



Cooling Packed Cherries in 1 Hour
By James D Still, Global Cooling Inc., June 22, 2014

Summary - A number of forced-air cooling trials have been completed, commencing with the 3rd day of this year's Wenatchee cherry harvest, on June 14, 2014, and continue to be run as of the date of this report.

In the tests, a Jet Precooler fully-cooled 10 pallets of packed cherries in 1 hour.

The cherries cooled in the tests were both in bags and clamshell containers, weighing approximately 2,000 pounds per pallet, with an entering temperature of approximately 43°F, and were fully cooled, to industry standards using industry standard temperature measurement protocols in 1 hour., using a new type of specially-designed portable forced-air cooling unit, the Jet Precooler.

Benefits of Faster Cooling - This fast final cooling, results in appreciable greater net weight of final-cooled cherries to sell, that will have longer shelf life, be more disease resistant, and have a healthier appearance. This also results in tunnel cooling electrical savings that can be described as "40-HP-hours" motor runtime per full truckload of cherries cooled. This logically is increased by at least a factor of 2, to 80-HP-hours of electrical savings per truckload, when all related system electrical savings are considered.

Details - A new design of portable forced-air cooling tunnel, named the Jet Precooler, was used for the tests. The Jet has (2) 10HP axial fans, that were specially designed for the specific task of forced-air cooling cartons and bins of fresh produce, and it has proven to deliver more than 3,000 cfm per pallet, under very high static pressure conditions. This high volume high pressure airflow, as opposed to the calculated 500 cfm at low static pressure being delivered by the typical farm-built general purpose fan structure, enables cooling at a rate 5 to 6 times as fast as all known competitive systems.

New Forced-Air Cooling Unit Used for the Tests - The Jet Precooler comes complete with foam pads and pvc-pipe-reinforced vinyl tarp, a magnehelic gage, a 20 HP VFD, is mounted to a heavy-duty structural steel hot-dipped galvanized frame, has an analog static pressure gage, manual motor starters and overloads, and a fused disconnect, all UL-listed and Nema-4x washdown type, capable of operation in a USDA food plant. It is also portable and intermodal, measuring 40" x 48" and 88" tall, weighing 1,200 pounds. Power supply has to be 3-phase with ground/earth, but can



be either 60 or 50 hertz, with allowable voltage ranging from 360 to 520. It is rated 24 FLA at 460/60/3, and comes fused at 30 amps with type CC mini-fuses.

There is also an optional PLC controller, with digital static pressure sensor, and RTD temperature sensor for return air, enabling finalizing the cooling period by either preset time or final desired temperature, or whichever occurs first. Remote monitoring and control is enabled by connecting the PLC to the Internet, usually by company IT using wireless, and repeaters as might be necessary throughout the shed or cold room building. The Jet Precooler was invented and developed by James D Still, of Tarpless Ripening room renown, and is manufactured by Jim's company, Global Cooling Inc., at the Philadelphia Navy Yard Industrial Business Complex, using exclusively American-made and/or company-owned parts, with the fabrication, final assembly, and electrical, performed by skilled journey union labor.

Benefits of Fully-Cooling Packed-Out PNW Cherries in 1 Hour (as opposed to current industry best-standard practice of 6 to 8 hours):

- 1) Cherries retain more of the initial weight when they are brought down to ideal shelf-life temperature as fast as possible. For a number of reasons, 1 hour is about as fast as possible.
- 2) This weight loss savings occurs in two ways, less respiration and also less transpiration. More is explained about each in the end notes.
- 3) When respiration is lowered, so is the heat output of the fruit. This translates into savings from not having to provide as much refrigeration per cooling load. When fruit heat output is lessened, so is fruit weight loss and dehydration.
- 4) When respiration is lowered, less water vapor is given off by the fruit. This translates into electrical savings for the cooling systems in the cold rooms, from not having the latent load of the water vapor condensing on the cooling coils fins.
- 5) When water vapor condensation is lowered, less defrost cycles need to be run, which saves on electrical costs for defrost, and also as all defrost means add heat to a cold room, the cooling systems electrical savings are further increased by not having to work to remove the defrost heat from the cold room.
- 6) In refrigerant systems that recirculate coolant using pumps, there is also electrical savings from reducing pump run times. Most pump systems add at least a little heat to the refrigerant, from compression at the very least, and this heat burden is also removed by rapid final cooling.



- 7) With shortened full cooling times, more truckloads can be cycled through each cold room per day, we estimate at least a threefold improvement. That is, if a single cold room at present, can cycle through one truckload per day, using the high airflow Jet Precooler will result in at least three truckloads per day per cold room. Therefore by example, if at present 6 cold rooms are used for cooling tunnels, with the Jet Precooler this is reduced to 2 cold rooms, a savings of 4 cold rooms.
 - a) These now not needed cold rooms can be turned off completely, further reducing refrigeration system electrical costs.
 - b) These now not used cold rooms can instead be left running, and provide valuable added cold store space, for other packed-out product, instead of improperly cooling it, or using outside cold storage rented, or building more C.A. rooms.
- 8) The number of tractor trailers queued up in the lot, can be drastically lowered.
 - a) Drivers will save on fuel burned while waiting.
 - b) Drivers will be happier hauling loads for the packhouse.
 - c) Other benefits vary according to individual packhouse circumstances.
- 9) A forklift driver and the cost of owning and operating the forklift, can be eliminated, as all pallet moves happen faster, double and triple pallet moves are reduced if not eliminated, and there is less down time for fork lift operators waiting for pallets to fully cool
- 10) Ironically and surprisingly, using a VFD to slow motor speed, fan rotation, and cfm per pallet at static pressure, will not further reduce electrical costs, it will only once again increase them. It will also result in more weight loss by the fruit. The is because:
 - a) If cooling time is doubled, with a 70% VFD speed, this means the cold room refrigeration system has to run twice as many hours.
 - b) If cooling time is doubled, this also means the fruit loses more weight and gives off more water vapor, for a longer time period, and again the refrigeration system has to run longer, with more work to do.
 - c) Not as many extra cold rooms are opened up, to be turned off completely, nor used for extra cold storage.
 - d) Tractor trailers are not dispatched as fast, and



- e) The extra forklift operator and forklift itself, might not be able to be eliminated.
- f) Using a VFD at times is still required, however, to best handle small lots, that will still fully cool in 1 hour, but without unduly increasing static pressure, and overworking the fan motors.

Other Details -

- Although the Jet Precooler has 20HP of fan motors, running at 100% rpm, it only drew 20 amps, or 18 BHP input equivalent. It is listed as using 20HP or power however, to be fair, as the legacy 5HP fan motors, were never run with an amp meter measuring their exact BHP performance, and it is probably a little less than nameplate.
- There is also no contribution to peak demand from use of the Jet units, they accelerate to setpoint over a 20 second ramp, and never exceed 20 amps power draw. So there is no lock-rotor amp draw either.
- It would be a good idea to keep a spare Jet Precooler unit on hand, to swap in as might be needed, in case of prop damage or other type of temporary failure, if maintenance is otherwise occupied with breakdowns of hydrocoolers, sorting machines, filling lines, compressors, etc. Spare parts including props and fan guards should also always be on hand.
- To achieve fastest cooling times, it is important to fully and properly skirt all bypass air leaks, and to properly load and place each pallet tightly.
- In order to consistently achieve all of the benefits of 1 hour full cooling, the refrigeration equipment for the cold room housing the Jet Precooler, has to be set to full duty operation, without energy management systems that can cause a raise in supply air temperature, or a reduction in cold air volume. Defrost cycles also have to be managed so as not to occur during the forced air cooling period.
- It is thought that the cooling equipment in a Jet Tunnel room, can be turned off completely if the Jet is not actively cooling. In an airtight structure such as a C.A. room, with the door fully closed, there is no heat source to work against, other than room lights that might be left on.



- It seems obvious to the writer, that the same fruit enhancements and electrical savings ensue. when all sorted bin fruit and final packed-out tree fruit, gets the same high volume high pressure final cooling treatment. The time required might vary with commodity and pack, but the % fruit weight loss savings and electrical cost reductions, will be approximately the same, all 12 months of each year.
- Film that is used for pallet banding, blocks some airholes of the cartons. At the very least, perforated film should be considered, or other methods of strengthening the pallet stacks, that do not prohibit forced air cooling of the fruit.
- Possibly the biggest dollar benefit to this new and better plan for precooling. Is that as more packed fruit weight is retained, there is the probability of full truckloads going overweight, unless the after-sorting packout weight is reduced by adjustments to the filling machines. This will result in additional truckloads of fruit to sell, which will then be sold as pure profit, occurring once every 100 to 50 truckloads are sorted, packed, final cooled, and shipped.

The profit leverage of this free fruit to sell - in a way created out of thin (but watery) air, -exerts a net profit leverage that is powerful. For example, if a grower's net profit had been 4% of sales, and another 1% of fruit weight is retained, then the new net profit is 5%, a 25% improvement. The piece of fruit count to do this, is removing 8 cherries from each 18 pound carton. If the cherries are not removed during packing, tractor trailer loads will go overweight as they cross the scales in transit.