

Slice Shear Force Protocol for Large Volume at Higher Cost

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The USDA neither guarantees nor warrants the standard of the products mentioned to the exclusion of other products that also may be suitable.

This protocol is for longissimus. We also have developed slice shear force protocols and their descriptions for 20 other muscles. If you are interested in these, contact us.

This option will give slice shear force results that are just as repeatable as the lower throughput option, but this higher throughput option requires higher capital investment and is less labor intensive. We have processed over 400 samples in a day with four people assisting using this protocol.

We recommend you send someone to our lab to be trained in person. However, if that is not possible the following description of the protocol is fairly detailed. If you have any questions, do not hesitate to call us.

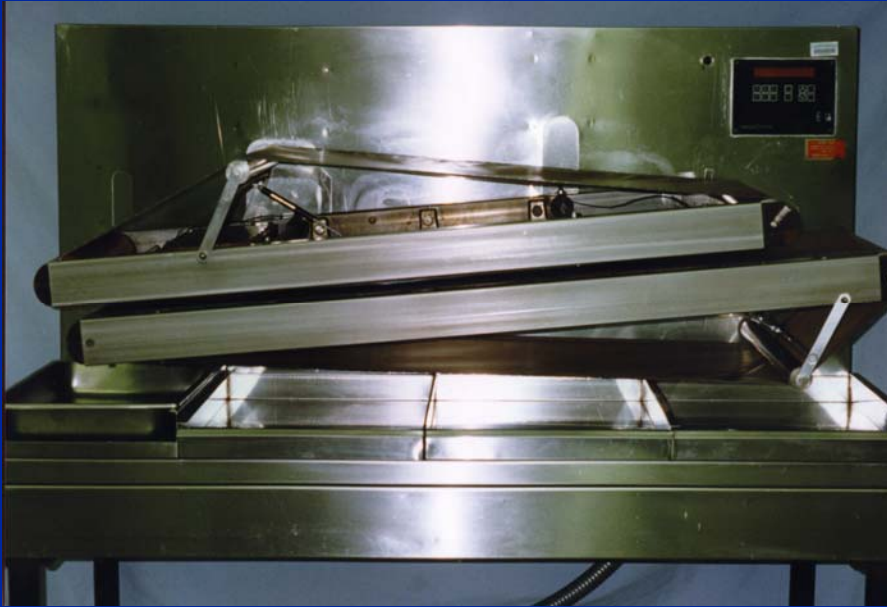
Cooking Equipment

- (TBG-60 Magigrill Belt Grill, MagiKitch'n Inc., Quakertown, PA). These grills are no longer being manufactured.

or

- Model 1132 Impingement Oven
Lincoln Foodservice Products, Inc.
1111 North Hadley Road
Fort Wayne, IN 46804
260-459-8200

Cook steaks to 71° C using either a belt grill or an impingement oven.



SSF Standardized Equipment

Slice Shear Force Kit

To help ensure consistency across institutions a Slice Shear Force Kit is available that includes three items: a sizing box, a slice box, and a double-bladed knife (it also could include the shearing blade if you wanted an extra). We strongly recommend using this kit.

Contact:

Dick Lundquist

G-R Manufacturing

6402 Martin Ave

Manhattan, KS 66503-8631

Ph. 785-293-5120, Fax 785-293-5124

grmanufacturing@twinvalley.net

Temperature Monitoring Equipment

Many sources and products are available. The following are products we use in our lab:

Digi-Sense thermometer, type J thermocouple. Cole Parmer Company. Catalog # EW-91100-00. Price-\$165. Phone: 800-323-4340. Fax: 847-247-2929. Email: info@coleparmer.com Website: www.coleparmer.com

Hypodermic temperature probe with 2.5" needle and mini connector. Omega Engineering Company. Catalog # EI1 107108/2.5"/HYP2-21-2.5-J-G-48-SMPW-M. Price-\$96. This is a special order product with an additional set up charge of \$50 per order. Place the order to the attention of John Bach, Extension 2310. Phone: 888-826-6342. Fax: 203-359-7700. Website: www.omega.com

Cooking Method A: Belt Grill Cookery

Steak thickness must be uniform for belt grill cooking.

The simplest method is to cut one-inch thick steaks from frozen muscle sections using a band saw.

Internal temperature of the steaks should be 2 to 5°C prior to cooking. Thaw frozen steaks at 2 to 5°C for approximately 24 to 36 hours to reach the correct internal temperature.

Steaks should be cooked to a final internal temperature of 71°C. The belt grill should be operated as follows: preheat = 149°C, top heat = 163°C, bottom heat = 163°C, height of gap = 2.16 cm, and cook time = 5.5 min. (Test these settings on your grill to ensure 71°C end point is reached on average).

Steak exiting belt grill



Cooking Method B: Impingement Oven Cookery

Internal temperature of the steaks should be 2 to 5°C prior to cooking. Thaw frozen steaks at 2 to 5°C for approximately 24 to 36 hours to reach the correct internal temperature.

Steaks should be cooked to a final internal temperature of 71°C.

Temperature set at 204°C and belt speed to get 14 min 30 sec cooking time. (Test these settings on your oven to ensure 71°C end point is reached on average).

Impingement Oven



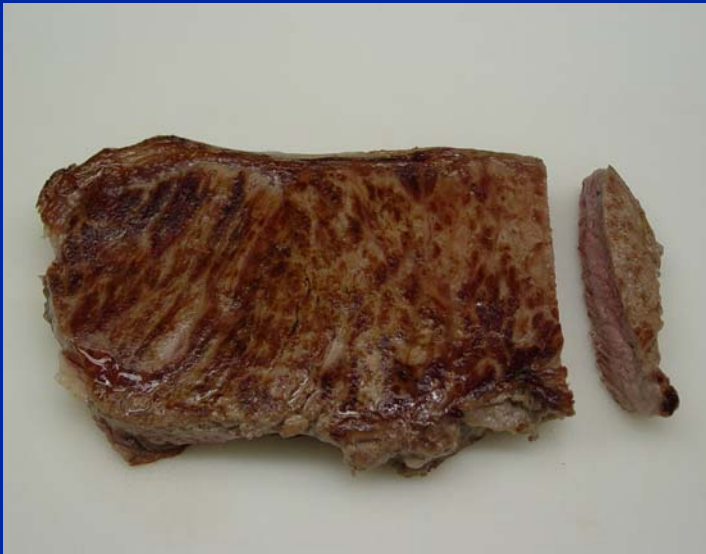
Immediately after exiting from the grill or oven, monitor the internal steak temperature using a hand held thermometer with a needle thermocouple probe inserted into the geometric center of the steak. Record the maximum temperature the steak reaches during post-cooking rise as the final cooked temperature. Remove the thermocouple probe and proceed with slice shear force procedure.

SSF Protocol

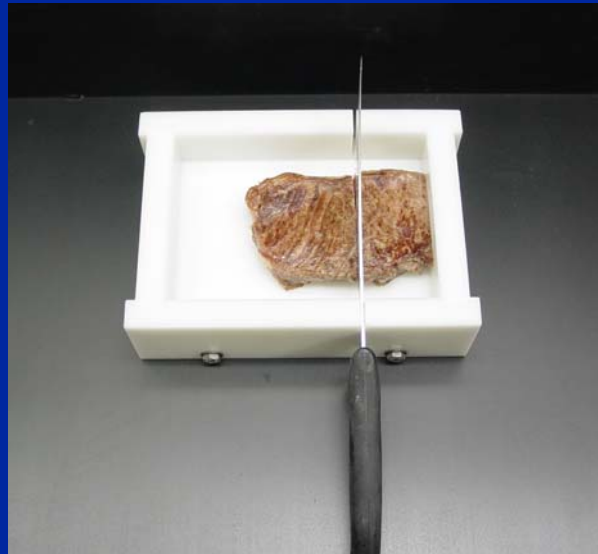
After recording final cooked temperature of the steak, remove from the lateral end of each steak a 1-cm-thick, 5-cm-long slice that is parallel to the muscle fibers.

Obtaining 1 cm-thick, 5 cm-long slice

1



2



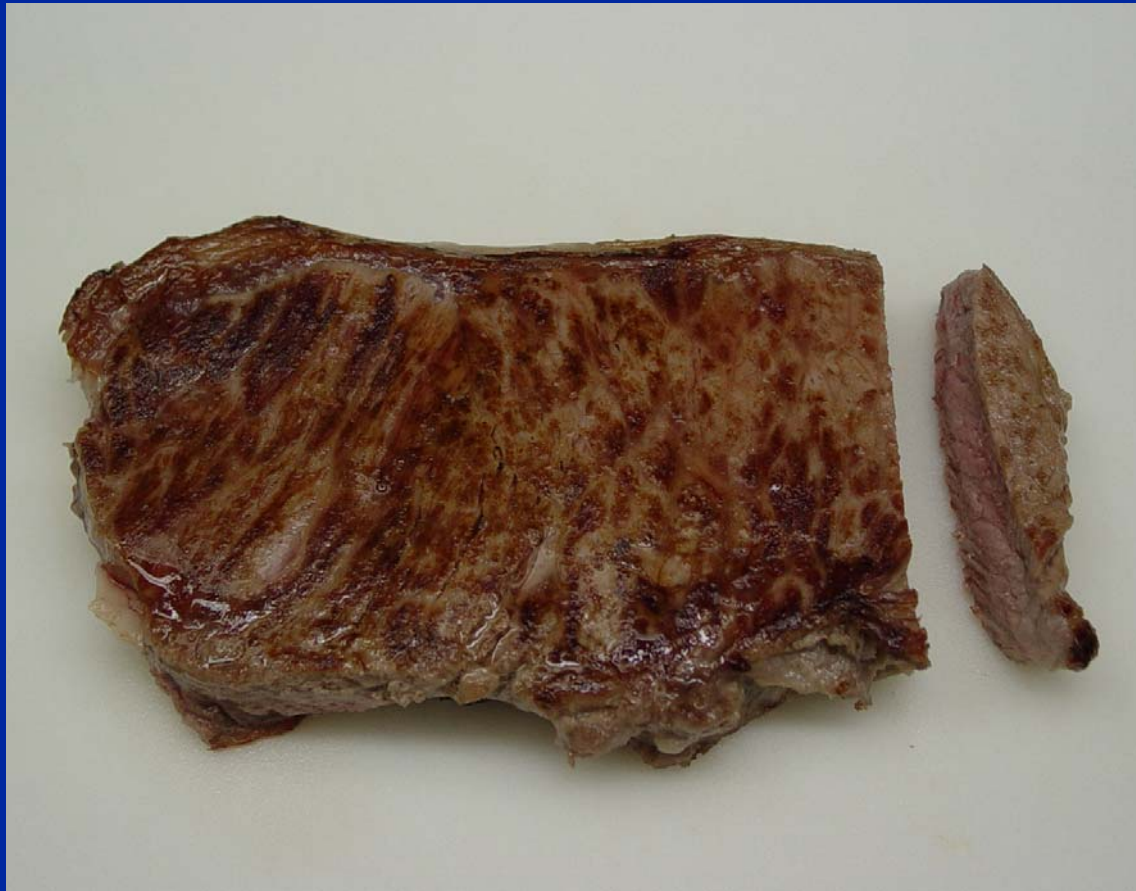
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SSF Protocol

1. A cut is made across the width of the longissimus at a point about 1 to 2 cm from the lateral end of the muscle.

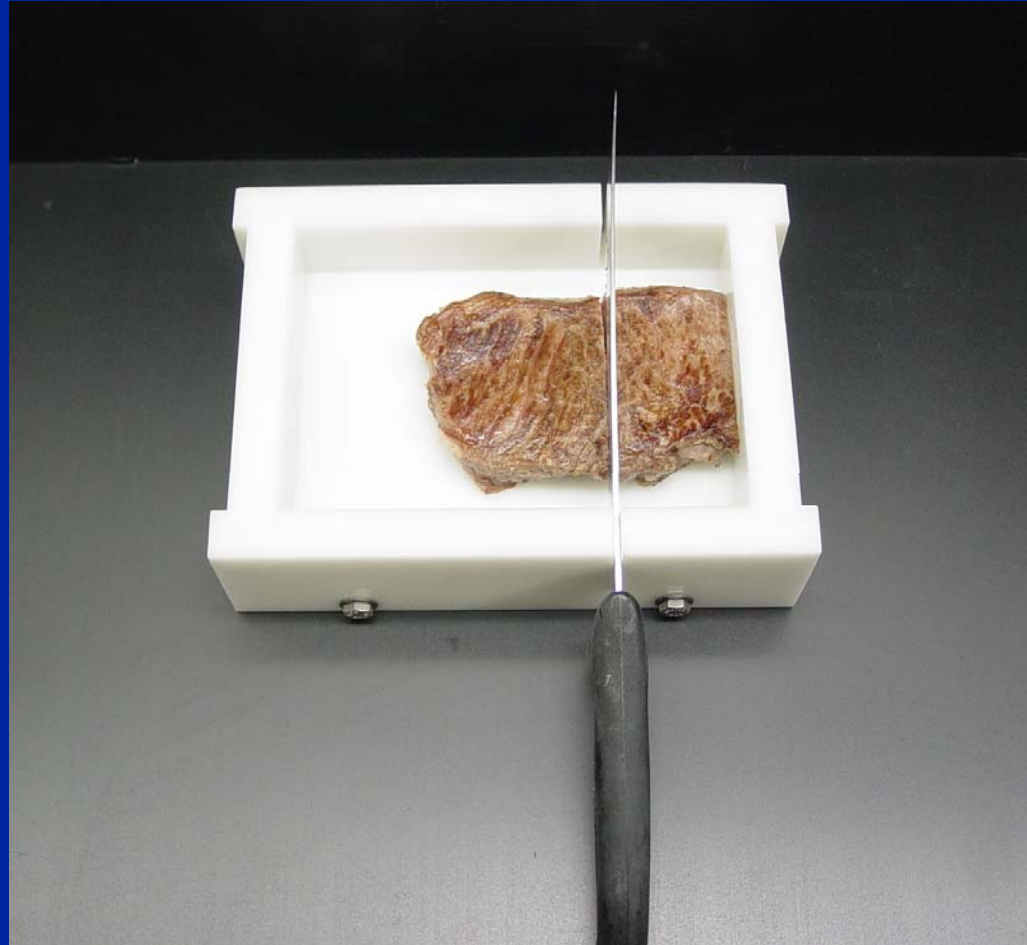
Step 1. Square off the end of the muscle



SSF Protocol

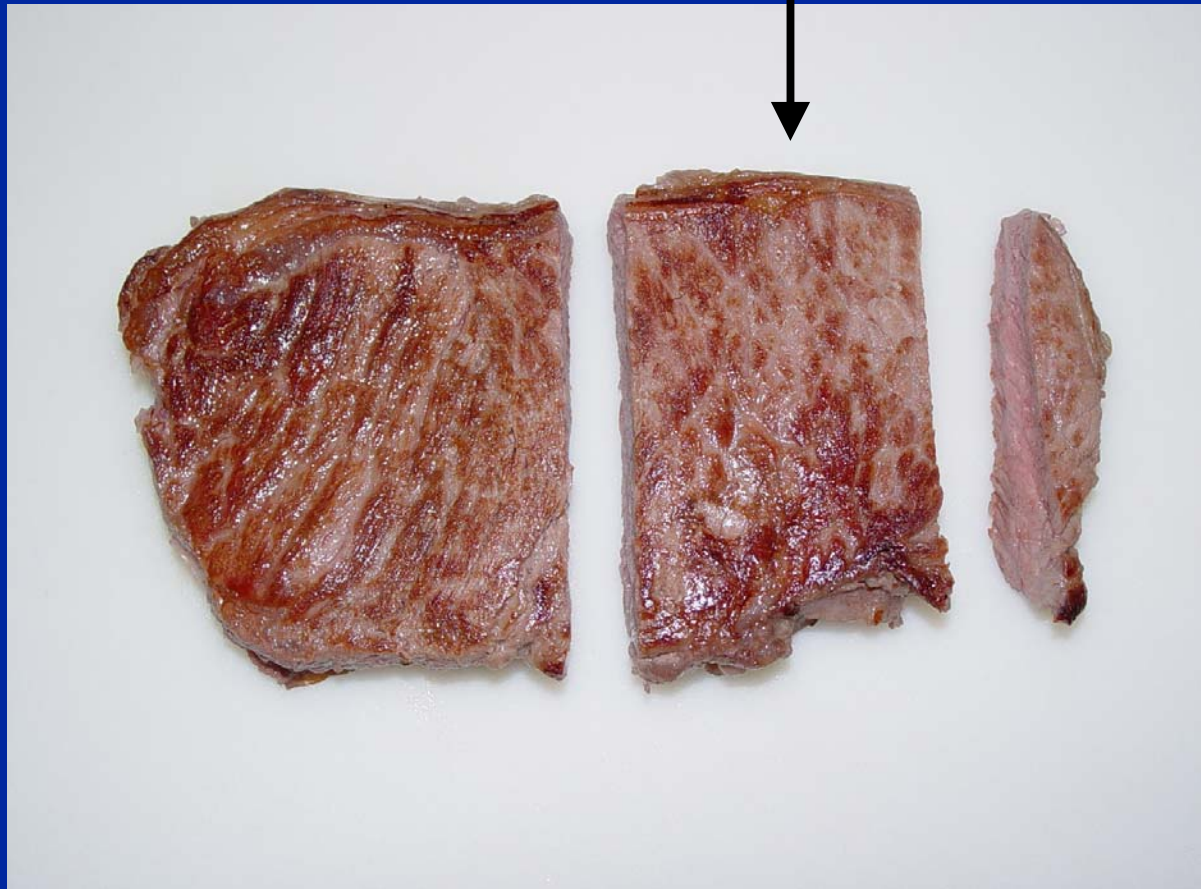
2. Using the sample sizing box, a second cut is made across the width of the longissimus, parallel to and at a distance of 5 cm from the first cut.

Step 2. Obtain the 5-cm long section

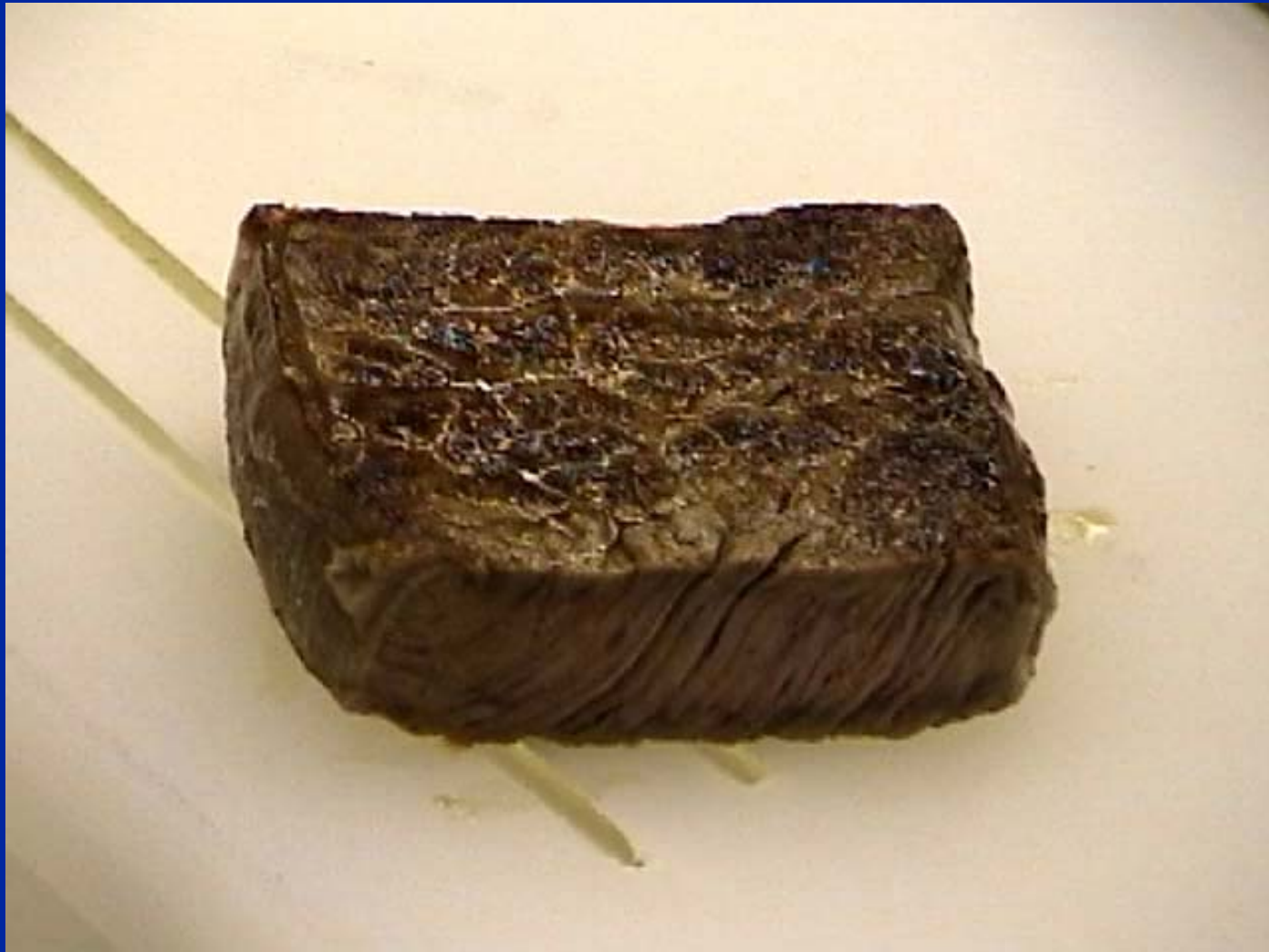


We now have a 5-cm long section from the lateral end of the longissimus with muscle fibers at a 45° angle.

5-cm section



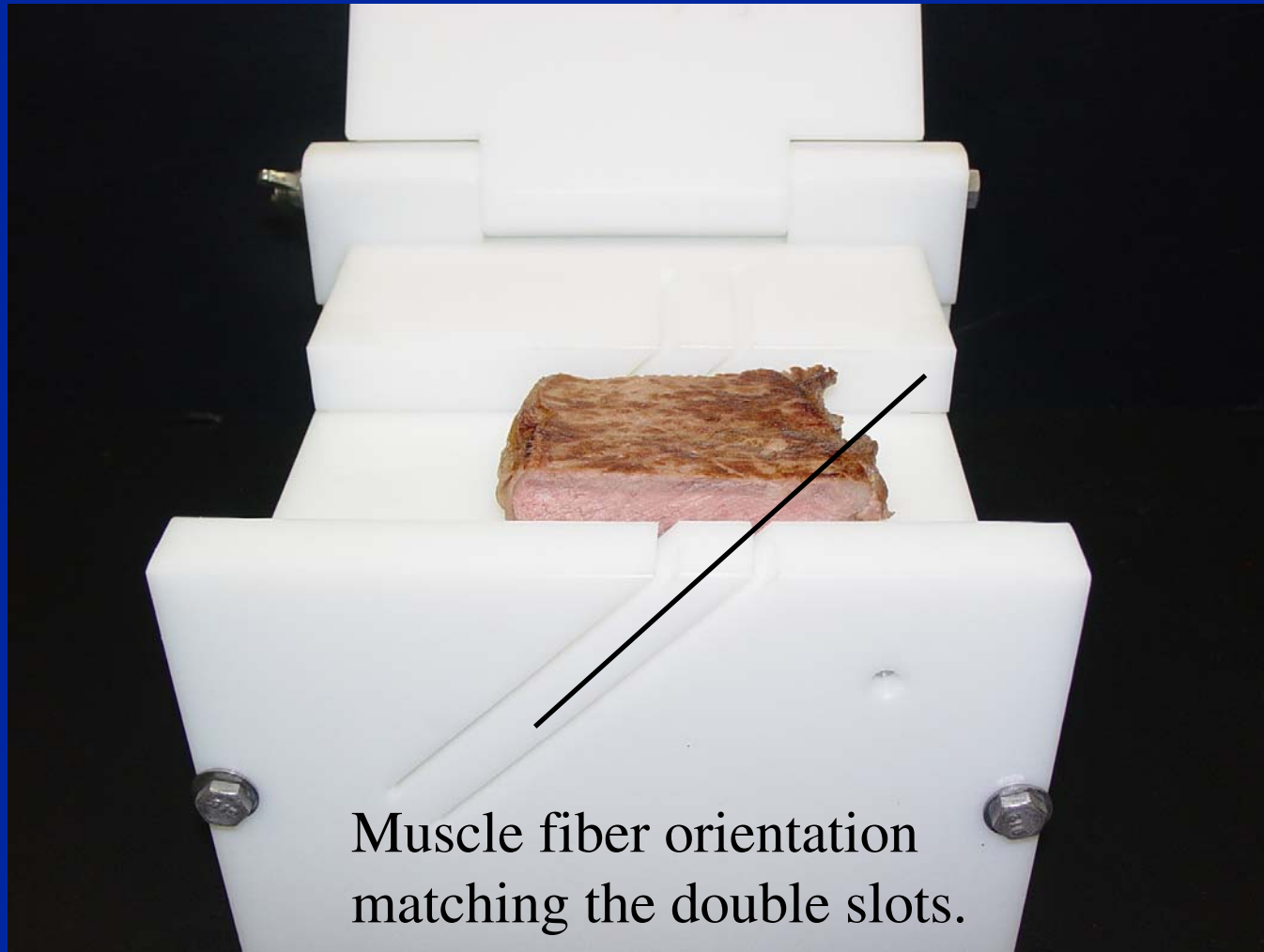
5-cm section with 45° fiber angle



SSF Protocol

3. The 5-cm long section is placed in the slice box and centered on the two 45° slots with the angle of the slots lined up with the muscle fiber angle.

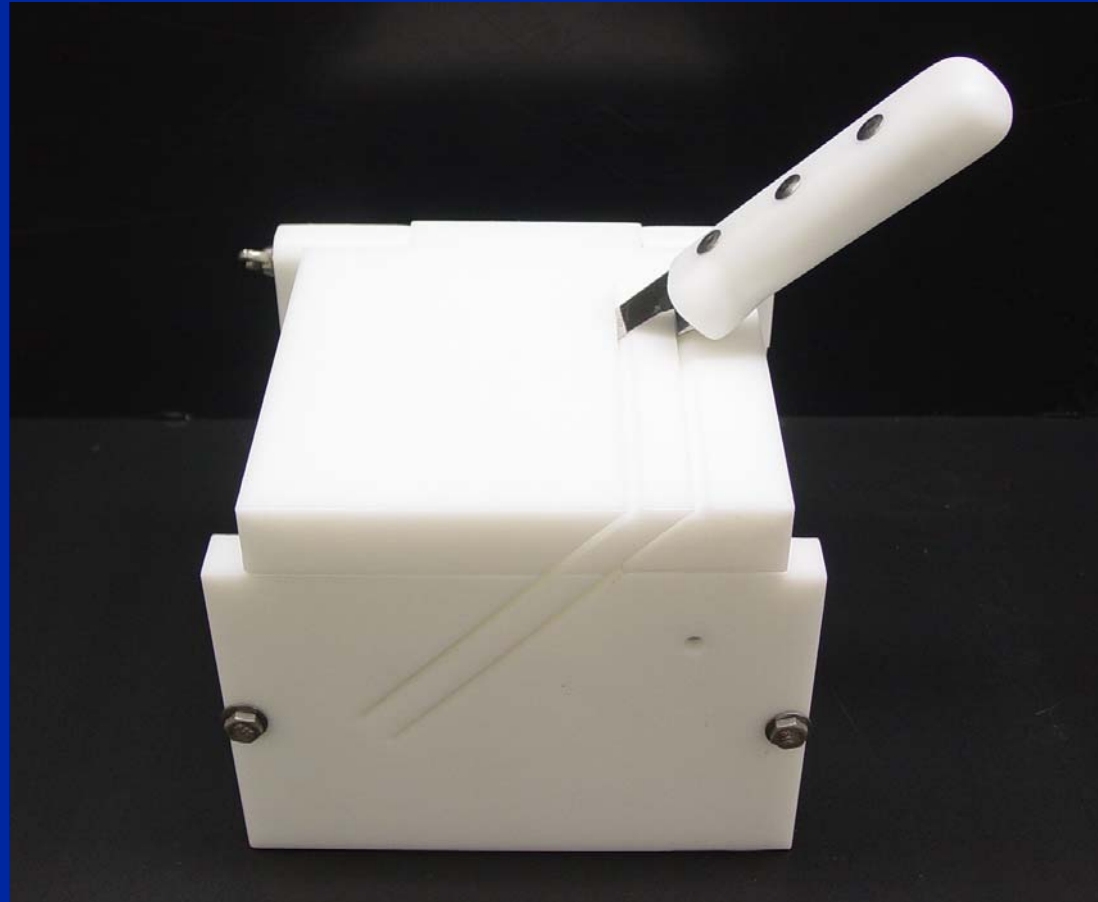
Step 3: Muscle fiber orientation in slice box



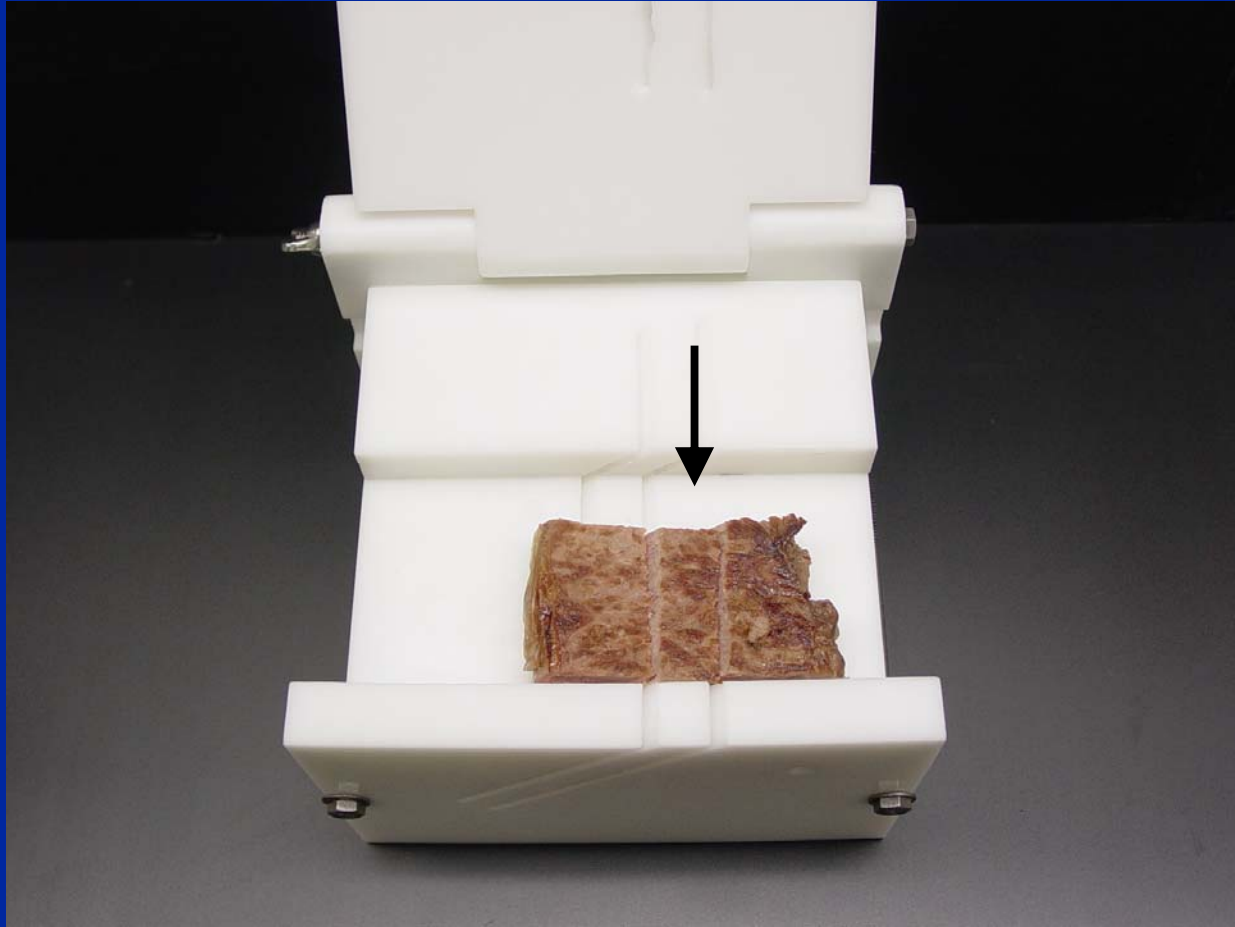
SSF Protocol

4. Close the lid of the box. Insert the double-bladed knife that consists of two parallel blades spaced 1 cm apart into the slots at the back and make two parallel cuts simultaneously through the length of the 5-cm long section. This cut is made with 4 to 5 up-and-down sawing motion strokes while pulling the knife forward (the knife blades must be kept sharp to get a good “clean” cut – failure to do so will result in slices less than the full thickness and underestimate SSF). This cut provides a 1-cm thick, 5-cm long slice that is parallel to the muscle fibers.

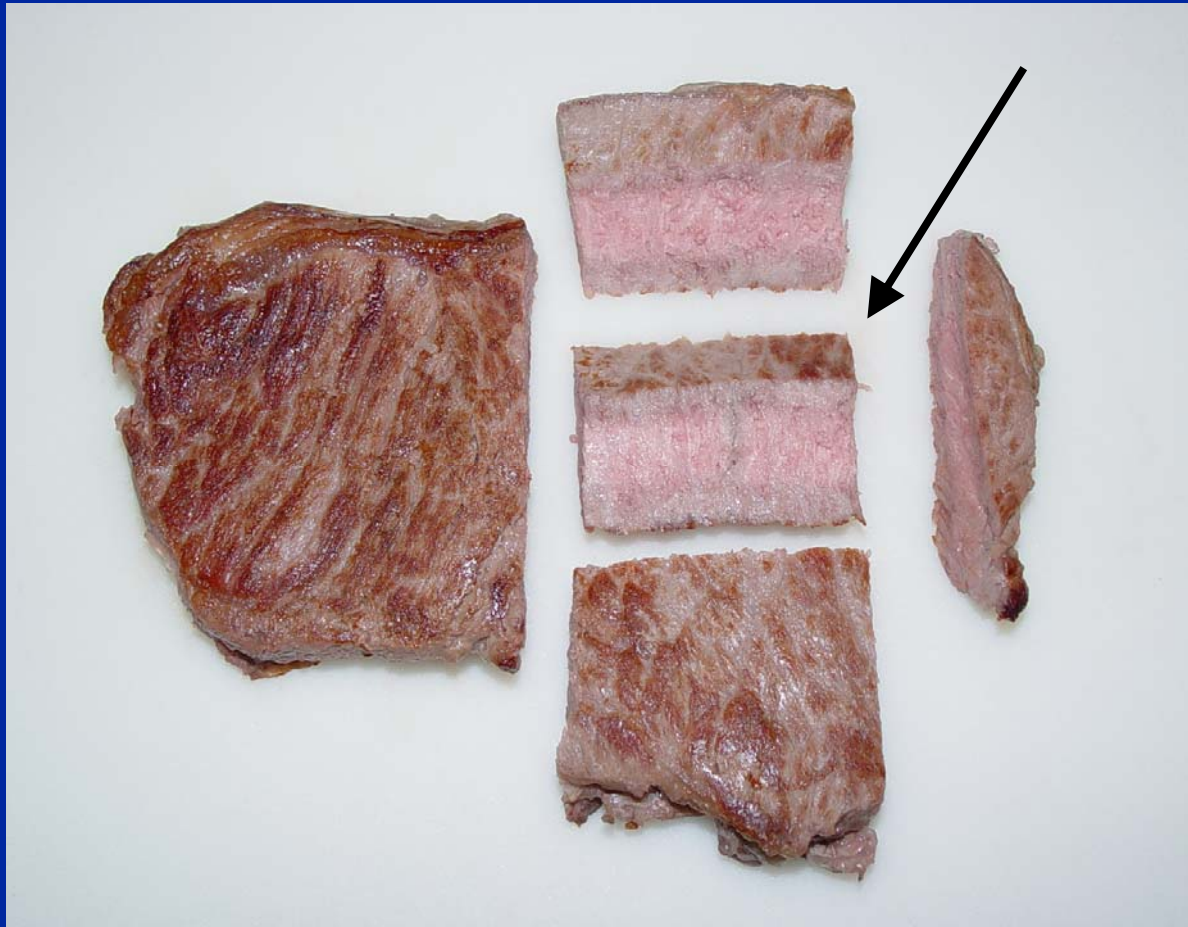
Step 4. Obtaining 1 cm-thick, 5 cm-long slice



The slice



1 cm-thick, 5 cm-long slice parallel to fibers

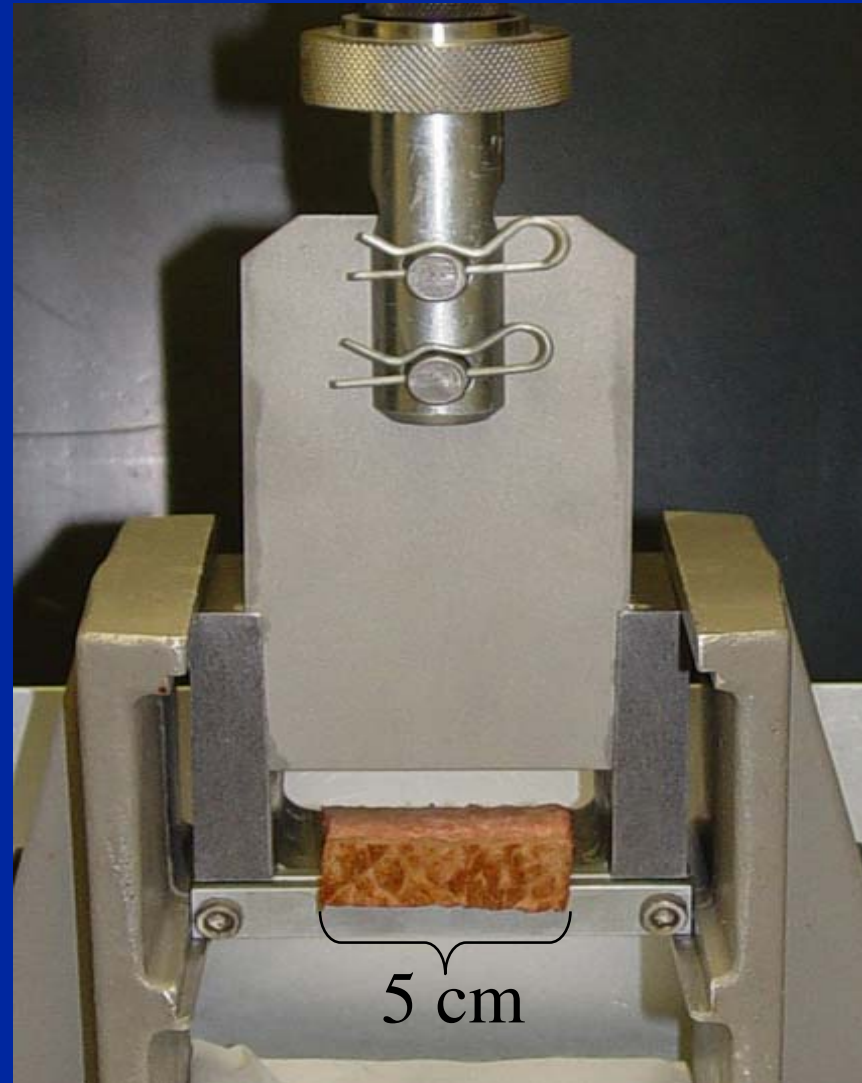
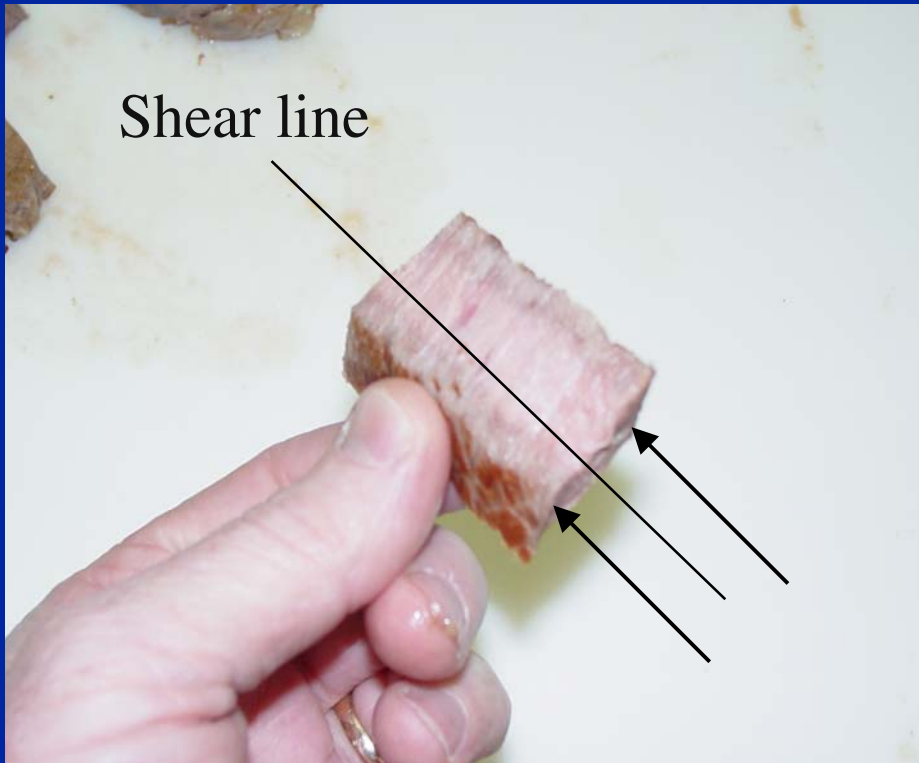


1 cm-thick, 5 cm-long slice parallel to fibers



The slice is placed in the testing machine so that the blade shears perpendicular to the muscle fibers along the 5-cm dimension of the slice. When positioning the slice, it must be exactly centered so the blade shears in the center and avoids the cooked crust on both the top and bottom sides of the slice.

Slice positioned in testing machine



The slice blade should be 1.016 mm (0.04 inches) thick with the cutting edge beveled to a half-round. The spacers creating the gap for the cutting blade to slide through should be 2.0828 mm (0.082 inches) thick. The crosshead speed should be 500 mm/min for Universal Testing Machines (e.g., Instron, United, Texture Technologies, etc.).

SSF Testing Machines

Instron testing machine



United testing machine



Texture Technologies testing machine



Shear the slice. The data should be captured by the instrument software on the computer running the instrument. We record the values as a backup for computer failure. The slot the blade passes through should be cleaned periodically with a paper clip. Rinse the slots the blade passes through with water periodically. The blade should be cycled through periodically with no slice to ensure the blade is free and not dragging.