

Safe Transportation Recommendations for Chemicals Used in Demonstrations or Educational Activities

American Chemical Society Committee on Chemical Safety

July 2021

Introduction

U.S. Department of Transportation (USDOT) regulations allow for the safe transport of small amounts of hazardous materials for their use in chemical demonstrations and other educational activities such as National Chemistry Week without burdening the educator with transportation documents or vehicle placarding. The exemption is called *Materials of Trade Exceptions* and the regulations are found in 49CFR173.6.

The quantity of material is limited by its Hazard Class/Division and Packing Group. The Hazard Class is a very general description of the type of material while the Packing Group is a general description of level of hazard the material possesses during transportation:

Hazard Class and Division	Description
1	Explosives
2	Gases
Division 2.1	Flammable Gases
Division 2.2	Non-Flammable/Non Toxic Gases under pressure
Division 2.3	Toxic Gases
3	Flammable Liquids
4	Other Flammable Substances
Division 4.1	Flammable Solids
Division 4.2	Substances liable for spontaneous combustion
Division 4.3	Substances which, in contact with water, will emit flammable gas
5	Oxidizing Substances/Organic Peroxides
Division 5.1	Oxidizers
Division 5.2	Organic Peroxides
6	Toxic/Poisonous and Infectious Substances
Division 6.1	Toxic Substances
Division 6.2	Infectious Substances
7	Radioactive Materials
8	Corrosives
9	Miscellaneous Dangerous Goods

Packing Group	Description
I	Great Danger
II	Medium Danger
III	Minor Danger

The Proper Shipping Name, Hazard Class/Division and Packing Groups are assigned by regulation and can be found in the Hazardous Materials Table, 49CFR172.101. For example, gasoline is Hazard Class 3, Packing Group II (or, abbreviated, HC3, PGII). Establishing a proper shipping name is a key step in deciding how to package and transport hazardous materials.

It does not matter if the chemical is purchased at the hardware or grocery store. However, when transported for demonstrations or educational activities, the chemical is subject to USDOT regulations. For example, methylene chloride, a common paint stripper, when purchased at the hardware store can be transported home without regulation. However, the same chemical, purchased at the same location, when used for a demonstration or other educational purpose becomes Hazard Class/Division 6.1 and is subject to DOT regulations.

The quantity limits found in 49CFR173.6 are subject to regulatory changes and the latest version should always be consulted before making a determination if your demonstration chemicals can be safely transported. As of this writing (December 2013), the limits for Materials of Trade Exceptions are:

Hazard Class / Division	Quantity Limitation (container OR actual amount)
1	FORBIDDEN
3, 8, 9, 4.1, 5.1, 5.2, 6.1,	PG I: 0.5 kg/0.5 L; PGII, PGIII or ORM-D (Note 1): 30 kg/30 L
9	1500 L, diluted to < 2%
2.1 or 2.1	Cylinder with gross wt < 100 kg
4.3	PGII or PGIII: < 30 mL
6.2	See regulations
Self- Reactive, Poison by Inhalation or Hazardous Waste	Forbidden

Note 1: ORM-D was previously a marking for shipping meaning "Other Regulated Material for Domestic Transport Only." The classification was eliminated effective 12/31/2020.

Requirements and Guidelines

Requirements

There are several regulatory requirements that must be followed when transporting hazardous material under the Materials of Trade Exception:

- **Explosives (All Hazard Class/Division 1) are not eligible for Materials of Trade Exception.**
- **All self-reactive, poison-by-inhalation materials or hazardous waste materials are not eligible for Materials of Trade Exception, regardless of Hazard Class or Division.**
- Packaging must be leak-tight for liquids and gases, sift-proof for solids.
- Packages must be securely closed, protected against shifting during transport, and protected against damage.
- Each material must be packaged in the manufacturer's original packaging **or** a packaging of equal or greater strength and integrity.
- Outer packaging is not required for receptacles (e.g., cans/bottles) that are secured against shifting in cages, carts, bins, boxes or compartments.
- For transportation of gasoline, the packaging must be of metal or plastic (no glass) and conform with other USDOT and DOL/OSHA (Occupational Safety and Health Administration) regulations (specifically 29 CFR 1910.106(d)(2)).
- Compressed gas cylinders containing Division 2.1 or 2.2 gases must conform to DOT regulations.
- All non-bulk packaging of a Material of Trade must be marked with the common or proper shipping name to identify the material; the letters "RQ" must be added if the "Reportable Quantity" is exceeded. Reportable Quantities are found in the *Consolidated List of Chemicals Subject to the Emergency Planning and Community Right-to-Know Act (EPCRA) and Section 112(r) of the Clean Air Act, as Amended*, or better known by the short title "SARA Title III List of Lists."
- If transporting a bulk packaged diluted mixture of Hazard Class 9 material, the package must be marked on two opposing sides with the 4-digit identification number, displayed on the proper placard. If there is any question regarding this section, consult a professional knowledgeable in the regulations before transporting.
- Compressed gas cylinders must be marked and labeled as specified in USDOT regulations.
- The operator of the motor vehicle must be informed of the presence of the hazardous material, if there is a Reportable Quantity, and the requirements of 49CFR173.6.
- With few exceptions, the aggregate gross weight of all chemicals in a motor vehicle must not exceed 200 kg.

Guidelines

- **Attempt to use chemicals unregulated by the Department of Transportation whenever possible.**
- Determine the proper shipping name/basic description when preparing documentation or lists. Use the “Transportation” section of the manufacturer’s Safety Data Sheet for this. Do not attempt to make this determination on your own unless you have been properly trained in accordance with DOT Hazardous Materials Regulations. Be aware that there may be inaccurate or insufficient information on the SDS regarding transportation, so it may be beneficial to confirm proper shipping names in the DOT Hazardous Materials Table which can be found at: <http://www.gpo.gov/fdsys/pkg/CFR-2008-title49-vol2/pdf/CFR-2008-title49-vol2-sec172-101.pdf>. Additionally, there is a useful training module on determining proper shipping names from the U.S. Department of Transportation: <http://phmsa.dot.gov/hazmat/training/publications/modules>
- **Transport only the minimum amount of material in the lowest concentration commensurate with the demonstration or educational activity.**
- Packaging must be chemically compatible with the chemical.
- Label all containers with the identity of the chemical and its concentration.
- Place individual containers in a suitable secondary containment capable of containing the aggregate quantity of material.
- Segregate chemicals to prevent reaction in the event of a spill.
- Avoid glass containers whenever possible.
- Cushion all liquids with absorbent material.
- Pack a spill kit containing appropriate personal protective equipment in the event of a spill.

Notes

- After the demo is completed, transportation of waste and surplus chemicals must comply with the same DOT requirements as described above. Since state hazardous waste transport regulations differ, check with your state for specific requirements.
- Some private automobile insurance is void when hazardous materials are transported. Be sure to check with your own insurance carrier for their requirements and restrictions.

References

Materials of trade exceptions. 49 CFR 173.6, accessed electronically at: <http://www.gpo.gov/fdsys/pkg/CFR-2011-title49-vol2/pdf/CFR-2011-title49-vol2-sec173-6.pdf>, 28 December 2013.

Table of Hazardous Materials and Special Provisions. 49CFR172.101 et seq., accessed electronically at: <http://www.gpo.gov/fdsys/pkg/CFR-2011-title49-vol2/pdf/CFR-2011-title49-vol2-part172.pdf>, 28 December 2013.

Hazard Communication. 29CFR1910.1200, accessed electronically at: https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10099, 28 December 2013.

Prudent Practices in the Laboratory: Handling and Management of Chemicals. Updated Edition. National Research Council. National Academies Press: Washington, D.C. 2011. p. 102.