

Hazardous Materials Packagings

I. Hazmat Basics

Bulk Containers, Non-Bulk Packagings and Intermediate Bulk Containers

- Packagings and containers used to transport Hazardous Materials are regulated in the U.S. by the Department of Transportation, which typically models its regulations on recommendations of the UN Subcommittee of Experts on the Transport of Dangerous Goods.
- Bulk containers are those greater than 119 gallons.
- Non-bulk containers are 119 gallons or less; also, those used for solids may carry up to 400 kg net mass.
- Intermediate Bulk Containers are often referred to as “IBCs”; typically 260-300 gallons; some regulations are written specifically for IBCs
- The term “packaging” refers to an empty or emptied container; the term “package” is when full and in the process of shipment.

The Hazardous Materials Table

Found in the regulations “49 CFR” (49 Code of Federal Regulations), the table contains:

- A Material’s Hazard Class
- The material’s “Proper Shipping Name”
- 4-Digit UN Number
- Packing Group I, II, or III
- Packaging Authorizations, and
- Special Instructions (where applicable)

Classes of Hazardous Materials

- There are 9 Classes of Hazardous Materials.
- A material's classification is a key consideration in how the material must be packaged, marked, labeled, shipped and handled.

- Class 1 - Explosives
- Class 2 - Gases
 - Division 2.2 - Non-flammable Gas
 - Division 2.1 - Flammable Gases
 - Division 2.3 - Poisonous Gas
- Class 3 - Flammable Liquid (flash point < 141° F)
Combustible Liquid (flash point 141 - 200° F)
- Class 4 - Solids
 - Division 4.1 - Flammable Solids
 - Division 4.2 - Spontaneously Combustible
 - Division 4.3 - Dangerous When Wet
- Class 5 - Oxidizers and Peroxides
 - Division 5.1 - Oxidizers (can cause other materials in contact to burn more rapidly)
 - Division 5.2 - Organic peroxides (can easily burn or explode)
- Class 6 - Toxic and Infectious
 - Division 6.1 - Toxics (poisonous)
 - Division 6.2 - Infectious Substances
- Class 7 – Radioactive
- Class 8 - Corrosive
- Class 9 - Miscellaneous Hazard (present a hazard, such as pollution, that doesn't fall within any other classification)

DOT Packing Groups

A hazardous material's Packing Group reflects the level of hazard and determines the mark required on the packaging.

<u>Packing Group</u>	<u>Degree of Hazard</u>	<u>Packaging Mark</u>
I	most serious	X
II	moderate hazard	Y
III	low hazard	Z

Package Labels

- Diamond-shaped; they communicate the hazard and hazard class with text and images. Examples:



Vehicle Placards

- Similar to package labels, but larger.
- Appear on all sides of vehicles carrying hazmat (1,000 lbs or more for most materials).
- Trailers with only emptied drums & pails headed for reconditioning are exempt from placards.
- Currently, emptied IBCs are *not* exempt; remember to remove vehicle placards when emptied IBCs are unloaded.

Shipping Papers

- Not required for empty drums & pails shipped by contract carrier or on reconditioner's trucks for reuse or reconditioning.
- Required for empty IBCs.
- Offer shipping papers to law enforcement when asked.
- Driver must keep shipping papers in cab of vehicle.

II. Package Markings and Design Types

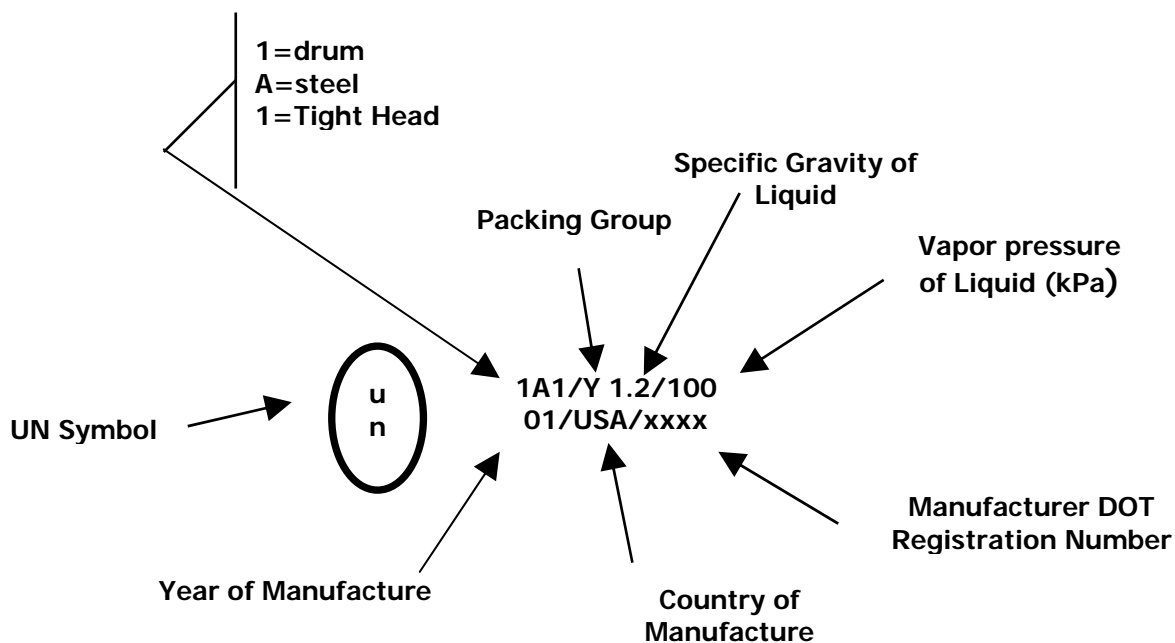
Package Markings

A three-part code indicates the type of packaging.

- | | | |
|--------------|-------------|----------------|
| 1. Drums | A. Steel | 1. Closed Head |
| 2. Barrels | B. Aluminum | 2. Open Head |
| 3. Jerricans | C. Wood | |
| 4. Boxes | G. Fibre | |
| 5. Bags | H. Plastic | |
| 6. Composite | | |

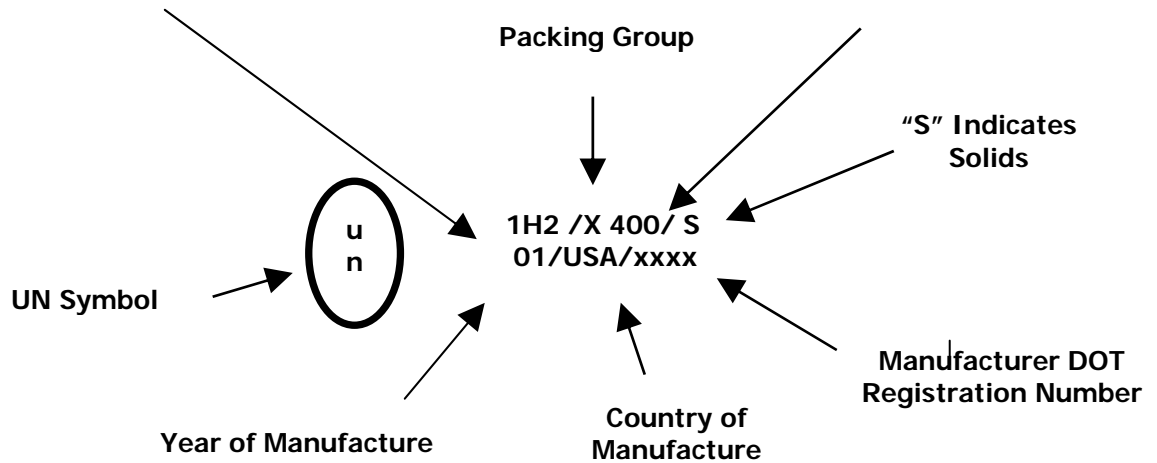
Thus, "1A1" is a closed-head steel drum; "1H2" is an open-head plastic drum, etc.

Markings (Example: liquids drum)



Markings (Example: solids drum)





Durable Label or Stencil on Side

For Liquids:

For Solids:	<div style="border: 1px solid black; border-radius: 50%; width: 30px; height: 30px; display: flex; align-items: center; justify-content: center;"> <div style="text-align: center; margin-bottom: 2px;">u</div> <div style="text-align: center; margin-top: 2px;">n</div> </div>	1A1/Y1.2/100	("first line mark")
	01/USA/xxxx	("second line mark")	

For Solids:

For Solids:	<div style="border: 1px solid black; border-radius: 50%; width: 30px; height: 30px; display: flex; align-items: center; justify-content: center;"> <div style="text-align: center; margin-bottom: 2px;">u</div> <div style="text-align: center; margin-top: 2px;">n</div> </div>	1A2/Y400/S	("first line mark")
	01/USA/xxxx	("second line mark")	

Bottom embossment for steel drums

- Bottom must be permanently marked (embossed) with "birth certificate"

Example: UN 1A1 / Y 1.4 / 200 / 98
 1.2 0.9 1.2

- 1.2 / 0.9 / 1.2 is thickness in mm (top, body, bottom)
- Would be simply "1.0" for an "all-1 mm" drum

III. Drum Reconditioning

De-labeling
Chaining / shot blast (for steel)
Wash or burn-off residues
Painting / lining
Leakproofness test
Marking / labeling

Reconditioners' Markings

- Durable side mark (e.g. label or stencil)
- Re-applied by reconditioner
- Same as manufacturer's mark but must also show:
 - country code;
 - reconditioner's address or *registered* symbol or number;
 - year (last two digits);
 - "R" (reconditioned); "L" (leakproofness tested).

Example: Reconditioner's Durable Mark (tight-head drum/ liquids)

1A1/ Y1.2 / 100
USA / M-xxxx / 01 RL

"R" indicates reconditioned

"L" indicates leakproofness tested

IV. Drum Remanufacturing

- Rebuilding tight-head drums
- Converting tight-head drums to open-head drums
- Converting non-UN drums to UN-type hazmat drums
- Remanufacturing triggers the requirements for full design-type testing

V. Intermediate Bulk Containers (IBCs)

- Flexible or rigid IBCs
- Some are all metal or all plastic

- Composite IBCs : “Bottle in a Cage”
- Typically 260 – 300 gallons
- IBCs have separate, but similar, hazmat rules

Marks for Composite IBCs

- UN symbol
- 21HA1 (solids) or 31HA1 (liquids) “H” indicates IBC; “A” indicates composite (“bottle-in-cage”)
- X, Y, or Z Packing Group
- Month and last two digits of year of manufacture or remanufacture
- Country (USA)
- Name or symbol of manufacturer or re-manufacturer
- Stacking test load, in kilograms
- Maximum permissible gross mass, kilograms
- Capacity in liters
- Tare mass, kilograms
- Hydraulic test pressure, kPa
- Maximum filling/discharge pressure.
- Body material and minimum thickness in mm
- Date of last leakproofness test for liquids
- Month and year of last inspection

IBC Mark (Example)

UN 31HA1 / Y/12 01/USA/ M1234
 4067 kg/1066kg/1070L/73kg
 100 kpa/12 01/12 01

Note: December '01 (12 01) is date of last leakproofness test, and last complete inspection.

Composite IBC: Inner Bottle Marks

New bottles should come already marked with:

- Name or symbol of bottle manufacturer

- Month and year of bottle manufacture
- Country of bottle manufacture

Leaktesting IBCs

- IBCs intended for hazmat liquids (or solids discharged under pressure) must be inspected and leak tested every 2 ½ years.
- All IBCs must be internally inspected at least every 5 years

“Routine Maintenance” of IBCs

- Cleaning.
- Removal and reinstallation or replacement of body closures and gaskets, or service equipment meeting the original manufacturer's design type. (Note: verify leaktightness of reinstalled or replaced closures and service equipment; full leakproofness test not required).
- Restoration of structural parts such as legs and lifting attachment .

Marking on Routinely Maintained Composite IBCs

- Country code
- Name, registered symbol or registered number of company maintaining the IBC

Note: This marking for routine maintenance is a condition of RIPA's IBC Code of Operating Practice, as well as a UN recommendation; however, marking IBCs for routine maintenance is not currently a regulatory requirement of the U.S. DOT.

“Repair” of Composite IBCs

- The repair of rigid plastic IBCs and inner plastic bottles is not authorized
- Replace damaged bottles with new bottles conforming to the original IBC manufacturer's specification

- Conduct leakproofness test on repaired IBCs (New, replacement bottles should come already tested!)
- Record the test

Marking on Repaired Composite IBCs

- Mark applied by the company that tests and inspects the repaired IBC
Country;
Name or symbol of the company performing the repair;
Month and year of tests and inspections.

Remanufacture of Composite IBCs

- Any change to the IBC design type is remanufacturing.
- The design type of the remanufactured IB must be tested as if it were a new IBC.
- Prepare a full design qualification test report.
- Repeat design qualification tests and prepare a report at least annually for each design type.
- Mark the remanufactured IBC with the same information required on a new IBC of the same type.

VI. Closure Notifications

All suppliers of hazmat packagings (including reconditioners) must provide users with written instructions on closing the packagings in the same manner as “proto-types” were closed for testing and certification.

Typically, written closure instructions can be obtained from the manufacturers of packagings or closures.

VII. Minimum Thickness for Reconditioning in U.S.

- Steel drums (55 gallon): 1.2 / 0.9 / 1.2 mm or “all-1.0” mm throughout.
- Steel drums marked 1.1 / 0.8 / 1.1 may not meet minimums .
- Plastic Drums (55 gallon): 2.2mm

U.S. Minimum Thickness Requirements for Steel Drum Reconditioning

Thinner Drums May Not be Reconditionable

U.S. DOT states that a non-bulk packaging used for hazardous materials more than one time must meet a series of requirements, one of which is minimum thickness. Minimum thickness standards do not apply to drums used for non-hazardous materials.

Steel drums' minimum thickness standards are set forth in a table with footnotes found in 49 CFR 173.28(4). The table lists seven packaging sizes from 20 liters to 450 liters. The applicable size for 55-gallon drums is 220 liters.

The table shows that a 55-gallon drum must be at least 0.92 millimeters thick throughout. For drums with different thicknesses in body and heads, a footnote reads:

.....Metal drums or jerricans manufactured and marked on or after January 1, 1997, and intended for reuse, must be constructed with a minimum thickness of 0.82 mm body and 1.11 mm heads.

These DOT minimums specify the *actual* minimum steel thicknesses, rather than a drum's marked *nominal* thickness.

A drum's marked *nominal* thickness indicates a theoretical thickness midpoint from which *actual* thickness will vary. Nominal marks are used because no steel mill can roll a perfect sheet of steel. There will always be thickness variations, particularly out towards the edges of the sheet.

Permissible variances (i.e., “tolerances”) in steel thickness have been recognized in international standards and the U.S. hazardous materials regulations. Steel used in the manufacture of a drum marked 0.8 may vary in actual thickness from 0.73 to 0.87 mm (+/- 0.07). Obviously, then, there will be some doubt as to whether a drum body marked “0.8” will

meet the DOT minimum of 0.82 mm. (Steel marked 1.1 or 1.2 may vary in actual thickness +/- 0.09 mm.)

Reconditioners prefer a drum that will in all cases meet the minimum *actual* thickness requirements of DOT. Such drums are marked either 1.0 mm (throughout) or 1.2/0.9/1.2 (top/body/bottom). Of course, drums marked with even thicker walls and heads are also acceptable.

Drums marked 1.1/0.8/1.1 cannot be presumed to meet DOT 's minimum thickness requirements for reuse. Their *actual* thicknesses may fall outside the DOT's minimum for actual thickness. And drums marked simply "0.8" (throughout) obviously will not meet the 0.92 mm minimum.

Tolerances (Variances) for Nominal Steel Drum Marks (mm)

