



Organic Peroxide Producers  
Safety Division

# SAFE TRANSPORT OF ORGANIC PEROXIDES BEST PRACTICES

**This is presented by the Organic Peroxide Producers Safety Division of the American Chemistry Council (ACC).**



This is an adaptation of a document of the same name originally written by the European Organic Peroxide Safety Group (EOPSG). The American Chemistry Council (ACC) Organic Peroxide Producers Safety Division (OPPSD) would like to thank the EOPSG for allowing the use.

This brochure is intended to provide general information on the transport of organic peroxides. It is not intended to serve as legal advice, a substitute for in-depth training or specific handling or storage requirements, nor is it designed or intended to define or create legal rights or obligations. This brochure is not intended to be a "how-to" manual or a prescriptive guide. All persons involved in the transport of organic peroxides have an independent obligation to ascertain that their actions are in compliance with current federal, state and local laws and regulations and should consult with legal counsel concerning such matters. The brochure is necessarily general in nature and individual companies may vary their approach with respect to particular practices based on specific factual circumstance, the practicality and effectiveness of particular actions and economic and technological feasibility. Any mention of specific products in this brochure is for illustration purposes only and is not intended as a recommendation or endorsement of such products.

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## PURPOSE

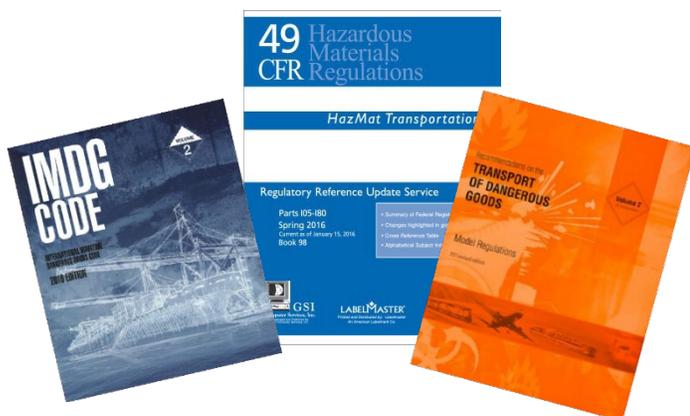


This brochure provides guidelines regarding practical safety aspects in handling and transport operations of organic peroxides for road and sea transport.

The existing transport regulations give the general framework for the legal requirements of safe transportation. The transport regulations, however, do not fully describe technical equipment, procedures for operational issues like pre-loading, truck and/or container preparation, combined loading, instruction manuals, hand-over procedures and emergency procedures. These aspects are important for safe handling, transport and operation.

This brochure was compiled by the European Organic Peroxide Safety Group (EOPSG) and the Organic Peroxides Producers Safety Division (OPPSD) of the American Chemistry Council (ACC). The members of these organizations are Arkema, LyondellBasell, Nouryon, Pergan and United Initiators. The procedures outlined in this manual are used by OPPSD members internally.

# REGULATORY ASPECTS OF ORGANIC PEROXIDE TRANSPORTATION



## More Recent Publications

As organic peroxides are mainly transported by road and sea, the main transport rules for dangerous goods are the United States Department of Transportation regulations in Title 49 of the Code of Federal Regulations (road) and International Maritime Organization (IMO) International Maritime Dangerous Goods Code (IMDG) (sea). Organic peroxides are categorized in division 5.2 according to the classification principles in the UN Recommendations on the Transport of Dangerous Goods (UN-RTDG).

Organic peroxide types are assigned to UN-numbers based on their properties, their physical state (liquid/solid) and whether temperature control is required (**Table 1**). In addition, some organic peroxides may have subsidiary risks such as corrosive, explosive, or environmentally hazardous.

**Table 1**

Organic Peroxide Type	UN number			
	Not Temperature Controlled		Temperature Controlled	
	Liquid	Solid	Liquid	Solid
<b>A</b>	*	*	*	*
<b>B</b>	3101	3102	3111	3112
<b>C</b>	3103	3104	3113	3114
<b>D</b>	3105	3106	3115	3116
<b>E</b>	3107	3108	3117	3118
<b>F</b>	3109	3110	3119	3120
<b>G</b>	**	**	**	*

\* Organic Peroxides of Type A are not accepted for transport

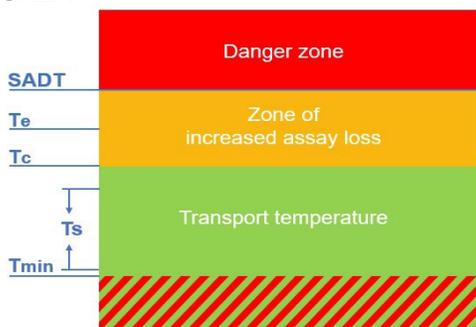
\*\* Organic Peroxides of Type G are not subject to the provisions applicable to class 5.2.

## TEMPERATURE CONTROL

For safety reasons, and to preserve quality, some organic peroxides must be transported and handled under refrigerated conditions, whereas other peroxides can be shipped and handled at ambient temperature. Im- proper transport conditions could lead to an uncontrolled decomposition.

### *Relevant temperatures for organic peroxides*

#### **SADT**



The Self-Accelerating Decomposition Temperature is defined as the lowest temperature at which self-accelerating decomposition may occur in a substance within one week in the packaging as used in transport. If you exceed the SADT, thermal decomposition will occur which may result in a fire. This temperature is used to determine the temperatures required to safely transport organic peroxides. For temperature controlled organic peroxides the following temperatures apply:

#### **Control Temperature**

It is the temperature an organic peroxide formulation must be at or below when offered for transport. If the shipped goods exceed this temperature, corrective measures must be initiated to avoid reaching the emergency temperature.

#### **Emergency Temperature**

It is the temperature at which emergency procedures shall be implemented (see: Section 10. Emergency Response Procedures). As mentioned, both of these temperatures ( $T_C$  and  $T_E$ ) are derived from the SADT. If the SADT of an organic peroxide formulation is less than or equal to  $50^\circ\text{C}$ , then the  $T_C$  and  $T_E$  are listed in the organic peroxide tables in the transport regulations and are mentioned in the transport documents. If the SADT is greater than  $50^\circ\text{C}$ , then no explicit transportation temperatures are listed. But in cases where the organic peroxide is being transported or warehoused in hot geographic regions, temperature control should be used, particularly for organic peroxide formulations that have an SADT below  $65^\circ\text{C}$ .

#### **Set Temperature For Transport ( $T_s$ )**

For improved safety and quality reasons, the recommended maximum set temperature,  $T_s$ , is lower than  $T_C$  and higher than  $T_{\min}$ . In some cases, non-temperature controlled organic peroxides will be transported under temperature controlled conditions for quality reasons.

#### **Minimum Transport Temperature**

The minimum transport temperature ( $T_{\min}$ ) must be followed because in some products dangerous phase separation of the peroxide from the diluent, crystal deposits or solidification can occur. Product-specific temperature data can be found on the product label and Safety Data Sheet (e.g., Sections 7, 9 or 14).

## SAFE PACKAGING OF ORGANIC PEROXIDES FOR TRANSPORT

Organic peroxides (Type B-F) are packed in special packaging:

- With UN approval.
- With volumes/quantities as given in the packing instructions.
- Made of compatible materials like HDPE plastics, stainless steel, etc.
- Provided with vented caps (if necessary for some specific products).
- With readily visible and legible labels with the correct UN-number and proper shipping name, as well as the class 5.2 label and, if required, any subsidiary hazard labels.

To allow a product to be transported in IBCs or tanks, additional tests must prove that adequate emergency relief and/or venting is guaranteed.



Either plastic or wooden pallets may be used during storage or transportation of packaged organic peroxides.

### **It is important to ensure that:**

- The pallets are new, dry and clean.
- The pallets are free of dirt and any materials that may damage the packaging, such as nails sticking out, etc.
- The goods are palletized in a safe and stable manner and secured well with film pallet wrap or other suitable means.

# SAFE PREPARATION FOR LOADING, STORAGE & UNLOADING OF CONTAINERS OR TRUCKS

Several measures are taken for safe preparation, loading, stowage and unloading of containers or trucks. For organic peroxides the key elements are:

## General aspects

- All activities must be carried out by well-trained experienced personnel and third-party service providers.
- All temperature controlled organic peroxides are pre- cooled to or below the set-temperature ( $T_S$ ).
- If a variety of organic peroxides are transported together, then  $T_S$  is always based on the product with the lowest control temperature ( $T_C$ ), taking also into consideration the minimum transport temperature ( $T_{min}$ ) if applicable.
- The member companies of the OPPSD have stowage plans in place taking into consideration different control temperatures, solid/liquid stowage, etc.

## Securing cargo

- Blocking, bracing, and lashing must be done according to applicable standards.
- Suitable stowage and bracing of the cargo with ample air- circulation must be applied.

## Stowage-plans

- For temperature controlled organic peroxides, a stowage plan must be considered if different organic peroxides are combined inside one reefer container. Therefore, stowage plans must be available.

## Documentation & Checklist

- ✓ Evidence for correct loading, stowage and temperature along the transport-chain has to be provided. This should include adequate documentation, such as:
  - checklists,
  - illustrated documentation (photo) of loading and stowage
- ✓ Pre-Trip Inspection (PTI) and temperature records for temperature controlled organic peroxides must be organized by the shipper and/or its third parties.

CONTAINER STOWAGE PLAN ISCC-Code 7.1.2.3

Order No. \_\_\_\_\_ Refer. cont. No. \_\_\_\_\_

REFRIGERATION UNIT		
STOWING POSITION	Gross weight kg	Lit. No.
Product		

DOOR SIDE

Working temperature of refrigeration: \_\_\_\_\_ °C

Control temperature: \_\_\_\_\_ °C

Emergency temperature: \_\_\_\_\_ °C

## SPECIAL TRANSPORT EQUIPMENT

### Non-temperature controlled transport

For non-temperature controlled organic peroxides no specific transport equipment is necessary, however, the transport regulations must be followed (e.g., closed trucks or dry box container).

In addition, for non-temperature controlled products where, for safety reasons, the  $T_{\min}$  has to be respected, temperature control (i.e., keeping the product above the crystallization temperature) must be applied and the appropriate transport equipment must be selected.

### Temperature controlled transport

#### Road transport

Temperature controlled products are transported in refrigerated trucks, reefer containers or tanks with at least thermal insulation and cooling unit(s). It is strongly recommended that the cooling unit(s) be mechanical and capable of working independently from the truck engine. The trucks should have both an optical and acoustic alarm that recognizes and indicates when the alarm temperature is exceeded. The temperature of the cooling compartment should always be readable in the truck driver's cabin. It is standard practice to use mechanical or digital temperature recorders for monitoring the transport temperature.

Spare parts for refrigeration must be available at roadside service providers or in the truck. Further, transport companies must have lists of service providers for the refrigeration system along the transport route.

#### Sea transport

Temperature controlled organic peroxides for sea transport are shipped in refrigerated containers (reefers) or refrigerated tank containers. These containers are equipped with a redundant (double) cooling system or, in special cases, a single unit (only where allowed according to IMDG code).

OPPSD members use GPS/CMS for reefers with redundant cooling systems to receive an early warning regarding temperature deviations.



## ESCORTING

Escorting provides the organized, planned supervision of reefer containers on every transit point in the transport chain. This is done by a qualified escorting person (company's employee or third party who must have received dedicated training). Escorting makes sure that the reefer container is working properly and maintains the correct temperature.



Elements of the escorting procedures are:

- Presence of the escorting person during loading procedure of the container on the ship.
- Handover of sea transport instruction, transport emergency card and Dangerous Goods Declaration (DGD) in the reefer container manual to responsible ship's officer.
- Check of reefer-position on the ship (accessibility of doors and cooling units) and inform the carrier in case of deviations.
- Check of fuel-level of diesel generator whenever the container is loaded on the ship.
- Verification of correct connection with electric power supply of the ship and reefer container settings.
- Explanation of reefer function as well as location of spare parts to responsible ship's officer.
- Availability of escorting person for answering questions.
- Signature of the hand-over protocol by ship's responsible officer.

## ARRANGING SAFE INTERMEDIATE STORAGE IN THE TRANSPORT CHAIN

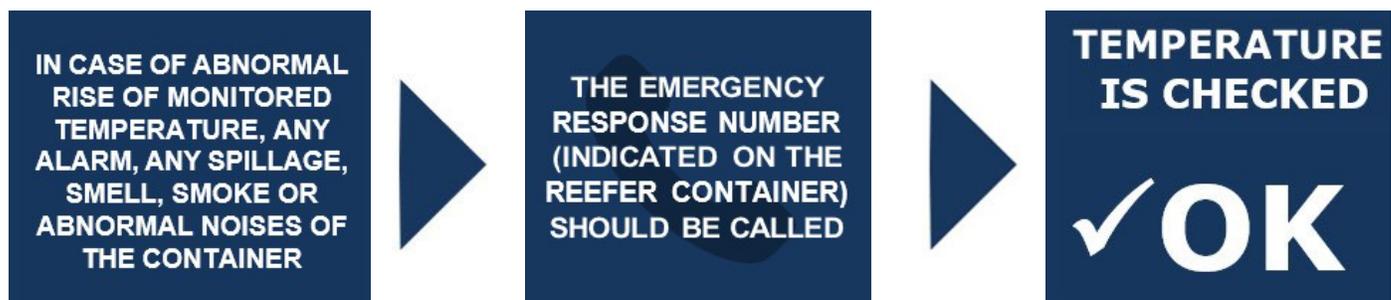
Direct transfers from vessel to trailer, or vice versa, are preferable. Intermediate storage, e.g., during trans-shipments, should be reduced to a minimum. In general, reefer containers and dry boxes are regarded as inherently not suitable to permanently store organic peroxides. If unavoidable, respect the following principles:

### General

- Take provisions against unauthorized access and theft.
- Prohibit smoking in the area around the peroxide container/tank.
- Avoid heating the containers, such as by sunlight or other sources of heating.
- Store in shaded places.
- Make appropriate technical and organizational resources and emergency responders available for emergency situations (see also Section 10. **Emergency Response Procedures**).

### For reefers

- Keep doors and machinery accessible
- Ensure proper electrical connection and operation
- Keep set temperature for the product secured
- Consider checks and records with a frequency not longer than 4 hours to verify that:
  - the cooling units are working properly
  - reefer-container is controlling at the set temperature
- In addition, OPPSD members use GPS/CSM-monitoring systems to recognize temperature deviations in an early stage.
- A checklist showing that the reefer was in full working order prior to road-transport or at scheduled transit ports is required.



## DEALING WITH MIXED LOADING AND SEGREGATION

As most organic peroxides are of the same hazard division (5.2), and consequently have the same properties, they can be stowed together in one container or transport unit. Even if a product has a subsidiary hazard label or mark (e.g., corrosive, explosive, environmentally hazardous), it can be stowed together with any other organic peroxide. Further information on the segregation of hazardous materials is available in 49 CFR 177.848. Nevertheless, compatibility of other co-loaded goods with organic peroxides must be taken into consideration as well as transport regulatory segregation rules. Organic peroxides must not be shipped in one container together with foodstuffs or pharmaceuticals.



### Segregation

Class	5.2	5.2 + 1	5.2 + 8	5.2 + "N"	9	4.1
5.2	✓	✓	✓	✓	✓	✓
5.2 + 1		✓	✓	✓	✓	✓
5.2 + 8			✓	✓	✓	✓
5.2 + "N"				✓	✓	✓
4.1					✓	✓

**5.2** = Organic Peroxide

**1** = Explosive

**8** = Corrosive

**"N"** = Environmentally hazardous substance

**9** = Miscellaneous dangerous goods

**4.1** = Flammable Substance (Type G Organic Peroxide, UN1325)

✓ = Co-loading allowed

## EMERGENCY RESPONSE PROCEDURES

Despite the hazards associated with organic peroxides due to their high reactivity, they can be transported safely if the relevant regulations and adequate precautions are followed.

### Deviations

However, any deviation of normal transport conditions must be considered potentially dangerous and treated accordingly.

Examples of deviations from normal transport conditions include:

- Abnormal rise of monitored temperature above  $T_s$
- Any alarm
- Malfunctioning of cooling units
- Any spillages/leakages
- Odors and smoke coming from the container or fire
- Traffic accidents

### Emergency response 24 hours/7 days

Call CHEMTREC at 1-800-424-9300, an emergency response number available 24 hours a day (in Canada call CANUTEC at 1-888-CANUTEC). Immediate technical assistance in emergency response will be given.

The following information should be kept available in case of emergency calls:

- Your contact details
- Name of the vessel and position (only for sea transport)
- Carrier
- Container ID (for reefers)
- Location (for road transport)
- Product type (UN number), product name and quantity
- Nature of the incident and its development
- Corrective actions undertaken
- If available recorded temperature values
- Current temperature of the cargo

## Recommended actions when deviations occur

Abnormal rise of temperature above  $T_S$ , any alarm or malfunctioning cooling units:

- If temperature is checked regularly, deviation will be recognized in early stage and as a result there will be ample time for emergency measures
- Always call the emergency response number

Any spillage/leakages:

- Ensure proper personal protection (Maintain proper distance and use proper personal protective equipment (PPE) as indicated in the SDS when investigating.)
- Avoid all sources of ignition
- Stop the leak if possible
- Use non-combustible absorbent materials or clean with plenty of water. Do not use Vermiculite, Peat Moss, or Oil-Dry®. Refer to the manufacturer's SDS for acceptable absorbents.

Smell and smoke coming from the container or fire:

- Ensure proper personal protection (Maintain proper distance and use proper personal protective equipment (PPE) as indicated in the SDS when investigating.)
- Maintain safety distance
- Alert emergency responders
- Avoid all sources of ignition
- Fight fire from a safe distance and cool surroundings and surface of container
- On ships: Alert the crew

## Traffic accidents

Check if cargo is affected by the incident and if cooling system (if applicable) is still working. In case of deviations see above and inform authority.

For more information, contact producer and/or consult available emergency procedures in the Emergency Response Guidebook (ERG) guide, which helps satisfy DOT/Transport Canada requirement that hazmat shipments be accompanied by emergency response information.

## **AVAILABLE TRAINING, EDUCATION AND TRAINING MATERIAL**

OPPSD members can provide training material.

Specialists can provide dedicated transport safety training. This training can give in depth information on organic peroxides as well as their safe transport and safe handling. The content of such training can be tailored to the specific needs of the target group who can be:

- Employees in logistics
- External warehouse employees
- Carriers
- Agents
- Shipping lines
- Reefer container service providers
- Operators in ports of departure, transit and arrival
- Customers
- Authorities

Such transport safety training includes:

- Transport regulations, classification, and temperature control aspects
- Packaging and related issues
- Preparation, loading, stowage and unloading of the container or truck
- Transport equipment and escorting
- Intermediate storage
- Documentation, statements and checklists
- Incidents and emergency response

For more information and assistance do not hesitate to contact your supplier or consult the OPPSD bulletin entitled Safety and Handling Organic Peroxides.

## LIST OF ABBREVIATIONS

Abbreviation	Meaning
ACC	American Chemistry Council
CANUTEC	Canadian Transport Emergency Centre
CMS	Control Management System
DGD	Dangerous Goods Declaration
DOT	United States Department of Transportation
EmS	Emergency response procedures for ships carrying dangerous goods
EOPSG	European Organic Peroxide Safety Group
ERG	Emergency Response Guidebook
ERI-card	Emergency Response Intervention Card
GPS	Global Positioning System
GSM	Global System for Mobile Communications
HDPE	High Density Polyethylene
IBC	Intermediate Bulk Container
IMDG	International Maritime Code for Dangerous Goods
IMO	International Maritime Organization
OPPSD	Organic Peroxide Producers Safety Division
PTI	Pre-Trip Inspection
SADT	Self Accelerating Decomposition Temperature
$T_C$	Control Temperature
$T_E$	Emergency Temperature
$T_{min}$	Minimum Transport Temperature
$T_S$	Set Temperature
UN-RTDG	United Nations Recommendations on the Transport of Dangerous Goods

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