

Acceptance Sampling and AQL

http://www.siliconfareast.com/ltpd_aql.htm

A simplified introduction and an explanation of acceptance testing and Acceptable Quality Levels (AQL)

Acceptance sampling is an important aspect of statistical quality control. It originated back in World War II when the military had to determine which batches of ammunition to accept and which ones to reject. They knew that they couldn't test every bullet to determine if it will do its job in the field. On the other hand, they had to be confident that the bullets they're getting will not fail when their lives are already on the line. Acceptance sampling was the answer - testing a few representative bullets from the lot so they'll know how the rest of the bullets will perform.

Acceptance sampling is a compromise between not doing any inspection at all and 100% inspection. The scheme by which representative samples will be selected from a population and tested to determine whether the lot is acceptable or not is known as an *acceptance plan* or *sampling plan*. There are two major classifications of acceptance plans: based on *attributes* ("go, no-go") and based on *variables*.

Sampling plans can be *single*, *double* or *multiple*. A single sampling plan for attributes consists of a sample of size n and an acceptance number c . The procedure operates as follows: select n items at random from the lot. If the number of defectives in the sample set is less than c , the lot is accepted. Otherwise, the lot is rejected.

In order to measure the performance of an acceptance or sampling plan, the Operating Characteristic (OC) curve is used. This curve plots the probability of

accepting the lot (Y-axis) versus the lot fraction or percent defectives.

LTPD - Lot Tolerance Percent Defective

The LTPD of a sampling plan is the level of quality routinely rejected by the sampling plan. It is generally defined as the percent defective (number of defectives per hundred units X 100%) that the sampling plan will reject 90% of the time. In other words, this is also the percent defective that will be accepted by the sampling plan at most 10% of the time. This means that lots at or worse than the LTPD are rejected at least 90% of the time and accepted at most 10% of the time.

The LTPD can be determined using the operating characteristic (OC) curve by finding that quality level on the bottom axis that corresponds to a probability of acceptance of 0.10 (10%) on the left axis.

Associated with the LTPD is a confidence statement one can make. If the lot fails the sampling plan, one can state with 90% confidence that the quality level of the lot is worse than the LTPD (i.e., the defective rate of the lot > LTPD). On the other hand, if a lot passes the sampling plan, then one can state with 90% confidence that its quality level is equal to or better than the LTPD.

The LTPD of the sampling plan describes what the sampling plan will reject, but it is also important to know what the sampling plan will accept. Information on what the sampling plan will accept is provided by the [AQL](#) of the sampling plan.

Table 1. LTPD Sampling Table based on the Mil-S-19500 and Mil-M-38510

Max % Defective	20%	15%	10%	7%	5%	3%	2%	1.5%	1%	0.7%	0.5%
Acceptance Number (c); rejects=c+1	Minimum Sample Size Needed										
0	11	15	22	32	45	76	116	153	231	328	461
1	18	25	38	55	77	129	195	258	390	555	778
2	25	34	52	75	105	176	266	354	533	759	1056
3	32	43	65	94	132	221	333	444	668	953	1337
4	38	52	78	113	158	265	398	531	798	1140	1599
5	45	60	91	131	184	308	462	617	927	1323	1855

AQL - Acceptable Quality Level

The AQL of a sampling plan is a level of quality routinely accepted by the sampling plan. It is generally defined as the percent defective (defectives per hundred units X 100%) that the sampling plan will accept 95% of the time. This means lots at or better than the AQL are accepted at least 95% of the time and rejected at most 5% of the time.

The AQL can be determined using the operating characteristic (OC) curve by finding that quality level on the bottom axis that corresponds to a probability of acceptance of 0.95 (95%) on the left axis.

Associated with the AQL is a confidence statement one can make. If the lot passes the sampling plan, one can state with 95% confidence that the quality level of the lot is equal to or better than the AQL (i.e., the defective rate of the lot < AQL). On the other hand, if the lot fails the sampling plan, one can state with 95% confidence that the quality level of the lot is worse than the AQL.

The AQL describes what the sampling plan will accept, but it is also important to know what the sampling plan will reject. Information on what the sampling plan will reject is provided by the LTPD of the sampling plan

Table 2. AQL Sampling Table based on the Mil-STD-105D

Lot Size/ Sample Size	Acceptable Quality Levels for Normal Inspection (% defective)													
	.01	.015	.025	.04	.065	.10	.15	.25	.40	.65	1.0	1.5	2.5	4.0
	Lot Acceptance (Ac) Number (maximum number of rejects to accept the lot)													
LS=2 to 8 SS=2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LS=9 to 15 SS=3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LS=16 to 25 SS=5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LS=26 to 50 SS=8	0	0	0	0	0	0	0	0	0	0	0	0	1	1
LS=51 to 90 SS=13	0	0	0	0	0	0	0	0	0	0	0	0	1	1
91 to 150 SS=20	0	0	0	0	0	0	0	0	0	0	0	0	1	2
151 to 280 SS=32	0	0	0	0	0	0	0	0	0	0	0	1	2	3
281 to 500	0	0	0	0	0	0	0	0	0	0	1	2	3	4

SS=50														
501 to 1200 SS=80	0	0	0	0	0	0	0	0	0	1	2	3	5	7
1201 to 3.2K SS=125	0	0	0	0	0	0	0	0	1	2	3	5	7	10
3201 to 10K SS=200	0	0	0	0	0	0	1	1	2	3	5	7	10	14
10001-35K SS=315	0	0	0	0	0	0	1	2	3	5	7	10	14	21
35001-150K SS=500	0	0	0	1	1	1	2	3	5	7	10	14	21	-
150001-500K SS=800	0	0	0	1	1	2	3	5	7	10	14	21	21	-
	.01	.015	.025	.04	.065	.10	.15	.25	.40	.65	1.0	1.5	2.5	4.0

About the Author

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