

UN for dummies: Choices and responsibilities when packaging dangerous goods

By Maxence Wittebolle

CurTec International offers packaging and packaging knowhow for industrial and distribution applications in the pharmaceutical, speciality chemicals and other industries.

We strongly believe in offering added value through quality, functionality, user-friendliness and design. Added value can be found in many other aspects than just the tangible product. To select or develop the optimal packaging it is essential to have a complete insight in all these aspects.

Through the publishing of a series of White Papers on Packaging we hope to make a small contribution to the packaging issues you are confronted with.

The CurTec Team

UN for dummies:

Choices and responsibilities when packaging dangerous goods

Who is responsible? What are the important aspects? How do I choose the right packaging? These are common questions which arise when packaging and transporting dangerous goods. Fingers are often pointed when damage occurs. But is this justified? Maxence Wittebolle from the Belgian Packaging Institute (BVI) gives step-by-step advice on the choices and responsibilities when packaging dangerous goods in solid form.

There are risks associated with packaging and transporting dangerous goods. However, nobody wants to be ultimately responsible for these risks. The parties involved in packaging and transporting dangerous goods do not always appear to be aware of where each responsibility lies.

Who is responsible for what?

The company that manufactures a product is in principle always responsible. They know which products they want to package. They often spend months, or even years, researching the optimal composition. Before a company brings a product onto the market, it must perform a chemical analysis or have it done through another company to see whether the regulations on dangerous goods apply.

Material Safety Data Sheet

When a chemical company develops a new product, it needs to be analysed by an independent chemical analysis laboratory prior to its launch. Based on the results, a Material Safety Data Sheet can be generated which is essential for the commercialisation of the product.

Chemical analysis: three criteria

A chemical analysis tests products for three criteria:

- Flammability
- Toxicity
- Corrosiveness

The results are used to determine whether a product is considered as a “dangerous product” and if so, automatically also determines the danger level. This danger level ranges from extreme danger (I) to medium danger (II) and less dangerous goods (III). Whichever danger level applies, will be stated on the Material Safety Data Sheet (MSDS).

Applicable regulations

After classifying the product (see frame), it needs to be awarded a UN number. This can vary from a very specific number to a general number for a product that is not described elsewhere. The latter cannot be found directly in the legislation, but they have the characteristics of a flammable product, mixture or formulation for instance.

Every chemical substance has a UN number. This number can be used together with the legislation to determine the type of packaging required. The MSDS also states which packaging group the substance comes under. Each UN quality mark contains a letter that corresponds to a packaging group (see illustration):

| | I | II | III |
|------|---|----|-----|
| UN-X | ■ | ■ | ■ |
| UN-Y | | ■ | ■ |
| UN-Z | | | ■ |

Using the classification and the UN number, we have to look at the regulations associated with the desired form of transport. ADR (EU), DOT (US) apply to road transport, RID applies to rail transport, IDMG applies to maritime transport and ICAO applies to transport by air.

Classification of dangerous goods

Dangerous goods are classified into nine categories:

1. Explosives
2. Gases
3. Flammable liquids
4. Flammable solids
5. Oxidising substances
6. Toxic and infectious substances
7. Radioactive materials
8. Corrosives
9. Miscellaneous

This white paper only deals with handling solids.

'The legislation changes every two years so take this into account when choosing your packaging'

Packaging instructions

The permitted types of packaging for the product and the choice of transport can be found in the packaging instructions. These instructions contain a specific description (usually in chapter 4) that the packaging has to meet. You can also find information here about whether simple, complex or composite packaging can be used. This choice is also often determined by the company producing the chemical or recommendations from a packaging supplier.

No interaction with packaging

An important question here is how the packaging affects the product. For certain filling products, the packaging may not in any way lead to a change in its composition. This is the case for instance with high quality chemicals which need to retain an extremely pure composition. However, safety considerations are equally important.

On the other hand, a filling company is also responsible for ensuring that the product to be packaged is compatible with the packaging. In other words, there cannot be any interaction. Interaction can lead to changes in the composition and so present risks. Another packaging choice is whether the barrier properties are necessary.

Means of transport

Another important element of choosing packaging is the transport distance and route. Whether goods are moving for 100 or 1000 km greatly determines what is required from a pack. If you are transporting via air or rail, there are different factors at play than with road transport. However, the manner in which the product is to be transported, either as individual items or on pallets, is important when choosing the packaging.

Final choice for the type of packaging

There are also issues which play a role in your final choice of packaging, aside from rules and regulations, transport and preventing interaction. How does the packaging fit in your production line? Who are the clients that will purchase the product? Is the packaging intended for large (bulk) or small recipients? A packaging supplier is also able to help here by analysing the supply chain. In doing this, it remains important to dwell on the fact that responsibility for the correct choice lies with the chemical manufacturer.

‘Responsibility always ultimately lies with the company producing the chemicals’

What are the responsibilities of the packaging manufacturer?

Does this mean that the packaging manufacturer is protected from any responsibility? No. A packaging manufacturer must ensure that its packaging complies with a number of basic testing systems. It does this by performing the following tests:

- Fall tests
- Stacking tests
- A hydraulic pressure and atmospheric density test for liquids

A UN number is allocated to the packaging on the basis of these tests. A manufacturer will always aim to get the most out of its packaging, or to put it another way, to get the best possible UN quality marking. When the certificate for a certain UN quality marking is obtained, the manufacturer is responsible for the stability of the production process. In other words, the quality of the packaging must remain steady. A manufacturer must be able to demonstrate this throughout the process, from the raw material to the final product. This can be done with the help of certificates (raw materials, master batch, etc.) and/or inspections (during production). The manufacturer can also use a certificate from its supplier for this purpose.

It is important at all times that the production can be traced. For this reason, the manufacturer must take measures such as samples midway through the production run. The entire production process also needs to be inspected each year by an official, independent inspection body.

What are the consequences of choosing the wrong packaging?

Choosing the wrong packaging for instance can lead to damage during use or transport. In this case, people will always look to who ultimately chose the packaging. A packaging manufacturer or supplier can provide advice based on the delivered information and safety

data sheet. However, you should bear in mind that legally speaking, the responsibility still lies with the chemical manufacturing company.

Furthermore, consignments are frequently held at borders or ports because products are not correctly packaged. This often happens when there are doubts about the UN marking for instance.

Case studies

Philippe Holthof, an expert and examiner at the Federal Public Service of Mobility and Transport in Antwerp (Belgium), has to deal with hazmat violations at the border on a daily basis. He explains why shipments are seized and how it can be prevented.

'Many problems occur due to packaging used from non-Western countries. On paper they seem fine, but in reality they do not meet the necessary safety requirements. Another



common cause is bad loading restraint which leads to stowage. Carriers must realise that a packaging should be in good condition, both before and after transport. Putting different types of goods together in a container can also lead to impoundment at the border. Hazmat for instance cannot be shipped together with food products.

The costs of inferior packaging, bad load restraint and erroneous

combining can run up easily and range from missing a departure to salvage. Many costs can be avoided by getting good advice from a national shipping authority.'

What should you pay attention to when selecting a packaging supplier?

When you are transporting dangerous goods, it is wise to choose partners which meet the specific quality requirements. This relates to both packaging suppliers and the inspection authorities.

Various standards

Criteria for regulatory bodies vary depending on the country. This means that a UN marking issued in country X may differ from a UN marking in country Y. We know that the criteria in certain countries vary considerably from the generally applicable criteria. This makes it difficult for fillers to have a clear picture of the right choice. However, the majority of Western, North-European and North-American institutions are considered to be reliable.

When choosing a packaging manufacturer or supplier, choose a party that:

- Possesses the correct certifications
- Supplies UN approved packaging

- Performs production checks (itself and through third parties)
- Is up-to-date with the laws and regulations

Although the final responsibility lies with the filler, the packaging supplier performs an important advisory role: if the law changes, a packaging recommendation may change as well. A packaging supplier that has its change control in order can generally anticipate any changes.

Differences in laws and regulations

There are often discussions about differences in legislations. In principle, all legislations use the same classifications; however the type of packaging deployed may vary. This is particularly the case when comparing the ADR, RID and IMDG to ICAO. Simple packaging is permitted for many products to be transported by road, rail and maritime transport, but this does not suffice for air transport. In 80% of air shipments, these products must be transported in complex packaging. If liquids are being transported, then there is a considerable difference between American and European laws and regulations. For instance, in America, a so-called “Grandfather clause” (see frame) is often sufficient. This does not apply to Europe.

Grandfather’s clause

An exemption based on the circumstances existing prior to the approval of a future policy.

The 10 most important points for consideration in a nutshell:

- The filler/owner of the product is always responsible
- Make sure that you know the laws
- Find out the classification of your product
- Make sure that you possess a Safety Information Sheet
- Find out which materials may be compatible with your product
- Make sure that you know which rules apply for the transport you wish to use
- A packaging supplier may be able to provide more specific packaging advice if provided with a Safety Information Sheet.
- Take into account the differences in legislation between countries
- In the event of problems, always consult someone who is familiar with the applicable laws and regulations
- Choose a packaging manufacturer or supplier that has appropriate certifications and that has its quality management in order

Legislation

ADR

The transport of dangerous substances by road in Europe is regulated in the ADR. The regulations are based on the "Recommendations on the Transport of Dangerous Goods", issued by the United Nations. The ADR classification is harmonised with the classifications in other forms of transport (sea, air, rail and inland waterways). This is necessary since containers or lorry trailers for instance do not only travel by road, but also by rail or water.

RID

The transport of dangerous substances by rail is regulated in Europe in the Règlement concernant le transport International ferroviaire de marchandises Dangereuses (RID). This contains a precise description of how every kind of dangerous substance should be transported. There are regulations for matters such as the design and materials used for tank wagons, period tank inspections, packaging regulations, documents, training of staff, checks during transport.

ICAO

ICAO or the "International Civil Aviation Organization" sets the standards and rules which are required for aviation safety, security, efficiency and regularity and also environmental protection in the aviation industry. It uses the same classifications as the ADR.

IMDG

The transport of dangerous goods by sea is regulated in the IMDG. This also uses the same classifications as the ADR. However, these regulations include points which are specific to maritime transport (such as the stowage of containers on a ship).

DOT (Department Of Transportation)

The DOT is the federal ministry of the United States that is involved with transport in the United States. The DOT applies the Hazardous Materials Regulation (HMR; 49 CFR Parts 171-180). This contains the specific requirements for the safe transport of dangerous substances by rail, air, ship and motor vehicles.

FAQ

What is a UN packaging?

Packaging for shipping hazardous materials has to be certified to UN standards. The international agreements for the carriage of dangerous goods require packaging to be of a design-type certified by a national competent authority.

This involves testing the packaging to ensure its suitability for the carriage of certain dangerous goods. Such packaging is often referred to as "UN certified" and carries a UN mark containing codes, the details of which may be found in part 6 of ADR. CurTec offers UN certified packaging for hazardous solids.

What is a UN marking?

The transportation of hazardous goods is only permitted with packaging that bears a UN marking. A UN marking indicates the type of package and the levels to which the packaging has been approved. For example: N/1H2/Y26/S/13/NL/CURTEC 3278

| | |
|---------|--|
| UN: | United Nations |
| 1H2: | Plastic open top drum |
| Y: | Packaging group II/III |
| 26: | Maximum gross mass of the packaging including the contents in kg |
| S: | Approved for solids |
| 13: | Last two digits of the year of manufacturing |
| NL: | Country where UN certificate has been issued |
| CURTEC: | Manufacturer name or code |
| 000066: | Certificate registration number |

A UN marking is unique for a single product or series of products and should not be confused with a product reference.

What does UN stand for in UN marking?

UN stands for United Nations. The United Nations have established a universal system for the classification, packaging, marking and labelling of dangerous goods to facilitate their safe transport. National and international regulations governing road, rail, sea and air transport are all based on the UN system. Under the regulations, packaging must meet or exceed minimum standards of performance before it can be authorised for the carriage of dangerous goods.

Package performance is established by subjecting specimens of the packaging to the tests described in Chapter 6.1 of the UN Model Regulations. If they pass the tests, packaging subsequently manufactured to the same specification, (known as a design-type) may be regarded as meeting the requirements and marked accordingly.

How long is a UN marking valid?

Packaging bearing a UN marking is valid for maximum 5 years. A UN marking is recorded in a UN test report. The validity of a UN marking depends on the validity of the UN test report which is different per country. All our UN test reports have unlimited validity because they were issued in Belgium and The Netherlands. Read more in the article [‘How long is a UN test report valid?’](#)

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Where lies the difference between hazardous solids and liquids? How can I verify it?

To explain this question we need to distinct liquid, gas and solids.

Liquid means a substance or mixture which at 50°C has a vapour pressure of not more than 300 kPa, which is not completely gaseous at 20°C and at a standard pressure of 101.3 kPa, and which has a melting point or initial melting point of 20 °C or less at a standard pressure of 101.3 kPa.

Gas means a substance which at 50 °C has a vapour pressure greater than 300 kPa; or is completely gaseous at 20 °C at a standard pressure of 101.3 kPa.

Solids are the substance or mixtures that do not meet the definitions of liquid or gas.

You can easily verify the physical state of a product by checking it material safety data sheet (MSDS). Section 9 indicates whether it is liquid, solid or gas. Section 14 gives transport information including UN number and packaging group.

CurTec supplies UN-certified packaging for hazardous solids. CurTec does not supply UN-certified packaging for hazardous liquids.

What is the difference between conductive and UV safe drums?

Conductive and UV safe drums are often confused because they are both black. Although they both look the same, they are black for different reasons.

A conductive drum is able to conduct static electricity caused by surface contact and separation, thus avoiding ignition. A conductive drum is made of a special HDPE blend with a high percentage of carbon black which of course colours the drum black. Adding other colorant does not have any visible effect.

A UV safe drum protects against UV light. It is made of regular HDPE. CurTec adds black colorant because of all colorants it offers the best possible UV protection at low dosage.

How do I properly use a conductive drum?

A conductive drum needs to be properly earthed so that it can safely dissipate static electricity. It is important to use static earthing systems that can determine if a drum is actually static dissipative to a maximum resistance of 1×10^8 ohms. This will ensure that 'rogue' containers made of normal plastic cannot be used in the hazardous area. A static earthing system will also ensure that the static dissipative content of the container has not degraded through normal lifecycle effects and is reliably performing its intended safety function of dissipating potentially hazardous electrostatic charges from its surface once it has been connected to earth.

For more information CurTec recommends you read the white paper '[Is it ever safe to use plastic drums and containers in hazardous areas?](#)' by Newson-Gale.

How do we test the surface resistivity of conductive drums?

Conductive drums have a surface resistance $\leq 10^6$ Ohm. During manufacture every separate drum and lid is measured. The equipment used to measure is a MetrISO 2000 resistance meter. Drums are measured between the rolling ribs on the side and lids in the middle around the injection point. Handgrips are also measured by tapping all separate items with the measuring electrodes. The distance between the electrodes needs to be at least 25 millimetres.

The maximum limit for product acceptance is 1 Mega Ohm. All products with resistive properties above that limit are rejected. The data acquired during each production run is transferred to our machine registration software where it is stored for future reference.

About the author



Maxence Wittebolle is General Manager of the Belgian Packaging Institute (BVI). For the last 30 years he has advocated a high-quality, safe and harmonised system for transporting dangerous goods.

Together with a number of colleagues in other countries he establishes the results of coordinated test procedures (CEN/ISO standards) and interpretations.

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