

Operating Characteristic Curve

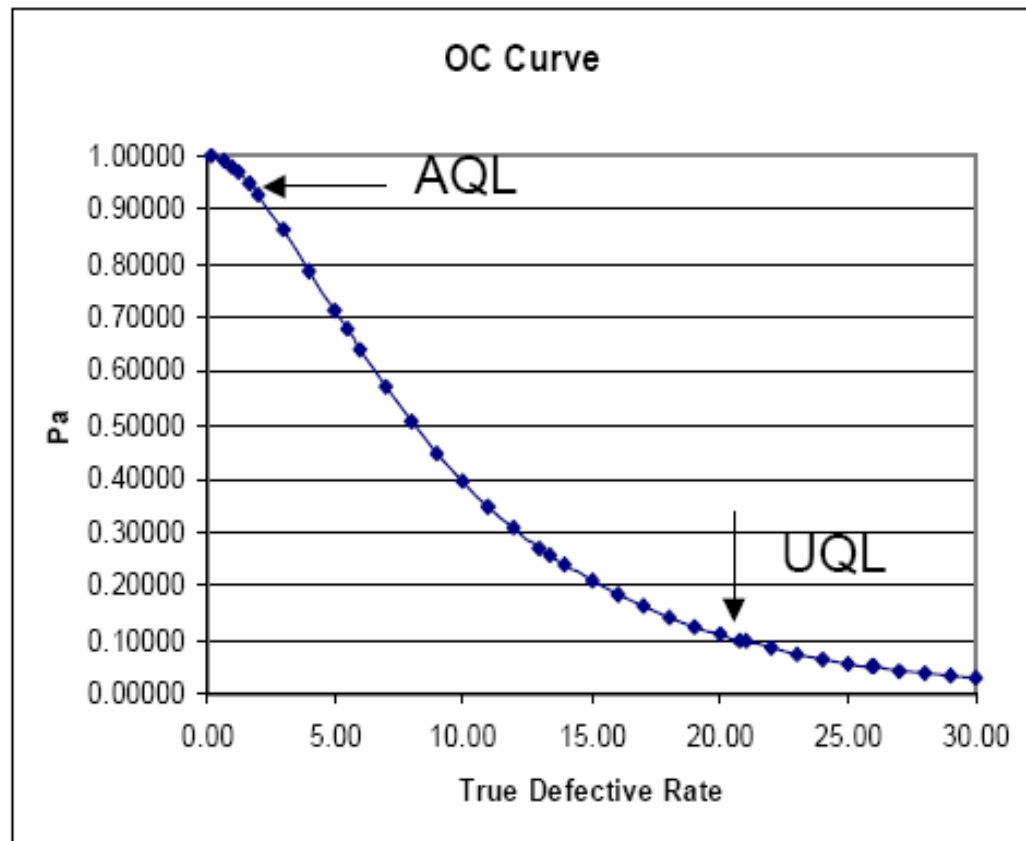


Figure 1

A typical way to illustrate any sampling plan is a graph called an Operating Characteristic curve. The probability of accepting a lot for any true but unknown defective rate is displayed. Ideally low defects should be accepted frequently and high defects should be routinely rejected. This curve illustrates the risk of the lot acceptability decision. Often two points on the curve are used to describe the characteristics of the sampling plan. The Acceptable Quality Limit or AQL is the defective rate the plan will routinely accept. That's usually the 95% point on the curve; around 2% in this example. Lots with 2% or less defectives would be accepted 95% of the time. The other point of interest is at the other end of the curve, the Unacceptable Quality Level or UQL (sometimes also called the Lot Tolerance Percent Defective). This is the defective rate the plan will routinely reject. The usual UQL point is chosen at 10% pass or 90% fail; here around 21%. Lots with defect rates higher than 21% would be rejected 90% of the time. Plans with similar OC curves offer the same protection and carry similar risks to the lot disposition decision.

$\sqrt{N+1}$ Sampling Plans versus Military Standard for Lot Size 16 to 25 (Code C)

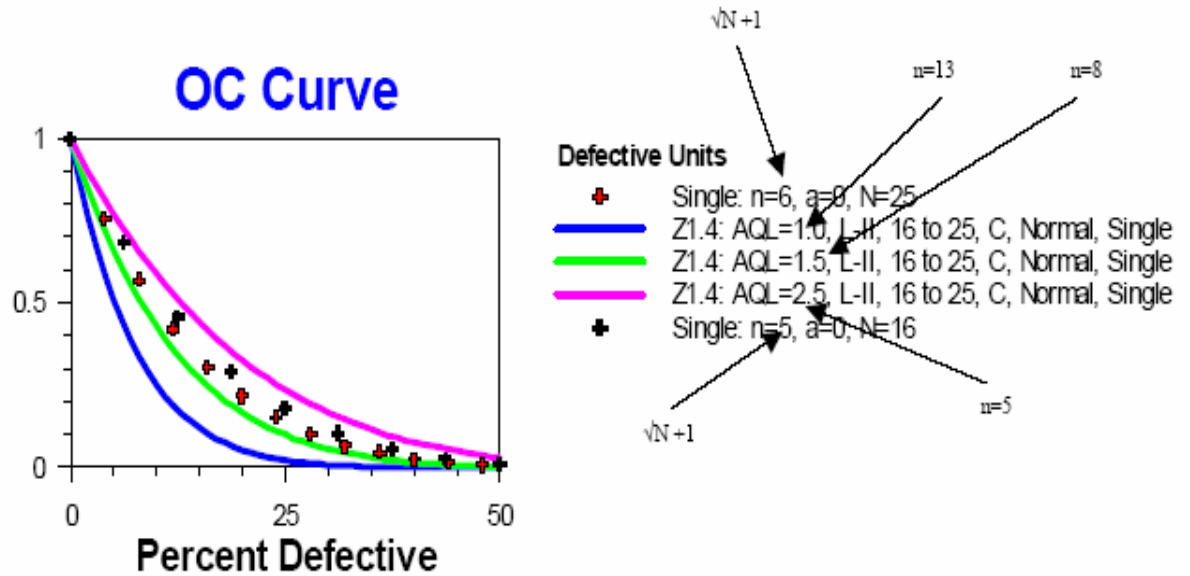


Figure 2

How similar are the $\sqrt{N+1}$ plans and the Military Standard? For the most part the $\sqrt{N+1}$ curves are bracketed by Military Standard plans with AQL levels between 1.0 and 1.5. The exception is shown above for the 16 to 25 lot size where the AQL of 2.5 must be used to bracket the $\sqrt{N+1}$ plans.

$\sqrt{N+1}$ Sampling Plans versus Military Standard for Lot Size 26 to 50 (Code D)

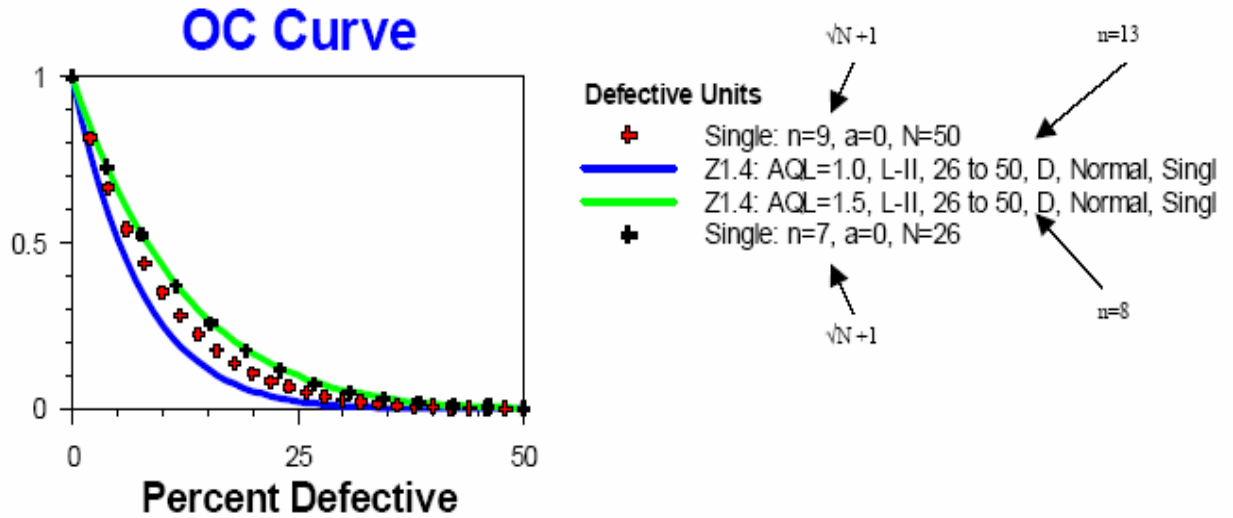


Figure 3

These OC curves show that if you choose your AQL between 1.0 and 1.5 for general, level II inspection for a lot size between 26 and 50, the protection is similar. The Military Standard curves completely bracket the $\sqrt{N+1}$ plans. The protection and risks for $\sqrt{N+1}$ plans in this lot size category are similar to the MIL-STD plan with a specified AQL of 1.0-1.5.

**$\sqrt{N+1}$ Sampling Plans versus Military Standard
for Lot Size 51 to 90 (Code E)**

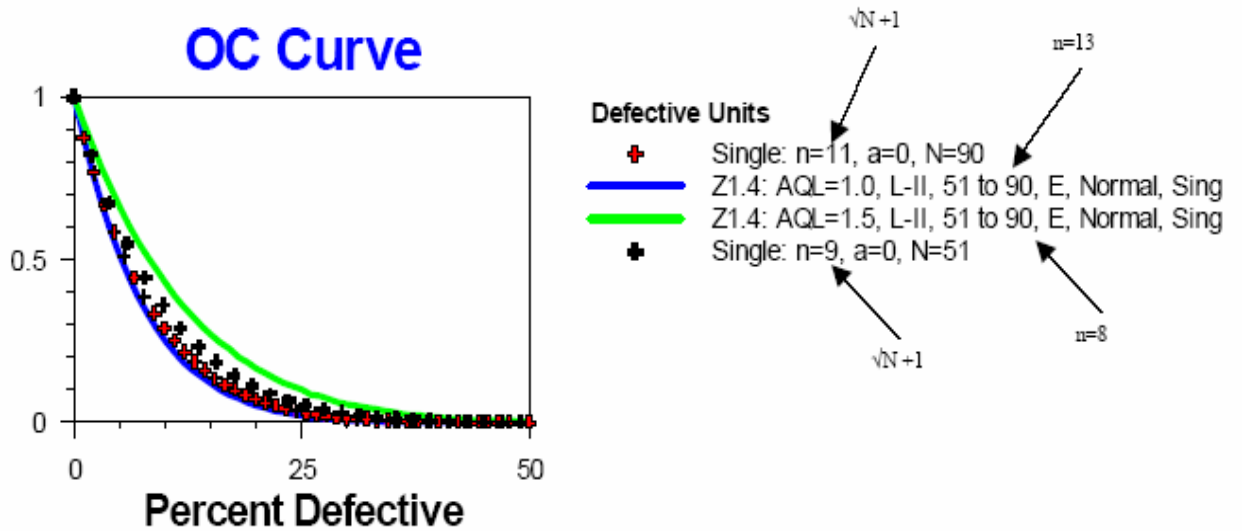


Figure 4

For the next MIL-STD lot size category the OC curves illustrate the same conclusion: the protection and risk of the $\sqrt{N+1}$ plans are similar to MIL-STD plans with AQL between 1.0 and 1.5.

$\sqrt{N+1}$ Sampling Plans versus Military Standard for Lot Size 91 to 150 (Code F)

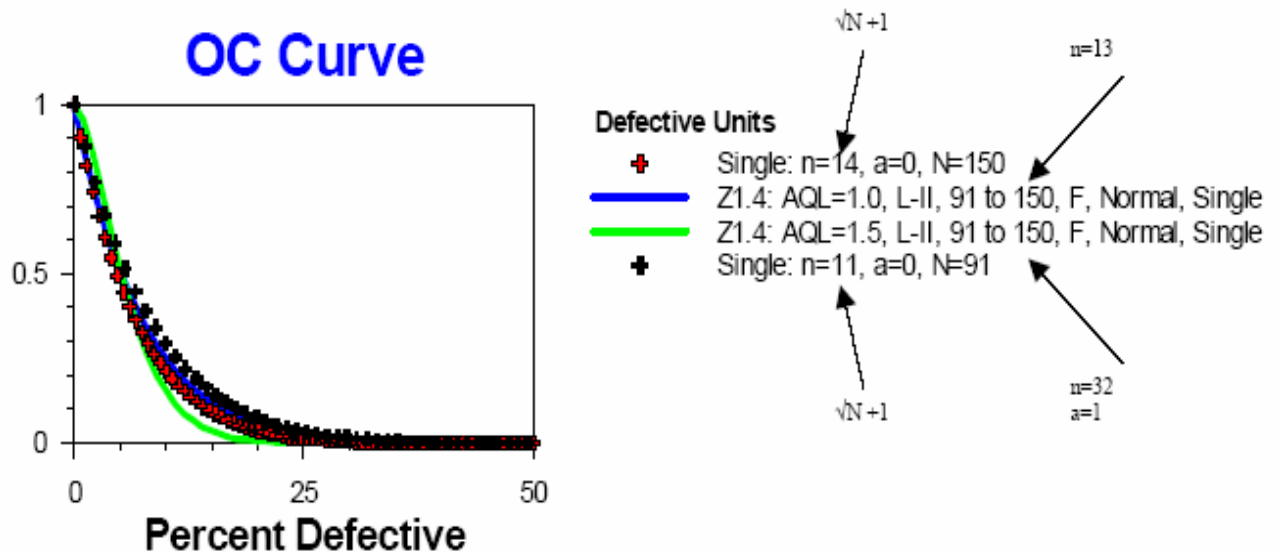


Figure 5

In the next higher lot size category the curves almost lie on top of each other; once again illustrating the similarity of the MIL-STD and $\sqrt{N+1}$ plans when the AQL is chosen between 1.0 and 1.5. Note the AQL=1.5 plan allows 1 defective unit to be found in 32 samples and still pass the lot. All other plans here and in the lower lot sizes are accept on zero defects in the sample plans.

Table 1 Interchangeable Plans

Lot Size	$\sqrt{N+1}$ Sample Size	ANSI Z1.4 AQL Equivalent Normal, General Inspection Level II	ANSI Z1.4 Code / Sample Size Normal, General Inspection Level II
16	5	AQL=2.5	Code=C
17-25	6	1.5 <AQL< 2.5	n=5 or n=8
26-36	7	1.0 <AQL< 1.5	Code=D
37-49	8	AQL=1.5	n=8 or n=13
50	9	1.0 <AQL< 1.5	
51-64	9	1.0 <AQL< 1.5	Code=E
65-81	10	1.0 <AQL< 1.5	n=8 or n=13
82-90	11	1.0 <AQL< 1.5	
91-100	11	1.0 <AQL< 1.5	Code=F
101-121	12	1.0 <AQL< 1.5	n=8 orb n=13
122-144	13	AQL=1.0	
145-150	14	1.0 <AQL< 1.5	

Plan Summaries

Table 2				Table 3			
Sampling Plans	AQL	LTPD	AOQL	Sampling Plans	AQL	LTPD	AOQL
$\sqrt{N+1}$ plan: Single: n=14, a=0, N=150	0.36	14.67	2.54	$\sqrt{N+1}$ plan: Single: n=11, a=0, N=90	0.45	18.89	3.23
Z1.4: AQL=1.0 , L-II, 91 to 150 , F, Normal, Single, n=13, a=0	0.39	16.23	2.73	Z1.4: AQL=1.0 , L-II, 51 to 90 , E, Normal, Single, n=13, a=0	0.39	16.23	2.73
Z1.4: AQL=1.5 , L-II, 91 to 150 , F, Normal, Single, n=32, a=1	1.12	11.62	2.60	Z1.4: AQL=1.5 , L-II, 51 to 90 , E, Normal, Single, n=8, a=0	0.64	25.01	4.33
$\sqrt{N+1}$ plan: Single: n=11, a=0, N=91	0.45	18.68	3.23	$\sqrt{N+1}$ plan: Single: n=9, a=0, N=51	0.56	21.57	3.78
Table 4				Table 5			
Sampling Plans	AQL	LTPD	AOQL	Sampling Plans	AQL	LTPD	AOQL
$\sqrt{N+1}$ plan: Single: n=9, a=0, N=50	0.56	22.00	3.81	$\sqrt{N+1}$ plan: Single: n=6, a=0, N=25	0.83	32.00	5.90
Z1.4: AQL=1.0 , L-II, 26 to 50 , D, Normal, Single, n=13, a=0	0.39	16.23	2.73	Z1.4: AQL=1.0 , L-II, 16 to 25 , C, Normal, Single, n=13, a=0	0.39	16.23	2.73
Z1.4: AQL=1.5 , L-II, 26 to 50 , D, Normal, Single, n=8, a=0	0.64	25.01	4.33	Z1.4: AQL=1.5 , L-II, 16 to 25 , C, Normal, Single, n=8, a=0	0.64	25.01	4.33
$\sqrt{N+1}$ plan: Single: n=7, a=0, N=26	0.71	26.92	4.49	Z1.4: AQL=2.5 , L-II, 16 to 25 , C, Normal, Single, n=5, a=0	1.02	36.90	6.70
				$\sqrt{N+1}$ plan: Single: n=5, a=0, N=16	1.00	37.50	7.16