Lot Acceptance by Attributes in MIL-STD-1916

MIL-STD-1916 offers the Department of Defense preferred methods for acceptance of product. The standard says that process control and statistical control methods are the preferable means to prevent nonconformities, control quality, and generate information for continuous improvement. On the other hand, the standard says that sampling inspection is an inefficient practice to demonstrate conformity.

Notwithstanding the inefficient aspects of sampling, the standard provides sets of sampling plans. The standard has a unified approach to lot inspection by attributes, lot inspection by variables, and continuous sampling by attributes. In this article we look at lot inspection by attributes.

The three kinds of sampling plans use a common approach matched through seven verification levels (VL) and five code letters (CL). The sampling plan selection follows a four step process.

- Determine the specified verification level (from the contract).
- Decide on the sampling type (lot-attributes, lot-variables, or continuous-variables).
- Determine the code letter (CL) based on the lot or production size.
- Determine the switching state (normal, tightened, or reduced) based on production history.

The verification levels (VL) determine the level of effort in the sampling plan, *i.e.*, the higher the verification level the larger the sample size. All the sampling plans use lot acceptance on zero nonconforming items in the sample and lot rejection on one nonconforming item.

The Concept of AQL

The sampling plans do not use an Acceptable Quality Level (AQL), such as the method in ANSI/ASQ Z1.4. AQL helps describe the operating level of the supplier's process. The concept is that the supplier's process should run at the best possible level; the percent of nonconformance should be as low as possible. In the classic case, the customer will take all the lots from the supplier's process as long as it operates at or below a given level. The customer will reject all lots if the process operates above a given level. This level is the Acceptable Quality Level (AQL).

Some people object to the AQL concept, stating that it allows the supplier to operate a process that produces nonconforming material. This is a misunderstanding, since an AQL is not a "license" to produce nonconforming material. Rather, it is a description of a relationship between supplier and customer.

The AQL concept described above provides the "ideal" operating characteristic (OC) curve. The OC curve shows the probability of acceptance (y-axis) for operating levels of the process (x-axis). In the ideal case the OC curve is "square". It is 100% at the AQL point and below, but is 0% above the AQL. One cannot achieve the ideal OC curve using sampling.

Examples Using MIL-STD-1916

The following example illustrates the four step process to determine a sampling plan.

- The contract requires a verification level (VL) of IV.
- The example uses lot acceptance by attributes.
- Assume the lot size is 1,000, so Table I gives a code letter (CL) of B.
- The lot history sets the switching state to Normal.

Table II gives a sample size of 96, accept on 0, reject on 1.

MIL-HDBK-1916, a companion to MIL-STD-1916, draws the OC curves for the plans and tabulates some values. We learn from Table D-XXVII that for this plan:

Probability of Acceptance	Process Nonconformance Rate
95%	0.0534%
50%	0.7194%
10%	2.3700%

Consider this same example expect that the lot history sets the switching state to Tightened. The contract specifies a VL of IV, but Tightened inspection requires increasing the VL by one step. The new sampling plan, from Table II, has a sample size of 256, accept on 0, reject on 1.

The table in MIL-HDBK-1916 says the probability of acceptance of 96% occurs with a process nonconformance rate of 0.0200%; the OC has shifted.

Summary
MIL-STD-1916 does not specify AQLs, so it avoids the concern discussed above. However it does use sampling plans and, as such, must have some way to select them. The method is the verification level (VL) used to index the plans and the code level (CL) used to adjust the sample size to the lot size. Regardless of the method (VL or AQL) the sampling plan has an OC curve that describes the probability of acceptance as a function of process nonconformance.