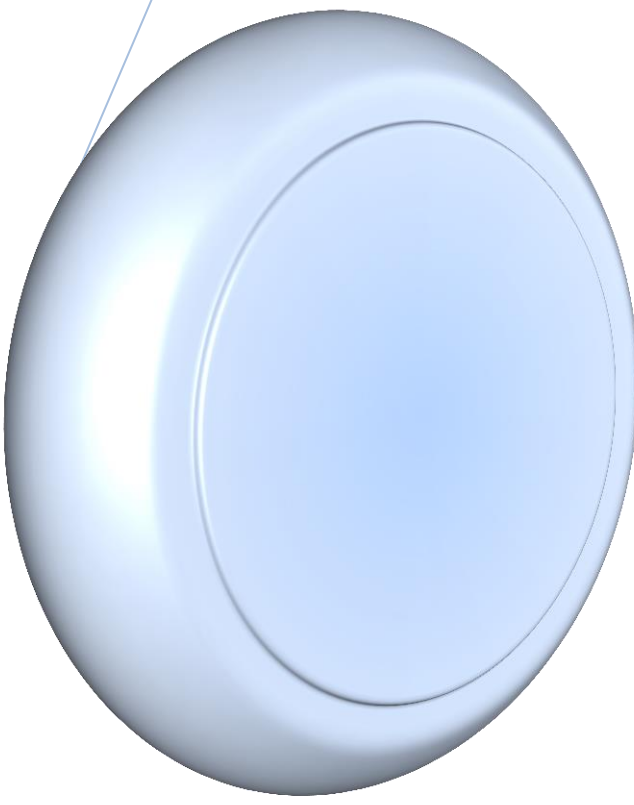
Acceptance Sampling Vs Acceptance Quality Limit (AQL) in Quality Control

Olanrewaju, Adebayo Bamidele



Acceptance Sampling

Let's imagine that a consumer receives some lots of products from a supplier. A sample of parts from the lot is taken and the number of defective items counted, if there is. If the number of defective items is low, the entire lot will be accepted, but if the number of defective items is high, the entire lot is rejected. Deciding on accepting a good-quality lot and rejecting a poor-quality lot is referred to in quality as **acceptance sampling**.

Acceptance sampling is a statistical technique utilized in quality control, allowing a manufacturer to determine the quality level of a batch of products from a specific production run by selecting a predetermined number for testing. The quality of the sample selected during sampling becomes the quality level for the entire group of products.

The primary objective of acceptance sampling is to determine the quality level of a batch with a specified degree of statistical certainty without having to test every single unit of that batch. After completing the sampling exercise or testing, the manufacturer decides whether to accept a lot or reject it based on how many of the predetermined number of samples passed or failed the test.

The concept of acceptance sampling was originally applied by the U.S. military to the testing of bullets during World War II and became very popular throughout that time and beyond. The concept was developed by Harold Dodge, a veteran of the Bell Laboratories quality assurance department, who was acting as a consultant to the Secretary of War.

Why Sampling?

Random sampling is conducted for the following reason:

- **Sensitive of Products:** Comprehensive testing might damage the product or make it unfit for sale in some way. An example is testing a food or pharmaceutical products. This is an especially important point to consider when testing method is a destructive one.
- **Cost & Time:** Inspecting too many products at a reasonable cost or within a reasonable timeframe poses another challenge. Much time is spent in the course of testing and more inspectors might be needed which amounts to more cost.
- **Cumbersomeness of Lot Size:** It is practically unrealistic to test every single product of a particular lot of very large size at the same time due to the level of cumbersomeness of the batch which makes handling quite difficult.

Acceptance Sampling Methods

The following are two methods listed below:

- **Singular Sampling:** This is the simplest which involves testing a single unit at random, per say X units produced (sometimes called an (n, c) plan). The acceptance is thereafter evaluated based on the number of defective units say, C, found in the sample size, say, N.
- **Multiple Sampling:** This method involves multiple sampling, which relies on several such (N, C) evaluations. This method of sampling is more costly, but may be more accurate.

When Acceptance Sampling should be used

Since acceptance sampling relies on statistical inference made from a small sample, thus not as accurate as more comprehensive measures of quality control, it should only be used when so many products are made that are impractical to test a large percentage of its units; or when inspection of a unit would result in its destruction or render it unusable.

Designing a Sampling Plan

Since sampling involves selection of only a part of the lot, the probabilities of errors in decisions need to be considered. This is because the error of rejecting a good-quality lot creates a problem for the producer. The probability of this error can be called the producer's risk. Likewise, the error of accepting a poor-quality lot equally creates a problem for the buyer or consumer of the product; in this case, the probability of is called the consumer's risk.

Designing an acceptance sampling plan involves first determining a sample size *n* and an acceptance criterion *c*, where *c* is the maximum number of defective items that can be found in the sample and the lot still be accepted. One key way of gaining proper understanding of both the producer's risk and the consumer's risk assuming that a lot of product has some known percentage of defective items and computing the probability of accepting such a lot for a given sampling plan.

When the assumed percentage of defective items in a lot is varied, many different sampling plans can be evaluated and a sampling plan is thereafter selected in such a way that both the producer's and consumer's risks are reasonably low.

Acceptance Quality Limit (AQL)

ISO 2859-1 defines acceptable quality level (AQL) as the "quality level that is the worst tolerable." What this means is that, AQL, expressed as a percentage or ratio of the number of defects compared to the total quantity, measures how many defective components are considered acceptable during random sampling quality inspections. AQL refers to the maximum number of defective units, beyond which the lots containing the defects are rejected.

AQL Parameters

These parameters are used in AQL tables to determine the acceptable level of production run.

- **Lot size**

Lot size refers to the quantity of a product manufactured in a single production run. That is, the total quantity of a product ordered for manufacturing. If different products are ordered, each product is considered as a separate lot. If you ordered only one product, the lot size is the total batch quantity. The quantity of each product is the lot size.

- **Inspection Level**

Inspection level refers to the number of samples to check. They are categorized into three (3), namely, level I, II & III. Different inspection levels commands different numbers of samples to inspect. Level I entail checking fewer samples, level II are in-between level I & III and are acceptable for most importers, while Level III involves tightening up and checking more samples.

- **The AQL limits**

The AQL limits provide an upper limit to defective products. It is wise to set a lower AQL for both major and minor defects if the customer accepts very few defects.

- **AQL Tables**

These tables are a set of statistical tools (charts) for product inspection that allow users to easily determine the number of samples that are necessary for testing and the number of allowable defective units based on a given AQL.

How Acceptable Quality Level (AQL) Works

Manufactured parts are often randomly tested according to some defined sampling plans. If the number of defective items falls below the predetermined amount, such a product will be said to meet the acceptable quality level (AQL). If the acceptable quality level (AQL) is not

reached for a particular inspection exercise, a review of the various parameters in the production process is conducted to determine the possible and root cause of the defects for an appropriate corrective action.

For instance, say we are to conduct an AQL of 2% on a specific manufacturing batch, meaning that no more than 2% of the batch should be found with defects. If the batch is made up of say, 1,000 products, only 20 products can be defective. If more than 20 (e.g. 20.5) products are found defective, the entire batch is scrapped.

It should be noted that AQL of products are not fixed, in that, they depend on the type of industry. AQL of medical equipment manufacturers, metallurgical, food production, electronics, pharmaceutical, automobiles industries etc. are all different. They depend on the nature of the products and their effect on their consumers. Hence, pharmaceutical products are more likely to have more stringent AQL than say, metallurgical products, because defective pharmaceutical products can result in severe health risks to the vast majority.

Some factors being considered while setting up an acceptable quality limits could include safety, business and financial implication of a products and their associated defects.

Categories of AQL Defects

Defects are simply a fault, or anything that makes a product or service not useful. Defects can be categorized into three:

- **Critical defects**

Defects, when accepted could harm users. These defects cannot be accepted because of the danger they pose. They are designated as 0% AQL.

- **Major defects**

These too are not acceptable by the end-users, as they are likely to result in failure when in use. Hence, they are termed ‘major’ with designated of AQL of 2.5%.

- **Minor defects**

These products differs from specified standard but are likely not going to reduce the usability of the products , as they can still be ‘managed’ by the users. The AQL for minor defects is 4%.

About the Author

Olanrewaju, Adebayo Bamidele *is a Lead Auditor of ISO 9001, FSSC 22000 / ISO 22000, 14001, 45001, Certified Six Sigma Master Black Belt (CSSMBB), process engineer, and quality management professional with strong working experience and proven skills in manufacturing excellence, ISO management systems implementation, lean / digital manufacturing, and project management. He is an author of over 15 books and has published over 45 online courses on various e-learning platforms including Udemy, Alison, Learndesk & Study Plex.*

Contact

Phone: *+2347037710839, +2348077486016;*
Email: *adebayoolanrewaju206@gmail.com*
Social Media Accounts: *LinkedIn, Facebook & Instagram*