

## **Foreword**

The formulation of this national standard was initiated by the Agricultural Machinery Testing and Evaluation Center (AMTEC) under the project entitled “Enhancing the Implementation of the AFMA Through Improved Agricultural Engineering Standards” which was funded by the Bureau of Agricultural Research (BAR) of the Department of Agriculture (DA).

This standard has been technically prepared in accordance with PNS 01-4:1998 (ISO/IEC Directives Part 3:1997 – Rules for the Structure and Drafting of International Standards. It specifies the general requirements for the construction of fruit and vegetable primary processing plant.

The word “shall” is used to indicate requirements strictly to be followed in order to conform to the standard and from which no deviation is permitted.

The word “should” is used to indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required.

In the preparation of this standard, the following references were considered:

Bautista, O.K. Postharvest Technology for Southeast Asian Perishable Crops. University of the Philippines Los Baños, Technology and Livelihood Resources Center, 1990.

CIGR Handbook of Agricultural Engineering. American Society of Agricultural Engineers. United States of America, 1999.

Fellows, P., Guidelines for Small Scale Fruit and Vegetable Processors. FAO Agricultural Services Bulletin-127. Rome, 1997.

General Guidance for the Food and Drink Sector. Draft Version 3. Integrated Pollution Prevention and Control. Scottish Environment Protection Agency, July 2001.

Henderson, S and R. Perry, Agricultural Process Engineering, 3<sup>rd</sup> ed. AVI Publishing Co. Westport, Connecticut, 1976.

Paltrinieri, G., F. Figuerola and L. Rojas, Technical Manual on Small-scale Processing of Fruits and Vegetables. FAO Chile, 1997.

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**Agricultural Structures – Primary Processing Plant for Fresh Fruit and Vegetable**

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**1 Scope**

This standard specifies the minimum requirements for fresh fruit and vegetable primary processing plant. It includes general, structural and functional requirements.

**2 Reference**

The following normative document contains provisions which through reference in this text constitute provisions of this National Standard:

**National Structural Code of Building****Philippine Electrical Code 2000****National Plumbing Code of the Philippines****National Building Code of the Philippines**

**PAES 414-1:2002** Agricultural Structures – Waste Management Structures: Part 1 –  
Agricultural Liquid Waste

**PAES 414-2:2002** Agricultural Structures – Waste Management Structures: Part 2 –  
Agricultural Solid Waste - Composting

**PAES 417:2002** Agricultural Structures - Fruit and Vegetables Storage

**3 Definition**

For the purpose of this standard, the following definitions shall apply:

**3.1****primary processing**

product handling which include steps to make a harvested commodity more suitable for manufacturers or consumers

**3.2****grading**

process of classifying into groups according to a set of recognized criteria of quality and size, each group bearing an accepted name and size grouping

### **3.3**

#### **sizing**

process of classifying into sizes according to criteria that may or may not be recognized or accepted by the industry

### **3.4**

#### **sorting**

Process of classifying into groups designated by the person classifying the produce either according to a set of criteria or whatever criteria he may set

### **3.5**

#### **air change ratio**

ratio of the volume of air that enters a room to the volume of air of the empty room

### **3.6**

#### **inspection**

process of determining whether the grade standards have been interpreted or enforced properly by inspecting random samples usually of predetermined amount large enough to give an indication of the correctness of the grading procedure

### **3.7**

#### **packaging**

process to ensure adequate protection and safe delivery of a product from the producer to the ultimate consumer

## **4 Location**

**4.1** The location shall conform to the land use plan of the area.

**4.2** The location of the processing plant in relation to raw material supplies shall be near as possible.

**4.3** The site shall be accessible to service roads, water supply and electric lines.

**4.4** There shall be provision for parking area.

**4.5** The site shall be well drained.

**4.6** The site shall be away from any source of smells and insects.

## **5 Space requirements**

**5.1** Capacity of the processing plant shall be calculated based on the volume of commodity being processed. An area of 20 square meter per ton of commodity shall be provided.

**5.2** The storage area of a processing plant shall have a capacity for temporary storage of raw materials for 2-5 processing days.

5.3 Additional area shall be for equipment, working tables and space for circulation.

## **6 Structural Requirements**

### **6.1 Roof**

6.1.1 The roof structure should be treated timber or steel with anti-rust paint.

6.1.2 Roofing materials should be G.I. sheet and other steel sheeting with corrosion resistant coatings.

6.1.3 Provisions of skylights (i.e. plastic roofing sheets) at media preparation and sterilization area for natural lighting are recommended.

6.1.4 Roof vents, when provided, shall be properly screened.

### **6.2 Ceilings**

6.2.1 Ceilings shall be at least 2.4 m from the finished floor line.

6.2.2 Ceilings shall be constructed to prevent the collection of dirt or dust that might sift through from the areas above or fall from overhead collecting surfaces onto equipment or exposed products.

6.2.3 Ceilings shall be painted with white emulsion or latex paint.

### **6.3 Wall**

6.3.1 The wall shall be concreted, smooth finished and properly painted. Internal surface of the walls should be painted with white emulsion or latex paint.

6.3.2 All wall tops and ledges shall slope at 45°.

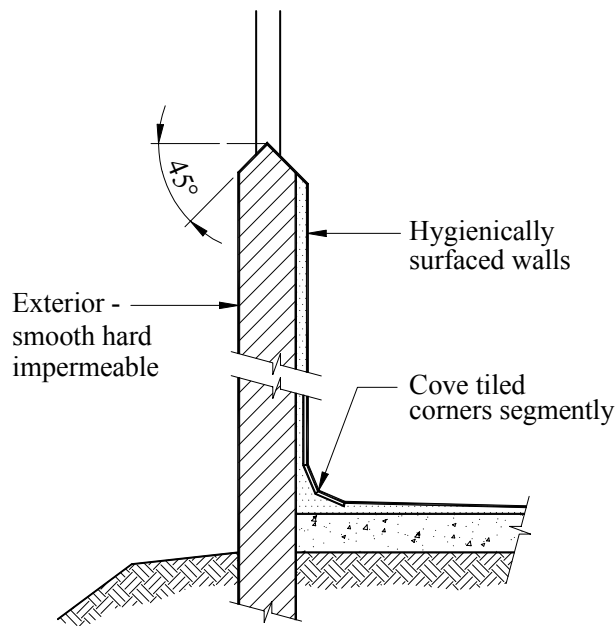
6.3.3 It shall be coved to the floor-wall and at wall-to-wall junctions with a minimum radius of 50 mm - 60 mm.

### **6.4 Windows**

6.4.1 All windows shall be properly installed with 16-mesh screen.

6.4.2 Window ledges shall be sloped about 45° to prevent the accumulation of dirt, water, or debris (Refer to Figure 1).

6.4.3 Windowsill shall be at least 1 m from the finish floor line.



**Figure 1 – Finishing of a processing wall**

## **6.5 Doors and jambs**

**6.5.1** Doors shall have a minimum width of 1.5 m.

**6.5.2** Doors and doorjambs shall be constructed of moisture and rust-resistant material.

**6.5.3** Doors shall be fitted with screens, air flaps or provided with air curtain.

**6.5.4** The juncture between the wall and the doorjambs shall be effectively sealed with a flexible sealing compound.

## **6.6 Floor**

**6.6.1** The floor of processing rooms and storerooms shall be constructed of good quality concrete, properly reinforced to prevent cracks and shall be smooth finished.

**6.6.2** Intersection with the wall shall be coved with 50 mm - 60 mm radius.

**6.6.3** The floor shall slope 2% - 4% towards the drainage.

**6.7** All other matters concerning structural design of the building not provided in this Standard shall conform with the provisions of the National Structural Code of Building.

## **7 Functional Requirements**

### **7.1 Receiving area**

**7.1.1** The plant shall be provided with an area for the reception and temporary storage of raw materials until it is used in the process.

**7.1.2** There shall be provision for unloading the fruit and vegetable with minimum damage.

**7.1.3** The area shall be either a shed or a more appropriately designed room to meet the requirements in terms of temperature, humidity cleanliness, and exposure to sunlight. Refer to **PAES 417:2002**.

**7.1.4** Raw material storage area shall not be used for the storage of other products that may be contaminating, such as pesticides, paint, or cleaning utensils, all of which must be kept in specially designated areas.

## **7.2 Processing area**

**7.2.1** Processing area shall be sufficient to accommodate all of the necessary equipment on a continuous line, even in barely automated facilities.

**7.2.2** It shall be physically divided into areas where different functions are performed. The dirty area shall not extend to the section of the plant or of the processing room where the cleanest operations are carried out. Separation of one area from the other shall be achieved through the use of light partitions and painted wood panels.

**7.2.3** Processing area shall include space for:

### **7.2.3.1 Unloading area**

There shall be provision for unloading the fruit and vegetable with minimum damage.

### **7.2.3.2 Washing area**

There shall be provision for washing the commodity either by immersion, by spray/ showers or by combination of these two processes. Washing stand, tables and drying racks should be provided.

### **7.2.3.3 Sorting and grading area**

**7.2.3.3.1** There shall be provision for sorting and/or screening and grading of raw materials.

**7.2.3.3.2** The height of sorting and grading surface shall be about 100 mm - 150 mm below the bottom of the elbow in the normal working position (sitting or standing).

**7.2.3.3.3** Edges of the sorting table should be lined with thin layer of foam to protect the commodity from bruising during sorting, and should slope from the center toward the sorter by 10 degrees.

**7.2.3.3.4** Reject chutes for substandard product should be placed in a convenient position at the level of the table.

### **7.2.3.4 Trimming and peeling area**

There shall be provision for trimming for removal of inedible parts and parts with defects or cutting to a size feasible for further processing.

### 7.2.3.5 Packing area

7.2.3.5.1 Packing stand and table should be provided.

7.2.3.5.2 Packaging materials should either be corrugated cartons, plastic bags, shrinkwrap, stretch-wrap, layer pads, pallets and slip sheets, drums and other containers and filler materials (i.e. polystyrene, foam paper, etc.).

7.2.3.5.3 Table 1 shows the recommended dimension of container or cartons.

**Table 1 – Recommended dimension of fruit and vegetable container**

<b>Outside Dimension</b> mm	<b>Number per Layer</b>	<b>Pallet Surface Area Utilized</b> %
600 x 500	4	100
500 x 400	6	100
600 x 400	5	100
500 x 333	7	97
600 x 333	6	99
500 x 300	8	100
475 x 250	10	99
400 x 300	10	100
433 x 333	8	96
400 x 250	12	100

### 7.2.3.6 Labeling

Label should either by stamping with the company's brand or logo or putting stickers on them bearing the brand name of the company. If stamped, the ink should be approved by the Food and Drug Administration.

## 7.3 Inspection and quality control area

7.3.1 A separate area shall be provided where the basic inspection and tests required to establish the quality of a given raw material or a given process may be performed.

7.3.2 It shall be preferably equipped with a small sink, running water and a counter where tests may be carried out.

## 7.4 Storeroom for finished products

7.4.1 The area shall be clean, the temperature and humidity levels shall be appropriate (less than 25 C° and 60% of relative humidity), and it shall be protected from foreign matter.

7.4.2 It shall be easily accessible, so that tests may be performed during product storage, and any problems may be detected on the spot.

## 7.5 Equipment and facilities

### 7.5.1 Equipment and utensils

**7.5.1.1** Equipment and utensils shall be designed and constructed so that they are adequately cleanable and will not adulterate commodity with lubricants, fuel, metal fragments, contaminated water, and other contaminants.

**7.5.1.2** Equipment should be installed so that it, and the area around it, can be easily cleaned.

**7.5.1.3** Food contact surfaces shall be made of nontoxic materials and must be corrosion-resistant.

**7.5.1.4** Seams on commodity contact surfaces shall be smoothly bonded, or maintained in order to minimize the accumulation of particles, dirt and organic matter.

### 7.5.2 Lighting facilities

**7.5.2.1** Well-distributed, good quality artificial lighting shall be provided at all places where natural light is unavailable or insufficient. Table 2 shows the minimum lighting intensity for processing plant.

**Table 2 - Recommended lighting intensity for fruit and vegetable processing plant**

Area	Lighting intensity lux (lumen/m <sup>2</sup> )
Outside the building	100
General	200
Working table	500

\* Refer to Annex B

**7.5.2.2** Light fixtures shall be flushed in ceiling and shall be provided with diffuser.

**7.5.2.3** All electric power points shall be placed at a sufficient height above the floor. Waterproof sockets shall be used.

**7.5.2.4** All plugs shall be fitted with fuses that are appropriate for the power rating of the equipment and ideally the mains supply shall have an earth leakage trip switch.

**7.5.2.5** All electrical wiring design and installation shall conform with the Philippine Electrical Code.

### 7.5.3 Water supply and plumbing facilities

**7.5.3.1** The water supply shall be ample, clean, and potable with adequate pressure and with facilities for distribution and protection against contamination and pollution.

**7.5.3.2** If necessary, covered storage tanks either in the roof-space or on pillars outside the building shall be constructed.



**7.5.3.2.1** The capacity of each tank shall be sufficient for one day's production.

**7.5.3.2.2** The tanks shall have a sloping base and be fitted with drain valves above the slope and at the lowest point.

**7.5.3.2.3** In use, water is taken from the upper valve and when the tank is almost empty, the lower valve shall be opened to flush out any sediment that has accumulated.

**7.5.3.3** Drainage and plumbing system for the fruit and vegetable processing plant shall be in accordance with the National Plumbing Code.

**7.5.3.4** Sewage should flow into an adequate sewage system or disposed of through other adequate means.

**7.5.4** Toilet and hand-washing facilities

**7.5.4.1** Toilets and hand-washing facilities shall be provided inside the laboratory.

**7.5.4.2** Toilet rooms shall not open directly into areas where the culture is exposed unless steps have been taken to prevent airborne contamination (example: double doors, positive airflow).

**7.5.4.3** Toilet rooms must have self-closing doors.

**7.5.4.4** Adequate and convenient hand-washing and, if necessary, hand-sanitizing facilities should be provided anywhere in the laboratory where the nature of employees jobs requires that they wash, sanitize and dry their hands.

**7.5.4.5** Water control valves should be designed and constructed to protect against recontamination of clean and sanitized hands.

## **7.5.5 Fire extinguishing system**

Construction of fire extinguishing system shall conform with the provision of the National Building Code of the Philippines.

## **7.6 Ventilation**

**7.6.1** Screens and filters shall be used to prevent product contamination from dust, odors, and insects.

**7.6.2** Mechanical ventilation shall be used to provide fresh air to areas where natural ventilation is inadequate.

## **8 Waste disposal**

For waste management, refer to **PAES 414-1:2002** and **PAES 414-2:2002**.

**Annex A**  
(informative)

**Processing operations for some fruits and vegetables**

Commodity	Operations							
	Sorting	Trimming	Curing	Washing/ Cleaning	Disease Control	Waxing	Packaging	Packaging Method
Asparagus	Discard diseased, damaged spears	Bundled spears should have same length		Wash with water			Cartons	Pack vertically, leave clearance for spear growth
Bell pepper	Remove bruised, diseased fruit	Trim stalk close to shoulder		Apply 1% chlorox solution using damp cloth; or brush/ spray 15% alum solution on cut stem			Pack in plastic crate with PEB liner (20 kg); Pack 3 pieces in individual PEBs	
Broccoli	Cull yellowed, open, diseased florets	Remove leaves, excess stalk			Spray/brush with 15% alum solution		Individual PEB (8 pin-pricks per 2 heads) pack in plastic crate	
Cabbage	Discard diseased heads	Trim butt, remove diseased, discolored wrapper leaves			Spray/brush/ wipe with 15% alum solution on trimmed stem end		Plastic crate with perforated PEB liner	Wrap heads individually with newsprint
Carrot	Cull bruised, diseased forked roots; remove those with broken tips, green shoulders	Trim off tops	15°C - 25°C 100%RH 12 hours	Do not wash before long-term storage; after storage, wash in plastic tub or steel drum filled with 1% chlorox solution; use brush/ sponge to remove dirt			Plastic crate with PEB liner	
Cauliflower	Cull out florets with dark spots	Trim off all leaves, excess stalk			Spray/brush with 15% alum solution		Wrap individually in onion skin paper; place in plastic crate	
Celery	Cull out diseased, blackened stalks	Trim to desired length, trim roots		Wash with 200 ppm chlorox solution if dirty			Plastic crate with PEB liner	
Cucumber	Remove bruised, diseased fruit			Wipe with cloth dampened with 1% chlorox		Wax emulsion	Plastic crate with PEB liner	
Green beans	Cull out broken, bruised beans						Pack in PEB with one perforation per 500 gram	
Lettuce	Cull out heads with advanced disease	Trim butt, 2-3 wrapper leaves		Wash off dirt, foreign material; shake off excess water	Spray/brush with 15% alum solution; shake off excess water		Wrap individually in newsprint, place in plastic crate with PEB	
Honeydew melon	Cull bruised,						Plastic crate	

Commodity	Operations							
	Sorting	Trimming	Curing	Washing/ Cleaning	Disease Control	Waxing	Packaging	Packaging Method
	diseased, soft fruit							
Sweet peas	Cull yellowed pods, those with insect infestation						Pack in PEB (1 pin-prick per 250 gram) in plastic crate	
Tomato	Cull out fruit with disease, mechanical damage and insect damage			1% chlorox solution applied by dipping, spraying or wiping with a damp cloth; dry fruit before packing			Plastic crate with PEB liner (12 pinholes per 23 kg -27 kg); wooden crate with liner	Shake crate twice during filling for tight fill
'Carabao' mango	Cull out fruit with disease, mechanical damage and insect damage	Trim stem close to shoulder		Place fruits stem-end down to allow latex to drip off; use delatexing racks	Hot water treatment 52 °C – 55°C, 10 minutes within 24 hours after harvest; air-dry		Local: cartons, wood crates; Export: cartons with dividers, wrapped in onion skin paper	Place-packing
Calamansi	Cull fruits with disease, defects, damage, over-ripe fruits	Use pruning shears to trim stem to 5 mm					Bamboo baskets or crates; perforated polyethylene bags	
'Solo' papaya	Cull damaged, deformed, overripe fruits	Trim peduncle	Air-drying at ambient for 24 hours remove latex with 20% alum or 1% chlorox solution	Thiabendazole 1.5 mL/L			Wooden crates with newsprint liner	Wrap fruits individually in newsprint, place pack
Lazones	Cull damaged, immature fruits; separate loose fruits						Pack in wooden crates with newsprint liner, or perforated PEB pack in wooden crates or cartons with newsprint liner	
Banana	Cull damaged hands, overripe fruit	Remove dried floral parts, excess crown			Spray/brush with 15% alum solution			
Rambutan	Cull small, immature, poorly-colored fruit						Wooden crates cardboard cartons or net bags	
Pumelo	Cull fruits with fruit fly damage, physical defects		28 °C – 29°C 95-98% RH 1 – 2 weeks	Wipe with a piece of cotton cloth		Wax with 0.4% thiabendazole	Wooden crates with liner	
Young corn	Cull out ears with disease, injuries and insect damage	Remove husk, silk; use razor blade to remove silk stubs		Remove insect larvae with a soft brush			Styrofoam tray with clingwrap; use shallow plastic trays as master container	Pack in crushed ice in alternating layers in insulated box

**Annex B**  
(informative)

**Lighting Requirements**

Lighting Intensity lux	No. of Bulbs Required per m <sup>2</sup>							
	Incandescent lamp						Fluorescent lamp	
	25W	40W	60W	100W	150W	200W	20W	40W
500	3.935	1.989	1.052	0.520	0.314	0.226	0.682	0.266
400	3.148	1.591	0.842	0.416	0.251	0.181	0.546	0.213
300	2.361	1.193	0.631	0.312	0.189	0.136	0.409	0.160
200	1.574	0.796	0.421	0.208	0.126	0.090	0.273	0.107
150	1.180	0.597	0.316	0.156	0.094	0.068	0.205	0.080
100	0.787	0.398	0.210	0.104	0.063	0.045	0.136	0.053
50	0.393	0.199	0.105	0.052	0.031	0.023	0.068	0.027
10	0.079	0.040	0.021	0.010	0.006	0.005	0.014	0.005