but at least 60 °C (140 °F), and a flash point greater than 5 °C (41 °F). Type B diluents may be used for desensitizing all organic peroxides provided that the boiling point is at least 60 °C (140 °F) above the SADT of the peroxide in a 50 kg (110 lbs) package. A type A diluent may be used to replace a type B diluent in equal concentration.

(iii) The required mass percent of "Inert solid" is specified in column 4c. An inert solid is a solid that does not detrimentally affect the thermal stability or increase the hazard of the organic peroxide.

(5) *Concentration of water.* Column 5 specifies, in mass percent, the minimum amount of water, if any, which must be in formulation.

(6) *Packing method.* Column 6 specifies the highest packing method (largest packaging capacity) authorized for the organic peroxide. Lower numbered packing methods (smaller packaging capacities) are also authorized. For example, if OP3 is specified, then OP2 and OP1 are also authorized. The designation "IBC" means Special Provision IB52 in §172.102 of this subchapter applies. The designation "Bulk" means paragraph (e) of this section applies. When an IBC or bulk packaging is au-

thorized and meets the requirements of paragraph (e) of this section, lower control temperatures than those specified for non-bulk packagings may be required. The Table of Packing Methods in paragraph (d) of this section defines the non-bulk packing methods.

(7) *Temperatures.* Column 7a specifies the control temperature. Column 7b specifies the emergency temperature. Temperatures are specified only when temperature controls are required. (See §173.21(f)).

(8) *Notes.* Column 8 specifies other applicable provisions, as set forth in notes following the table.

ORGANIC PEROXIDE TABLE

Technical name (1)	ID number (2)	Concentration (mass %) (3)	Diluent (mass %)			Water (mass %) (5)	Packing method (6)	Temperature (°C)		Notes (8)
			A (4a)	B (4b)	I (4c)			Control (7a)	Emergency (7b)	
Acetyl acetone peroxide	UN3105	≤42	≥48			≥8	OP7			2
Acetyl acetone peroxide [as a paste]	UN3106	≤32					OP7			21
Acetyl benzoyl peroxide	UN3105	≤45	≥55				OP7			
Acetyl cyclohexanesulfonyl peroxide	UN3112	≤82				≥12	OP4	-10	0	
Acetyl cyclohexanesulfonyl peroxide	UN3115	≤32		≥68			OP7	-10	0	
tert-Amyl hydroperoxide	UN3107	≤88	≥6			≥6	OP8			
tert-Amyl peroxyacetate	UN3107	≤62	≥38				OP8			
tert-Amyl peroxybenzoate	UN3103	≤100					OP5			
tert-Amyl peroxy-2-ethylhexanoate	UN3115	≤100					OP7	+20	+25	
tert-Amyl peroxy-2-ethylhexyl carbonate	UN3105	≤100					OP7			
tert-Amyl peroxyneodecanoate	UN3115	≤77		≥23			OP7	0	+10	
tert-Amyl peroxyvalerate	UN3113	≤77		≥23			OP5	+10	+15	
tert-Amylperoxy-3,5,5-trimethylhexanoate	UN3101	≤100					OP5			
tert-Butyl cumyl peroxide	UN3105	>42 – 100					OP7			1, 9
tert-Butyl cumyl peroxide	UN3106	≤42		≥58			OP7			1, 9
n-Butyl-4,4-di-(tert-butylperoxy)valerate	UN3103	>52 – 100					OP5			
n-Butyl-4,4-di-(tert-butylperoxy)valerate	UN3106	≤52		≥48			OP7			
n-Butyl-4,4-di-(tert-butylperoxy)valerate	UN3108	≤42		≥58			OP8			
tert-Butyl hydroperoxide	UN3103	>79 – 90				≥10	OP5			13
tert-Butyl hydroperoxide	UN3105	≤80	≥20				OP7			4, 13
tert-Butyl hydroperoxide	UN3107	≤79				>14	OP8			13, 16
tert-Butyl hydroperoxide	UN3109	≤72				≥28	OP8, IBC, Bulk.			13, 14
tert-Butyl hydroperoxide [and] Di-tert-butylperoxide	UN3103	<82+>9				≥7	OP5			13
tert-Butyl monoperoxymaleate	UN3102	>52 – 100					OP5			
tert-Butyl monoperoxymaleate	UN3103	≤52	≥48				OP6			
tert-Butyl monoperoxymaleate	UN3108	≤52		≥48			OP8			
tert-Butyl monoperoxymaleate [as a paste]	UN3108	≤52					OP8			
tert-Butyl monoperoxymaleate [as a paste]	UN3110	≤42					OP8			
tert-Butyl monoperoxyphthalate	UN3102	≤100					OP5			
tert-Butyl peroxyacetate	UN3109	≤32	≥68				OP8, IBC			
tert-Butyl peroxyacetate	UN3103	>32 – 52	≥48				OP6			
tert-Butyl peroxyacetate	UN3109	≤32	≥68				OP8			
tert-Butyl peroxyacetate	UN3119	≤32	≥68				Bulk	+30	+35	
tert-Butyl peroxyacetate	UN3109	≤22	≥78				OP8			14
tert-Butyl peroxybenzoate	UN3103	>77 – 100	≤23				OP5			
tert-Butyl peroxybenzoate	UN3105	>52 – 77	≥23				OP7			1
tert-Butyl peroxybenzoate	UN3106	≤52		≤48			OP7			
tert-Butyl peroxybutyl fumarate	UN3105	≤52	≥48				OP7			
tert-Butyl peroxycrotonate	UN3105	≤77	≥23				OP7			
tert-Butyl peroxydiethylacetate	UN3113	≤100					OP5	+20	+25	

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ORGANIC PEROXIDE TABLE—Continued

Technical name (1)	ID number (2)	Concentration (mass %) (3)	Diluent (mass %)			Water (mass %) (5)	Packing method (6)	Temperature (°C)		Notes (8)
			A (4a)	B (4b)	I (4c)			Control (7a)	Emergency (7b)	
tert-Butyl peroxydiethylacetate [and] tert-Butyl peroxybenzoate.	UN3105	≤33+≤33	≥33				OP7			
tert-Butyl peroxy-2-ethylhexanoate	UN3113	>52–100					OP6	+20	+25	
tert-Butyl peroxy-2-ethylhexanoate	UN3117	>32–52	≥48				OP8	+30	+35	
tert-Butyl peroxy-2-ethylhexanoate	UN3118	≤52		≥48			OP8	+20	+25	
tert-Butyl peroxy-2-ethylhexanoate	UN3119	≤32	≥68				OP8	+40	+45	
tert-Butyl peroxy-2-ethylhexanoate	UN3119	≤32	≥68				IBC	+30	+35	
tert-Butyl peroxy-2-ethylhexanoate	UN3119	≤32	≥68				Bulk	+15	+20	14
tert-Butyl peroxyneodecanoate [as a stable dispersion in water].	UN3117	≤52					OP8, IBC	0	+10	
tert-Butyl peroxyneodecanoate [as a stable dispersion in water].	UN3119	≤42					IBC	-5	+5	
tert-Butyl peroxy-2-ethylhexanoate [and] 2,2-di-(tert-Butylperoxy)butane.	UN3115	≤31+≤36	≥33				OP7	+35	+40	
tert-Butyl peroxy-2-ethylhexanoate [and] 2,2-di-(tert-Butylperoxy)butane.	UN3106	≤12+≤14	≥14		≥60		OP7			
tert-Butyl peroxy-2-ethylhexylcarbonate	UN3105	≤100					OP7			
tert-Butyl peroxyisobutyrate	UN3111	>52–77	≥23				OP5	+15	+20	
tert-Butyl peroxyisobutyrate	UN3115	≤52	≥48				OP7	+15	+20	
tert-Butylperoxy isopropylcarbonate	UN3103	≤77	≥23				OP5			
1-(2-tert-Butylperoxy isopropyl)-3- isopropenylbenzene	UN3105	≤77	≥23				OP7			
1-(2-tert-Butylperoxy isopropyl)-3- isopropenylbenzene	UN3108	≤42		≥58			OP8			
tert-Butyl peroxy-2-methylbenzoate	UN3103	≤100					OP5			
tert-Butyl peroxyneodecanoate	UN3119	≤32	≥68				OP8, IBC	0	+10	
tert-Butyl peroxyneodecanoate	UN3115	≤77	≥23				OP7	0	+10	
tert-Butyl peroxyneodecanoate [as a stable dispersion in water (frozen)].	UN3118	≤42					OP8	0	+10	
tert-Butyl peroxyneodecanoate	UN3119	≤32	≥68				IBC	0	+10	
tert-Butyl peroxyneohexanoate	UN3115	≤77	≥23				OP7	0	+10	
tert-Butyl peroxyneodecanoate [as a stable dispersion in water].	UN3119	≤42					OP8, IBC	-5	+5	
3-tert-Butylperoxy-3-phenylphthalide	UN3106	≤100					OP7			
tert-Butyl peroxy-pivalate	UN3113	>67–77	≥23				OP5	0	+10	
tert-Butyl peroxy-pivalate	UN3115	≤67	≥33				OP7	0	+10	
tert-Butyl peroxy-pivalate	UN3119	≤27	≥73				Bulk	+5	+10	14
tert-Butyl peroxy-pivalate	UN3119	≤27	≥73				OP8	+30	+35	
tert-Butyl peroxy-pivalate	UN3119	≤27	≥73				IBC	+10	+15	
tert-Butylperoxy stearylcarbonate	UN3106	≤100					OP7			
tert-Butyl peroxy-3,5,5-trimethylhexanoate	UN3109	≤32	≥68				OP8, IBC			

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tert-Butyl peroxy-3,5,5-trimethylhexanoate	UN3109	≤32	≥68			OP8				
tert-Butyl peroxy-3,5,5-trimethylhexanoate	UN3119	≤32	≥68			Bulk	+35	+40	14	
3-Chloroperoxybenzoic acid	UN3102	>57-86			≥14	OP1				
3-Chloroperoxybenzoic acid	UN3106	≤77			≥6	OP7				
3-Chloroperoxybenzoic acid	UN3106	≤57			≥3	OP7				
Cumyl hydroperoxide	UN3107	>90-98	≤10			OP8			13	
Cumyl hydroperoxide	UN3109	≤90	≥10			OP8, IBC, Bulk.			13, 14, 15	
Cumyl peroxyneodecanoate	UN3115	≤77	≥23			OP7	-10	0		
Cumyl peroxyneodecanoate	UN3115	≤77	≥23			OP7	-10	0		
Cumyl peroxyneodecanoate [as a stable dispersion in water]	UN3119	≤52				OP8	-10	0		
Cumyl peroxyneodecanoate [as a stable dispersion in water]	UN3119	≤52				IBC	-15	-5		
Cumyl peroxyvalate	UN3115	≤77	≥23			OP7	-5	+5		
Cyclohexanone peroxide(s)	UN3104	≤91			≥9	OP6			13	
Cyclohexanone peroxide(s)	UN3105	≤72	≥28			OP7			5	
Cyclohexanone peroxide(s) [as a paste]	UN3106	≤72				OP7			5, 21	
Cyclohexanone peroxide(s)	Exempt	≤32			≥68	Exempt.				
Diacetone alcohol peroxides	UN3115	≤57	≥26		≥8	OP7	+40	+45	5	
Diacetyl peroxide	UN3115	≤27	≥73			OP7	+20	+25	8,13	
Di-tert-amyl peroxide	UN3107	≤100				OP8				
1,1-Di-(tert-amylperoxy)cyclohexane	UN3103	≤82	≥18			OP6				
Dibenzoyl peroxide	UN3102	>51-100			≤48	OP2			3	
Dibenzoyl peroxide	UN3102	>77-94				OP4			3	
Dibenzoyl peroxide	UN3104	≤77			≥23	OP6				
Dibenzoyl peroxide	UN3106	≤62			≥28	OP7				
Dibenzoyl peroxide [as a paste]	UN3106	>52-62				OP7			21	
Dibenzoyl peroxide [as a paste]	UN3108	≤56.5			≥15	OP8				
Dibenzoyl peroxide	UN3106	>35-52			≥48	OP7				
Dibenzoyl peroxide [as a paste]	UN3108	≤52				OP8			21	
Dibenzoyl peroxide	UN3107	>36-42	≥18		≤40	OP8				
Dibenzoyl peroxide	UN3107	>36-42	≥58			OP8				
Dibenzoyl peroxide [as a stable dispersion in water]	UN3109	≤42				OP8, IBC				
Dibenzoyl peroxide	Exempt	≤35			≥65	Exempt				
Dibenzoyl peroxydicarbonate	UN3112	≤87			≥13	OP5	+25	+30		
Di-(4-tert-butylcyclohexyl)peroxydicarbonate	UN3114	≤100				OP6	+30	+35		
Di-(4-tert-butylcyclohexyl) peroxydicarbonate [as stable dispersion in water]	UN3119	≤42				OP8, IBC	+30	+35		
Di-tert-butyl peroxide	UN3107	>32-100				OP8				
Di-tert-butyl peroxide	UN3109	≤52	≥48			OP8, IBC, Bulk.			14, 24	
Di-tert-butyl peroxide	UN3109	≤32	≥68			Bulk			14	
Di-tert-butyl peroxyazolate	UN3105	≤52	≥48			OP7				
2,2-Di-(tert-butylperoxy)butane	UN3103	≤52	≥48			OP6				
1,1-Di-(tert-butylperoxy)cyclohexane	UN3101	>80-100				OP5				
1,1-Di-(tert-butylperoxy)cyclohexane	UN3103	>52-80	≥20			OP5				
1,1-Di-(tert-butylperoxy)cyclohexane	UN3105	≤52	≥48			OP7				
1,1-Di-(tert-butylperoxy)cyclohexane	UN3106	≤42	≥13		≥45	OP7				
1,1-Di-(tert-butylperoxy) cyclohexane	UN3109	≤42	≥58			OP8, IBC				
1,1-Di-(tert-butylperoxy)cyclohexane	UN3107	≤27	≥36			OP8			22	

ORGANIC PEROXIDE TABLE—Continued

Technical name (1)	ID number (2)	Concentration (mass %) (3)	Diluent (mass %)			Water (mass %) (5)	Packing method (6)	Temperature (°C)		Notes (8)
			A (4a)	B (4b)	I (4c)			Control (7a)	Emergency (7b)	
1,1-Di-(tert-butylperoxy)cyclohexane	UN3109	≤25	≥25	≥50			OP8			
1,1-Di-(tert-butylperoxy)cyclohexane	UN3109	≤13	≥13	≥74			OP8			
Di-n-butyl peroxydicarbonate	UN3115	>27–52		≥48			OP7	–15	–5	
Di-n-butyl peroxydicarbonate [as a stable dispersion in water (frozen)]	UN3118	≤42					OP8	–15	–5	
Di-n-butyl peroxydicarbonate	UN3117	≤27		≥73			OP8	–10	0	
Di-n-Propyl peroxydicarbonate	UN3113	≤100					OP3	–25	–15	
Di-sec-butyl peroxydicarbonate	UN3113	>52–100					OP4	–20	–10	6
Di-sec-butyl peroxydicarbonate	UN3115	≤52		≥48			OP7	–15	–5	
Di-(2-tert-butylperoxyisopropyl)benzene(s)	UN3106	>42–100			≤57		OP7			1, 9
Di-(2-tert-butylperoxyisopropyl)benzene(s)	Exempt	≤42			≥58		Exempt			
Di-(tert-butylperoxy)phthalate	UN3105	>42–52	≥48				OP7			
Di-(tert-butylperoxy)phthalate [as a paste]	UN3106	≤52					OP7			21
Di-(tert-butylperoxy)phthalate	UN3107	≤42	≥58				OP8			
2,2-Di-(tert-butylperoxy)propane	UN3105	≤52	≥48				OP7			
2,2-Di-(tert-butylperoxy)propane	UN3106	≤42	≥13		≥45		OP7			
1,1-Di-(tert-butylperoxy)-3,3,5-trimethylcyclohexane	UN3101	>90–100					OP5			
1,1-Di-(tert-butylperoxy)-3,3,5-trimethylcyclohexane	UN3103	>57–90	≥10				OP5			
1,1-Di-(tert-butylperoxy)-3,3,5-trimethylcyclohexane	UN3105	≤77		≥23			OP7			
1,1-Di-(tert-butylperoxy)-3,3,5-trimethylcyclohexane	UN3106	≤57			≥43		OP7			
1,1-Di-(tert-butylperoxy)-3,3,5-trimethylcyclohexane	UN3107	≤57	≥43				OP8			
1,1-Di-(tert-butylperoxy)-3,3,5-trimethylcyclohexane	UN3107	≤32	≥26	≥42			OP8			
Dicetyl peroxydicarbonate	UN3116	≤100					OP7	+30	+35	
Dicetyl peroxydicarbonate [as a stable dispersion in water]	UN3119	≤42					OP8, IBC	+30	+35	
Di-4-chlorobenzoyl peroxide	UN3102	≤77			≥23		OP5			
Di-4-chlorobenzoyl peroxide [as a paste]	UN3106	≤52					OP7			21
Di-4-chlorobenzoyl peroxide	Exempt	≤32			≥68		Exempt			
Dicumyl peroxide	UN3109	>52–100		≤48			OP8, IBC, Bulk.			9, 11, 14
Dicumyl peroxide	UN3110	>52–100		≤48			OP8, IBC, Bulk.			9, 11, 14
Dicumyl peroxide	Exempt	≤52	≥48				Exempt			
Dicumyl peroxide	Exempt	≤52			≥48		Exempt			
Dicyclohexyl peroxydicarbonate	UN3112	>91–100					OP3	+5	+10	
Dicyclohexyl peroxydicarbonate	UN3114	≤91			≥9		OP5	+5	+10	
Didecanoyl peroxide	UN3114	≤100					OP6	+30	+35	
2,2-Di-(4,4-di(tert-butylperoxy)cyclohexyl)propane	UN3106	≤42			≥58		OP7			
2,2-Di-(4,4-di(tert-butylperoxy)cyclohexyl)propane	UN3107	≤25		≥75			OP8			
Di-2,4-dichlorobenzoyl peroxide	UN3102	≤77				≥23	OP5			
Di-2,4-dichlorobenzoyl peroxide [as a paste with silicone oil]	UN3106	≤52					OP7			
Di-(2-ethylhexyl) peroxydicarbonate	UN3113	>77–100					OP5	–20	–10	

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2,2-Di-(4,4-di-(tert-butylperoxy cyclohexyl) propane	UN3107	≤22	≥78			OP8		
Di-(2-ethylhexyl) peroxydicarbonate [as a stable dispersion in water].	UN3119	≤52				IBC	-20	-10
Di-(2-ethoxyethyl) peroxydicarbonate	UN3115	≤52	≥48			OP7	-10	0
Di-(2-ethylhexyl) peroxydicarbonate	UN3115	≤77	≥23			OP7	-15	-5
Di-(2-ethylhexyl) peroxydicarbonate [as a stable dispersion in water].	UN3117	≤62				OP8	-15	-5
Di-(2-ethylhexyl) peroxydicarbonate [as a stable dispersion in water].	UN3119	≤52				OP8	-15	-5
Di-(2-ethylhexyl) peroxydicarbonate [as a stable dispersion in water (frozen)].	UN3118	≤42				OP8	-15	-5
Diethyl peroxydicarbonate	UN3115	≤27	≥73			OP7	-10	0
2,2-Dihydroperoxypropane	UN3102	≤27		≥73		OP5		
Di-(1-hydroxycyclohexyl)peroxide	UN3106	≤100				OP7		
Diisobutyl peroxide	UN3111	>32-52	≥48			OP5	-20	-10
Diisobutyl peroxide	UN3115	≤32	≥68			OP7	-20	-10
Diisopropylbenzene dihydroperoxide	UN3106	≤82	≥5		≥5	OP7		
Diisopropyl peroxydicarbonate	UN3112	>52-100				OP2	-15	-5
Diisopropyl peroxydicarbonate	UN3115	≤52	≥48			OP7	-20	-10
Diisopropyl peroxydicarbonate	UN3115	≤28	≥72			OP7	-15	-5
Diisotridecyl peroxydicarbonate	UN3115	≤100				OP7	-10	0
Dilauroyl peroxide	UN3106	≤100				OP7		
Dilauroyl peroxide [as a stable dispersion in water]	UN3109	≤42				OP8, IBC		
Di-(2-methylbenzoyl)peroxide	UN3112	≤87			≥13	OP5	+30	+35
Di-(3-methoxybutyl) peroxydicarbonate	UN3115	≤52	≥48			OP7	-5	+5
Di-(3-methylbenzoyl) peroxide + Benzoyl (3-methylbenzoyl) peroxide +Dibenzoyl peroxide.	UN3115	≤20	≥58			OP7	+35	+40
		+≤18						
		+≤4						
Di-(4-methylbenzoyl)peroxide [as a paste with silicone oil]	UN3106	≤52				OP7		
2,5-Dimethyl-2,5-di- (benzoylperoxy)hexane	UN3102	>82-100				OP5		
2,5-Dimethyl-2,5-di- (benzoylperoxy)hexane	UN3104	≤82			≥18	OP5		
2,5-Dimethyl-2,5-di-(benzoylperoxy)hexane	UN3106	≤82		≥18		OP7		
2,5-Dimethyl-2,5-di-(tert- butylperoxy)hexane	UN3105	>52-100				OP7		
2,5-Dimethyl-2,5-di-(tert- butylperoxy)hexyne-3	UN3101	>87-100				OP5		
2,5-Dimethyl-2,5-di-(tert- butylperoxy)hexyne-3	UN3103	>52-86	≥14			OP5		
2,5-Dimethyl-2,5-di-(tert- butylperoxy)hexane	UN3106	≤52		≥48		OP7		
2,5-Dimethyl-2,5-di-(tert- butylperoxy)hexane	UN3109	≤52	≥48			OP8		
2,5-Dimethyl-2,5-di-(tert- butylperoxy)hexyne-3	UN3106	≤52		≥48		OP7		
2,5-Dimethyl-2,5-di-(tert- butylperoxy)hexane [as a paste]	UN3108	≤47				OP8		
2,5 Dimethyl 2,5 di-2-ethylhexanoylperoxy hexane	UN3113	≤100				OP5	+20	+25
2,5-Dimethyl-2,5-di-(tert-butylperoxy)hexane	UN3108	≤77		≥23		OP8		
2,5-Dimethyl-2,5-di-(tert-butylperoxy)hexyne-3	UN3101	>86-100				OP5		
2,5-Dimethyl-2,5-dihydroperoxyhexane	UN3104	≤82		≥18		OP7		
2,5-Dimethyl-2,5-di-(3,5,5- trimethylhexanoylperoxy)hexane	UN3105	≤77	≥23			OP7		
1,1-Dimethyl-3- hydroxybutylperoxyneohexanoate	UN3117	≤52	≥48;			OP8	+0	+10
Dimyristyl peroxydicarbonate	UN3116	≤100				OP7	+20	+25
Dimyristyl peroxydicarbonate [as a stable dispersion in water]	UN3119	≤42				OP8	+20	+25
Dimyristyl peroxydicarbonate [as a stable dispersion in water].	UN3119	≤42				IBC	+15	+20
Di-(2-neodecanoylperoxyisopropyl)benzene	UN3115	≤52	≥48			OP7	-10	0

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ORGANIC PEROXIDE TABLE—Continued

Technical name (1)	ID number (2)	Concentration (mass %) (3)	Diluent (mass %)			Water (mass %) (5)	Packing method (6)	Temperature (°C)		Notes (8)
			A (4a)	B (4b)	I (4c)			Control (7a)	Emergency (7b)	
Di-n-nonanoyl peroxide	UN3116	≤100					OP7	0	+10	
Di-n-octanoyl peroxide	UN3114	≤100					OP5	+10	+15	
Diperoxy azelaic acid	UN3116	≤27			≥73		OP7	+35	+40	
Diperoxy dodecane diacid	UN3116	>13–42			≥58		OP7	+40	+45	
Diperoxy dodecane diacid	Exempt	≤13			≥87		Exempt.			
Di-(2-phenoxyethyl)peroxydicarbonate	UN3102	>85–100					OP5			
Di-(2-phenoxyethyl)peroxydicarbonate	UN3106	≤85				≥15	OP7			
Dipropionyl peroxide	UN3117	≤27		≥73			OP8	+15	+20	
Di-n-propyl peroxydicarbonate	UN3113	≤100					OP3	-25	-15	
Di-n-propyl peroxydicarbonate	UN3113	≤77		≥23			OP5	-20	-10	
Distearyl peroxydicarbonate	UN3106	≤87			≥13		OP7			
Disuccinic acid peroxide	UN3102	>72–100					OP4			18
Disuccinic acid peroxide	UN3116	≤72				≥28	OP7	+10	+15	
Di-(3,5,5-trimethyl-1,2-dioxolanyl-3)peroxide [as a paste]	UN3116	≤52					OP7	+30	+35	21
Di-(3,5,5-trimethylhexanoyl)peroxide	UN3115	>38–82	≥18				OP7	0	+10	
Di-(3,5,5-trimethylhexanoyl)peroxide [as a stable dispersion in water]	UN3119	≤52					OP8, IBC	+10	+15	
Di-(3,5,5-trimethylhexanoyl)peroxide	UN3119	≤38	≥62				OP8	+20	+25	
Di-(3,5,5-trimethylhexanoyl)peroxide	UN3119	≤38	≥62				IBC	+10	+15	
Di-(3,5,5-trimethylhexanoyl) peroxide	UN3119	≤38	≥62				Bulk	-5	+5	14
Ethyl 3,3-di-(tert-amylperoxy)butyrate	UN3105	≤67	≥33				OP7			
Ethyl 3,3-di-(tert-butylperoxy)butyrate	UN3103	>77 - 100					OP5			
Ethyl 3,3-di-(tert-butylperoxy)butyrate	UN3105	≤77	≥23				OP7			
Ethyl 3,3-di-(tert-butylperoxy)butyrate	UN3106	≤52		≥48			OP7			
3,3,6,6,9,9-Hexamethyl-1,2,4,5-tetraoxacyclononane	UN3102	>52 - 100					OP4			
3,3,6,6,9,9-Hexamethyl-1,2,4,5-tetraoxacyclononane	UN3105	≤52	≥48				OP7			
3,3,6,6,9,9-Hexamethyl-1,2,4,5-tetraoxacyclononane	UN3106	≤52		≥48			OP7			
tert-Hexyl peroxyneodecanoate	UN3115	≤71	≥29				OP7	0	+10	
tert-Hexyl peroxy-pivalate	UN3115	≤72		≥28			OP7	+10	+15	
Isopropylcumyl hydroperoxide	UN3109	≤72	≥28				OP8, IBC, Bulk.			13, 14 ROW≤
p-Menthyl hydroperoxide	UN3105	> 72 - 100					OP7			13
p-Menthyl hydroperoxide	UN3109	≤72	≥28				OP8, IBC, Bulk.			14
Methylcyclohexanone peroxide(s)	UN3115	≤67		≥33			OP7	+35	+40	
Methyl ethyl ketone peroxide(s)	UN3101	≤52	≥48				OP5			5, 13
Methyl ethyl ketone peroxide(s)	UN3105	≤45	≥55				OP7			5
Methyl ethyl ketone peroxide(s)	UN3105	≤37	≥55		≥8		OP7			5
Methyl ethyl ketone peroxide(s)	UN3107	≤40	≥60				OP8			5
Methyl isobutyl ketone peroxide(s)	UN3105	≤62	≥19				OP7			5, 23
Organic peroxide, liquid, sample	UN3103						OP2			12

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Organic peroxide, liquid, sample, temperature controlled	UN3113	OP2	12
Organic peroxide, solid, sample	UN3104	OP2	12
Organic peroxide, solid, sample, temperature controlled	UN3114	.....	.....	.....	.....	OP2	.....	.....	12
Peracetic acid with not more than 26% hydrogen peroxide	UN3109	≤17	.....	.....	≥27	OP8	.....	.....	13
Peroxyacetic acid with not more than 20% hydrogen peroxide	Exempt	≤6	.....	.....	≥60	Exempt	.....	.....	28
Peroxyacetic acid with not more than 26% hydrogen peroxide	UN3109	≤17	.....	.....	.....	OP8, IBC	.....	.....	13, 20, 28
Peroxyacetic acid with 7% hydrogen peroxide	UN3107	≤36	.....	.....	≥15	OP8	.....	.....	13, 20, 28
Peracetic acid with 7% hydrogen peroxide	UN3107	≤36	.....	.....	≥15	OP8	.....	.....	13
Peroxyacetic acid, type D, stabilized	UN3105	≤43	.....	.....	.....	OP7	.....	.....	13, 20
Peroxyacetic acid, type E, stabilized	UN3107	≤43	.....	.....	.....	OP8	.....	.....	13, 20
Peroxyacetic acid, type F, stabilized	UN3109	≤43	.....	.....	.....	OP8, IBC	.....	.....	13, 20, 28
Peroxyacetic acid, distilled, Type F, stabilized	UN3119	≤41	.....	.....	.....	Bulk	+30	+35	14, 27, 28
Pinanyl hydroperoxide	UN3105	56-100	.....	.....	.....	OP7	.....	.....	13
Pinanyl hydroperoxide	UN3109	≤56	>44	.....	.....	OP8, Bulk	.....	.....	14
Tetrahydronaphthyl hydroperoxide	UN3106	≤100	.....	.....	.....	OP7	.....	.....	13
1,1,3,3-Tetramethylbutyl hydroperoxide	UN3105	≤100	.....	.....	.....	OP7	.....	.....	13
1,1,3,3-Tetramethylbutylperoxy-2-ethylhexanoate	UN3115	≤100	.....	.....	.....	OP7	+20	+25	13, 20
1,1,3,3-Tetramethylbutyl peroxyneodecanoate	UN3115	≤72	.....	≥28	.....	OP7	-5	+5	13, 20, 28
1,1,3,3-Tetramethylbutyl peroxyneodecanoate [as a stable dispersion in water].	UN3119	≤52	.....	.....	.....	OP8, IBC	-5	+5	14, 27, 28
1,1,3,3-Tetramethylbutyl peroxy phenoxyacetate	UN3115	≤37	.....	≥63	.....	OP7	-10	0	13
3,6,9-Triethyl-3,6,9-trimethyl-1,4,7-triperoxonane	UN3105	≤42	.....	≥58	.....	OP7	.....	.....	26

NOTES:

1. For domestic shipments, OP8 is authorized.
2. Available oxygen must be <4.7 percent.
3. For concentrations <80 percent OP5 is allowed. For concentrations of at least 80 percent but <85 percent, OP4 is allowed. For concentrations of at least 85 percent, maximum package size is OP2.
4. The diluent may be replaced by di-tert-butyl peroxide.
5. Available oxygen must be ≤9 percent.
6. For domestic shipments, OP5 is authorized.
7. [RESERVED]
8. Only non-metallic packagings are authorized.
9. For domestic shipments, this material may be packaged in bulk packagings under the provisions of paragraph (e)(3)(xii) of this section.
10. [RESERVED]
11. Up to 2000 kg per container authorized.
12. Samples may only be offered for transportation under the provisions of paragraph (c)(2) of this section.
13. "Corrosive" subsidiary risk label is required.
14. This material may be transported in bulk packagings under the provisions of paragraph (e) of this section.
15. No "Corrosive" subsidiary risk label is required for concentrations below 80%.
16. With <6% di-tert-butyl peroxide.
17. With ≥8% 1-isopropylhydroperoxy-4-isopropylhydroxybenzene.
18. Addition of water to this organic peroxide will decrease its thermal stability.
19. [Reserved]
20. Mixtures with hydrogen peroxide, water and acid(s).
21. With diluent type A, with or without water.
22. With >36 percent, by mass, ethylbenzene.
23. With >19 percent, by mass, methyl isobutyl ketone.
24. Diluent type b with boiling point >100 C.
25. No "Corrosive" subsidiary risk label is required for concentrations below 56%.
26. Available oxygen must be ≤ 7.6%.
27. Formulations derived from distillation of peroxyacetic acid originating from peroxyacetic acid in a concentration of not more than 41% with water, total active oxygen less than or equal to 9.5% (peroxyacetic acid plus hydrogen peroxide).
28. For the purposes of this section, the names "Peroxyacetic acid" and "Peracetic acid" are synonymous.

(c) *New organic peroxides, formulations and samples.* (1) Except as provided for samples in paragraph (c)(2) of this section, no person may offer for transportation an organic peroxide which is not identified by technical name in the Organic Peroxides Table of this section, or a formulation of one or more organic peroxides which are identified by technical name in that table, unless the organic peroxide is assigned a generic type and shipping description and is approved by the Associate Administrator under the provisions of § 173.128(c) of this subchapter.

(2) *Samples.* Samples of new organic peroxides or new formulations of organic peroxides identified in the Organic Peroxides Table in paragraph (b) of this section, for which complete test data are not available, and which are to be transported for further testing or product evaluation, may be assigned an appropriate shipping description for organic peroxide Type C, packaged and offered for transportation, under the following conditions:

(i) Data available to the person offering the material for transportation must indicate that the sample would pose a level of hazard no greater than that of an organic peroxide Type B and that the control temperature, if any, is sufficiently low to prevent any dangerous decomposition and sufficiently high to prevent any dangerous phase separation;

(ii) The sample must be packaged in accordance with packing method OP2, for a liquid or solid, respectively;

(iii) Packages of the organic peroxide may be offered for transportation and transported in a quantity not to exceed 10 kg (22 pounds) per transport vehicle; and

(iv) One of the following shipping descriptions must be assigned:

(A) Organic peroxide Type C, liquid, 5.2, UN 3103;

(B) Organic peroxide Type C, solid, 5.2, UN 3104;

(C) Organic peroxide Type C, liquid, temperature controlled, 5.2, UN 3113; or

(D) Organic peroxide Type C, solid, temperature controlled, 5.2, UN 3114.

(3) *Mixtures.* Mixtures of organic peroxides individually identified in the Organic Peroxides Table in paragraph (b) of this section may be classified as the same type of organic peroxide as that of the most dangerous component and be transported under the conditions for transportation given for this type. If the stable components form a thermally less stable mixture, the SADT of the mixture must be determined and the new control and emergency temperature derived under the provisions of § 173.21(f).

(d) *Packing Method Table.* Packagings for organic peroxides and self-reactive substances are listed in the Maximum Quantity per Packing Method Table. The packing methods are designated OP1 to OP8. The quantities specified for each packing method represent the maximum that is authorized.

(1) The following types of packagings are authorized:

(i) Drums: 1A1, 1A2, 1B1, 1B2, 1D, 1G, 1H1, 1H2;

(ii) Jerricans: 3A1, 3A2, 3B1, 3B2, 3H1, 3H2;

(iii) Boxes: 4C1, 4C2, 4D, 4F, 4G, 4H1, 4H2, 4A, 4B; or

(iv) Composite packagings with a plastic inner receptacle: 6HA1, 6HA2, 6HB1, 6HB2, 6HC, 6HD1, 6HD2, 6HG1, 6HG2, 6HH1, 6HH2.

(2) Metal packaging (including inner packagings of combination packagings and outer packagings of combination or composite packagings) are used only for packing methods OP7 and OP8.

(3) In combination packagings, glass receptacles are used only as inner packagings with a maximum content of 0.5 kg or 0.5 L.

(4) The maximum quantity per packaging or package for Packing Methods OP1–OP8 must be as follows:

MAXIMUM QUANTITY PER PACKAGING/PACKAGE FOR PACKING METHODS OP1 TO OP8

Maximum quantity	Packing method							
	OP1	OP2 ¹	OP3	OP4 ¹	OP5	OP6	OP7	OP8
Solids and combination packagings (liquid and solid) (kg)	0.5	0.5/10	5	5/25	25	50	50	≈200

MAXIMUM QUANTITY PER PACKAGING/PACKAGE FOR PACKING METHODS OP1 TO OP8—Continued

Maximum quantity	Packing method							
	OP1	OP2 ¹	OP3	OP4 ¹	OP5	OP6	OP7	OP8
Liquids (L)	0.5	.....	5	.....	30	60	60	³ 225

¹ If two values are given, the first applies to the maximum net mass per inner packaging and the second to the maximum net mass of the complete package.

² 60 kg for jerricans and 100 kg for boxes.

³ 60 L for jerricans.

(e) *Bulk packagings for organic peroxides.* The following bulk packagings are authorized:

(1) *Rail cars.* Class DOT 103, 104, 105, 109, 111, 112, 114, 115, or 120 fusion-weld tank car tank are authorized. DOT 103W, 111A60F1 and 111A60W1 tank car tanks must have bottom outlets effectively sealed from inside. Gauging devices are required on DOT 103W tank car tanks. Riveted tank car tanks are not authorized.

(2) *Cargo tanks.* Specification MC 307, MC 310, MC 311, MC 312, DOT 407, and DOT 412 cargo tank motor vehicles with a tank design pressure of at least 172 kPa (25 psig) are authorized.

(3) *Portable tanks.* The following requirements apply to portable tanks intended for the transport of Type F organic peroxides or Type F self-reactive substances. DOT 51, 57, IM 101 portable tanks, and UN portable tanks that conform to the requirements of T23 (see § 172.102(c)(7) of this subchapter), when T23 is specified in Column (7) of the § 171.101 Table of this subchapter for the Type F organic peroxide or Type F self-reactive substance. Type F organic peroxide or self-reactive substance formulations other than those indicated in T23 may be transported in portable tanks if approved by the Associate Administrator. The following conditions also apply:

(i) The portable tank must be designed for a test pressure of at least 0.4 MPa (4 bar).

(ii) Portable tanks must be fitted with temperature-sensing devices.

(iii) Portable tanks must be fitted with pressure relief devices and emergency-relief devices. Vacuum-relief devices may also be used. Pressure relief devices must operate at pressures determined according to both the properties of the hazardous material and the construction characteristics of the

portable tank. Fusible elements are not allowed in the shell.

(iv) The pressure relief devices must consist of reclosing devices fitted to prevent significant build-up within the portable tank of the decomposition products and vapors released at a temperature of 50 °C (122 °F). The capacity and start-to-discharge pressure of the relief devices must be in accordance with the applicable requirements of this subchapter specified for the portable tank. The start-to-discharge pressure must in no case be such that liquid would escape from the pressure relief devices if the portable tank were overturned.

(v)(A) The emergency-relief devices may be of the reclosing or frangible types, or a combination of the two, designed to vent all the decomposition products and vapors evolved during a period of not less than one hour of complete fire engulfment as calculated by the following formula:

$$q = 70961 F A^{0.82}$$

Where:

q = heat absorption (W)

A = wetted area (m²)

F = insulation factor (-)

(B) Insulation factor (F) in the formula in paragraph (e)(3)(v)(A) of this section equals 1 for non-insulated vessels and for insulated vessels F is calculated using the following formula:

$$F = \frac{U(923 - T_{PO})}{47032}$$

Where:

U = K/L = heat transfer coefficient of the insulation (W·m⁻²·K⁻¹); where K = heat conductivity of insulation layer (W·m⁻¹·K⁻¹), and L = thickness of insulation layer (m).

T_{PO} = temperature of material at relieving conditions (K).

(vi) The start-to-discharge pressure of emergency-relief devices must be higher than that specified for the pressure relief devices in paragraph (e)(3)(iv) of this section. The emergency-relief devices must be sized and designed in such a way that the maximum pressure in the shell never exceeds the test pressure of the portable tank.

NOTE TO PARAGRAPH (E)(3)(VI): An example of a method to determine the size of emergency-relief devices is given in Appendix 5 of the UN Manual of Tests and Criteria (incorporated by reference, see §171.7 of this subchapter).

(vii) For insulated portable tanks, the capacity and setting of emergency-relief devices must be determined assuming a loss of insulation from 1 percent of the surface area.

(viii) Vacuum-relief devices and reclosing devices on portable tanks used for flammable hazardous materials must be provided with flame arresters. Any reduction of the relief capacity caused by the flame arrester must be taken into account and the appropriate relief capacity must be provided.

(ix) Service equipment such as devices and external piping must be designed and constructed so that no hazardous material remains in them after filling the portable tank.

(x) Portable tanks may be either insulated or protected by a sun-shield. If the SADT of the hazardous material in the portable tank is 55 °C (131 °F) or less, the portable tank must be completely insulated. The outer surface must be finished in white or bright metal.

(xi) The degree of filling must not exceed 90% at 15 °C (59 °F).

(xii) DOT 57 metal portable tanks are authorized only for tert-butyl cumyl peroxide, di-(2-tert-butylperoxyisopropyl)-benzene(s), dicumyl peroxide and mixtures of two or more of these peroxides. DOT 57 portable tanks must conform to the venting requirements of paragraph (e)(5) of this section. These portable tanks are not subject to any other requirements of paragraph (e) of this section.

(4) For tertiary butyl hydroperoxide (TBHP), each tank car, cargo tank or portable tank must contain 7.6 cm (3.0

inches) low density polyethylene (PE) saddles having a melt index of at least 0.2 grams per 10 minutes (ASTM D1238, condition E) as part of the lading, with a ratio of PE to TBHP over a range of 0.008 to 0.012 by mass. Alternatively, plastic or metal containers equipped with fusible plugs having a melting point between 69 °C (156 °F) and 71 °C (160 °F) and filled with a sufficient quantity of water to dilute the TBHP to 65 percent or less by mass may be used. The PE saddles must be visually inspected after each trip and, at a minimum, once every 12 months, and replaced when discoloration, fracture, severe deformation, or other indication of change is noted.

(5) *IBCs*. IBCs are authorized subject to the conditions and limitations of this section if the IBC type is authorized according to Special Provision IB52 (see §172.102(c)(4) of this subchapter), as applicable, and the IBC conforms to the requirements in subpart O of part 178 of this subchapter at the Packing Group II performance level. The additional requirements in paragraphs (e)(5)(i) and (e)(5)(ii) of this section also apply. Type F organic peroxides or self-reactive substances that are not authorized for a specific IBC may be transported in IBCs other than those specified in IB52 if approved by the Associate Administrator.

(i) IBCs shall be provided with a device to allow venting during transportation. The inlet to the pressure relief device shall be sited in the vapor space of the IBC under maximum filling conditions during transportation.

(ii) To prevent explosive rupture of metal IBCs or composite IBCs with complete metal casing, the emergency-relief devices shall be designed to vent all the decomposition products and vapors evolved during self-accelerating decomposition or during a period of not less than one hour of complete fire-engulfment as calculated by the formula in paragraph (e)(3)(v) of this section. The control and emergency temperatures specified in IB52 are based on a non-insulated IBC.

[Amdt. 173–224, 55 FR 52643, Dec. 21, 1990]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting § 173.225, see the List of CFR

Sections Affected which appears in the Finding Aids section of the printed volume and on GPO Access.

§ 173.226 Materials poisonous by inhalation, Division 6.1, Packing Group I, Hazard Zone A.

Division 6.1, Packing Group I, materials that are poisonous by inhalation and that fall within the boundaries of Hazard Zone A in the graph found in § 173.133 must be packed in non-bulk packagings in accordance with the following paragraphs:

(a) In seamless specification cylinders conforming to the requirements of § 173.40. However, a welded cylinder filled before October 1, 2002, may be transported for reprocessing or disposal of the cylinder's contents until December 31, 2003.

(b) In 1A1, 1B1, 1H1, 1N1, or 6HA1 drums further packed in a 1A2 or 1H2 drum. Both inner and outer drums must conform to the performance test requirements of subpart M of part 178 of this subchapter at the Packing Group I performance level. The outer drum must have a minimum thickness of 1.35 mm (0.053 inch) for a 1A2 outer drum or 6.30 mm (0.248 inch) for a 1H2 outer drum. Outer 1A2 and 1H2 drums must withstand a hydrostatic test pressure of 100 kPa (15 psig). Capacity of the inner drum may not exceed 220 L (58 gallons). In addition, the inner drum must—

(1) Be capable of satisfactorily withstanding the hydrostatic pressure test in § 178.605 of this subchapter at a test pressure of 550 kPa (80 psig);

(2) Satisfactorily withstand the leakproofness test in § 178.604 of this subchapter using an internal air pressure of at least twice the vapor pressure at 55 °C (131 °F) of the material to be packaged;

(3) Have screw-type closures that are—

(i) Closed and tightened to a torque prescribed by the closure manufacturer, using a device that is capable of measuring torque;

(ii) Physically held in place by any means capable of preventing back-off or loosening of the closure by impact or vibration during transportation; and

(iii) Provided with a cap seal that is properly applied in accordance with the cap seal manufacturer's recommenda-

tions and is capable of withstanding an internal pressure of at least 100 kPa (15 psig).

(4) Have a minimum thickness as follows:

(i) If the capacity of the inner drum is less than or equal to 120 L (32 gallons), the minimum thickness of the inner drum is—

(A) For a 1A1 or 1N1 drum, 1.3 mm (0.051 inch);

(B) For a 1B1 drum, 3.9 mm (0.154 inch);

(C) For a 1H1 drum, 3.16 mm (0.124 inch); and

(D) For a 6HA1 drum, the plastic inner container shall be 1.58 mm (0.0622 inch) and the outer steel drum shall be 0.96 mm (0.0378 inch).

(ii) If the capacity of the inner drum is greater than 120 L (32 gallons), the thickness of the inner drum is—

(A) For a 1A1 or 1N1 drum, 1.7 mm (0.067 inch);

(B) For a 1B1 drum, 4.7 mm (0.185 inch);

(C) For a 1H1 drum, 3.16 mm (0.124 inch); and

(D) For a 6HA1 drum, the plastic inner container shall be 1.58 mm (0.0622 inch) and the outer steel drum shall be 1.08 mm (0.043 inch); and

(5) Be isolated from the outer drum by a shock-mitigating, non-reactive material.

(c) In combination packagings, consisting of an inner packaging system and an outer packaging, as follows:

(1) *Outer packagings:*

Steel drum: 1A2
 Aluminum drum: 1B2
 Metal drum, other than steel or aluminum:
 1N2
 Plywood drum: 1D
 Fiber drum: 1G
 Plastic drum: 1H2
 Wooden barrel: 2C2
 Steel jerrican: 3A2
 Plastic jerrican: 3H2
 Aluminum jerrican: 3B2
 Steel box: 4A
 Aluminum box: 4B
 Natural wood box: 4C1 or 4C2
 Plywood box: 4D
 Reconstituted wood box: 4F
 Fiberboard box: 4G
 Expanded plastic box: 4H2
 Solid plastic box: 4H2

(2) *Inner packaging system.* The inner packaging system consists of two packagings: an impact-resistant receptacle