The forces that will act upon hazardous materials packages that are in transportation include:

- Vibration
- Friction
- Roll, pitch, yaw
- Sway, heave, surge
- Hogging, sagging, torsion
- Acceleration, retardation
- Temperature
- Tension, compression
- Pressure
- Radiation

Liquid hazardous materials intended for transport should be tightly packed in strong inner receptacles that are capable of withstanding expansion or a sudden loss of pressure. They should also be packed into leak-proof liners (e.g., plastic bags) with enough cushioning and absorbent packing material (e.g., vermiculite) to absorb the volume of the receptacles within the package.

Unless otherwise excepted, packages containing dangerous goods must be certified to the United Nations’ Performance Oriented Packaging (UN POP) standards. UN Performance Oriented Packaging is subjected to a series of tests including:

- Drop
- Hydrostatic pressure
- Stacking
- Heating and cooling
- Dragging
- Jerking
- Pressure differential
- Vibration
A typical UN POP mark for a package carrying liquids is shown below:

![UN Symbol]

1A1/Y1.8/200/16/USA/M4181

A typical UN POP mark for a package carrying solids or liquids in inner packaging is shown below:

![UN Symbol]

4G/Z10/16/CDN/+AA123

The first code in the sequence is the UN symbol, which signifies that the package conforms to the United Nations’ POP standards. The symbol may be expressed either as lower case letters in a circle or as capital letters (without the circle).

The next code in the UN POP marking sequence is the packaging type, where:

- 1 - Drum
- 2 - Barrel
- 3 - Jerrican
- 4 - Box
- 5 - Bag
- 6 - Composite packaging

UN POP markings applied to packages containing liquids include the following:

- Packaging type
- Performance level
- Relative density (max)
- Hydrostatic test pressure (max)
- Year of manufacture
- Country of manufacture
- Manufacturer (registered code)
The following codes apply to packages containing solids or liquids in inner packaging:

- Packaging type
- Performance level
- Gross mass (max)
- Solids (or liquids in inner packagings)
- Year of manufacture
- Country of manufacture
- Manufacturer (registered code)

The next code in the packaging type is the material of construction:

- A - Steel
- B - Aluminum
- C - Natural wood
- D - Plywood
- F - Reconstituted wood (e.g., particle board, chip board)
- G - Fiberboard
- H - Plastics
- L - Textiles (e.g., burlap, cotton)
- M - Multi-wall paper
- N - Metals other than steel or aluminum (e.g., brass, tin, copper)
- P - Glass, porcelain, earthenware (e.g., clay)

Some packaging-type codes will also have a number that follows the material of construction. For example, drums and jerricans may have the following codes:

- 1 - Closed (non-removable) head
- 2 - Open (removable) head

Wooden boxes may have the following codes:

- 4C1 - Ordinary wood box
- 4C2 - Wooden box with silt-proof walls
The next code in the sequence is the **Performance Level**. The Performance Level indicates which packing groups are permitted to be shipped in the package. The Performance Level codes are as follows:

- X - Packing groups I, II or III
- Y - Packing groups II or III
- Z - Packing group III (only)

On rare occasions, the following codes may also be shown:

- W - Specially approved packaging
- V - Variation packaging

**UN Performance Oriented Packaging that is intended for liquids** will be marked with the maximum relative density, or specific gravity, following the Performance Level. For example, the following mark indicates that the drum is intended to carry packing group II liquids up to a maximum relative density of 1.8 kilograms per liter (kgs/L).

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1A1/Y1.8/200/16/USA/M4181
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**UN Performance Oriented Packaging that is intended for solids, or liquids in inner receptacles**, will be marked with the maximum gross mass, in kilograms, following the Performance Level. For example, the following mark indicates that the fiberboard box is designed to carry solids or liquids in inner receptacles up to a maximum gross mass of 10 kilograms (approximately 22 lbs).

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4G/Z10/S/16/CDN/+AA123
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Packages that are designed to contain solids or liquids in inner receptacles will be marked with the letter "S."

The next code in the sequence for UN POP that is intended for liquids is the **maximum hydrostatic test pressure**. Packaging that is designed to carry liquids must be capable of withstanding the pressure from the expanding liquid when transported at higher ambient temperatures.
The following mark indicates that the jerrican has been tested to a maximum hydrostatic test pressure of 100 kPa (kiloPascals) or approximately 1 atmosphere (14.5 psi).

3A1/Y1.4/100/16/USA/M4181

- Following the maximum hydrostatic test pressure or "solids" designation, the year in which the packaging was manufactured will be indicated on the packaging.

The next designation in the UN POP marking is the code for the country in which the packaging was manufactured, followed by the manufacturing or testing facility's name and address, or code and registration number, which is registered with the Competent Authority for the country of manufacture.

- A - Austria
- ROK - Republic of Korea
- J - Japan
- MEX - Mexico
- D - Germany (Deutschland)
- USA - United States
- CDN - Canada
- S – Sweden

- There are certain types of packaging which are not recognized by the United Nations. These generally include cylinders for gases and packaging for infectious substances and radioactive materials. Packages that carry these types of dangerous goods are required to meet U.S. DOT requirements for transport into, from, or within the United States.
Cylinders will generally be marked as follows:

- DOT - Department of Transportation
- TC - Transport Canada
- Cylinder Type (e.g., 3AL)
- NRC - Non-Refillable Container
- Max Allowable Working Pressure (e.g., 2105 psi)
- Serial Number (e.g., F123456)
- Manufacturer (e.g., Luxfer)
- Month (MM) & Year (YY)
- Testing Agency Stamp (e.g., A)

Certain hazardous materials and hazardous materials in limited or excepted quantities may be excepted from the use of UN or DOT specification packaging provided they are capable of passing the prescribed tests for packing group III packaging (e.g., drop test, stacking test). Non-specification packaging must be strong, durable, compatible with the materials, and capable of withstanding the forces typically encountered in transportation such as vibration, temperature extremes, and superimposed weight.

Non-specification fiberboard packaging will often be marked on the bottom with a box maker's certificate or seal, a notation indicating that the packaging conforms to Item 222 of the National Motor Freight Classification (NMFC) rules. The NMFC system is a freight industry standard that most common carriers comply with. Please note that, if the shipper certifies on bills of lading that the boxes conform to Item 222 provisions, a box maker's certificate is not required.

The box maker's certificate (BMC) will identify the following:

- Manufacturer name & location
- Wall thickness (e.g., singlewall, triplewall)
- Burst Strength (e.g., PSI or Edge Crush Test)
- Density (e.g., lbs per thousand square feet)
- Size Limit (e.g., L+W+H)
- Gross Mass (e.g., 65 lbs, 20 kgs)
Although not required by DOT, many carriers (e.g., UPS) require non-specification boxes to display the BMC. Packages less than 20 lbs must be certified to 200 psi or 32 ECT and packages of 20 lbs or more must be certified to 275 psi or 44 ECT.

In addition to the marks and warning labels required to communicate risks associated with hazardous materials, hazardous materials and other packages may also be marked with international symbols. The international symbols (ISO 780) are universally recognized and readily understood pictorial markings that eliminate the need for handling instructions in several languages. The symbols include, but are not limited to:

- Arrows to indicate the upright position
- A glass to signify "handle with care"
- An umbrella to signify "keep dry"

Liquids should be packed in leak-proof intermediate packaging (e.g., plastic bags) with enough absorbent material (e.g., vermiculite) to absorb the entire liquid volume of the package. UN Performance Oriented and DOT specification packaging must be tightly closed in accordance with the packaging manufacturer's instructions, including using the appropriate closure method (e.g., tape, glue, staples). Packaging closure instructions are available from the packaging supplier or through the parts distribution center.

Hazardous materials packages that are damaged may not be offered or re-offered into transportation.

Regarding repackaging, fiberboard, and other packaging which is used to contain hazardous materials services parts and accessories, such as air bag modules and batteries, are generally non-reusable containers (NRC) or single-use packaging that may not be reused after it have been opened. Therefore, it is important to ensure that fiberboard boxes and other hazardous materials packaging is not opened until the part is actually used or installed.