POSTHARVEST TOOLS AND SUPPLIES KIT
Utilization, Calibration and Maintenance Manual

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This publication is a guide to the proper use and care of the common tools used by commercial operators of packinghouses, cooling facilities, cold storages and transport services and those tools and supplies utilized by educational providers of training in postharvest technology. Each chapter will provide the details on how to operate, calibrate, clean and care for a specific tool or analytical supply used to measure postharvest characteristics of fruits or vegetables. These tools allow the users to measure important quality factors such as firmness and sweetness, which are related to maturity and market value, and pulp temperature or relative humidity of the storage environment, which are related to the predicted storage life of the produce.

Chapter 1: Digital temperature probe; measuring temperatures.
Chapter 2: Firmness or pressure tester; measuring firmness
Chapter 3: Refractometer; measuring soluble solids or sugars
Chapter 4: Psychrometer; measuring relative humidity
Chapter 5: Chlorine test strips; measuring ppm free chlorine
Chapter 6: pH test strips; measuring acidity or alkalinity
Chapter 7: Other useful tools and supplies (scales, calipers, sizing rings)
Chapter 8: Sources of postharvest measurement tools, equipment and supplies

Chapter 1: Digital temperature probe; measuring pulp temperatures.

The FlashCheck Pocket Probe Digital Thermometer is a fast, accurate HACCP and quality assurance tool that allows you to quickly determine temperatures of foods throughout handling, preparation, and storage. You can check the pulp temperature of produce within 10 seconds by inserting the tip of the probe into the item. If you do not want to damage the produce, you can get an accurate reading of the internal temperature by holding the tip of the probe BETWEEN two items for 15 seconds.

The digital probe included in your Postharvest Tool Kit has a stainless steel reduced tip probe that provides a fast response time, a thermistor sensor at the tip of the probe with an accuracy of ± 1.8°F (1°C), and an operating range of -40°F to 302°F (-40°C to 150°C). A rugged ABS unibody structure with a molded steel collar probe construction braces against severe pull and push flex actions. It can be field calibrated, and is waterproof so it can be washed with soap and water for thorough cleaning and sanitization.

Details	
Temperature Range	-40°F to 302°F (-40°C to 150°C)
Accuracy	±1.8°F (20°F to + 165°F) ±1.0°C (-7°C to + 74°C)
Resolution	0.1°F (0.1°C)
Display Update	Every 2 Second
Water Resistant Rating	IP67, NEMA 6
Probe	Stainless steel reduced tip probe, 3.5 in. (90mm) Reduced probe tip .09 in. (2.3mm)
Body/ Dimensions	Polycarbonate & ABS/ 6.75 in. (171.45mm)
Calibration	Field calibratable. NIST traceable calibration certifiable. Manufacturers certificate of compliance available from DeltaTRAK
Battery	1.5V Button

CALIBRATION PROCEDURE - DeltaTRAK 11024, 11025 & 11026 DIGITAL PROBE THERMOMETERS

PLEASE NOTE: Performing this procedure voids all warranties regarding calibration and DeltaTRAK assumes no liability for the accuracy of products calibrated by the customer.

Tools Needed:
1) Small Phillips(+) screwdriver
2) Small Flat Tip(-) screwdriver(shaft diameter and blade width 1/16” or less)
3) 16 ounce cup (disposable plastic preferred)
4) Crushed ice
5) Calibrated NIST Traceable Reference Thermometer (If available)

1) Remove the small screw from the center of the pocket clip on the back of the Digital Probe Thermometer. Be careful not to lose the rubber O-Ring which is needed to make the seal waterproof. The Temperature Adjustment Potentiometer is inside. The Flat Tip screwdriver size is critical—it must be small enough to fit in the hole but large enough

to turn the adjustment potentiometer. It may be necessary to grind one slightly smaller than the size of the hole.
2) Mix thoroughly crushed ice in water (60% ice and 40% water) in plastic cup. You can use the thermometer to be calibrated to do this and it will cool the metal tip faster. Mix for 1 minute and let sit for 5 minutes.
3) Mix again with probe for 30 seconds. Insert Reference Thermometer, if available, and probe to be calibrated in water approximately 3” deep and allow to sit for 5 minutes. The pocket clip on the Digital Probe Thermometer can be clipped over the rim of the cup to hold it in place, See Fig 1. Stir ice and water using probe(s), for 30 seconds. Note Reference Thermometer temperature reading.
4) Using the Flat Tip screwdriver adjust the temperature through the hole of the probe to be calibrated until it matches the Reference Thermometer ± .1°F or °C. Remove the screwdriver, mix the ice and water with the probe to be calibrated for 30 seconds, and verify that the temperature still matches the Reference Thermometer reading ± .1°F or °C. If the reading is not the same, re-adjust the temperature reading of the probe and repeat verification, adjusting and mixing until the reading is the same.
5) If no Reference Thermometer is available complete steps 1- 2. Mix the ice and water with the probe to be calibrated for 30 seconds. Insert the probe into the ice water approximately 3” and allow it to sit for 5 minutes. The pocket clip on the Digital Probe Thermometer can be clipped over the rim of the cup to hold it in place, see Fig. 1 on reverse. Stir the ice and water using the probe, for 30 seconds. Using the Flat Tip screwdriver, adjust the temperature reading of the probe to 32°F or 0°C ± .1°F or °C.
6) Remove the screwdriver, mix again for 30 seconds and verify that the reading is the same.
7) If the reading is not the same, re-adjust the temperature reading of the probe and repeat verification, adjusting and mixing until the reading is the same.
8) Replace the rubber O-Ring and then the screw.

DIGITAL PROBE CALIBRATION PROCEDURE FIGURE 1

THE DIGITAL PROBE CAN BE ATTACHED TO THE SIDE OF THE PLASTIC CUP DURING CALIBRATION BUT IT IS ALWAYS RECOMMENDED IT BE HELD WITH ONE HAND (NOT SHOWN) WHILE CALIBRATING TO PREVENT SPILLING THE CUP CONTENTS. THE METAL PART OF THE PROBE SHOULD NOT MAKE CONTACT WITH THE SIDES OR BOTTOM OF THE CUP.

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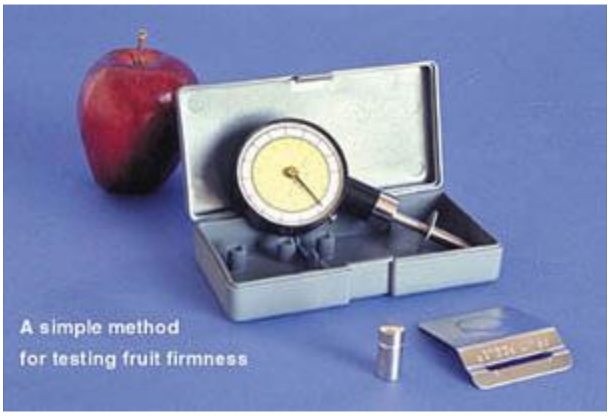
Chapter 2: Firmness or pressure tester; measuring firmness

Using a firmness tester

The degree of softness or crispiness can be estimated by squeezing produce, or by taking a bite. Objective measurements can be made with inexpensive penetrometers. The most common way to measure firmness is resistance to compression or pounds-force (lbf). The Effe-gi fruit penetrometer is a hand-held probe with a gauge for pounds-force.

To measure firmness, use fruit that are uniform in temperature, since warm fruit are usually softer than cold fruit. Use fruits that are uniform in size, since large fruit are usually softer than smaller fruit. Make two puncture tests per fruit on larger fruits, once on opposite cheeks, midway between stem and blossom ends. Remove a disc of skin (larger than the tip to be used) and choose the appropriate plunger tip (see below). Hold the fruit against a stationary, hard surface, and force the tip into to fruit at a slow, uniform speed (take 2 seconds) to the scribed line on the tip. Take the reading to the nearest 0.5 lb-force.



Appropriate Effi-gi plunger tip sizes to use when measuring firmness in selected fruits:

1.5mm (1/16 inch)	Olive
3 mm (1/8 inch)	Cherry, grape, strawberry
8 mm (5/16 inch)	Apricot, avocado, kiwifruit, pear, mango, nectarine, papaya, peach
11 mm (7/16 inch)	Apple

Calibrate firmness testers by holding the tester vertically and placing the tip on the pan of a scale. Press down until the scale registers a given weight, then read the firmness tester. Repeat 3 to 5 times, if you find the instrument reads the same as the scale, it is ready to use. You can adjust the penetrometers by inserting washers in the appropriate locations (follow the instructions that come with the instrument).

HARVESTING - Fruit Testing Equipment

Penetrometer

Penetrometers are used by fruit growers world wide to help determine the harvest times for plums, navel oranges, nectarines, kiwifruit, peaches, and other varieties or stone or pome fruit. The penetrometer included in your kit is made in Italy by Effegi and has been considered the standard penetrometer for fruit growers for decades.

The plunger of the unit is pressed against the fruit and measurements of the rupture pressure can be seen on the gauge. Different varieties will have different rupture points. Can be used hand held or can be mounted on a drill press for additional accuracy.

Each unit comes with appropriate tips, a foam lined carrying case, a protective splash plate, a fruit peeler, a manual and recommended pressure test readings for specific fruits are including with each penetrometer. All units come with a one year "unconditional warranty."

Article: American Fruit Grower
September 1998

Measuring up: Picking A Penetrometer

Three popular tools for measuring fruit firmness are the Magness-Taylor, the Effigi, and the electronic EPT. Here are some key points of each, according to Cornell's Chris Watkins. The Magness-Taylor pressure tester has a long plunger that is encased in a metal barrel. The plunger is attached to the barrel with a steel tension spring. When using the pressure tester, a metal ring slides along the barrel to indicate fruit firmness.

The Effigi pressure tester is smaller than the Magness-Taylor and easier to use. A needle on a circular dial indicates the maximum force required to insert the plunger into the fruit.

The more expensive EPT uses a probe on the end of a pivoting arm to measure fruit firmness. Its digital output can be downloaded into a computer. It can also alert the user if the sample was taken too fast, too slow, or in a soft part of the fruit.

You should use the large diameter plunger for apples and the small diameter plunger for pears with all of these instruments. Check your penetrometer daily before use, loosening the springs by working the plunger a few times. You can calibrate each by slowly pressing the plunger down on the pan of a weighing scale (not a spring scale) until the scale measures close to what you expect fruit firmness in subsequent tests to be. Make sure the reading of the penetrometer is the same the scale reading. Do this a few times to ensure the instrument is calibrated correctly.

Selecting the right fruit for testing is as important of making sure your penetrometer is properly calibrated:

Avoid testing undersized or oversized fruit;

Trees you take fruit from should be representative of the entire block's age and vigor;

Use ten or more fruit from many different trees; and

Take comparative readings from fruit that is the same temperature.

Once you've got your sample, measure firmness on each side of the fruit by using a peeler to remove the skin with a single, shallow cut. Avoid taking measurements in bruised areas. Place the fruit on a hard surface never take a measurement by holding the fruit. Push the plunger into the fruit up to the line on the probe, not the plate. Pushing the plunger at a consistent speed is important.

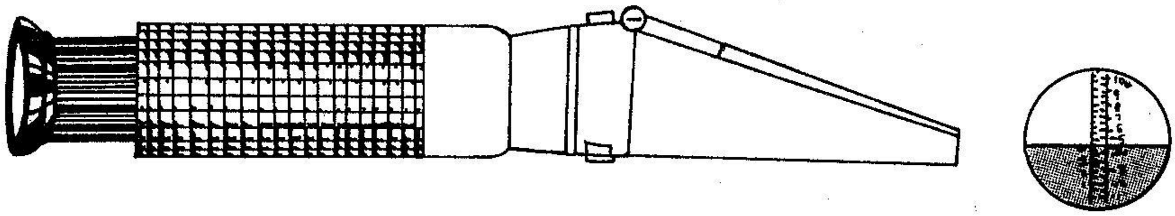
Because of the many variables involved in taking penetrometer readings by hand, it's best to have one well-trained person do the testing for consistency.

Source: http://www.findarticles.com/p/articles/mi_qa3824/is_199809/ai_n8818915

Chapter 3: Refractometer; measuring soluble solids or sugars

Sugars are the major soluble solids in fruit juices and therefore soluble solids can be used as an estimate of sweetness. A hand-held refractometer can be used outdoors to measure % SSC (equivalent degrees Brix for sugar solutions) in a small sample of fruit juice. Temperature will affect the reading (increasing about 0.5% SSC for every 5 ºC or 10 ºF), so you should adjust the measurement for the ambient temperature.

A garlic press works well to squeeze the juice from fruit samples. For small fruits, use the whole fruit. For large fruits, take a wedge for the stem end to the blossom end and to the center of the fruit. Remove any pulp by filtering the juice through a small piece of cheesecloth. You must clean and standardize the refractometer between each reading with distilled water (should read 0% SSC at 20 ºC or 68 ºF).

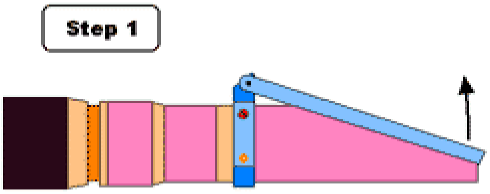


Here are some examples of proposed minimum % SSC for selected commodities. If your reading indicates a higher % SSC, then your produce is better than the minimum standard. Strawberries which are of excellent flavor, for instance, would measure 8% SSC or above.

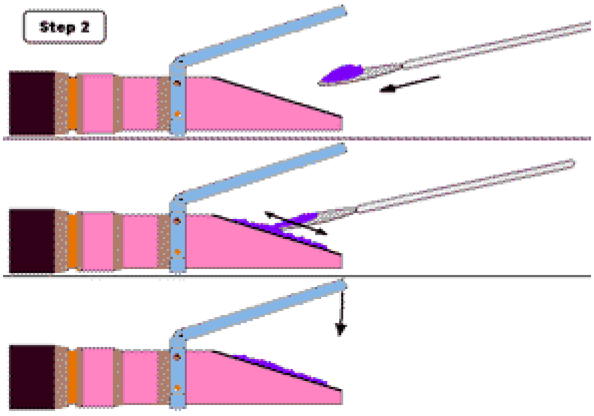
Minimum %SSC

Apricot	10%
Blueberry	10
Cherry	14-16
Grape	14-17.5
Kiwifruit	6.5
Mango	10-12
Muskmelon	10
Nectarine	10
Papaya	11.5
Peach	10
Pear	13
Pineapple	12
Plum	12
Pomegranate	17
Strawberry	7
Watermelon	10
Source: Kader, A.A. 1999. Fruit maturity, ripening and quality relationships. Acta Hort 485: 203-208.	

Article: HOW TO USE A REFRACTOMETER TO TEST BRIX LEVELS
Brix is the measure of % sugar in a given sample. The instrument which is used to measure brix is called a refractometer.

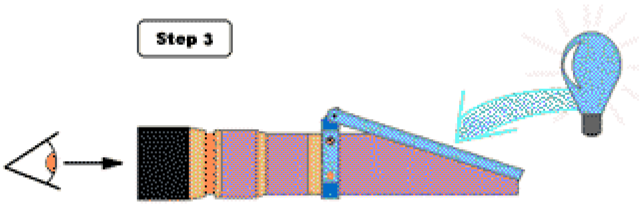


Step 1
Expose the refractometer measuring surface by lifting the surface cover. Inspect the surface to ensure it is clean. If needed, clean the surface by spraying it with distilled water, and wiping it dry with a delicate cloth. Be careful not to scratch the measuring surface.

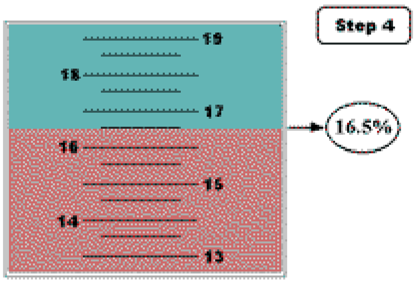


Step 2
Carefully place a drop of the sample being measured onto the measuring surface. Use a rubber spatula or rod if possible (metal may scratch the prism surface and impair readings).

Spread the sample in a thin and even layer over the measuring surface. Replace the surface cover. Remove any trapped air bubbles from underneath the cover by gently pressing.



Step 3
Look through the eyepiece while holding the refractometer up to a light source.



Step 4
Read where the contrast line (difference between light and dark areas) crosses the scale. Record the brix value.

Brix: The reading is taken through the refractometer eyepiece. A light source is needed to illuminate the scale (step 3). The value is read at the point where the contrast line crosses the scale (step 4).

Note:
* If the sample is very opaque it may be necessary to measure the juice/syrup from the sample. To do this, simply place a drop of the sample onto a piece of filter paper and press the juice/syrup onto the measuring surface.

* Do not measure samples which contain seeds, grains, or other particulate matter which could scratch the measuring surface. To measure such samples, filter out the juice/syrup as described above.

* Refractometers require periodic calibration. This is done by taking a brix reading on distilled water. The contrast line should cross the scale at the zero mark. If it does not, the scale needs to be adjusted. Refer to the specific refractometer manual for calibration instructions (in most cases, there is a screw located on the refractometer body which will adjust the scale).

* Clean the refractometer after each measurement using distilled water. Dry it carefully using delicate cloth.

Source: http://www.circle-one.com/refractometer.html

Chapter 4: Sling Psychrometer; measuring relative humidity

Relative humidity has a direct impact on produce quality because as RH% in the packinghouse, storage environment or during transport decreases, the rate of water loss increases. Knowing the RH of the environment in which produce is being handled can assist the postharvest handler to reduce water loss, which is weight loss of the produced and decreases its quality (with symptoms of shriveling or wilting) and its quantity (the amount or weight available to sell).

Article: Sling Psychrometer

Relative humidity can be measured by an instrument called a hygrometer. The simplest hygrometer - a sling psychrometer - consists of two thermometers mounted together with a handle attached on a chain. One thermometer is ordinary. The other has a cloth wick over its bulb and is called a wet-bulb thermometer.

When a reading is to be taken, the wick is first dipped in distilled water and then the instrument is whirled around. During the whirling, the water evaporates from the wick, cooling the wet-bulb thermometer. Then the temperatures of both thermometers are read.

The wet-bulb thermometer cools to the lowest value possible in a few minutes. This value is known as the wet-bulb temperature. The drier the air the more the thermometer cools and hence, the lower the wet-bulb temperature.

If the surrounding air is dry, more moisture evaporates from the wick, cooling the wet-bulb thermometer more so there is a greater difference between the temperatures of the two thermometers. If the surrounding air is holding as much moisture as possible - if the relative humidity is 100% - there is no difference between the two temperatures. Meteorologists have worked out charts of these differences for each degree of temperature so that the observer can find relative humidity easily. A sample is shown below:

Partial Relative Humidity Chart for 30° C

Difference Between Dry Bulb and Wet Bulb Temperatures	Relative Humidity
None	100%
0.5°	96%
1.0°	93%
1.5°	89%
9.0°	44%
9.5°	42%
14.5°	19%
15.0°	17%
18.0°	5%

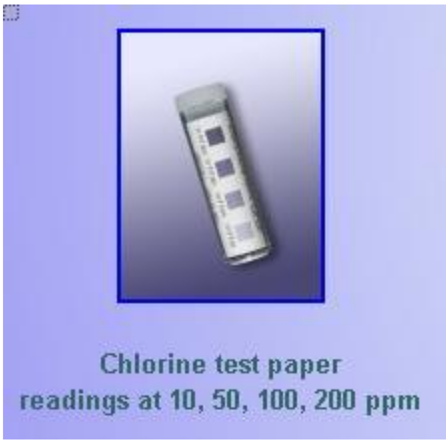
You can make a sling psychrometer by using two commercial thermometers. Wrap the bulb of one tightly with a piece of cloth. Attach the thermometers to a narrow, thin board with wire or strong tape. Drill a hole in the top of the board and attach a wooden handle to the board with a short piece of chain.

Source: NASA website http://asd-www.larc.nasa.gov/SCOOL/psychrometer.html

Chapter 5: Chlorine test strips; measuring free chlorine in ppm (parts per million).

Measuring the chlorine level in wash water is an important part of assuring produce quality during postharvest handling. The wash water can easily spread disease from one unit of produce to another if the water is not kept clean and sanitized with chlorine bleach (hypochlorite). 100 to 150 ppm is the recommended level of chlorine in wash water that will provide adequate protection when the pH is 6.5

To use Cl Test Strips:
Dip a test strip into the water sample for 5 seconds. Wait 10 seconds and match with the closest color on the color chart found on the package.



Chapter 6: pH test strips; measuring acidity or alkalinity

pH test strips provide a simple uncomplicated way of determining the degree of acidity/alkalinity of aqueous solutions. pH test strips can be used for measuring the acidity/alkalinity of wash water samples. If the wash water is found to be too alkaline, muratic acid should be added until the pH level reads 6.5

Simple to use:

- Immerse strip and read results in 2 or 3 seconds
- Fast, easy, cost-effective measurements
- No costly instrumentation
- Accurate to 0.5 pH units

Chapter 7: Other useful tools and supplies

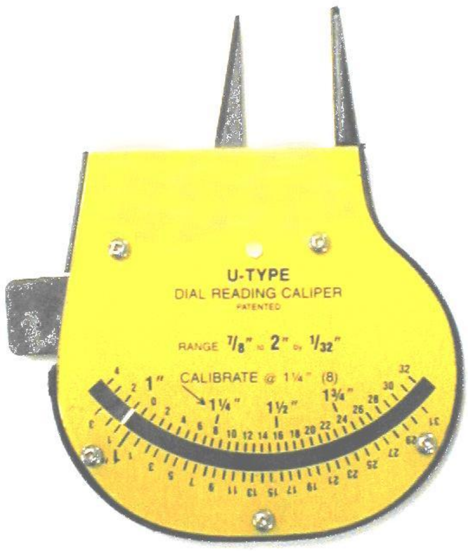
Scales

Measurements of produce weight at various points in the handling chain can help postharvest trainers demonstrate how different handling methods, packages, treatments, etc can affect weight loss. Digital scales (battery operated) can be carried to the field or market and used easily during demonstrations.

Calipers

Example: banana calipers used in the tropics to measure diameter of banana fingers to determine fruit grade.

- Quick and easy readings simply by pressing caliper button which squeezes against banana finger and gives diameter in inches.
- Scale: 7/8" to 2" by 1/32"



Sizing rings

Orange Sizing Rings

Used by growers and the USDA to determine sizing of packing house oranges. Each orange size has its own ring constructed of heavy duty poly plastic. Box and inch sizes are clearly marked on the rings. Each individual ring can be removed easily from it's holder to use independently. Six boxes sizes include: 48, 64, 80, 100, 125, & 163.

Cherry Sizer Card

Plastic laminate card with 11 cherry sizes.

Tomato Sizer Rings

12 panels secured together by a screw/pin.

Sizes: 2 4/32, 2 9/32, 2 8/32, 2 17/32, 2 16/32, 2 25/32, 2 24/32, 3, 3 4/32, 3 8/32, 3 16/32, 3 24/32.

Ethylene absorbers

Ethylene Absorber Sachets, 9 Gram Sachets

Ryan Ethylene Sachets

The Ethylene Control pellets are sealed in a 5, 9 or 28 gram teabag size pouch. One sachet in an individual box will keep produce fresh and free of ethylene and reduces airborne spores from packing to end-user.

The material and ink on the packaging material is F.D.A. approved. This sachet when exposed to high humidity, will not bleed on your produce, but will allow ethylene gas thru to be oxidized.

The Ethylene Control Pellets are transformed naturally into an organic fertilizer (manganese dioxide).

Applications sachets

- 5 gram sachets can be used in boxed produce up to 5 kg.
- 9 gram sachets can be used in boxed produce up to 14 kg.
- 28 gram sachets can be used to reduce ethylene gas and control odors in super market reach-in coolers and display cases

Ryan Ethylene Filters

A special honeycomb design allows better air-flow across the pellets. Our patented pellets have more surface area to oxidize more ethylene gas than other products on the market.

The filters work with the air circulation system of the application and also help reduce odors and taste migration with mixed-load shipments for up to three months. Filters are used in supermarkets, trucks, sea containers and small cold storages.

The Ethylene Control Pellets are transformed naturally into an organic fertilizer (manganese dioxide).

Applications filters

- small filters are ideal for supermarket and food service walk-in coolers, refrigerated trucks or containers up to 110m3.
- large filters are ideal for larger walk-in coolers and small cold storages up to 365m3.

Harvesting bags

This is an example of a FISKARS® 2-in-1 Harvest Bag. It can be used as both a shoulder harvest bag or a waist harvest bag. The convenient, easy-to-adjust strap quickly changes to accommodate the desired location for use. It is 16" deep and 9" in diameter and can accommodate a wide variety of fruits and vegetables. You can also rinse vegetables right in the heavy-duty mesh bag.

Features

- 2 bags in one - functions as either a shoulder or waist harvest bag
- Bag measures 16" high X 9" in diameter.
- Adjustable strap allows for a custom fit
- Mesh fabric allows you to rinse and dry right in the bag

Cordura Picking Sacks

The Frostproof Cordura picking sacks are designed to put less weight on the picker's spine. Heavily padded should strap prevents worker fatigue. Cordura fabric resists mildew and will all fruit to breathe. Has been overwhelming endorsed by pickers on both coasts as the longest lasting and most comfortable bag ever used. Available in 90 lb & 80 lb sizes. Bottom opens up to allow produce to be emptied from the bottom of the bag.

Source: http://frostpro.virtualfocus.com/catalog/m915.html

Chapter 8: Sources of postharvest measurement tools, equipment and supplies

QA Supplies
www.qasupplies.com

Cole Parmer
http://www.coleparmer.com/catalog/catalog_toc.asp?cat=1&view=all

iBuys.com Thermometers and Test Strips
PO BOX 117, Franklin, NJ 07416
973-209-4276 | sales@ibuys.com

FrostPro
http://frostpro.virtualfocus.com/catalog/productcatalog.html

USDA website
http://www.ams.usda.gov/fv/fpbdepot.htm