

## **PRELIMINARY DESIGN MODEL TESTING REQUIREMENTS**

### **9-mm V0 Back Face Deformation (BFD) V0 Testing**

- Five (5) shots per panel, totaling twenty (20) shots shall be taken at 0° obliquity on clay that meets the clay validation requirements outlined in AR/PD 10-04 Rev D. All velocities shall be translated into strike velocities.
- Back face deformation measurements shall be measured using a caliper with a FARO arm in accordance with AR/PD 10-04 Rev D.

#### Upper Tolerance Limit Calculations:

For back face deformation, the metric of merit is a one-sided Upper Tolerance Limit (UTL) based on the assumption of normally distributed BFD data; The 90 percent UTL at 90 percent confidence provides the estimated BFD measurement below which 90 percent of BFD measurements will occur, with 90 percent confidence. p. The BFD UTLs are calculated by combining shot locations, plate sizes, and environmental conditions. All 20 shots will be used to calculate the UTL. All shots must be valid and fair according the specifications above (IOTV PD??).

Validated one-decimal place BFD measurements, for tested hard armor inserts that did not experience complete penetrations, are the basis for any UTL calculation. The UTL is defined<sup>1</sup> as  $Y_u = \bar{Y} + ks$ , where  $\bar{Y}$  is the mean of all valid BFD measurements, k is a look-up constant<sup>3</sup> (varying with the sample size, UTL percentage, and confidence percentage), and s is the sample standard deviation. The UTL is reported to one decimal place precision after adjusting upwards via the “ceiling function” – ensuring that a conservative UTL is reported. For example, calculated results of 38.1349 mm and 38.1999 mm are each reported as 38.2 mm. Compliance with the BFD requirement is achieved only if the associated UTL is less than or equal to 44.0mm.

When calculating the sample average (mean) and standard deviation in order to compute the UTL, calculate both the mean and standard deviation to six significant digits. This is to avoid the rounding of these intermediate quantities affecting the reported UTL. The final result (the UTL) is then reported to one decimal place as specified above.

- Test Procedures:

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<sup>1</sup> NIST/SEMATECH e-Handbook of Statistical Methods <http://www.itl.nist.gov/div898/handbook/prc/section2/prc263.htm>

<sup>3</sup>  $k = \frac{z_{UTL} + \sqrt{z_{UTL}^2 - ab}}{a}$  where  $a = 1 - \frac{z_{conf}^2}{2(N-1)}$ ,  $b = z_{UTL}^2 - \frac{z_{conf}^2}{N}$  and  $z_{UTL}$  is the critical value from the standard normal distribution associated with the UTL percentage.  $z_{conf}$  is the critical value from the standard normal distribution associated with the Confidence percentage and N is the total sample size for the data of interest.

- Samples will be mounted on a clay block that shall be rigidly held by a suitable (metal) stand. The armor test sample must remain coplanar throughout the test and shall be secured in the vertical position, perpendicular to the projectile line of flight. The frame supports must be capable of retaining the sample and withstanding the shock resulting from ballistic impacts. The test sample mounting shall be capable of adjustment for moving the sample in the vertical or horizontal positions so that the point of impact can be located anywhere on the sample.
- The first shot will be  $2.75 \pm 0.5$  inch from any edge.
- The second shot shall be located  $3.5 \pm 0.5$  inch from the first shot.
- The third shot shall be located  $3.5 \pm 0.5$  inch away from any of the first two shots.
- The fourth shot shall be located  $3.5 \pm 0.5$  inch away from any of the first three shots.
- The fifth shot shall be located  $3.5 \pm 0.5$  inch away from any of the first four shots.
- Test shots shall be staggered at least 0.50 inch off the horizontal and vertical lines of any previous shots. Shot locations will be measured as the impact point on the strike face of the ballistic panel and not the surface of the vest.
- Test specimens shall be reconditioned to a smooth shape after every shot on a firm flat surface.

#### **9-mm V50 Testing – Sea Water**

- V50 Testing shall be conditioned and conducted in accordance with the first article testing in accordance with the purchase description AR/PD 10-04 Rev D.
- V50 Calculation:
  - 3 Partial and 3 Complete within 125 feet/second or 5 Partial and 5 Complete within 150 feet/second. If both a 5 x 5 and a 3 x 3 are achieved, the 5 x 5 should be used.

#### **17-grain FSP V50 Testing – All conditions**

- V50 Testing shall be conditioned and conducted in accordance with the first article testing in accordance with the purchase description AR/PD 10-04 Rev D.
- V50 Calculation:

- 3 Partial and 3 Complete within 125 feet/second or 5 Partial and 5 Complete within 150 feet/second. If both a 5 x 5 and a 3 x 3 are achieved, the 5 x 5 should be used.

**Areal Density Measurement** – Areal density measurement of the ballistic package will be measured by the source selection board. The offeror must provide the following:

- Ballistic material layup build sheet detailing material type, denier, weave, ply count, etc.
- One (1) ply, 80 inch x 54 inch of each material used shall be supplied to the Government.
- The source selection board will weigh each ply of materials independently, multiple the weight of each ply by the number of plies used of a given material, and will calculate the overall areal density.