

9.1.3 Extract from PPECB Blue Book - Chapter 8

3. TIME TEMPERATURE TOLERANCES

3.1 Definition

Time temperature tolerances (TTT's) refer to the total time that a refrigerated perishable product can be without cooling during the handling and loading process. It can also be defined as the total cumulative time in the breaks in the cold chain. TTT's are based on product requirements and not on logistical processes and least to provide for operational inadequacies.

3.2 Effect of temperature fluctuations

Temperature increases in both chilled and deep frozen perishable products can have a very negative effect on product quality, eating quality, food safety and cosmetic appearance. Fresh produce are still alive and metabolic rates increase with an increase in temperature. This results in accelerated ripening and moisture losses. Microbiological spoilage also increases in both fresh and frozen produce when the product temperature increases. Fluctuating product temperatures also cause moisture of condensation to form on the packaging material and the product. This moisture can result into microbiological growth (rots and decay), can turn into ice inside and onto deep frozen produce.

It is therefore essential to maintain constant temperatures as soon as the cold chain is initiated. This is not always possible especially if the product is transferred between different refrigerated environments or during handling and transport. Maximum exposure times and temperature increases that can be tolerated by the product are specified as Time and Temperature Tolerances (TTT's). These TTT's may however vary according to product, ambient condition, handling method, equipment etc. TTT's for various products are defined in PPECB Handling Procedure documents within the ISO 9001-2000 system. TTT's were calculated for different products and types. Different criteria must be used for different products and conditions. Some of the important criteria considerations are:

- Inherent product requirement e.g. degreened citrus fruit or past maturing summer pears.
- Effect of increased temperature on fruit ripening (avocado and mango).
- Effect of increased temperature on condensation (waste in polybag packed grapes) and frost formation (icing of deep frozen produce)
- Efficiency of refrigeration unit to recool the product to the optimum temperature
- Cooling rate of the carton and pallet as affected by ventilation and position.

3.3 Specific product requirements

3.3.1 **Deciduous and citrus fruit** – The minimum time it takes for the temperature of the fruit in the center of the pallet to show an increase in product temperature. The TTT for this product group is a maximum period of six (6) hours taking into account product respiration and packaging.

3.3.2 **Subtropical fruit** – The maximum time it takes to create a temperature differential of 1,0°C between the coldest and warmest fruit on the same pallet. The TTT for this group of produce is a maximum period of three (3) hours.

3.3.3 Deep frozen produce

The international requirement of a maximum increase of 3°C in the warmest position during the transfer of the frozen product from a cold store into a refrigerated deck shall apply. The product must be re-cooled to the specified carrying temperature before loading can commence.

3.3.4 **Other products** – The maximum TTT of six (6) hours also apply to most other less temperature sensitive products. It is important to keep the TTT as short as possible because free water of condensation becomes a major problem during extended periods of breaks in the cold chain. This condensation may cause a dramatic increase in fungal and bacterial waste development and may also severely affect packaging material and printing.

3.4 General TTT breakdown per action

3.4.1 Container handling – deciduous and citrus fruit

| | | |
|---|-------------------|-------------------|
| | 6 hour TTT | 3 hour TTT |
| Loading of container out of cold store | 1 hour | 1 hour |
| Transport of container to the port terminal | 2 hours | - |
| Handling of container in the port terminal | 1 hour | 1 hour |
| Loading on to vessel | 2 hours | 1 hour |
| Total | 6 hours | 3 hours |

3.1.2 **Conventional deck loading**

It is impractical to measure and apply TTT's during the loading of conventional decks. The rule on maximum pulp temperature increases therefore applies. Decks must be closed and recooling commenced as soon as the following pulp temperatures, are reached:

- All fruit not packed in polyethylene bags except
 - Subtropical fruit
 - All subtropical
 - All fruit packed in polyethylene bags
- Pulp temperature in center of pallets No increase

12°C

5°C above the temperature

8°C