1. INTRODUCTION

1.1 The purpose of this document is to provide the industry with the latest information regarding the optimum handling conditions required to handle the South African **stone fruit** destined for export by sea. The information is based on many years of practical experience as well as ongoing research. The recommended handling conditions are designed to preserve the postharvest quality of fruit and ensure that good quality fruit is delivered to the consignee.

1.2 The recommendations given in this document assume a one week accumulation of produce in a cooling facility, a 72 hour pre-cooling period, three week shipping and distribution period. The PPECB is mandated and obliged by law to act in the best interest of the South African perishable industries as a whole and to enforce specific shipping temperature regimes that form part of the optimum handling conditions described herein above. In an event where the farmers or their export agents need to deviate from the regulated shipping protocol prescribed herein, they are required to request in writing, a temperature dispensation which should be submitted on a dispensation (T13).

The approval of dispensation request is based on the following conditions:

- The T13, dispensation form indemnifies the PPECB of any and all liabilities that may arise from deviating from the regulated shipping protocols, even in cases where the dispensation request is granted and or approved.
- A written consent from a grower is supplied with the T13 form to the PPECB or alternatively the requesting party may indicate the grower consent by ticking the provided box on the T13 form. The requesting party is therefore responsible for ensuring that this subject consent is in fact legitimate to the agreement of the Grower/Exporter.
- Included on the T13 form, the PPECB must be provided with written consent from the respective/responsible Shipping Line in which they agree to and accept the requested deviation.
- The requested deviations are not detrimental to the quality of the product, failing which the PPECB has the right to reject request.
- Parties requesting T13 conditions during which advised conditions are diverged from, are requested to arrange this well in advance with PPECB to avoid delays in their shipment the consignment.

2. STONE FRUIT PRODUCT REQUIREMENTS

2.1 Delay in cooling

It is important to pack, cool and ship stone fruits as soon as possible after harvest. Stone fruits have a rapid rate of respiration and therefore have a high quality deterioration rate after harvest, if they are not handled optimally. Poor temperature management within the supply chain of these fruits would therefore result in shorter shelf life and marketability.

2.2 Optimum handling procedure

Advised optimal handling application to maximize fruit quality of plums, apricots and also peach and nectarine cultivars that do not require special conditioning:

- Harvest fruit at the correct maturity
- Transport to the pack-house and pre-cool without delay in order to rapidly remove field heat from the produce
- Pre-cool in two or three stages to prevent excessive moisture transpiration which subsequently entices chilling injury
- strongly recommended to transport the fruit under refrigeration at optimum recommended carrying delivery air temperature to of the cargo that is highly detrimental to the quality
- Should logistics prevent packing on the same day, fruit should be cooled overnight to remove field heat and reduce pulp temperature. During packing some condensation may occur, but the benefits of cooling will reduce the respiration rate, moisture loss, ethylene synthesis and germination potential of pathogen

spores, outweighs the disadvantages of condensation. Even if fruit is only cooled to slightly above the dew point temperature, this will be of benefit to the long term quality.

2.3 Fruit age

It is crucial to avoid exporting stone fruit older than eight (8) days from the time of picking to the time of departure of the vessel. Due to the questionable long term storage of this sensitive, proper and correct application of cooling procedures prior to delivery to the port is vitally important to the ultimate shelf live. Additionally products not within the specification may have to be held back for a later shipment to allow for re-cooling in the port. Any potential temperature deviation should immediately be reported to the PPECB to ensure timeous action.

2.4 Storage and shipping temperatures are discussed in more detail under the specific product categories and defined in the Schedule1/HP22 document. It is important however, to assert that local growing conditions have a major influence on the postharvest behavior of most fruit kinds and particularly stone fruits. There have been many instances where a certain cultivar grown in one country performs well under particular shipping temperatures, but the same cultivar grown in South Africa requiring different shipping conditions. Exporters are urged to keep this in mind, and to communicate with PPECB and local research organizations with experience in this field before insisting on adopting conditions as used elsewhere.

3. PROCEDURES FOR LOADING OF CONTAINERS

3.1 Integral refrigerated containers

These containers are also commonly known as reefer containers. These containers are fitted with their **own cooling unit** as integral part of the container. It must be remembered that an integral reefer container is a transport unit designed to maintain temperature and **not a mobile cold store**.

The cooling unit is designed and built to take up as little space as possible and has therefore very limited refrigeration capacity to re-cool the product and can only lower pulp temperature by a very small amount over an extended period of time.

Cold air is supplied by the cooling unit via the “T-bar” floor to the length of the container and cargo and air having gained heat from the cargo is removed at the top and returned to the cooling unit where this heat is removed from the air, leaving it cold.

It is vitally important to recognize and accept that a cooling system of any sort or type is not a mobile hospital, so any existing product quality problem is guaranteed worsen, not improve, and stone fruit is of no exception.

3.2 The following are very important for the loading/stuffing of all types of containers:

- The total floor surface must be covered to avoid short circuiting of cold air. Use void plugs where any gaps are prevalent. This forces much needed air through the pallets instead of unwanted bypass of air.
- Pallet height must not exceed the horizontal RED loading line.
- Last pallets loaded, must not extend beyond the vertical RED loading line at the door end or the end of the T-bar floor.
- Fan spaces and air passages must be unobstructed.

Integral containers need an external source of electricity (360-380V) to power the cooling unit and air circulating fans. Special plugs are provided on the ships, in container handling and port terminals and also some loading depots. Clip-on diesel-powered electric generators (Gensets) are required to supply electricity during road and rail transport.

Some integral containers can be fitted with special equipment to maintain controlled atmosphere (CA) conditions.

3.3 Capacity

Integral containers are available in both 20-foot (6M) and 40 foot (12M) units - also known as FEU's. The FEU's (40 foot) usually take 20 ISO pallets but some of the older types only take 19 pallets with the 20th pallet stowed breakbulk at the door end. The TEU (20 foot) take 9 pallets, with the 10th pallet stowed breakbulk. So called "high cube" (FEU) integral containers, can take 20 pallets up to 2,35m high including the pallet base. These containers can take the equivalent of 23 pallets normal height pallets.

3.4 Containers

All fresh fruit are required to be **precooled to the specified carrying temperature prior to loading** into containers. This will ensure maximum storage and shelf life, reduce moisture loss, and reduce the incidence of decay.

4. TEMPERATURE REQUIREMENTS

4.1 <u>STONE FRUIT EXCLUDING PLUMS</u>

Shipping temperatures for stone fruit are specified under the relevant product. These are optimum temperatures and the following tolerances are applicable:

4.1.1 **Maximum** pulp temperatures measured in the center of the pallets (with thermocouples or with penetration probes) at the time of loading into shipping spaces, are as follows:

4.1.1.1 All containers, both inland and port loading, pulp temperatures shall not exceed plus 1.0°C, which is a plus 1.5°C tolerance above the required set-point temperature of minus 0.5°C.

4.1.1.2 Specialised Refrigerated vessels**:** pulp temperatures shall not exceed plus 2.0°C which is a plus 2.5°C tolerance above the set-point temperature of minus 0.5°C.

4.1.1.3 Product Pulp Measurements (Refer to PPECB Work Instruction TWI01 document)

4.2 <u>PLUMS ONLY</u>

Optimum storage conditions: Temperature varies according to cultivar, maturity and duration of the voyage; 90 to 95% relative humidity. Integral container fresh air vents must be set at 15 cubic meters per hour. Specialised Refrigerated vessel decks must be ventilated 4 hours per every 24 hour period during the coolest part of the day.

4.2.1 Most plum cultivars are susceptible to flesh breakdown if exposed to low temperatures (minus 0.4°C) for longer than about ten (10) days. As is typical for many chilling-related disorders, the symptoms often develop most rapidly once fruit are exposed to higher temperatures after storage. Research conducted over many seasons led to the development of the dual temperature storage regime, in which fruit is initially stored at minus 0.4°C for up to ten (10) days to derive the maximum benefits of reduced ripening and deterioration rates, followed by an increase of temperature to 7.5°C. The period of 7.5°C is dependent on the cultivar and maturity. After exposure to 7.5°C the temperature will be lowered to minus 0.4°C.

4.2.2 Maximum pulp temperatures measured in the center of the pallets (with thermocouples or with penetration probes) at the time of loading into shipping spaces, are as follows:

4.2.2.1 All containers, both inland and port loading, pulp temperatures shall not exceed plus 3.0°C, which is a plus 3.4°C tolerance above the required set-point temperature of minus 0.4°C.

4.2.2.2 Specialised Refrigerated vessels: pulp temperatures shall not exceed plus 3.0°C which is a plus 3.4°C tolerance above the set-point temperature 0f minus 0.4°C.

4.2.2.3 Product Pulp Measurements (Refer to PPECB Work Instruction TWI01 document)

4.2.3 Cooling to minus 0.4°C must be applied immediately after packing and the plums must be transported to the port in such a way as to ensure no temperature increase in the inside of the pallet. Immediate forced air cooling shall be applied on arrival in the port to ensure that all plums are on temperature at the time of loading into shipping compartments.

4.2.4 Plums not on temperature should ideally not be shipped, but re-cooled for the next shipment, provided they do not exceed the 21 day re-inspection limit, in which case a temperature dispensation.

4.3 GUIDLINES

4.3.1 **The Time Temperature Tolerances** (TTT), as stipulated in Regulation 917 (Government Gazette, 4 May 1984), are the absolute maximums. Market and quality requirements, however, dictate the following commercial maximum TTT's. It must be stressed that these TTT's are the total accepted time (cumulative) without cooling while being handled in the cold chain.

4.3.2 **Containerized shipments**: A maximum TTT of 6 hours after loading of the pre-cooled fruit shall apply, after which re-cooling must commence. Container handling in the port area often takes more than 3 hours. Although this means that the maximum period without cooling between removing the fruit from the cold store (± 1 hour) to the arrival of the container in the port (± 3 hours travelling) is 4 hours, the agreed maximum time may not exceed 6 hours in total. The practical implication of the TTT is that containers loaded inland at a point further than 3 hours travelling time to the port, must have gensets (generators) fitted, to allow for the cooling system to operate during transportation to the port.

4.3.3 **Specialised Refrigerated vessel shipments**: Loading of a deck or common (multiple) decks normally take longer than 6 hours to complete, but it is however possible to measure fruit pulp temperatures of the fruit already loaded. Pulp temperature increases therefore become the main criteria and not so much the 6 hour TTT.

Decks must be closed and re-cooling commenced as soon as the pulp temperatures measured on the outside of the pallets have increased to the following levels:

- All fruit not packed in polyethylene bags 12°C
- All fruit packed in polyethylene bags 8°C

Important:

All active/relevant/responsible parties concerned with a shipment of stone fruit must ensure at all costs that no rise in pulp temperature occurs in the center of the pallet.

4.4 The PPECB Regional Operations Manager at the loading port shall keep daily records of each shipment and of all procedures and temperatures irrespective of whether consignments are passed or rejected.

4.5 The PPECB is responsible to ensure that all in-transit cold sterilization shipments are correctly loaded and exported as per RSA and the importing countries requirements/protocols. **(Refer Par. 6)**

4.6 The PPECB provides reasonable technical support to the industry on all matters pertaining to postharvest handling, including storage and shipping conditions.

5. APRICOTS

5.1 **Optimum storage conditions: minus 0.5°C, 90 to 95% relative humidity and closed fresh air vents.**

5.2 Apricots ripen extremely rapidly and therefore also exhibit a rapid rate of deterioration. They should be regarded as highly sensitive products. Cultivars for storage have an approximate four (4) week storage life at minus 0.5°C. Fruit should be cooled to minus 0.5°C as soon as possible after packing, preferably by forced air, but advisable to apply at least two cooling stages to reduce excessive cooling stress to the fruit. Adequate air circulation through the packed carton is critical. Increases in pulp temperature during transport to the port should be kept to an absolute minimum, and refrigerated transport should be used where possible. Where necessary and when loading is to commence, rapid forced air re-cooling must be used at the port to ensure that pulp temperatures do not exceed minus 0.5°C.

6. PEACHES AND NECTARINES

6.1 **Optimum storage conditions: minus 0.5°C, 90 to 95% relative humidity and closed fresh air vents.**

6.2 Botanically peaches and nectarines belong to the same genus and species. They differ in appearance, but physiologically they are very similar. Generally there are bigger cultivar differences in postharvest behavior than differences between the peaches and nectarines *per se'*.

6.3 Many cultivars of peaches and nectarines are susceptible to a physiological disorder known as woolliness. The disorder is characterized by a lack of free juice at the eating ripe stage. It is ascribed to an imbalance in pectin metabolism, leading to the formation of peptic gels which bind free juice. Fruit maturity, storage- and ripening temperatures are important factors responsible for the development of this disorder.

6.4 Woolliness can be effectively controlled by conditioning (so-called 'wilting') fruit after harvest and packing, prior to cooling. Fruit is held at 20°C and 80% RH to initiate ripening to a firmness of ca. 7.3 kg (16 lbs.). Fruit firmness must be monitored every few hours as over-ripening can be rapid. Prompt and rapid cooling (forced air) to a pulp temperature of minus 0.5°C after the conditioning is very important. A two-step cooling procedure is advisable. Initial forced air cooling at -1.0°C applied immediately to fruit at a temperature of 20°C for example may cause excessive stress that can negatively affect fruit quality permanently. For cultivars that do not require conditioning, prompt hydro-cooling after harvest can significantly decrease the rate of fruit deterioration.

6.5 A very strong interaction exists between fruit maturity, shipping/storage temperature and storage period. For this reason every consignment, container and or shipment must be considered individually. This means that some fruit may have been precooled to the carrying temperature of minus 0.5°C prior to loading into the container.

7. COLD TREATMENT

7.1 SPECIAL SHIPMENTS FOR INTRANSIT COLD TREATMENT

A number of countries require very strict pre-cooling and shipping temperature control to comply to quarantine requirements. These cold treatment protocols are government-to-government (Bilateral) agreements and are therefore not open to debate. The protocols are covered in separate documents, obtainable from the various applicable PPECB port offices, or from the PPECB website at www.ppecb.com.

Cold treatment requirements also come in the form of an import permit that is generally a little less strict than the bilateral protocol. Exporters are to scrutinize the importing countries permit requirement and ensure that the required procedures and processes are being upheld by their role-players.

PPECB are to be immediately informed of any changes to the permit requirements or the addition of a new import country.

8. GENERAL

8.1 If fruit temperatures of minus 1. 2°C or colder are recorded at any time in any port, then the shipping process must be stopped, and all relevant information must be reported immediately to the responsible Manager of the facility. This also applies to any conditions where chilling injury or worse, freezing is suspected At least five (5) temperature readings (coldest position) per pallet must be taken to verify the suspicion. These temperatures must be submitted to PPECB Service Manager for further action.

8.2 Changing the temperature set point of integral containers during the voyage can only be done after prior consultation with the Shipping Line and if necessary, the exporter as well. If products such as dual temperature plums are to be shipped and a temperature change is required during the voyage, the exporter must request such change in writing at the time of export booking. The Shipping Line will then reply in writing indicating whether or not the temperature can be changed. The final decision to change set points of an integral refrigerated container rests with the Master of the vessel. The Master cannot be held responsible if requested changes are not made due to dangerous conditions such as bad weather for example whilst en-route.

8.3 PPECB will install USDA temperature sensors or portable temperature loggers as and when required by the importing country's protocol or permit. The Master will be instructed to report air and product pulp temperatures to the PPECB on a daily basis. This data together with quality reports from abroad will be used to manipulate the DAT in an attempt to ensure the best arrival quality and still remaining within the required temperature tolerance. This will take place in consultation with the relevant exporter. Temperature data will be made available to exporters prior to arrival of the cargo at the port of destination, to assist in decision making on final temperature management as well as marketing strategy.

8.4 The PPECB realizes that the export business is very dynamic, and that plans are made and altered at short notice to adjust to changing marketing circumstances. We are however bound by legislation to perform the necessary quality maintenance steps in the process. In order to enable us to do this with the least disruption possible, an open line of communication must be maintained at all times.