Questions and Answers for the Use of Intermediate Bulk Containers (IBCs) on the European market

Choice of a composite IBC

1.) What is a composite IBC?

Composite IBCs (intermediate bulk containers) are packagings for the transport and storage of mainly liquid and / or high viscosity filling-goods.

Extract from UN Model Regulations:
“Intermediate bulk container (IBC)” means any rigid or flexible portable packaging, other than those specified in Chapter 6.1, that has a capacity of not more than 3m³ for solids and liquids of packaging groups II and III, is designed for mechanical handling and is resistant to the stresses produced in handling and transport as determined by the tests specified in Chapter 6.5.

Most IBCs consist of

- a plastics inner receptacle
- an outer packaging (iron cage)
- a pallet attached to the cage
- a filling opening with screw crap
- an outlet valve.

There can be other components, such as protective devices and support cushions and, if permitted, further inlet or outlet nozzles. Pressure relief devices must be provided for some filled products, or in the case of hot-filling.

Inner receptacles are typically manufactured of HDPE, providing excellent consistency for a variety of product containment. The correct gasket types & materials are always chosen according to the intended filled product. For maximum safety you should choose the gasket type which is most appropriate for the product to be filled into the IBC. If you are uncertain about the correct gaskets to be used, you should consult the IBC manufacturer.

Some gasket manufacturers are using colours to specify the gasket material; the specific colour will then be the colour of the outlet valve handle.
Example: In accordance with chapter 5.4.2 of the German standard DIN 30823, the handles of IBC outlet valves should be specifically coloured as follows:

Gasket material	Designation
FKM	grey white
NBR	graphite black
EPDM	carmine red
PTFE	sky blue

2. What IBC is best suited for my purposes?

A composite Intermediate Bulk Container (IBC) consists of an outer casing and a rigid plastics inner receptacle.
Once assembled, both components become an inseparable unit, which can be used as intended; i.e. filled, stored, carried and emptied. Returnable and non-returnable composite IBCs can be used for the storage and transport of both hazardous and non-hazardous liquids up to packing group II.

Each IBC design type, intended for the transport of dangerous goods, needs a certificate of approval and a marking confirming that the design type (including any specialised components), meets the test requirements. The UN approval will be granted to composite IBCs intended for the transport of dangerous goods that have successfully passed several design type tests (UN Model Regulations, chapter 6.5.6).

You should discuss with your supplier, which IBC type is most suitable for your requirements.
The following aspects should be taken into account; weight and type of the filling product, as well as the required method of filling, transport, storage and emptying. The suitability of the composite IBC for the intended filling product is the responsibility of the user.

The more precisely you specify the product to be filled / contained, the better your supplier can recommend the right IBC (along with any specialised gaskets and accessories), for your requirements. You should make clear if your composite IBC needs to be suitable for specific requirements, such as the transport of dangerous goods, use in ex-zones or the transport of food products.

If the filling product has a flashpoint of 60°C/140°F or less (in closed container), provisions must be taken to prevent dangerous electrostatic discharge. Electrostatic charging often occurs during quick filling and emptying or stirring and mixing operations. Regardless of the flashpoint of the filling product, explosion-protected IBCs should also be used in ex-zones to prevent electrostatic discharging. An example for marking ex-IBCs are the two labels standardized within the members of IK (Germany):

Special requirements also have to be met for packagings used for transporting food products, primary products of the pharmaceutical industry and similar products. The compliance with national and international guidelines for packagings coming into contact with food should ensure that packagings will not cause impurities which might endanger human health, bring about unacceptable change in the composition of the foodstuffs or deterioration in the organoleptic properties thereof.

Depending on the filling product, the use of a composite IBC with permeation barrier may be recommended. Permeation defines the temperature-dependent mass transfer through solid material (especially plastic), when the diffusing substance permeates such a solid material mainly as a result of the concentration or pressure gradient.

A permeation barrier minimizes the permeation of the filling product or particular product ingredients both from the inside to the outside and vice versa. Dependant on the barrier type, this applies also to the permeation of water vapour, oxygen and other gases. To check whether use of a permeation barrier is recommended for your product, you should contact your supplier.

3.) How should composite IBCs be marked?

Each composite IBC, intended for use according to the UN Model Regulations, shall bear markings which are durable, legible and placed in a location so as to be readily visible. The marking shall show:

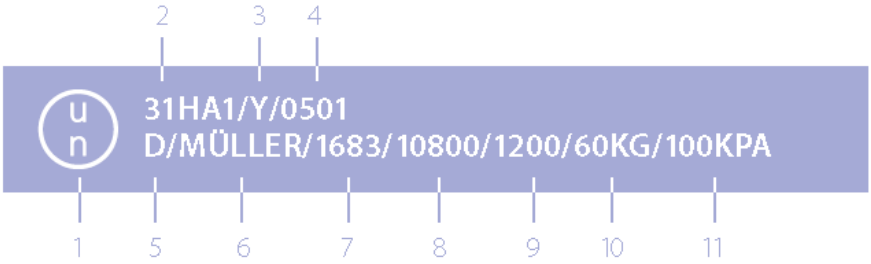
<u>Primary marking:</u>

- the United Nations packaging symbol
- IBC-Code
- a capital letter designating the packaging group for which the design type has been approved
- month and year of manufacture
- the State in which the design type was approved
- the name of the manufacturer or other identification of the IBC as specified by the competent authority
- the stacking test load (in kg)
- the maximum permissible gross mass (in kg)

Additional marking:

- capacity (in litres)
- tare mass (in kg)
- test pressure (in kPa)
- date of the last leakproofness test
- date of last inspection

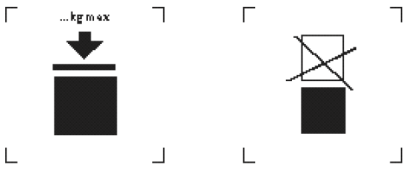
According to the UN recommendations composite IBCs approved for the transport of dangerous goods have to be marked durably (see following example):



1) The United Nations packaging symbol
2) The type of IBC: composite IBC for the transport of liquids with rigid plastics inner receptacle and a steel outer casing
3) Packaging group for which the design type is approved:
   X: for packaging groups I, II and III (IBCs for solids only)
   Y: for packaging groups II and III
   Z: for packaging group III only
4) Month and year (last two digits) of manufacture
5) The State authorizing the allocation of the mark (according to the distinguishing sign for motor vehicles in international traffic)
6) The name of the manufacturer or other identification of the IBC as specified by the competent authority
7) The stacking test load in kg. For IBCs not designed for stacking, the figure “0” shall be shown
8) The maximum permissible gross mass in kg (composite IBC and content)
9) Capacity in litres at 20°C
10) Tare mass in kg
11) Test (gauge) pressure in kPa or bar, if applicable

4.) What is the maximum permitted stacking load label good for?

According to chapter 6.5.2.2.2 of the UN Model Regulations the maximum permitted stacking load applicable when the IBC is in use shall be displayed on a symbol as follows:



The symbol shall be not less than 100 mm x 100 mm, be durable and clearly visible. The mass marked above the symbol shall not exceed the load imposed during the design type test divided by 1.8.

The stacking load symbol only applies to the stacking load during transport. The stacking load relevant for the static load or storage is indicated in the UN-marking as “stacking test load in kg”. The stacking load label is only needed with dangerous goods.

Chemical compatibility of composite IBCs

5.) What has to be considered or tested in respect to the resistance of plastics and composite IBCs with a plastics inner receptacle?

Before an IBC is used for the transport of dangerous goods, its chemical compatibility with the filling substances must be sufficiently verified. Chemical compatibility can be tested in Europe by the Assimilation Test according to ADR 4.1.1.19 lab tests, or an original filling substance test. The different methods are described as follows:

- Original filling substance test:
  According to ADR 6.5.6.3.3 the sample IBC shall be filled with the substances they are intended to contain and then be subjected to a preliminary storage for six months at room temperature. After this storage, the test samples shall undergo the complete design type test. Once the design type is approved and the proof of chemical compatibility has been demonstrated, the IBC can be used according to its approval. The duration of the procedure is around 8 months. In particular cases the duration of storage can be reduced to 28 days by increasing the temperature to 40°C. However, this procedure has to be agreed with the competent authority (for example; BAM in Germany) before the test is started.

- Standard liquids (ADR 6.1.6):
  In addition to the above-mentioned procedure, there is also the possibility to verify the chemical compatibility of IBCs with so-called ‘standard liquids’ and then allocate the filling substances accordingly (ADR 6.5.6.3.5). The IBCs are filled with standard liquids, which are representative for the processes of deterioration on polyethylene, and stored for 21 days at 40°C. After storage, the test samples shall undergo the design type test. The allocation of the filling substance (and the proof of chemical compatibility) is either made by assimilation as described in ADR 4.1.1.19 or by laboratory tests.

- Assimilation according to 4.1.1.19:
  By means of a Filling Substances List, and rules regarding the combination of different chemicals to be used, the option of assimilation to standard liquids or the combination of standard liquids is possible. A prerequisite of this is that all components of the filling substance are known and included in the Assimilation List.

- Laboratory tests:
  In case assimilation is not possible, determination can also be made on the basis of lab tests. Test samples are stored with the original filling substance and then tested. The following test procedures shall be applied to simulate relevant damaging effects:

  - *Lab method A, resistance against absorption/swelling:*
    This method determines the resistance against swelling (absorption) of the plastics packaging material, in contact with the filling substance. In the test using the product to be filled, the mass increase in percentage should only be as high as the value reached in the test with the appropriate standard liquid.

  - *Lab method B, resistance against cracking under stress:*
    This method determines the resistance against stress cracking of plastics packaging materials in contact with the product to be filled. There are three alternative methods; the current, popular method, is the pin impression procedure. The results of this test method shall show that, under the impact of the filling substance, the residual tensile strength is equal to, or higher than, the standard liquid used for control.

  - *Lab method C, resistance against molecular degradation:*
    This method determines the resistance against the molecular degradation of plastics packaging in contact with the filling substance. One of three alternative methods has to be applied. A method that is often applied is the measurement of the melt flow rate:
    The melt flow rate of the test sample stored in the filling substance shall not exceed that of an identical test sample stored in 55° nitric acid.

  The test samples shall be stored for 42 days at 40°C, the complete laboratory tests take ca.12 weeks. In case allocation is possible neither following 4.1.1.19 nor by laboratory methods A, B and C there is only the possibility to run tests with the original filling product as described above.

Tests of gasket compatibility and the resistance of fittings, which are not made of HDPE, can be relevant. In such cases, assessment is done by compatibility lists.

IBC Handling

6.) How do I safely fill a composite IBC?

First of all it must be ensured that the outlet valve is closed during the filling procedure. Fill the product into the top fill aperture at atmospheric pressure. Maximum filling temperature should not exceed 70°C (~158°F), depending on product and design type. Sufficient venting of the inner receptacle made of PE must be ensured to prevent vacuum deformation when cooling down.
Screw the screw scrap back into place on the fill aperture and tighten it before storage or dispatch. More details are listed in the technical information for IK members about closures of dangerous goods packaging and IBCs.

Composite IBCs are intended for pressure-free filling, storage and discharge. We generally recommend avoiding pressurization of the IBC.

Inspection prior to filling is the responsibility of the filler (UN Model Regulations chapter 4.1.1.9). For further detailed information, especially regarding filling with dangerous goods and chemical resistance, please contact your supplier.

Transport

7.) How do I safely lift a composite IBC?

Check the composite IBC for any damage caused by transport before lifting operations. For the lifting of full or empty IBCs always use forks which reach fully underneath the pallet, for example:

hand pallet truck

electro stacker (not advised for frame pallets)

lift truck

Protect the IBC from impact and also prevent damage to the fittings. Never use ropes attached to the traverses or the cage to move the IBC. Please contact your supplier for alternative lifting methods.

If it is evident, or suspected, that any form of heavy impact has damaged the IBC, it should not be used any more.

8.) How do I safely transport a composite IBC by truck or freight container?

Load securing is important to transport the product safely and undamaged to the customer. IBCs have to be secured by an appropriate means, capable of

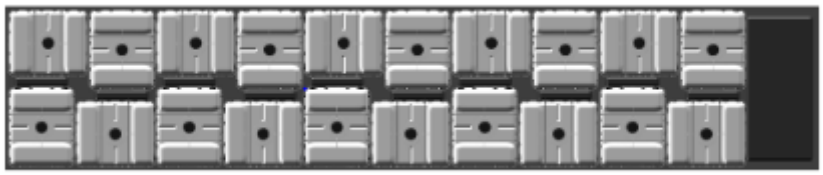
restraining the goods in the truck or container, to prevent movements during transport which could cause a position change or damage to the IBCs.

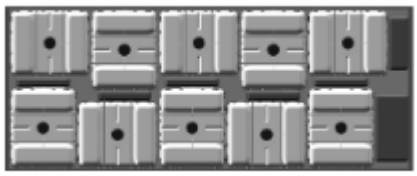
Securing loads is an essential contribution to the prevention of accidents. Legal requirements and instructions for safe transport have to be observed.

For transport in ISO sea containers it must be noted that the IBC pallets can be nested. To prevent unintended bouncing, the IBCs shall be secured either with airbags filling the gap between the IBC and the container ceiling or attached to each other by appropriate materials.

Please keep in mind that the height in the door aperture is lower than in the rest of the sea container, therefore simple stacking might only be possible.

Packing of IBCs of 1000x1200 mm in 20'- and 40'-container according to the CTU-code:





All gaps must be filled

Storage and stacking

9.) How to stack composite IBCs when filled?

Ensure that the ground on which the IBCs are stacked is flat. Only use forklift trucks that have the necessary lifting capacity. Make sure that the length of the forks is correct to reach fully underneath the IBC.

When IBCs are stacked, correct nesting must always be ensured, e.g. 2 on 2 instead of 1 on 3. Only stack filled IBCs which are correctly nested. Stack only IBCs of the same type.

Stacking of filled, composite IBCs in warehouses is authorised if the stability of the stack is guaranteed. Please refer to the stacking test load stated in the UN marking on the identification plate. If uncertain ask your supplier.
Stacking of filled, composite IBCs during transport is possible with up to 2 IBCs, if the stability of the stack is ensured and the composite IBC approved for stacking (see stack pictogram chapter 4).

Because of the asymmetry of the pallets, the containers have to be stacked according to the loading space, with the upper container correctly nested into the lower container.

10.) How to store composite IBCs?

For the storage of composite IBCs, storage regulations with different provisions and requirements must be considered. In contrast to the transport regulations, there are only national requirements relating to storage.

The different requirements of regulations for the storage of combustible materials and the requirements for storage of water-polluting substances, which are grouped in different provisions, should be noted.

Emptying

11.) How to safely empty composite IBCs?

Ensure that the IBC is placed on a flat, clean surface. Ensure that the IBC is supported by the whole surface when emptying. If possible, empty the IBC through the outlet valve on the lower side.

Before opening the outlet valve, loosen the upper filling lid and let air flow into the container to avoid a collapse of the inner receptacle due to vacuum. The emptying of composite IBCs should not be carried out under pressure.

In case the outlet valve is connected to a fixed pipe installation, the attachment of the fixed pipe must be made in such a way that any movements and vibrations, liable to cause mechanical damage, will not affect the safety of the IBC. It must also be ensured that no vacuum is caused during discharge of the filling product.

Another way to empty IBCs is through the upper fill opening by use of a pump. Mixers, pumps or other devices shall not be attached directly onto the cage. If a pipeline is connected, filters, heavy isolating valves or heavy pipes must be supported independently from each other. Make sure that the pump device will not transmit vibration to the container.

Multiple use

12.) How often and how long can composite IBCs be used?

Composite IBCs can be reused if inspected before each filling and carriage, to ensure that they are free from corrosion, contamination or other damage. Every IBC must be inspected to ensure the proper function of any service equipment, such as valves.

It must be ensured that the composite IBC, when reused, fulfils the same requirements as for its first use. Any IBC which shows signs of reduced strength shall no longer be used (cf. UN Model Regulations ADR chapter 4.1.1.9). The user bears responsibility for inspection and reuse.

It must also be observed that the user of IBCs for the transport of dangerous goods, in accordance with IMDG-Code and RID/ADR (see chapters 6.5.4.4.1 – 6.5.4.4.3), has to run so-called periodic inspections on every IBC at intervals of not more than two and a half years. The inspections shall be carried out and documented by experts. The report has to be kept at least until the next periodic inspection.

The periodic inspection of IBCs for dangerous goods includes at least a visual check of the external condition, the proper functioning of the service equipment and a leakproofness test.

After expiry of the inspection period, the IBC must not be filled and handed over for carriage any more. The period of use, permitted for the transport of dangerous goods, shall not exceed 5 years from the date of manufacture, depending on the filling product.

In case of multiple use with aggressive filling products the adequate strength of the inner receptacle must be ensured, in consideration of the properties of the filling product, with respect to degradation caused by the substance contained.

To give an example, for nitric acid, with a concentration of 55% or more, an inner receptacle protected from light and with higher weight should be used in case of repeated use.

Reconditioning

13.) What about reconditioning of a composite IBC?

There are different reconditioning methods for composite IBCs:

- Cleaning
  Composite IBCs are washed or steam cleaned, with original closures or gaskets replaced where necessary. Replacement of the fittings is

excluded. In general, the function of fittings and gaskets is controlled visually. Apart from the periodic inspection (2,5 years) there is no other control during the period of use. The user bears responsibility during the period of use. Any replacement of fittings requires a documented leakproofness test.

- Repair
  Composite IBCs are restored to be capable of withstanding the design type test. In case of damage to the rigid, inner receptacle, this will be replaced by a new inner receptacle and fittings, conforming to the original design type, from the same manufacturer.
  The IBC will be subjected to an inspection and a leakproofness test. After repair a marking will be placed on the IBC to show the State in which the inspections and tests were carried out and the Party performing the tests and inspections. The UN marking will not be changed. Any replacement of fittings requires a documented leakproofness test.

- Remanufacturing
  Remanufacturing means the converting of a specific IBC from one UN design type to another UN design type. The outer cage must be inspected and repaired if necessary and a new inner receptacle must be fitted. Both elements have to be approved. In this case a new UN marking has to be applied and the tests during production correspond to the new design type. Repaired and remanufactured composite IBCs shall be marked in an appropriate manner.

14.) Can composite IBCs be recycled?

The manufacturer may offer a return system and there are also reconditioners practising different recycling methods. One method is the mechanical recycling of used raw materials (HDPE and metal). The recycled material obtained from used HDPE can serve as raw material for different applications, for example pallets, replacing virgin plastics material.
Another method is energy recovery through incineration of composite IBCs.

16.) What collection conditions are applied to composite IBCs?

The following collection conditions have to be met by the end user of the composite IBC to comply with required recycling targets, required by national and international legislation:

1.) The IBC is completely drained, i.e. drip and granule-free and scraped completely clean,
2.) The IBC is free of external solidified product residues,

3.) All discharge valves and/or other closure systems must be in place and securely closed,
4.) The IBC must not be damaged, i.e. inner bottle, steel grid, pallet may show no signs of damage or oxidation,
5.) The last filling product of the IBC must be clearly identifiable, label plates, product labels and hazardous material labels, as well as warning labels required by the valid hazardous goods regulations, have to be legible.