Guidelines for Completion of Armor Conditioning by NIJ Standard–0101.06 Section 5

Note: When planning conditioning testing, it is important to try to plan the start of testing such that the testing will be completed during CTP's normal working business hours (Monday through Friday 8:30 am to 5:00 pm Eastern Time) in case there are problems with the armor after completion of conditioning that will require assistance from CTP.

1 Purpose of This Document

The purpose of this document is to provide guidance to laboratories performing conditioning of ballistic-resistant body armor according to NIJ Standard–0101.06 Section 5. In an effort to improve the consistency of results obtained from different laboratories performing the conditioning, this document provides information on best practices for loading armor into the tumbler, monitoring the armor during conditioning, flattening of the armor after completion of conditioning, and preparation of the armor for shipment. The flattening of the armor after completion of conditioning is of particular importance because the armor must be flattened as much as possible prior to ballistic testing according to NIJ Standard–0101.06 Section 7.

2 Beginning Conditioning

1. Gather all eight armors (16 armor panels) for conditioning. Document condition of each armor prior to loading tumbler.

2. Load armor panels into tumbler with no two panels taking the same direction, as shown in Figures 1 and 2 (below).

3. If possible, during the armor conditioning, periodically observe the armor panels to determine if they are tumbling independently. If the armors are not tumbling independently, then stop the conditioning cycle, manually reorient the armor, and then restart the conditioning protocol. The *Environmental Chamber Door Opening Guidelines* described in Section 2 should be followed. Describe in detail what adjustments were made in the test report.

Figure 1: Orientation of armor panels in tumbler.

Figure 2: Closeup of orientation of armor panels in tumbler.

3 Environmental Chamber Door Opening Guidelines

1. Prior to opening the chamber or entering a walk-in, the conditions must be adjusted to prevent condensation.

2. Reduce the humidity in the chamber prior to reducing the temperature to avoid generation of condensation in the tumbler. As described in NIJ Standard–0101.06 Section 5, tumbling must be stopped while the environment is in the out-of-tolerance conditions.

3. The amount of time that the armors spend in the out-of-tolerance conditions must be made up at the end of the protocol, as described by the Test Interruption Flow Chart, Figure 10, in Section 5 of NIJ Standard–0101.06.

4 Armor Handling After Completion of Conditioning

1. At least the last 4 hours of conditioning should be monitored to ensure that the proper number of rotations are achieved in the allowable time period (which may require adjustment of the rotation speed within the limits set in NIJ Standard–0101.06).

2. When the conditioning protocol has been completed, remove the armors from the tumbler and stack them on a flat surface as quickly as possible. Ideally this should be within minutes. The objective of this requirement is to ensure that the armors are removed before they cool to room temperature (less than 1 hour). The following steps are only effective if they are completed while the armor is still warm.

3. Place the most wrinkled armors on the bottom, straightening and smoothing them as much as possible, as shown in Figures 3 through 5, then stack other, flatter armors on top of the most wrinkled armors to help press out the wrinkles, as shown in Figures 6 through 8.

4. If these procedures are not sufficient to return the samples to a condition that is acceptable for ballistic testing, additional smoothing procedures, described in Section 4.1, may be necessary.

Figure 3: Folded and wrinkled armor panel after removal from tumbler.

4.1 Opening the Armor Panel for Additional Smoothing

Prior to any additional effort to smooth the armors, call the Body Armor CTP immediately at 800-248-2742 to inform them of the situation with the armor and involve them in the decisions of how to proceed with the flattening of the armor. If CTP personnel are not available before applying procedures, the CTP should be informed of what procedures were used as soon as possible.

1. If necessary, and after all other attempts to flatten one or more armors have been exhausted, then the affected armor (or armors) may be

Figure 4: Demonstration of technique for unfolding and flattening armor panels.

Figure 5: Demonstration of technique for unfolding and flattening armor panels.

Figure 6: Stacking of flatter armor panels on top of wrinkled armors to assist in pressing out wrinkles.

Figure 7: Stacking of flatter armor panels on top of wrinkled armors to assist in pressing out wrinkles.

Figure 8: Combination of stacking and flattening armor panels when additional wrinkled armors are placed on the stack.

warmed in an environmental chamber, with conditions of 1 hour ± 10 minutes at 45 °C and 50 % relative humidity, with the same tolerances of temperature and relative humidity as specified in NIJ Standard–0101.06. Only the affected armor should be placed in the chamber for rewarming. Then the preceding stacking procedure repeated in an effort to flatten the armor. If this is necessary, then describe what was done in detail in the test report. This rewarming may only be performed one time on each batch of armor.

2. If necessary, and after all other attempts to flatten the armor have been exhausted, the armor may be removed from its carrier and the armor panel covering material slit to assist in flattening the armor, as depicted in figures 9 through 19.

3. Horizontally slit only the armor panel cover (not the ballistic pad) with a razor blade at the bottom of the armor panel.

4. Fold the armor panel cover back to access the part of the armor that requires flattening.

5. Immediately mark the strike face of the ballistic material to ensure that it will be reinserted with the correct orientation.

6. To reduce the possibility of an incorrect reinsertion of the ballistic material inside of the armor panel cover, if possible, keep the armor panel partially inside of the armor panel cover to help maintain is original orientation, as shown in Figure 14.

7. Flatten the ballistic material, including unfolding any corners or edges that may have become folded or dog-eared.

8. Re-insert the ballistic material through the hole in the panel cover, reversing the steps that were necessary for removal. Once again, if these steps are required, what was done should be described in detail in the test report.

Figure 9: Armor panel prior to removal of armor panel cover.

5 Preparing Conditioned Armor for Shipment

1. When it is necessary to ship the armor, package the armor securely to protect it from becoming folded, wrinkled, or moved about in the container during shipment.

2. Try to preserve the stacked orientation with the flattest armors on top, and more wrinkled armors on bottom to improve the chances that the armors will be flat when they reach the ballistic testing facility.

3. Select a shipping container that does not require the armor to be folded.

4. Use packing material around the armor to keep it in place in the shipping container.

If you have any questions about this document, call the Body Armor CTP at 800-248-2742 before proceeding.

Figure 10: Use of a razor blade to to slit just the bottom of armor panel cover.

Figure 11: Continuation of slit in bottom of armor panel cover.

Figure 12: Continuation of slit in bottom of armor panel cover.

Figure 13: Completion of slit in bottom of armor panel cover.

Figure 14: Armor panel with panel covering material folded back to allow access to ballistic package (so as to preserve original orientation of ballistic package within the armor panel cover). Note that the armor panel was not removed from the panel covering material.

Figure 15: Use of flattening to press out additional wrinkles in the ballistic package.

Figure 16: Reinsertion of the armor panel in the armor panel cover, preserving original orientation.

Figure 17: Smoothing and flattening of armor after reinsertion into the armor panel cover.

Figure 18: Reinsertion of the armor panel into its carrier.

Figure 19: Armor panel in its carrier, being readied for packaging and shipment.