WESTERN GROWERS SCIENCE

WESTERN GROWERS

APPENDIX S
Harvest Equipment Cleaning and Sanitation

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TABLE OF CONTENTS

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EXECUTIVE SUMMARY

This document outlines guidelines for cleaning and sanitation of harvesting equipment. This document uses descriptions, images, and tables, to supplement the implementation of Issue 8: HARVESTING EQUIPMENT SANITATION AND DESIGN, PACKAGING MATERIALS, AND BUILDINGS in the Commodity Specific Food Safety Guidelines for the Production and Harvest of Lettuces and Leafy Greens (hereby referred to as the Leafy Green Guidelines).

Key sections include:

A. **Hygienic Design:** Concepts related to hygienic design of harvesting equipment and conducting a hygienic design review.

B. **Master Sanitation Schedule:** Concepts for harvesting equipment. Establishes a structured cleaning and sanitizing routine, assigning responsibilities and defining zones and frequencies to ensure food safety, prevent contamination, and maintain produce quality by regularly updating and documenting cleaning and sanitizing practices.

C. **General Harvester SSOP – 7-Steps for Cleaning Sanitation Process:** A detailed Standard Sanitation Operating Procedure (SSOP) is provided for daily equipment cleaning, outlining each step from preparation to sanitization to ensure complete removal of soil and contaminants.

D. **Personal Protective Equipment (PPE):** Recommendations for PPE usage to protect workers from chemicals and debris during cleaning, enhancing both safety and sanitation efficacy.

E. **Cleaning and Sanitation Tools and Equipment:** An overview of essential tools, such as brushes, sprayers, and foaming devices, emphasizing their role in effective use for cleaning and sanitation and cross-contamination prevention.

F. **Chemical Usage and Concentration Verification:** Detailed guidance on the appropriate chemicals (detergents and sanitizers), concentration standards, and verification methods to maintain effective cleaning and prevent microbial contamination.

G. **Periodic Equipment Cleaning (PEC):** This section includes Procedures on how to perform PECs, as well as an assessment for PECs.

H. **Cleaning and Sanitation Verification:** Verification methods, including visual inspections, ATP soil load reduction, and microbial testing, to ensure sanitation effectiveness.

I. **Safety Resources:**

ABBREVIATIONS AND DEFINITIONS

ADJACENT SURFACES	Surfaces that are near food-contact surfaces but do not directly touch the food. The surfaces can still be a contamination source if human pathogens are transferred to the food or food-contact surfaces through drainage, drips, dirt or debris.
AEROBIC PLATE COUNT (APC)	A microbiological testing method is used to estimate the number of viable aerobic microorganisms (bacteria, yeasts, or molds) in a sample. This count is often used as an indicator of the overall microbial quality or hygienic status of food, water, or other products. Also known as Total Plate Count (TPC).
ADENOSINE TRI-PHOSPHATE (ATP)	A high-energy phosphate molecule that provides energy for cellular function.
ATP TEST METHODS	Exploits knowledge of the concentration of ATP as related to viable biomass or metabolic activity; provides an estimate of cleanliness.
BIOFILMS	The accumulation of microorganisms on a surface, which often happens in a hard-to-remove structure of bacterial origin.
CLEANING	Refers to the physical removal of visible and invisible soil and dirt from food-contact and non-food-contact surfaces.
CROSS-CONTAMINATION	The transfer of microorganisms, such as bacteria and viruses, from one place to another.
EQUIPMENT CATEGORIES	Categorization of harvesting equipment based on LGMA guidelines. The categorization of harvesting equipment is as follows: • **Category 1:** Equipment used to harvest lettuce and leafy greens for further processing (i.e., clean and core lettuce, top and tail romaine, and mechanical harvesting of leafy greens). Examples of food-contact surfaces include belts with/without cleats, mechanical blades, coring rings, knives, and cutting boards. • **Category 2:** Equipment used to harvest lettuce and leafy greens for field pack (i.e., whole head lettuce, romaine hearts). Examples of food-contact surfaces include those that are primarily used for conveyance. • **Category 3:** Equipment that does not come in direct contact with produce (i.e., tractors, trailers, forklifts, water tanks).

ABBREVIATIONS AND DEFINITIONS (CONTINUED)

FIELD PACK	Refers to the process of harvesting and packing lettuce and leafy greens in the field, which are harvested, sorted, and placed into packaging containers for distribution.
FOOD-CONTACT SURFACES	Those surfaces that contact human food and those surfaces from which drainage, or other transfer, onto the food or onto surfaces that contact the food ordinarily occurs during the normal course of operations. "Food-contact surfaces" includes food-contact surfaces of equipment and tools used during harvest, packing and holding. Examples: Conveyor belts, cutting boards, knives, and baskets.
FOOD SAFETY PROFESSIONAL	Person entrusted with management level responsibility for conducting food safety assessments before food reaches consumers; requires documented training in scientific principles and a solid understanding of the principles of food safety as applied to agricultural production.
FURTHER PROCESSING	Refers to the additional steps taken after the initial harvesting of lettuce and leafy greens. Examples of further processing could include, but are not limited to: cleaning, coring, cutting, sorting, washing, or shredding.
HARBORAGE SITES	An area on a piece of equipment that is difficult to clean and sanitize effectively. These are places where microbes have access to nutrients and water, making them ideal areas for bacteria to grow.
HARD-TO-REACH AREAS	Parts of the harvesting equipment that are difficult to access for cleaning, sanitation, and inspection due to location, design, or obstruction of components. Ensuring that these areas are properly cleaned and sanitized is important to prevent contamination.
MASTER SANITATION SCHEDULE (MSS)	The document that contains the list of cleaning tasks with frequencies. It includes routine equipment cleaning (REC), periodic equipment cleaning (PEC) tasks, and annual tasks such as hygienic design reviews.
MONITORING	A planned sequence of observations or measurements to assess whether the sanitation program is being adequately implemented, and it is used to produce an accurate record for future use in verification.
PARTS PER MILLION (ppm)	Usually describes the concentration of something in water or soil; one particle of a given substance for every 999,999 other particles.

ABBREVIATIONS AND DEFINITIONS (CONTINUED)

PATHOGEN	A disease-causing agent, such as a virus, parasite, or bacteria.
PERACETIC ACID (PAA)	Oxidizing agent used as a disinfectant, sanitizer, and sterilant in the food industry.
PERIODIC EQUIPMENT CLEANING (PEC)	Cleaning tasks for areas considered hard to reach, hard to see, touch, or sample, and therefore need disassembly to enable cleaning. Examples of these areas could include, but are not limited to the following: • wear strips under belts • sandwich spots (adjoined laminated surfaces such as support strips, flaps to chlorine tunnels) • hidden surfaces such as cutting board attachments and framework • mechanical drive and support rollers • bearings
PERSONAL PROTECTIVE EQUIPMENT (PPE)	Specialized clothing, equipment, or accessories designed to protect individuals from hazards during cleaning and sanitation activities.
ROUTINE EQUIPMENT CLEANING (REC)	Cleaning tasks that are performed daily using the seven steps of cleaning and sanitation.
SANITATION	Maintenance or restoration of clean, hygienic conditions; it includes cleaning and sanitizing.
SANITATION STANDARD OPERATING PROCEDURE (SSOP)	A specific type of Standard Operating Procedure that focuses on the sanitation processes and practices required to ensure cleanliness, hygiene, and food safety of facilities and harvesting equipment.
SANITIZING	The treatment of a surface to reduce the number of disease-causing microorganisms to safe levels. FDA's definition of "sanitizing" is to eliminate 99.9% of the bacteria present.
STANDARD OPERATING PROCEDURE (SOP)	A detailed, written set of instructions designed to guide workers in performing specific tasks or processes consistently and safely. SOPs include steps and verification activities for the specified tasks.

BASIC CONCEPTS: SANITATION, CLEANING, AND SANITIZING

Sanitation:

- Sanitation is the maintenance or restoration of clean, hygienic conditions. In leafy greens production, sanitation programs are needed to eliminate microorganisms that can cause food spoilage or foodborne illness.
- Sanitation programs include several cleaning and sanitizing steps. Cleaning and sanitizing are two different activities with two different objectives. It is important to make the distinction, as one without the other results in a process that does not work.

Cleaning:

- Cleaning is the removal of all soil, dust, and debris from the surface. Soil provides nutrients for microorganisms to survive and grow. It can originate from the food or from the field (dirt, dust, grease, animal hazards, etc). Good cleaning methods reduce microbial contamination from food-contact surfaces.
- Cleaning removes product residue and visible soil from food-contact and non-food-contact surfaces, so sanitization can occur. Most often, the cleaning process will require physical action (i.e., scrubbing, scraping, elbow grease) to ensure that the surfaces are clean. During this step, a specified cleaner (or detergent) is applied and used according to the manufacturer's instructions. These instructions may include cleaner type, concentration, contact time, and temperature.
- The cleaner helps remove grime through the interaction of detergent and soil. After cleaning, no leafy green residues should remain in or on any part of the harvesting equipment or utensil.
- The cleaning method and the chemical agents used will depend on the type of soil. The Food Safety Professional will be responsible for determining the procedures and chemicals that will be used to clean the tools and equipment.

Sanitizing:

- During the sanitizing process, a clean surface is treated with a chemical sanitizer, UV or heat to reduce the number of microorganisms to safe levels.
- All surfaces should be thoroughly cleaned, and all detergents and/or cleaners rinsed off before the sanitizing step.
- Remember, you cannot sanitize a dirty surface: dirt and debris will prevent the sanitizer from doing its job.
- Always sanitize using food-grade sanitizers at the concentration stated in your company's policies and procedures. The concentration of your sanitizer must be tested with the appropriate test strip to ensure that it is in line with company procedures. Note that test strips are designed to be used with specific types of sanitizers. A test strip can only be used with the chemical sanitizer it is designed for.

BASIC CONCEPTS: EQUIPMENT CATEGORIES

The LGMA Leafy Green Guidelines requires companies to categorize all the harvesting equipment used in their operation. Each piece of equipment must be placed into one of the following categories. These categories will be used throughout this document:

Category 1:
Equipment used to harvest lettuce and leafy greens for further processing (i.e., clean and core lettuce, top and tail romaine, and mechanical harvesting of leafy greens). Examples of food-contact surfaces on this type of equipment include belts with/ without cleats, mechanical blades, coring rings, knives, and cutting boards.

Category 2:
Equipment used to harvest lettuce and leafy greens for field pack (i.e., whole head lettuce, romaine hearts). Examples of food-contact surfaces on this type of equipment include those that are primarily used for conveyance.

Category 3:
Equipment that does not come in direct contact with produce (i.e., tractors, trailers, forklifts, water tanks).

BASIC CONCEPTS: SURFACES

Food-Contact Surfaces

Food-contact surfaces are surfaces or areas that may come in direct contact with exposed leafy greens. Surfaces that have immediate influence on, and are adjacent to, direct product surfaces should also be considered food-contact surfaces. Some examples are:

- Conveyor belts
- Tabletops
- Working tables
- Elevators
- Knives

Food-contact surfaces are more likely than other surfaces to be sources of cross-contamination. Special care must be taken in cleaning and sanitizing these areas.

Non-Food-Contact Surfaces

Non-food-contact surfaces, such as outer parts of machines, framework, walkways, etc., are exposed areas that do not have contact with leafy greens. Although they were not designed to have contact with food, they can still become a source of contamination. Workers need to be aware of these areas and clean and sanitize them properly on a regular basis. Some examples include:

- Structural frameworks (guard rails, frames)
- Exterior panels and covers (motor housing, cover shields)
- Tires and undercarriage
- Operator areas
- Electrical components

BASIC CONCEPTS: HARBORAGE SITES

A harborage site is an area on a piece of equipment that is difficult to clean and sanitize. Dirt, product, and other types of organic material can accumulate in these areas, providing ideal conditions (i.e., nutrients and water) for microbes to survive and grow.

When combined with other factors, such as time and temperature, that allow for pathogen survival and growth, these sites can be particularly dangerous. They need special attention during cleaning and sanitizing; do not take shortcuts and always take your time cleaning the hard-to-reach areas of equipment.

Field equipment has many places that can become harborage sites for microorganisms. Harborage sites include:

- Ledges
- Conveyor belts
- Equipment seams
- Temporary repairs
- Unsanitary welds
- Enclosed hollow parts/structures accessible to water and dust

A. HYGIENIC DESIGN

Sanitary or hygienic design refers to the engineering of harvesting equipment to ensure it can be thoroughly and appropriately cleaned and sanitized before entering the field. Hygienic design incorporates techniques that allow for efficient cleaning and inspection of harvesting equipment while minimizing the risk of contamination and ensuring the safety of harvested lettuce and leafy greens.

This type of design requires that materials used to construct contact- and non-food-contact surfaces on the harvesting equipment be durable, smooth, drainable, easy to clean, non-absorbent, non-toxic, and resistant to corrosion. The design and construction must prevent microbial ingress, survival, growth, and reproduction on both food-contact and non-food-contact surfaces.

Hygienic design focuses on minimizing the areas where pathogens can accumulate such as in hard-to-clean areas. Proper welding is also essential to **prevent the buildup of soil and leafy greens and biofilm formation.**

Hygienic design enhances the efficiency and cost effectiveness of sanitation programs by enabling cleaning and sanitizing tasks to be completed more efficiently and faster.

Develop a hygienic design program

A harvesting equipment hygienic design program (i.e., an SOP) shall minimally address the following:

- Conduct a hygienic design review for Category 1 harvesting equipment that evaluates areas of concern for food-contact surfaces and machine infrastructure. This should be done at least annually (frequency to be determined based on your assessment), and after designing, purchasing, or modifying harvesting equipment.
- The hygienic design program should incorporate the areas addressed in the following checklist Document Here.
- This checklist addresses:
  - For food-contact surfaces as applicable, minimally evaluate whether (or not) they are:
    - Accessible for cleaning.
    - Resistant to corrosion, non-toxic, and non-absorbent.
    - Properly painted or coated.
    - Ripped, torn, or damaged (e.g., belts and tarps).
    - Equipped with belts that can be adjusted or removed to allow cleaning of unexposed areas.
    - Rust-free, and adjacent areas are also rust-free.
  - For machine infrastructure as applicable, minimally, evaluate whether (or not):
    - Hydraulic fluid, motors, trash, or oil pans drip, drain or are drawn to food-contact surfaces.
    - Drives, chain guards, control boxes, or bearings are located over open food-contact surfaces.
    - Standing water accumulates, drips, or drains onto food-contact surfaces during operation.
    - Unique features on the harvesting equipment could affect its cleanability or allow for microbial ingress, survival, growth, and reproduction (e.g., cracks or holes in square tubbing or welds, temporary welds, adjoined flat surfaces "sandwich joints").

Based on the findings of the hygienic design review, consider the need for Periodic Equipment Cleaning (PEC) as well as documenting the frequency of PECs to be performed. (See PEC Section Page 29)

B. MASTER SANITATION SCHEDULE (MSS)

Your company's sanitation program should include a Master Sanitation Schedule (MSS). Proper cleaning and sanitation of harvesting equipment are critical for maintaining food safety and preventing contamination during harvest. A well-designed MSS for harvesting equipment provides a structured approach to cleaning and sanitizing, reducing the likelihood of contamination, and promoting the efficacy of your cleaning and sanitation program.

The MSS details: (i) how frequently all harvesting equipment and utensils should be cleaned and (ii) who is responsible for executing these tasks. It includes routine equipment cleaning (REC), periodic equipment cleaning (PEC) tasks, and annual tasks such as hygienic design reviews.

This guide outlines best practices for implementing an MSS for harvesting equipment. Following these practices ensures that all equipment is consistently cleaned and sanitized, which helps maintain produce quality and prevents product contamination. Here are the recommended steps to create an effective MSS for harvesting equipment cleaning and sanitation:

Steps to develop a Master Sanitation Schedule (MSS):

Step 1: Establish cleaning frequencies

- The cleaning frequency should be based on the risk that the machine or utensil poses as a contamination source. For instance, equipment like tractors and trailers do not normally directly contact produce. They do not need to be cleaned on a daily basis, so cleaning them once every two weeks should be adequate.
- ***Routine Equipment Cleaning (REC):***
  - Food-contact surfaces should be cleaned and sanitized daily when moving between commodities and fields or when excessive soil has built up.
  - Non-food-contact surfaces must be cleaned regularly to maintain sanitary conditions.
- ***Periodic Equipment Cleaning (PEC):***
  - Certain pieces of harvesting equipment may need to be disassembled to perform in-depth cleaning and sanitation.
  - Include PEC in your MSS and establish frequencies based on your hygienic design review and PEC assessments.

Step 2: Establish assessment frequencies

- ***PEC assessment:***
  - After routine sanitation has been completed, initiate a PEC assessment to evaluate soil and microbial loads in hard-to-reach or non-routinely cleaned locations (e.g., harborage points, elevated or enclosed areas). Schedule PEC assessments as part of the MSS to ensure you are covering all equipment types and locations over time. Consider increasing PEC assessment frequency based on risk (e.g., recent maintenance, high organic loading, or post-harvest environmental conditions).
- ***Sanitation Program self-assessment (Issue 8.1):***
  - Handlers and shippers must perform and document this self-assessment at least once per season. The purpose of the self-assessment is to evaluate compliance with sanitation protocols, identify gaps in implementation, and assess opportunities for improvement.

Incorporate findings from cleaning and sanitation verification data (e.g., ATP trends, microbial swab results) to guide improvements. During your self-assessment, evaluate tool use, crew practices, sanitizer coverage, and time spent per cleaning phase, as supported by CPS project findings.

- ***SSOP verification:***
  - On the highest category harvest equipment: At least once per season, verify your SSOPs using a quantitative method, such as ATP bioluminescence, rapid residue detection, or microbiological swabbing (e.g., APC, total coliform, or generic E. coli). Perform verification both pre- and post-sanitation to measure reduction effectiveness. Where possible, compare results against historical data to evaluate performance trends and training effectiveness. The CPS 2024 findings support the use of ATP thresholds (e.g., ≤20,000 RLU) and show that microbial reductions are more strongly correlated with thorough cleaning than sanitizer use alone. Use this report to interpret your data and corrective actions taken.

Step 3: Scheduling

- Develop and follow a cleaning schedule for each piece of harvesting equipment. Document any modifications to the schedule.

Step 4: Assign responsibility to team members:

- ***Cleaning and sanitation crew:*** Designate responsible personnel for cleaning and sanitation tasks. Ensure that each team member knows which parts of the equipment they are accountable for, if not all. Also ensure that the designated personnel comply with the training specified under Issue 4 in the Leafy Green Guidelines.
- ***Supervisor/lead/crew foreman:*** Designate personnel responsible for reviewing cleaning and sanitation activities. This includes pre-operational inspections, as well as conducting reviews of the cleaning and sanitation activities.

Step 5: Adapt and update the MSS:

- ***Review and update as needed:*** It is recommended to conduct a review of the MSS at least annually, when equipment changes, seasonal demands are elevated, and any new food safety information is obtained.
- ***Continuous improvement:*** Improve process effectiveness over time by soliciting feedback from the cleaning team to identify potential improvements.

Step 6: Documentation

- ***Detailed documentation:*** Keep a log of each cleaning task, documenting equipment ID, time, date, and personnel involved in cleaning and sanitation.
- ***Effective communication:*** Ensure all employees understand the importance of equipment sanitation and encourage open communication to address any issues promptly.

C. GENERAL HARVESTER SSOP – 7 STEPS FOR CLEANING AND SANITATION

As part of the sanitation program, companies that harvest leafy greens must develop, implement and maintain standard SSOPs for cleaning and sanitizing harvesting equipment to reduce and control the potential for cross-contamination.

An SSOP is a type of SOP that focuses on sanitation and provides detailed instructions on how each harvesting machine or utensils should be cleaned and sanitized to prevent contamination.

Prepare SSOPs for all categories of harvesting equipment (examples of equipment categories as noted in the "Categorization of Harvesting Equipment" section), and tools that address the following:

- Frequency of cleaning and sanitation activities (i.e., after daily use, when moving between commodities and fields and when excessive soil has built up)
- Documentation of cleaning and sanitation activities
- Cleaning and sanitizing of harvesting equipment (i.e., Categories 1 & 2) to reduce and control the potential for microbial cross-contamination, follow the preparation steps in Table 5 of the CA LGMA Metrics/ Table 4A of the AZ LGMA Metrics, and the 7 steps of cleaning and sanitation in Table 6 of the CA LGMA Metrics / Table 4B of the AZ LGMA Metrics
- Cleaning and sanitizing of non-food-contact surfaces (i.e., Category 3) to reduce and control the potential for microbial cross-contamination (i.e., tractors, trailers and other equipment utilized in harvest)

Best practices for cleaning and sanitation of harvesting equipment:

- Conduct Steps 1 through 7 in **Table 1** below after daily equipment use.
- On the day of harvest, follow the "day of harvest steps" in **Table 1** below.
- To avoid cross-contamination, do not place clean equipment or equipment parts on the ground.
- Take precautions to avoid cross-contamination of product and/or equipment from high-pressure water sprays.
- Perform cleaning and sanitation activities away from un-harvested products.
- If possible, conduct cleaning and sanitation activities during the daytime.
    - o Nighttime cleaning poses challenges such as restricting your vision to where the harvester lights shine, or where the sanitation truck lights and/or headlight is positioned. It's hard to clean and rinse what you can't see.
    - o Daytime cleaning allows for all areas of the machine to be visible in direct sunlight making it easier to see hard-to-reach areas. Be mindful that cleaning agents will dry faster in the daytime/ direct light.
    - o If sanitizer is drying on surfaces before the 10 minutes of contact time, apply detergent in smaller sections to avoid rapid drying. Rapid drying occurs more commonly during daylight cleaning. Nighttime cleaning allows for more working time with the chemistry before drying.
- If an area becomes excessively muddy during sanitation, move the harvester to a drier area.

Cleaning and Sanitation Preparation Steps

- Personnel and resources: Ensure you have the appropriate resources to conduct cleaning and sanitation activities. The resources include but are not limited to:
  - Trained personnel to conduct cleaning and sanitation activities.
  - Instruments or controls used to measure, regulate, or record temperatures, hydrogen ion concentration (pH), sanitizer efficacy, or other conditions. These must be:
    - Accurate and precise as necessary and appropriate for their intended use
    - Adequately maintained
    - Adequate in number for their designated uses
  - Sanitation tools that are in good condition.
    - Check tools for availability and condition.
    - Use single-use scrub pads and designated brushes that are color-coded for food-contact and non-food-contact surfaces.
- PPE: Ensure all staff have and use appropriate PPE for safety and repeatability of sanitation work (See section B of this document).
- Cleaning and sanitation chemicals: Check that cleaning and sanitizing chemicals are used according to manufacturer's specifications (see section D of this document).

7 Steps for Cleaning and Sanitation

Table 1: 7 Steps for cleaning and sanitation and LGMA documentation requirements

DOCUMENTATION REQUIREMENTS	STEP DETAILS	LGMA DOCUMENTATION REQUIRMENTS
Step 0: Sanitation preparation	• Have the harvest crew remove product, harvesting supplies, and waste from equipment and cleaning area. • Move the harvester to a location away from unharvested product to avoid cross-contamination from spray and run-off. Cleaning and sanitizing chemicals should not reach unharvested product. • Stay on walking surfaces. Never walk or step on food-contact surfaces.	Document and report abnormal conditions prior to cleaning and follow-up as necessary.
Step 1: Dry cleaning	• Prepare equipment to facilitate accessibility to "hard-to-reach" areas. • Remove gross soils from food-contact surfaces and adjacent surfaces. • Wipe excess grease from motors and bearings. • Slowly run conveyers to aid in removal of gross soils as necessary.	

Table 1: 7 Steps for cleaning and sanitation and LGMA documentation requirements (Continued)

DOCUMENTATION REQUIREMENTS	STEP DETAILS	LGMA DOCUMENTATION REQUIRMENTS
Step 2: **Pre-rinse; remove all visible soils and debris**	• Rinse and pay attention to "hard-to-reach" areas. • Remove all visible soils and debris (top to bottom). • Rinse food-contact and adjacent surfaces. • Slowly run conveyers to aid in removal of debris during rinsing as necessary.	
Step 3: **Detergent application, removal of remaining soils**	• Select a detergent that can be applied in field conditions to remove soil and debris. • Apply detergent solution to ensure coverage of food-contact and adjacent surfaces. • Do not allow detergent solutions to dry before scrubbing and rinsing.	
Step 4: **Scrubbing**	• All areas should be scrubbed with hygienic color-coded brushes for food- and non-food-contact surfaces. • Scrub pads are designated for food- and non-food-contact surfaces and are for single-use only.	
Step 5: **Detergent rinse, removal of detergents and remaining soils**	• Rinse equipment top to bottom in the order detergents were applied, to ensure no chemical residues, soils and debris are evident. • Be sure to rinse "hard-to-reach" areas. • Slowly run conveyers to aid the removal of soap and detergent. • Avoid spraying on the ground to avoid splashing and cross-contamination of clean equipment.	

Table 1: 7 Steps for cleaning and sanitation and LGMA documentation requirements (Continued)

DOCUMENTATION REQUIREMENTS	STEP DETAILS	LGMA DOCUMENTATION REQUIRMENTS
Step 6: **Post-cleaning self-inspection and approval for sanitation**	• Prior to putting cleaning materials away, the operator or lead must self-inspect equipment to make sure it is visibly clean (e.g. removal of chemical residues, soils, and debris). • Remove any identified chemical residues, soils, and debris observed during the self-inspection and re-clean as necessary. • Release equipment for sanitizing when visual results and equipment conditions are acceptable.	Document cleaning date and time, equipment identification and inspection results. Identify any damage or items that may need further maintenance (frayed belts, stable condition, hoses, corrosion, chipping paint, excessive lubricant); document and address these items. Document deficiencies and corrective actions including recleaning and follow-up inspection results. If any items represent a food safety risk, equipment must not be placed back into service until corrected.

Table 1: 7 Steps for cleaning and sanitation and LGMA documentation requirements (Continued)

DOCUMENTATION REQUIREMENTS	STEP DETAILS	LGMA DOCUMENTATION REQUIRMENTS
Step 7: Sanitize	• Thoroughly sanitize food-contact and adjacent surfaces. • Upon completion, place cleaning equipment and supplies in designated locations. • Reassemble conveyers and other components. • Clean, wrap and store hoses. • Release equipment for harvesting.	Verify strength of sanitizing solution. Complete remaining sanitation documentation
Day of harvest activities: Prior to beginning harvest, conduct a daily inspection that addresses cleaning and sanitation or a noticeable change in conditions since prior sanitation. Based on the daily inspection, it may be necessary to re-clean or re-rinse and re-sanitize food-contact surfaces and adjacent surfaces on harvest equipment (i.e., accumulation of dirt, debris, dust, droppings, etc.) Document any corrective actions you take, and if a piece of equipment represents a food safety risk, do not put it back in service.		

D. PERSONAL PROTECTIVE EQUIPMENT (PPE)

The use of Personal Protective Equipment is essential in cleaning and sanitizing harvesting equipment to ensure the workers' safety and the effectiveness of the sanitation process.

Best practices for PPE use

- Harvester sanitation personnel must utilize PPE equipment, such as gloves, aprons, boots, face shields, respirators (if required) in a manner that prevents cross-contamination of harvest equipment, tools, etc.
- Using PPE, such as gloves, masks, goggles, and protective clothing, helps protect workers from exposure to hazards (i.e. chemicals, heat/cold, debris, sharp materials) that may be present during cleaning and sanitation activities. Recommended PPEs for cleaning and sanitation activities are identified in Table 2.
- PPE must be handled and stored in a manner that prevents cross-contamination. Place PPE in a container (e.g., bag or box) and not on the ground or just thrown on the back of the truck.
- Supervisors must ensure the crew wears the PPE according to the company's policies.
- When it comes to PPE, do not skip steps or take shortcuts.

Table 2: PPE recommendation for performing harvesting equipment cleaning and sanitation activities

PERSONAL PROTECTION EQUIPMENT (PPE)	BEST PRACTICES AND GOALS
Eye protection *Safety glasses, goggles, or face shields*  	• This preventive eyewear prevents particulates, water, or chemicals from entering the eyes. • Ensure eye protection fits properly and comfortably • Eye protection should allow unrestricted vision and movement
Eye wash stations *(eye wash bottles)* 	• An eye wash station should be made available on the sanitation truck or nearby to sanitation activities. • Eye-wash bottles are made for one-time use and should be fully depleted when used. Eye-wash is an isotonic buffered solution with an expiration date. Use eyewash within the specified shelf-life period. • If eye irritation persists, seek medical attention.

Table 2: PPE recommendation for performing harvesting equipment cleaning and sanitation activities (Continued)

PERSONAL PROTECTION EQUIPMENT (PPE)	BEST PRACTICES AND GOALS
Hearing protection *Earplugs or earmuffs*	• Hearing protectors reduce the noise exposure level and the risk of hearing loss when worn correctly. • Decibel levels above 85 may require hearing protection
Skin protection *Rain Suit (Jacket/Overalls) or Aprons* 	• Rainsuits are used to protect the body from water and chemicals. • The material of these rainsuits is polyvinyl chloride. • To prevent overheating, choose breathable rain jackets with ventilation and ensure workers have regular breaks for cooling and hydration.
Waterproof boots 	• Waterproof boots protect footwear from chemicals and water. • Ensure waterproof boots are slip-resistant, provide ankle support, and fit properly to prevent falls, discomfort, and injury in wet conditions.
Chemical-resistant gloves 	• Use chemical resistant gloves for all cleaning and sanitizing activities. • Chemical resistant gloves are not the same as latex gloves. Unlike latex gloves, chemical resistant gloves are made of a thick waterproof material that does not rip easily.
Verification Activities: Examine skin protection equipment periodically to make sure there are no rips or holes that allow chemicals to get onto clothes and skin. • Check boots periodically to make sure the soles are intact. Worn soles make it easier to slip or fall.	

E. CLEANING AND SANITATION TOOLS AND EQUIPMENT

Sanitation tools and equipment play a crucial role in maintaining food safety by ensuring that food-contact and adjacent surfaces are free from microorganisms, debris, and other contaminants. Effective sanitation practices, supported by the right tools, allow for proper cleaning and sanitation of the harvesting equipment. Properly designed and maintained sanitation tools and equipment, such as brushes, sprayers, and cleaning stations, ensure thorough cleaning of hard-to-reach areas and reduce the risk of cross-contamination, and development of niches. The following section contains information on the tools and equipment used to perform cleaning and sanitation.

Table 3. Cleaning and sanitation tools and equipment

TOOLS OR EQUIPMENT NAME	PURPOSE AND USE
Conveyor belt scrubber with replaceable pads *Brite belt (Unit)*  *Replaceable pads* 	This equipment was developed to clean conveyor belt surfaces in combination with cleaning and sanitizing solutions. This is essential for mechanical scrubbing as it allows for getting rid of debris and biofilm. Replaceable pads should not contain abrasives to prevent scratching the conveyor belt. Replaceable pads should be single-use. Use steps: • Step 1: Attach the pad to the bottom of the unit. • Step 2: Fill the scrubber with your preferred detergent or sanitizer. • Step 3: Bungee or fasten the scrubber unit to the conveyor frame keeping the unit stationary. • Turn on the conveyor for the necessary amount of time to allow proper scrubbing and surface cleaning.
Scrub brushes 	Use color-coded schemes to distinguish brushes for food-contact and non-food-contact surfaces. Scrub brushes should be the appropriate color to prevent cross-contamination between different areas. These brushes should be stored separately by color in a sanitary fashion. Use different shapes and sizes of scrub brushes to increase access to hard-to-reach areas and coverage.

Table 3. Cleaning and sanitation tools and equipment (Continued)

TOOLS OR EQUIPMENT NAME	PURPOSE AND USE
Scrub pads 	Develop a list of approved scrub pads that are non-abrasive. Only use approved scrub pads. Scrub pads should be used on similar surfaces, dedicated to a single wash event and discarded after use (only use single-use pads). Heavy duty scrubbing pads can be too rigid and can scratch the harvester's surfaces.
Pressure washer 	The pressure washer allows for water to have high enough pressure to help remove caked on soils. It is helpful to have a variety of pressure washer tips to use for different types of soil and debris loads.
Buckets/chemical containers 	For cleaning and sanitation activities, two-to-five-gallon buckets may be used for: • holding the appropriate amount of cleaning solution • wetting brushes or pads while cleaning Use color-coded buckets to prevent cross-contamination between food-contact and non-food-contact surfaces.
Portable sprayers	A portable sprayer is used to apply detergents and sanitizers to the harvester's surface. Depending on the application, these sprayers may restrict the volume of solutions that can be prepared.
Foaming device (foamer) 	A foaming device is a preferred tool for applying cleaning solutions to the harvester's surface. These tools deliver desired volumes for achieving uniform coverage of surfaces. When applying detergent, foam should not be allowed to dry on surfaces. If it dries before rinsing, reduce the area being cleaned by applying detergent in a smaller area to minimize the time detergent sits on the equipment.

Table 3. Cleaning and sanitation tools and equipment (Continued)

TOOLS OR EQUIPMENT NAME	PURPOSE AND USE
Foamer metering tips 	Foamer metering tips are small, color-coded nozzles that control the dilution rate of chemicals in foam applicators. Each tip has a specific orifice size, which regulates the amount of chemical drawn into the water flow, allowing for precise control over the foam's consistency and strength. By adjusting the metering tip, users can achieve the desired chemical concentration for effective cleaning, sanitizing, or disinfecting applications, optimizing both product usage and application results.
Ladder or platformed trailer/truck	A ladder-platformed trailer or truck can be used to access hard-to-reach areas on the harvester. Ladders or platformed equipment are used so that no food-contact-surfaces, or adjacent areas are stepped on during the process of sanitation.

F. CHEMICAL USAGE AND CONCENTRATION VERIFICATION

Chemicals are essential for the effective cleaning and sanitation of harvesting equipment. Harvesting equipment often comes into direct contact with soil, plants, and other organic matter, that may contain pathogens and cause contamination of harvested product. By using properly formulated cleaning agents and sanitizers, harmful residues and biofilms can be broken down, effectively removing bacteria and other contaminants that could transfer to fresh produce.

Each company should speak directly to its chemical supplier for recommendations.

- You can use the EPA tool to find labels with instructions of use (Tool).
- The Produce Safety Alliance has also developed a list of 105 commonly used sanitizers in produce operations with specific information and EPA labels (List).

Table 4. Chemical solutions purpose and use and recommended rates.

CHEMICAL	PURPOSE AND USE	RECOMMENDED RATES
Detergents: cleaning agent specifically designed to remove dirt, grease, and other unwanted particles from surfaces and objects		
Alkaline detergents Removes organic soils, such as proteins, fats, and fibers.	• May or may not contain chlorine, foaming agents, wetting agents, surfactants, and rinsing agents. • These solutions can be applied to surfaces with foamers, bucket and brush or flooding using pump sprayers and scrub with a brush or scrub pad. • Allow sufficient time (5-10 minutes) for the solution to penetrate and dislodge and suspend production soils. Do not allow the solution to dry. • Scrub with brush or scouring pad and rinse from top to bottom.	Common recommended dilution for alkaline detergents is 2-8 oz per gallon of fresh water for light to heavy soil. This amount will vary depending on the concentration of the active ingredients. *Reference EPA labels or consult with the chemical distributor for appropriate use rates.*

Table 4. Chemical solutions purpose and use and recommended rates. (Continued)

CHEMICAL	PURPOSE AND USE	RECOMMENDED RATES
Acid detergents Removes Non-Organic soils, such as minerals, salts, and inorganic residues	• Available as non-foaming and foaming detergents. • Applications are for non-soft metal surfaces. It is recommended to test for compatibility and desired results before widespread use. o Acid solution can be applied with a foamer, sprayer, or by bucket and brush. o For best results, start at the bottom of the surface and work up to the top. o Allow the solution to penetrate and dissolve built-up soils. o More than one application may be required, some scrubbing may be necessary to remove exceptionally heavy soils. o Rinse surface from top to bottom with fresh water.	Common recommended dilution for most acid detergents is 3-10 oz per gallon of fresh water. This amount will vary depending on the concentration of the active ingredients. *Reference EPA labels or consult with the chemical distributor for appropriate use rates.*
Sanitizers: Chemical agents used to reduce the number of microorganisms on surfaces		
Chlorine sanitizers	12.5% sodium hypochlorite • 12.5% sodium hypochlorite can be used as a sanitizer. • Prior to using on equipment, rinse all surfaces thoroughly with the sanitizing solution, maintaining contact for at least two minutes. • Do not rinse equipment with water after treatment and do not soak equipment overnight. • The ideal pH range for chlorine sanitizers is between 6.0 and 7.5, where chlorine is most effective as hypochlorous acid, the active form that effectively inactivates pathogens. At a pH above 7.5, chlorine's effectiveness decreases significantly as it converts to hypochlorite, a less potent form.	For 12.5% sodium hypochlorite solutions, use 1 oz per 4 gallon for food-contact sanitizer (200 ppm). If the solution contains less than 200 ppm available chlorine, as determined by a suitable test kit, either discard the solution or add sufficient product to re-establish a 200-ppm residual. *Reference EPA labels or consult with the chemical distributor for appropriate use rates.*

Table 4. Chemical solutions purpose and use and recommended rates. (Continued)

CHEMICAL	PURPOSE AND USE	RECOMMENDED RATES
Quaternary ammonia sanitizers (QAS)	• Many QAS are registered as a sanitizer and disinfectant for use in conventional (non-organic) processes. • Use on precleaned surfaces, thoroughly wetting surfaces with a sprayer or by immersion. For spray applications, use a pump or trigger sprayer. Spray 6 to 8 inches from surface, rub with brush, sponge, or cloth.	The concentration of quaternary ammonia will depend on the manufacturer's instructions. *Reference EPA labels or consult with the chemical distributor for appropriate use rates.*
Peracetic acid sanitizers (PAA)	Peracetic acid is a 5.6% sanitizer solution. • Use in precleaned, hard surfaces thoroughly, wetting surfaces with a sprayer.	Recommended dilution of PAA solutions are 1.0-6.1 oz diluted in 6 gallons of water for 82-500 ppm active PAA. *Reference labels or consult with the chemical distributor for appropriate use rates.*
Other Specialty Detergents and Disinfectants		
Powdered alkaline detergent for use on cutting boards and inside the conveyance	• May be purchased as a chlorine powder with alkaline buffers. • When using for conveyors, make sure the inside of the conveyor is still wet before adding powdered alkaline detergent. Stop the conveyor, add powdered alkaline detergent to the inside of the conveyor, and then run the belt.	The commonly recommended use is to add 1 to 2 lbs. per conveyor but will depend on the size of the conveyor. This amount will vary depending on the concentration of the active ingredients. *Reference EPA labels or consult with the chemical distributor for appropriate use rates.*

Table 4. Chemical solutions purpose and use and recommended rates. (Continued)

CHEMICAL	PURPOSE AND USE	RECOMMENDED RATES
Sterilex disinfectant and Sterilex ultra activator solution For food-contact surface application, environmental, and equipment.	• PerQuat technology combines cleaner and disinfectant all in one solution. • Apply Sterilex solution directly to surface with foam apparatus and scrub with a brush or scouring pad. Allow sufficient time (5-10 minutes) for Sterilex solution to penetrate and dislodge all soils. Do not allow the Sterilex solution to dry. Scrub with brush or scouring pad and rinse from top to bottom.	Mix 1 gallon of Sterilex disinfectant and 1 gallon of Sterilex activator to 10 gallons of water or ½ gallon of each Sterilex solution to 5 gallons of water. *Reference EPA labels or consult with the chemical distributor for appropriate use rates.*

Verification activities for chemicals

Verification of chemicals used in cleaning and sanitation ensures they are effective and correctly applied. It helps confirm proper concentrations to remove potential contamination. Verification prevents misuse and ensures that the cleaning and sanitation performs as expected.

Table 5. Verification activities for chemicals used during cleaning and sanitation activities

Verification Activities:	
Frequency	**Concentration verifications:** After mixing chemicals in solution, the concentration of the solutions must be verified before use. The two most common methods of verifying chemical dilutions are titration kits and test strips.
Verification methods	**Titration kits:** The most accurate way to check the chemical concentration. Provides quantified results (PPM). Please consult chemical provider to know which titration kit should be used based on chemistry. **Test strips:** Provide rapid estimate of sanitizer solution strength. Commonly used to check the following: Chlorine, PAA, and quaternary ammonia. Chemical-specific — each chemical has its own specific test strip. Ensure the test strip concentration range is specific to the concentration you are trying to verify and that the test strips are not expired and are properly maintained.

G. PERIODIC EQUIPMENT CLEANING (PEC)

PEC stands for Periodic Equipment Cleaning, which is a non-routine sanitation task. PEC activities should be part of a facility's master sanitation schedule, and these should be coordinated with preventive maintenance and other departments.

The goals of a PEC include:

- Deeply cleaning hard-to-reach areas to ensure that equipment is free of contaminants that could compromise product safety and quality.
- Meeting regulatory standards and guidelines that require regular maintenance and cleaning protocols.

Hygienic design review

The hygienic design of harvesting equipment is crucial to prevent contamination and ensure the safety of lettuce and leafy greens. Hygienic design focuses on minimizing the areas where pathogens can accumulate (hard-to-clean areas). The best practices for hygienic design are:

- Design or modify harvesting equipment and tools to facilitate cleaning. Food-contact equipment must be constructed and maintained to ensure effective cleaning of the equipment over its lifespan. The equipment should be designed to prevent microbial ingress, survival, growth, and reproduction on both food-contact and non-food-contact surfaces.
- For operations with Category 1 harvesting equipment, a harvesting equipment hygienic design program (i.e., an SOP) shall be implemented and minimally address the following:
  - Conduct a hygienic design review for Category 1 harvesting equipment that evaluates areas of concern for food-contact surfaces and machine infrastructure at least annually, and after designing, purchasing, or modifying harvesting equipment.
  - Areas to evaluate are listed in the hygienic design checklist posted in the LGMA resource website Document Here.
- Document areas of concern that need corrective actions and develop and maintain a timeline for their completion. At the next annual review, review the corrective actions to ensure they were effectively implemented.
- Based on the findings of the hygienic design review, consider the need for PEC as well as documenting the frequency of PECs to be performed.

PEC assessment and PEC frequency

A PEC assessment is initiated after routine sanitation has been completed to assess soil and microbial loads in locations that are not typically accessible. Schedule PEC assessments as part of the MSS. Steps for conducting a PEC assessment include:

- Disassemble equipment to expose niches and sandwiched surfaces.
- Inspect and swab selected areas that have been exposed through disassembly.
- Rinse and clean equipment and parts that have been fully disassembled to remove exposed soils.
- Inspect and re-swab the same sites that were evaluated at the disassembly step. This will help identify areas to pay attention to during PECs. These areas may include but are not limited to:
  - Guide strips under conveyor belts, bearing at the conveyor drive, conveyer cog wheels, support rollers, the mechanical drive and idle rollers, tunnel flaps (sandwich joints), sprayer nozzles (hose and connections), unexposed areas of cutting boards, and sandwich joints.

- Sanitize all surfaces of the disassembled equipment and parts.
- Re-assemble disassembled parts/equipment and fully clean the equipment.

PEC frequency will depend on the hygienic design review and PEC assessment. Include the frequency of cleaning as part of the MSS.

Steps for performing a PEC

- **Sanitation after using the equipment:** Before the PEC activities take place, the sanitation crew must follow the 7 steps of cleaning and sanitation to remove all soils and organic material.
- **Preparation for disassembly:** Set up clean plastic pallets to place the machinery components or parts on them, as well as containers with sanitary solutions to dip small parts. Disassemble the equipment to expose niches and sandwiched surfaces.
- **Visual inspection and pre-swabbing**
  - Perform a visual inspection to identify the hard-to-clean components. (For examples of these hard-to-clean components, reference the Harvest Forward Group White Paper on PEC.)
  - Collect the swabs from the sites identified (see section G for an example of swabbing sites and swabbing procedures) and place the samples in a properly refrigerated cooler box for further analysis.
  - Dismantle the equipment and place the parts on clean pallets and tables. Do not place it on the floor.
  - Perform cleaning and sanitation on the equipment parts.
  - Collect pictures for future reference and data validations.
  - Dip small parts in containers with an appropriate sanitizing solution.
- **7 steps – deep cleaning**
  - Perform deep cleaning activities following the specified SOP for deep cleaning activities.
  - Allow the machine to air dry.
  - Perform the 7 steps for cleaning and sanitation identified in Section B of this document.
- **Post-swabbing**
  - Conduct post-swabbing activities by swabbing the identified swabbing sites in the pre-swab step. (See section G for an example of swabbing sites and swabbing procedures.)
  - Discard single-use cleaning and sanitation tools.
  - Perform remaining sanitation of areas/tools to be used during reassembly.
- **Reassembly and final inspection:**
  - Reassemble the equipment using clean, sanitized tools.
  - Perform a test to ensure that the equipment was reassembled correctly.
  - Perform an inspection and conduct re-cleaning and sanitation if needed.
  - Document activities that took place.
- **Release**
  - During this step, any excess oil/grease is manually removed.
  - Maintenance will release the machine before returning to harvesting activities.

H. CLEANING AND SANITATION VERIFICATION

Sanitation verification is essential in harvesting equipment cleaning to ensure that procedures are followed correctly and effectively, helping to detect any residual contamination. This process includes three types of verification activities:

- **Visual verification:** Check for visible cleanliness.
- **ATP verification:** Use ATP swabs to detect any remaining organic material. ATP testing involves swabbing a surface, mixing the sample with a reagent, and using a luminometer to measure light produced by the reaction. The results provide immediate feedback on surface cleanliness, allowing for quick corrective action if needed.
- **Microbial verification:** Assesses for the presence or quantification of microorganisms to confirm and verify cleaning and sanitation activities. This involves collecting surface samples, typically through swabbing or contact plates, and analyzing them to detect and/or quantify microorganisms on equipment surfaces.

Table 5: Types of Cleaning and Sanitation Verification Procedures:

VERIFICATION TYPE	DESCRIPTION	COMMENTS
Visual inspections	This is the process of looking over a piece of equipment using the naked eye to look for deficiencies. When conducting a visual inspection, be sure to look at the top side and underside of belts, rollers, between support structures, and any often-overlooked areas. Visual inspections should be done by trained individuals.	To be done after routine equipment cleaning (daily) and as part of the pre-operational inspection.
ATP readings	An ATP meter is used to quickly assess surface cleanliness by measuring (ATP) levels, which indicate biological contamination. After swabbing a surface, the sample is placed in the meter, which quantifies ATP through a luminescence reaction, with results displayed in relative light units (RLU). Higher RLU readings suggest higher contamination levels, allowing for immediate corrective action if cleanliness standards are not met. **Limitations:** Little correlation with microbial load or presence of pathogens.	Entry point for monitoring, useful for first time swabbing and continued use on food-contact surfaces. Should ONLY be done after routine cleaning activities. Interpreting and accepting the results should be relative to historical data and observations as factors, such as the type of ATP unit, different surfaces, etc. affect results.

Table 5: Types of Cleaning and Sanitation Verification Procedures: (Continued)

VERIFICATION TYPE	DESCRIPTION	COMMENTS
Microbial testing†	Indicator organisms: • Directly verify the effectiveness of cleaning and sanitation • Serve as early warning of potential pathogen presence • APCs, coliforms, generic *E. coli, Listeria spp.* Pathogens: • Can be used to verify control measures • Useful in "seek and destroy" programs • *L. monocytogenes, Salmonella* *†Use of microbial testing is recommended for indicator organisms. If testing for pathogens, do it cautiously.*	Ideally, microbial verification would be done to verify the efficacy of the cleaning and sanitation procedures.

Generic SOP to perform ATP verification and microbial verifications.

Below, you will find a generic SOP for performing ATP verification and microbial verification. These procedures outline basic recommendations and are intended as a general guide. Each company should perform a thorough risk assessment and leverage the expertise of their food safety professionals to develop customized verification programs tailored to their specific needs and operational risks.

Table 6. Generic SOP for performing ATP verification

STEP	DESCRIPTION
Setting thresholds	While many other test types have well-established or regulated levels at which corrective action must be taken, acceptable ATP levels are based on historical data and observations as factors, such as the type of ATP unit, different surfaces, etc. affect results. Thresholds can be established by three different methods. (Those toward the bottom of the list require more data points to decide the threshold.) a. By following manufacturer guidance b. By performing statistical analysis of before and after cleaning tests c. By performing in-depth statistical analysis.

Table 6. Generic SOP for performing ATP verification (Continued)

STEP	DESCRIPTION
Setting thresholds (Continued)	Information of setting cut-off levels can be found here: Environmental Monitoring Handbook • Passing = less than _____RLU • Failed = greater than _____ RLU; this requires a corrective action and re-swab
Generic ATP testing procedure	**Preparation** • Ensure the swab test kit is at room temperature for at least 10 minutes before use. • Do not remove the swab from its packaging until you are ready to begin sampling. **Handling the swab** • Carefully remove the swab by the handle to avoid contaminating it. • Only touch the handle; avoid contact with the swab tip. **Sampling technique** • Hold the swab between your thumb and forefinger. • Apply consistent downward pressure and rotate the swab to ensure full contact with the surface. • Avoid touching the swab tip or allowing it to contact surfaces not intended for sampling. **Sampling area** • Swab a defined area (e.g., 10 cm x 10 cm) for a representative sample. • For irregular surfaces, ensure the entire swab tip contacts all areas consistently. **Getting results** • Break the valve or stem with the enzyme and mix the liquid into the tube to activate the reaction. • Shake for a few seconds. • Insert the swab into the luminometer chamber and close the lid. • Initiate the measurement in the luminometer. • Read the results. • Record the number of relative light units (RLUs). **Avoidance of adverse conditions** • Avoid excessively wet areas, which can dilute the sample. • Avoid direct sunlight exposure to prevent false readings. • Refrain from sampling visibly soiled surfaces.

Table 6. Generic SOP for performing ATP verification (Continued)

STEP	DESCRIPTION
Frequency and location recommendations Per CPS research, sampling frequency of sites should be based on the results of appropriately designed and executed swabbing surveys of the process and sanitation effectiveness.	ATP is recommended for Zones 1 and 2 only. Daily - 3 ATP swabs completed per harvester • Top of horizontal vinyl belt • Top incline • Inside stainless or canvas collar Weekly - 5 ATP swabs and 5 APC swabs. • Top of horizontal vinyl belt • Top incline • Inside collar stainless or canvas collar • Inside vinyl conveyor • Inside incline
Corrective actions	• Must be conducted in a timely manner. • When a corrective action is required, re-rinse the entire surface with chlorinated water. Re-apply detergent, re-scrub, and rinse the entire section of the equipment including failed area. Repeat this step until you get results below the established threshold. • Correction actions taken in the event of a failing result should be documented as part of the quality system and followed up with to prevent a recurrence.

Table 7: Generic SOP for performing a microbial (indicator organisms) verification

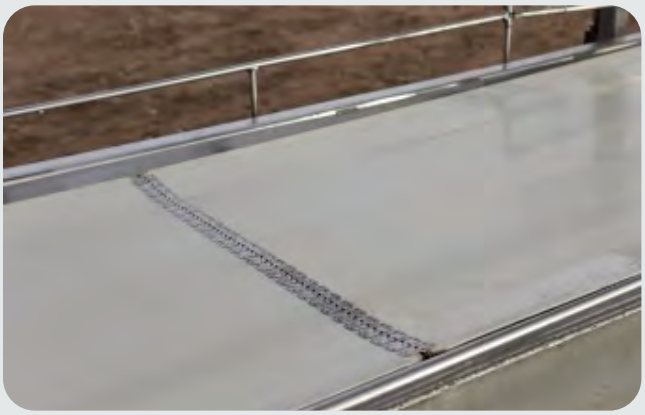
STEP	DESCRIPTION
Establishing a baseline for indicators and cut-off levels	• Quantitative results from indicator organism testing are especially valuable, as they enable further analysis and can help establish baseline levels. • Regular analysis of this data helps identify trends and specific issues, allowing for timely corrections and corrective actions. • Baseline levels indicate the consistent effectiveness of a sanitation program across the facility or process and can reveal when results fall outside the desired sanitation standards. • Baselines can be established by collecting samples after successive sanitation cycles from each test point, with results plotted on a process control chart to define the baseline. • The limits can be determined in several ways, including utilizing the baseline levels and leveraging historical data. • Following sanitation, low levels of indicator organisms are expected on surfaces. Information on setting baseline and cut-off levels can be found in the linked environmental monitoring handbook.
Swabbing procedure	• Write sample information on bag. • Tear open the sample pouch by pulling the tabs on either side of the top of the pouch to create a large opening from which to remove the sponge. • Push on the outside of the pouch to pop the handle out so it protrudes from the opening. • Grasp the handle behind the thumb-stop and remove the sponge from the pouch. Do not touch the inside of the bag. Do not touch the stick below the thumb stop. • Swab a sampling surface 12 in x 12 in with the sponge, ensuring to turn the sponge over to gather sample on all ends. Ensure a reasonable amount of force is applied to the sponge when swabbing any surface. • Return the sponge to the pouch. Do not insert the sponge any further than the thumb-stop. • Pinch the sponge from the outside of the bag with thumb and forefinger, then bend the handle back and forth to break off the sponge at the score mark below the sponge edge. • Fold down the top of the pouch and use the wire tabs to secure the pouch.

Table 7: Generic SOP for performing a microbial (indicator organisms) verification (Continued)

STEP	DESCRIPTION
Swabbing locations	When used for verification of sanitation efficacy, sampling should take place after every sanitation cycle and prior to production startup to allow for the analysis of the results and early identification of issues. Weekly - 5 APC swabs. Locations should be randomized to ensure representative sampling of the equipment. Potential sampling sites include: • Top of horizontal vinyl belt • Top incline • Inside collar stainless or canvas collar • Inside vinyl conveyor • Inside incline
Corrective actions	• Corrective action documentation should include details of actions taken, outcomes, dates, and personnel involved. • Significant deviations should prompt a re-evaluation of the sanitation plan and retraining in sample collection techniques.

POTENTIAL HARBORAGE SITES LOCATIONS.

Conveyor Belts



Equipment Seams

Welds

Rollers

I. SAFETY RESOURCES

Ensuring the safety of personnel involved in cleaning and sanitizing harvesting equipment is paramount. Adherence to established safety standards and guidelines is essential to protect workers from potential hazards. Key resources include:

- Occupational Safety and Health Administration (OSHA) Standards: OSHA provides specific regulations for agricultural operations, including the guarding of farm field equipment to prevent injuries during maintenance and cleaning activities. (Information here)
- National Institute for Occupational Safety and Health (NIOSH): NIOSH provides resources on reducing risks associated with chemical exposure, ergonomics, and machine safety. (Information here)

ADDITIONAL RESOURCES

- Commercial Food Sanitation resource page: Resources | Commercial Food Sanitation

Cleaning and sanitation guides:

- Harvester cleaning procedure guidance: Harvester - CFS Harvester Cleaning Procedure Guidance 3.pdf (kc-usercontent.com)

Specific pieces of equipment:

- Cutting boards: Harvester - Cutting Boards 3.pdf (kc-usercontent.com)
- Knives and sheaths: Harvester - Knives and Sheaths 3.pdf (kc-usercontent.com)
- Tarps: Harvester - Tarps 3.pdf (kc-usercontent.com)
- Trucks: Harvester - Trucks 3.pdf (kc-usercontent.com)

Scientific information:

- PEC White paper: Harvester - White Paper Periodic Deep Cleaning Study of Harvesting Equipment 2022.03.14.pdf (kc-usercontent.com)
- Fresh Produce Harvesting Equipment – A Review of Cleaning and Sanitizing Practices and Related Science
- CPS Tri-State Special Project on Harvest Equipment: A data-informed consensus of "clean for the intended purpose" – Research by: Dr. Channah Rock and Dr. Michelle Danyluk in collaboration with Dr. Trevor Suslow, Justin Kerr
  - Final Report
  - Webinar PPT

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