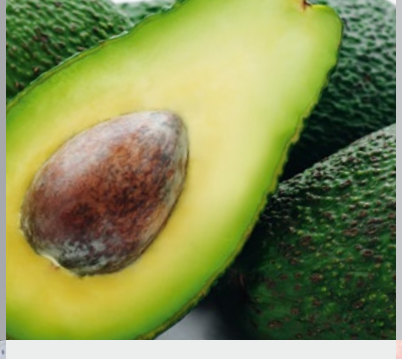






STAY COOL – WE CARE

HAMBURG SÜD


HAMBURG SÜD
SCANIA

CONTENTS

Hamburg Süd and its reefer services

Since its founding in 1871, Hamburg Süd has established itself as one of the top ten major providers of worldwide ocean transport, and is recognized for its ability to provide individual, single-source logistics solutions and optimized services that are tailored to its customers' needs.

Hamburg Süd is a future-driven company with proud traditions. As a member of the family-owned Oetker Group – which is also home to Dr. Oetker, one of the world's leading high-quality food brands – a specific area of expertise naturally lies in the transportation of food, with a focus on temperature-controlled – or reefer – cargoes; this encompasses fruit, meat, fish, vegetables, dairy and other perishable products. We have over 90 years of experience in the reefer sector and, today, with the help of our in-house Global Reefer Competence Team, rank among the top five reefer container carriers in the world and the largest container carriers within the South American markets.

Always innovative and at the forefront of new technologies, Hamburg Süd's cutting-edge fleet – one of the youngest in the market – features state-of-the-art reefer containers capable of transporting perishables reliably and quickly. The latest Xtend-FRESH Controlled Atmosphere (CA) equipment, developed in partnership with container manufacturer Carrier, ensures optimal cargo care for fresh fruit and vegetables, while remote monitoring solutions allow for the continuous supervision of individual integrated reefer container operations throughout the voyage. Mobile connectivity devices that enable live and central analysis of our reefer fleet are also in the pipeline, and together with our customers we are currently exploring new ways to deliver the world's single largest reefer commodity: bananas. This ever-popular fruit – once a mainstay of conventional reefer vessels – is increasingly being transported in reefer containers.

Together with the highly regarded Aliança and CCNI brands, Hamburg Süd sets the standard for service quality and value. We are strongly focused on the customer and the market: our mission statement outlines the partnership that we strive to establish with our customers, ensuring their needs are met with high schedule integrity and short transit times – both essential for time-sensitive reefer cargo shipments.

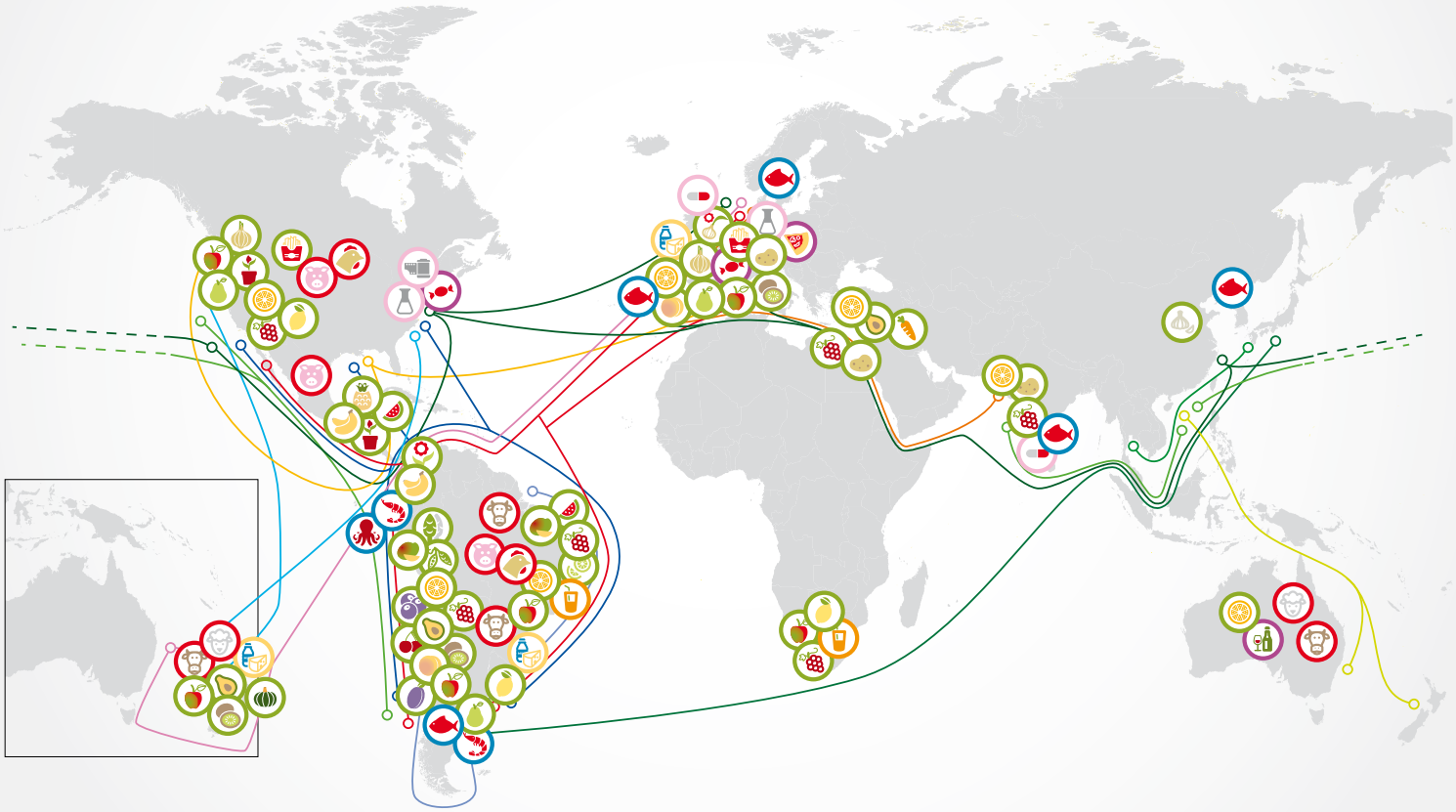
Our extensive research into ecologically friendly, energy-saving software solutions to protect the environment and the world's natural resources also ensures that the future of reefer cargoes is a green one.

Integrated management system

Hamburg Süd's integrated management system encompasses the issues of safety, environmental protection and quality. The quality standard ISO 9001 and the ISM Code were implemented as early as 1996, with the environmental norm ISO 14001 being added in 2000. It is the overriding goal of the Hamburg Süd Group to ensure and constantly improve the quality and environmental compatibility of the services offered, and to avoid errors and risks. Customer satisfaction is a fundamental concern, and is ensured by meeting to the greatest degree possible all requirements relating to quality, environmental protection and safety. It is further verified by regular measurements and analyses.

Service quality is fostered by working with selected and regularly vetted partners and specialist companies who also have the appropriate qualifications. Environmental impact is continuously reduced by environmental activities such as running a young fleet with modern technology and using resources sparingly.

Hamburg Süd offers services along most of the world's key reefer trades.



Our vessels transport a variety of reefer cargo that requires temperature control and, in some cases, atmosphere management to maintain quality.

Main Liner Operations

- Europe / Mediterranean – South America / Central America / North America
- Europe – Mediterranean / Inner Med / Middle East / Pakistan / India
- Mediterranean – North America / Central America
- Europe – Central America / New Zealand / Australia
- North America / Central America / Caribbean – South America
- Intra South America
- North America – New Zealand / Australia / Pacific Islands
- East West Services
- Asia – South Africa / South America
- Intra Asia
- Asia – Central America / North America / South America
- Asia – India / Pakistan
- Asia – Australia / New Zealand

The preferences of consumers across the globe determine the trade patterns for foodstuffs. When one part of the world increases its demand for a special kind of fruit, growers on another continent are quick to cater to this demand. A continuous adaptation to changing customer demands is Hamburg Süd's key to success in the reefer business.

Reefer cargo is mainly carried from the production areas in the Southern Hemisphere to the industrialized countries in the Northern Hemisphere. Hamburg Süd is traditionally strong in the North-South services that typically transport many reefer cargoes and, as such, has long-standing experience in shipping perishable goods.

The dominant cargoes that are transported globally in temperature-controlled containers are fruit and vegetables, with bananas representing the single most important reefer cargo. Other commodities are meat, fish and seafood, dairy products, flowers, and pharmaceuticals.

When it comes to transporting reefer cargo, factors such as temperature control, air exchange, humidity levels, and proper packing and stuffing become extremely important. Because the characteristics of reefer cargo vary from commodity to commodity, handling procedures and transit environments will vary as well. Some cargoes, such as meat, have to be kept either chilled between 0°C and −2°C or frozen at −18°C or colder. Other cargoes, such as fresh fruit, have to be kept at temperatures ranging from −3°C to +16°C to ensure that they arrive in the best possible condition.

We have the perfect solution for your reefer cargo: ask your local Hamburg Süd representative for more information.

Hamburg Süd has a large fleet of modern integrated reefer containers (reefers) with cooling facilities built into the container. They come in 20′ and 40′ sizes, and are available on all of our trade routes. The integrated container is especially suitable for door-to-door transport; only electrical power is required. Hamburg Süd's reefer containers are built to the highest possible technical standards. As a result, our equipment is regarded by the industry as state-of-the-art. The design reflects a combination of long experience, extensive research and testing programs.

Pre-Trip Inspection (PTI) and container check

One of Hamburg Süd's highest priorities is to provide its customers with the most suitable container equipment for their needs at any time. Before one of our reefer containers is released to a customer, it must always pass through a "Pre-Trip Inspection" (PTI). The Hamburg Süd PTI is a long and extensive check of the container and the operation of the reefer machinery. This ensures that only clean and undamaged containers with reefer machinery in perfect running order are made available to our customers.

Main technical features:

- Temperature range:
  Regular reefer: –30°C to +30°C PrimeLINE®/MAGNUM PLUS®: –35°C to +30°C
- Ventilation (air exchange) range: 0 to 285 cbm/h
- Dehumidification range: 50% to 95% maximum relative humidity
- Operating voltage: 360 to 500 Volt/50 to 60 Hertz
- High-tech insulation ensures minimum heat leakage
- Special "T-bar" floors ensure optimum air circulation
- Temperature-controlled using built-in microprocessors
- High-quality cooling machinery

Container details

Equipment Type		20′ Standard Reefer Container	40′ High Cube Reefer Container*
Exterior Dimensions	Length (foot)	20′	40′
	Width (foot)	8′	8′
	Height (foot)	8′6″	9′6″
Interior Dimensions	Length (mm)	5,470 – 5,555	11,586 – 11,610
	Width (mm)	2,290	2,280 – 2,310
	Height (mm)	2,266 – 2,324	2,530 – 2,607
	Height up to max. red load line (mm)	2,191 – 2,249	2,430 – 2,507
Door Opening	Width (mm)	2,296	2,288 – 2,310
	Height (mm)	2,290	2,490 – 2,576
Weights	Gross (kg)	30,480	34,800
	Tare (kg)	2,500 – 3,050	4,260 – 4,900
	Payload (kg)	27,100 – 27,980	29,900 – 30,540
Volume	(cbm)	30.00	67.10 – 68.70

* Various equipment types are available (AFAM+, XtendFRESH™, EverFRESH®).

Air circulation

Internal air circulation is essential for maintaining prescribed temperatures in reefer containers; therefore, temperature-controlled air is constantly circulated throughout the cargo space. Hamburg Süd's reefer containers are equipped with "bottom air supply": temperature-controlled air is forced down the bulkhead and blown in at the bottom of the refrigeration unit through the gratings in the ducted floor, or T-floor. After circulating inside the container, the air is forced through the air cooler – or evaporator – and guided into the T-floor again.

Each commodity has different airflow requirements. The airflow inside a reefer container is affected by the type of packaging and the method of stuffing that is being used. Depending on the type of commodity, different stuffing patterns need to be considered. The perishable industry has developed successful solutions in this regard, some examples of which are illustrated on the following pages.

Chilled products

When transporting chilled products such as fruit and meat, the temperature-controlled air must be circulated throughout the entire load. This is because heat within the container is not only generated from the outside, but may also be produced by the cargo itself. The respiration process of fresh fruit and vegetables, for example, requires air circulation both around the commodity and throughout the load to remove respiratory heat, water vapor, and gases such as carbon dioxide and ethylene.

Example 1 - Chilled products

Fresh fruit and vegetables in palletized stowage (cartons on pallets).

Air always takes the path of least resistance. If air gaps or chimneys are left in a stow, they provide an easier route for airflow than that through the cargo. Air that does not go through the cargo cannot remove respiratory heat, and air moving through chimneys near the air distribution area cannot reach further parts of the cargo. Gaps and chimneys therefore reduce the capability to maintain temperature; ergo, the cargo must cover the entire T-floor to ensure proper distribution of temperature-controlled air.

When the cargo does not cover the entire T-floor, some type of filler material (heavy cardboard, dunnage, etc.) must be placed wherever there is no cargo. This prevents a short-circuiting of the circulating air, and forces air up and through the cargo to ensure proper air distribution in reefer containers with bottom air supply. Improper stuffing, and consequently the bypassing of circulating air, initiates a larger spread of temperatures within the cargo and can lead to severe cargo damage. Ensure that air can circulate under, over and to each side and end of the stow and, in the case of respiring cargo, throughout the load.

The load should not be squeezed into the container: leave a space of a few millimeters to the side walls of the container in order to allow air circulation between the cargo and the inner surface of the container.

Please note: In a reefer container, both the cargo and any filler material must be blocked and braced to stop the load from shifting. The graphs in this guide are general schematic illustrations depicting air circulation in reefers only and do not show any required cargo-securing material.

1 REFRIGERATION UNIT

2 MAX. RED LOAD LINE

The height of the cargo must not exceed the red cargo load line, which indicates the maximum allowed cargo height and ensures sufficient space is left above the stow to facilitate proper air circulation around the load.

3 T-FLOOR

The most common form of ducted floor is known as a T-bar floor (T-floor), which takes its name from the T-shaped cross-section of aluminum extrusions that form the floor.

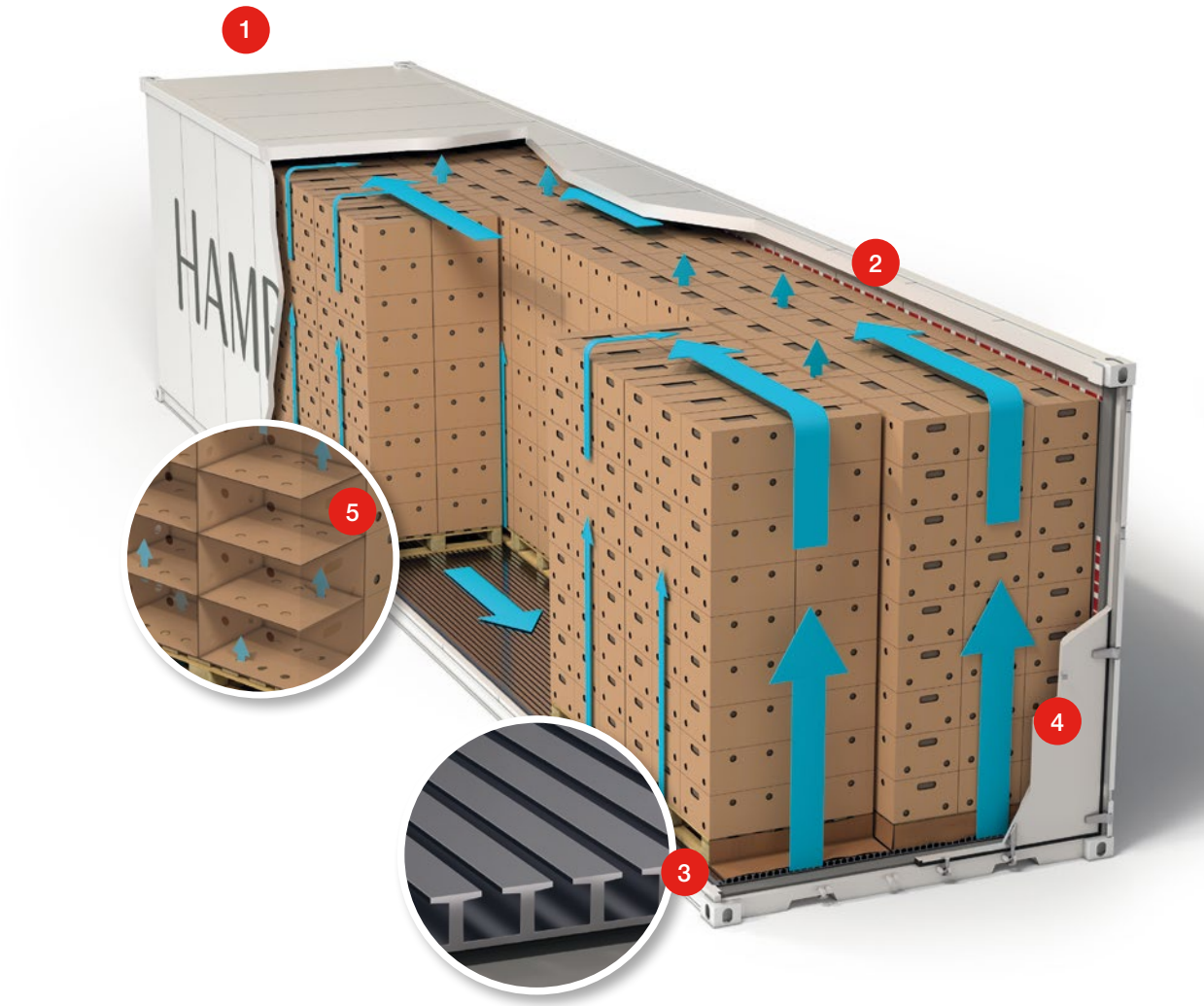
The container must not be loaded with cargo or filler material beyond the T-floor at the door end.

4 DOORS

With regard to pallet stuffing, the front face of the last pallet(s) at the door should be blocked or covered, as this increases the pressure to force air up and through the cargo.

5 AIRFLOW

The arrows indicate the air circulation inside a reefer container.



Airflow

Correct cargo packaging is essential to maintain product quality during transportation and marketing. The most commonly used types of packaging are cartons, crated boxes and bags. The material used for this packaging depends on the product, packing method, pre-cooling method, strength and buyer's specifications.

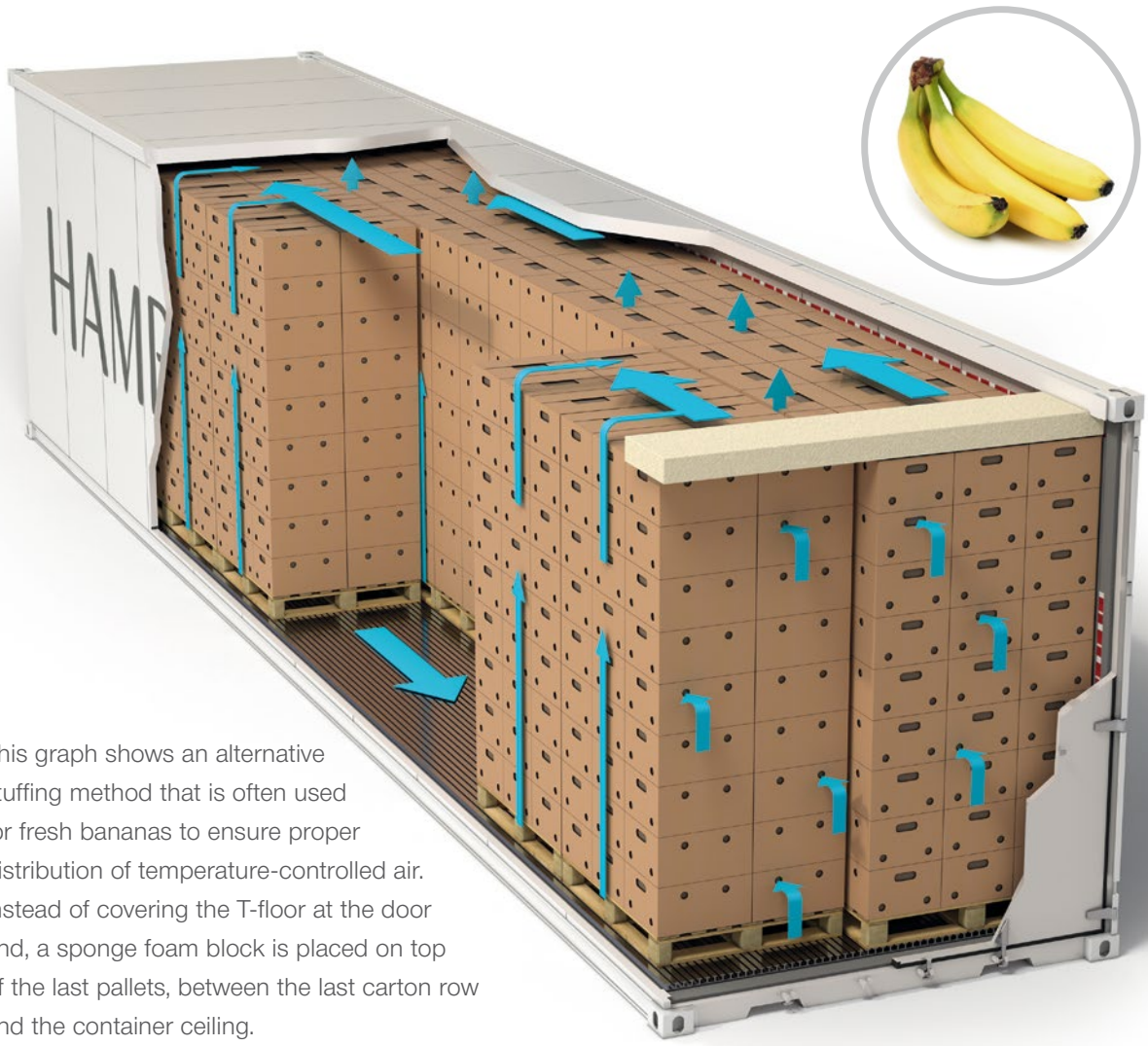
The packaging must withstand:

- rough handling (stuffing and unstuffing)
- compression from the accumulated weight of stacked packages
- impact and vibration during transport
- high humidity during pre-cooling, transit and storage

Cartons for fresh fruit and vegetables require airflow holes in the top and bottom that, when stacked, align with adjacent cartons. The number, placement, size and shape of the air holes are determined by the product being packaged. Wax-impregnated cardboard or other materials that will not lose strength in high-humidity environments are to be applied. The strength of a carton is in its corners. Stacking cartons directly on top of each other is recommended to minimize crushing cartons below. If loading cargo on pallets, the cartons on the pallets should be placed so that air flows up into the cartons unrestricted. The corners of each carton should be supported directly by the pallet and, if pallets are wrapped in plastic to provide stability, the bottom and top of the pallet/cartons must not be covered.

Example 2 - Chilled products

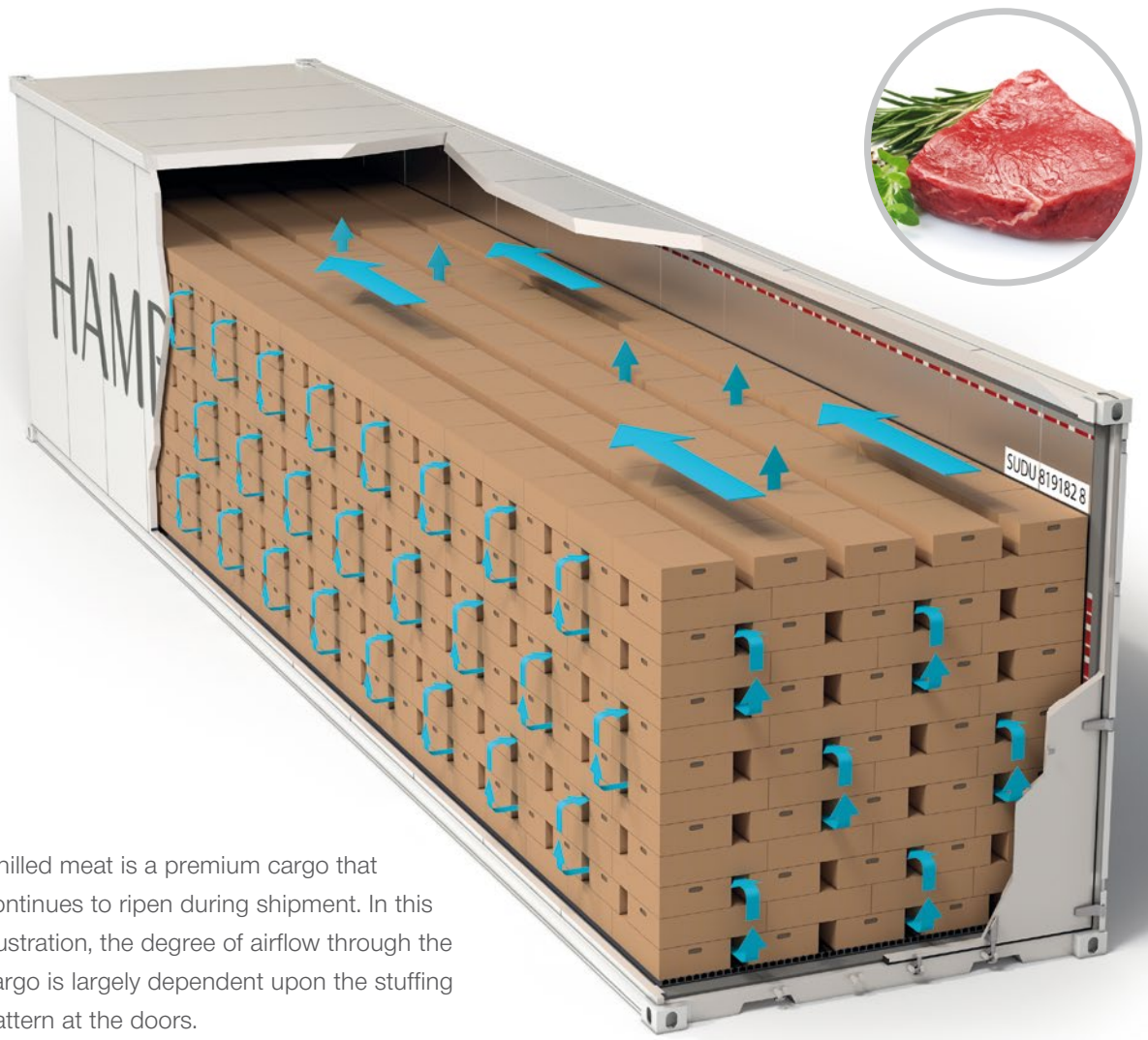
Fresh fruit and vegetables in palletized stowage (cartons on pallets).



This graph shows an alternative stuffing method that is often used for fresh bananas to ensure proper distribution of temperature-controlled air. Instead of covering the T-floor at the door end, a sponge foam block is placed on top of the last pallets, between the last carton row and the container ceiling.

Example 3 - Chilled products

A pigeonhole stow is common for chilled meat in break bulk cargo (loose cartons).

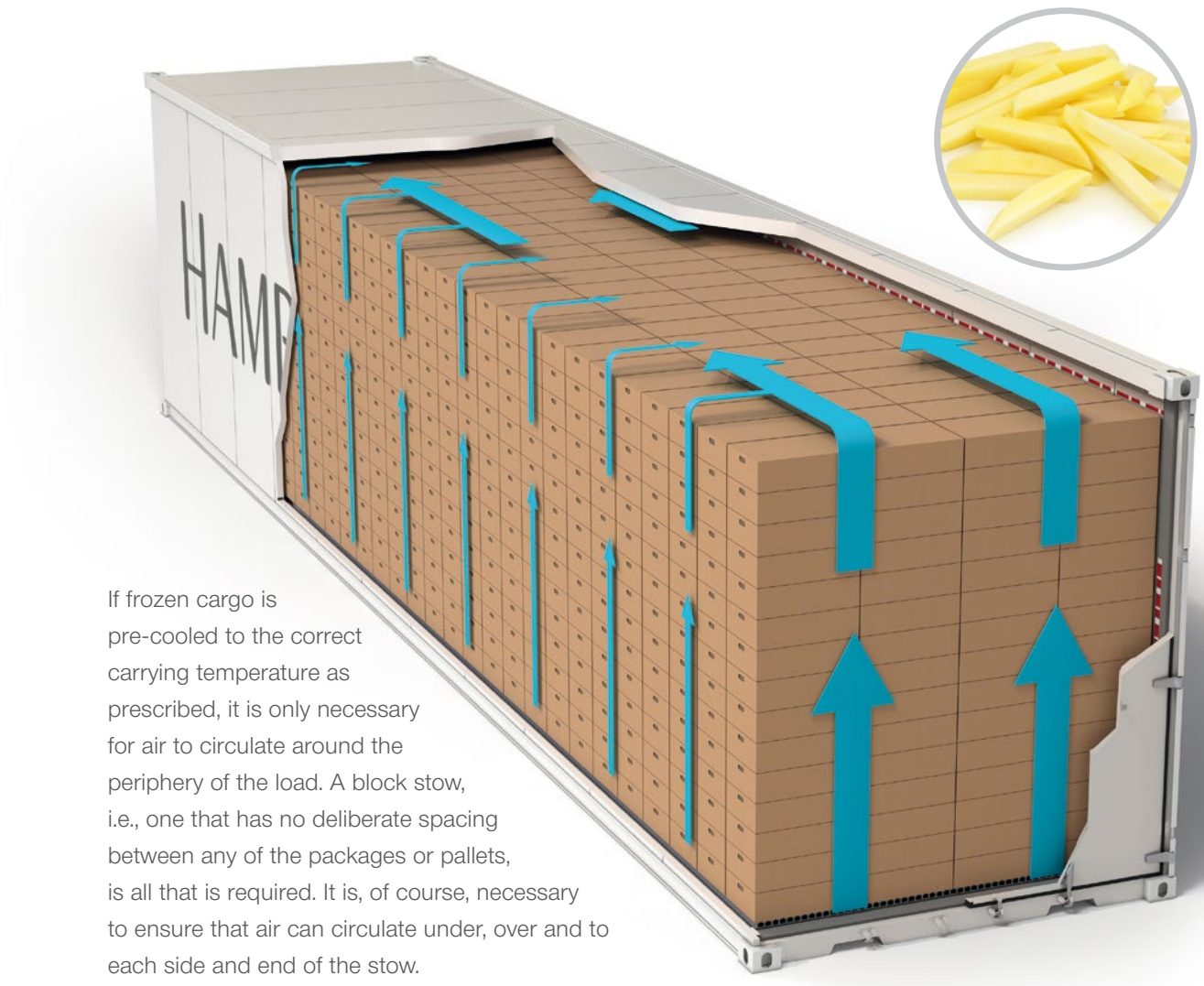


Chilled meat is a premium cargo that continues to ripen during shipment. In this illustration, the degree of airflow through the cargo is largely dependent upon the stuffing pattern at the doors.

Example 4 - Frozen products

Block stow of frozen break bulk cargo (loose cartons).

In the case of pre-cooled frozen goods, temperature-controlled air only has to flow around the cargo, since no heat has to be dissipated from the cargo itself. Only the heat that penetrates the insulation from outside (and the heat of the fan motors) has to be removed.



If frozen cargo is pre-cooled to the correct carrying temperature as prescribed, it is only necessary for air to circulate around the periphery of the load. A block stow, i.e., one that has no deliberate spacing between any of the packages or pallets, is all that is required. It is, of course, necessary to ensure that air can circulate under, over and to each side and end of the stow.

Proper temperature control is the most important factor in maintaining the quality of perishable commodities; ergo, a continuous optimal temperature setting throughout the complete “cold chain” must be maintained. If breaks in the cold chain occur, product integrity will be compromised and products will be more susceptible to ageing and decay.

For optimal quality, it is therefore critical to maintain proper temperatures from origin all the way to the end consumer.

Unbroken perishable supply cold chain

Shipments of perishables are permanently supervised by qualified reefer personnel within Hamburg Süd’s global network. Example: Hamburg Süd is doing its utmost to ensure cold chain maintenance even under difficult local circumstances. For this reason, we have developed so-called “transfer-” or “sortie containers” to secure the cold chain during anti-narcotics control in ports lacking reefer warehouses.

All of our integrated reefer containers are equipped with their own refrigeration unit, which can be plugged into electric power supplies at depots, terminals and aboard ships. During land transport, the refrigeration units may require the support of a diesel engine-driven generator set (genset).

Hamburg Süd’s reefer containers are typically designed to keep temperature at set points in the range of –30°C to +30°C in ambient temperatures from –30°C to +50°C, i.e., they can maintain temperature by cooling AND heating.

The PrimeLINE and MAGNUM PLUS reefers maintain temperatures down to as low as –35°C and are thus particularly suited to achieve effective enzyme inhibition and a longer shelf life for (fatty) fish products. But the rule “colder is better” for increased cargo protection throughout the cold chain also applies to other types of frozen cargo, such as seafood and ice cream. Moreover, the higher cooling capacity and faster temperature pull down of PrimeLINE/MAGNUM PLUS containers can provide a higher extent of tolerance for premium products such as pizza already at –30°C.

Reefer containers are designed to maintain cargo temperature in the given range, not to cool it down further. Products must therefore always be correctly pre-cooled to transport temperature prior to being loaded into the container, unless specific exceptional cases apply.

The proper pre-cooling of products has a positive effect on their shelf life and results in an enhanced output compared to products that have not been pre-cooled. When the products are packed at temperatures above the carriage temperature, this might have a negative effect on cargo quality.

The following example perfectly describes the importance of temperature effects on perishable cargo and the necessity of a fast pre-cooling of the cargo at origin:

Table grapes deteriorate more in 1 hour at +32°C than in 1 week at 0°C!

The post-harvest processes of fruit and vegetables can produce appreciable amounts of heat. Respiration heat is typically between two and seven times higher at +10°C than at 0°C. Although it might therefore appear to make sense to store fruit and vegetables at as low a temperature as can be achieved, some fruits are intolerant to excessively low temperatures, resulting in a physiological alteration known as “chilling injury”. Tropical and sub-tropical fruit and vegetables such as bananas, melons, avocados, mangoes and papayas are particularly at risk.

Pre-cooling of the reefer container itself should generally not take place. It should only be pre-cooled before loading if the container is loaded at an airlock (“cold tunnel”), for instance in a cold store, so that the temperature outside the opened doors is approximately the same as the temperature inside the container. Otherwise, when the doors of a pre-cooled container are opened in warm ambient air, water will condense on the cold container walls, which may cause subsequent damage to the cargo.

Defrost intervals

When water and heat pass the air cooler (evaporator) of the refrigeration machinery, ice is formed. This effect needs to be kept to a minimum, as it has a negative impact on the cooling performance of the refrigeration machinery. Refrigeration machineries provide different options of ice removal via defrost cycles. The usual defrost cycle is Defrost on Demand (Auto Defrost), which minimizes defrosting activity and maximizes cooling performance.

If a reefer container does not have an Auto Defrost option, the following settings apply:

- For frozen cargo, the defrost interval must be set at 24 hours.
- For chilled cargo with closed ventilation, the defrost interval must be set at 12 hours.
- For chilled cargo with open ventilation, the defrost interval must be set at 6 hours.

Temperature control systems

In reefer containers, the temperature is maintained by a thermostat controlling the refrigeration machinery. The temperature sensor measures the air temperature and sends a signal to the controller, which adjusts the refrigeration system. Modern refrigeration systems control the temperature by generally applying three different modes: full capacity, modulation control and on-off control. Frequency modulation is the most technologically advanced way to adjust the power output of the compressor, enabling it to speed up or slow down according to the requirement of the loaded reefer cargo.

The set point is the temperature at which the controller is set.

The main object of reefer transport is to ensure minimum loss of quality during transport; therefore, precise control at the lowest temperature the cargo can tolerate is crucial. When transporting chilled goods (–9.9°C or warmer), our modern refrigeration units are controlled by a sensor located in the supply air-stream, i.e., the air leaving the unit and about to enter the cargo space. This is called supply air control. The units retain a sensor in the return air for control when transporting frozen goods (return air control at –10.0°C or colder). It must be emphasized that the set-point temperature should not be confused with the product temperature. The air warms up as it moves through the cargo space, and the temperature of the return air will be higher than the temperature of the supply air.

Remote monitoring

All Hamburg Süd ships built since 1998, and those currently on order, are equipped with Remote Monitoring Systems, which continually check individual integrated reefer container operations throughout the voyage. Our equipment has Remote Monitoring Modems (RMM) installed that enable the vessels' specialists and many terminals to monitor the temperatures and alarms of all reefer containers via a central monitoring system. In addition, the expert electronics engineers on board ensure the smooth functioning of all components. Moving forward, we are testing mobile connectivity devices that allow live and central monitoring of our reefer fleet.

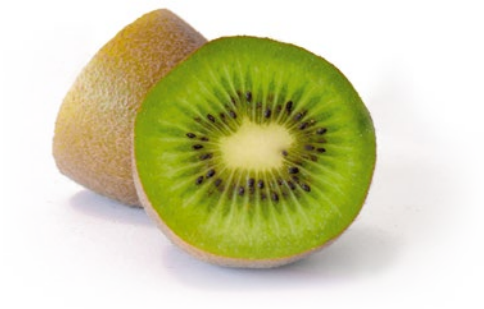
Our reefer units are fitted with controllers that have both return and supply air-temperature sensors that feed control signals to an electronic, computer-based controller. The controller adjusts the refrigeration unit, the fans and the overall capacity of the refrigeration unit to give a very precise supply air temperature. The signals (temperatures) from the sensors are recorded by our electronic temperature monitoring systems and stored in memory, along with other information, for later retrieval for up to two years.

Special features

Cold treatment

Cold treatment (CT), or cold sterilization, is commonly practiced in reefer containers. It means that sustained cold temperatures are maintained for lengthy durations: a postharvest method that is utilized to disinfest fruit subject to the fruit-fly pest and other potentially damaging insects. Our state-of-the-art reefer equipment can maintain specific temperatures for the proper duration as required by CT specifications. Hamburg Süd offers manual as well as Automatic CT (ACT) services from various origins to CT-requesting destinations in accordance with import authority guidelines. In the case of ACT, the reefer machinery will automatically raise the set point to the recommended transport temperature of the specific fruit once the CT protocol requirements have been fulfilled.

Multi-temperature mode



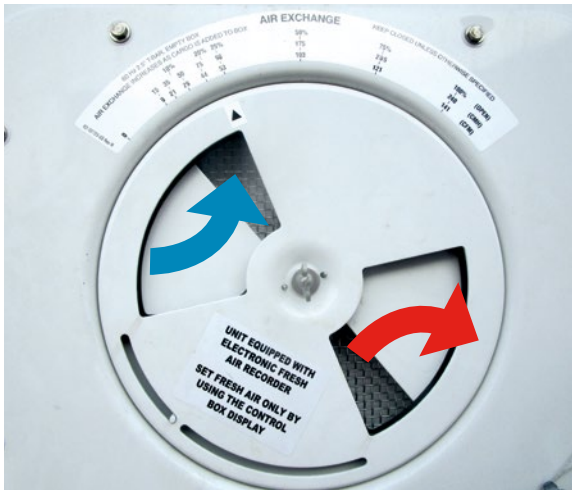
Instead of maintaining just one set-point temperature throughout the trip, our reefer containers can also be set to run a defined temperature program as per the needs of our customers and their individual cargo.

Bulb mode

Hamburg Süd reefer containers are certified for the transport of flower bulbs. Set in the so-called “bulb mode”, our reefer containers follow the standards for flower bulb transportation of the Dutch Agrotechnological Research Institute (ATO).


HAMBURG SÜD

Fresh-air ventilation



Ambient Air **Carbon Dioxide, Ethylene**

Fresh-air vents of a reefer container

For commodities that require fresh-air circulation, like most fresh fruit and vegetables, our reefer containers can provide air exchange through ventilation.

During transport, fresh fruit and vegetables continually respire and, thus, produce gases such as carbon dioxide and ethylene. As these respiratory gases can lead to cargo damage such as uncontrolled ripening, ageing and off-flavor, they have to be removed from the container atmosphere. Depending on the respiration rate of the commodity that is being shipped, fresh-air vents of a reefer container are usually opened at defined set points in cbm/h for most fresh fruit and vegetables. Hamburg Süd's reefer containers can provide vent openings in the set-point range of 0 to 285 cbm/h.

The single permitted dimension unit for ventilation settings is "cbm/h". Due to a lack of standardization, ventilation measured in percentages ("%") is not acceptable, as it could lead to severe misinterpretations depending on the manufacturer of the cooling unit. Vent openings must be closed when transporting frozen goods or controlled-atmosphere loads.

Humidity control

Our reefer containers are equipped with automatic drains that open and close automatically as required in order to release any excess water that might accumulate inside the container. Simultaneously, drains prevent outside water from entering the container.

The relative humidity of the air inside a reefer container can be of particular importance in the transport and storage of chilled reefer cargo. Dry air may cause desiccation of fresh fruit and vegetables, which can affect the appearance and will certainly reduce the weight at the point of sale. Very damp air, with high relative humidity, will encourage the development of various fungal disorders on many fruits and vegetables.

The relative humidity of the air around fresh produce in a reefer container is dependent on transpiration (and respiration) through the surface of the product, the rate of fresh air ventilation, the relative humidity of the fresh air, and the temperature of the refrigerant coil relative to the dew point of the air in the cargo space.

The relative humidity of the air around fresh fruit and vegetables in a reefer container is dependent on the following factors:

- When humid air is cooled down at the start of the transport, the relative humidity increases (+).
- Transpiration and respiration through the surface of the product provide additional humidity to the air (+).
- Fresh-air ventilation with humid air can raise the relative humidity level further (+).
- The cooling process itself usually removes humidity from the container air through condensation at the evaporator fins (–).

As a result, a natural balance of 85% to 95% relative humidity is usually formed automatically.

Recommended relative humidity levels for fresh fruit and vegetables vary, but generally fall between 85% and 95%, depending on the fruit and variety. In most cases, these high humidity levels are formed automatically in a reefer container due to the concurrence of the above-mentioned factors, and no further humidity control is required by the reefer container.

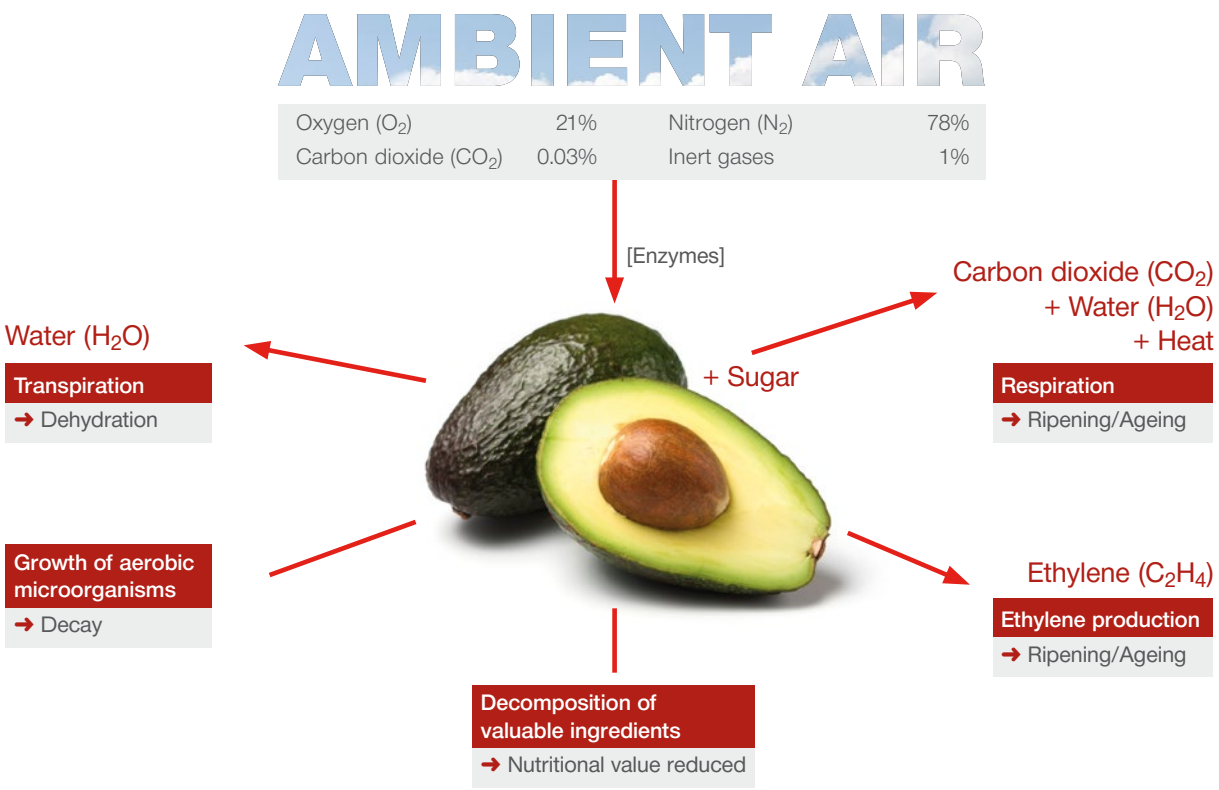
Dehumidification

Some products, like fresh garlic and onions, ginger or seed potatoes, are susceptible to high humidity and may require a reduced level of relative humidity during transport to prevent germination or decay. For these products, our reefer containers can offer dehumidification that keeps the air inside the container at a specific maximum level of humidity. The controller of a reefer container cannot be set to humidify the air, but only to dehumidify to a set-point level between 50% to 95% relative humidity in the chilled temperature range.

MA and CA containers

Modified Atmosphere (MA) and Controlled Atmosphere (CA) have become effective means of securing and preserving the quality of fresh fruit and vegetables. Hamburg Süd is leading the way worldwide with MA and CA shipments. Fresh fruit and vegetables are living metabolizing items: the lifespan of this perishable commodity ticks away the moment it is harvested. Fruit is inherently on a starvation diet once it is picked from the mother plant. The key to delivering better quality produce is to slow down the consumption of the produce's food reserves.

Post-harvest processes on fruit and vegetables



Fruit and vegetables are still alive during transport, and undergo the normal processes associated with life (i.e., respiration and ageing). Respiration results in the conversion of oxygen into carbon dioxide.

During transport, post-harvest processes on fruit and vegetables are generally minimized through temperature control and fresh-air ventilation. In order to reduce them even further, MA and CA containers have been developed. This special type of reefer equipment can specifically change the gas composition of the container atmosphere in order to enhance the effect of refrigeration and thereby prolong product shelf-life. Roughly speaking, atmospheric air consists of 21% oxygen (O_2) and 0.03% carbon dioxide (CO_2), with the remainder consisting chiefly of nitrogen (N_2) and inert gases. For both MA and CA, the O_2 content of the container atmosphere is generally decreased while the CO_2 content is increased. Both of these changes will tend to slow down the life process of the produce.

MA is a rather passive, partly controlled change of air composition, while CA provides the most technologically advanced way of constantly measuring and actively maintaining the atmospheric conditions in a reefer container throughout a shipment's entire journey. The most important gases in the atmosphere are O_2 and CO_2. O_2 is required for the respiration process; if the availability of O_2 is reduced, the respiration rate (and, thus, ethylene formation) can be slowed down dramatically. The same effect occurs when the CO_2 content is increased. Growth of aerobic bacteria, yeast and mold is inhibited in high concentrations of CO_2. In addition, mold requires oxygen to grow, so limiting the amount of O_2 in the environment will limit the capacity of mold to cause spoilage. The decomposition of valuable ingredients is inhibited as well, due to the fact that (pro)vitamins are more stable in an O_2 -reduced environment.

Hamburg Süd offers you the following types of MA and CA containers:

Modified Atmosphere (MA)	Controlled Atmosphere (CA)
■ AFAM+*	■ XtendFRESH™
■ Maxtend®	■ EverFRESH®
■ Liventus®	

* The more advanced XtendFRESH system will completely replace AFAM+ in the Hamburg Süd MA/CA container fleet within the next couple of years.

The lifespan of perishables can be prolonged if they are kept at their optimal temperature and in the most effective atmosphere.

The art of MA and CA for fruit and vegetables is to tailor the atmospheric composition to the requirements of the particular product. Too little O_2 content in the atmosphere may cause a product to suffocate. Similarly, an excessive CO_2 content could cause suffocation of the "living" product, as it will be unable to release the CO_2 it breathes out. It is therefore essential to apply the most suitable technology and atmospheric settings to each individual type of fruit.

The ideal composition of MA and CA transport is commodity specific. Our team of dedicated reefer specialists will support you in developing tailor-made solutions for your MA and CA cargoes.

Potential benefits of MA/CA containers for fresh produce:

- Prolonged shelf life of products through delayed ripening, ageing and decay, therewith providing the retail food trade with extended selling periods.
- Reduced water loss and weight shrinkage.
- Longer transit times become possible; so, cargo can be shipped to more distant destinations and/or to new markets.
- MA/CA containers represent an alternative to handling- and waste-intensive MA packaging.
- Fruit can be shipped with a higher degree of ripeness.
- Enhanced quality, taste, nutritional value and appearance result in more sales for the retail food trade and less spoilage.
- Post-harvest treatment of fruit can be reduced.
- More attractive prices due to lower transport costs compared to air freight.
- The move away from transport-by-air means a significant gain for the environment due to reduced CO_2 emissions.

Please note: MA packaging (such as Banavac bags for bananas) must never be applied in MA/CA containers. Any packaging used in MA/CA containers must be perforated/with holes to allow contact between the cargo and container atmosphere (such as Polypac/polybag does for bananas).

AFAM+ MA

The “Automated Fresh Air Management” method takes advantage of the fact that the respiration of fruit converts O_2 into CO_2. If produce is placed in a reefer container with vents closed, the CO_2 content produced by the respiration process is allowed to increase. The O_2 content is reduced to an equal extent. As atmospheric air contains 21% O_2 and approximately 0% CO_2, an increase of, say, 10% in the CO_2 content will reduce the O_2 content to approximately 11%. The combined total percentage of CO_2 and O_2 always remains at 21%. The percentage of N_2 (including inert gases) remains unchanged and is just the same as in ambient air: 79%.

AFAM+ is a type of MA container that utilizes a motorized fresh-air exchange system. After reaching the required atmosphere conditions, the CO_2/O_2 set point is maintained throughout the voyage simply by opening the fresh-air ventilation. The system monitors CO_2 levels and constantly opens and closes the container vent in response to produce respiration. Installation of extra ethylene scrubbers to take ethylene out of the container atmosphere is recommended for products that produce high amounts of this so-called “ripening gas”.

Maxtend MA and Liventus MA

The Maxtend and Liventus systems are based on the same principles as AFAM+ (see left). However, in order to establish the initial atmosphere more quickly and/or independently of produce respiration, gases from cylinders can be pre-injected into the container once, before commencement of ocean transport. A so-called “curtain” (plastic sealing sheet) is used at the container door to improve gas tightness and to ensure that the pre-injected gas mixture cannot escape. Atmosphere maintenance during the trip is similar to AFAM+ and therefore relies solely on using controlled fresh-air ventilation to replace O_2 consumed by continuing fruit respiration. Depending on the commodity, the extra-installation of ethylene and/or CO_2 scrubbers is recommended.

XtendFRESH CA

The XtendFRESH system is initially based on the AFAM+ principle (please see previous page). However, while the AFAM+ system is limited to set points where the combined total percentage of CO_2 and O_2 remains at 21% as per respiration balance, the XtendFRESH system offers an innovative key solution. By making use of the container's evaporator fans, the container atmosphere flows through a scrubber with activated carbon that takes out excessive CO_2 (a permanent reactivation system sends the excessive CO_2 to the outside) to finally reach the ideal CA condition for the respiring fruit. After reaching the required set points, the CO_2 and O_2 levels are actively maintained throughout the voyage by a combination of CO_2 removal and fresh-air injection. On top of that, the XtendFRESH system is the first CA technology that, through its combined CO_2/ethylene scrubber, automatically takes ethylene out of the container atmosphere during the shipment. This means that no extra installation of ethylene scrubbers is required, even for products that produce high amounts of this so-called "ripening gas". A curtain is regularly applied to ensure airtightness at the door end.

EverFRESH CA

The crucial difference between the above-mentioned MA techniques and CA is that, in EverFRESH, the container atmosphere is not regulated by ventilation but by active N_2 injection during transport. An N_2 gas-separating membrane is integrated into the refrigeration unit and allows each container to have a fresh stream of N_2 throughout the journey whenever the O_2 and CO_2 sensors activate N_2 production. A compressor takes the ambient air, compresses it, then forces it through the hollow-fiber membrane, which separates and thereby concentrates the N_2. When piped into the reefer container, the N_2-enriched atmosphere stream dilutes the O_2 level to reach set point: in most cases below 5% O_2, with N_2 levels distinctly above 79%.

Depending on the carried product, CO_2 can be increased in parallel, the same as described for MA. The controller continuously monitors and controls the O_2 and CO_2 concentrations and adjusts their levels towards the set points by varying the volume and purity of the nitrogen introduced into the container. EverFRESH containers regularly apply a curtain at the door end and, depending on the commodity, may require extra installation of ethylene scrubbers.

Transport plan and pre-treatment of reefer cargo

The basic requirement in the carriage of reefer cargoes is to deliver the goods, insofar as possible, in the same condition as they were received; in other words, to maintain quality.

To achieve this, it is imperative that the total transit time of perishables must never get too close, reach or exceed their approximate overall shelf life. In addition to shelf life, the condition of the product before it is stuffed plays an important role in its condition upon arrival: it is therefore essential that all products are treated correctly prior to stuffing.

Even though temperature control and atmosphere management are optimal during the entire voyage, products will only arrive in perfect condition if the pre-treatment has been performed correctly. Cargo quality can never be improved during the trip – even the very best CA container is not a hospital. Successful shipping begins at the point of origin of reefer cargo, and the carrier must fully reject responsibility for cargo damage encountered due to inadequate pre-treatment.

There is no technology available to overcome or reverse the process of fruit ripening; only technologies that slow the process exist. If, at loading time, a cargo is already too mature or is of too substandard a quality to arrive at the required level of maturity, a rejection or claim for damages by the recipient is the logical consequence notwithstanding the reasonable care and diligence exercised by the carrier.

As temperature-sensitive goods deteriorate at a rate that is temperature dependent, temperature maintenance is paramount. For frozen goods, this requires the maintenance of a temperature low enough to effectively stop deterioration. For chilled goods, temperature must be maintained at the lowest possible temperature that will not damage the cargo, and atmosphere management may be necessary as well.

The optimal transport conditions will depend on many factors, and may require expert advice. Our team of dedicated reefer specialists is ready to support you.

Ice-cold and efficient

The number of reefer shipments is continuously growing and, with them, the number of reefer containers. The latter only fulfil their purpose when they keep the temperature constant in adverse ambient conditions. To do this, reefer containers require electricity; how efficiently it is converted into refrigerating capacity is a quality feature and an important criterion for the environmental compatibility of a reefer shipment.

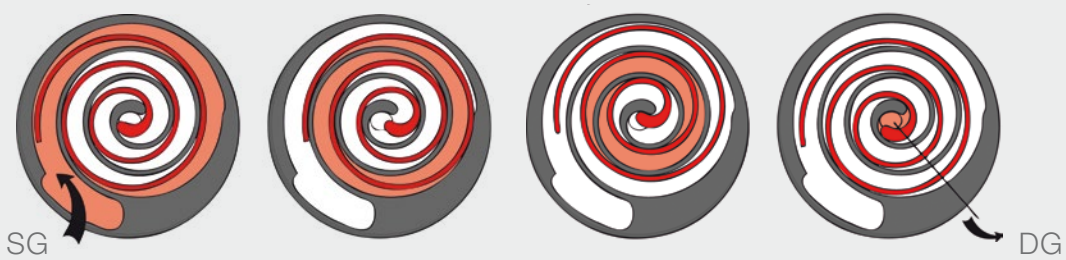
Hamburg Süd is one of the first shipping companies worldwide, and has championed compression-efficient scroll compressors since 1997. A very large proportion of our fleet therefore sails with these units, which work up to 40% more efficiently than traditional piston compressors. The economical operation of our reefer containers with scroll technology benefits not only our customers, but also the environment. Our latest technological advance is the introduction of variable-speed scroll compressors, which are the most economic hardware of its kind.

Energy-saving software solutions

To improve our reefer shipments still further, we reproduce the operating conditions of a reefer container in elaborate laboratory tests and measure the resulting energy consumption. Only with these tests is it possible to optimize reefer container operation and therefore reduce unnecessary energy expenditure. One result of these tests has been the development of software in cooperation with reefer manufacturers that saves approximately 30% energy; this is achieved through a more efficient use of refrigeration components. Energy-saving software used by other shipping lines might allow a higher bandwidth of air temperatures. In contrast to these approaches, Hamburg Süd continues to provide tight air-temperature control.

What is a SCROLL COMPRESSOR?

A scroll compressor in a refrigerated container compresses the gaseous coolant. It consists of two interleaved scrolls, or spirals – one rigid and one flexible. The coolant flows in through the suction tube (SG) and compression begins. The flexible scroll orbits the fixed scroll eccentrically without rotating. Since the scrolls touch on two opposite sides, pockets are produced which become ever smaller from the outside inwards, thereby compressing the coolant. It then escapes at the center, highly compressed (DG). Compared with traditional piston compressors, in which a piston moves up and down as in a combustion engine, scroll technology has higher energy efficiency.



The coolant enters the compressor (SG), is forced inwards by the rotary movements of the two metal scrolls and compressed. The compressed medium then escapes at the center (DG).

Good atmosphere for fresh produce

MA/CA shipments are a significant gain for the environment, because they mean a move away from transport by air for sensitive fruit and vegetables such as exotics. In a MA or CA container, fruits carried by ship can reach their destination just as fresh and flavorful as they would be by plane. The difference: carriage by ship causes just a fraction of the climate-malign gases produced by air transport per tonne moved.










Recommended transport conditions and approximate shelf life of reefer cargo

The following table provides recommended settings (temperature, ventilation, and dehumidification) and shelf life information for selected products in standard reefer containers. Relevant data for reefer container settings are shown in red.

If your product is not mentioned or additional information is required, please ask your local Hamburg Süd representative. Our dedicated reefer specialists can support you for other reefer commodities not mentioned here, including pharmaceuticals or flower bulbs; where special requirements apply; and for further information on the use of MA and CA containers.

Commodity	Temperature °C	Ventilation (air exchange) cbm/h	Humidity relative % relative	Dehumidification (max. relative humidity setting) ON/OFF	Approximate shelf life after harvest (in ambient air)	Methods for further shelf life extension
A						
Apples (fresh)	–1 to +4	10 to 60	90 to 95	OFF	1 to 7 months	CA containers often employed
Apricots (fresh)	–0.5 to 0	15 to 60	90 to 95	OFF	1 to 4 weeks	MA/CA containers often employed
Artichokes, globe (fresh)	0 to +2	0 to 15	90 to 95	OFF	2 to 3 weeks	
Asparagus (fresh)	0 to +2	15 to 25	90 to 98	OFF	2 to 3 weeks	MA packaging or CA containers often used
Avocados (fresh)	+4 to +13	30 to 60	85 to 95	OFF	2 to 3 weeks	MA/CA containers usually employed
B						
Bakery products (chilled)	+10 to +18	0 (=closed)	60 to 95	ON or OFF	depending on commodity	
Bakery products (frozen)	–18 or colder	0 (=closed)	–	OFF	3 to 18 months	
Bananas (fresh)	+13 to +14.4	25 to 60	90 to 95	OFF	18 to 22 days	MA packaging (Banavac) or CA containers often used
Beans, green, snap (fresh)	+4 to +7.5	20 to 30	95 to 98	OFF	7 to 10 days	
Blueberries (fresh)	–1 to 0	0 to 10	90 to 95	OFF	10 to 14 days	MA packaging or CA containers often used
Broccoli (fresh)	0 to +1	20 to 60	90 to 98	OFF	10 to 14 days	
Butter (chilled)	0 to +8	0 (=closed)	–	OFF	2 to 6 weeks	
Butter (frozen)	–18 or colder	0 (=closed)	–	OFF	8 to 12 months	
C						
Cabbage, Chinese (fresh)	0 to +2	20 to 60	90 to 98	OFF	2 to 3 months	

Commodity	Temperature °C	Ventilation (air exchange) cbm/h	Humidity relative % %	Dehumidification (max. relative humidity setting) ON/OFF	Approximate shelf life after harvest (in ambient air)	Methods for further shelf life extension
Cabbage, early (fresh)	0 to +2	20 to 60	90 to 98	OFF	3 to 6 weeks	
Cabbage, late (fresh)	0 to +2	20 to 60	90 to 98	OFF	5 to 6 months	
Carrots, topped (fresh)	0 to +2	10 to 20	90 to 98	OFF	1 to 9 months	
Cassava, yuca, manioc (fresh)	0 to +5	10 to 20	85 to 90	OFF	1 to 2 months	
Cauliflower (fresh)	0 to +1	20 to 60	90 to 98	OFF	2 to 4 weeks	
Cheese (chilled)	0 to +18	0 (=closed)	–	OFF	depending on variety	
Cherries, sweet (fresh)	–1 to 0	0 to 15	90 to 95	OFF	2 to 3 weeks	MA packaging often applied
Chocolate (chilled)	+8 to +18	0 (=closed)	65 to 85	ON or OFF	5 to 15 months	
Cocoa butter (chilled)	+15 to +25	0 (=closed)	–	OFF	12 to 24 months	
Coconuts, dehusked (fresh)	0 to +2	0 to 25	75 to 85	ON or OFF	1 to 2 months	
Codfish, dried, salted (chilled)	+1 to +3	0 (=closed)	65 to 70	ON	12 months	
Corn, sweet, baby (fresh)	–0.5 to +1	10 to 15	90 to 98	OFF	5 to 8 days	
Cucumbers (fresh)	+10 to +13	15 to 25	90 to 95	OFF	10 to 14 days	
D						
Dates (fresh)	0 to +2	0 to 5	65 to 85	ON or OFF	6 to 12 months	
E						
Eggplants, aubergine (fresh)	+8 to +12	10 to 15	90 to 95	OFF	1 to 2 weeks	
Eggs, dried, whole solids (chilled)	+4 to +10	0 (=closed)	–	OFF	1 to 2 years	
Eggs, with shell (chilled)	–1 to +3	0 (=closed)	–	OFF	5 to 6 months	
F						
Figs (fresh)	–0.5 to 0	0 to 5	85 to 90	OFF	7 to 10 days	
Fish (frozen)	–18 or colder	0 (=closed)	–	OFF	4 to 12 months	
French fries, potato wedges (frozen)	–18 or colder	0 (=closed)	–	OFF	12 to 24 months	
Fruit (frozen)	–18 or colder	0 (=closed)	–	OFF	depending on commodity	

Commodity	Temperature °C	Ventilation (air exchange) cbm/h	Humidity relative %	Dehumidification (max. relative humidity setting) ON/OFF	Approximate shelf life after harvest (in ambient air)	Methods for further shelf life extension
G						
Garlic (fresh)	–3 to +1	0 to 15	60 to 70	ON	6 to 7 months	
Ginger (fresh)	+12 to +14	10 to 15	65 to 75	ON	2 to 3 months	
Grapefruit (fresh)	+10 to +15	15 to 50	85 to 90	OFF	1 to 2 months	sometimes carried at +8°C though subject to chilling injury below +10°C
Grapes, table (fresh)	–1 to 0	10 to 15	85 to 95	OFF	1 to 5 months with sulphur dioxide pads	
H						
Honey, strained (chilled)	+10 to +20	0 (=closed)	–	OFF	1 to 2 years	
I						
Ice cream, dairy desserts (frozen)	–26 or colder	0 (=closed)	–	OFF	4 to 6 months	
IQF, individually quick-frozen products (frozen)	–18 or colder	0 (=closed)	–	OFF	depending on commodity	
J						
Juice, concentrate, fruit (frozen)	–18 or colder	0 (=closed)	–	OFF	1 year	
K						
Kiwifruit, green, golden (fresh)	–0.5 to +5	20 to 40	90 to 95	OFF	2 to 3 months	
L						
Lemons (fresh)	+10 to +14	15 to 25	85 to 95	OFF	1 to 3 months	up to 4 weeks at +5 to +9°C is tolerated by most varieties, though chilling sensitive
Lettuce, iceberg (fresh)	0 to +1	20 to 50	90 to 98	OFF	2 to 3 weeks	
Limes (fresh)	+8 to +12	15 to 25	85 to 90	OFF	2 to 5 weeks	often carried at +7°C though subject to chilling injury below +8°C; dehumidification sometimes applied to reduce mold growth
Lychees (fresh)	+2 to +6	10 to 15	90 to 95	OFF	3 to 5 weeks	

Commodity	Temperature °C	Ventilation (air exchange) cbm/h	Humidity relative %	Dehumidification (max. relative humidity setting) ON/OFF	Approximate shelf life after harvest (in ambient air)	Methods for further shelf life extension
M						
Mandarins, clementines, tangelos, tangerines, easy peelers (fresh)	+4 to +8	15 to 25	90 to 95	OFF	3 to 8 weeks	
Mangoes (fresh)	+8 to +14	25 to 30	85 to 95	OFF	2 to 4 weeks	
Margarine (chilled)	0 to +8	0 (=closed)	–	OFF	4 to 5 months	
Meat (chilled)	–2 to –1	0 (=closed)	–	OFF	1 to 8 weeks	
Meat (frozen)	–18 or colder	0 (=closed)	–	OFF	6 to 18 months	
Melons, cantaloupe, charentais (fresh)	+2 to +5	25 to 30	90 to 95	OFF	1 to 2 weeks	MA packaging often applied
Melons, galia, orange flesh (fresh)	+7 to +8	25 to 30	90 to 95	OFF	2 to 3 weeks	MA packaging often applied
Melons, water, honeydew, piel de sapo (fresh)	+9 to +12	25 to 30	85 to 95	OFF	2 to 3 weeks	
Milk, dried (chilled)	+7 to +21	0 (=closed)	–	OFF	6 to 9 months	
Milk, pasteurized (chilled)	0 to +1	0 (=closed)	–	OFF	2 to 4 months	
Mushrooms (fresh)	0 to +1	0 to 10	90 to 98	OFF	5 to 7 days	
O						
Onions, bulbs (fresh)	0 to +8	10 to 40	65 to 75	ON	2 to 9 months	
Oranges (fresh)	+2 to +10	15 to 25	85 to 90	OFF	1 to 3 months	
P						
Papayas (fresh)	+7 to +13	25 to 30	85 to 90	OFF	1 to 3 weeks	
Peaches, nectarines (fresh)	–0.5 to 0	15 to 25	90 to 95	OFF	2 to 5 weeks	MA/CA containers often employed
Pears (fresh)	–1.5 to 0	15 to 25	90 to 95	OFF	1 to 8 months	
Peas, snow, sugar snap (fresh)	0 to +1	15 to 25	90 to 98	OFF	1 to 2 weeks	MA packaging or CA containers often used
Peppers, bell, sweet, chili (fresh)	+7 to +10	10 to 15	90 to 95	OFF	2 to 3 weeks	
Persimmon, kaki (fresh)	–1 to +1	15 to 25	85 to 95	OFF	1 to 3 months	
Physalis, cape gooseberries (fresh)	+10 to +16	0 to 15	65 to 85	ON or OFF	3 to 6 weeks	

Commodity	Temperature °C	Ventilation (air exchange) cbm/h	Humidity relative % relative	Dehumidification (max. relative humidity setting) ON/OFF	Approximate shelf life after harvest (in ambient air)	Methods for further shelf life extension
Pineapples (fresh)	+7 to +13	15 to 25	85 to 90	OFF	2 to 3 weeks	often carried at +6.5°C though subject to chilling injury below +7°C
Plantains (fresh)	+9 to +13.5	20 to 25	85 to 95	OFF	1 to 4 weeks	MA packaging (Banavac) or CA containers often used
Plums (fresh)	–0.5 to 0	15 to 25	90 to 95	OFF	2 to 5 weeks	MA/CA containers often employed
Pomegranates (fresh)	+5 to +9	10 to 25	90 to 95	OFF	2 to 3 months	
Potatoes, for processing (fresh)	+10 to +15	10 to 50	85 to 95	OFF	2 to 12 months	
Potatoes, seed (fresh)	+4 to +8	10 to 25	65 to 90	ON or OFF	2 to 6 months	
Potatoes, sweet (fresh)	+12 to +16	0 to 30	80 to 95	ON or OFF	4 to 6 months	
Potatoes, table (fresh)	+5 to +10	10 to 50	85 to 95	OFF	2 to 12 months	
Poultry (frozen)	–18 or colder	0 (=closed)	–	OFF	6 to 16 months	
R						
Radish (fresh)	0 to +5	0 to 15	90 to 95	OFF	1 to 4 weeks	
S						
Seafood, shrimps, mussels, octopus, squid (frozen)	–18 or colder	0 (=closed)	–	OFF	6 to 12 months	
Squash, summer, soft rind (fresh)	+5 to +10	0 to 10	90 to 95	OFF	10 to 14 days	
Squash, winter, hard rind, pumpkins (fresh)	+10 to +13	0 to 60	60 to 85	ON or OFF	5 to 8 weeks	
Strawberries (fresh)	–0.5 to 0	10 to 15	90 to 95	OFF	3 to 8 days	
T						
Taro, malanga (fresh)	+7 to +13	10 to 15	85 to 90	OFF	2 to 5 months	
Tomatoes (fresh)	+7 to +15	15 to 30	65 to 90	ON or OFF	1 to 4 weeks	
Turnips (fresh)	0 to +4	0 to 10	90 to 95	OFF	4 to 5 months	
V						
Vegetables (frozen)	–18 or colder	0 (=closed)	–	OFF	depending on commodity	
W						
Wine (chilled)	+12 to +15	0 (=closed)	–	OFF	1 to several years	
Y						
Yams (fresh)	+16 to +20	0 to 10	65 to 85	ON or OFF	2 to 5 months	

Temperature conversion chart – Celsius and Fahrenheit

°F	°C	°F	°C	°F	°C	°F	°C
–31.0	–35.0	–1.0	–18.3	29.0	–1.7	59.0	15.0
–30.0	–34.4	0.0	–17.8	30.0	–1.1	60.0	15.6
–29.0	–33.9	1.0	–17.2	31.0	–0.6	61.0	16.1
–28.0	–33.3	2.0	–16.7	32.0	0.0	62.0	16.7
–27.0	–32.8	3.0	–16.1	33.0	0.6	63.0	17.2
–26.0	–32.2	4.0	–15.6	34.0	1.1	64.0	17.8
–25.0	–31.7	5.0	–15.0	35.0	1.7	65.0	18.3
–24.0	–31.1	6.0	–14.4	36.0	2.2	66.0	18.9
–23.0	–30.6	7.0	–13.9	37.0	2.8	67.0	19.4
–22.0	–30.0	8.0	–13.3	38.0	3.3	68.0	20.0
–21.0	–29.4	9.0	–12.8	39.0	3.9	69.0	20.6
–20.0	–28.9	10.0	–12.2	40.0	4.4	70.0	21.1
–19.0	–28.3	11.0	–11.7	41.0	5.0	71.0	21.7
–18.0	–27.8	12.0	–11.1	42.0	5.6	72.0	22.2
–17.0	–27.2	13.0	–10.6	43.0	6.1	73.0	22.8
–16.0	–26.7	14.0	–10.0	44.0	6.7	74.0	23.3
–15.0	–26.1	15.0	–9.4	45.0	7.2	75.0	23.9
–14.0	–25.6	16.0	–8.9	46.0	7.8	76.0	24.4
–13.0	–25.0	17.0	–8.3	47.0	8.3	77.0	25.0
–12.0	–24.4	18.0	–7.8	48.0	8.9	78.0	25.6
–11.0	–23.9	19.0	–7.2	49.0	9.4	79.0	26.1
–10.0	–23.3	20.0	–6.7	50.0	10.0	80.0	26.7
–9.0	–22.8	21.0	–6.1	51.0	10.6	81.0	27.2
–8.0	–22.2	22.0	–5.6	52.0	11.1	82.0	27.8
–7.0	–21.7	23.0	–5.0	53.0	11.7	83.0	28.3
–6.0	–21.1	24.0	–4.4	54.0	12.2	84.0	28.9
–5.0	–20.6	25.0	–3.9	55.0	12.8	85.0	29.4
–4.0	–20.0	26.0	–3.3	56.0	13.3	86.0	30.0
–3.0	–19.4	27.0	–2.8	57.0	13.9		
–2.0	–18.9	28.0	–2.2	58.0	14.4		

Formulae: C = 5/9 (F – 32); F = 9/5 C + 32

Disclaimer

All information contained in this brochure corresponds to the information available at the time of going to press, is for preliminary information only and is not legally binding.

The prerequisites are: top-quality cargo, correct customary pre- and post-harvest treatments, suitable packaging, correct stacking on pallets and stuffing of container, etc. Subject to the varieties, their maturities and ripeness stages, their origin (growing regions), their growth conditions (i.e., seasons), previous storage history and many more factors, there can be variations in the data for shipments of natural products.

Our liability for any and all damages in connection with the use of and/or the reliance on inaccurate and/or incomplete information, whether in contract or in tort, is limited only to instances in which we have acted with gross negligence or intent.

All information contained in this brochure is subject to change.

As of February 2016

Recommended checklist – Part I

Preparing for shipment

- ☐ Optimal temperature requirement (in °C or °F)
- ☐ Fresh-air ventilation, if required (in cbm/h)
- ☐ For dehumidification: max. relative humidity setting (in %)
- ☐ For MA/CA: gas composition (O_2 and/or CO_2 in %) and type of scrubber, if required
- ☐ Transport time versus practical shelf life of the product
- ☐ Volume and weight of cargo
- ☐ Stuffing pattern and packaging material
- ☐ Required documentation, including legislative requirements
- ☐ Genset requirement for pre- and on-carriage

Recommended checklist – Part II

Before and during stuffing

- [ ] Cargo was correctly pre-treated, packed and is pre-cooled to transport set-point
- [ ] Container is in a sound and clean condition, and is set at the required set points (temperature, ventilation, etc.)
- [ ] Container unit is not run with doors open
- [ ] Container floor and drains stay free of debris
- [ ] Cargo is never stuffed above the maximum red load line
- [ ] Cargo is stable and evenly stuffed according to stuffing guidelines (weight should be distributed for maximum stability and the entire T-floor should be covered)
- [ ] Entire T-floor is covered with cargo (or filler material)
- [ ] Cargo (as well as any filler material) is blocked and braced as necessary to avoid shifting
- [ ] T-floor space is not left open between cargo and the front/end bulkhead or side walls (for fresh fruit: instead of covering the T-floor at the door end, a rubber foam wedge can be placed on top of the last pallets)
- [ ] Cargo (or filler material) is usually not loaded beyond the end of the T-floor (check air flow requirements)
- [ ] Total cargo weight does not exceed the maximum payload of the container
- [ ] Total weight of the container (container, cargo, chassis and genset) does not exceed the road limitations in any country crossed during transport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