1. INTRODUCTION

Leather leaf ferns and other plants are commercially produced in subtropical climates and sea exported through South African Ports. Although these products can be shipped and stored at a wider temperature range than most other products they are extremely sensitive to chilling injury. High temperatures and temperature fluctuation resulting in condensation cannot be tolerated either.

It is vitally important to note that refrigeration will not improve the condition of any product. It can merely maintain the quality for a limited period of time until deterioration begins. For this reason it is imperative that only high quality and fresh products are exported. Apart from the pre-export period, one must always consider that transit times from the RSA to most importing countries are at least two weeks.

Many plant and flower types can favorably be maintained under controlled atmosphere conditions, but the required ideal conditions for a specific type/variety must be known and carefully monitored during the refrigeration storage period.

Refer to the PPECB Regulation-Schedule 1/HP22 for standard carrying temperatures regimes.

2. PRESHIPMENT REQUIREMENTS FOR LEATHER LEAF FERNS

2.1 **The ferns must be pre-cooled** as soon as possible after harvest. Best results are obtained when the packed product is under cooling within hours of harvesting, and pre-cooled to the storage temperature within 8 hours.

2.2 **The ferns must be transferred immediately** from the refrigerated truck (RRMT) into the cold store to ensure continuous cooling and to avoid condensation.

2.3 **Care must be** taken to ensure that the RH (Relative Humidity) in the cold store is maintained within the range of 90% to avoid desiccation.

2.4 **The ferns must be as fresh as possible** and should not be kept over for a next shipment. Delays in cooling, handling, transport and shipment should be avoided at all times. Any delays that might or did occur must be reported to the respective PPECB Regional Manager in the port, who will liaise with the exporter on possible corrective procedures to be followed.

3. PRESHIPMENT CONDITIONS FOR POT PLANTS AND PALMS

The nature of the plants and palms makes it totally impractical to pre-cool them prior to loading into containers. Colder temperatures, normally between plus 4.0°C and plus 16°C, are applied during transport, mainly to reduce water loss (transpiration) and, to a lesser extent, to control fungal growth.

Pot plants and palms therefore do not have to be pre-cooled prior to loading into containers, The Cold Chain must, however, be maintained from the time pre-cooling is initiated until the product is received by the buyer.

Integral refrigerated containers should have sufficient cooling capacity to cool these products fairly quickly to the optimum carrying temperature because of the big surface to mass ratio and good air distribution around the leaves.

Care must be taken to ensure sufficient water supply during transit. Etiolation will also occur because of no lighting in the container, therefore sufficient time must be allowed after discharge for chlorophyll development.

4. SHIPPING CONDITIONS

To ensure that the most optimum shipping temperatures are maintained, the following procedures must be followed:

4.1 It is advisable to separate the pre-cooling and holding cold room facilities from each other.

4.2 Refrigerating as soon as possible after harvest reduces risk of post-harvest disease and reduces depletion of stored carbohydrates by slowing down the respiration rate.

4.3 Picking maturity is vital for long transport period. (Age of plants and flowers).

4.4 Avoid losses by greater attention to careful handling, good temperature and humidity management and sanitation/housekeeping.

4.5 A high relative humidity and good ventilation will reduce the possibility of premature wilting.

4.6 It is of utmost importance to regularly clean and sanitize the cold storage area with a good SABS approved detergent that contains a disinfectant to keep micro-organisms under control.

4.7 Cold stores must ensure that they have proper temperature and humidity monitoring and recording equipment to ensure that cooling conditions are known and recorded at all times.

4.8 Care must be taken to avoid temperature fluctuations.

4.9 Conditions to be aware of are:

4.9.1 Too low temperature that will cause chilling injury.

4.9.2 Too high temperature will cause faster respiration leading to more stored foods being used up, faster moisture transpiration and finally wilting.

4.10 The exporter must know the ideal/required storage and transport conditions for specific products, for example humidity, temperature, fresh air supply, etc.

4.11 Avoid rough handling. Nursery products are sensitive. Transporters tend to throw specifically cartons of flowers around because they are generally light. Rough handling will sure to result in product injury.

4.12 Ensure that packaging and or cartons have sufficient ventilation openings on the sides for cold store cooling air flow direction and on the bottom and top for containers and ship cooling air flow direction. Flowers produce and give off ethylene gas specifically if injured as they continue to mature after harvest, therefore it is imperative that the mode of transport and cartons are well ventilated. Even a minute amount of ethylene will affect the quality of flowers. Common symptoms of ethylene injury include: downward bending of leaves; premature withering or rapid development and aging, dropping of leaves, florets or berries, yellowing of foliage and closing of previously opened petals.

4.13 Damaged or diseased blooms and plant must be removed before shipment, as they will contaminate others.

4.14 The Exporter or his agent must book shipping space with the shipping line and the booking information with PPECB according to standard procedures.

4.15 The Exporter must ensure that the product arrives in the port at least 24 hours prior to the ETA of the vessel. Ferns must be adequately pre-cooled prior to dispatch to the port in a PPECB approved refrigerated truck. This is to ensure that the product is on temperature on arrival at the transfer depot in the port and to allow for immediate transfer into the shipping container. It must be remembered that cooling capacity in the port is limited and can only take care of temperature increases that may have occurred during transfer from the truck or cold store.

4.16 The container must be transported to the container terminal in the port and cooling must be applied within two hours from completion of loading.

Delivery air temperatures (DAT) must be recorded every 4 hours to ensure that temperatures are maintained within the specified optimum range.

4.17 Maintenance of the Cold Chain is required to ensure minimum quality losses during handling and transport process.

5. OPTIMUM STORAGE AND SHIPPING TEMPERATURES

The following are guideline temperatures and can be subjected to change. Consult the official PPECB Schedule 1/HP22 carrying instruction document.

5.1 Shipping Temperatures

5.1.1 Leather Leaf Ferns

- Subtropical 5.0°C ± 3.0°C
- Knysna types 2.0°C ± 1.0°C

5.1.2 Plants

- Azalea 4.5°C ± 0.5°C minimum DAT 3.5°C
- Cacti 12°C ± 1.0°C minimum DAT 10.0°C
- Chincherinchees 1.5°C ± 0.5°C minimum DAT 0.0°C
- Greenery 2.0°C ± 1.0°C minimum DAT 0.0°C
- Orchids 8.5°C ± 0.5°C minimum DAT 7.0°C
- Proteas 1.5°C ± 0.5°C minimum DAT 0.0°C
- Strawberry 0.5°C ± 0.5°C minimum DAT 0.0°C

5.1.3 Pot Plants

The required transport temperature must be specified by the exporter due to the variety of plants that is involved and the phonological stage (leafy, dormant, etc.).

Notes:

- The exporter must ensure that the plants are correctly packed and watered (if necessary).
- The exporter must inform the PPECB well in advance of any special requirements such as special lights that must be fitted.

6. LOADING PROCEDURES, TEMPERATURES AND TOLERANCES

Refrigerated Road Motor Transport equipment is built and operated to transport the product to a specified destination. This type of equipment is not "mobile cold stores" and cannot effectively pre-cool warm cargo. It is designed to maintain product temperature only, although some pre-cooling can take place with the latest refrigerated equipment fitted but is not guaranteed to accomplish this. The following loading temperatures and tolerances will apply:

6.1 Leather Leaf Ferns

6.1.1 Loading of ferns out of cold stores into RRMT's

- **The product must be pre-cooled** to the specified shipping temperature prior to dispatch to avoid heat buildup in the pack (e.g. sub-tropical leather leaf ferns must be cooled to 5.0°C before loading into RRMT's). Ensure that product temperature in the center of cartons with poly bags or poly liners and cartons in the center of pallets are also at the carrying temperature.

- The Exporter must check **that the** RRMT is set to deliver air at the specified temperature. The RRMT must also be pre-cooled to the required temperature prior to arrival at the Cold Store (pre-cooling for at least 3 hours is recommended).

- **Quick transfer** of the product from the Cold Store into the RRMT is crucial. Special covered and insulated loading bays are recommended. RRMT loading should be completed in less than 30 minutes.

- **Product temperatures** must be recorded in the cold store prior to loading and during loading into the RRMT. The same temperature tolerances apply as specified for loading into shipping spaces (Par 6.1.3)

- **The RRMT** must not load warmer cargo (shared loads) en-route to the port and must arrive in the port within allocated transit time.

6.1.2 Loading out of RRMT's into port cold stores or shipping spaces

- **Special care** must be taken to transfer the product as quickly as possible and to minimize any temperature increase.

- **Ensure correct temperature** set point of the cold store, container or other shipping space. PPECB personnel will check on correct temperature settings of shipping spaces.

- **Do not store products** in cold stores for long periods, as it will result in severe quality losses.

- **PPECB** can be requested with prior arrangement, to verify RRMT condition, set points and product temperatures during offloading process.

6.1.3 Loading temperatures of ferns into shipping spaces

PPECB must take product temperatures from the warmest and coldest positions prior to, during and on completion of loading. The following shall apply:

- **Integral refrigerated container**

  Ferns must be pre-cooled to the temperature specification of the exporter. A maximum temperature tolerance of 1.0°C warmer than the specified shipping temperature shall apply during loading. Special care must be taken to ensure that the product temperature does not reach more than 1.0°C below the specified carrying temperature or below 0.0°C for products sensitive to freezing.

  Example: Tropical leather leaf ferns

Specified carrying temperature	-	5.0°C ± 0.5°C
Maximum loading temperature	-	6.0°C

7. PLANTS AND POT PLANTS

Although sometimes possible, it is very impractical to pre-cool plants prior to loading into transport units. The cold chain must also be maintained once started to avoid condensation on the leaves.

It is therefore not a requirement to pre-cool plants and pot plants prior to loading into shipping spaces. The Shipping Companies must be informed of this aspect prior and during the booking process.

The exporter must, however, comply with the specification of the buyer. Exporters are also invited to discuss procedures with the PPECB to ensure most optimum temperature maintenance.

8. RELATIVE HUMIDITY (RH)

This is a term describing the presence of moisture or water vapour in the air.

Relative humidity in a cold store is very dependent on the design of the refrigeration compressor, the evaporator capacity and size for a given application and “td” (Temperature Difference) between the desired room temperature and refrigerant temperature inside the evaporator.

Humidity is a matter of considerable importance with unwrapped products that are to be stored for long periods of time.

Fresh plant material is still alive and must be kept alive as long as possible. Low moisture content in the atmosphere will result in moisture loss from the transpiring (and respiring) plant. This moisture loss will result in desiccation, shriveling and drying out. The following are some important aspects to ensure maximum RH in the atmosphere surrounding the product to minimize moisture loss:

- **Maintain optimum temperatures** and minimize temperature increases and fluctuations.
- **Store the product** at the correct temperature and do not load warm products into the same cold store while trying to cool others.
- **Maintain the “cold chain”** as soon as refrigeration procedures is introduced.
- **Use the correct packaging** material. Some types of packaging can absorb large quantities of moisture. This moisture comes from the product.
- **Ensure correct and adequate cold air circulation** around the product. This will result in even product temperatures and a high RH.

Never overexpose cold products to warm ambient conditions as this will result in excess condensation. Free water may harm the product and acts as stimulant to fungal and bacterial infection.

9. TIME TEMPERATURE TOLERANCES (TTT)

The TTT is normally defined as the total cumulative time the product is not under cooling during pre-shipment handling operations.

The standard maximum cumulative TTT of three (3) hours must be applied to ensure minimum quality loss, desiccation and condensation. This can be broken down as follows:

- **Container loading** ex RMT or cold store - maximum 30 minutes
- **Container transport** to port terminal - maximum 2 hours
- **Container handling** in the port - maximum 30 minutes

This implies that refrigeration must be applied to all containers with a transport time to the port of longer than two (2) hours after the product is removed from the cold store for loading.

- **Integral containers: External electric power must be supplied either by "Generator sets" or some other suitable power supply to ensure constant refrigeration during handling, transfer and shipping.**

10. DEVIATIONS

The PPECB will do its utmost to ensure that the product is handled and shipped at optimum temperature as stipulated. It may however under certain circumstances not be possible to apply these temperatures. The following procedures will then be implemented:

10.1 **The PPECB** will inform the Exporter of alternative temperatures available and reach a joint decision on the temperatures or procedures to be followed.

10.2 **Should the Exporter wish to deviate from the above carrying conditions, PPECB and the Shipping Line must receive a written** request **accordingly.** PPECB must receive such a request in the form of a "T13" dispensation (dispensations@ppecb.com) request form that can be obtained from the nearest PPECB office.

11. SHIPPING TEMPERATURES

- **The PPECB will discuss** the shipping conditions with the Master and will also supply him with a written instruction on the required voyage carrying conditions.

- On request by the Exporter t**he PPECB** will instruct the Vessel to report set point, ventilation settings delivery (DAT) and return (RAT) air temperatures on a daily basis to the PPECB. These temperatures can be captured and placed on the PPECB website for the exporter to scrutinize and request corrections via PPECB if so desired.

- **The PPECB** will also scrutinize the shipping logs and prepare a report on the shipping conditions should an insurance claim arise from any losses due to incorrect procedures. The exporter however must request such investigation in writing to the PPECB and tender relevant information including an independent surveyor's report.