Classification of Petroleum Crude Oil

Pipeline and Hazardous Materials Safety Administration

Office of Hazardous Materials Safety

Objectives

- **Determine** responsibility for the proper classification of hazardous materials
- **Discuss** potential hazards associated with petroleum crude oil
- **Determine** hazard class and packing group for a select material
- **Determine** classification for a material with multiple hazards

Responsibility

- The offeror (shipper) of the hazardous materials bears the responsibility to properly classify and describe the materials based on the testing criteria and most accurate proper shipping names and packing groups for the material.

- Packaging, hazard communications and emergency response is based off of proper classification and description of the material

Petroleum Crude Oil Hazards

- Petroleum crude oil poses a unique risk to transportation. Viscosity, specific gravity, Hydrogen Sulfide (H_2S), flammable dissolved gases, corrosive materials and flammable liquids are just a few examples of variations that may be experienced from one well to another or even day to day.

Petroleum Crude Oil Hazards

Class	Division	Name
2	2.1	Flammable gas
2	2.2	Non-Flammable Gas
2	2.3	Toxic Gas
3		Flammable and combustible liquids
6	6.1	Poisonous materials
8		Corrosive materials

An offeror must determine whether the particular shipment of crude oil contains additional hazards that require additional descriptions or changes in packing groups.

Class 2, Division 2.1, 2.2 & 2.3 Gases

Gas: a material which has a vapor pressure greater than 300 kPa (43.5 psia) at 50 °C (122 °F) or is completely gaseous at 20 °C (68 °F) at a standard pressure of 101.3 kPa (14.7 psia).

2.1 **Flammable Gas**

- Any material which is a gas at 20 °C (68 °F) or less and 101.3 kPa (14.7 psia) of pressure (a material which has a boiling point of 20 °C (68 °F) or less at 101.3 kPa (14.7 psia))
- Ignitable in mixture of ≤ 13%
- Flammable range of ≥ 12%

2.2 **Non-Flammable Gas**

- a non-flammable, nonpoisonous compressed gas means any material (or mixture) which:
- packaging a gauge pressure of 200 kPa (29.0 psig/43.8 psia) or greater at 20 °C (68 °F), is a liquefied gas or is a cryogenic liquid & does not meet the definition of Division 2.1 or 2.3

§173.115; §173.116

Class 2, Division 2.1, 2.2 & 2.3 Gases

2.3 **Toxic Gas**

- *A gas poisonous by inhalation* (Division 2.3) means a material which is a gas at 68 °F or less and a pressure of 14.7 psia (sea level) (a material which has a boiling point of 68 °F or less at 14.7 psia)
- Toxic to humans
- LC_{50} value of not more than 5000 mL/m3
- Hazard Zone assignments: §173.116
- LC_{50} values for mixtures may be determined using the formula in §173.133(b)(1)(i) or CGA P-20 (IBR, see §171.7 of this subchapter).

Example:
Hydrogen Sulfide (H_2S)

Class 3 – Flammable Liquids

FLAMMABLE liquids

- Flashpoint ≤ 60°C (140°F)
- Incorporated flashpoint test procedures: §171.7 “Reference Material”

Packing group	Flash point (closed-cup)	Initial boiling point
I		≤35 °C (95 °F)
II	<23 °C (73 °F)	>35 °C (95 °F)
III	≥23 °C, ≤60 °C (≥73 °F, ≤140 °F)	>35 °C (95 °F)

§173.120; §173.121

Class 6 – Poisonous / Toxic Substances

Poisonous material (Division 6.1) means a material, other than a gas, which is known to be so toxic to humans as to afford a hazard to health during transportation

- ***Oral Toxicity:*** A liquid or solid with an LD_{50} for acute oral toxicity of not more than 300 mg/kg
- ***Dermal Toxicity:*** A material with an LD_{50} for acute dermal toxicity of not more than 1000 mg/kg.
- ***Inhalation Toxicity:*** A dust or mist with an LC_{50} for acute toxicity on inhalation of not more than 4 mg/L or acute toxicity of vapors of not more than 5000 mL/m3

§173.132; §173.133

Class 8 – Corrosive Substances

- Damage living tissue
- Severe corrosion rate on steel or aluminum
- PG determined by destructive power
- Time vs. Damage

In Vitro Testing

Testing Methods

- Testing methods for different hazard classes and packing groups are incorporated by reference in 49 CFR 171.7
- Incorporated references include:
  - UN Manual of Tests and Criteria
  - American Society for Testing and Materials (ASTM)
  - International Organization for Standards (ISO)
  - Organization for Economic Cooperation and Development (OECD)

Multiple Hazards for a single commodity?

Classification test result often exhibit multiple hazards in raw petroleum crude oil. In an effort to best characterize the materials, the Hazardous Materials Regulations (HMR) has a descending list of hazards as well as a **"Precedence of Hazard Table"** as a decision matrix to best describe, package and communicate the true hazards of the single material.

Precedence of Hazards

Classification of a material having more than one hazard. Except as provided in paragraph (c) of this section, a material not specifically listed in the §172.101 table that meets the definition of more than one hazard class or division as defined in this part, shall be classed according to the highest applicable hazard class of the following hazard classes, which are listed in descending order of hazard.

Precedence of Hazards

(1) Class 7 (non - LTD QTY)	**(2)** Division 2.3	**(3)** Division 2.1
(4) Division 2.2	**(5)** Division 6.1, PGI, TIH	**(6)** Division 4.2, pyrophoric
	(7) Division 4.1, self-reactive material	
(8) Class 3 (flammable liquids), Class 8 (corrosive materials), Division 4.1 (flammable solids), Division 4.2 (spontaneously combustible materials), Division 4.3 (dangerous when wet materials), Division 5.1 (oxidizers) or Division 6.1 (poisonous liquids or solids other than Packing Group I, poisonous-by-inhalation). The hazard class and packing group for a material meeting more than one of these hazards shall be determined using the precedence table in paragraph (b) of this section.		
(9) Combustible liquids	**(10)** Class 9	

Precedence of Hazards Table

Precedence of hazard table for Classes 3 and 8 and Divisions 4.1, 4.2, 4.3, 5.1 and 6.1. The following table ranks those materials that meet the definition of Classes 3 and 8 and Divisions 4.1, 4.2, 4.3, 5.1 and 6.1:

PRECEDENCE OF HAZARD TABLE

[Hazard class or division and packing group]

	4.2	4.3	5.1 I[1]	5.1 II[1]	5.1 III[1]	6.1, I dermal	6.1, I oral	6.1 II	6.1 III	8, I liquid	8, I solid	8, II liquid	8, II solid	8, III liquid	8, III solid
3 I[2]		4.3				3	3	3	3	3	([3])	3	([3])	3	([3])
3 II[2]		4.3				3	3	3	3	8	([3])	3	([3])	3	([3])
3 III[2]		4.3				6.1	6.1	6.1	3[4]	8	([3])	8	([3])	3	([3])
4.1 II[2]	4.2	4.3	5.1	4.1	4.1	6.1	6.1	4.1	4.1	([3])	8	([3])	4.1	([3])	4.1
4.1 III[2]	4.2	4.3	5.1	4.1	4.1	6.1	6.1	6.1	4.1	([3])	8	([3])	8	([3])	4.1
4.2 II		4.3	5.1	4.2	4.2	6.1	6.1	4.2	4.2	8	8	4.2	4.2	4.2	4.2
4.2 III		4.3	5.1	5.1	4.2	6.1	6.1	6.1	4.2	8	8	8	8	4.2	4.2
4.3 I			5.1	4.3	4.3	6.1	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
4.3 II			5.1	4.3	4.3	6.1	4.3	4.3	4.3	8	8	4.3	4.3	4.3	4.3
4.3 III			5.1	5.1	4.3	6.1	6.1	6.1	4.3	8	8	8	8	4.3	4.3
5.1 I[1]						5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
5.1 II[1]						6.1	5.1	5.1	5.1	8	8	5.1	5.1	5.1	5.1
5.1 III[1]						6.1	6.1	6.1	5.1	8	8	8	8	5.1	5.1
6.1 I, Dermal										8	6.1	6.1	6.1	6.1	6.1
6.1 I, Oral										8	6.1	6.1	6.1	6.1	6.1
6.1 II, Inhalation										8	6.1	6.1	6.1	6.1	6.1
6.1 II, Dermal										8	6.1	8	6.1	6.1	6.1
6.1 II, Oral										8	8	8	6.1	6.1	6.1
6.1 III										8	8	8	8	8	8

Do I meet the definition of any of the nine 49 CFR Hazard Classes?

Do I meet the definition of more than one Hazard Class?

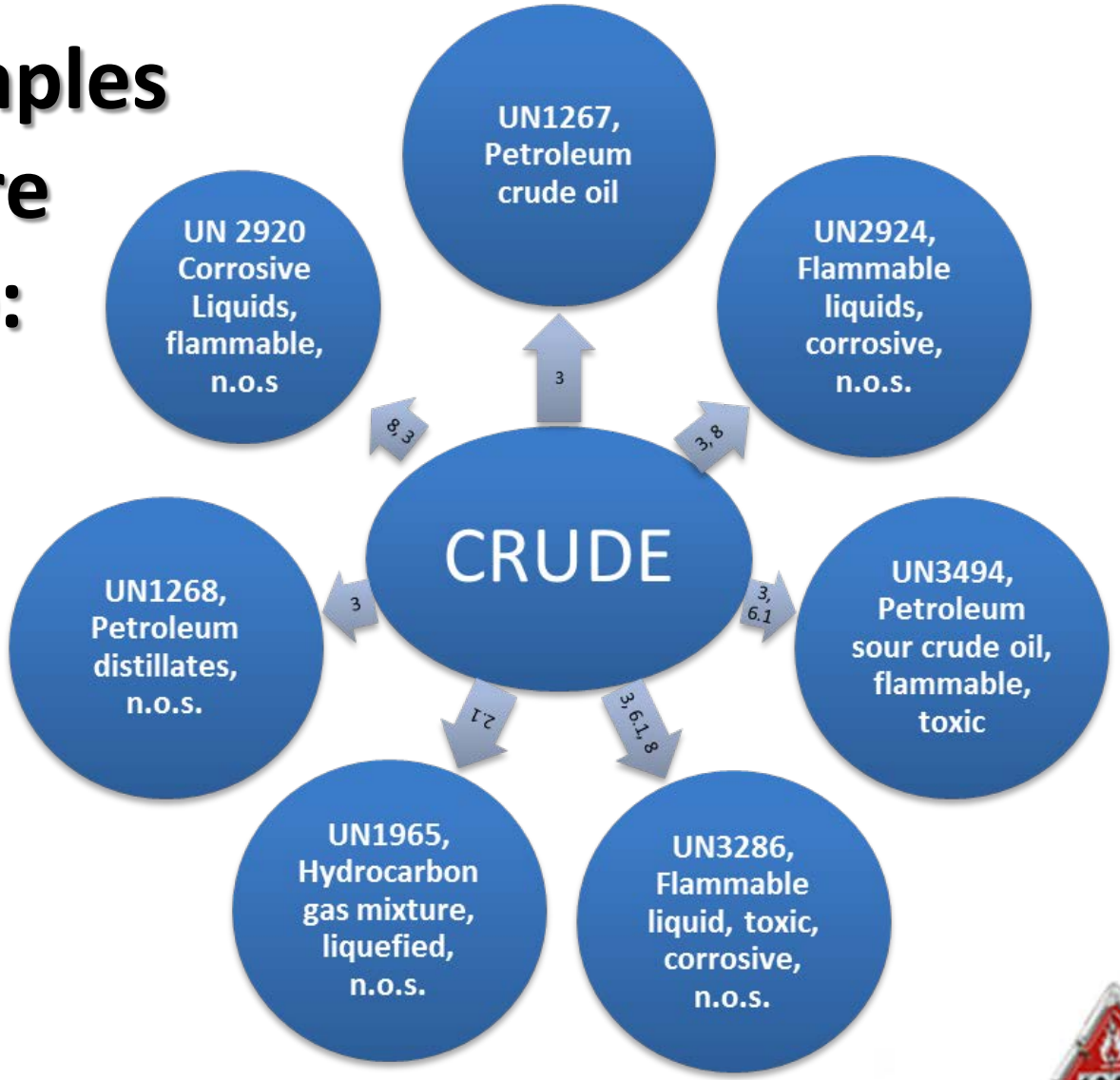
If I meet more than one Hazard Class which one takes precedence?

Now that I know what my primary hazard class is what packing group is appropriate?

Knowing these, what Proper Shipping Name, hazard class and packing group best identifies my material?

Based on the Proper shipping name select appropriate packaging.

Possible Examples include but are not limited to:



Importance of proper classification

The inherent safety of the transportation system is based of off the shippers initial classification of their hazardous materials being offered for transportation. Packaging selection, marking, labeling, shipping papers and placarding are all dependent upon this.

Proper classification reaches beyond the wheels, wings, and water that carries HAZMAT throughout our communities. Our dedicated first responders must depend on the information derived from proper classification and on the proper packaging maintaining it's structural integrity during an accident.

The decisions fire fighters, police and EMS make, and the actions they take to protect us, starts with you!

Where to Find More Information…

http://wiser.nlm.nih.gov/

http://hazmat.dot.gov

Hazardous Material Info-Center

1-800-HMR-4922

(1-800-467-4922)

E-mail: infocntr@dot.gov

Hours of Operation: 9 am – 5 pm ET

- Obtain answers to HMR questions
- Request copies of Federal Register, special permits or training materials
- Report HMR violations
- Fax on Demand

Thank You!

GOT A HAZMAT QUESTION?

http://hazmat.dot.gov

INFO-LINE
1-800-467-4922

U.S. Department of Transportation
Pipeline and Hazardous Materials Safety Administration

Hazardous Material Safety Assistance Team

Stuart Streck
HMSAT, Southern Region
233 Peachtree St. NE,
STE #602 (PHH-46)
Atlanta, GA. 30303
Phone: 404-576-3842

Stuart.Streck@DOT.GOV