IK Industrievereinigung
Kunststoffverpackungen e.V.

Questions & Answers

on the use of rigid plastic packaging

Selection of plastic packaging containers

1. What are rigid plastic packaging containers?

Rigid plastic packaging containers – also called packaging containers – are containers (drums, canisters and bottles) for the transport and storage of liquid and/or pasty as well as powdery or solid filling substances.

Rigid packaging containers mainly consist of a blown container manufactured in one piece – with either a round or rectangular cross section – which are provided with at least one opening. The capacity is normally limited to 250 l.

There may be other components for example handles, support rings and other connecting pieces for extraction or filling. Closures can be equipped with a number of different functional elements.

The packaging containers are mostly manufactured from polyethylene which allows a certain universality for the filling products. Depending on the application, the material used may be a combination with other polymers (e.g. co-extrusion from PE/PA). Necessary seals are always selected in conjunction with the planned filling product.

Comment: For maximum operational safety, choose the type of seal that best suits the product that is to be filled into the packaging container. If in doubt, consult the manufacturer for advice on choosing the right seal.

If dangerous goods are to be transported in the packaging container, various laws and regulations will have to be complied with depending on the means of transport:

- ADR for road transport
- RID for railway transport
- IMDG code for maritime transport
- IATA /ICAO-Ti for air transport

2. Which packaging container is the right one for my purposes?

Packaging containers with both non-removable and removable lids form an inseparable entity which is filled, stored, transported and emptied as such. According to the relevant approval, they can be used for the storage and single or multiple shipment of hazardous and non-hazardous liquids or solids of all packaging groups.

For each type of container intended for the transport of dangerous goods, a design type approval and a registration number must be issued which confirms that the design including its equipment conforms to test specifications. Packaging destined for the transport of dangerous goods must undergo various design type tests for UN certification (ADR subsection 6.1.5).

You should discuss which packaging container is appropriate for your purposes with your supplier. The following aspects should be taken into account: weight and type of filling product and desired method of filling, transport, storage and emptying. The user is responsible for the suitability of the packaging container for the filling product.

Comment:
For UN hazardous goods packaging, all the provisions and instructions of the existing UN approval on the proper use of packaging containers should be observed. Only the closures authorised in the relevant approval may be used. You can obtain the necessary information from the manufacturer of the packaging containers.

The more precisely you can specify your filling product and how the packaging container will be used, the more precisely your supplier can tailor the packaging container to your requirements. You should definitely clarify whether the packaging container needs to be suitable for specific requirements such as the transport of hazardous material, use in explosive zones or the transport of raw food materials.

Packaging containers are normally manufactured from insulating plastics and cannot be used in explosive gas atmospheres over a volume of 5 l, unless it can be proved that loading is not dangerous.

Special requirements are also imposed for the transport of food, pharmaceutical intermediates and similar filling products. By complying with nationally and internationally applicable guidelines for packaging containers that come into direct contact with food, it should be ensured that the packaging containers do not cause any contamination that would endanger human health, would lead to an unacceptable change in the composition of food or to an impairment in the organoleptic properties of the food.

Depending on the filling product, the use of permeation barriers may also be appropriate. Permeation is the highly temperature-dependent transport of a substance through solid materials (especially plastics) in which the diffusing substance penetrates the solid material mainly in the direction of the concentration or pressure gradient.

A permeation barrier minimises the permeation of the filling product or individual product ingredients both from the inside to the outside and in the other direction. Depending on the type of barrier, this also applies to the permeation of steam, oxygen and other gases. To clarify whether the use of a permeation barrier is appropriate for your filling product, please consult your supplier.

3. What norms and technical rules exist for the use of packaging containers?

DIN EN 13972:2003-01 – Rigid plastics containers – Definition of nominal, brimful and total capacity and measurement of brimful and total capacity

DIN EN 13973:2003-01 – Rigid plastics containers – Method for determination of drainability

DIN EN 13974:2003-01 – Rigid plastics containers – Specification of tolerance for dimensions, weight and volume

DIN EN ISO 20848-1:2006-09 – Packaging – Plastics drums – Part 1: Removable head (open head) drums with a nominal capacity of 113.6 l to 220 l

DIN EN ISO 20848-2:2006-09 – Packaging – Plastics drums – Part 2: Non-removable head (tight head) drums with a nominal capacity of 208.2 l and 220 l

DIN EN ISO 20848-3:2006-09 – Packaging – Plastics drums – Part 3: Plug/bung closure systems for plastics drums with a nominal capacity of 113.6 l to 220 l

DIN EN 862:2015-11 Draft – Packaging – Child-resistant packaging – Requirements and testing procedures for non-reclosable packages for non-pharmaceutical products

DIN EN 8317:2016-05 – Child-resistant packaging – Requirements and testing procedures for reclosable packages

DIN EN 14375:2015-12 Draft – Child-resistant non-reclosable packaging for pharmaceutical products – Requirements and testing

DIN EN ISO 13127:2013-03 – Packaging – Child resistant packaging – Mechanical test methods for reclosable child resistant packaging systems

DIN EN ISO 11683:1997-11 – Packaging – Tactile warnings of danger – Requirements

DIN EN ISO 13274:2014-06 – Packaging – Transport packaging for dangerous goods – Plastics compatibility testing for packaging and IBCs

DIN EN ISO 16495:2013-12 – Packaging – Transport packaging for dangerous goods – Test methods
UN recommendations for the transport of dangerous goods
(ADR, RID, IMDG-Code, Orange Book, Chapter 6.1,
Dangerous goods regulations of the BAM (BAM-GGR))
EU-CLP Regulation art. 35 paragraph 2
Child-resistant fastenings and tactile warnings
TRGS 727:2016-01
Avoiding ignition hazards as a result of electrostatic charges

IEC TS 60079-32-1:2013 – Explosive atmospheres – Part 32-1: Electrostatic hazards, guidance
IK Torque List

4. What markings are stamped on hazardous material packaging containers?

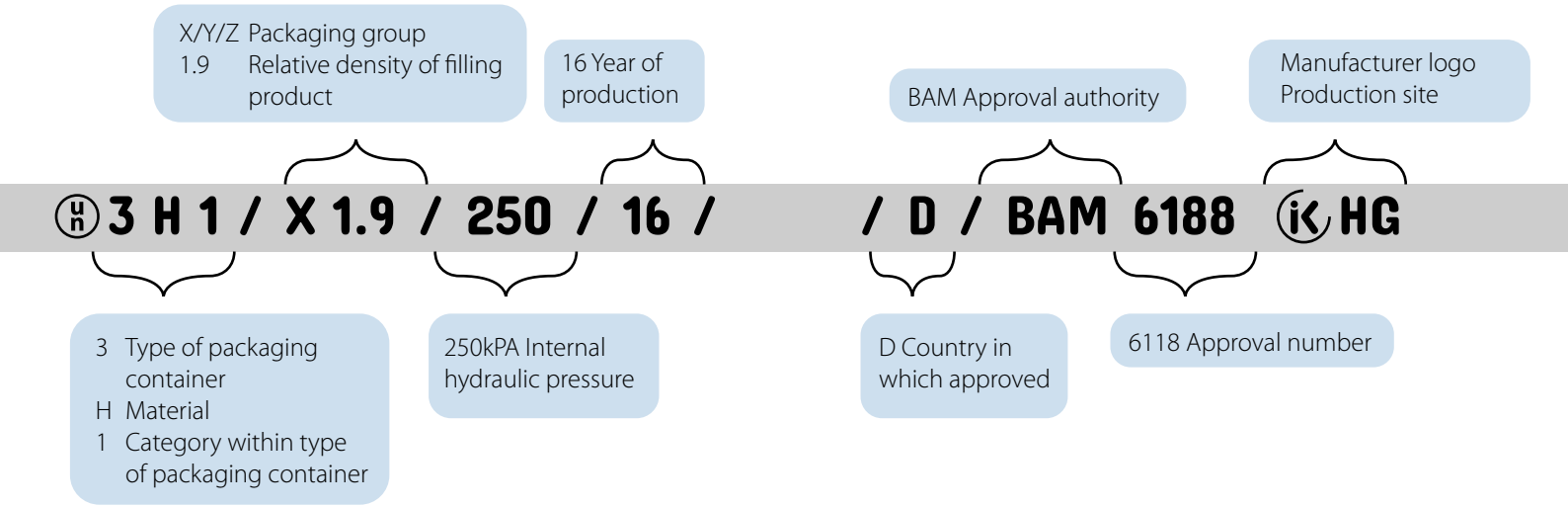
Every packaging container that is built and intended for use in accordance with ADR must be provided with a permanent, legible marking in a clearly visible location. The marking must include the following details:

Marking:

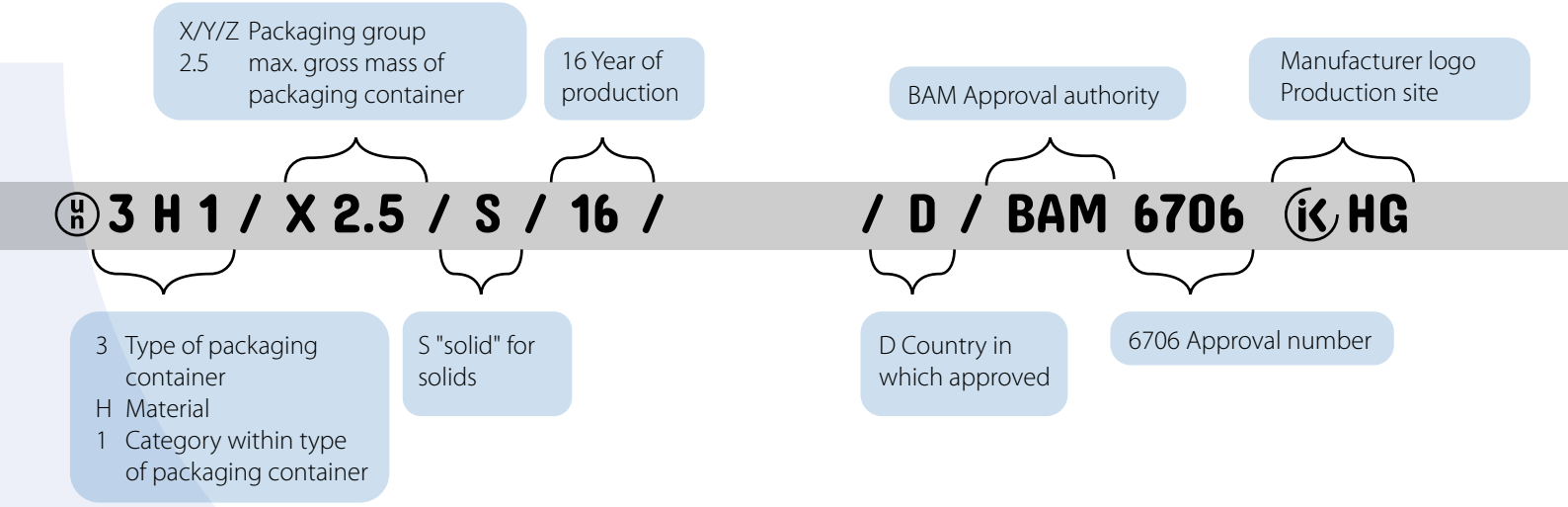
- Packaging symbol of the United Nations
- UN Code
- Authorised packaging group
- Density / Gross mass (solids only)
- Testing pressure in kPa (liquids only)
- "S" (=Solids for solids only)
- Year of production
- Country in which type of construction was approved
- Name and symbol of the manufacturer and any other identification as specified by the competent authority
- Month of production (date stamp)

According to UN guidelines, packaging containers approved for the transport of hazardous materials must be permanently marked with the following details (see example below):

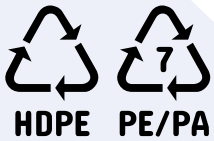
Marking liquid (with declaration):



Kennzeichnung Feststoff (mit Erklärung):



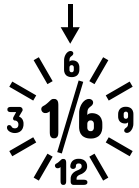
Optional markings:



Recycling symbol


Glass-fork symbol


Tactile danger notice



Date stamp


Orientation arrows

Chemical stability of plastic packaging containers

5. What needs to be taken into account/ tested with respect to the stability of plastic packaging containers?

Before using a packaging container, especially one intended for the transport of a hazardous material, it must be proved that the container is sufficiently chemically stable with respect to the filling product. The simplest way to test this is to apply the assimilation method in accordance with ADR 4.1.1.21, carry out laboratory method tests or an original filling substance test. The individual tests are described below:

Original filling substance test:
According to ADR 6.1.5.2.6, the test samples must be filled with the respective goods for whose transport they are intended. The containers must then be stored for six months at room temperature. After this storage, the test samples undergo the complete design type test. If this test is passed, then evidence of chemical compatibility is deemed to have been provided and the packaging container can be used in the version tested.

The entire procedure takes approx. 8 months. In individual cases, the length of storage can be shortened to 28 days by raising the temperature to 40°C. However, this must be agreed before storage and testing with the respective competent authority (in Germany, the BAM).

Standard liquids (ADR 6.1.6):
In addition to this method, it is also possible to test packaging containers with so-called standard liquids and then allocate the filling products to these accordingly (ADR 6.1.5.2.6).

For this purpose, the packaging containers are filled with standard liquids which are chosen to represent the damage mechanisms in PE, and then stored at 40°C for 21 days. After storage, the type test is then carried out.

The filling product is then allocated (and hence evidence of chemical compatibility provided) either using the assimilation method described under ADR 4.1.1.21 or via allocation according to a laboratory method test.

Assimilation in accordance with ADR 4.1.1.21:
In brief outline, a list of filling products and rules relating to the combination of various chemicals is used to test whether it is possible to allocate a product to standard liquids or to a mixture of standard liquids.

The basic prerequisite for this is that all the components of the filling product are known and are included in the assimilation list. This method is just paper testing and can be carried out relatively quickly.

Laboratory method test:
If assimilation is not possible, allocation can also be carried out using the results of laboratory method tests. For this purpose, plastics test specimens are stored in the original filling substance and then correspondingly tested.

There are three different tests which again simulate the corresponding damage mechanisms:

Laboratory method A –
Resistance to absorption/swelling:
This method determines the resistance to swelling (absorption) of plastics packaging containers when the latter come into contact with the filling product. The percentage increase in the mass on testing with the filling product must not exceed the value reached in the test with the applicable standard liquid.

Laboratory method B –
Resistance to cracking under stress:
This method determines the resistance of plastics packaging containers to cracking under stress when the latter come into contact with the filling product. One of three alternative methods can be used. The most commonly used method is the pin impression method. The results of this test method must show that under the impact of the filling product, the residual tensile strength is equal to or higher than the standard liquid used for control.

Laboratory method C –
Resistance to molecular degradation:
This method determines the resistance of plastics packaging containers to molecular degradation when the latter come into contact with the filling product. One of three alternative methods can be used. A method that is frequently used is the measurement of the melt flow rate.

In this method, the melt flow rate of the test sample from the relevant material in contact with the filling substance must not exceed that of an identical test sample stored in 55° nitric acid. The test samples are stored at 40°C for 42 days, all the laboratory method tests take approx. 12 weeks.

If allocation is not possible using either assimilation in accordance with ADR 4.1.1.21 or using laboratory methods A, B and C, there is only the possibility of running tests with the original filling substance as described above.

Handling of plastic packaging containers:

If packaging containers are to be used for the transport of dangerous goods, it is essential to take all valid and applicable sets of rules into account. Requirements for handling can be found in Chapter 4 of the ADR /RID.

6. How do I safely fill a packaging container?

Firstly the filler must ensure that the packaging container is free of damage and impurities. Ensure the packaging container is securely positioned and fill the filling product into the filler opening provided for this purpose at atmospheric pressure. If the filling temperature should ever exceed 40°C, consult the supplier of the packaging container beforehand. To prevent vacuum deformation when cooling down, measures must be taken to ensure sufficient ventilation of the packaging container to compensate for the vacuum. Stacking should also be avoided until the packaging container has completely cooled down.

High temperatures may occur when transporting liquid substances. This is why it is necessary to leave an empty space when filling the packaging container. This prevents the filling substance leaking out and/or causing permanent deformation of the packaging container.

Packaging containers for the transport of dangerous goods must be properly closed both after filling and before handing over for carriage. Leakage of the contents especially as a result of vibration, changes in temperature, pressure or humidity should be avoided under transport conditions. When closing the packaging, care must be taken to ensure the edges or bungs are clean and dry. Care should also be taken to ensure the closure seal is correctly positioned. Bung packaging containers are to be tightened to the recommended torque using suitable tools.

Example:
Torque wrench with adapter flange for screw caps

To prevent a vacuum building and accompanying deformation of the PE top containers, the latter are provided with ventilation flaps during production. These prevent the lid forming a tight seal to the container which has not yet completely cooled down. It is essential that these ventilation flaps are removed before closing the filled PE

top containers as otherwise it is impossible to achieve a perfect seal through the sealing material of the lid.

Packaging containers are destined for pressure-less filling, storage and emptying. We generally recommend avoiding pressurisation with packaging containers. However, if pressurisation is unavoidable for certain reasons, please consult your supplier about this.

Only labels optimised for use on polyethylene should be used to mark the filled packaging containers. Background: Polyethylene is a nonpolar substance and commonly used labels do not stick well to this material. Furthermore, the labels should only be affixed to surfaces suitable for this purpose due to their geometry and surface quality.

7. What is panelling?

Plastic packaging containers are relatively thin-walled packaging containers. If the difference between the pressure inside the packaging container and the ambient pressure exceeds the acceptable tolerance limit, this can lead to deformation of the container surface known as "panelling".

There are possible solutions for all causes of panelling. If panelling is caused by a temperature difference, allow the filling substance to cool down to ambient temperature before closing the packaging container or work with vent plugs. If you suspect that permeation has caused the panelling, talk to your supplier about the possibility of a packaging container with permeation barrier. You can counteract panelling caused by oxygen absorbers by flushing the head space of the packaging container with an inert gas (e.g. by nitrogen flushing).

8. How should you store and stack plastic packaging containers?

Shipping packaging containers with liquids are to be stored with closures upwards. If available, packaging containers should be stored and transported upright in accordance with the stamped orientation arrows.

Before stacking, you should check whether the packaging containers are independently stackable or if additional aids are needed when stacking.

Ideally you should stack the individual packaging containers so that they are correctly nested into each other. Any centring aids must be properly locked into place. The filling level should be at maximum according to the relevant valid regulations and the filling level of the

upper packaging containers should not exceed that of the lower packaging containers. The packaging containers should be placed on a suitable pallet that spreads the weight evenly – e.g. a frame pallet such as the chemical pallet

CP-9. This pallet should be in good condition and none of the containers should project over the edge of the pallet. This also applies to any layer pads used.
The ambient temperature should be under 40°C and the stack should be protected from direct sunlight. The ground should be sufficiently stable and flat.
Ambient temperatures of 40°C or more lower the stability of packaging containers and consequently reduce their stacking capability. Please refer to the container manufacturer's documentation for further information on stacking capability.

Packaging containers filled at high temperatures must first be cooled to room temperature before stacking. The cooling time is to be selected accordingly.

Examples of pallet stacking:

9. How can I transport packaging containers safely?

Both empty and full packaging containers should be handled with care as damaged openings can lead to leakages. Damaged packaging containers do not belong on the loading unit.

The packaged goods should be secured on the pallet to prevent slipping or tipping over (e.g. by means of shrink and stretch wrap or bands). If stretch wrap or cord is used, this must not be drawn too tight otherwise it will cause deformations and consequent instability when stacking.

Packaging containers should always be moved in their full or empty state with the help of suitable equipment. Alternatively, packaging containers can be moved on a pallet. If the safety of the packaging container has been impaired by a fall or damage, it should no longer be used.

When loading the packaging containers before transport, care must be taken to ensure the packaging containers or pallets are adequately secured. In this connection, here are some of the rules and regulations to be complied with in Germany:

- Traffic law:
  Road Traffic Act (StVO), Road Traffic Permit Act (StVZO)
- Hazardous Goods Law:
  ADR (International Carriage of Dangerous Goods by Road)
- Rules of Technology:
  DIN, EN norms, VDI standards (2700 ff.), CTU packing guidelines, BGI 649

Other specialist information with examples of load securing can be found in the following publications:

- European Commission:
  European Best Practice Guidelines on Cargo Securing for Road Transport
- BAM Federal Institute for Materials Research and Testing:
  Load-security Information System (LIS)

10. What do I need to take into account when emptying?

As packaging containers do not usually have a bottom outlet, they can only be emptied via the filler opening. This can be done independently or by using suitable pumps or suction devices.
When the content is poured out independently, there is a tendency for the packaging container to "gurgle" (content surge) so the container must be emptied with appropriate caution. If the packaging container is mounted on a surface when the content is emptied out, the surface should be such that it does not damage the packaging container. If larger packaging containers are also emptied in this way, appropriate levers and turning devices are to be used.

When emptying using a drum pump or suction device, ensure that the packaging container is standing on a level surface free of foreign bodies. The container must be secured to prevent it from tipping over. The extraction lances should be suitable for the size of the container and the diameter of the filler opening so that these do not damage the packaging container.

The emptying of the container should never be carried out under pressure. It should also be ensured that no vacuum forms in the packaging container during emptying.

After emptying, the packaging containers should be closed with the original closures.

For further information on safe emptying of packaging containers, please refer to the following:

- BGI 623 Info – Decanting of liquids from small casks to containers
- BAUA Control Guidance Sheet 213 – Emptying drums using drum pumps

Re-use or recycling of plastic packaging containers:

11. Can a packaging container be re-used?

Packaging containers are basically designed for one-off use, or they can be reused depending on the design and the preceding use. The prerequisite is that before refilling and handing over for conveyance, the container is inspected to ensure it is free from corrosion, contamination or other damage.
In any event, it should be ensured that the packaging container meets the same standards for re-use as it did before the initial filling. Every packaging container that shows signs of reduced strength must no longer be used. (ADR sub-article 4.1.1.9) The responsibility for inspection and re-use lies with the user.

If multiple use is intended with aggressive filling products, care should be taken to ensure that only packaging containers with the corresponding features (e.g. material, weight, wall thickness) are used. It is also necessary to take appropriate filling substance requirements concerning light protection into account.
As an example, for multiple use for nitric acid, packaging containers in muted colours with higher initial weights should be used.

The maximum permissible period of use for the transport of hazardous materials is up to 5 years depending on the filling material, calculated from the date of manufacture. This period may be shortened accordingly by factors such as filling product influences and storage and transport conditions.

12. What sort of recycling is there?

For the recycling of dangerous goods packaging, the filling industry may offer return systems for example. There are also reconditioners who carry out various types of recycling. For consumer packaging, there are corresponding systems for disposal or recycling (e.g. Duales System Deutschland – "green dot").

13. How does reconditioning of packaging containers work?

In reconditioning, packaging containers are cleaned by rinsing or steaming. If necessary, original closures and seals are replaced. After cleaning, there will be a visual check of the packaging container for any visible damage such as cracks, lines, fractures, damaged threads or closures and other significant defects.
Packaging containers approved for liquid substances also need to undergo a leakage test.

The responsibility for the reconditioned packaging container lies with the company carrying out the operation (distributing company) and not with the original manufacturer of the packaging container.

14. Can packaging containers be recycled?

Plastic packaging containers can be mechanically recycled. In this case the raw materials used (polymers or metal) are processed mechanically. The new material obtained from the used polyethylene (recyclate) can serve as a raw material for different applications and represents an environmentally friendly replacement for new granulate.

Packaging containers can also be recycled by converting them into energy i.e. the energy contained in the packaging container can be recovered through incineration.

15. Member companies

Company	Bottles	Bag in Box	Canisters up to x l	Buckets	Open-head drum	Tight-head drum	Closures / accessories
ALPLA-Werke Alwin Lehner GmbH & Co. KG	X		5–10 l				
AST Kunststoffverarbeitung GmbH			60 l		X	X	X
BEKUM Maschinenfabriken GmbH	X		60 l		X	X	
BERGI-PLAST GmbH Kunststofftechnik u. Formenbau							X
BERICAP GmbH & Co. KG							X
E + E Verpackungstechnik GmbH & Co. KG			30 l				
EURO Mouldings BV Kunststoff Verpakkingen	X		30 l				
Georg Menshen GmbH & Co. KG Kunststoffwerk							X
GFV Verschlusstechnik GmbH & Co. KG							X
Greif Germany GmbH					X	X	X
HC HessentalerContainer GmbH			30 l	X	X		
hünersdorff GmbH			30 l	X			X
Kautex Textron GmbH & Co. KG	X		30 l	X	X		X
Mauser Kunststoffverpackungen GmbH	X		60 l	X	X	X	X
Plastikpack GmbH			2–30 l				X
Rieke Germany GmbH & Co. KG							X
Rikutec Richter Kunststofftechnik GmbH & Co. KG						X	X
RPC Promens Industrial Germany, Ettlingen		X					
RPC Promens Industrial Packaging, Neumünster	X						
RPC Promens Industrial Packaging, Theeßen	X		40 l				
SAIER VERPACKUNGSTECHNIK GmbH & Co. KG				X			
Schoeller Allibert Swiss SARL				X			X
SCHÜTZ GmbH & Co. KGaA					X	X	
Siepe GmbH	X		60 l		X	X	
STELIOPLAST Roland Stengel Kunststoffverarbeitung GmbH			35 l				
WERIT Kunststoffwerke W. Schneider GmbH & Co. KG			25 l				

Technischer Ausschuss Hohlkörper

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