Best Practices for Beef Slaughter

Developed By:

National Meat Association
Southwest Meat Association
American Meat Institute
National Cattlemen’s Beef Association

Facilitated By:

Kerri B. Harris and Jeff W. Savell
Department of Animal Science
Texas A&M University

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This document was designed to discuss food safety best practices that can be used throughout the slaughter operation. The use of best practices along with current science and technology allows slaughter operators to produce visibly clean carcasses and to reduce the incidence level of pathogenic contamination. There are multiple ways to reach the desired results, and each operator must be able to apply the practices and procedures that best fit their individual operation. This document is not designed to force the use of any specific system or technology or to address regulatory issues. The purpose is to stress the importance of knowing that each establishment must determine the desired end-results that it wishes to achieve and to provide insight on process steps that my be useful and implement the appropriate practices based on the plant’s specific system.

It is also important to note that the finished product is still a raw product and may not be free of pathogens. Because we are not able to identify the carcasses that are contaminated with pathogens, it is best to assume and treat 100% of the carcasses as if they are contaminated.

Before we discuss the steps that can be taken at each point of the process, there are several broad issues that each establishment should take into consideration.

Facilities:

Facilities must be assessed to ensure that the design, construction, product flow, personnel flow, and overall operation contribute to the production of safe and wholesome products. The entire operation should be analyzed to determine locations and/or activities that can contribute to carcass or product cross-contamination.

Facilities:
Facilities must be assessed to ensure that the design, construction, product flow, personnel flow, and overall operation contribute to the production of safe and wholesome products. The entire operation should be analyzed to determine locations and/or activities that can contribute to carcass or product cross-contaminations. Items that should be considered:

- Slaughter floor “hide-on vs hide-off” separations - by adding physical barriers, proper designing of air flows, and/or flow of the operation and personnel. The clean vs dirty concept should include design of facilities, as well as actions taken by maintenance, QA, inspectors, and flow of traffic (employees and tour groups) to prevent contamination of carcasses.
- Air Flows – air movement must be controlled and move through the plant coming in from ‘clean’ areas and moving out through ‘dirty’ areas. Operations should consider the air-flow throughout the plant – coolers, cut floors, kill floors - including air from personnel fans, on the kill floors and ensure that air is not carrying contamination into exposed product.
- Air Quality - make-up air pulled in to plant should be assessed for directional source, environmental contamination potential, filtrations may be needed.
• Roofing – roof leaks and leakages must be prevented, especially in the carcass chilling coolers and hot boxes. Continuous preventative maintenance and QA assessment programs are critical.

• Drains – drains in coolers and plant rooms must be assessed for proper constructions and maintenance [P-traps, blockages, breakages, etc]. Continuous preventative maintenance and QA assessment programs are critical.

• Separation of welfare areas of employees from clean areas vs dirty areas [Production, Maintenance, QA, etc - cafeterias, break-rooms or locker rooms for employees or scheduling of breaks and lunch to reduce the potential for contamination during these times are examples of operational changes].

• Mid-shift clean-up and cooler cleanings should be conducted in a manner to prevent splash and aerosols onto exposed product.

• Rendering & Hide systems – plants with rendering or hide systems located under or near the slaughter plant need to attend to proper air flows and personnel and product movements, including contingency plans when mechanical failures or backed up inedible products occur. Programs should be developed to ensure proper procedures for employee hygienic practices, hand-washing practices, cleanliness of dress, use of equipment, etc. are followed.

• Employee training is a critical part of the success of the overall operation. Establishments should be committed to providing the employees with the knowledge and the resources to conduct their jobs as efficiently and effectively as possible.

**Maintenance/Production Issues:**

Procedures should be available to ensure that all maintenance employees, equipment, tools, etc. are cleaned and sanitized or used in designated areas to control contamination. These procedures should also address proper dress (frocks, boots, gloves) for maintenance employees.

**Emergency Procedures**

If unexpected interruptions occur (extended mechanical downtime, refrigeration failure, power outage, etc.), the plant should have procedures, that can be implemented quickly, in place to ensure the safe handling of edible products. This may include extraordinary measures of carcass or product protection or inspection, including time-temperature monitoring, extraordinary cooling-chilling actions, discarding of sensitive or heavily abused product, microbiological testing of carcasses or product, extraordinary finished product testing, etc. Each situation is different and must be assessed case-by-case.

**Water Re-use:**

Operations re-using water must follow all FSIS guidelines including treatments to ensure that there is no introduction of pathogens. This applies to re-circulated water in thermal pasteurization units. If re-use water is not reaching a potable water standard, then it is
important to ensure that this re-used water is not used in areas that could cause contamination of product, equipment, contact surfaces or employees.

The regulatory requirements for water reuse are listed in 9 CFR 416.2(g). FSIS also issued a Sanitation Performance Standards Compliance Guide which provides in-depth guidance on how an establishment may meet the regulatory requirements with respect to specific water reuse applications. It can be found at http://www.fsis.usda.gov/oppde/rdad/frpubs/sanitationcover.htm.

**Plant Sanitation Program:**

Establishments should meet all regulatory requirements of the Sanitation Performance Standards and the Sanitation Standard Operating Procedures. Each plant should develop and implement an effective sanitation program that will ensure sanitary conditions for both pre-operational and operational activities. The program should provide details on sanitizing specific areas, complete equipment breakdown, zone cleaning, etc. The plant may set a target microbial level or utilize bioluminescence testing to demonstrate sanitary conditions are maintained and develop a system for monitoring and documenting this on an ongoing basis. It is important to be able to demonstrate the effectiveness of the program. Non-routine cleaning of indirect areas can be conducted per a master sanitation plan.

**Training:**

Documented training programs should be in place to ensure that employees know, understand, and can fully execute appropriate tasks for their specific position.

These tasks include but are not limited to:
- Prevention of visible contamination from the hide or viscera to the carcass surface
- Sanitizing of hand tools
- Washing/sanitizing of equipment
- Necessary actions in the event of visible contamination
- Procedures for notifying supervisor of abnormal events or activities that may impact product safety.

**Validation:**

Validation is a very important issue that each plant must address. Validation should include both the individual parameters, (i.e., CCPs) and the overall food safety system. Validation is the process of ensuring that the CCPs and program will control the identified food safety hazards. This can be done using scientific literature, in-plant data, and other information. It is important that establishments demonstrate in-plant capabilities through ongoing documentation when possible. To achieve the optimum level of safety, a company must have a validated program and must be able to successfully execute the program on a consistent basis. Failure to validate the system and
to conduct ongoing verification may lead to failure of the overall system.

The rest of the document focuses on the major steps for processing cattle. Every establishment has a slightly different process, but these were identified as key steps.

Cattle Receiving/Unloading:

Note: This document focuses on safety issues. For information on humane handling the following link can be used to access the American Meat Institute’s Recommended Animal Handling Guidelines and Audit Guide
http://www.animalhandling.org/ht/d/sp/i/26752/pid/26752

It is noted that all operators should be receiving statements to confirm compliance with the ruminant feed ban from all cattle suppliers. These should be on file and updated as needed to ensure compliance.

• **Holding Pens:** A pen-cleaning schedule should be developed to ensure that pens and troughs are kept as clean as possible irrespective of the season and condition of the cattle.
• **Mud/Dust Scoring** - no direct relationship has been established between condition of cattle and presence of O157:H7. However, many processors utilize a mud/dust scoring system to aid in assessing incoming hide conditions that allow for adjustment to the slaughter process to minimize or prevent hide contaminants that may be present.
• **Long Haul or Stressed Cattle** – special considerations are needed for cattle that have experienced inordinate stress in movement to slaughter. Physiological stress causes dehydration/rehydration issues to consider.
• **Hold-Over Cattle** - If cattle are held over on long weekends or fed during holding then handlers should address appropriate feed withdrawal procedures in consideration to issues that may occur during evisceration and processing of these types of cattle.
• **Size Variations and Extreme** – cattle of different sizes and shapes must be considered in the facility design and dressing hygiene applications.

If the operation processes cattle that may have a greater potential i.e., show steers, veal and cull cows, for chemical residues, then procedures should be in place to relay information back to the suppliers. This system should help identify repeat violators and decrease the potential for violative chemical and antibiotic residues. For more information on residues, please see
Cattle/Hide Washing:

Properly designed and engineered cattle wash systems have been demonstrated to show a reduction in pathogen loads on hides as they start the de-hiding process. Simply washing cattle with a hose has been shown in some cases to increase the microbial problem and in other cases to improve it. Because of this, there is still an uncertainty on the microbial benefits or problems created by washing cattle prior to entering the pens. Some establishments have demonstrated that washing the cattle helps reduce visible contamination and aids with the sanitary dressing procedures. Misting the cattle often helps reduce airborne dust and dirt particles on the slaughter floor. There is a tremendous amount of variation with seasonal influences and types of cattle being processed. Therefore, if an establishment chooses to implement a cattle wash system, the procedures for application may vary and validation of effectiveness is needed.

There are post-stunning/bleeding hide washing systems in place that apply antimicrobial agents. These systems have been shown to significantly reduce pathogens on hides and the resultant carcasses. The procedures for application may vary and validation of effectiveness would be plant dependent.

Hide Removal & Evisceration

Hygenic hide removal and evisceration techniques are critical to prevention of direct and indirect contaminations from the hide and ingest onto the exposed carcass and associated offals. Many process steps are involved in the effective and hygenic removal of the hide and viscera. Areas that merit special attention and focus are:

Sanitizing equipment:

It is important that the sanitizing process for equipment is effective. If using hot water to sanitize a knife, then the establishment may need to leave the knife in the dip long enough sanitize (180°F has been shown to take approximately 4-6 seconds, but this varies based on the level of contamination) See Taorima, et. al., JFP, 70: 648-654. Other options include adding a chemical sanitizer. Remember, it is important that the plant be able to demonstrate proper sanitation.

Hand tools and knives that contact the outside of the hide or the viscera should be rotated with each use and placed in 180 degree water when not in use (alternate colored handles may help assess compliance with knife rotation) to ensure adequate time/temperature for sanitizing. This is accomplished by having at least two tools per key hide opening positions and leaving one in the sanitizer while the other is being used. Knives must be sharpened (or steeled) prior to sanitizing to prevent cross-contamination.
Sticking:

Initial hide opening should be done with as small of opening as possible to expose the jugular. Actual bleeding may be performed using a two-knife system that allows for one knife to remain in the sanitizer while the other one is being used (as described above).

Hide Removal

Establishments must ensure that the facility is designed properly to provide sufficient sanitation stations, tools, gloves, equipment, etc., to allow the employees to properly conduct the recommended procedures.

The hide removal personnel must follow procedures for hand washing, cleaning of arms and gloves based on the task being performed to prevent contamination. These practices will vary based upon the task and should be monitored and evaluated on a routine basis to ensure process control.

Establishments should have sanitary dressing procedures during hide removal. The success of proper dressing procedures relies heavily upon the employees conducting the activities with a high level of skill and care. Therefore, the employees must be trained, supervised effectively, and audited routinely to ensure proper dressing. When problem areas are identified, the root cause of the contamination should be determined and steps taken to prevent contamination and achieve process control.

Manual Hide Removal: Hide opening patterns should be as clean as possible, and may require the removal of visible contamination before hide opening. Clean and sanitized equipment should be used to prevent contamination of the carcass surface. If contamination occurs, it should be removed as soon as possible. It is noted that it may be best if the contamination is removed at a subsequent step because it might not be possible to remove it at the point of occurrence without causing more contamination.

Mechanical Hide Removal: Mechanical hide pullers should be implemented in a manner designed to reduce hide slaps, splatters, and operator contamination from the hide onto the carcass. The operator should maintain clean hands and equipment to prevent contaminating the carcass during removal. Operators should closely observe the equipment to ensure that it is functioning properly to prevent cross-contamination of the carcass from the equipment.

When using mechanical hide pullers, the tremendous energy exerted during the final removal of the hide can generate aerosols. Air flow at this step in the slaughter operation should direct any aerosols created away from the carcasses being skinned to prevent contamination of the carcasses.

Operations may explore opportunities for using hooks for holding the hide or the use of paper/plastic on key areas (brisket, leg, etc.) and bags (tails and bungs) to reduce potential visible contamination.
Carcasses requiring reconditioning should be identified and handled appropriately throughout the system to reduce potential contamination.

**Pre-evisceration carcass wash:**

Carcasses should be subjected to a water rinse and/or antimicrobial treatment shortly after hide removal.

**Bunging:**

The bunging process must start with a clean, sanitized knife/equipment. Employee should make one incision to separate the bung. A hook may be used to hold the separated bung ensuring that it does not touch the carcass and should be bagged, tied or banded to prevent leakage. Employees should use proper procedures for cleaning equipment and hands/gloves, etc. to prevent contamination between animals. If contamination occurs during the bunging process, then the carcass should be identified and handled appropriately to remove the visible contamination. These are important steps and must be done properly to reduce the potential of contaminating the carcass.

**Open Brisket:**

Brisket opening is usually a two-part process (knife and saw). The initial knife cut should be made with a clean and sanitized knife. The saw should be cleaned and sanitized between carcasses to prevent cross-contamination.

**Head Removal:**

Heads must be removed in a sanitary manner to prevent contamination. This process step may also involve the activities for dehorning, ear removal, etc. Employees must clean and sanitize hands and equipment throughout the head removal process to ensure sanitary dressing.

The washing of heads should be done in compartments or areas that will control the splash of wastewater to prevent contamination of other heads or adjacent carcasses. The oral and both nasal cavities should be thoroughly flushed before washing the outer surfaces of each head. Each head should also be free of all hair and other contamination prior to inspection. Depending on the use of the heads and/or cheek meat, establishments may consider applying an antimicrobial intervention to reduce biological contamination.

**Rod Weasand:**

To ensure sanitary conditions, the employee must wash hands and use a sanitized rod for each carcass.

**Evisceration:**
Evisceration procedures must be developed and implemented for proper sanitary dressing, including the proper weasand removal and bunging activities conducted previously. The equipment should be sanitized to prevent contamination. An automated viscera table will often include automatic sanitation; however, establishments using carts/trucks should make sure that procedures are in-place to prevent cross-contamination. If there is a problem during evisceration that results in contamination, then the carcass should be identified and handled appropriately.

Viscera should remain intact and all paunch opening and viscera processing should be conducted in an area/manner that will prevent contamination of the carcass by either direct or aerosol contamination.

The actual removal of the viscera from the carcass is a critical phase of the dressing operation. Care should be taken to avoid cutting or breaking the paunch and intestines. If carcass tissues become contaminated from visceral contents, they should be removed by trimming with a knife or cleaver.

**Splitting Saw:**

Carcass split saws should be cleaned and sanitized frequently during operations with 180 degree water or chemical sanitizer.

**Final Trim:**

All employees must be properly trained to conduct trimming of visible contamination. All equipment (hooks and knives) should be sanitized between each use to reduce cross-contamination between areas and/or carcasses.

All visible fecal contamination should be removed as soon as possible after it occurs to prevent microbial attachment. As noted previously, it may be best if the contamination is removed at a subsequent step because it might not be possible to remove it at the point of occurrence without causing more contamination.

**Rail Out:**

All employees must be properly trained to conduct trimming of visible contamination. All equipment (hooks and knives) should be sanitized between each use to reduce cross-contamination between areas and/or carcasses. Carcasses that are railed out for visible contamination, such as busted guts, fecal contamination, etc., should be reconditioned as quickly as possible to get the carcass through the process and back into the system.

For carcasses that spend an excessive amount of time in an out-rail location, establishments may consider treating these cattle with a separate intervention (i.e.,
organic acid spray) upon entering and/or exiting the out rail. Other considerations should include carcass spacing, time on the rail, etc.

The establishment should work with agency personnel to ensure that carcasses are moved through the system as rapidly as possible, so that they do not remain on the slaughter floor for extended periods.

Carcass Wash:

The carcass washing procedure is designed to remove incidental contamination (blood specs, bone dust, hair, etc.). Carcass washing is designed to impact carcass quality and to prepare the carcass for chilling. The washing should proceed from the top of the carcass in a downward direction to prevent recontaminating an area. Washing should be completed before shrouding, if applicable.

If using a wash cabinet, the carcass wash should address the spray patterns, the pressure of the water, the volume of water applied, and the time the carcass is in the cabinet. The pressure should not be high enough to drive the contamination into the fat and carcass tissue. Also, the drains must be working properly to prevent backup that could create additional contamination as the carcass passes through the wash cabinet.

The cabinets must have a preventive maintenance schedule to ensure that the equipment is functioning as designed, including nozzles, filters, etc. The parameters of the equipment should be documented to demonstrate that it is efficient.

If the carcass wash is conducted by hand with a hose, then the lift must be sufficient to reach the top of the carcass and the wash should be sufficient to clean the carcass.

Carcass wash areas, hoses and equipment should be maintained in a clean and sanitary condition.

• Microbial intervention methods are best applied after the carcass wash step because this is the last step before chilling. Microbial intervention methods are effective in removing bacterial contamination that may not be visible on the carcass. Establishments should tailor the intervention method to be used to the specific processing operation. Several microbial intervention methods are discussed in a subsequent section in this guidance, and scientific references are available at in a document entitled, “Reference Document: Antimicrobial Interventions for Beef” located at <http://www.bifsco.org/>.

• Measures should be implemented to ensure that bacterial reduction achieved by the intervention methods used is maintained during the rest of the operation, and that additional contamination does not occur.

Cold Chain Management:
The emphasis of carcass chilling should focus on the carcass surface temperature because this is where the pathogen contamination is most likely. Operators must know the
parameters of their cold chain system to achieve the desired chill rate to minimize the potential for pathogen growth. In order to ensure the optimal level, operators should know the chill capacity of the boxes, the locations of hot spots and the variation in chill rates for different carcass locations. This includes all factors that contribute to temperature reduction of the carcass — spray chill, carcass spraying, air-flow, BTUs, etc.

Although not regulatory requirements, FSIS recommends the following: (FSIS, Guidance for Minimizing the Risk of Escherichia coli O157:H7 and Salmonella in Beef Slaughter Operations <http://www.fsis.usda.gov/OPPDE/rdad/FRPubs/00-022N/BeefSlauterGuide.pdf>).

• All carcasses need to begin chilling within 1 hour from bleed-out. All variety meats need to begin chilling within 1 hour after removal from carcass. Refrigeration parameters should be defined, established and recorded so that carcass reach a temperature of 40 °F or less within 24 hours, and that this temperature is maintained on all products. Carcass temperature should be taken and recorded daily from 5 randomly spaced locations, usually 1 mm under fascia on the inside round.
• To prevent cross contamination and to allow efficient air circulation, cooler storage rails must be placed at least two feet from refrigeration equipment, walls, columns, and other fixed parts; traffic or header rails during transport, at least 3 feet from the walls. Sides of beef should be placed in the chiller so that there is no contact between them to allow efficient air circulation. Condensation should be prevented or minimized.
• Finished product storage areas should not exceed 40 °F.
• Aged beef should be held no longer than 7 days at a temperature not exceeding 40 °F.

The cooling capacity must be sufficient to reach desired chill rate and to minimize the formation of dripping condensation in the hot boxes. In order to minimize condensation, establishments should explore options for rotating the filling of the hot boxes, carcass spacing, increasing air-flow and BTUs, etc.

Walk-ways should be cleaned on a routine frequency to prevent contamination from the floor and wall from splashing onto the carcass. Hot boxes, including spray chill systems, should be emptied and thoroughly cleaned from the top to the bottom on a rotational basis.

Procedures should be in-place to recondition any carcasses that fall, become contaminated during chilling, etc. The reconditioning should include a microbial intervention such as an organic acid spray.

Because the following products may be used in ground beef and/or pure beef patties, consideration should be given to establishing a CCP for E.coli O157:H7 in the HACCP production plans.

Cheeks
Head Meat
Establishments should explore options for using microbial interventions to reduce contamination and procedures should be in-place to reduce the temperature of variety meats and by-products as quickly as possible to prevent pathogen growth. If products are destined for raw ground beef production, *E. coli* O157:H7 testing should be conducted using a robust sampling method and a laboratory methodology that is at least as sensitive as the FSIS method. (See Best Practices for Using Microbiological Sampling <www.bifsco.org>.)

Whole Heads – Proper procedures must be in place for flushing the brains, cutting the tongue, and presenting the heads for post-mortem inspection. Employees should work with inspectors to ensure these procedures occur in a timely manner. Heads can be treated with a microbial intervention.

Processing – Proper procedures for maintaining clean and sanitized equipment must be in-place throughout the process for removing and processing the cheek meat, head meat, salivary glands, lips, tongue, weasand, and the brains. Employees must be trained in the proper handling procedures for these items. It is important to chill these items in a timely manner to maintain product quality and safety. As stated previously, variety meats need to begin chilling within 1 hour after removal from carcass. Refrigeration parameters should be defined, established and recorded so that carcasses reach a temperature of 40 °F or less within 24 hours and maintained on all products.

Chemicals used as processing aids for certain variety meats should be used according to the manufacturers’ guidelines.

Edible Blood: For operations that are collecting edible blood, it is important to ensure sanitary collection practices and proper temperature control of the product.

Edible Rendering: (Edible Fat, Bones, Viscera) Operations that are collecting product for edible rendering must have a procedure in place to ensure that specified risk materials are removed and not allowed to enter the edible rendering process. The temperatures used in the edible rendering process should be controlled and documented.

**Interventions:**

**Validation:**
Validation is a very important issue that each plant must address. Validation should
include both the individual parameters, (i.e., CCPs) and the overall food safety system. Validation is the process of ensuring that the CCPs and program will control the identified food safety hazards. This can be done using scientific literature, in-plant data, and other information. It is important that establishments demonstrate in-plant capabilities through ongoing documentation when possible. To achieve the optimum level of safety, a company must have a validated program and must be able to successfully execute the program on a consistent basis. Failure to validate the system and to conduct ongoing verification may lead to failure of the overall system.

To maximize the effectiveness of the interventions that are being used, the best practice is to make sure that carcasses are as clean as possible before the application of the intervention.

Steam Vacuum: Steam vacuums are a processing aid used to help remove visible contamination on the cut pattern. When using steam vacuums, it is important to monitor the temperature, vacuum, and steam pressure of the equipment to ensure that it is working properly. There should be a preventive maintenance procedure for cleaning the canister of the equipment. The steam vacuums should be used according to the manufacturer’s specifications and maintained in a condition to ensure they can achieve desired results. Operators should consider developing a procedure for monitoring and documenting the parameters of the equipment. Operators must also follow the regulatory guidelines for removal of contamination based on size of contamination (less than 1 inch).

Thermal Pasteurization (Hot Water or Steam Pasteurization):

For hot water cabinets, the water pressure is an important factor because it should not be high enough to force contamination into the fat or tissue of the carcass.

For thermal pasteurization, the temperature of water or steam is also important and should be able to deliver hot water sufficient to raise the carcass surface temperature to 165° for a sufficient time to reach desired results for bacterial reduction. Each operation should know the parameters of their equipment — ability to deliver the temperature of water and time of delivery throughout the process, nozzle placement, etc., to achieve the desired bacterial reduction. The establishment must be able to monitor and document the effectiveness of the equipment in the specific plant operation to achieve the desired reduction.

Surface treatments:

Parameters must be monitored to ensure consistent delivery of the surface treatment. The establishment must be able to monitor and document the effectiveness of the equipment in the specific plant operation to achieve the desired bacterial reduction. Treatments can be applied pre-evisceration or as a final carcass application.
Trimming:

Operations may decide to trim pattern lines when hide opening occurs to help ensure best dressing procedures. Trimming is also used to remove visible contamination. Trimmers must be properly trained to conduct the trimming in a manner that will create a smooth surface to prevent the formation of flaps and/or rough surfaces that could decrease the effectiveness of the interventions later in the process. It is also important to ensure proper cleaning and sanitizing of knives and equipment to prevent contamination.

Hock Sanitizer (vacuum) or blow-off:

This type of equipment should be designed to prevent air-borne contamination onto other areas or carcasses. The equipment should be used and maintained in a manner to ensure the effective use to accomplish the desired results, such as maintaining steam temperature and vacuum pressure, etc. All of these are important considerations for an operation to properly implement the equipment into the specific operation.

References


CFR Part 310, Post-Mortem Inspection.


Questions

Questions or suggestions are welcome and should be addressed to: Ken Mastracchio, National Meat Association ken@nmaonline.org and Joe Harris, Southwest Meat Association joe@southwestmeat.org.