

Reduction of Unintentionally Produced Persistent Organic Pollutants (UPOPs) emissions by improving waste management practices at landfills

Introduction to Hazardous Wastes

GEF Project ID: 5558 – Component 2 - Development and Implementation of a Sustainable Management Mechanism for POPs in the Caribbean

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Resources & Waste
Advisory Group



Types, sources, identification and classification of Hazardous wastes

Topics covered within presentation

1. Definitions
2. Hazard classes
3. Magnitude of the problem
4. Sources and Types
5. Identification and classification
6. Material safety Data Sheet and use

Definitions

Waste

- Basel description - substances disposed of, intended to be disposed of, required to be disposed of by law
- Generic description- Undesirable and superfluous byproduct, emission or residue

General waste

- Does not pose immediate threat to humans or the environment

Hazardous waste

- Has significant effects on humans and the environment even in small amounts

Basel Convention

- **Annex 1 and Annex 3** Waste streams or Wastes having as constituents e.g. clinical wastes from medical facilities, wastes from the production of solvents, waste mineral oils etc. displaying waste characteristics under Annex III e.g. explosivity, corrosivity, flammability etc.
- **Annex 2** – Categories of wastes requiring special consideration – Y46 Wastes collected from households
- **Annex VIII-List A** Wastes contained in this Annex are characterized as hazardous under the Convention, and their designation on this Annex does not preclude the use of Annex III to demonstrate that a waste is not hazardous.
- **Annex IX-List B** Wastes contained in the Annex will not be wastes covered by this Convention unless they contain Annex I material to an extent causing them to exhibit an Annex III characteristic.

Hazard classes

Classification of dangerous goods is broken down into nine classes according to the type of danger materials or items present

- CLASS 1 – [Explosives](#)
- CLASS 2 – [Gases](#)
- CLASS 3 – [Flammable Liquids](#)
- CLASS 4 – [Flammable Solids](#)
- CLASS 5 – [Oxidizing Substances](#)
- CLASS 6 – [Toxic & Infectious Substances](#)
- CLASS 7 – [Radioactive Material](#)
- CLASS 8 – [Corrosives](#)
- CLASS 9 – [Miscellaneous Dangerous Goods](#)

Hazard Class 1 – Explosives

Examples:

- Ammunition/cartridges
- Fireworks/pyrotechnics
- Flares
- Blasting caps /
detonators



Hazard Class 2 – Gases

Division 2.1 – Flammable gases

Division 2.2 – Non-toxic, non-flammable gases

Division 2.3 – Poisonous gas

Examples of waste gases

- Insecticide gases
- Refrigerant gases
- Acetylene / Oxyacetylene
- Carbon dioxide
- Helium / helium compounds
- Hydrogen / hydrogen compounds
- Oxygen / oxygen compounds
- Nitrogen / nitrogen compounds



Hazard Class 3 – Flammable liquids

Commonly Flammable Liquids Wastes:

- Acetone
- Adhesives
- Paints / lacquers / varnishes
- Alcohols
- Perfumery products
- Gasoline / Petrol
- coal tar distillates
- Petroleum crude oil / Petroleum distillates
- Gas oil / Heating oil / Kerosene
- Resins
- Esters/ Ethers / Ethanol
- Benzene
- Methanol



Hazard Class 4 – Other Flammable Substances

Examples:

- Alkali metals / Metal powders
- Aluminium phosphide
- Sodium cells
- Firelighters
- Matches
- Calcium carbide
- Camphor
- Oily cotton waste
- iron (spent)
- Naphthalene
- Nitrocellulose
- Phosphorus
- Sulphur



Hazard Class 5 – Oxidizing Substances & Organic Peroxide

Common Oxidizers & Organic Peroxides Wastes:

- Ammonium nitrate fertilizers
- Chlorates
- Nitrates / Nitrites
- Perchlorates
- Permanganates
- Persulphates
- Aluminium nitrate
- Ammonium dichromate / nitrate / persulphate
- Calcium hypochlorite / nitrate / peroxide
- Hydrogen peroxide



Hazard Class 6 – Toxic & Infectious Waste

Commonly Toxic Waste

- Alkaloids
- Acids
- Arsenates
- Arsenites
- Cyanides
- Arsenic / arsenic compounds



Commonly Infectious Waste

- Medical/Biomedical waste
- Clinical waste
- Biological cultures / samples / specimens
- Medical cultures / samples



Hazard Class 7 – Radioactive materials

Radioactive waste includes any material that is either intrinsically radioactive, or has been contaminated by radioactivity, and that is deemed to have no further use.

It is not covered within this workshop as it's handling and management is not considered a part of the proposed HWISF.



Hazard Class 8 – Corrosives

Commonly Corrosives Wastes

- Acids/acid solutions
- Batteries
- Battery fluid
- Fuel cell cartridges
- Sulphides
- Polysulphides
- Alkalis / alkaline solutions
- Bromine
- Phenol / carbolic acid



Hazard Class 9 – Miscellaneous

Miscellaneous dangerous wastes are substances and articles which during transport present a danger or hazard not covered by other classes.

Commonly Miscellaneous Waste

- Expandable polymeric beads / polystyrene beads
- Ammonium nitrate fertilizers
- Lithium-ion batteries
- Lithium metal batteries
- Battery powered equipment



Magnitude of the problem

No hazardous waste management system due to:

- Lack of institutional capacity in hazardous waste Management
- Lack of infrastructure for storage and disposal
- Lack of systems to monitor impacts, exports and imports
- Lack of awareness on the negative impacts of such wastes

Wastes of particular concern are:

- Health care and medical wastes
- Pesticides and contaminated containers
- Obsolete chemicals
- Oils
- E wastes

Magnitude of problem

- No waste generation records kept
- Environmentally unsound waste disposal methods e.g. the burning and burial of medical wastes at the different medical facilities very often lead to incomplete combustion products that are sold
- Disposal in non-engineered landfill sites
- The mixing of hazardous wastes
- Improper segregation and storage
- Unawareness

Sources

- Hospitals and clinics
- Farming activities
- Tanneries
- Breweries
- Paint manufacturing
- Soap manufacturers
- Oil storage facilities
- Transportation sector
- Research and teaching institutions
- Households

Types

- Waste oil
- Polychlorinated Biphenyls (PCBs), Chlorinated compounds in general
- Wet and dry cell batteries containing Pb, Zn, Cd
- Paint production waste
- Pesticides
- Inorganic compounds
- Brominated flame retardants
- Acids and alkalis

Identification and classification

Identification is...

procedure of determining whether a specific waste is hazardous

Classification is...

the procedure used to specify the type of waste

Identification and Classification

Requires

Fundamental chemical knowledge

- to identify waste types
- to predict the generation of hazardous wastes
- to identify appropriate treatment techniques

knowledge of the hazardous properties of chemical substances

- to understand the requirements for handling of hazardous wastes
- to understand why specific waste types need special handling and treatment

Identification of Hazardous Waste

Obtain a description from waste generator

Initial identification by:

- description from generator
- source of waste
- basic physical and chemical properties
- Inspect to verify information submitted

Does generator use hazardous materials in his process?

Use **Materials Safety Data Sheets** (if available) to identify the use of hazardous materials by generator

What Hazardous Waste looks like

Liquid, sludge, powder or solid lumps

Obsolete chemicals

Off-specification product (eg. solvents or paints)

Stored in:

- Small unlabelled containers
- metal or plastic drums - often dirty
- “big bags”
- large storage tanks or containers
- cardboard boxes, or simply in heaps

What Hazardous Waste looks like



Hazardous waste characteristics

Information to be provided (if available)

- Category of the waste (can make use of Basel Convention classification if none is locally available);
- Origin – from which process, activity, occurrence, etc. the waste is generated;
- Physical properties of the waste;
- Flash point;
- Boiling point;
- Physical state (gas, liquid, sludge, solid);
- Vapour density relative to air;
- Solubility in water;
- Waste density relative to water;
- Risks involved by inhalation, by oral intake, by dermal contact.

Physical assessment of the wastes - Visual

Solid

- powder
- mineral fibres
- small pieces
- medium size
- large size

Sludge

- wet
- Dry
- non-aqueous

Liquid

- aqueous solution
- emulsion
- oil
- other hydrocarbon

Chemical assessment -description and/ or simple tests)

Chemical description of the waste:

- Organic waste
- Metallic waste
- Mix of organic materials
- Mix of inorganic and organic materials
- acidic waste
- basic waste
- Neutral waste
- Unknown composition

Unknown wastes

- Composition of a particular waste may not be known.
- Waste assessment will need to be carried out by the waste generator
- Wastes should be sealed in 2 mm thickness plastic bags (if solid),
- Plastic bag labelled "unknown" and placed in a drum labelled "unknown".
- If origin is known , it should be stated
- Tests should be done to determine characteristics and composition (as far as possible)

Tests

- Assessment of :
 - Acidity/alkalinity
 - Flammability
 - Reactivity
 - Corrosivity
 - Volatility

Material Safety Data Sheet (MSDS)

- Material Safety Data Sheet provides detailed information about a specific hazardous material/good/waste.
- Is prepared by the manufacturer or the supplier of the product.
- Has a 16 section format
- Includes information such as physical data, toxicity, health effects, First aid, PPE, reactivity, disposal etc.

MSDS

Example:



Health	2
Fire	1
Reactivity	0
Personal Protection	H

Material Safety Data Sheet Eugenol MSDS

Section 1: Chemical Product and Company Identification

Product Name: Eugenol	Contact Information:
Catalog Codes: SLE1156	Sciencelab.com, Inc. 14025 Smith Rd. Houston, Texas 77396
CAS#: 97-53-0	US Sales: 1-800-901-7247 International Sales: 1-281-441-4400
RTECS: SJ4375000	Order Online: ScienceLab.com
TSCA: TSCA 8(b) inventory: Eugenol	CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300
CI#: Not available.	International CHEMTREC, call: 1-703-527-3887
Synonym: Hydroxy-1-methoxy-2-allyl-4-benzene	For non-emergency assistance, call: 1-281-441-4400
Chemical Formula: C ₁₀ H ₁₂ O ₂	

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Eugenol	97-53-0	100

Toxicological Data on Ingredients: Eugenol: ORAL (LD50): Acute: 1930 mg/kg [Rat]. 3000 mg/kg [Mouse]. 2130 mg/kg [Guinea pig].

Section 3: Hazards Identification

Potential Acute Health Effects:

Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator).

Potential Chronic Health Effects:

Hazardous in case of skin contact (irritant), of ingestion, of inhalation. CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to lungs, the nervous system, mucous membranes. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact: Check for and remove any contact lenses. Do not use an eye ointment. Seek medical attention.

MSDS

Section 1: Chemical Product and Company Identification

Section 2: Hazard Identification

Section 3: Composition, information on ingredients

Section 4: First Aid Measures & Precautions

Section 5: Firefighting Measures

Section 6: Accidental Release Measures

Section 7: Handling & Storage

Section 8: Exposure Controls and Personal Protection

Section 9: Physical and Chemical Properties

Section 10: Stability and Reactivity

Section 11: Toxicological Information

MSDS (cont.)

Section 12: Ecological Information

Section 13: Disposal Considerations

Section 14: Transport Information

Section 15: Regulatory Information

Section 16: Other Information

Segregation

Incompatible wastes

- Placement in an unsuitable container which may cause corrosion or decay of the container or its liner
- Mixing with another waste which would produce hazardous situations such as:
 - Violent reaction, Heat generation, Flammable gases (e.g. H₂) , Toxic gases (e.g. H₂S, HCN)

Incompatible wastes need to be stored in separate containers, and such containers shall be placed in separate containment areas.

High risk wastes

- Potential risk of fire or explosion , for the release of toxic substances in case of fire
- Waste containing PCBs or other highly toxic organic materials
- Infectious wastes
- Mercury wastes

Segregation of Chemicals According to Chemical Compatibility

To help with segregation decisions, dangerous goods with similar chemical properties have been grouped together in Segregation Groups as follows:

1. Acids	10. Liquid halogenated hydrocarbons
2. Ammonium compounds	11. Mercury and mercury compounds
3. Bromates	12. Nitrites and their mixtures
4. Chlorates	13. Perchlorates
5. Chlorites	14. Permanganates
6. Cyanides	15. Powdered metals
7. Heavy metals and their salts	16. Peroxides
8. Hypochlorites	17. Azides
9. Lead and its compounds	18. Alkalis

Segregation groups

these... +	Away from these... →Keep	Or you may get these...
Acids	Bases	Heat violent reaction
Acids or bases	Reactive metals (aluminum, beryllium, calcium, lithium, potassium, magnesium, sodium, zinc powder) metal hydrides	Fire Explosion Hydrogen gas
Water or alcohols	Concentrated acids or bases calcium, lithium, potassium, metal hydrides, other waste reactives	Heat / Fire / Explosion Flammable and toxic gases
Reactive organic compounds or solvents (alcohols, aldehydes, nitrated hydrocarbons)	Concentrated acids or bases, reactive metals and metal hydrides	Fire Explosion

Segregation groups

Keep these... +	Away from these... →	Or you may get these...
Cyanide or sulfide solutions	Acids	Toxic hydrogen Cyanide Sulfide gas
Strong oxidizers (chlorates, chlorine, chlorites, chromic acid, hypochlorites, nitrates, perchlorates, permanganates, peroxides)	Organic acids, concentrated mineral acids, reactive metals, metal hydrides, reactive organic compounds or solvents, flammable or combustible waste	Fire Explosion

Segregation Table

CLASS		1.1 1.2 1.5	1.3 1.6	1.4	2.1	2.2	2.3	3	4.1	4.2	4.3	5.1	5.2	6.1	6.2	7	8	9
Explosives	1.1, 1.2, 1.5	*	*	*	4	2	2	4	4	4	4	4	4	2	4	2	4	X
Explosives	1.3, 1.6	*	*	*	4	2	2	4	3	3	4	4	4	2	4	2	2	X
Explosives	1.4	*	*	*	2	1	1	2	2	2	2	2	2	X	4	2	2	X
Flammable gases	2.1	4	4	2	X	X	X	2	1	2	2	2	2	X	4	2	1	X
Non toxic, non-flammable gases	2.2	2	2	1	X	X	X	1	X	1	X	X	1	X	2	1	X	X
Toxic gases	2.3	2	2	1	X	X	X	2	X	2	X	X	2	X	2	1	X	X
Flammable liquids	3	4	4	2	2	1	2	X	X	2	2	2	2	X	3	2	X	X
Flammable solids, etc.	4.1	4	3	2	1	X	X	X	X	1	X	1	2	X	3	2	1	X
Spontaneously combustible	4.2	4	3	2	2	1	2	2	1	X	1	2	2	1	3	2	1	X
Dangerous when wet	4.3	4	4	2	2	X	X	2	X	1	X	2	2	X	2	2	1	X
Oxidizing substances	5.1	4	4	2	2	X	X	2	1	2	2	X	2	1	3	1	2	X
Organic peroxides	5.2	4	4	2	2	1	2	2	2	2	2	2	X	1	3	2	2	X
Toxic substances	6.1	2	2	X	X	X	X	X	X	1	X	1	1	X	1	X	X	X
Infectious substances	6.2	4	4	4	4	2	2	3	3	3	2	3	3	1	X	3	3	X
Radioactive material	7	2	2	2	2	1	1	2	2	2	2	1	2	X	3	X	2	X
Corrosive substances	8	4	2	2	1	X	X	X	1	1	1	2	2	X	3	2	X	X
Miscellaneous	9	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Segregation code	Meaning
X	No segregation required (unless specific segregation provisions are provided in the DGL)
1	'Away from' - the distance between the packages to be at least 3 meters.
2	'Separated from' - the distance between the packages to be at least 6 meters.
3	'Separated by a complete compartment or hold from' (at least 12 meters.)
4	'Separated longitudinally by an intervening complete compartment or hold from' (at least 24 meters.)

Proper Packaging

- UN approved packaging - built, tested, and certified to carry liquid or solid dangerous materials. This is a unified means to ensure dangerous materials are transported safely.
- UN Rating is a series of number and letter codes that show what a container is regulated to handle. They determine this through a series of tests that all containers must undergo if they are to be UN Rated.



4G / X 3 / S / 16 / USA / LM0000



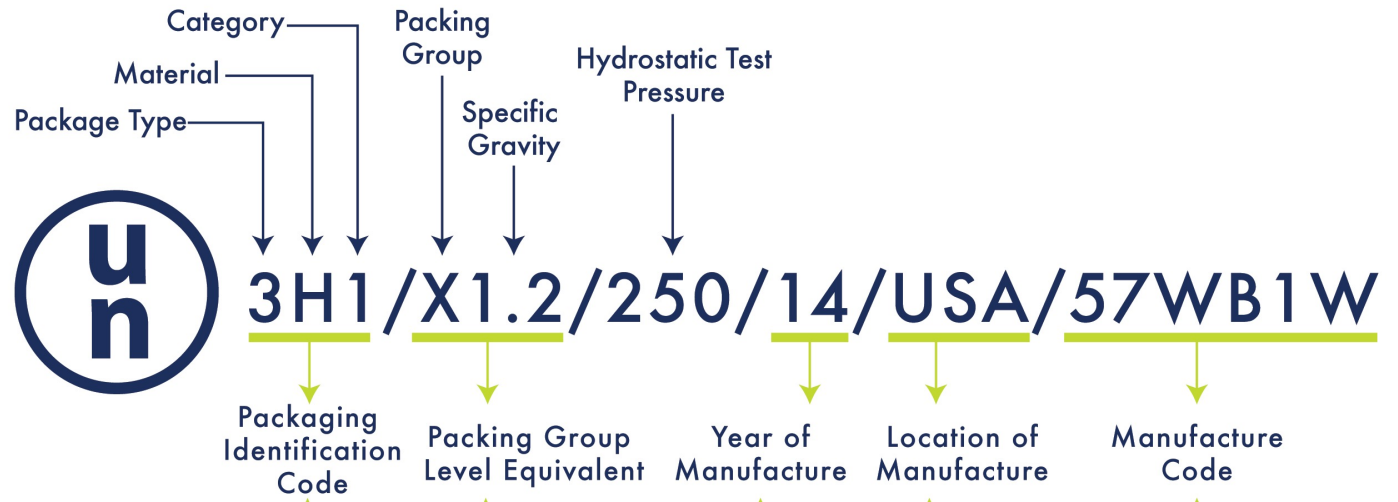
1A1 / X 1.5 / 250 / 16 / USA / LM0000

Proper Packaging - UN Rating codes

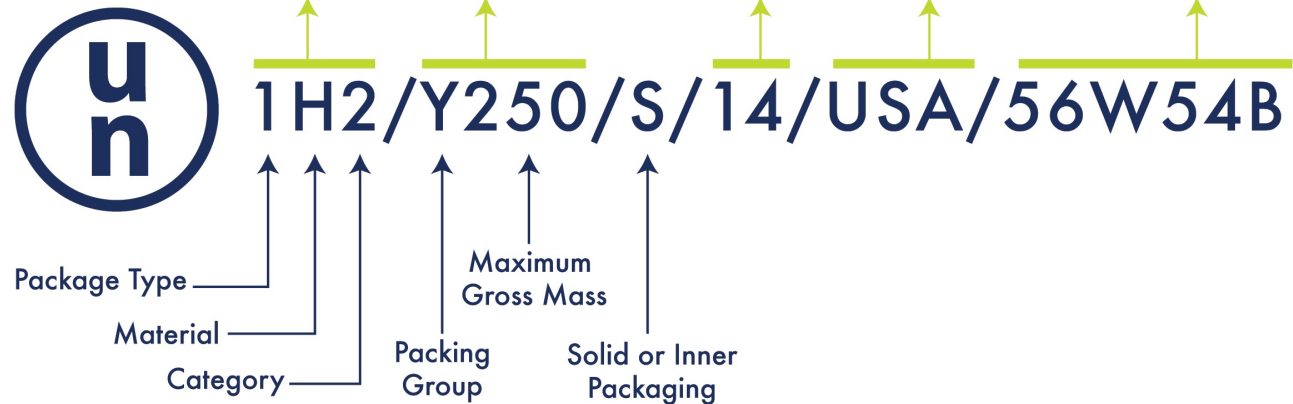
Type of Container	Container Material	Container Packaging Head or Material Wall Type
1 - Drums/Pails	A - Steel	<p>For Drums:</p> <p>1 - Closed Head (Non-Removable Head)</p> <p>2 - Open Head (Removable Head)</p> <p>For Bags:</p> <p>5M1 - Multiwall</p> <p>5M2 - Multiwalled, Water-Resistant</p> <p>13H1 - Woven PP fabric without coating or inner liner</p> <p>13H2 - Woven PP fabric coated</p> <p>13H3 - Woven PP fabric with inner liner</p> <p>13H4 - Woven PP fabric coated With inner liner</p>
2 - Barrels	B - Aluminum	
3 - Jerricans	C - Natural Wood	
4 - Boxes	D - Plywood	
5 - Bags	F - Reconstituted Wood	
6 - Composite Packaging	G - Fiberboard	
7 - Pressure Receptacle	H - Plastic	
13- Flexible IBC for Solids	L - Textile	
	M - Paper	
	N - Metal other than Steel or Aluminum	
	P - Glass, Porcelain or Stoneware	

Proper Packaging - UN Rating codes

Packaging for Liquid Hazardous Materials



Combination Packaging/
Single Packaging for Solid Hazardous Materials



Packing groups

Dangerous goods are assigned into 3 packing groups (also known as UN Packing Group) in accordance with the degree of danger they present:

- X = Packing Group I (Highest Degree of Danger)
- Y = Packing Group II (Medium Degree of Danger)
- Z = Packing Group III (Lowest Degree of Danger)

The letter X, Y, or Z indicates what packing group the package was tested to. Under the regulations, if a packaging has been tested to the highest degree of danger, it may be appropriate to place materials in that packaging which have a lower hazard.

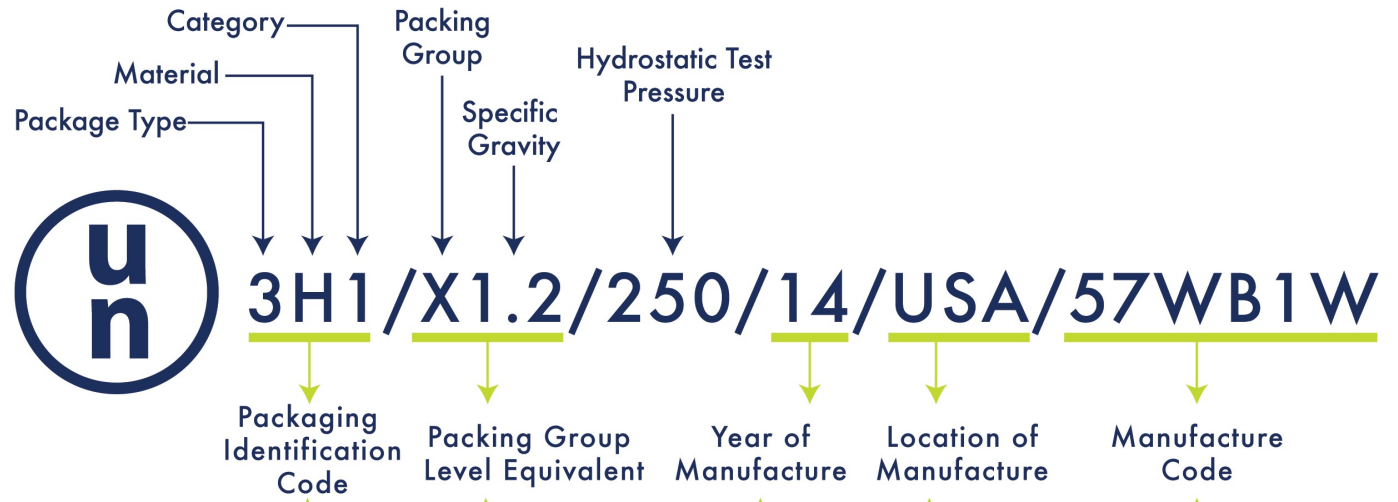
Therefore, the following is also correct:

- X = Packing Group I, II, III
- Y = Packing Group II, III
- Z = Packing Group III

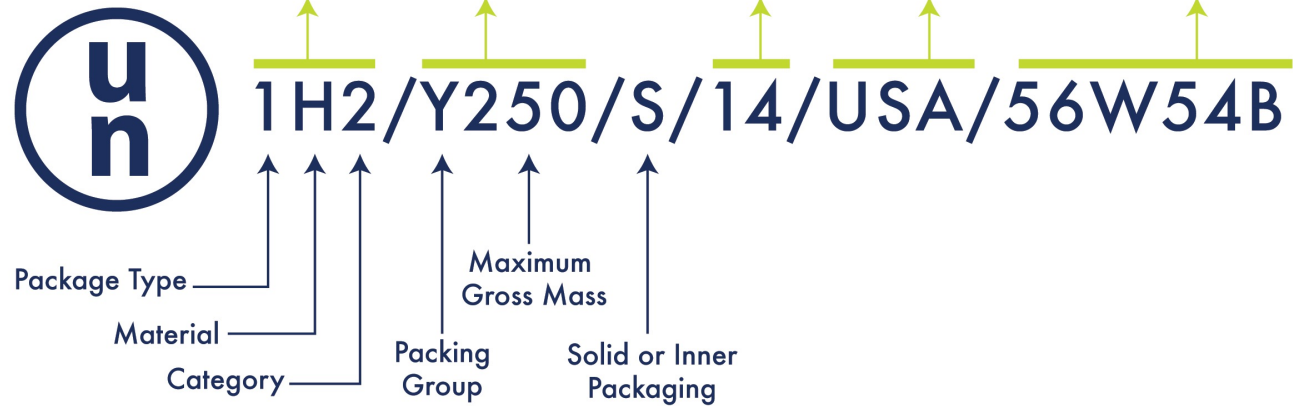
Note: articles and some dangerous goods classes (Class 2, Division 6.2 and Class 7) do not have packing groups.

Proper Packaging - UN Rating codes

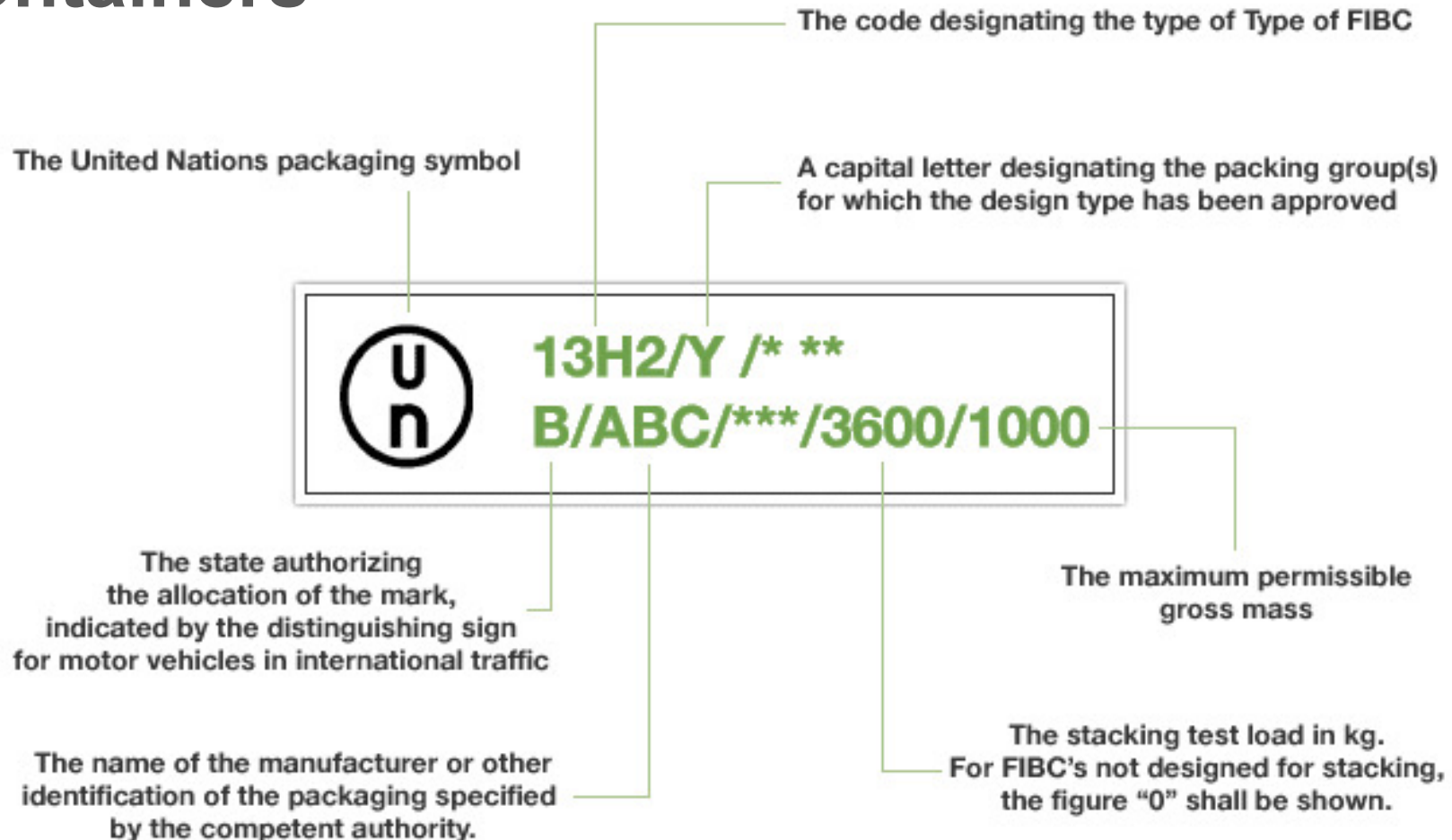
Packaging for Liquid Hazardous Materials



Combination Packaging/
Single Packaging for Solid Hazardous Materials



Proper Packaging - UN Rating codes for FIBCs (flexible intermediate bulk containers)



- * : month of manufacture
- ** : year of manufacture (last two digits)
- *** : registration number to be attributed by the competent authority