Packaging, Labeling, and Storage

8

Abstract

Packaging is an unavoidable function for all kinds of foodstuff, but special care should be taken for frozen shrimp because final products of frozen shrimp are transported in frozen condition (−18 °C) in all aspects of their cycle. Packaging means wrapping of goods. The chapter highlighted the details of packaging and packaging materials; description of artwork/label and rider card; properties of inner bag, inner box, and master cartons; specification of bag, box, and master cartons (components, flute, flute height, flute type, mount paper, etc.), and information on MC sticker, rider card, its dimension, pallet (US and Euro pallet), palatalization, metal detection, barcode scanning, and frozen storage. Storage monitoring, storage loss, and defects of packaging are also included in this chapter. Different types of calculation like calculation of pallet, area of pallet, no. of cartons per pallet, no. of cartons per layer, no. of layers per pallet, and air gap determination are specified clearly in this chapter with some related exercise.

Keywords

Artwork · Rider card · Master cartons · Pallet · Metal detection

8.1 Packaging

Packaging means wrapping of goods. It serves a great role in food and food products, especially for frozen products. Everything from packaging materials, labeling information, packaging design, color, to logo should be accurate as per buyer's instruction and must satisfy the international packaging law. Packaging should be more attractive to look at, which helps to promote sales and marketing and make a brand image worldwide. Remember that packaging of frozen products must be waterproof. The purposes of the packaging of frozen shrimp are as follows**:**

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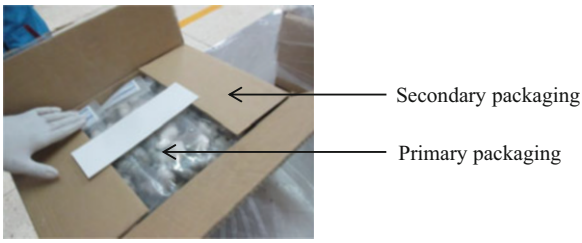


Fig. 8.1 Primary and secondary packaging of frozen shrimp

- Ease handling
- Identify product
- Protect from heat, light, air, and moisture
- Keep safe from contamination
- Make convenient storage and transportation
- Help in advertisement and communication
- Promote sales and marketing
- Make a brand image worldwide

Packaging is an important part of shrimp business. Shrimps are sent for final packaging after completion of production process. There are two types of packaging that are in practice in seafood business (Fig. 8.1).

(a) Primary packaging:	Primary packaging means inner packaging, i.e., packaging of inner box or bag.
(b) Secondary packaging:	Secondary packaging means outer packaging, i.e., packaging of master carton.

Packaging is performed immediately after final processing of shrimp. In some exceptional cases, temporary packaging can be performed immediately after final processing of shrimp. It happens when packaging materials are not available in processing industry or packaging company fails to supply packaging materials on time. Final packaging can be done again after receiving of final packaging materials. Labeling of packaging must be accurate, because any kinds of deviations or wrong packaging may stop the shipment. On the contrary, importers may claim demurrage to suppliers for their mislabeling or late shipment. Goods are packed as per buyer instruction. If buyer has any special instruction, it must be followed during final packaging. Keep in mind that packaging and labeling must be 100% accurate and as per international packaging law. The following parameters should be checked very carefully during final packaging:

- Are color, logo, and other design okay as per buyer instruction?
- Is dimension perfect as per buyer's instruction or not?
- Is labeling okay or not?
- Is labeling visible enough to read or not?

- Is there any mislabeling in master carton, inner bag, or box or rider card or not?
- Is barcode scanning properly or not?
- Is there any mismatch with barcode or not?
- Is sealing perfect or not?
- Is there any damaged master carton or not?
- Is master carton strong enough to protect frozen shrimp or not?
- Is there any damage inner box or bag or not?

8.2 Packaging Materials of Frozen Shrimp

Packaging materials are major concern of frozen products because of dealings with food-grade items and chances of cross-contamination. Packaging materials of frozen products are also important for the transportation of long distances and long-term storage. Remember that the shelf life of frozen shrimp is around 2 years. Now, the question is what would be the packaging materials of frozen shrimp?

The following are the characteristics of package materials of frozen shrimp:

- Packaging materials should be available and cost-effective.
- Package materials should be convenient for the size, shape, and type of frozen shrimp.
- Package materials should be potable and durable for longtime preservation.
- Package materials should be convenient for frozen storage and long transportation.
- Package materials should be convenient for easy handling and processing.
- Package materials should be suitable for printing and labeling and good looking.
- Package materials should be strong enough to protect heavy weight of frozen shrimp.
- Package materials should be safe to use and free from chances of cross-contamination.
- Package materials should be recyclable and biodegradable.

8.3 Description of Artwork/Label

The artwork is a vital part of the packaging. A full set of packaging is called artwork. It is also called label. Artwork includes the design and dimension of the master carton, inner box, inner bag, sticker, rider/header card, and others. Standard packaging law should be followed during the preparation of artwork. All information present on artwork must be accurate and authentic. The preparation of artwork is a mandatory process for all seafood businesses. Suppliers prepared their artwork upon approval of the importers. See the following characteristics of an ideal artwork.

(a) PO No.:	PO number means purchased order number. It's an identification number of the purchased consignment. The buyers marked their purchased consignment as PO number for their convenience. The buyers provide their purchase reference (PO) number after confirmation of the purchase negotiation. PO number must be mentioned on artwork/label. It helps to identify and track the consignment very easily. PO number is also known as reference number.
(b) Lot No.:	Lot number means the identification number of the raw materials or shipped products. Lot number should be mentioned in artwork for identification of the source of raw materials.
(c) Art. No./Article No.:	Art. no./article no. is the identification mark of the product. Different article numbers are assigned for different items of products of the consignment. Different Art. nos. are assigned for different types of products. For example, BTI-2020 is the article no. of black tiger, HLSO-EZP 16/20 IQF shrimp and BTB-2020 for BT-HLSO 16/20 block shrimp. Every buyer has his or her own product identification system that is marked as article number. It helps the buyer to manage his or her product within a variety of items. Art no./article number has to be mentioned on artwork/label.
(d) Factory approval No.:	Every factory has to take an approval number from the responsible authority of the country. The factory approval number is the only identifying mark that is present on retail items of frozen foods. For example, KLN-77 is the EU approval number for Atlas Sea Food Ltd., Khulna, Bangladesh, one of the renowned shrimp-processing industries of Bangladesh. Factory approval number must be mentioned on artwork.
(e) Name of product:	Product name has to be mentioned on artwork/label, i.e., black tiger shrimp or giant freshwater shrimp or cat tiger shrimp or harina shrimp or vannamei shrimp, etc.
(f) Scientific name:	Scientific name must be mentioned on artwork/label, i.e., *Penaeus monodon* is scientific of black tiger shrimp or *Litopenaeus vannamei for vannamei shrimp or Macrobrachium rosenbergii for giant freshwater prawn.*
(g) Production description:	Production description has to be mentioned on artwork/label, i.e., head-on shell-on raw semi-IQF shrimp or head-less shell-on cooked IQF shrimp.
(h) Size/grade of shrimp:	Size/grade of shrimp has to be mentioned on artwork/label, i.e., 8/12, 13/15, 16/20, etc.
(i) Count of shrimp:	Count of shrimp has to be mentioned on artwork/label, i.e., either the shrimp is real count or frozen count.
(j) Production method:	Production method should be mentioned on artwork/label, i.e., marine catch or catch in freshwater or farmed or aquaculture product.
(k) Name of fishing gear:	Name of fishing gear has to be mentioned on artwork/label for wild catch, i.e., trawl net.
(l) Frozen weight:	Frozen weight has to be mentioned on the artwork, i.e., 1000 g for frozen IQF shrimp or 1800 g for block shrimp, etc.
(m) Net weight:	Net weight has to be mentioned on the artwork/label, i.e., net weight 800 g for 10 × 1 kg 80% NW, IQF shrimp.

(continued)

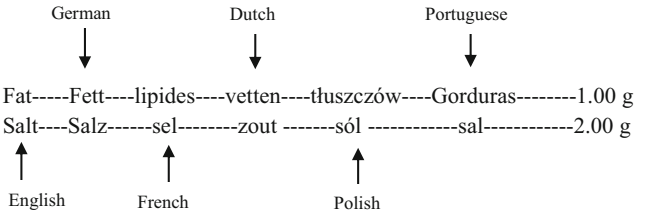
(n) Production date:	Production date has to be mentioned on artwork/label, i.e., production date is 31.12.2021.
(o) Freezing date:	Freezing date has to be mentioned on artwork/label, i.e., freezing date is 31.12.2021. Normally production date and freezing date are the same because products are frozen after production.
(p) Best before date/best before end:	Best before date has to be mentioned on artwork/label. Best before date is also known as best before end. Best before date is around 2 years for frozen shrimp, i.e., 30.12.2023.
(q) Ingredients:	Ingredients should be mentioned on artwork for clear identification of the product, i.e., shrimp (%), water (%), salt (%), STTP (%), etc.
(r) E-Numbers:	Name of additives or its assigned E-numbers have to be mentioned on artwork/label. Additive's name or E-numbers help consumers to choose their desired products, i.e., E450, E451, and E452 are the E-numbers of phosphate treatment.
(s) Barcode:	Barcode of the product has to be mentioned on artwork/label both of inner bag or master carton. It must be visible clearly and readable by the barcode scanner.
(t) Name and address of the importer:	Name and address of the importer must be mentioned on artwork.
(u) Brand name	Brand information text/logo should be mentioned on artwork.
(v) Frozen instructions:	Instructions of conservation and storage of frozen seafood should be mentioned on artwork. The following are the instructions of frozen shrimp.

Product name	Star marks	Temperature	Storage time
Black tiger shrimp	No star	Refrigerator	1 day
Black tiger shrimp	One star/*	−6 °C	1 week
Black tiger shrimp	Two stars/**	−12 °C	1 month
Black tiger shrimp	Three star/***	−18 °C	2 years

(w) Nutritional content:	Tested nutritional values of the frozen shrimp should be displayed on artwork. It helps consumers to know details of nutritional content of the product. Nutritional values are calculated per 100 g of sample. See the following example for more details:

Nutritional value per 100 g:	
Energy	= 320/72 kj/kcal
Fat	= 1.00 g
Carbohydrates	= 0.00 g
Proteins	= 16.0 g
Salt	= 2.00 g
Minerals	= 0.50 g

(x) Language:	Different languages are displayed on artwork so that consumers of different countries of different languages can get a better idea about the product and product instructions before consumption. How many languages will be presented on the artwork/label depends on which country the products will be shipped. See the following example of different languages.



(y) Special instruction:	:	If the buyers have special instruction or special character (brand name, logo, certification logo, etc.) that may be displayed on the artwork/label.

8.4 Inner Bag/Polybag (IQF)

Polybags are used for inner packaging of IQF products. Style, dimension, and design of polybag may vary from product to product, buyer to buyer, country to country, etc. It's totally dependent on buyer's requirements. Different types of polybags are used in seafood business worldwide. There are three types of polybags that are used commonly in shrimp processing industries around the world like:

- Plain bag with rider card
- Preprinted bag with rider card
- Preprinted bag without rider card

Preprinted bag with rider card is the mostly used for IQF shrimp packaging. It is the easiest way of packaging and handling information. Normally, information of polybag and information of rider can be divided in two parts. These are as follows.

1. Fixed information:	Product name, scientific name, freezing instructions, nutritional content, etc. are considered as fixed information.
2. Variable information:	Factory approval no., production date, freezing date, expiry date, size, count, etc. are considered as variable information because it may change time to time.

Fixed information is displayed on polybag and variable information goes to rider card. Sometimes all information goes to rider card, and polybag is used only for

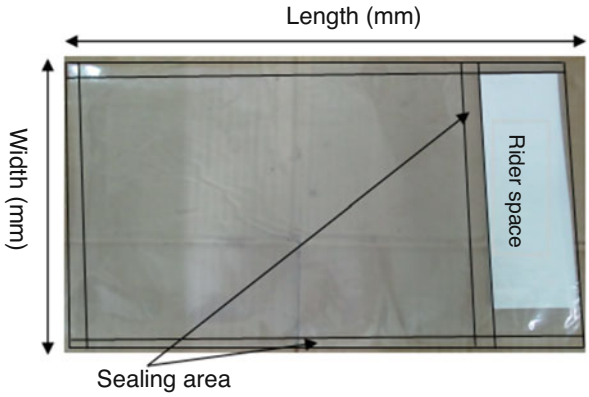


Fig. 8.2 Design of a polybag

attractive design and packaging. The following is the design and dimension of a sample polybag of IQF shrimp (Figs. 8.2 and 8.3).

8.4.1 Properties of Inner Bag/Polybag

Everything from packaging materials, style, design, font, color, logo, information, to dimension must be accurate and approved by the buyers and also satisfy the international packaging law. The cylinder is the essential equipment for the printing of polybag. The preparation of cylinders depends on dimension, design, and color variation of a polybag. Note that a variety of cylinders are required to complete a multicolor bag. The cause is that one cylinder is required to print one color, but if a bag has five colors, it requires five cylinders to complete the polybag. Once a cylinder is being completed, it can be continued year after year. The following are the properties of inner bag/polybag:

- Inner bag should be constructed with double line poly paper.
- Polyethylene terephthalate (PET), low-density polyethylene (LDPE), high-density polyethylene (HDPE), linear low-density polyethylene (LLDPE), orientated polypropylene (OPP), NYLON, etc. are the raw materials for polybags. Note that raw materials of inner polybags must be with permitted materials.
- Raw materials should be safe and free from contamination and have no health hazards.
- Polybag should be flexible and strong enough to protect the frozen products.
- Thickness of the liner poly paper should be around 100–120 micron.
- Weight of polybag should be around 15–30 g.
- Air should not be allowed inside the polybag.
- A small size punch should be done on polybag to avoid air inside the polybag.
- If there any special mark (ASC, BAP, HACCP, Halal, etc.) that may be inserted on the polybag.
- A packaging approval certificate should be provided by the packaging company.

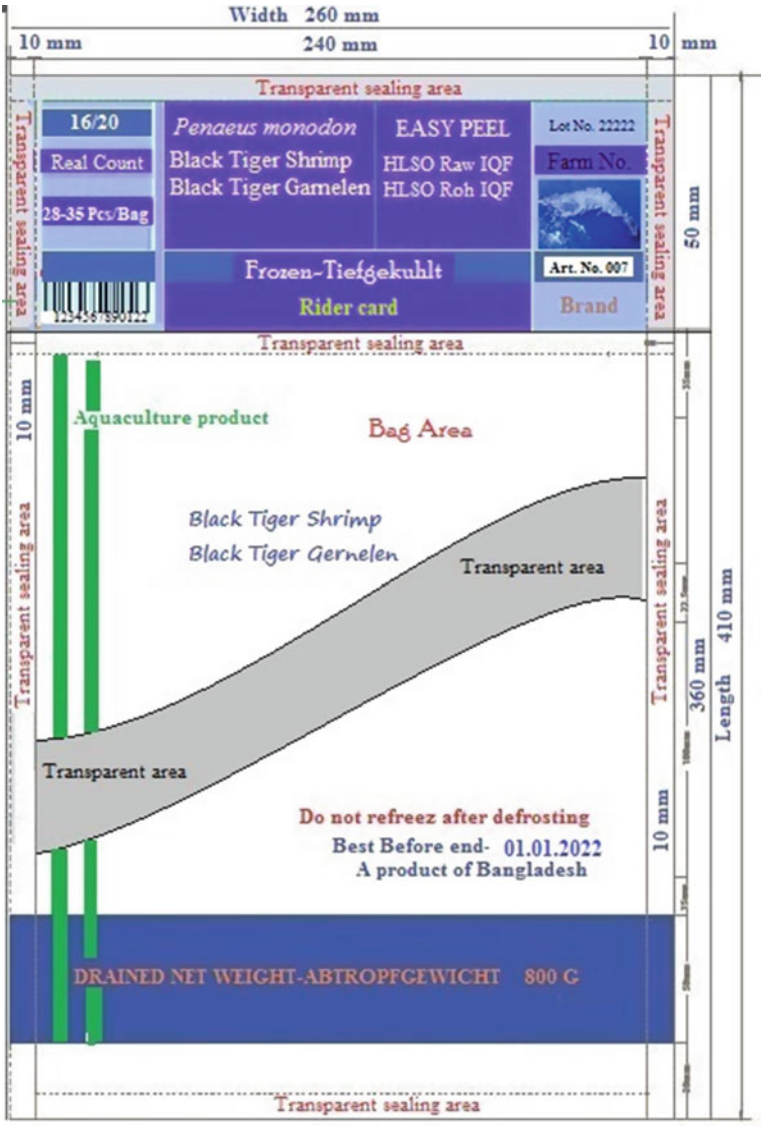


Fig. 8.3 Details design and dimension of a polybag

- **Dimension (s)**

Dimension (s) of polybag depends on size, shape, type, and volume of product. It also depends on size of master carton. The dimension of master carton, polybag, and rider card is given below for your reference (Table 8.1).

[Note: Dimension is not a rigid thing. It may vary buyer to buyer and country to country as per requirement]

Table 8.1 Dimension of master carton, polybag, and rider card

Types of products	Length (mm)	Width (mm)	Height (mm)	Remarks
Rider card	220 ± 10	60 ± 10	–	1 rider card/bag
Inner bag	410 ± 10	260 ± 10	–	1 kg product/bag
Master carton	380 ± 10	280 ± 10	230 ± 10	10 inner bag/MC

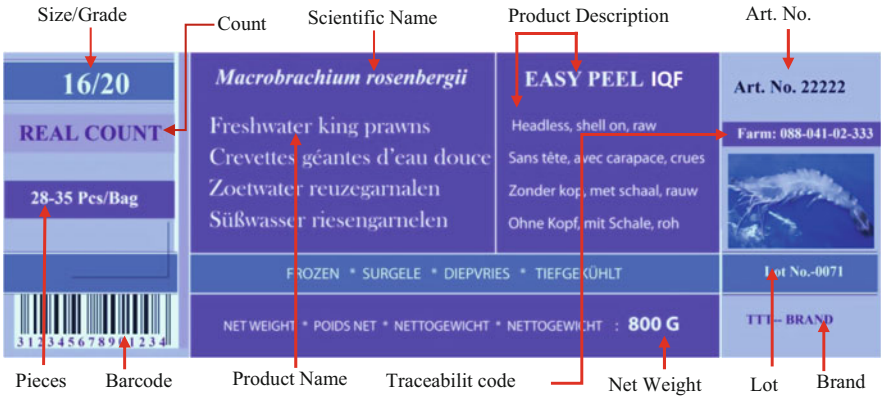


Fig. 8.4 Rider card (front side)

8.4.2 Rider Card

Rider card is also called header card because it is inserted into the top/head region of the polybag. Rider cards are inserted into polybag before sealing of goods. Uses of rider cards are the easiest way and cost-effective method of packaging. No need to purchase expensive equipment for it. Dimension, color, design, labeling, etc. should be accurate for rider cards. The following are the examples of an ideal rider card (Figs. 8.4 and 8.5).

- **Precaution**
  - Dimension, design, color, and logo must be accurate.
  - Labeling information must be accurate. Polybags with wrong labeling are not accepted.
  - Sealing should be perfect. Improperly sealed bags and rider cards are not accepted.
  - Damaged/tare/punctured bags are not accepted.
  - Uses of chemicals or metals are strictly prohibited.
  - Packaging materials must be safe and inactive in chemical reactions.

[Note: Polybag is used for IQF packaging, but some factories are now using polybag for the packaging of block products.]

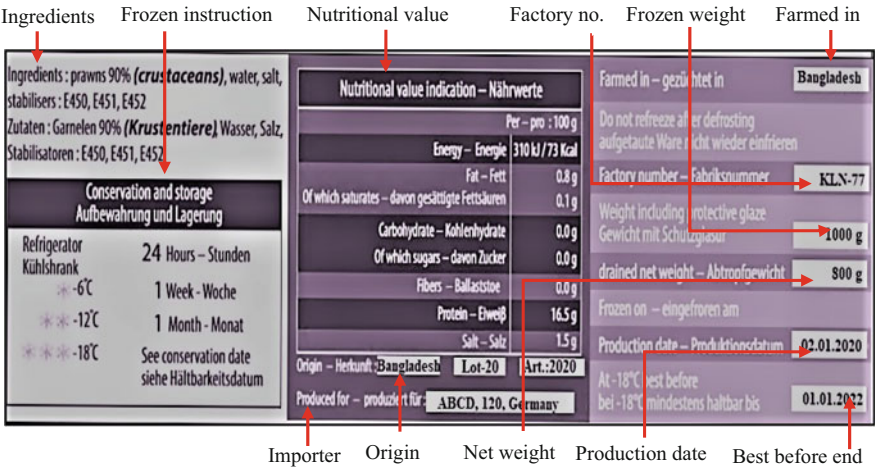


Fig. 8.5 Rider card (back side)

8.5 Inner Box (Block and Semi-IQF)

Inner boxes are used for the inner packaging of block and semi-IQF products. Style, design, and dimensions are different for block and semi-IQF products of shrimp. There are two types of boxes that are used for inner packaging of block and semi-IQF shrimp. These are:

- Preprinted box without sticker
- Preprinted box with sticker

All information is displayed on a printed box as there is no sticker here. On the contrary, the information goes to sticker area if the sticker is attached in the box. A preprinted box with sticker is the best practice because it is very easy to change information and a cost-effective method. Fixed information goes to the preprinted box, and variable information goes to sticker area. Description of the inner box is given below for both block and semi-IQF shrimp.

8.5.1 Properties of Inner Box for Block Products

The following are the criteria of the inner box of block products:

- Packaging materials of inner box should be approved by the buyers.
- Design, dimensions, color, and logo must be accurate.
- Kraft liner paper should be used for the preparation of inner box.

- The box should be made by folding of Kraft liner paper. Preprinted Kraft liner papers are cut in such a way that it can be transformed into the box by just folding of Kraft liner paper. No need to use tape, pin, gum, rubber, or others.
- Thickness of the inner box should be 200–300 gsm or 350–400 micron.
- Box should be laminated by a poly paper to avoid direct contact of the frozen block. Direct contact of Kraft liner paper may damage the Kraft paper. Thickness of the laminated paper should be 10–20 micron.
- Materials of the inner box should be safe, free from contamination, and free of health hazards.
- Box should be strong enough to protect the frozen products.
- Sticker should be attached in an appropriate position in the box (if necessary).
- Labeling must be accurate.
- The paper should be suitable for attractive color and printing.
- A packaging certificate should be collected from the packaging company.
- The box should be recyclable and biodegradable.

- **Dimension (s)**

Dimension (s) of the inner box should be approved by the buyer. It may vary from supplier to supplier, buyer to buyer, or country to country. Dimension (s) of the master carton, inner box, and sticker of inner box for block products are given below for your reference (Table 8.2).

[Note: Dimension is not a rigid thing. It may vary buyer to buyer and country to country as per requirement. Polybag could be used as an alternative to the inner box. Some buyers have already introduced polybag for the packaging of block products. It would be more convenient for handling and transportation, but it's time to think biodegradable issue also.]

The followings are the design and dimension of an inner box for your reference (Fig. 8.6).

8.5.2 Properties of Inner Box for Semi-IQF Products

A special type of box is used for semi-IQF shrimp. The following are the criteria of inner box for semi-IQF shrimp:

Table 8.2 Dimension (s) of the master carton, inner box, and sticker of inner box for block products

Types of products	Length (mm)	Width (mm)	Height (mm)	Remarks
Master carton	380 ± 10	280 ± 10	170 ± 10	6 inner box/MC
Inner box	280 ± 10	180 ± 10	55 ± 10	1.8 kg weight unit box
Inner box sticker	155 ± 10	115 ± 10	–	1 sticker/inner box

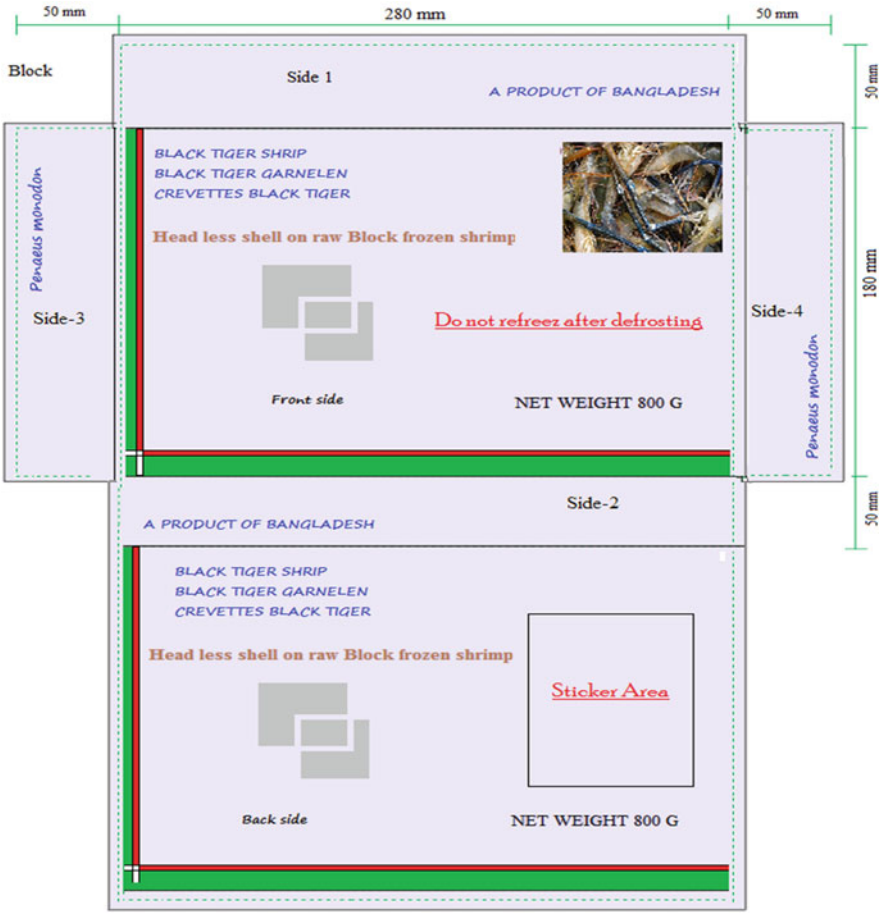


Fig. 8.6 Dimension and design of inner box for block products

- Inner box of semi-IQF products is divided into two parts: (1) top (upper) part and (2) bottom (lower) part. The top part is greater than the bottom part so that bottom part can easily be entered inside the top. Top part is used as a lid and bottom as a base. Frozen shrimps are kept in the bottom part.
- Printed top and plain bottom are commonly used for semi-IQF inner box.
- Both the top and bottom of inner box are made by the folding process. Preprinted Kraft liner papers are cut in such a way that they can be transformed into a box by folding process. No need to use tape, pin, gum, or others.
- Thickness of inner box should be around 200–300 gsm or 350–400 micron.
- Boxes are laminated with poly paper to avoid direct contact of frozen block. The thickness of laminated paper should be around 10–20 micron.
- Finally, a complete box (both top and bottom) is wrapped with a poly paper to make it air tight. The wrapping also helps to protect cross-contamination as it is

Table 8.3 Dimension of master carton and inner box for semi-IQF shrimp

Types of products	Length (mm)	Width (mm)	Height (mm)	Remarks
Inner box (top)	260 ± 10	180 ± 10	50 ± 10	1 kg weight/inner box
Inner box (bottom)	255 ± 10	175 ± 10	50 ± 10	
Master carton	370 ± 10	270 ± 10	160 ± 10	10 inner box/MC

semi-IQF shrimp and sensitive to contamination. Shrink poly paper is used to wrap the box.

- A window is a special character of semi-IQF shrimp. Every box has a window in the top part of the box. Window is used to visualize the frozen shrimp from outside.
- Size, shape, design, and dimension of the box are dependent on buyer requirements.
- Sticker should be attached in an appropriate position of the box (if necessary). Size of sticker depends on the size of box.
- Materials of the box should be safe, free from contamination, and free of health hazards.
- Box should be strong enough to protect frozen product.
- Labeling must be accurate.
- Paper should be suitable for attractive color and printing.
- A packaging certificate should be collected from the packaging company.
- The box should be recyclable and biodegradable.
- Easily available and cheap.

- **Dimension (s)**

Dimension (s) should be approved by the buyer. It may vary from packer to packer and buyer to buyer (Table 8.3, Fig. 8.7).

[Note: Dimension is not a rigid thing. It may change from buyer to buyer and country to country as per requirement]

- **Precaution**
  - Design, dimension, color, logo, and labeling should be correct.
  - Box should be strong enough to protect the frozen product.
  - Sticker should be attached to a fixed place. Size of sticker should be more accurate.
  - Closing, sealing, and wrapping of box should be accurate.
  - Damaged/punctured boxes are not accepted.
  - Chemicals, gums, or metal staples are strictly prohibited.
  - Never walking on semi-IQF packaging. It may damage the window, carton, and product.

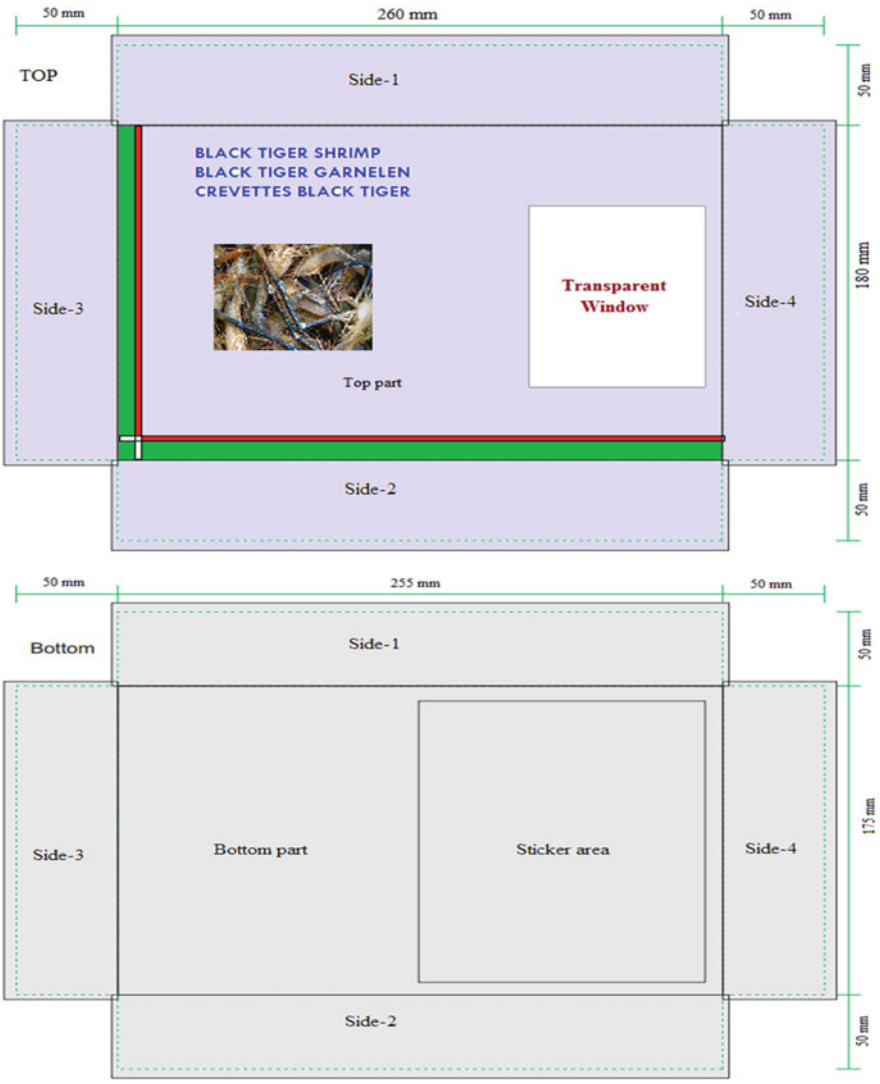


Fig. 8.7 Design and dimension of inner box for semi-IQF shrimp

8.6 Master Carton (MC)

Master carton is the final outer box that is used for the packaging of retail items. It is a large carton packaging used to pack a number of inner boxes or bags for greater protection from damage, reduces the number of cartons during handling process, and helps to transport easily for long distances. Master carton is also called shipping

carton because it is the final box in which the product will be shipped. The following are characteristics of an ideal master carton:

- Raw materials of MC should be safe, free from contamination, and free of health hazards.
- MC should be strong enough to protect heavyweight.
- MC should be convenient for handling and processing.
- MC should be attractive to look at.
- MC should be convenient for long-term frozen storage and transportation.
- MC should be durable, lightweight, fine finishing, and suitable for printing and labeling.
- Size, shape, design, and dimension of the MC should be accurate as per requirement.
- MC should be recyclable and biodegradable.
- MC should be cheap and easily available.

The following information should be presented on a master carton:

- Art. No./Article No.
- Lot No./PO No./Reference No.
- Factory approval No.
- Name of product
- Origin of country
- Frozen instructions
- Logo/brand
- Farming method
- Packing
- Size and count
- Production date
- Expiry date
- Gross weight
- Net weight
- MC opening identification mark
- Barcode
- Country of destination
- Importer name and address
- Special sign/text (if any) or
- Others

In case of wild catch, the FAO catch area should be inserted instead of farming method. FAO identified the zone area in the ocean and marked it by different FAO numbers. This is the easiest way to identify products and their origin in the open ocean.

There are three different styles of the master carton that are in practice:

- Preprinted master carton
- Preprinted master carton with sticker
- Plain master carton with sticker

8.6.1 Properties of Master Carton (MC)

Packaging materials of the master carton should be approved by the buyers and it must satisfy the international packaging law. The following are the properties of an ideal master carton.

Materials:	Solid wood, plywood, or vegetable origin corrugated fibers are used to prepare the master carton. Master carton consists of corrugated paper, media paper, and mount paper. Thickness of corrugated papers, media papers, and mount paper should be ranged 150–200 gsm, 200–300 gsm, and 300–350 gsm, respectively. The media paper and corrugated paper should be treated at 250^0 C temperature and above.
Ply:	3 ply or 5 ply or 7 ply corrugated paper is used to prepare master carton, but 5 ply corrugated paper is most common. Corrugated papers are in high strength, biodegradable, and environment-friendly in nature.
Flute:	The flute is another important factor that distinguished the characteristics of corrugated paper. Common sizes of flutes are A, B, C, E, F, N, BB, AB, BC, BE, etc. Flute size refers to the number of flutes per linear feet. Flute requirement depends on the buyer's instruction. EB flute and BB flute are commonly used for master carton construction. EB flute means the combination of E and B flute, and BB flute means the combination of B and B.
Laminating:	Outer side of the master carton should be laminated with poly paper. Thickness of laminated poly papers should be around 10–15 micron.
Wax coating:	Wax coating may use inner side of the master carton. Wax coating must be with organic wax. Inorganic wax is not allowed. Thickness of wax coating should be 110–150 micron. Wax coating makes the master cartons strong enough.
Sealing:	Adhesive tape is used for the sealing of master carton. Organic gums may also be allowed for sticking of paper/sticker. Uses of metals are strictly prohibited.
Strap:	Strap can be used, but metallic straps are strictly prohibited.
Biodegradation:	Master carton should be recyclable and biodegradable.
Packaging certificate:	Packaging certificate should be collected from the packaging company.

The following are the components of a master carton (Fig. 8.8, Table 8.4):

[Note: Flute height and flutes per linear foot are not constant always]

The following are the images of different types of master carton (Figs. 8.9, 8.10, 8.11, and 8.12).

Image of master carton sticker (Fig. 8.13).

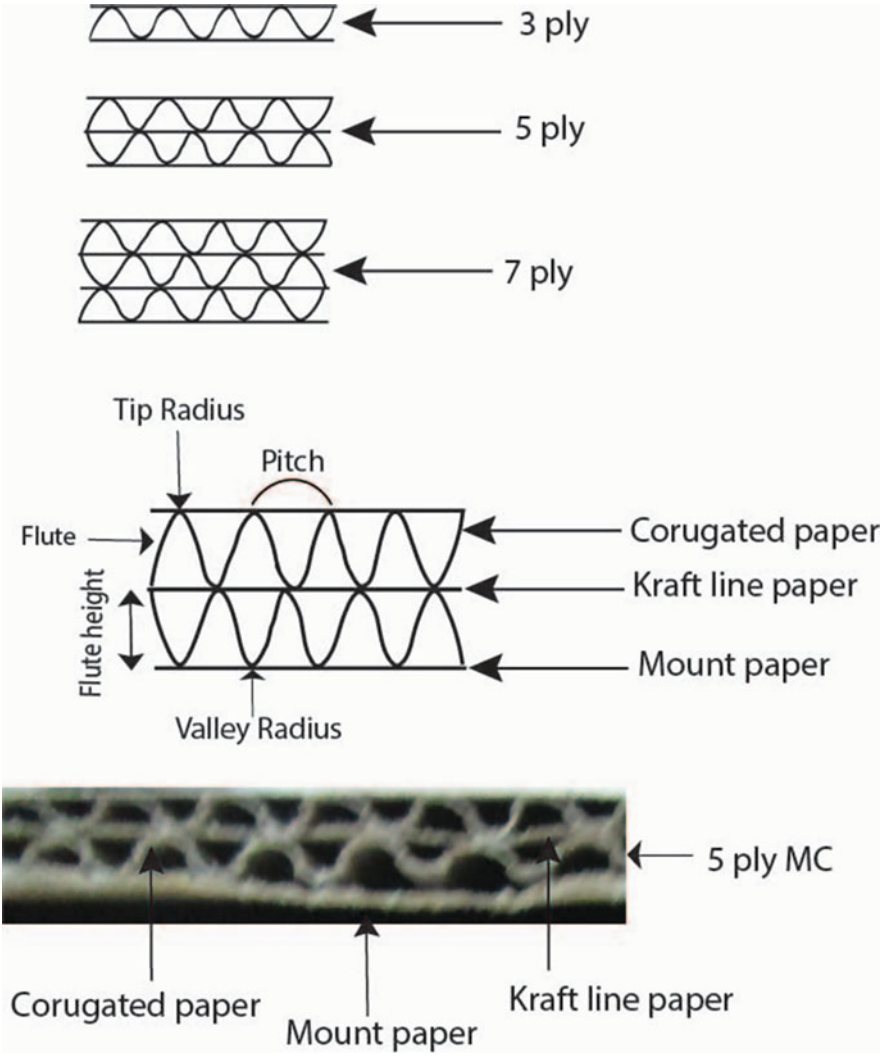


Fig. 8.8 Components of master carton

8.6.2 Procedure of Master Carton Preparation

The description of the production process is given below (Fig. 8.14).

Step 1 (Receiving of raw materials):	Raw materials mainly Kraft liner paper and other necessary materials are imported from the foreign country if not available in local market. Developing countries import the Kraft liner paper from Indonesia and Thailand.
Step 2 (Heat treatment):	Kraft liner paper and the media paper are treated at 260 °C through a boiler machine to make it food grade.
Step 3 (Corrugation and sticking):	The media paper became corrugated first. Corrugated paper is a brown color paper that is very strong, firm, and light weight material suitable for frozen shrimp transportation. The corrugated media paper and the Kraft liner paper pass together with organic gum (starch) to stick them together.
Step 4 (Laminating and assembling):	Preprinted mount paper is used in corrugated board. The mounting paper is laminated with poly paper. The laminated mount paper and corrugated sticking paper (liner and media paper) are paired together with gum by using hydraulic pressure. Lamination is used only in the outer side of the master carton.
Step 5 (Drying):	After lamination and assembling process, the papers are sent for drying. Drying should be done properly since it helps to make paper harder.
Step 6 (Wax coating):	Organic wax is used for the coating of the master carton. Wax coating is given over inner side of the carton. Wax coating makes the carton strong enough to protect the frozen weight. Use of inorganic gum is strongly avoided.
Step 7 (Cutting):	After wax coating, the papers were cut properly to make a master carton. Dimension of master carton is specified previously as per requirements of the products.
Step 8 (Folding and re-cutting):	The prepared paper board was folded and cut again to make them in accurate shape as per the buyer's requirement.
Step 9 (Shipment):	After completion of the whole process, the complete master cartons are delivered to shrimp processing industry.

- **Precaution**
  - Handling of cartons should be very careful during transportation.
  - Uses of chemicals and metals are strictly prohibited.
  - Walking over cartons is strictly prohibited.
  - Damaged cartons (inner and outer) are not accepted anymore. If found, need to replace before shipment.
  - Printing and labeling should be 100% accurate. Zero tolerance in mislabeling.
  - Packer has no right to change design, color, logo, dimension and other information without buyer consent.
  - All packaging materials should be kept in dry, clean, and safe place.
  - Cartons must be well labeled. Removable label or temporary information on master cartons will not be accepted anymore.

Table 8.4 Flute characters of master cartons (http://www.realisticpack.com/infrastructure.php)

Flute type	Flute image	Flute height (mm)	Flutes/linear foot
A		4.5–4.9	Around 35 flutes/linear foot
B		2.2–3.0	Around 50 flutes/linear foot
C		3.2–4.0	Around 40 flutes/linear foot
E		1.0–1.8	Around 100 flutes/linear foot
F		0.8–1.2	Around 130 flutes/linear foot
N		0.5–0.6	Around 170 flutes/linear foot

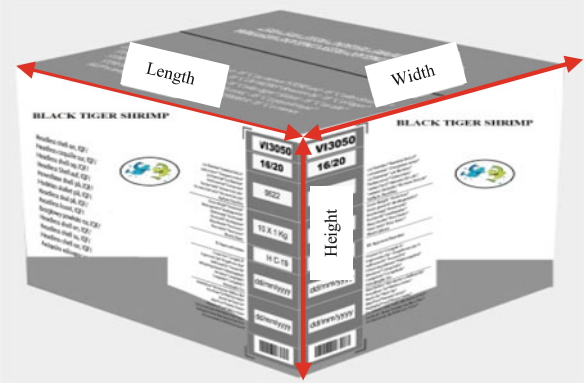


Fig. 8.9 3D structure of a master carton

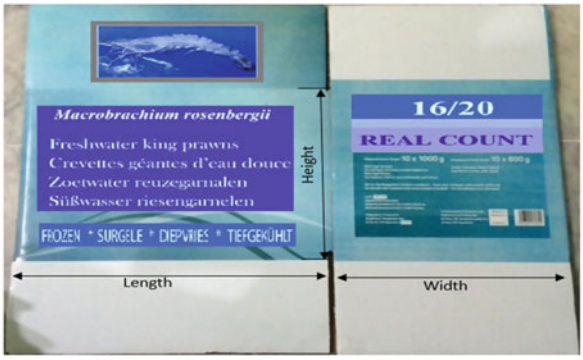


Fig. 8.10 Preprinted master carton

Fig. 8.11 White master carton with sticker

Fig. 8.12 Master carton with strap

- **Defects of Packaging**

  The following are the defects of inner packaging and outer packaging (Figs. 8.15, 8.16, 8.17, 8.18, 8.19, and 8.20).

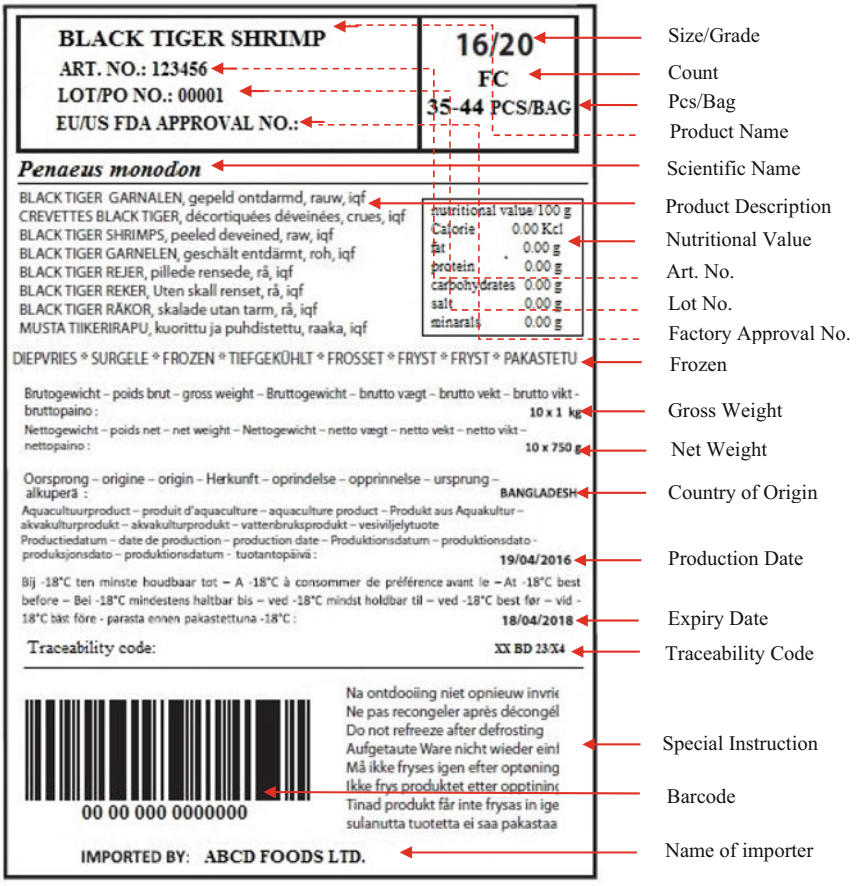


Fig. 8.13 Master carton sticker

8.7 Pallet

A pallet is a horizontal platform, typically affixed to a superstructure and a bottom deck which allows it to be lifted and moved by material handling equipment. It provides the base for assembling, storing, handling, and transporting materials and frozen products. Additionally, a pallet provides protection to the product on it. Pallet jack is a commonly used vehicle that helps to transport heavy-weighted pallets from one place to another easily.

Typically, hardwood or plastic pallets are used for standard pallet. Wooden pallets are most commonly used in shrimp industries. Wooden pallet offers a great combination of weight, stiffness, durability, and cost. Preparation and customization are easy for wooden pallets. Plastic is the second most common material used for

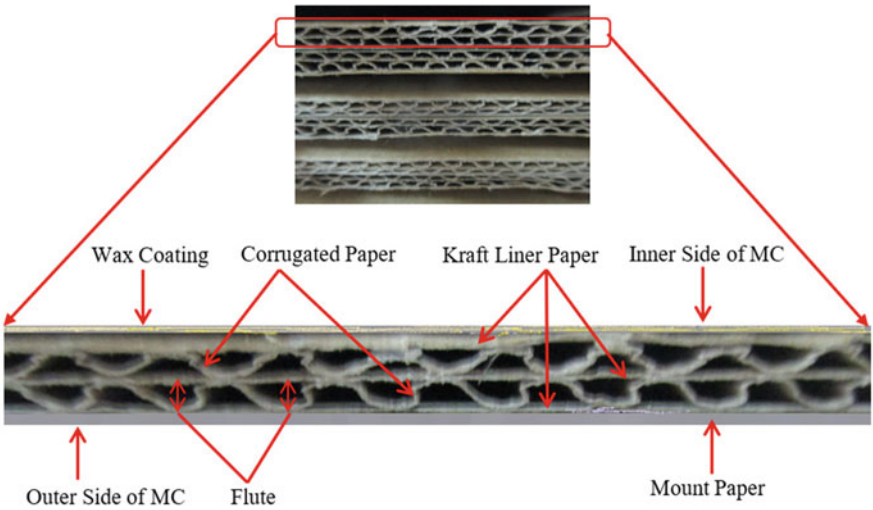


Fig. 8.14 Specification of master carton

pallet preparation. Plastic pallets are lightweight, durable, high-performance design, and good for sanitation performance but typically expensive comparative to a wooden pallet. Other materials (metals, papers) are also used for pallet preparation.

Pallets generally comply with local standards. Different countries have different standards and dimensions for pallets. Dimensions of pallet depend on the dimensions of master cartons. Cartons are stacked on a pallet in such a way that a little gap is present in between two master cartons. This is called air space or air gap. Refrigerated air passes through the gaps and keeps product cool. Uses of pallets are very common in shrimp processing industries. It should be mandatory for all because of buyer's preference. The dimensions of different types of pallets are as follows.

Type of pallet	Dimension (mm)
Euro pallet	1200 × 800
	1200 × 1000
	1140 × 1140
USA pallet	1200 × 1100
	1100 × 1100

[Note: Size and type of pallet may vary on buyer's specification. The base height of the pallet is around 150 mm, and pallet height is 1800 mm standard unless the product itself exceeds 1800 mm. Pallet height means maximum no. of master carton cover the vertical height. The pallet must be shrink wrapped.]

Fig. 8.15 Dirt and forest on carton

Fig. 8.16 Tear carton

Fig. 8.17 Damaged carton

Fig. 8.18 Imperfect sealing of bag

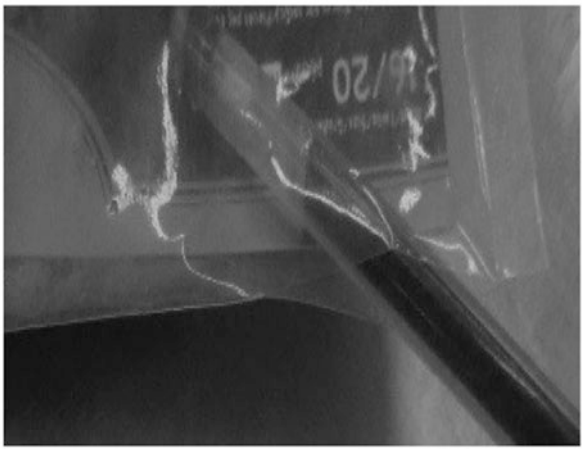


Fig. 8.19 Imperfect sealing of rider

The following are the images of different types of pallets (Figs. 8.21, 8.22, 8.23, 8.24, and 8.25).

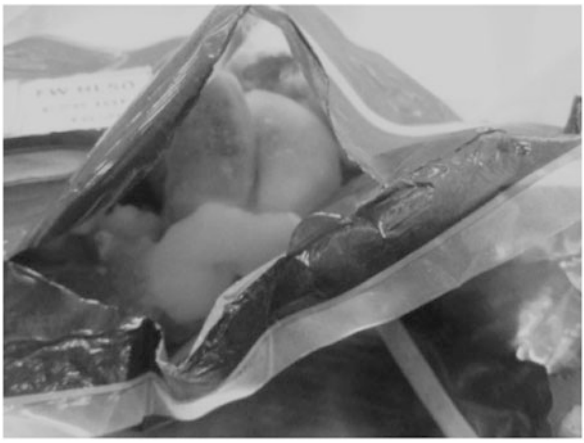
8.7.1 Pallet Calculation

*Calculate how many cartons will be in a pallet if dimension of a carton is 380 × 280 × 250 mm and dimension of euro pallet is 1200 × 800 × 150 mm. [Consider max. pallet height is 1800 mm].

Area of master carton = Length × Width = 380 × 280 mm = 106,400 mm^2 Again, Area of pallet = Length × Width	Here, Length of carton = 380 mm Width of carton = 280 mm Height of carton = 250 mm Length of pallet = 1200 mm

(continued)

Fig. 8.20 Damaged bag



$= 1200 \times 800$ mm $= 960{,}000$ mm^2 No. of cartons per layer $= \frac{\text{Area of pallet}}{\text{Area of master carton}}$ $= \frac{960000}{106400}$ $= 9.02$ $= 9.0$ No. of layers per pallet $= \frac{\text{Height of pallet}}{\text{Height of master carton}}$ $= \frac{1800}{250}$ $= 7.2$ $= 7.0$	Width of pallet = 800 mm Max pallet height = 150 mm Now calculate: No. of cartons per layer = ? No. of layer per pallet = ? Total cartons per pallet = ? Calculate following air space: 1. Space left per layer = ? 2. Space left in upper region = ? 3. Total air space left in pallet = ?
Total no. of cartons per pallet = No. of carton per layer × No. of layers $= 9 \times 7$ $= 63$ So, Total no. of cartons per pallet is 63.	
Air gap or space for air flow	
1. Space left per layer = 960,000–957,600 mm^2 $= 2400$ mm^2 2. Space left in upper region = 1800–1750 mm $= 50$ mm (Space left vertically)	Area of master carton = 106,400 mm^2 Total space used/layer = 106,400 × 9.0 $= 957{,}600$ mm^2 Area of pallet = 960,000 mm^2 Carton height = 7 × 250 mm $= 1750$ mm Pallet height = 1800 mm
Total space or air space left in a pallet is = Volume of pallet − Volume of master cartons $= 1{,}728{,}000{,}000$ mm^3 − $1{,}675{,}800{,}000$ mm^3 $= 52{,}200{,}000$ mm^3	

Fig. 8.21 Wooden pallet

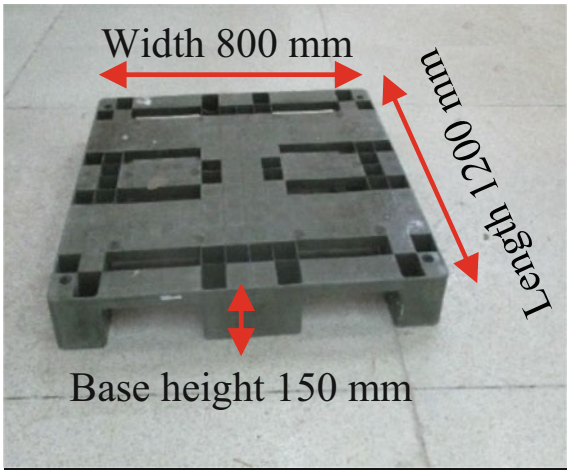


Fig. 8.22 Plastic pallet

Perform the following exercise

Exercise 1:	Calculate how many cartons are present in a pallet if dimension of a carton and a pallet is 380 × 280 × 230 mm and 1200 × 800 × 150 mm, respectively, and pallet height is 1850 mm. Is pallet size suitable for the size of master carton?
Exercise 2:	Calculate how many cartons are present in a pallet if dimension of a carton is 380 × 280 × 250 mm and dimension of a pallet is 1200 × 1100 × 130 mm. Is pallet size suitable for the size of master carton? [Height of cold storage is 1900 mm].
Exercise 3:	Calculate how many cartons are present in a pallet if dimension of carton is 380 × 285 × 180 mm and dimension of a pallet is 1200 × 800 × 150 mm. Is pallet size suitable for the size of master carton? [Pallet height is 1750 mm].

(continued)

Fig. 8.23 Cartons on pallet

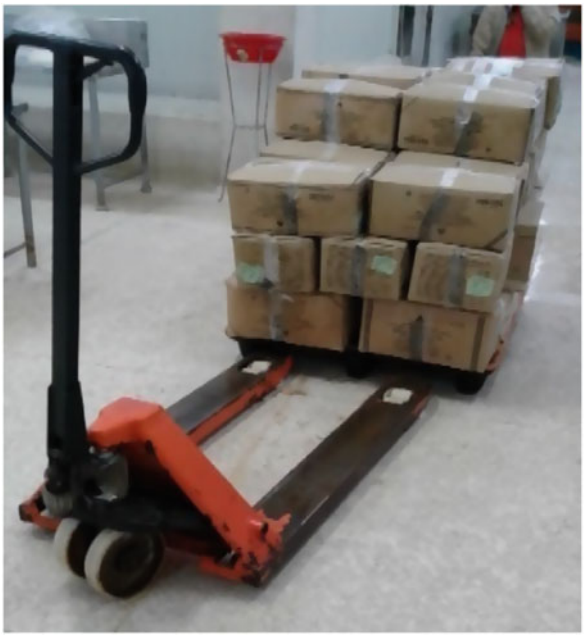


Fig. 8.24 Pallet jack

Exercise 4:	Calculate how many cartons are present in a pallet if dimension of a carton is 390 × 285 × 255 mm and dimension of a pallet is 1140 × 1140 × 150 mm. Calculate air space. [Cold storage height is 1850 mm and maximum capacity of pallet is 600 kg].
Exercise 5:	Suppose dimension of a carton and a pallet is 380 × 280 × 230 mm and 1100 × 1100 × 130 mm, respectively. Height of cold storage is 1910 mm. Calculate the following: 1) No. of cartons per layer, 2) No. of layer per pallet, 3) Total air space left in the pallet.

8.8 Barcode Scanning

A bar code is the small image of bars (lines) and spaces that represent a set of data. The code uses a sequence of vertical bars and spaces to represent numbers and other symbols. Systematically it represents data by varying the widths and spacings of parallel lines. A bar code symbol typically consists of following parts (Fig. 8.26):

- A quiet zone
- A start character
- Data characters
- A stop character
- Another quiet zone

Fig. 8.25 Pallet description

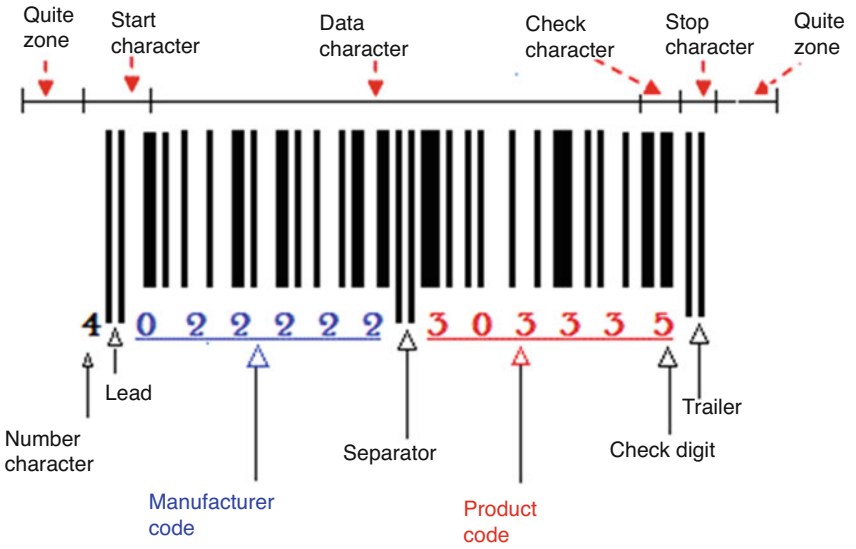


Fig. 8.26 Characteristics of barcode

Fig. 8.27 Different types of barcode

Each country has a coding authority (or numbering association) which assigns codes to manufacturers and maintains a central database. Separate Article Numbering Associations are assigned for separate countries. Usually EAN-13, GTIN-13, and ITF-14 are commonly used to identify seafood products, but EAN-128 is also used sometimes in some countries. The products contain the EAN number used to identify product itself. The standard EAN/GTIN product code has 13 digits, but a short version of EAN/GTIN code that is EAN-8 is also used for smaller sized product. The following are the characteristics of standard EAN/GTIN code (Fig. 8.27):

- The first 2 digits of the EAN-13 or GTIN code are containing the country of the article. The country is coded with 2 numbers. For example, 40, 41 represent Germany.
- The next 5 digits code the producer of the article.
- The following 5 digits represent the article number which is given by the producer.

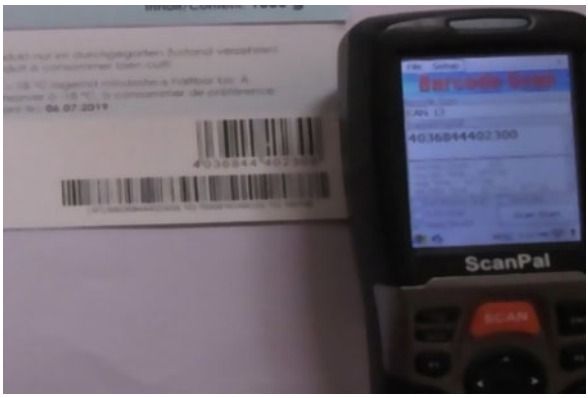


Fig. 8.28 Scanning of rider card

- The remaining last digit is the check digit. Software automatically calculates the digit and helps to justify the barcode.

A barcode scanner is an optical readable machine that identified a set of data. This data usually describes details of the products. The reader uses a laser beam that is sensitive to the reflections from the line and space thickness and variation. The reader translates the reflected light into digital data that is transferred to a computer for immediate action or storage (Fig. 8.28).

8.9 Metal Detection

Metal detection is a mandatory process for frozen shrimp. This process can be performed for the protection of consumers. It's true that maximum care is taken during processing of shrimp, but metallic contaminations of frozen shrimp may not be fully excluded. Metal detection is the last step of shrimp processing after completion of final packaging. Products are sent to metal detector for the confirmation of metal fragments whether they are present or not. Each sealed polybag/master carton must be passed through the metal detector for the confirmation of metal fragments. Metal detectors for frozen shrimp provide effective protection against ferrous and non-ferrous metals (iron, aluminum, stainless steel, etc.). Standard limits of metal detection depend on its capacity metal detector, i.e., 2 mm Fe, 3 mm non-Fe, and 3 mm St-St. After confirmation of the metal detection process, products free from metal fragments are sent to cold storage for preservation. At the same time, products are kept outside for further evaluation if found positive in metal detection. Note that products containing metal fragments are not allowed for shipment. Detection of metals in food items will be the result of negative brand image and loss of consumer trust (Figs. 8.29, 8.30, and 8.31).

Fig. 8.29 Metal detector

Fig. 8.30 Metal detection of shrimp

Fig. 8.31 Metal detection of shrimp

8.10 Frozen Storage

Finished products are sent to cold storage immediately after metal detection of frozen shrimp. Products should be stored on a first-in, first-out basis. Products are stored in a well-packed and sealed condition with proper labeling. Storage must be well facilitated, clear, and hygienic. The following should be considered during storage of frozen shrimp:

- Cold storage temperature must be at least −18 °C or below.
- Storage environment must be clean, hygienic, and free from dust, rodents, and insects.
- Pallet should be used for the stacking of master cartons.
- Stacking of cartons must be product-wise and lot-wise.
- Products of different lots must be in different pallets and different locations.
- It is strongly avoided to stack different products of different buyers at the same stack.
- Master carton serial no. should be maintained before going to final stacking.
- Too much handling and too long storage is strongly avoided.
- Cold storage should be free from excessive frost. It may damage master cartons. Damaged master cartons are not accepted anymore by the importers. It's better to cover master cartons with poly papers to avoid direct contact with frost.
- Walking above master cartons or stack of master cartons is strongly avoided. It may damage/crack/tear outer and inner packaging especially the window of semi-IQF products and bag of IQF products.

- **Changes of Products in Frozen Storage**

There are some changes observed in final products of frozen storage. The changes in frozen storage are as follows:

- Moist/damaged/tear/crack cartons
- Nutrient loss, drip loss, and freeze-burn in shrimp
- Rigidity and toughness of muscle in frozen shrimp

The following are the causes of changes in frozen storage (Figs. 8.32, 8.33, and 8.34)**:**

- Lack of well-facilitated cold storage
- No palatalization in frozen storage
- Unhygienic condition of cold storage
- Frequently or long-term temperature fluctuation
- Excess frost in cold storage
- Walking over master cartons
- Improper glazing of frozen shrimp
- Lower quality of packaging materials

Fig. 8.32 Walking over MC

Fig. 8.33 Excess frost on MC

Fig. 8.34 Protection from frost