INFORMATION SHEET: Thermocouples as decision aid for loading out pallet stacks directly from refrigerated holding stores or to re-apply forced-air cooling on table grape pallets. *(Orig. Ver.1.0*, Dec 2019); *Ver. 1.2* , July 2022.

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It remains as important as ever before, to avoid the interception of live FCM and Fruit fly larvae in South African table grapes in overseas markets, to avoid the associated risks at the market destination. For this reason, the new container booking codes (GT08 and GT15*), were introduced in 2016 as part of the South African Table Grape Industry's False Codling moth management system (FMS) and Fruit Fly management system (FFMS), to ensure efficient low temperature regimes which provides appropriate levels of protection (A.L.O.P) against these pests of concern. An additional booking code (GT02) was added in June 2022, with the specific focus on improved temperature management and maintenance of quality during prolonged/congested export logistics (See PPECB HP27).The codes influence decision making after long distance transport to the close-to-shore cold storage facilities (e.g. C.T., DBN, PE). Issues pertaining to appropriate 'cut-off' pulp temperature specifications was raised , when deciding whether re-cooling of pallets is required after road transport, prior to containerisation.

- In December 2017, detailed temperature profiles were measured on the inside and outer (periphery) of table grape pallet loads, during refrigerated transport from Blouputs to Cape Town.
- In the trial pallets, which were temperature-stabilised using forced-air cooling (FAC) in the on-farm cold store before transport, the pulp temperature increase in the centre of the pallets was negligible and either remained constant or increased by a maximum of 0.25°C during refrigerated road transport. The inner core of the pallet therefore remained largely unaffected.
- On these same trial pallets, the pulp temperature increased on the periphery of the pallets by between 2.5°C and 6°C during refrigerated road transport to Cape Town.
- After off-loading in Cape town, the pallets were held under un-forced refrigerated air conditions in a holding cold store. The pulp temperature on the outside of the pallets returned to target levels within 10 hours of static cooling, after off-loading from the refrigerated truck.
- When un-forced refrigerated air (-1.2˚C to -0.5°C) was delivered around the pallets for 10 h, the keeping of the pallets in the "hold store'' was sufficient to restore pulp temperatures on the periphery of the pallet loads, within the same duration (10 h) than the just-completed road transport leg which was responsible causing the upwards pulp temperature creep in affected positions.
- This commercial experiment also confirmed the well-known need to monitor pulp temperature on the inside (dead-column) of the pallet stacks, for accurate decision-making and cold chain management (See PPECB HP27).
- While the thermocouple/KM instrumentation is regarded as less accurate than the PT 100 stainless steel probes, the Type T thermocouple (T/C) technology is sufficiently accurate for the purpose of cold chain management of commercial grape pallets, for booking codes GT02, GT08 and GT15. Furthermore, T/C's currently provide the most versatile and cost-effective solution, to monitor on the inside of the table grape pallets. Manual PT 100 steel probing can often not reach the innermost positions of the pallet stacks during randomly executed, manual monitoring methods.
- Therefore, the pulp temperature on the inside of the pallets should be the main determinant for informed decision making whether a pallet is suitable for loading and shipment in a refrigerated container, or whether the pallet is a candidate for further re-cooling in a forced-air tunnel.

Responsibility at the producer, packhouse and cold-storage facility:

- Purchase only high-quality Type T thermocouple wires. The ''cheapies'' give inaccurate readings and create much confusion and unnecessary costs down the cold chain, to the detriment of the producer.
- Place the T/C correctly on the inside of the pallet load. Installing the T/C incorrectly towards the side of the pallet, will result in higher temperature readings after road transport and unnecessary re-cooling cycles.
- T<u>o avoid** the requirement for re-cooling after transport as much as possible, when requesting the ***GT02 booking code***</u>; pre-cool the inner pulp temperature of the majority of the pallets to between *minus* 0.3°C and *minus* 1.1°C and the balance of the pallets to a maximum of 0.0°C in the centre of the pallets, prior to refrigerated road transport. **This serves as a guideline only and may vary according to actual conditions.
- <u>To avoid*** the requirement for re-cooling after transport as much as possible, when requesting the ***GT08 booking code;***</u> pre-cool the inner pulp temperature of the majority of the pallets to between *plus* 0.3°C and *minus* 1.1°C and the balance of the pallets to a maximum of *plus* 0.6°C in the centre of the pallets, prior to refrigerated road transport. ***This serves as a guideline only and may vary according to actual conditions.
- Use a T/C in each pallet. I<u>f the T/C is absent, probing on all sides of the pallet will be done by the PPECB assessor, in which case the likelihood for rejection and therefore the requirement for re-cooling (FAC) after road transport will be higher.</u>

***GT15 should be avoided where time from packing on farm till arrival in the market exceeds 4 weeks.**