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Safe Transportation Recommendations for Chemicals Used in Demonstrations or Educational Activities

U.S. Department of Transportation (USDOT) regulations allow for the safe transportation 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 49 CFR 173.6.

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

The proper shipping name, Hazard Class/Division, and Packing Group are assigned by regulation and can be found in the Hazardous Materials Table, 49 CFR 172.101. 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 store or the grocery store. 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 USDOT regulations.

PACKING GROUP	DESCRIPTION
I	Great Danger
II	Medium Danger
III	Minor Danger

HAZARD CLASS/ DIVISION	DESCRIPTION
Class 1	**Explosives**
Class 2	**Gases**
Division 2.1	Flammable Gases
Division 2.2	Non-Flammable/Non-Toxic Gases under Pressure
Division 2.3	Toxic Gases
Class 3	**Flammable Liquids**
Class 4	**Other Flammable Substances**
Division 4.1	Flammable Solids
Division 4.2	Substances Liable to Spontaneous Combustion
Division 4.3	Substances Which, in Contact with Water, Emit Flammable Gases
Class 5	**Oxidizing Substances/Organic Peroxides**
Division 5.1	Oxidizing Substances
Division 5.2	Organic Peroxides
Class 6	**Toxic/Poisonous and Infectious Substances**
Division 6.1	Toxic Substances
Division 6.2	Infectious Substances
Class 7	**Radioactive Materials**
Class 8	**Corrosive Substances**
Class 9	**Miscellaneous Dangerous Goods**

The quantity limits found in 49 CFR 173.6 are subject to regulatory changes, and the latest version should always be consulted before making a determination about whether your demonstration chemicals can be safety transported. As of this writing (December 2018), the quantity 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, ORM-D (Note 1)	PGI: 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 2.2	Cylinder with gross weight <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 is a marking for shipping meaning "Other Regulated Material for Domestic Transport Only". It is commonly found on consumer commodities of hazardous material.

Requirements

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

- **Explosives (All Hazard Class 1) are not eligible for Materials of Trade Exceptions.**
- **All self-reactive materials, poison-by-inhalation materials, or hazardous wastes are not eligible for Materials of Trade Exceptions, regardless of Hazard Class/Division.**
- Packaging must be leak-proof for liquids and gases, and sift-proof for solids.
- Packages must be securely closed, protected against shifting during transportation, 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 must conform with other USDOT and U.S. Department of Labor/Occupational Safety and Health Administration (DOL/OSHA) regulations, specifically 29 CFR 1910.106(d)(2).
- Compressed gas cylinders containing Division 2.1 or 2.2 gases must conform to USDOT 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), Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and Section 112(r) of the Clean Air Act, as Amended*, 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, including whether there is a Reportable Quantity, and of the requirements of 49 CFR 173.6.
- 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 USDOT whenever possible.**
- Determine the proper shipping name/basic description when preparing documentation or lists. Use the "Transportation" section of the manufacturer's Material Safety Data Sheet (MSDS) or Safety Data Sheet for this. Do not attempt to make this determination on your own unless you have been properly trained in accordance with USDOT Hazardous Materials Regulations. Be aware that there may be inaccurate or insufficient information on the MSDS regarding transportation, so it may be beneficial to confirm proper shipping names in the USDOT Hazardous Materials Table, which can be found at: www.gpo.gov/fdsys/pkg/CFR-2008-title49-vol2/pdf/CFR-2008-title49-vol2-sec172-101.pdf. In addition, there is a useful training module on determining proper shipping names from the USDOT: www.phmsa.dot.gov/training/hazmat/training-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 for use in the event of a spill.

Note: 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. www.gpo.gov/fdsys/pkg/CFR-2011-title49-vol2/pdf/CFR-2011-title49-vol2-sec173-6.pdf (accessed Nov 26, 2018).

Table of Hazardous Materials and Special Provisions. 49 CFR 172.101 et seq. www.gpo.gov/fdsys/pkg/CFR-2011-title49-vol2/pdf/CFR-2011-title49-vol2-part172.pdf (accessed Nov 26, 2018).

Hazard Communication. 29 CFR 1910.1200. www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10099 (accessed Nov 26, 2018).

Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards. Updated Version. National Research Council. National Academies Press: Washington, DC, 2011; p. 102. www.ncbi.nlm.nih.gov/books/NBK55878 (accessed Nov 26, 2018).