# MSA DIRECTIVE	10,010.2 Rev. 1	7/1/20

VERIFICATION ACTIVITIES FOR SHIGA TOXIN-PRODUCING *ESCHERICHIA COLI* (STEC) IN RAW BEEF PRODUCTS

CHAPTER I – GENERAL

I. PURPOSE

A. This directive provides instructions to inspection program personnel (IPP) on the verification activities, other than MSA sampling, related to Escherichia coli O157:H7 (*E. coli* O157:H7) and non-O157 Shiga toxin-producing E. coli (STEC). It includes instructions that previously appeared in MSA Directive 10,010.1, *Verification Activities for* Escherichia coli *O157:H7 in Raw Beef Products*. Although MSA is incorporating these instructions in this new directive, the Agency has not made fundamental changes to the approach IPP use when performing STEC verification activities other than MSA sampling.

B. New instructions concerning verification activities IPP are to perform at an establishment that has addressed hazards in a prerequisite program and its system fails to prevent the hazard will be provided in a forthcoming issuance.

KEY POINTS:

- *IPP verify HACCP regulatory requirements in establishments that produce raw beef products by performing the HACCP Verification Task and a HAV task*
- *MSA verification activities for raw beef products are applicable to raw veal products*

NOTE: For the purposes of this directive, when the directive references raw beef, veal and not-ready-to-eat (NRTE) beef are included.

II. CANCELLATIONS

MSA Directive 10,010.2 *Verification Activities for Shiga Toxin-Producing Escherichia Coli (STEC) in Raw Beef Products*, 08/20/15

III. BACKGROUND

A. MSA considers all raw non-intact beef and raw intact beef intended for use in raw non-intact product to be adulterated under the Texas Meat and Poultry Inspection Act (TMPIA) (HSC 433.003 (1)) if it is contaminated with adulterant STEC. Adulterant STEC include *E. coli* O157:H7 and the six non-O157 STEC: O26, O45, O103, O111, O121, and O145.

B. STEC contamination is a food safety hazard during the slaughter and processing of raw intact and raw non-intact beef products. The establishment may use a multi-hurdle approach and incorporate multiple controls and preventive measures to address the pathogen in its HACCP system. Thus, the establishment may control the pathogen through one or more critical control points (CCPs) in its HACCP plan or prevent the potential pathogen from becoming reasonably likely to occur (RLTO) through preventive measures in its Sanitation Standard Operating Procedures (Sanitation SOPs) or through other prerequisite programs,

or a combination of these mechanisms.

C. IPP are to be aware that an establishment producing raw beef product needs to make sure that it effectively addresses the hazard. At this time, there are few controls specific to non-O157 STEC that are not also effective against *E. coli* O157:H7. An establishment may determine that its controls or preventive measures for *E. coli* O157:H7 effectively control or prevent non-O157 STEC. Interventions validated to control *E. coli* O157:H7 should be effective in controlling the non-O157 STECs when properly implemented as described in the establishment's supporting documentation unless data such as multiple non-O157 STEC sample results indicate otherwise.

CHAPTER II – IPP HACCP VERIFICATION ACTIVITIES

I. GENERAL

IPP are to verify that establishments that produce raw intact and non-intact beef products meet HACCP regulatory requirements by performing Hazard Analysis Verification (HAV) Tasks and HACCP Verification Tasks.

II. PERFORMING THE HAV TASK

A. IPP are to use the instructions in Table 1 when performing Raw Intact and Raw Non-Intact HAV Tasks.

TABLE 1: STEPS IN PERFORMING THE HAZARD ANALYSIS VERIFICATION (HAV) TASK IN RAW INTACT AND RAW NON-INTACT BEEF PRODUCTS

Step	Description	Verification Questions	Regulatory Citation (9 CFR)
Step 1	Review flowchart and compare to production process. Determine whether the establishment has identified the product's intended use.	• Has the establishment described all of the steps of each process and product flow?	417.2(a)(2)
Step 2	Review the hazard analysis and consider guidance in the FSIS Meat and Poultry	• Has the establishment addressed possible hazards from STEC in its hazard	417.2(a)(1), 417.5(a)(1)

	Hazards and Controls Guide available on FSIS's website and Chapter IV, Section IV of this directive. Become familiar with any prerequisite programs the establishment uses as preventive measures support hazard analysis decision that STEC is not reasonably likely to occur (NRLTO) for the specific product type.	analysis? • If the establishment has determined that STEC is RLTO in the product, has the establishment implemented at least one CCP designed to control STEC? • Has the establishment identified non-O157 STEC in its hazard analysis as NRLTO because its preventive measures for *E. coli* O157:H7 are adequate for non-O157 STEC? If so, does the establishment receive multiple non-O157 STEC positives that call this decision-making into question? • If the establishment has not considered possible hazards from STEC, or is not controlling it through its HACCP plan or preventing it through its Sanitation SOP or prerequisite program, do IPP contact the DO so the DO can take enforcement action? • Does the establishment use the instructional or disclaimer statement as a control or CCP to address STEC? **NOTE:** This represents noncompliance with 417.5(a)(1) (See Chapter IV).	417.2(a)(1) 417.2(c)(2) 417.2(a)(1), 417.5(a)(1) 417.5(a)(1)

Step 3	For each hazard that the establishment considers RLTO, verify that the HACCP plan includes one or more CCPs to control it. *If no hazards are reasonably likely to occur, skip to step 4.* See Chapter IV, Section IV of this	• If the establishment considers STEC a hazard RLTO, has the establishment included one or more CCPs to control the hazard either at that step or a later step? • Is the establishment's HACCP plan designed to	417.2(c)(2) 417.5(a)(2)

	directive.	ensure that it includes the monitoring procedures and frequencies that it uses to monitor the CCPs?	417.2(c)(4)
		• If the establishment has included its antimicrobial intervention control measures as a CCP, has the establishment incorporated the critical operating parameters* (e.g., carcass and product coverage) into its written monitoring procedures? *Critical parameters are those parameters (e.g., carcass or product coverage, temperature, concentration, contact time) of an intervention that must be met in order for the intervention to operate effectively and as intended. **NOTE**: IPP are to use the information in Attachment 1 to assist them in reviewing the establishment's scientific support for antimicrobial treatments that establishments apply as part of a CCP, Sanitation SOP, or other prerequisite program.	417.2(c)(2), 417.5(a)(2) 417.2(c)(4)
		•If the establishment performs STEC testing, does the establishment have support for its sampling and testing procedures and the frequency for the procedures? **NOTE**: IPP are to be aware that establishments are not required to use the same sample analysis procedures as FSIS. However, IPP are to be aware that the regulations require the establishment to maintain documents that support its verification activities (including sampling	417.5(a)(2)

		and analysis) and frequency, as appropriate for their intended purpose. • Does the establishment use the instructional or disclaimer statement as a control or CCP to address STEC? **NOTE**: This represents noncompliance with 417.5(a)(1) (See Chapter IV of this directive).	417.5(a)(1)
Step 4	For each hazard, the establishment considers NRLTO, determine what evidence the establishment uses to support the decision. See Chapter IV, Section IV of this directive.	• If the establishment determines that STEC is NRLTO in its product, does it prevent STEC through a prerequisite program or its Sanitation SOP? Proceed to step 5. • Does the establishment determine that STEC is NRLTO in its product based on data concerning customary consumer preparation practices in conjunction with its purchase specifications and its own preventive measures employed during further processing that are incorporated as part of a prerequisite program? For example, certain cuts of meat contain a large amount of connective tissue, so consumers need to cook the product for a long time to make the product palatable (e.g., a brisket for use in corned beef). Other cuts of meat (e.g., "Philly" style cheese steaks) are thin and are cooked thoroughly quickly. Proceed to step 6.	417.5(a)(1) 417.5(a)(1)

Step 5	Review prerequisite programs and other supporting programs, including written programs, records, and employee activities. Verify the implementation of prerequisite programs.	• Does the establishment use prerequisite programs to support hazard analysis decision-making?	417.5(a)(1)
		• Does the establishment's antimicrobial intervention preventive measures on incoming raw materials incorporate the critical operating parameters (e.g., product or carcass coverage) identified in the establishment's scientific support? **NOTE**: IPP are to use the information in Attachment 1 to assist them in reviewing the establishment's scientific support for antimicrobial treatments that establishments apply as part of a CCP, Sanitation SOP, or other prerequisite program.	417.5(a)(1) 417.5(a)(1)
		• If the establishment has incorporated its antimicrobial intervention preventive measures or other STEC preventive procedures in a prerequisite program, does the establishment implement the antimicrobial intervention or other STEC preventive measures according to its supporting documentation?	417.5(a)(1)
		• If the establishment has determined that its prerequisite programs for *E. coli* O157:H7 adequately prevent non-O157 STEC, does the establishment implement its preventive measures according to its support?	417.5(a)(1) 417.5(a)(1)
		• Are the prerequisite programs consistently being implemented as written?	417.5(a)(1)

		• Do the prerequisite programs support the establishment's hazard analysis decision-making on an ongoing basis?	
Step 6	Review other supporting documentation.	• Does the establishment use data concerning customary consumer preparation practices information in conjunction with its purchase specifications and its own preventive measures employed during further processing as part of a prerequisite program to support its hazard analysis decisions? • Do the establishment's hazard analysis decision-making documents describe the basis for the establishment's determination that these practices constitute customary preparation?	417.5(a)(1) 417.5(a)(1)
Step 7	Review establishment validation documents, including scientific supporting documents and validation data.	• Does the in-plant validation data show that the establishment can implement its CCPs and prerequisite programs consistent with the scientific support to effectively control or prevent STEC?	417.4(a)(1)

Step 8	Verify reassessment requirements. Check the most recent signature and date for each HACCP plan.	• If an establishment that identifies non-O157 STEC in its hazard analysis as NRLTO because its preventive measures for *E. coli* O157:H7 are adequate for non-O157 STEC receives a non-O157 STEC positive result, has the establishment reassessed its HACCP plan and documented the reassessment?	417.3(b), 417.4(a)(3)
		• Has the establishment reassessed its HACCP plan when information (e.g., repetitive ongoing positive STEC results) indicates the HACCP plan is no longer adequate?	417.4(a)(3)

III. PERFORMING THE HACCP VERIFICATION TASK

IPP are to use the instructions provided in MSA Directive 5000.1, *Verifying an Establishment's Food Safety System*, and in Table 2 when performing Raw Intact and Raw Non-Intact HACCP Verification Tasks.

TABLE 2: STEPS IN PERFORMING THE HACCP VERIFICATION TASK IN RAW INTACT AND RAW NON-INTACT BEEF PRODUCTS

Step	Description	Verification	Regulatory Citation (9 CFR)
Step 1	Select the product type and specific production.	• IPP are to review the list of products, to ensure all product types are selected over time.	None
Step 2	Verify the monitoring requirements.	• If the establishment has included its antimicrobial intervention control measures as a CCP, IPP are to verify that the establishment implements the procedure as	417.2(c)(4)

		written. • If the establishment has determined that its CCPs for *E. coli* O157:H7 adequately control non-O157 STEC, IPP are to verify the establishment implements its procedures according to its support.	417.5(a)(2)
Step 3	Verify the verification requirements.	• If the establishment performs STEC testing, IPP are to: --Observe the establishment's employee collecting the sample and determine whether the sampling procedures are being performed as written. --Review sample results (including any non-O157 STEC results the establishment conducts in addition to *E. coli* O157:H7) and verify that the establishment takes corrective actions in response to positive results that meet the requirements of 9 CFR 417.3 (see step 5).	417.4(a)(2)
Step 4	Verify the recordkeeping requirements.	• IPP are to review sampling records to determine whether the establishment collected the number of samples at the frequency documented in its program.	417.5(a)(3)
Step 5	Verify the corrective action requirements. See Chapter III, Sections I and II for more information.	• IPP are to verify that the establishment: --Has included corrective actions as part of its HACCP plan and --Takes corrective action in response to STEC positive results from establishment or FSIS testing.	417.3

Step 6	Verify the pre-shipment review requirements. See Chapter III, Section III and Chapter IV of this directive for more information.	• IPP are to verify that product which bears an instructional or disclaimer statements is only being sent to an official establishment for further processing.	417.5(c)
Step 7	Consider the implications of any noncompliance. See Chapter III, Section I.B. for more information.	• IPP are to document noncompliance and consider the findings in the context of the establishment's food safety system as instructed in Chapter V of MSA Directive 5000.1.	

CHAPTER III – IPP RESPONSIBILITIES RELATED TO POSITIVE STEC SAMPLE RESULTS

I. IPP RESPONSIBILITIES WHEN AN ESTABLISHMENT RECEIVES A POSITIVE STEC SAMPLE RESULT FROM FSIS, ANOTHER FEDERAL ENTITY, OR STATE

A. Verify the corrective action requirements (Step 5 in Table 2):

1. IPP are to verify that products that tested positive for STEC received appropriate disposition.

2. IPP are to verify that the establishment transporting presumptive positive or positive product to another site for appropriate disposition has met all corrective action requirements by verifying that the establishment maintained:

   a. Records identifying the official establishment, renderer, or landfill operation that received presumptive positive or positive product;

   b. Control of product that was destined for a landfill operation or renderer while the product was in transit (e.g., through company seals);

   c. Control of product that was destined for an official establishment while the product was in transit (e.g., through company seals) or ensured that such product moved under MSA control (e.g., under seal or accompanied by MSA). IPP are to be aware that a voluntary instructional "For Cooking Only" statement is not a sufficient control; and

   d. Records showing that presumptive positive or positive product received the proper disposition, including documentation showing proper disposal of the product from the official establishment, renderer, or landfill operation where disposition occurred.

3. If the positive product is shipped to another official establishment for disposition (e.g., cooking), IPP at that establishment are to verify that the receiving establishment adequately addresses the pathogen in the product. Specifically, IPP are to verify that the establishment:

a. Documents the receipt of presumptive positive or positive product, as required under 9 CFR 417.5;

b. Maintains control of the product; and

c. Addresses the receipt of adulterant STEC in its hazard analysis, flow chart, and HACCP plan, so that the positive product will receive an adequate lethality treatment to destroy the pathogen.

4. If an establishment ships adulterated product to a renderer or landfill operation, IPP are to routinely verify the establishment denatures the product before the product leaves the establishment (9 CFR 314.3).

   a. There may be situations when an establishment may want to move product to a renderer or landfill without denaturing the product before the product leaves the establishment;

   b. In these situations, the establishment must put the request in writing, describe the controls it will uses in its request, and obtain permission from the MSA Central Office (CO); and

   c. IPP are to verify that the establishment follows the procedures agreed upon with the CO.

5. Generally, an establishment may not ship positive or presumptive positive product through a cold storage facility because the establishment that produced the product must maintain control of it during shipment. Ownership is typically passed once the cold storage facility holds the product. However, there may be circumstances in which either the producing or receiving establishment can ship positive or presumptive positive product through a cold storage facility. In this situation, IPP are to verify that the producing establishment maintains:

   a. Control of the product while it is in transit (e.g., through company seals) or ensure such product moves under MSA control (e.g., under seal or accompanied by MSA);

   b. Records identifying the cold storage facility and how the products will be controlled while stored in the cold storage facility;

   c. Records identifying the official establishment, renderer, or landfill that received the product; and

   d. Records that show that the product received proper disposition, including documentation evidencing proper disposal of the product from the official establishment where disposition occurred or from the renderer or landfill where disposition occurred.

6. When verifying adequate corrective actions in response to a non-O157 STEC positive from MSA testing, IPP are to first determine whether the establishment identified non-O157 STEC as a hazard in its hazard analysis.

   a. If the establishment identified non-O157 STEC, IPP are to verify that the establishment takes corrective action in accordance with 9 CFR 417.3(a).

b. If the establishment did not identify non-O157 STEC in its hazard analysis or does not have controls for *E. coli* O157:H7 that would also address non-O157 STEC, IPP are to verify that the establishment.

1. Performs reassessment to determine whether the newly-identified deviation or other unforeseen hazard should be incorporated into the HACCP plan, per 9 CFR 417.3(b)(4);

2. Documents the reasons for any changes to the HACCP plan based on the reassessment, or the reasons for not changing the HACCP plan based on the reassessment, per 9 CFR 417.4(a)(3)(ii); and

3. Provides all supporting documentation, including support for the decisions made during reassessment, per 9 CFR 417.5(a)(1).

c. IPP are to question whether the design or implementation of the establishment's unique food safety system is sufficient to control STEC when non-O157 STEC contamination is identified in the production process even though the *E. coli* O157:H7 results and other processing CCP records may indicate process control was maintained.

d. In response to one or more non-O157 STEC positives, IPP are to verify whether any additional establishment testing conducted includes non-O157 STEC as part of the validation, verification and reassessment requirements of 9 CFR 417.4 and supporting documentation requirements of 9 CFR 417.5(a)(1), until the establishment is able to demonstrate control over STEC in their unique HACCP system, or the HACCP system may be deemed inadequate (9 CFR 417.6).

B. Determining and documenting noncompliance:

1. IPP are to document a noncompliance record (NR) for the confirmed positive result from MSA testing, as described below. IPP are to take the following into consideration when issuing NRs:

a. If MSA finds the product to be positive for non-O157 STEC or *E. coli* O157:H7, and the establishment also tested the product, IPP are to check establishment test results to determine whether the establishment also found the sampled product positive for *E. coli* O157:H7 or non- O157 STEC.

i. If MSA finds the product positive, and the establishment testing found that the product was negative (or the establishment did not perform testing), then IPP are to issue an NR (citing 9 CFR 301.2 and 9 CFR 9 CFR 417.4(a)) because the establishment's HACCP system did not identify the adulterated product being produced.

ii. IPP are to issue an NR to establishments that have a written program to divert all product that MSA samples to cooking unless the establishment also tested the product and found it positive for STEC.

2. IPP are not to issue an NR in response to the positive MSA result if both of the following are true:

a. The establishment held the product or maintained control of the product (e.g., the establishment moved the product off-site but did not complete pre-shipment review or transfer ownership of the product to another entity) pending its own test results; and

b. MSA and the establishment found the product positive for either *E. coli* O157:H7 or non-

O157 STEC. Testing can find the product positive for different adulterant STEC.

3. IPP are to issue a NR to establishments that have a written program to divert all product that MSA samples to cooking unless the establishment also tested the product and found it positive for STEC.

4. If MSA finds the product positive, and the establishment testing found that the product was negative (or the establishment did not perform testing), then IPP are to issue an NR (cite 9 CFR 301.2 and 9 CFR 417.4(a)) because the establishment's HACCP system was inadequate resulting in adulterated product being produced.

5. IPP are to verify, after the establishment has implemented its corrective action, that the establishment implements corrective actions that meet the applicable requirements in 9 CFR 417.3, including ensuring the product receives appropriate disposition (see step 5 in Table 2).

6. For FSIS positive results from follow-up samples from raw non-intact products and raw intact products intended for raw non-intact use, IPP are to:

    a. Link noncompliance (e.g., previous FSIS STEC results, sanitary dressing, antimicrobial intervention implementation), as appropriate; and

    b. Cite 9 CFR 417.3(a) on the NR because the establishment's corrective actions were not implemented or not effective (i.e., failed to prevent the recurrence of a positive result).

7. If IPP find noncompliance with 9 CFR 314.3, they are to document it in accordance with FSIS Directive 5000.1. In situations where the establishment has not properly moved the product, IPP also are to notify the DO through supervisory channels.

8. If IPP have concerns about the adequacy of the HACCP system, they are to discuss their concerns with their supervisors.

II. IPP RESPONSIBILITIES WHEN AN ESTABLISHMENT HAS A POSITIVE STEC SAMPLE RESULT FROM ITS OWN TESTING

A. When performing the HACCP verification task (step 3 in Table 2), IPP are to review the records associated with any STEC testing conducted by an establishment. If IPP find presumptive positive or confirmed positive STEC results in the testing records, they are to verify that the establishment is implementing corrective actions (step 5 in Table 2). When an establishment tests product, a presumptive positive or positive result alone does not warrant a NR. IPP are only to issue an NR in response to an establishment's presumptive positive or positive finding if the establishment fails to take the appropriate actions in accordance with its HACCP system to meet the requirements in 9 CFR 417.3.

B. IPP are to verify that the establishment addresses the product as if it had tested positive if an establishment is only performing screening tests (e.g., a presumptive positive) and does not follow up with additional testing to determine whether STEC is isolated from the product. The establishment cannot use negative results for a second screening test for STEC as a means to support food safety because a screening test is not a conclusive (specific) test for the pathogen.

C. When performing a HACCP verification task (step 3 in Table 2 above), IPP are to verify that establishment employees conducting sampling for STEC do not sample sterile product that could not be contaminated with STEC (e.g., product taken from the interior of a carcass). If IPP observe such sampling, they are to document noncompliance with 9 CFR 417.4(a)(2) on an NR..

D. If establishment records show testing of trim and other raw ground beef components for STEC, but the establishment never finds any positives, IPP are to notify the CO. In addition, if establishment records show multiple positives for STEC in its own testing, evidencing a potential systemic problem, IPP are to notify the CO. The CO is to schedule an Enforcement, Investigations and Analysis Officer (EIAO) to review the establishment's trim and other raw ground beef components sampling and testing methods for trim for STEC.

III. ESTABLISHMENTS CONDUCTING PRE-SHIPMENT REVIEW FOR PRODUCT THAT IS NOT AT THE PRODUCING ESTABLISHMENT

When performing a HACCP verification task (step 6 in Table 2), IPP are to be aware that Agency policy allows establishments to conduct pre-shipment review when the product is at locations other than at the producing establishment, provided the product does not leave the control of the producing establishment. Some establishments analyze samples for STEC while they are moving the product, but the product is still under the establishment's control. IPP are to be aware that the Agency provides establishments the flexibility to move their product before pre-shipment review when the establishment is conducting testing for STEC and maintains control of the product (e.g., through company seals or MSA control).

CHAPTER IV –INSTRUCTIONAL OR DISCLAIMER STATEMENTS CONCERNING STEC

I. GENERAL

This chapter provides instructions for IPP for verifying an establishment's use of instructional or disclaimer statements during HACCP verification and HAV tasks.

II. INSTRUCTIONAL OR DISCLAIMER STATEMENTS CONCERNING STEC

A. An instructional statement concerning STEC is a statement that addresses how the product is to be prepared or handled to ensure that the pathogen is eliminated or reduced to below detectable levels. If an official establishment labels product with the phrase "for further processing" without further qualification, this phrase is not an instructional statement. It is a statement of limited use.

B. Examples of instructional statements concerning STEC in raw ground beef components, raw beef patty components, and raw ground beef products may include, "for full lethality treatment," "for cooking only," or "for further processing into RTE products that will receive a full lethality treatment." "Cooking" is applying heat to a product at a sufficient temperature and for a sufficient period of time to eliminate *E. coli* O157:H7. "Full lethality treatment" may be cooking or another process that eliminates *E. coli* O157:H7, such as fermentation or salt curing.

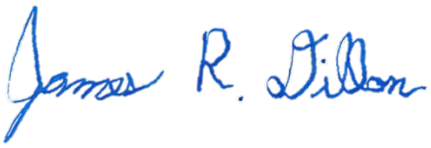
C. A disclaimer statement concerning *E. coli* O157:H7 is a statement regarding the type of verification activities addressing the pathogen that were not used in the production of the product. An example of a disclaimer statement concerning *E. coli* O157:H7 is, "product has not been tested for *E. coli* O157:H7."

D. Product to be sent to a State-inspected establishment may not bear either an instructional or a disclaimer statement.

NOTE: A statement that the establishment does not intend to use the product in ground product or other non-intact product is not an instructional or disclaimer statement (e.g., "not intended for grinding" or "not intended for raw ground"). These types of statements **may not be used at all** on product labels.

III. QUESTIONS

Refer questions through supervisory channels.



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Attachment 1

CRITICAL OPERATING PARAMETERS FAMILIARIZATION

IPP are to use the examples provided in this attachment to assist them in reviewing the establishment's scientific support for antimicrobial treatments that establishments apply as part of a critical control point (CCP), Sanitation SOP, or other prerequisite program**.**

EXAMPLE:

FSIS test results show that the percent positive for STEC in trim produced from veal appear to be higher than trim produced from other cattle slaughter classes. Following up on these results, FSIS conducted a review of Food Safety Assessments (FSAs) and onsite visits to veal slaughter establishments to identify concerns unique to veal slaughter. The results of the review indicate a common deficiency. Specifically, veal slaughter establishments, in applying their antimicrobial interventions, failed to achieve carcass coverage because of the practice of suspending carcasses from the rail system with both hind limbs on a single hook (see Figure 2). Because of this practice, spray interventions did not reach all parts of the carcasses. Carcass coverage –ensuring that the entire carcass surface is treated -- is necessary for the intervention to operate effectively. As a result of the incomplete carcass coverage, interventions were likely less effective than intended, and this ineffectiveness may have contributed to the production of products contaminated with STEC.

In addition, during on-site visits to beef fabrication establishments, FSIS found that those establishments, when applying their antimicrobial intervention, also failed to achieve product coverage. Reasons for inadequate application of the antimicrobial intervention to all product surfaces included the stacking of products and the folding of longer pieces, particularly loins (Figures 3 and 4). These actions prevented antimicrobial sprays from reaching all product surfaces. Additionally, establishment personnel failed to address these actions by adjusting the conveyor belt timing, properly designing spray applications, and ensuring that product was single-stacked and lying flat so that all product surfaces received the antimicrobial spray. Product coverage – ensuring that all of the product is treated – is necessary for the intervention to operate effectively and as intended.

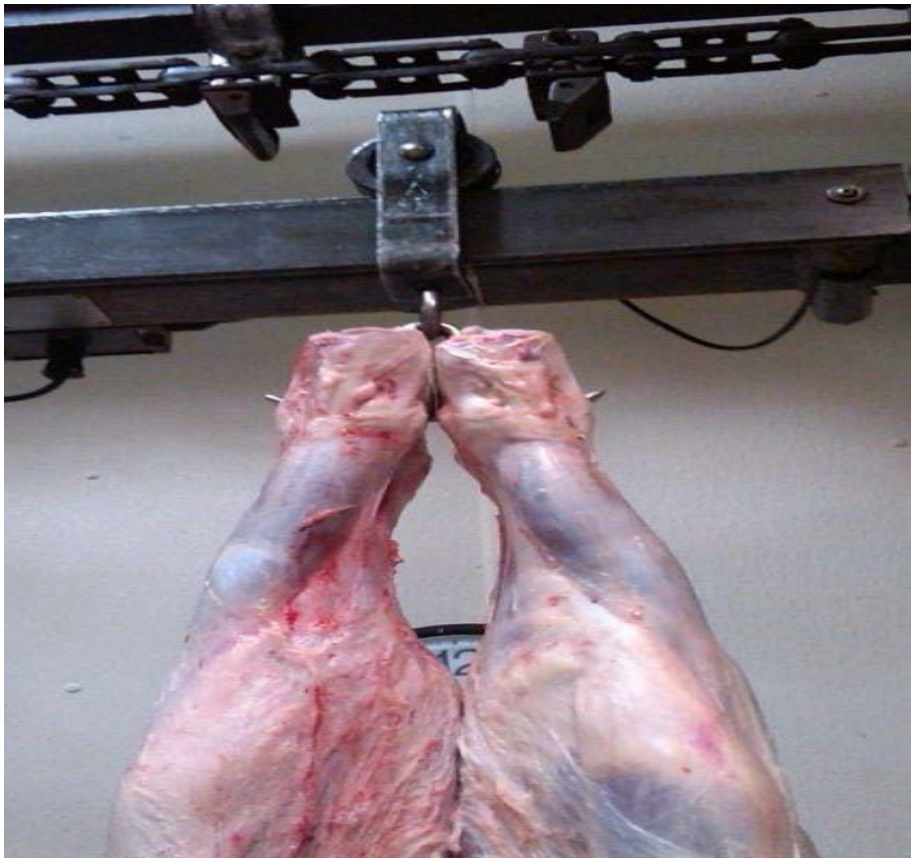

Figure 2. Example of a veal carcass with both hind limbs suspended from a single hook. This practice prevented the antimicrobial treatment from achieving full carcass coverage, a critical operating parameter.

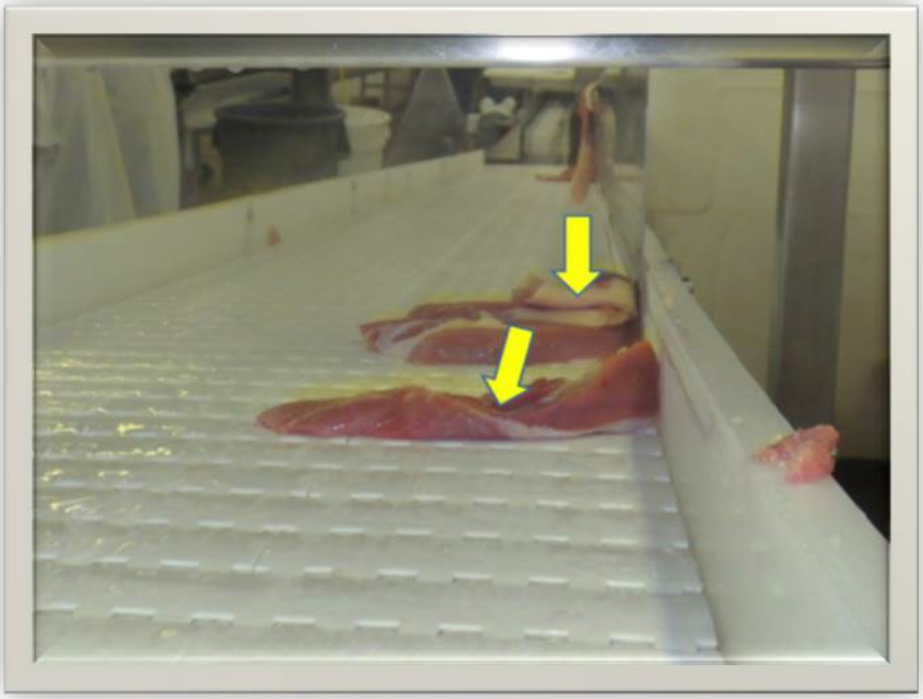

Figure 3. Product is folded as the antimicrobial treatment is applied, which prevents the antimicrobial treatment from achieving full product coverage, a critical operating parameter.

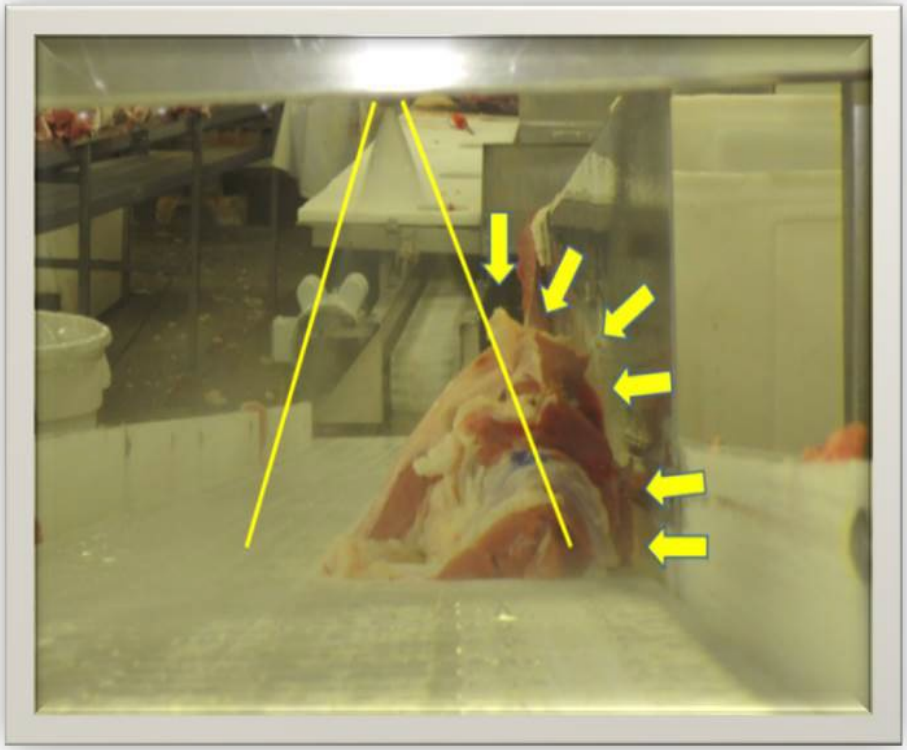

Figure 4. Product is stacked and folded and some of the product is outside the arc of the antimicrobial treatment. As a result, the antimicrobial treatment does not achieve full product coverage, which is a critical operating parameter.