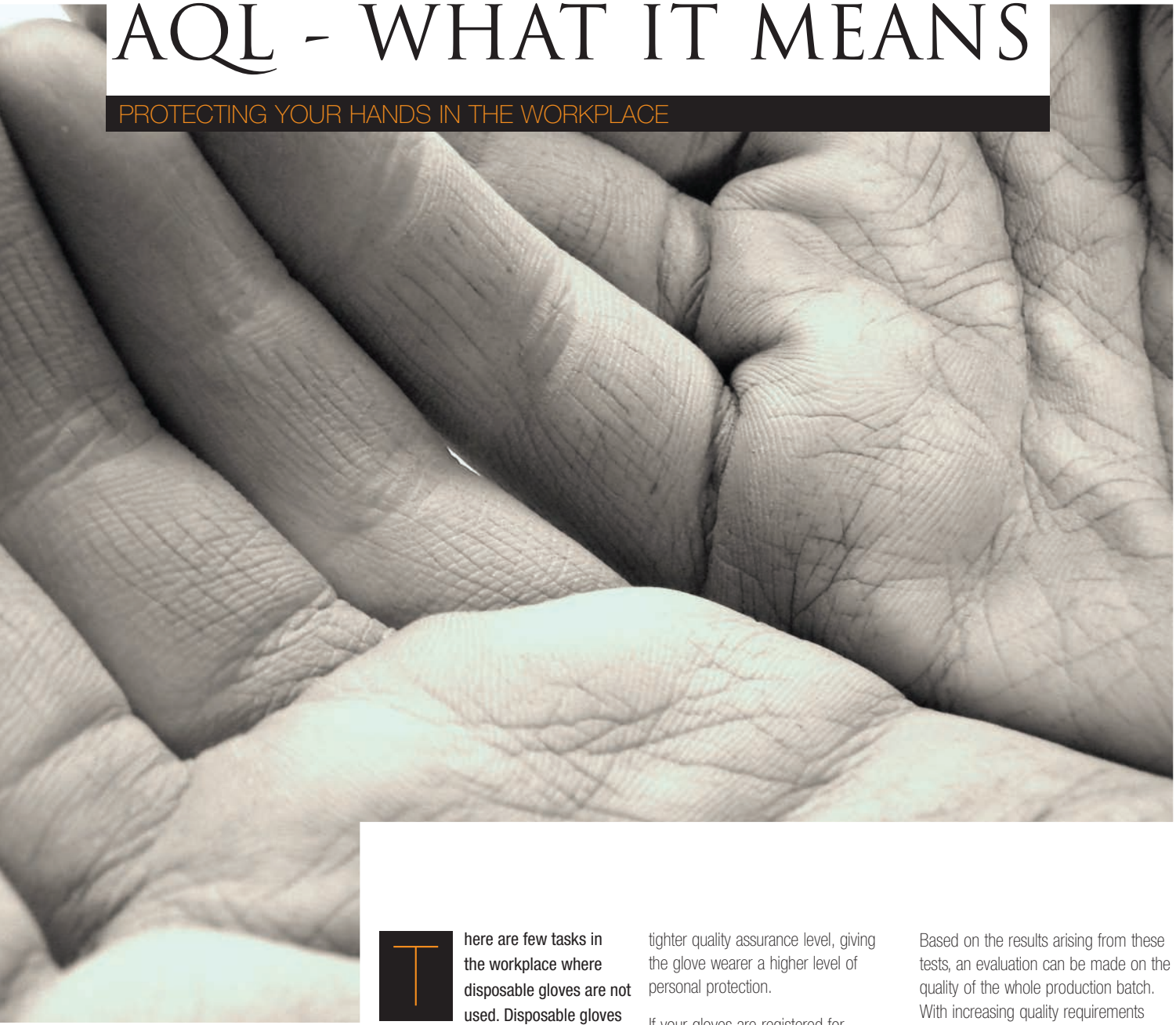
AQL - WHAT IT MEANS

PROTECTING YOUR HANDS IN THE WORKPLACE



There are few tasks in the workplace where disposable gloves are not used. Disposable gloves are now an integral part of our life in the workplace, but do we know how well they are protecting our hands.

A simple way is to seek out information on AQL or Acceptance Quality Limit. AQL is often featured on the box with numbers such as 0.65, 1.4 or 4.0 after these letters. Here it usually refers to the watertight test for detection of holes, which is a critical standard for assuring us that we are being protected from holes, rips or very weak areas. Thus an AQL of 1.5 accepts the statistical probability that there are less than 1.5% defects in a batch of gloves. An AQL of 0.65 assumes a tighter quality assurance level, giving the glove wearer a higher level of personal protection.

If your gloves are registered for protection against chemicals and micro-organisms (as defined by EN374-2: 2003 for resistance to penetration), then the glove manufacturer is obliged to show the AQL.

AQL relates to a sampling procedure, where a certain quantity of gloves is randomly selected from every batch for testing. These random samples are then tested according to standards such as EN374-2: 2003 (as part of the Personal Protective Directive 89/686/EEC) or EN455-3: 2000 (as part of the Medical Device Directive 93/42/EEC), which both use the watertight test for determining levels of acceptable holes.

Based on the results arising from these tests, an evaluation can be made on the quality of the whole production batch. With increasing quality requirements comes a need to follow more stringent guidelines on sampling procedure (i.e. if the AQL moves from 4.0 to 0.65). Thus we can see that AQL is nothing more than a statistical sampling process for evaluating quality. By applying recognised statistical procedures we avoid the need to inspect everything. It should also be noted that by setting an AQL and thereby testing only a partial amount from a batch, there is always the possibility that a certain quantity of inferior product will be accepted. The assumption that through random sampling, a level of statistical probability will be achieved for the entire batch is known as confidence interval.

	S1 to S4=Special Inspection levels				G1 to G3=General Inspection levels		
Batch or lot size	S1	S2	S3	S4	G1	G2	G3
2 to 8	A	A	A	A	A	A	B
9 to 15	A	A	A	A	A	B	C
16 to 25	A	A	B	B	B	C	D
26 to 50	A	B	B	C	C	D	E
51 to 90	B	B	C	C	C	E	F
91 to 150	B	B	C	D	D	F	G
151 to 280	B	C	D	E	E	G	H
281 to 500	B	C	D	E	F	H	J
501 to 1200	C	C	E	F	G	J	K
1201 to 3200	C	D	E	G	H	K	L
3201 to 10000	C	D	F	G	J	L	M
10001 to 35000	C	D	F	H	K	M	N
35001 to 150000	D	E	G	J	L	N	P
150001 to 500000	D	E	G	J	M	P	Q
500001 and over	D	E	H	K	N	Q	R

Table 1: Sample size with code letters (ISO 2859, Part1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection

What does AQL mean for my hands

If we accept that the glove's barrier performance is crucial in the workplace and this can best be reflected in a test that assesses acceptable levels of holes, then AQL is clearly important. In short, by selecting gloves manufactured to a more stringent AQL (e.g. AQL 0.65 rather than 1.5 or 4.0), then we could be significantly enhancing our personal protection.

Using AQL in glove manufacturing

Step 1 - coding

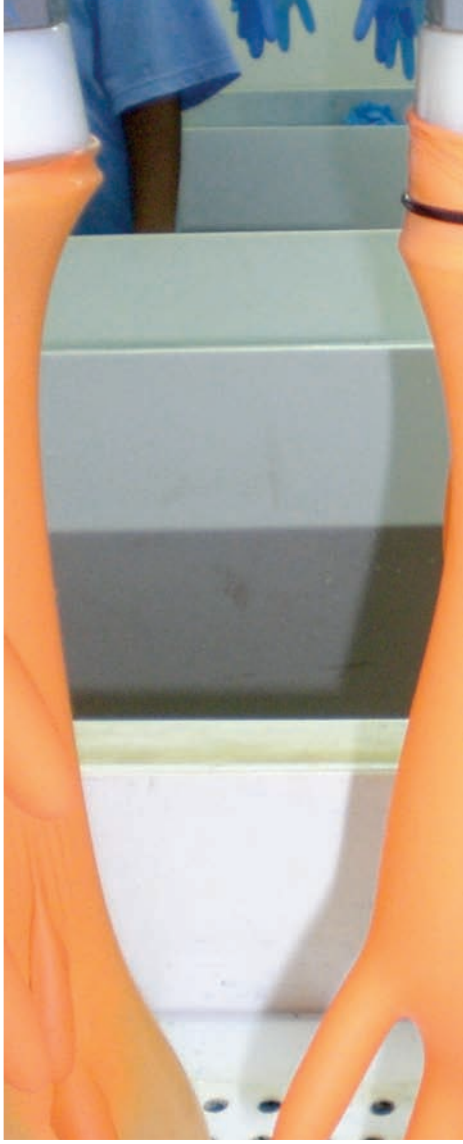
ISO 2859 (Sampling procedures for inspection by attributes) seems to be the most frequently followed standard for determining the AQL value and supersedes BS 6001. It is particularly suited to disposable glove manufacture, where the volumes are relatively high.

First the batch size needs to be defined and with disposable gloves this is typically the number of gloves produced in a single batch. Next the inspection level needs to be determined, with ISO 2859 referring to 'Special Inspection levels' and 'General Inspection levels'. As can be seen from the table 1, each inspection level has its own code letter (A to R).

With disposable glove manufacturing, batch volumes are often in the region of 150001 to 500000. If we are following the watertight test as outlined in EN374-2: 2003 (see table 2), then an inspection level of G1 is necessary for achieving the minimum AQL of 1.5. On this basis the appropriate code letter is 'M'.

Table 2: Annex A (EN374-2: 2003) Quality Assurance Procedure to be used in glove manufacture

Performance level	Acceptable quality level (AQL) unit	Inspection levels
Level 3	<0.65	G1
Level 2	<1.5	G1
Level 1	<4.0	S4



"if we select gloves manufactured to a more stringent AQL (i.e. 0.65 rather than 1.5 or 4.0) then we could be offering our hands superior protection"

Step 2 - The AQL

So far we have ascertained the batch size, the inspection level and the code letter. If we now look at table 3, we can use the code letter to select the number of samples to be subjected to random testing. In the case of 'M', this is 315 samples. Likewise on the assumption of a minimum AQL of 1.5, we can see in the column for normal inspection the figures 10 and 11. On this basis the batch would be accepted if there were up to 10 faults, but rejected if there were 11 or more faults. Therefore if we had a batch of 400000 gloves and were operating to inspection level G1 with an AQL of <1.5, we would need to test 315 gloves. If no more than 10 gloves were faulty, the batch would pass. If there are 11 or more defective gloves, the whole batch has to be rejected and cannot be sold.

Sample size code letter	Sample size	Acceptance quality limit, AQL, in percent nonconforming items and nonconformities per 100 items (normal inspection)																										
		0,010	0,015	0,025	0,040	0,065	0,10	0,15	0,25	0,40	0,65	1,0	1,5	2,5	4,0	6,5	10	15	25	40	65	100	150	250	400	650	1 000
		Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re
A	2	⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩	0 1	⇩	⇩	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	30 31
B	3	⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩	0 1	⇧	⇩	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	30 31	44 45
C	5	⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩	0 1	⇧	⇩	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	30 31	44 45	⇧
D	8	⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩	0 1	⇧	⇩	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	30 31	44 45	⇧		
E	13	⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩	0 1	⇧	⇩	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	30 31	44 45	⇧			
F	20	⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩	0 1	⇧	⇩	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	⇧	⇧	⇧				
G	32	⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩	0 1	⇧	⇩	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	⇧	⇧	⇧	⇧				
H	50	⇩	⇩	⇩	⇩	⇩	⇩	⇩	0 1	⇧	⇩	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	⇧	⇧	⇧	⇧	⇧				
J	80	⇩	⇩	⇩	⇩	⇩	⇩	0 1	⇧	⇩	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	⇧	⇧	⇧	⇧	⇧	⇧				
K	125	⇩	⇩	⇩	⇩	⇩	0 1	⇧	⇩	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	⇧	⇧	⇧	⇧	⇧	⇧	⇧				
L	200	⇩	⇩	⇩	⇩	0 1	⇧	⇩	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧				
M	315	⇩	⇩	⇩	0 1	⇧	⇩	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧				
N	500	⇩	⇩	0 1	⇧	⇩	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧				
P	800	⇩	0 1	⇧	⇩	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧				
Q	1 250	0 1	⇧	⇩	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧				
R	2 000	⇧	⇧	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧

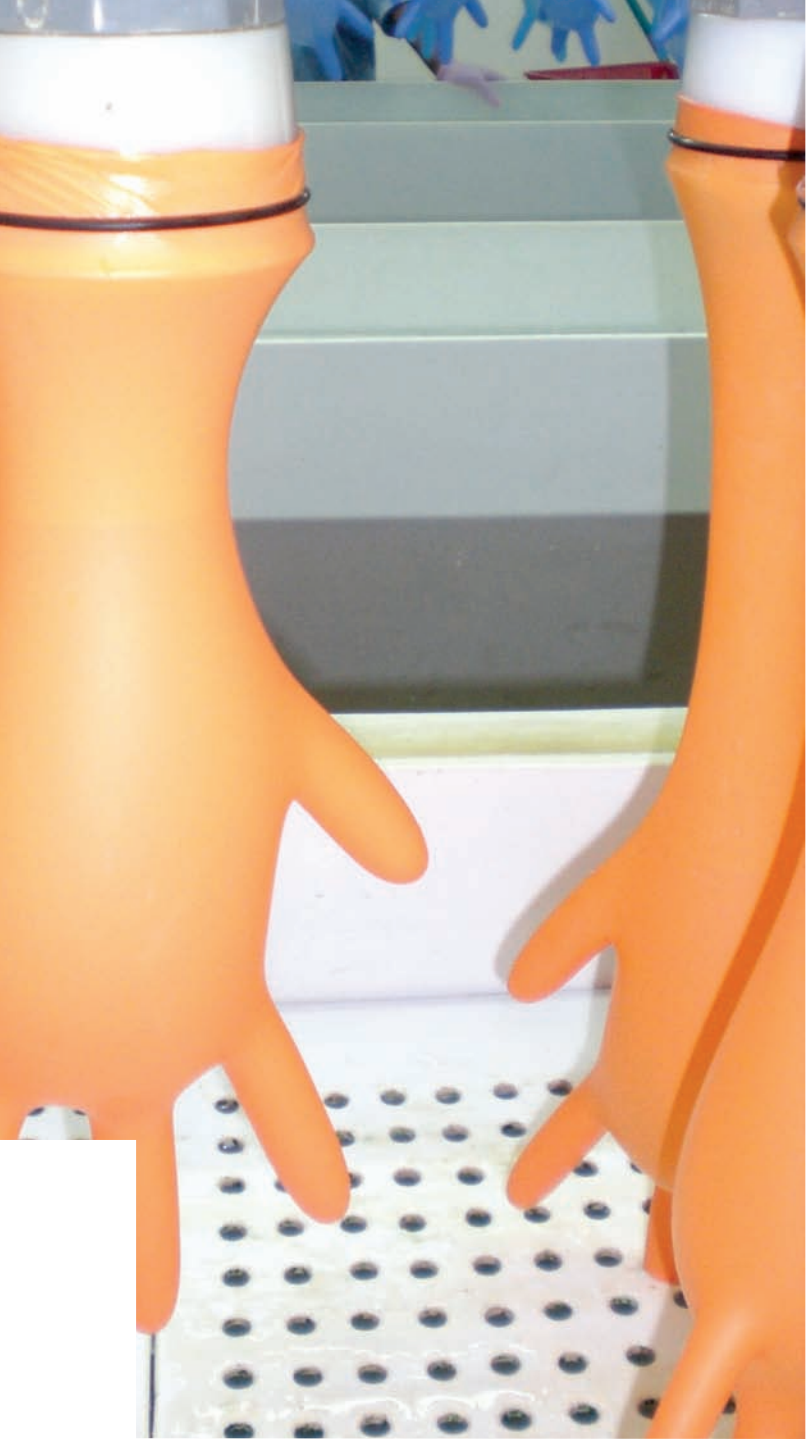
Table 3: Single sampling plans for normal inspection (Master table)

⇩ = Use the first sampling plan below the arrow. If sample size equals, or exceeds, lot size, carry out 100 % inspection.

⇧ = Use the first sampling plan above the arrow.

Ac = Acceptance number

Re = Rejection number



Tightened, normal and reduced inspection levels

ISO 2859 refers to tightened, normal and reduced inspection levels and makes the assumption that with successive acceptable batches, there is increasing confidence in the system leading to fewer mistakes. Thus if we produced five successive good batches of gloves, then we can reduce the level of inspection and move to 'reduced inspection'. Using the example of our batch of 400000 gloves with an AQL of <1.5 and an inspection level of G1, we would randomly test 125 gloves (in place of 315). Conversely if we encounter two successive unacceptable batches, we would need to move to 'tightened inspection'. In this case, the sample size remains the same as 'normal inspection' (i.e. 315) but the criteria for acceptance number and rejection number is tightened to respectively 8 and 9 (instead of 10 and 11).

Conclusion

As many of the gloves we use in the workplace are tested against EN374-2: 2003 as part of their registration as protective gloves against chemicals and micro-organisms, locating the AQL should be relatively easy. Whilst it is understood that AQL is a statistical sampling procedure (as defined in ISO 2859), its use with the watertight test to detect holes has important implications for assessing the barrier properties of gloves. Therefore if we select gloves manufactured to a more stringent AQL (i.e. 0.65 rather than 1.5 or 4.0) then we could be offering our hands superior protection. ■

References

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ISO 2859-1:1999 Sampling procedures for inspection by attributes - Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection

EN374-2:2003 Protective gloves against chemicals and micro-organisms - Part 2: Determination of resistance to penetration

EN455-1:2000 Medical gloves for single-use - Part 1: Requirements and testing for freedom from holes

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