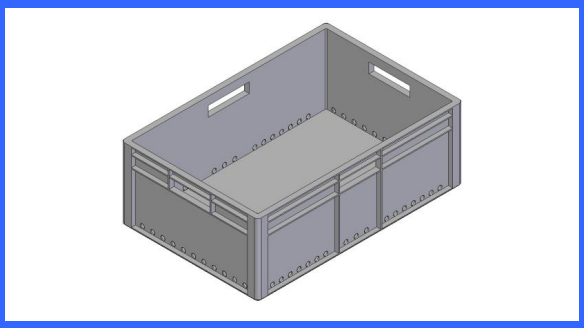
Industrieverband
Halbzeuge und Konsumprodukte
aus Kunststoff e.V.

pro-K Storage and Transport Systems



Position paper

Fire protection in the case of plastic storage containers

Preface

Plastic storage containers[1] are a standard feature of automatic warehouses. They are robust, strong, durable and extremely easy to recycle. When new warehouses are designed, however, the manufacturers of such containers are rarely consulted until the planning process is already complete. The plastic storage containers may then need to be adapted to fit the warehousing and automation technology being used. This can cause additional planning work and delays and thus extra costs for the builder and the party responsible for the investment. The manufacturers and their expertise in designing and making plastic storage containers must therefore be incorporated into the warehouse planning process from the very start.

Companies involved in this working group:

- bekuplast GmbH
- BITO-Lagertechnik Bittmann GmbH
- Georg Utz GmbH
- Paul Craemer GmbH
- Ringoplast GmbH
- Schoeller Allibert GmbH
- SSI Schäfer Fritz Schäfer GmbH

This technical position paper reflects how the manufacturers in pro-K's Storage and Transport Systems group that have come together in the Plastic Storage Containers working group interpret the current fire protection regulations laid down by FM Global and VdS Schadenverhütung GmbH in respect of the design of plastic storage containers/pallets.

The position paper reflects the state of knowledge as of March 2021.

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Photo credit on front cover: Georg Utz GmbH

Storage and Transport Systems group
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pro-K is a trustee association of the Gesamtverband Kunststoffverarbeitende Industrie e.V.
(general association of the plastics processing industry).

[1] Also known as plastic containers, plastic load carriers, plastic storage boxes and plastic storage trays.

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1. General classification: warehouse design and plastic storage containers/pallets

Warehouses require integrated planning. The only way to ensure that an ideal warehouse concept can be produced is to involve all the stakeholders from the moment planning starts – builders, operators, warehouse planners, steelworkers, plastic storage container/pallet manufacturers, fire protection engineers and fire protection experts.

1.1 Plastic storage containers and pallets

Plastic storage containers and pallets have been a standard feature of automatic warehouses for many years now. Plastics meet many of the criteria involved in selecting storage containers, with thermoplastics commonly being used. Storage containers made from these plastics are lightweight, robust and durable.
Plastic storage containers and pallets can also be reused. The materials from which they are made can be reused, meaning that damaged storage containers can be ground up and reprocessed directly into a new container of a similar quality. Being reusable solutions, therefore, plastic storage containers and pallets are sustainable and environmentally friendly products.

1.2 Design possibilities and limitations when developing plastic storage containers – complexity of manufacturing processes

The requirements of a project are highly specific. Since the design and manufacture of a highly technical storage container often require significant investment, the requirements have to be known before planning starts. The requirements made of the goods to be carried also have to be taken into account.
Involving the manufacturers of plastic storage containers and pallets in designing the warehouse from the outset and embracing an integrated warehouse concept allow standard options to be taken better into account when selecting the storage containers and thus investments and costs to be kept within the planned range.

1.3 Factoring in the fire risk of plastic storage containers

Property insurers classify plastic storage containers separately. However, the goods inside them often pose a higher fire risk than the containers themselves. As things stand, the distinction that insurers make between the two in their guidelines when considering storage containers and their contents is unclear at best as far the warehouse operators/planners are concerned. This working group believes that storage containers and their contents will have to be treated differently in future, as the contents necessarily have a significant impact on the design of the container used to store them, including from a fire protection perspective. Innovations in storage technology and warehouse logistics must be taken into account in the ongoing revision of these guidelines in the future.

1.4 Flame-retardant plastic storage containers

Although flame retardants will modify the ignition temperature, adding them will not have any effect on the heating value of plastics, meaning that the fire load will also stay the same.

The effects of flame retardants can include:

- Plastic storage containers with added flame retardants can be less robust in some circumstances.
- Reusing the materials from which these containers are made means complying with specific requirements and incurring higher costs.
- Adding flame retardants can increase pollutant emissions during processing on the manufacturer's premises and in the event of a fire.

Flame retardants are not generally used with plastic storage containers for all these reasons.

1.5 Plastic pallets in warehouses

When determining their fire risk, pallets made from polypropylene, polyethylene, polystyrene and plastics with a similar reaction to fire are lashed to the packaging and taken into account in the classification. When designing the fire protection technology elements of the warehouse accordingly with plastics in mind, therefore, a switch from wooden to plastic pallets is possible.

2. Fire protection guidelines for plastic storage containers

In Germany, the development of plastic storage containers to comply with fire protection requirements is based primarily on **FM Global data sheet 8-34** PROTECTION FOR AUTOMATIC STORAGE AND RETRIEVAL SYSTEMS, its data sheet 8-9 STORAGE OF CLASS 1, 2, 3, 4 AND PLASTIC COMMODITIES and **VdS guidelines CEA 4001 Section K. 7**.

Across the world, however, there are other guidelines and regulations issued by regional insurers that need to be taken into consideration.

The fire protection expert in charge on site is responsible for classifying a warehouse.

Contact:
https://vds.de/pruefung-anerkennung/technische-pruefstelle
https://www.fmglobal.de/about-us/office-locations

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2.1 Interpretation of the FM Global and VdS requirements for designing plastic storage containers permeable to water

Property insurers classify thermoplastic storage containers separately. The requirements for storage containers permeable to water can be less stringent as these cause the extinguishing water from sprinkler systems to cascade down onto lower levels of racks.

2.1.1 Plastic storage containers permeable to water as understood by FM Global

FM Global's rules for plastic storage containers permeable to water are contained in its data sheets 8-9 and 8-34. The wordings used in the two data sheets differ and are not to be interpreted in the same way either. This working group would welcome the harmonisation of the two data sheets. The working group is basing its interpretation on data sheet 8-34 (version dated October 2020):

Interpretation by this working group of FM Global's data sheet 8-34 on storage containers permeable to water:[2]

- The storage container has a solid base without a lid and is open at the top.
- The storage container allows water to run off extremely quickly around its entire perimeter.
- The type of storage container to which this definition usually applies has a minimum run-off area of 30% of its inside wall space within a vertical distance of 13 mm measured from the inside base of the storage container.

Graphical representation of permeability to water:
As any extinguishing water that flows in has to be discharged outwards, the plastic storage container has to be considered from the inside. The vertical distance of 13 mm is thus measured from the base of the storage container upwards. Viewed from the base inside the storage container and moving vertically upwards, 30% of the wall space must be open (Figure 1).

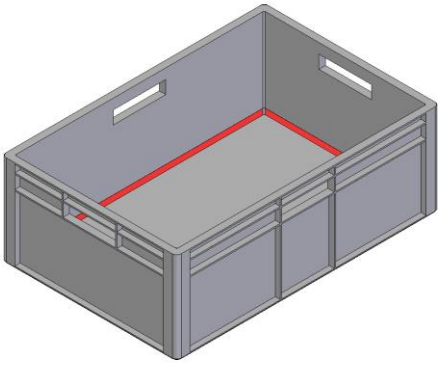

Figure 1

Interpretation of a storage container permeable to water in accordance with FM Global data sheet 8-34

Red line: 13 mm opening all the way round inside the base. Minimum run-off area of 30% in this area.

[2] FM Global's data sheet 8-34 uses the term "vented open-top container (mini-load or shuttle-type ASRS)".

Example of <u>one</u> potential design for interpreting permeability to water as understood by FM Global. Other potential designs for implementing the FM Global specifications include slotted holes or slits.

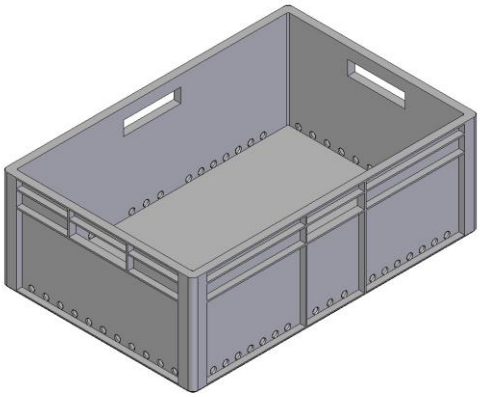

Figure 2

Example showing the interpretation of a storage container permeable to water as understood by FM Global where the container measures 600 mm x 400 mm

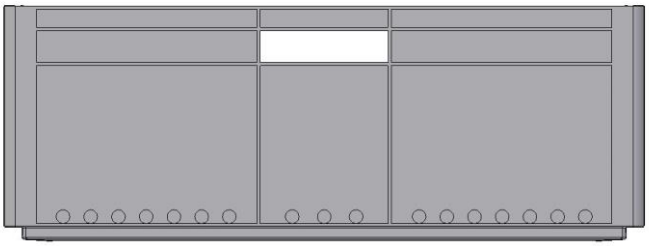

Figure 3

Example showing the interpretation of a storage container permeable to water as understood by FM Global where the container measures 600 mm x 400 mm: long side

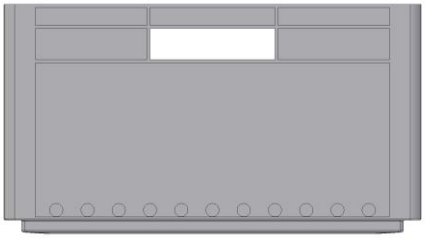

Figure 4

Example showing the interpretation of a storage container permeable to water as understood by FM Global where the container measures 600 mm x 400 mm: short side

2.1.2 Plastic storage containers permeable to water as understood by VdS CEA 4001 K.7

VdS CEA 4001 "Guidelines for Sprinkler Systems – Planning and Installation", version 2018-01 (06), places plastic storage containers[3] separately in Category IV (HHS4) (see Section K.7.1). Relevant requirements are listed in Annex K.7 to these guidelines.
They can be classified as Category III (HHS3) if the following criteria are met:

- The containers are single-walled, and
- The containers are permeable to water.

Interpretation by this working group of the concept of "double-walledness"
As a basic principle, functional and design-related elements such as struts, lifting shafts or sandwich bases that are required in order to fulfil technical requirements of the warehouse are not to be deemed double-walled.

[3] VdS CEA 4001 K.7 uses the term "container".

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Definition of plastic storage containers permeable to water as understood by VdS CEA 4001 K.7:

- Maximum water level of 10 mm (from inside base) at a water exposure rate of 20 mm/min.
- This degree of permeability to water **can** be achieved by drilling 50 holes, each 5 mm in diameter and spaced evenly apart, in the container base for every square metre of base area. Example: a container measuring 600 mm x 400 mm would need 12 holes (Figure 6).
- Other solutions are permitted provided that the abovementioned limits on the water level are not exceeded.
- Provided this criterion is met, whether the openings are located in the base or the sides of the container is irrelevant (Figure 5 or Figure 6) –
- what matters is how it behaves when loaded.

Interpretation by this working group of permeability to water as understood by VdS CEA 4001 K.7:

The most important parameters are the water level and the water exposure rate. The drilled holes mentioned above are to be understood as one of several possible suggestions. Other solutions are permitted provided that the limits on the water level are not exceeded. Provided this criterion is met, whether the openings are located in the base or the sides of the container is irrelevant.

Example of the interpretation of permeability to water as understood by VdS:

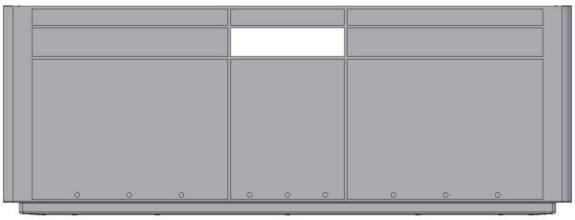

Figure 5

Example showing the interpretation of a storage container permeable to water as understood by CEA 4001 K.7 where the container measures 600 mm x 400 mm: 12 holes in the side

Permeability to water is ensured if water cannot rise above 10 mm inside the storage container at a water exposure rate of 20 mm/min.

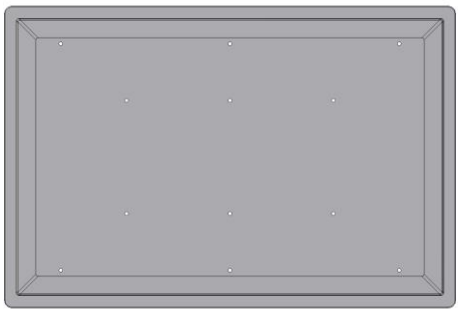

Figure 6

Interpretation of a storage container permeable to water as understood by CEA 4001 K.7 where the container measures 600 mm x 400 mm: 12 holes in the base

Provided the water level criterion is met, whether the openings are located in the base or the sides of the container is irrelevant.

The manufacturers of plastic storage containers test the maximum water level in their own laboratories. Permeability to water when loaded must be verified in an accredited laboratory (e.g. those of VdS Schadenverhütung) in the event of any doubt.

3. Conflicts of objectives in automatic warehouses due to the FM Global and VdS regulations

The degree of permeability to water to be ensured for plastic storage containers in accordance with the provisions of the FM Global and VdS regulations gives rise to various conflicts of objectives when considering the warehouse system as a whole:

- Operators will often require a minimum volume of liquid to be caught inside the storage container to prevent the conveyor systems from being contaminated if containers of liquid inside the storage container leak. For instance, the warehouse operator will require a storage container with the basic dimensions of 600 mm x 400 mm to be able to collect between 2.5 and 5 litres in this way. According to the FM Global and VdS specifications, however, this is not possible.
- It becomes harder for light barriers to detect the storage container reliably. Holes in the sides of the storage containers – as defined by FM Global – can cause false detections. Conflict with the standard positions of light barriers.
- As the water run-off holes defined by FM Global are at a height typically scanned by barcode scanners, a conflict with the positions envisaged for barcode ID labels may arise.

4. Fire protection recommendations by the manufacturers of plastic storage containers

The FM Global and VdS guidelines should be harmonised in the medium term so that the development of plastic storage containers can be planned reliably. Each organisation should recognise the other's regulations.
The working group preparing this paper believes that **water exposure rate (mm/min.) and flow volume** are the most appropriate parameters to ensure that plastic storage containers are protected against fire. These values are suitable for guaranteeing optimised fire protection. Design specifications or recommendations are not expedient.

The following aspects must be taken into account when considering the storage container as part of the warehouse system:

- A standard requirement in automatic warehouses is for storage containers with the basic dimensions of 600 mm x 400 mm, for example, **to be able to catch between 2.5 and 5 litres of escaping liquid**. This volume must be factored in when determining the maximum level that water is permitted to reach.
- Labelling areas are also standard practice for storage containers in automatic warehouses and must be excluded when calculating the run-off area on the sides. It is common to have labelling areas 70 mm wide on both sides of the storage container.