UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Kedua

Sidang Akademik 1996/97

April 1997

EBB 402/2 - KAWALAN MUTU

Masa : [2 jam]

Arahan Kepada Calon :

Kertas soalan ini mengandungi **LIMA BELAS (15)** muka surat bercetak dan **SEPULUH (10)** muka surat **LAMPIRAN**.

Kertas soalan ini mempunyai **ENAM (6)** soalan.

Jawab **EMPAT (4)** soalan sahaja **DUA (2)** soalan dari **BAHAGIAN A** dan **DUA (2)** soalan dari **BAHAGIAN B**.

Mulakan jawapan anda bagi setiap soalan pada muka surat yang baru.

Semua soalan mesti dijawab dalam Bahasa Malaysia ataupun maksimum **2 (DUA)** soalan dari **BAHAGIAN B** boleh dijawab dalam Bahasa Inggeris.

...2/-

BAHAGIAN A

SECTION A

1. (a) Manakah yang terbaik di antara pelan pensampelan tanggal, dubel dan berganda? Berikan penjelasan anda menggunakan contoh yang sesuai.

Between single, double and multiple sampling plans which one is the best?
Give your explanation with a suitable example.

(30 markah)

(b) (i) Anda akan melaksanakan peraturan ANSI/ASQC Z1.4 dalam tatacara kawalan mutu untuk suatu proses penghasilan barangan yang mempunyai saiz lot 2000. Paras mutu boleh terima 2.5% telah dipilih. Pensampelan tunggal dilakukan berdasarkan pemeriksaan umum paras III. Operasi dijalankan menggunakan pemeriksaan normal dan didapati satu sampel dari lot pertama mengandungi 6 unit taklulus. Berdasarkan maklumat ini, apakah tindakan yang anda akan lakukan?

You are to implement ANSI/ASQC Z1.4 in a quality control procedure for a production process that has lots of size 2000. An acceptable quality level of 2.5% is selected. Single sampling is to be used under general inspection level III. Operating under rules for normal inspection, a sample from the first lot contain 6 nonconforming units. What action(s) should be taken?

...3/-

(ii) Untuk proses yang dijelaskan di Bahagian (b)(i) di atas, sekiranya telah banyak lot yang diproses dan disebabkan oleh mutunya yang baik, maka pemeriksaan dikurangkan (reduced inspection) telah dilakukan. Dalam pelan pensampelan ini, satu sampel telah di ambil dan didapati mengandungi 5 unit taklulus. Dalam keadaan seperti ini apakah tindakan yang anda akan lakukan?

For the process described in (b(i)), suppose that many lots have been processed and, because of their good quality, reduced inspection has been instituted. Under this sampling plan, a sample is taken and contains 5 nonconforming units. What action(s) should be taken?

(iii) Untuk proses yang dijelaskan di Bahagian (b)(i) di atas, sekiranya telah banyak lot yang dilakukan proses pensampelan dan oleh kerana wujudnya dua lot yang berturutan memberikan keputusan yang tidak boleh diterima, maka pemeriksaan secara diperketat (tightened inspection) telah dilakukan. Berdasarkan kepada maklumat ini bilakah agaknya pemeriksaan normal boleh dilakukan semula?

For the process described in (b(i)), suppose that many lots have been sampled, and since the last two consecutive lots have been rejected, a switch has been made to tightened inspection. When can the normal inspection be re-instituted?

(70 markah)

...4/-

2. (a) Apakah yang dimaksudkan dengan AOQL (Purata Had Mutu Keluaran)?

What is the Average Outgoing Quality Limit (AOQL)?

(20 markah)

(b) Apakah yang dimaksudkan dengan ATI (Purata Pemeriksaan Total)?

What is the Average Total Inspection (ATI)?

(20 markah)

(c) Kita sedang menimbangkan untuk membeli beberapa buah almari. Apabila kita tanya pihak pengeluar berkenaan pecahan proses taklulus (p), kita telah diberitahu bahawa firma berkenaan menggunakan pemeriksaan penulinan dengan nilai ATI = 300, n = 100 dan c = 3. Tentukan nilai p daripada maklumat yang diberikan berdasarkan saiz lot, N = 4000 buah.

We are considering the purchase of some widgets. When we ask the manufacturer about the process fraction nonconforming (p), we are told that the firm uses rectifying inspection with ATI = 300, n = 100, and c = 3. Determine the value of p from that information and from the fact that the lot sizes are N = 4000.

(60 markah)

...5/-

3. (a) Berikan penjelasan ringkas mengenai kepentingan sistem ISO9000 kepada industri pengeluaran dan bagaimanakah ianya berkaitan dengan kepentingan pihak pengguna.

Write and briefly explain about the importance of the ISO 9000 series to any of the manufacturing industry and how it is related to the consumers interest.

(40 markah)

(b) Bagaimanakah Pensampelan Penerimaan boleh memberi manfaat kepada kedua-dua pihak pengilang dan pengguna?

How Acceptance Sampling could benefit both the manufacturers and consumers?

(30 markah)

(c) Jelaskan dengan ringkas mengenai keboleh harapan dan bagaimanakah ianya boleh dicapai?

Explain briefly about reliability and how it can be achieved?

(30 markah)

...6/-

BAHAGIAN B

SECTION B

4. (a) Bilangan zarah-zarah α yang disepaikan daripada suatu sumber radioaktif merupakan peristiwa rambang dalam sesuatu tempoh. Bilangan penyepaian untuk 2608 sela masa berturutan dalam tempoh yang ditetapkan telah diperolehi dan keputusannya diberikan dalam Jadual 4a. Padankan suatu Taburan Poisson dan bandingkan ulangan-ulangan yang dilakukan secara perkiraan dan yang diukur.

Bincangkan sama ada suatu taburan normal boleh digunakan untuk memadankan data yang diberikan di atas.

Jadual 4a: Bilangan penyepaian zarah α dari suatu sumber radioaktif

Bil. Penyepaian	Ulangan
0	57
1	203
2	383
3	525
4	532
5	408
6	273
7	139
8	45
9	27
10	10
11	4
12	2

The number of α particles emitted from a radio active source are random events in time. The number of emissions during 2608 successive intervals of fixed duration were marked and the results are given in table 4a. Fit a Poisson Distribution and compare the calculated and measured frequencies.

...7/-

Discuss whether a normal distribution can be used for fitting the above data.

Table 4a The number of emissions from a radioactive sources

No. of emissions	*Frequency*
0	*57*
1	*203*
2	*383*
3	*525*
4	*532*
5	*408*
6	*273*
7	*139*
8	*45*
9	*27*
10	*10*
11	*4*
12	*2*

(50 markah)

(b) Kekuatan untuk memutuskan wayar-wayar keluli nirkarat yang berdiameter tertentu telah diukur dan keputusannya diberikan di dalam Jadual 4b. Data yang diperolehi boleh dianggap sebagai berkeadaan taburan normal tanpa mengetahui nilai min dan varian.

(i) Dapatkan nilai anggaran terbaik untuk min dan sisihan piawai untuk kekuatan memutusan wayar berkenaan.

...8/-

(ii) Dapatkan nisbah nilai-nilai min dan varian pada paras konfiden 95%. Jadual-jadual kebarangkalian yang disediakan boleh digunakan.

Jadual 4b: Ukuran kekuatan tegangan wayar keluli nirkarat

Spesimen	Daya (Kg)
1	48.89
2	52.07
3	49.29
4	51.66
5	52.16
6	49.72
7	48.00
8	49.96
9	49.20
10	48.10
11	47.90
12	46.94
13	51.76
14	50.75
15	49.86
16	51.57

The breaking load of steel wires of a certain diameter was measured and the results are given in table 4b. The data may be assumed to have a normal distribution with unknown mean and variance.

(i) Obtain the best estimate for the mean and standard deviation for the breaking load.

...9/-

(ii) Obtain the range of values for the mean and variance at 95% confidence level. The statistical tables provided may be used.

Table 4b Tensile strength measurements on steel wire

Specimen	*Strength (Kg)*
1	*48.89*
2	*52.07*
3	*49.29*
4	*51.66*
5	*52.16*
6	*49.72*
7	*48.00*
8	*49.96*
9	*49.20*
10	*48.10*
11	*47.90*
12	*46.94*
13	*51.76*
14	*50.75*
15	*49.86*
16	*51.57*

(50 markah)

...10/-

5. (a) Kekerasan komponen-komponen besi tuangan daripada dua pembekal diberikan di dalam Jadual 5a. Uji hipotesis yang menyatakan bahawa kedua-dua pembekal berkenaan mempunyai min kekerasan yang sama pada paras konfiden 99%. Sisihan piawai kedua-dua bekalan ini boleh dianggap tidak diketahui tetapi mempunyai nilai yang sama.

Jadual 5a: Ukuran kekerasan besi tuangan

Pembekal 1	Pembekal 2
89.5	89.5
90.0	91.5
91.0	91.0
91.5	89.0
92.5	91.5
91.0	92.0
89.0	92.0
89.5	90.5
91.0	90.0
92.0	91.0

(a) *The hardness of cast iron components from two suppliers is given in table 5a. Test the hypothesis that the two suppliers have the same mean for hardness at the 99% confidence level. The standard deviations of the two supplies may be asumed to be unknown but equal.*

Table 5a Hardness Measurements on cast iron

Supplier 1	*Supplier 2*
89.5	*89.5*
90.0	*91.5*
91.0	*91.0*
91.5	*89.0*
92.5	*91.5*
91.0	*92.0*
89.0	*92.0*
89.5	*90.5*
91.0	*90.0*
92.0	*91.0*

(50 markah)

...11/-

(b) Dalam proses pengetinan, tin yang diisi mempunyai berat nominal 1 kg. 25 sampel yang bersaiz n = 4 telah diambil setiap setengah jam proses. Keputusan untuk purata-purata dan julat-julat sampel diberikan di dalam Jadual 5b.

(i) Adakah p masih dalam keadaan terkawal?

(ii) Bina carta-carta $\overline{X}$ & R untuk proses ini.

Jadual 5b

No. Sampel	1	2	3	4	5	6	7	8	9	10
Purata Sampel (X)	1.003	1.007	1.005	1.005	0.988	0.988	1.001	0.999	1.004	0.992
Julat Sampel (W)	0.016	0.028	0.014	0.035	0.018	0.028	0.022	0.010	0.027	0.041
No. Sampel	11	12	13	14	15	16	17	18	19	20
Purata Sampel (X)	0.995	0.998	1.002	1.000	0.998	0.994	1.008	1.002	1.001	0.999
Julat Sampel (W)	0.020	0.016	0.009	0.005	0.025	0.008	0.024	0.002	0.018	0.008
No. Sampel	21	22	23	24	25					
Purata Sampel (X)	1.003	0.998	1.006	1.000	1.002					
Julat Sampel (W)	0.025	0.017	0.031	0.021	0.028					

...12/-

(b) In a canning process the filled cans have a nominal weight of 1kg. 25 samples of size n = 4 were taken every half an hour from the process and the results of sample averages and ranges are given in table 5b.

(i) Is the p under control?

(ii) Construct $\overline{X}$ & R charts for the process.

Table 5b

Sample No.	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Sample average (X)	*1.003*	*1.007*	*1.005*	*1.005*	*0.988*	*0.988*	*1.001*	*0.999*	*1.004*	*0.992*
Sample range (W)	*0.016*	*0.028*	*0.014*	*0.035*	*0.018*	*0.028*	*0.022*	*0.010*	*0.027*	*0.041*
Sample No.	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*
Sample average (X)	*0.995*	*0.998*	*1.002*	*1.000*	*0.998*	*0.994*	*1.008*	*1.002*	*1.001*	*0.999*
Sample range (W)	*0.020*	*0.016*	*0.009*	*0.005*	*0.025*	*0.008*	*0.024*	*0.002*	*0.018*	*0.008*
Sample No.	*21*	*22*	*23*	*24*	*25*					
Sample average (X)	*1.003*	*0.998*	*1.006*	*1.000*	*1.002*					
Sample range (W)	*0.025*	*0.017*	*0.031*	*0.021*	*0.028*					

(50 markah)

...13/-

6. (a) Bilangan kecacatan tuangan pada permukaan atas yang rata untuk beberapa tuangan yang dihasilkan di sebuah foundri diberikan di dalam Jadual 6a. Bina suatu carta kawalan yang sesuai untuk proses ini.

Jadual 6a: Bilangan kecacatan-kecacatan permukaan

Bil. Tuangan	Luas Permukaan Meter Persegi (n_i)	Bil. Cacat (c_i)	Cacat Per Meter Persegi (c_i/n_i)
1	0.84	3	3.57
2	0.62	2	3.22
3	0.84	4	4.76
4	0.62	4	6.45
5	1.08	5	4.63
6	0.62	3	4.84
7	0.84	2	2.38
8	0.62	6	9.68
9	1.08	5	4.63
10	0.62	2	3.22
11	0.84	12	14.29
12	0.62	2	3.22
13	0.62	1	1.61
14	1.08	6	5.56
15	0.84	8	9.52
16	0.84	7	8.33
17	0.62	5	8.06
18	1.08	6	5.56
19	1.08	7	6.48
20	0.62	4	6.45
Total	16.02	94	

...14/-

(a) *The number of casting defects on the flat top surfaces of some castings produces in a foundry are given below in table 6a. Construct a suitable control chart for the process.*

Table 6a No. of surfaces defects

Casting No. (i)		*Surface Area Square Meters* (n_i)	*Number of Blemishes* (c_i)	*Blemishes per Square Meter* (c_i/n_i)
1		0.84	3	3.57
2		0.62	2	3.22
3		0.84	4	4.76
4		0.62	4	6.45
5		1.08	5	4.63
6		0.62	3	4.84
7		0.84	2	2.38
8		0.62	6	9.68
9		1.08	5	4.63
10		0.62	2	3.22
11		0.84	12	14.29
12		0.62	2	3.22
13		0.62	1	1.61
14		1.08	6	5.56
15		0.84	8	9.52
16		0.84	7	8.33
17		0.62	5	8.06
18		1.08	6	5.56
19		1.08	7	6.48
20		0.62	4	6.45
	Total	16.02	94	

(50 markah)

(b) (i) Bincangkan makna dan kepentingan indeks-indeks keupayaan proses Cp dan Cpk.

(ii) Tuliskan nota ringkas berkenaan carta Cusum.

(iii) Bincangkan berkenaan kesalahan Jenis I dan Jenis II serta kaitannya dalam menghuraikan carta-carta kawalan.

...15/-

(i) *Discuss the meaning and importance of the process capability indices Cp and Cpk.*

(ii) *Write a short note on Cusum charts.*

(iii) *Discuss Type I and Type II errors and their relevance in interpreting control charts.*

(50 markah)

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TABLE 11.12 Master Table for Normal Inspection—Single Sampling

Sample Size Code Letter	Sample Size	Acceptable Quality Levels (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	1000
		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	1250	0 1	↑	↓	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
R	2000	↑	↑	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑

↓ = Use first sampling plan below arrow. If sample size equals, or exceeds, lot or batch size, do 100 percent inspection.
↑ = Use first sampling plan above arrow.
Ac = Acceptance number.
Re = Rejection number.

TABLE 11.13 Master Table for Tightened Inspection—Single Sampling

Sample Size Code Letter	Sample Size	Acceptable Quality Levels (tightened 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	1000
		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	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	1 2	2 3	3 4	5 6	8 9	12 13	18 19	27 28
B	3	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 1	↓	↓	1 2	2 3	3 4	5 6	8 9	12 13	18 19	27 28	41 42
C	5	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 1	↓	↓	1 2	2 3	3 4	5 6	8 9	12 13	18 19	27 28	41 42	↑
D	8	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 1	↓	↓	1 2	2 3	3 4	5 6	8 9	12 13	18 19	27 28	41 42	↑	↑
E	13	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 1	↓	↓	1 2	2 3	3 4	5 6	8 9	12 13	18 19	27 28	41 42	↑	↑	↑
F	20	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 1	↓	↓	1 2	2 3	3 4	5 6	8 9	12 13	18 19	↑	↑	↑	↑	↑	↑
G	32	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 1	↓	↓	1 2	2 3	3 4	5 6	8 9	12 13	18 19	↑	↑	↑	↑	↑	↑	↑
H	50	↓	↓	↓	↓	↓	↓	↓	↓	0 1	↓	↓	1 2	2 3	3 4	5 6	8 9	12 13	18 19	↑	↑	↑	↑	↑	↑	↑	↑
J	80	↓	↓	↓	↓	↓	↓	↓	0 1	↓	↓	1 2	2 3	3 4	5 6	8 9	12 13	18 19	↑	↑	↑	↑	↑	↑	↑	↑	↑
K	125	↓	↓	↓	↓	↓	↓	0 1	↓	↓	1 2	2 3	3 4	5 6	8 9	12 13	18 19	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
L	200	↓	↓	↓	↓	↓	0 1	↓	↓	1 2	2 3	3 4	5 6	8 9	12 13	18 19	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
M	315	↓	↓	↓	↓	0 1	↓	↓	1 2	2 3	3 4	5 6	8 9	12 13	18 19	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
N	500	↓	↓	↓	0 1	↓	↓	1 2	2 3	3 4	5 6	8 9	12 13	18 19	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
P	800	↓	↓	0 1	↓	↓	1 2	2 3	3 4	5 6	8 9	12 13	18 19	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Q	1250	↓	0 1	↓	↓	1 2	2 3	3 4	5 6	8 9	12 13	18 19	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
R	2000	0 1	↑	↓	1 2	2 3	3 4	5 6	8 9	12 13	18 19	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
S	3150		↑	1 2																							

↓ = Use first sampling plan below arrow. If sample size equals, or exceeds, lot or batch size, do 100 percent inspection.
↑ = Use first sampling plan above arrow.
Ac = Acceptance number.
Re = Rejection number.

TABLE 11.14 Master Table for Reduced Inspection—Single Sampling

Sample Size Code Letter	Sample Size	Acceptable Quality Levels (Reduced 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	1000
		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	2	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 1	↑	↓	0 2	1 3	2 4	3 5	5 6	7 8	10 11	14 15	21 22	30 31
C	2	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 1	↑	↓	0 2	1 3	1 4	2 5	3 6	5 8	7 10	10 13	14 17	21 24	↑
D	3	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 1	↑	↓	0 2	1 3	1 4	2 5	3 6	5 8	7 10	10 13	14 17	21 24	↑	↑
E	5	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 1	↑	↓	0 2	1 3	1 4	2 5	3 6	5 8	7 10	10 13	14 17	21 24	↑	↑	↑
F	8	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 1	↑	↓	0 2	1 3	1 4	2 5	3 6	5 8	7 10	10 13	↑	↑	↑	↑	↑	↑
G	13	↓	↓	↓	↓	↓	↓	↓	↓	0 1	↑	↓	0 2	1 3	1 4	2 5	3 6	5 8	7 10	10 13	↑	↑	↑	↑	↑	↑	↑
H	20	↓	↓	↓	↓	↓	↓	↓	0 1	↑	↓	0 2	1 3	1 4	2 5	3 6	5 8	7 10	10 13	↑	↑	↑	↑	↑	↑	↑	↑
J	32	↓	↓	↓	↓	↓	↓	0 1	↑	↓	0 2	1 3	1 4	2 5	3 6	5 8	7 10	10 13	↑	↑	↑	↑	↑	↑	↑	↑	↑
K	50	↓	↓	↓	↓	↓	0 1	↑	↓	0 2	1 3	1 4	2 5	3 6	5 8	7 10	10 13	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
L	80	↓	↓	↓	↓	0 1	↑	↓	0 2	1 3	1 4	2 5	3 6	5 8	7 10	10 13	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
M	125	↓	↓	↓	0 1	↑	↓	0 2	1 3	1 4	2 5	3 6	5 8	7 10	10 13	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
N	200	↓	↓	0 1	↑	↓	0 2	1 3	1 4	2 5	3 6	5 8	7 10	10 13	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
P	315	↓	0 1	↑	↓	0 2	1 3	1 4	2 5	3 6	5 8	7 10	10 13	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Q	500	0 1	↑	↓	0 2	1 3	1 4	2 5	3 6	5 8	7 10	10 13	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
R	800	↑	↑	0 2	1 3	1 4	2 5	3 6	5 8	7 10	10 13	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑

↓ = Use first sampling plan below arrow. If sample size equals, or exceeds, lot or batch size, do 100 percent inspection.
↑ = Use first sampling plan above arrow.
Ac = Acceptance number.
Re = Rejection number.
† = If the acceptance number has been exceeded, but the rejection number has not been reached, accept the lot, but reinstate normal inspection.

TABLE 11.11 Sample Size Code Letters

Lot or Batch Size			Special Inspection Levels				General Inspection Levels		
			S-1	*S-2*	*S-3*	*S-4*	*I*	*II*	*II*
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	1,200	C	C	E	F	G	J	K
1,201	to	3,200	C	D	E	G	H	K	L
3,201	to	10,000	C	D	F	G	J	L	M
10,001	to	35,000	C	D	F	H	K	M	N
35,001	to	150,000	D	E	G	J	L	N	P
150,001	to	500,000	D	E	G	J	M	P	Q
500,001	and	over	D	E	H	K	N	Q	R

TABLE 11.15 Master Table for Normal Inspection—Double Sampling

Sample Size Code Letter	Sample	Sample Size	Cumulative Sample Size	Acceptable Quality Levels (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	1000
				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				↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*	↓	↓	*	*	*	*	*	*	*	*	*
B	First Second	2 2	2 4	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*	↑	↓	0 2 1 2	0 3 3 4	1 4 4 5	2 5 6 7	3 7 8 9	5 9 12 13	7 11 18 19	11 16 26 27	17 22 37 38	25 31 56 57
C	First Second	3 3	3 6	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*	↑	↓	0 2 1 2	0 3 3 4	1 4 4 5	2 5 6 7	3 7 8 9	5 9 12 13	7 11 18 19	11 16 26 27	17 22 37 38	25 31 56 57	↑
D	First Second	5 5	5 10	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*	↑	↓	0 2 1 2	0 3 3 4	1 4 4 5	2 5 6 7	3 7 8 9	5 9 12 13	7 11 18 19	11 16 26 27	17 22 37 38	25 31 56 57	↑	↑
E	First Second	8 8	8 16	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*	↑	↓	0 2 1 2	0 3 3 4	1 4 4 5	2 5 6 7	3 7 8 9	5 9 12 13	7 11 18 19	11 16 26 27	17 22 37 38	25 31 56 57	↑	↑	↑
F	First Second	13 13	13 26	↓	↓	↓	↓	↓	↓	↓	↓	↓	*	↑	↓	0 2 1 2	0 3 3 4	1 4 4 5	2 5 6 7	3 7 8 9	5 9 12 13	7 11 18 19	11 16 26 27	↑	↑	↑	↑	↑	↑
G	First Second	20 20	20 40	↓	↓	↓	↓	↓	↓	↓	↓	*	↑	↓	0 2 1 2	0 3 3 4	1 4 4 5	2 5 6 7	3 7 8 9	5 9 12 13	7 11 18 19	11 16 26 27	↑	↑	↑	↑	↑	↑	↑
H	First Second	32 32	32 64	↓	↓	↓	↓	↓	↓	↓	*	↑	↓	0 2 1 2	0 3 3 4	1 4 4 5	2 5 6 7	3 7 8 9	5 9 12 13	7 11 18 19	11 16 26 27	↑	↑	↑	↑	↑	↑	↑	↑
J	First Second	50 50	50 100	↓	↓	↓	↓	↓	↓	*	↑	↓	0 2 1 2	0 3 3 4	1 4 4 5	2 5 6 7	3 7 8 9	5 9 12 13	7 11 18 19	11 16 26 27	↑	↑	↑	↑	↑	↑	↑	↑	↑
K	First Second	80 80	80 160	↓	↓	↓	↓	↓	*	↑	↓	0 2 1 2	0 3 3 4	1 4 4 5	2 5 6 7	3 7 8 9	5 9 12 13	7 11 18 19	11 16 26 27	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
L	First Second	125 125	125 250	↓	↓	↓	↓	*	↑	↓	0 2 1 2	0 3 3 4	1 4 4 5	2 5 6 7	3 7 8 9	5 9 12 13	7 11 18 19	11 16 26 27	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
M	First Second	200 200	200 400	↓	↓	↓	*	↑	↓	0 2 1 2	0 3 3 4	1 4 4 5	2 5 6 7	3 7 8 9	5 9 12 13	7 11 18 19	11 16 26 27	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
N	First Second	315 315	315 630	↓	↓	*	↑	↓	0 2 1 2	0 3 3 4	1 4 4 5	2 5 6 7	3 7 8 9	5 9 12 13	7 11 18 19	11 16 26 27	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
P	First Second	500 500	500 1000	↓	*	↑	↓	0 2 1 2	0 3 3 4	1 4 4 5	2 5 6 7	3 7 8 9	5 9 12 13	7 11 18 19	11 16 26 27	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Q	First Second	800 800	800 1600	*	↑	↓	0 2 1 2	0 3 3 4	1 4 4 5	2 5 6 7	3 7 8 9	5 9 12 13	7 11 18 19	11 16 26 27	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
R	First Second	1250 1250	1250 2500	↑	↑	0 2 1 2	0 3 3 4	1 4 4 5	2 5 6 7	3 7 8 9	5 9 12 13	7 11 18 19	11 16 26 27	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑

↓ = Use first sampling plan below arrow. If sample size equals or exceeds lot or batch size, do 100 percent inspection.
↑ = Use first sampling plan above arrow.
Ac = Acceptance number
Re = Rejection number
* = Use corresponding single sampling plan (or alternatively, use double sampling plan below, where available).

TABLE 11.16 Master Table for Tightened Inspection—Double Sampling

Sample Size Code Letter	Sample	Sample Size	Cumulative Sample Size	Acceptable Quality Levels (Tightened 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	1000
				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				↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*	*	*	*	*	*	*	*
B	First Second	2 2	2 4	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*	↓	↓	0 2 1 2	0 3 3 4	1 4 4 5	2 5 6 7	3 7 11 12	6 10 15 16	9 14 23 24	15 20 34 35	23 29 52 53
C	First Second	3 3	3 6	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*	↓	↓	0 2 1 2	0 3 3 4	1 4 4 5	2 5 6 7	3 7 11 12	6 10 15 16	9 14 23 24	15 20 34 35	23 29 52 53	↑
D	First Second	5 5	5 10	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*	↓	↓	0 2 1 2	0 3 3 4	1 4 4 5	2 5 6 7	3 7 11 12	6 10 15 16	9 14 23 24	15 20 34 35	23 29 52 53	↑	↑
E	First Second	8 8	8 16	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*	↓	↓	0 2 1 2	0 3 3 4	1 4 4 5	2 5 6 7	3 7 11 12	6 10 15 16	9 14 23 24	15 20 34 35	23 29 52 53	↑	↑	↑
F	First Second	13 13	13 26	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*	↓	↓	0 2 1 2	0 3 3 4	1 4 4 5	2 5 6 7	3 7 11 12	6 10 15 16	9 14 23 24	↑	↑	↑	↑	↑	↑
G	First Second	20 20	20 40	↓	↓	↓	↓	↓	↓	↓	↓	↓	*	↓	↓	0 2 1 2	0 3 3 4	1 4 4 5	2 5 6 7	3 7 11 12	6 10 15 16	9 14 23 24	↑	↑	↑	↑	↑	↑	↑
H	First Second	32 32	32 64	↓	↓	↓	↓	↓	↓	↓	↓	*	↓	↓	0 2 1 2	0 3 3 4	1 4 4 5	2 5 6 7	3 7 11 12	6 10 15 16	9 14 23 34	↑	↑	↑	↑	↑	↑	↑	↑
J	First Second	50 50	50 100	↓	↓	↓	↓	↓	↓	↓	*	↓	↓	0 2 1 2	0 3 3 4	1 4 4 5	2 5 6 7	3 7 11 12	6 10 15-16	9 14 23 24	↑	↑	↑	↑	↑	↑	↑	↑	↑
K	First Second	80 80	80 160	↓	↓	↓	↓	↓	↓	*	↓	↓	0 2 1 2	0 3 3 4	1 4 4 5	2 5 6 7	3 7 11 12	6 10 15 16	9 14 23 24	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
L	First Second	125 125	125 250	↓	↓	↓	↓	↓	*	↓	↓	0 2 1 2	0 3 3 4	1 4 4 5	2 5 6 7	3 7 11 12	6 10 15 16	9 14 23 24	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
M	First Second	200 200	200 400	↓	↓	↓	↓	*	↓	↓	0 2 1 2	0 3 3 4	1 4 4 5	2 5 6 7	3 7 11 12	6 10 15 16	9 14 23 24	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
N	First Second	315 315	315 630	↓	↓	↓	*	↓	↓	0 2 1 2	0 3 3 4	1 4 4 5	2 5 6 7	3 7 11 12	6 10 15 16	9 14 23 24	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
P	First Second	500 500	500 1000	↓	↓	*	↓	↓	0 2 1 2	0 3 3 4	1 4 4 5	2 5 6 7	3 7 11 12	6 10 15 16	9 14 23 24	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Q	First Second	800 800	800 1600	↓	*	↓	↓	0 2 1 2	0 3 3 4	1 4 4 5	2 5 6 7	3 7 11 12	6 10 15 16	9 14 23 24	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
R	First Second	1250 1250	1250 2500	*	↑	↓	0 2 1 2	0 3 3 4	1 4 4 5	2 5 6 7	3 7 11 12	6 10 15 16	9 14 23 24	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
S	First Second	2000 2000	2000 4000			0 2 1 2									↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑

↓ = Use first sampling plan below arrow. If sample size equals or exceeds lot or batch size, do 100 percent inspection.
↑ = Use first sampling plan above arrow.
Ac = Acceptance number
Re = Rejection number
* = Use corresponding single sampling plan (or alternatively, use double sampling plan below, where available).

TABLE 11.17 Master Table for Reduced Inspection—Double Sampling

Sample Size Code Letter	Sample	Sample Size	Cumulative Sample Size	Acceptable Quality Levels (Reduced Inspection)† 0.010 Ac Re	0.015 Ac Re	0.025 Ac Re	0.040 Ac Re	0.065 Ac Re	0.10 Ac Re	0.15 Ac Re	0.25 Ac Re	0.40 Ac Re	0.65 Ac Re	1.0 Ac Re	1.5 Ac Re	2.5 Ac Re	4.0 Ac Re	6.5 Ac Re	10 Ac Re	15 Ac Re	25 Ac Re	40 Ac Re	65 Ac Re	100 Ac Re	150 Ac Re	250 Ac Re	400 Ac Re	650 Ac Re	1000 Ac Re
A				↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*	↓	↓	*	*	*	*	*	*	*	*	*
B				↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*	↑	*	*	*	*	*	*	*	*	*	*	*
C				↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*	↑	↑	*	*	*	*	*	*	*	*	*	*	*
D	First	2	2	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*	↑	↓	0 2	0 3	0 4	0 4	1 5	2 7	3 8	5 10	7 12	11 17	↑	↑
	Second	2	4	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↑	0 2	0 4	1 5	3 6	4 7	6 9	8 12	12 16	18 22	26 30	↑	↑
E	First	3	3	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*	↑	↓	0 2	0 3	0 4	0 4	1 5	2 7	3 8	5 10	7 12	11 17	↑	↑	↑
	Second	3	6	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 2	0 4	1 5	3 6	4 7	6 9	8 12	12 16	18 22	26 30	↑	↑	↑
F	First	5	5	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*	↑	↓	0 2	0 3	0 4	0 4	1 5	2 7	3 8	5 10	↑	↑	↑	↑	↑
	Second	5	10	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 2	0 4	1 5	3 6	4 7	6 9	8 12	12 16	↑	↑	↑	↑	↑
G	First	8	8	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*	↑	↓	0 2	0 3	0 4	0 4	1 5	2 7	3 8	5 10	↑	↑	↑	↑	↑
	Second	8	16	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 2	0 4	1 5	3 6	4 7	6 9	8 12	12 16	↑	↑	↑	↑	↑
H	First	13	13	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 2	↑	↓	0 3	0 4	0 4	1 5	2 7	3 8	5 10	↑	↑	↑	↑	↑	↑
	Second	13	26	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 2	↓	↓	0 4	1 5	3 6	4 7	6 9	8 12	12 16	↑	↑	↑	↑	↑	↑
J	First	20	20	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 2	0 3	↑	↓	0 4	0 4	1 5	2 7	3 8	5 10	↑	↑	↑	↑	↑	↑	↑
	Second	20	40	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 2	0 4	↓	↓	1 5	3 6	4 7	6 9	8 12	12 16	↑	↑	↑	↑	↑	↑	↑
K	First	32	32	↓	↓	↓	↓	↓	↓	↓	↓	0 2	0 3	0 4	↑	↓	0 4	1 5	2 7	3 8	5 10	↑	↑	↑	↑	↑	↑	↑	↑
	Second	32	64	↓	↓	↓	↓	↓	↓	↓	↓	0 2	0 4	1 5	↓	↓	3 6	4 7	6 9	8 12	12 16	↑	↑	↑	↑	↑	↑	↑	↑
L	First	50	50	↓	↓	↓	↓	↓	↓	↓	0 2	0 3	0 4	0 4	↑	↓	1 5	2 7	3 8	5 10	↑	↑	↑	↑	↑	↑	↑	↑	↑
	Second	50	100	↓	↓	↓	↓	↓	↓	↓	0 3	0 4	1 5	3 6	↓	↓	4 7	6 9	8 12	12 16	↑	↑	↑	↑	↑	↑	↑	↑	↑
M	First	80	80	↓	↓	↓	↓	↓	↓	0 2	0 3	0 4	0 4	1 5	↑	↓	2 7	3 8	5 10	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
	Second	80	160	↓	↓	↓	↓	↓	↓	0 2	0 4	1 5	3 6	4 7	↓	↓	6 9	8 12	12 16	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
N	First	125	125	↓	↓	↓	↓	↓	0 2	0 3	0 4	0 4	1 5	2 7	↑	↓	3 8	5 10	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
	Second	125	250	↓	↓	↓	↓	↓	0 2	0 4	1 5	3 6	4 7	6 9	↓	↓	8 12	12 16	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
P	First	200	200	↓	↓	↓	↓	0 2	0 3	0 4	0 4	1 5	2 7	3 8	↑	↓	5 10	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
	Second	200	400	↓	↓	↓	↓	0 2	0 4	1 5	3 6	4 7	6 9	8 12	↓	↓	12 16	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Q	First	315	315	*	↑	↓	0 2	0 3	0 4	0 4	1 5	2 7	3 8	5 10	↑	↓	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
	Second	315	630	↓	↓	↓	0 2	0 4	1 5	3 6	4 7	6 9	8 12	12 16	↓	↓	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
R	First	500	500	↑	↑	0 2	0 3	0 4	0 4	1 5	2 7	3 8	5 10	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
	Second	500	1000	↓	↓	0 2	0 4	1 5	3 6	4 7	6 9	8 12	12 16	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓

↓ = Use first sampling plan below arrow. If sample size equals or exceeds lot or batch size, do 100 percent inspection.

↑ = Use first sampling plan above arrow.

Ac = Acceptance number.

Re = Rejection number.

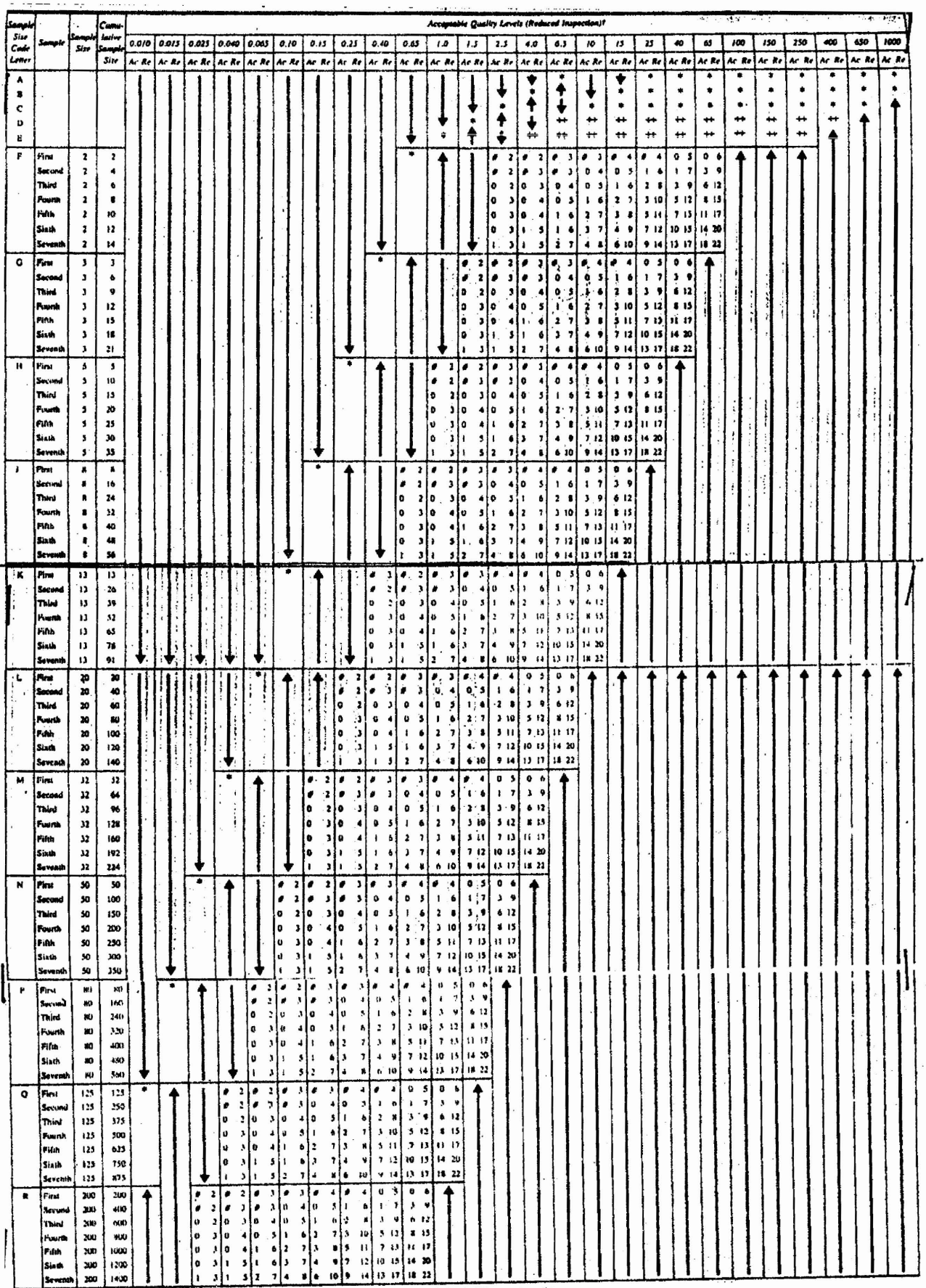
* = Use corresponding single sampling plan (or alternatively, use double sampling plan below, when available.)

† = If, after the second sample, the acceptance number has been exceeded, but the rejection number has not been reached, accept the lot, but reinstate normal inspection.

TABLE 11.21 Limit Numbers for Reduced Inspection

Number of Sample Units from Last 10 Lots or Batches	Acceptable Quality Level 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
20–29	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	0	0	2	4	8	14	22	40	68	115
30–49	*	*	*	*	*	*	*	*	*	*	*	*	*	*	0	0	1	3	7	13	22	36	63	105	178
50–79	*	*	*	*	*	*	*	*	*	*	*	*	*	0	0	2	3	7	14	25	40	63	110	181	301
80–129	*	*	*	*	*	*	*	*	*	*	*	*	0	0	2	4	7	14	24	42	68	105	181	297	
130–199	*	*	*	*	*	*	*	*	*	*	*	0	0	2	4	7	13	25	42	72	115	177	301	490	
200–319	*	*	*	*	*	*	*	*	*	*	0	0	2	4	8	14	22	40	68	115	181	277	471		
320–499	*	*	*	*	*	*	*	*	*	0	0	1	4	8	14	24	39	68	113	189					
500–799	*	*	*	*	*	*	*	*	0	0	2	3	7	14	25	40	63	110	181						
800–1249	*	*	*	*	*	*	*	0	0	2	4	7	14	24	42	68	105	181							
1,250–1,999	*	*	*	*	*	*	0	0	2	4	7	13	24	40	69	110	169								
2,000–3,149	*	*	*	*	*	0	0	2	4	8	14	22	40	68	115	181									
3,150–4,999	*	*	*	*	0	0	1	4	8	14	24	38	67	111	186										
5,000–7,999	*	*	*	0	0	2	3	7	14	25	40	63	110	181											
8,000–12,499	*	*	0	0	2	4	7	14	24	42	68	105	181												
12,500–19,999	*	0	0	2	4	7	13	24	40	69	110	169													
20,000–31,499	0	0	2	4	8	14	22	40	68	115	181														
31,500–49,999	0	1	4	8	14	24	38	67	111	186															
50,000 & Over	2	3	7	14	25	40	63	110	181	301															

*Denotes that the number of sample units from the last 10 lots or batches is not sufficient for reduced inspection for this AQL. In this instance more than 10 lots or batches may be used for the calculation, provided that the lots or batches used are the most recent ones in sequence, that they have been on normal inspection, and that none has been rejected while on original inspection.



Sample Size Code Letter	Sample	Sample Size	Cumulative Sample Size	Acceptable Quality Levels (Reduced 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	1000
				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				↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↑	↓	↓	*	*	*	*	*	*	*	*	*
B				↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*	↑	↓	↓	*	*	*	*	*	*	*	*	*	*
C				↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*	↑	↓	↓	*	*	*	*	*	*	*	*	*	*	*
D				↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*	↑	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
E				↓	↓	↓	↓	↓	↓	↓	↓	↓	*	↑	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
F	First	2	2													# 2	# 2	# 3	# 3	# 4	# 4	0 5	0 6						
	Second	2	4													# 2	# 3	# 3	0 4	0 5	1 6	1 7	3 9						
	Third	2	6													0 2	0 3	0 4	0 5	1 6	2 8	3 9	6 12						
	Fourth	2	8													0 3	0 4	0 5	1 6	2 7	3 10	5 12	8 15						
	Fifth	2	10													0 3	0 4	1 6	2 7	3 8	5 11	7 13	11 17						
	Sixth	2	12													0 3	1 5	1 6	3 7	4 9	7 12	10 15	14 20						
	Seventh	2	14													1 3	1 5	2 7	4 8	6 10	9 14	13 17	18 22						
G	First	3	3													# 2	# 2	# 3	# 3	# 4	# 4	0 5	0 6						
	Second	3	6													# 2	# 3	# 3	0 4	0 5	1 6	1 7	3 9						
	Third	3	9													0 2	0 3	0 4	0 5	1 6	2 8	3 9	6 12						
	Fourth	3	12													0 3	0 4	0 5	1 6	2 7	3 10	5 12	8 15						
	Fifth	3	15													0 3	0 4	1 6	2 7	3 8	5 11	7 13	11 17						
	Sixth	3	18													0 3	1 5	1 6	3 7	4 9	7 12	10 15	14 20						
	Seventh	3	21													1 3	1 5	2 7	4 8	6 10	9 14	13 17	18 22						
H	First	5	5													# 2	# 2	# 3	# 3	# 4	# 4	0 5	0 6						
	Second	5	10													# 2	# 3	# 3	0 4	0 5	1 6	1 7	3 9						
	Third	5	15													0 2	0 3	0 4	0 5	1 6	2 8	3 9	6 12						
	Fourth	5	20													0 3	0 4	0 5	1 6	2 7	3 10	5 12	8 15						
	Fifth	5	25													0 3	0 4	1 6	2 7	3 8	5 11	7 13	11 17						
	Sixth	5	30													0 3	1 5	1 6	3 7	4 9	7 12	10 15	14 20						
	Seventh	5	35													1 3	1 5	2 7	4 8	6 10	9 14	13 17	18 22						
J	First	8	8													# 2	# 2	# 3	# 3	# 4	# 4	0 5	0 6						
	Second	8	16													# 2	# 3	# 3	0 4	0 5	1 6	1 7	3 9						
	Third	8	24													0 2	0 3	0 4	0 5	1 6	2 8	3 9	6 12						
	Fourth	8	32													0 3	0 4	0 5	1 6	2 7	3 10	5 12	8 15						
	Fifth	8	40													0 3	0 4	1 6	2 7	3 8	5 11	7 13	11 17						
	Sixth	8	48													0 3	1 5	1 6	3 7	4 9	7 12	10 15	14 20						
	Seventh	8	56													1 3	1 5	2 7	4 8	6 10	9 14	13 17	18 22						
K	First	13	13													# 3	# 3	# 4	# 4	# 4	# 4	0 5	0 6						
	Second	13	26													# 2	# 3	# 3	0 4	0 5	1 6	1 7	3 9						
	Third	13	39													0 2	0 3	0 4	0 5	1 6	2 8	3 9	6 12						
	Fourth	13	52													0 3	0 4	0 5	1 6	2 7	3 10	5 12	8 15						
	Fifth	13	65													0 3	0 4	1 6	2 7	3 8	5 11	7 13	11 17						
	Sixth	13	78													0 3	1 5	1 6	3 7	4 9	7 12	10 15	14 20						
	Seventh	13	91													1 3	1 5	2 7	4 8	6 10	9 14	13 17	18 22						
L	First	20	20													# 2	# 2	# 3	# 3	# 4	# 4	0 5	0 6						
	Second	20	40													# 2	# 3	# 3	0 4	0 5	1 6	1 7	3 9						
	Third	20	60													0 2	0 3	0 4	0 5	1 6	2 8	3 9	6 12						
	Fourth	20	80													0 3	0 4	0 5	1 6	2 7	3 10	5 12	8 15						
	Fifth	20	100													0 3	0 4	1 6	2 7	3 8	5 11	7 13	11 17						
	Sixth	20	120													0 3	1 5	1 6	3 7	4 9	7 12	10 15	14 20						
	Seventh	20	140													1 3	1 5	2 7	4 8	6 10	9 14	13 17	18 22						
M	First	32	32													# 2	# 2	# 3	# 3	# 4	# 4	0 5	0 6						
	Second	32	64													# 2	# 3	# 3	0 4	0 5	1 6	1 7	3 9						
	Third	32	96													0 2	0 3	0 4	0 5	1 6	2 8	3 9	6 12						
	Fourth	32	128													0 3	0 4	0 5	1 6	2 7	3 10	5 12	8 15						
	Fifth	32	160													0 3	0 4	1 6	2 7	3 8	5 11	7 13	11 17						
	Sixth	32	192													0 3	1 5	1 6	3 7	4 9	7 12	10 15	14 20						
	Seventh	32	224													1 3	1 5	2 7	4 8	6 10	9 14	13 17	18 22						
N	First	50	50													# 2	# 2	# 3	# 3	# 4	# 4	0 5	0 6						
	Second	50	100													# 2	# 3	# 3	0 4	0 5	1 6	1 7	3 9						
	Third	50	150													0 2	0 3	0 4	0 5	1 6	2 8	3 9	6 12						
	Fourth	50	200													0 3	0 4	0 5	1 6	2 7	3 10	5 12	8 15						
	Fifth	50	250													0 3	0 4	1 6	2 7	3 8	5 11	7 13	11 17						
	Sixth	50	300													0 3	1 5	1 6	3 7	4 9	7 12	10 15	14 20						
	Seventh	50	350													1 3	1 5	2 7	4 8	6 10	9 14	13 17	18 22						
P	First	80	80													# 2	# 2	# 3	# 3	# 4	# 4	0 5	0 6						
	Second	80	160													# 2	# 3	# 3	0 4	0 5	1 6	1 7	3 9						
	Third	80	240													0 2	0 3	0 4	0 5	1 6	2 8	3 9	6 12						
	Fourth	80	320													0 3	0 4	0 5	1 6	2 7	3 10	5 12	8 15						
	Fifth	80	400													0 3	0 4	1 6	2 7	3 8	5 11	7 13	11 17						
	Sixth	80	480													0 3	1 5	1 6	3 7	4 9	7 12	10 15	14 20						
	Seventh	80	560													1 3	1 5	2 7	4 8	6 10	9 14	13 17	18 22						
Q	First	125	125													# 2	# 2	# 3	# 3	# 4	# 4	0 5	0 6						
	Second	125	250													# 2	# 3	# 3	0 4	0 5	1 6	1 7	3 9						
	Third	125	375													0 2	0 3	0 4	0 5	1 6	2 8	3 9	6 12						
	Fourth	125	500													0 3	0 4	0 5	1 6	2 7	3 10	5 12	8 15						
	Fifth	125	625													0 3	0 4	1 6	2 7	3 8	5 11	7 13	11 17						
	Sixth	125	750													0 3	1 5	1 6	3 7	4 9	7 12	10 15	14 20						
	Seventh	125	875													1 3	1 5	2 7	4 8	6 10	9 14	13 17	18 22						
R	First	200	200													# 2	# 2	# 3	# 3	# 4	# 4	0 5	0 6						
	Second	200	400													# 2	# 3	# 3	0 4	0 5	1 6	1 7	3 9						
	Third	200	600													0 2	0 3	0 4	0 5	1 6	2 8	3 9	6 12						
	Fourth	200	800													0 3	0 4	0 5	1 6	2 7	3 10	5 12	8 15						
	Fifth	200	1000													0 3	0 4	1 6	2 7	3 8	5 11	7 13	11 17						
	Sixth	200	1200													0 3	1 5	1 6	3 7	4 9	7 12	10 15	14 20						
	Seventh	200	1400													1 3	1 5	2 7	4 8	6 10	9 14	13 17	18 22						

↓ = Use first sampling plan below arrow. If sample size equals, or exceeds, lot or batch size, do 100 percent inspection.

↑ = Use first sampling plan above arrow (refer to preceding page where necessary).

Ac = Acceptance number.

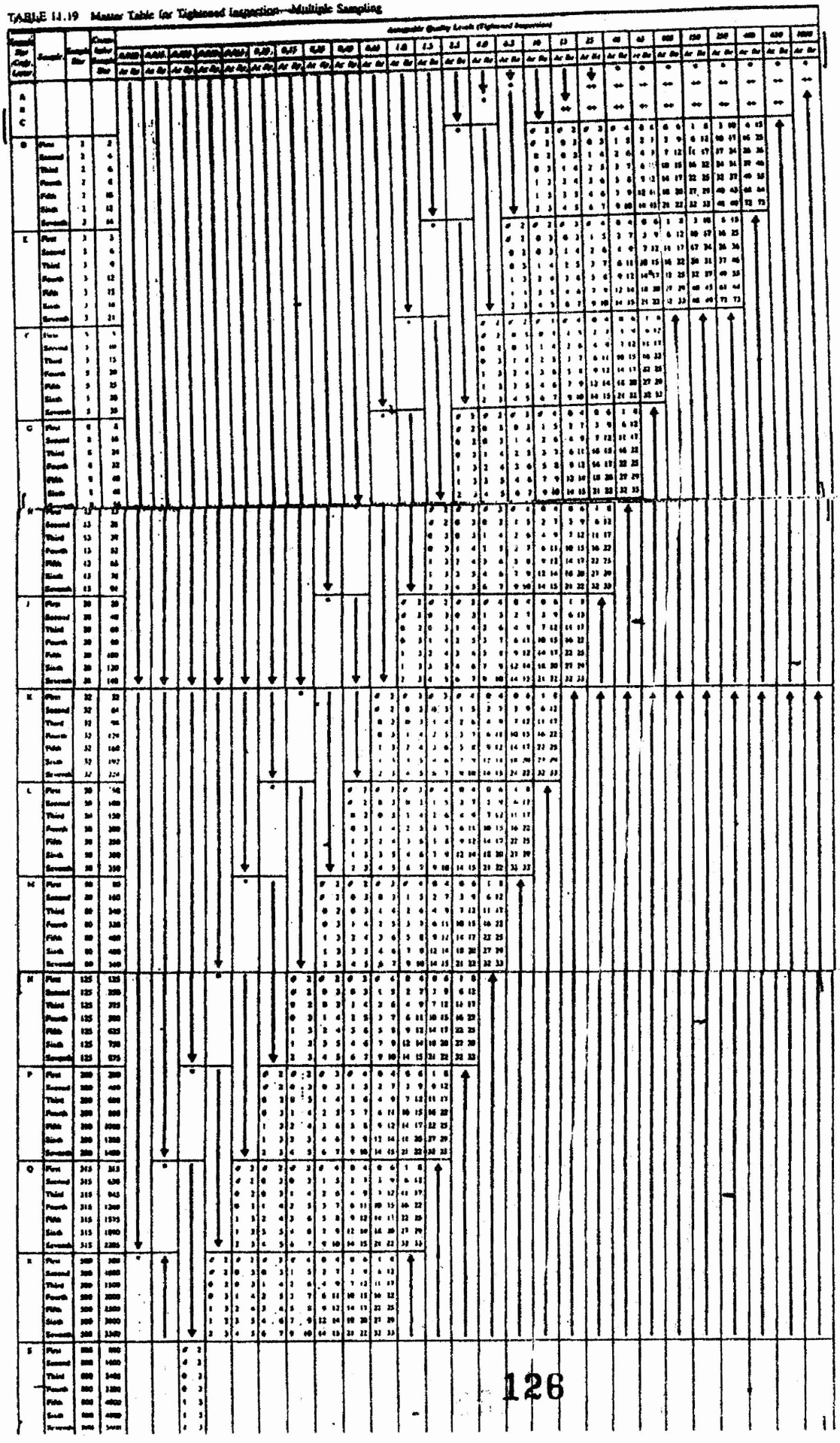
* = Use corresponding single sampling plan ↓ or alternatively, use multiple sampling plan below, where available).

Re = Rejection number.

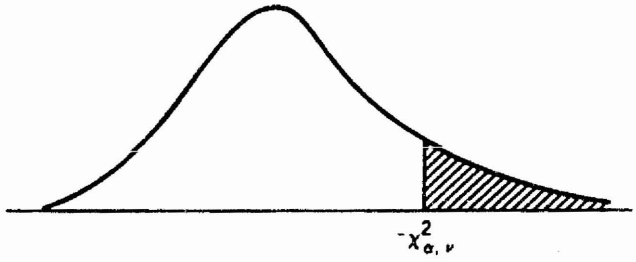
\# = Acceptance not permitted at this sample size.

† = If, after the final sample, the acceptance number has been exceeded, but the rejection number has not been reached, accept the lot, but reinstate normal inspection.

TABLE 11.19 Master Table for Tightened Inspection—Multiple Sampling

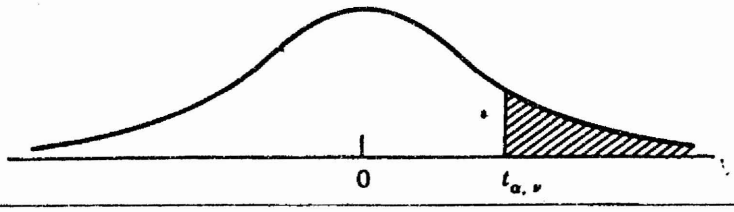


Percentage points of the χ^2 distribution[a]



ν	α 0.995	0.990	0.975	0.950	0.500	0.050	0.025	0.010	0.005
1	0.00+	0.00+	0.00+	0.00+	0.45	3.84	5.02	6.63	7.88
2	0.01	0.02	0.05	0.10	1.39	5.99	7.38	9.21	10.60
3	0.07	0.11	0.22	0.35	2.37	7.81	9.35	11.34	12.84
4	0.21	0.30	0.48	0.71	3.36	9.49	11.14	13.28	14.86
5	0.41	0.55	0.83	1.15	4.35	11.07	12.38	15.09	16.75
6	0.68	0.87	1.24	1.64	5.35	12.59	14.45	16.81	18.55
7	0.99	1.24	1.69	2.17	6.35	14.07	16.01	18.48	20.28
8	1.34	1.65	2.18	2.73	7.34	15.51	17.53	20.09	21.96
9	1.73	2.09	2.70	3.33	8.34	16.92	19.02	21.67	23.59
10	2.16	2.56	3.25	3.94	9.34	18.31	20.48	23.21	25.19
11	2.60	3.05	3.82	4.57	10.34	19.68	21.92	24.72	26.76
12	3.07	3.57	4.40	5.23	11.34	21.03	23.34	26.22	28.30
13	3.57	4.11	5.01	5.89	12.34	22.36	24.74	27.69	29.82
14	4.07	4.66	5.63	6.57	13.34	23.68	26.12	29.14	31.32
15	4.60	5.23	6.27	7.26	14.34	25.00	27.49	30.58	32.80
16	5.14	5.81	6.91	7.96	15.34	26.30	28.85	32.00	34.27
17	5.70	6.41	7.56	8.67	16.34	27.59	30.19	33.41	35.72
18	6.26	7.01	8.23	9.39	17.34	28.87	31.53	34.81	37.16
19	6.84	7.63	8.91	10.12	18.34	30.14	32.85	36.19	38.58
20	7.43	8.26	9.59	10.85	19.34	31.41	34.17	37.57	40.00
25	10.52	11.52	13.12	14.61	24.34	37.65	40.65	44.31	46.93
30	13.79	14.95	16.79	18.49	29.34	43.77	46.98	50.89	53.67
40	20.71	22.16	24.43	26.51	39.34	55.76	59.34	63.69	66.77
50	27.99	29.71	32.36	34.76	49.33	67.50	71.42	76.15	79.49
60	35.53	37.48	40.48	43.19	59.33	79.08	83.30	88.38	91.95
70	43.28	45.44	48.76	51.74	69.33	90.53	95.02	100.42	104.22
80	51.17	53.54	57.15	60.39	79.33	101.88	106.63	112.33	116.32
90	59.20	61.75	65.65	69.13	89.33	113.14	118.14	124.12	128.30
100	67.33	70.06	74.22	77.93	99.33	124.34	129.56	135.81	140.17

ν = degrees of freedom.



ν \ α	0.40	0.25	0.10	0.05	0.025	0.01	0.005	0.0025	0.001	0.0005
1	0.325	1.000	3.078	6.314	12.706	31.821	63.657	127.32	318.31	636.62
2	0.289	0.816	1.886	2.920	4.303	6.965	9.925	14.089	23.326	31.598
3	0.277	0.765	1.638	2.353	3.182	4.541	5.841	7.453	10.213	12.924
4	0.271	0.741	1.533	2.132	2.776	3.747	4.604	5.598	7.173	8.610
5	0.267	0.727	1.476	2.015	2.571	3.365	4.032	4.773	5.893	6.869
6	0.265	0.727	1.440	1.943	2.447	3.143	3.707	4.317	5.208	5.959
7	0.263	0.711	1.415	1.895	2.365	2.998	3.499	4.019	4.785	5.408
8	0.262	0.706	1.397	1.860	2.306	2.896	3.355	3.833	4.501	5.041
9	0.261	0.703	1.383	1.833	2.262	2.821	3.250	3.690	4.297	4.781
10	0.260	0.700	1.372	1.812	2.228	2.764	3.169	3.581	4.144	4.587
11	0.260	0.697	1.363	1.796	2.201	2.718	3.106	3.497	4.025	4.437
12	0.259	0.695	1.356	1.782	2.179	2.681	3.055	3.428	3.930	4.318
13	0.259	0.694	1.350	1.771	2.160	2.650	3.012	3.372	3.852	4.221
14	0.258	0.692	1.345	1.761	2.145	2.624	2.977	3.326	3.787	4.140
15	0.258	0.691	1.341	1.753	2.131	2.602	2.947	3.286	3.733	4.073
16	0.258	0.690	1.337	1.746	2.120	2.583	2.921	3.252	3.686	4.015
17	0.257	0.689	1.333	1.740	2.110	2.567	2.898	3.222	3.646	3.965
18	0.257	0.688	1.330	1.734	2.101	2.552	2.878	3.197	3.610	3.922
19	0.257	0.688	1.328	1.729	2.093	2.539	2.861	3.174	3.579	3.883
20	0.257	0.687	1.325	1.725	2.086	2.528	2.845	3.153	3.552	3.850
21	0.257	0.686	1.323	1.721	2.080	2.518	2.831	3.135	3.527	3.819
22	0.256	0.686	1.321	1.717	2.074	2.508	2.819	3.119	3.505	3.792
23	0.256	0.685	1.319	1.714	2.069	2.500	2.807	3.104	3.485	3.767
24	0.256	0.685	1.318	1.711	2.064	2.492	2.797	3.091	3.467	3.745
25	0.256	0.684	1.316	1.708	2.060	2.485	2.787	3.078	3.450	3.725
26	0.256	0.684	1.315	1.706	2.056	2.479	2.779	3.067	3.435	3.707
27	0.256	0.684	1.314	1.703	2.052	2.473	2.771	3.057	3.421	3.690
28	0.256	0.683	1.313	1.701	2.048	2.467	2.763	3.047	3.408	3.674
29	0.256	0.683	1.311	1.699	2.045	2.462	2.756	3.038	3.396	3.659
30	0.256	0.683	1.310	1.697	2.042	2.457	2.750	3.030	3.385	3.646
40	0.255	0.681	1.303	1.684	2.021	2.423	2.704	2.971	3.307	3.551
60	0.254	0.679	1.296	1.671	2.000	2.390	2.660	2.915	3.232	3.460
120	0.254	0.677	1.289	1.658	1.980	2.358	2.617	2.860	3.160	3.373
∞	0.253	0.674	1.282	1.645	1.960	2.326	2.576	2.807	3.090	3.291

ν = degrees of freedom.

POISSON DISTRIBUTION

c \ np_o	2.1		2.2		2.3		2.4		2.5	
0	0.123	(0.123)	0.111	(0.111)	0.100	(0.100)	0.091	(0.091)	0.082	(0.082)
1	0.257	(0.380)	0.244	(0.355)	0.231	(0.331)	0.218	(0.309)	0.205	(0.287)
2	0.270	(0.650)	0.268	(0.623)	0.265	(0.596)	0.261	(0.570)	0.256	(0.543)
3	0.189	(0.839)	0.197	(0.820)	0.203	(0.799)	0.209	(0.779)	0.214	(0.757)
4	0.099	(0.938)	0.108	(0.928)	0.117	(0.916)	0.125	(0.904)	0.134	(0.891)
5	0.042	(0.980)	0.048	(0.976)	0.054	(0.970)	0.060	(0.964)	0.067	(0.958)
6	0.015	(0.995)	0.017	(0.993)	0.021	(0.991)	0.024	(0.988)	0.028	(0.986)
7	0.004	(0.999)	0.005	(0.998)	0.007	(0.998)	0.008	(0.996)	0.010	(0.996)
8	0.001	(1.000)	0.002	(1.000)	0.002	(1.000)	0.003	(0.999)	0.003	(0.999)
9							0.001	(1.000)	0.001	(1.000)

c \ np_o	2.6		2.7		2.8		2.9		3.0	
0	0.074	(0.074)	0.067	(0.067)	0.061	(0.061)	0.055	(0.055)	0.050	(0.050)
1	0.193	(0.267)	0.182	(0.249)	0.170	(0.231)	0.160	(0.215)	0.149	(0.199)
2	0.251	(0.518)	0.245	(0.494)	0.238	(0.469)	0.231	(0.446)	0.224	(0.423)
3	0.218	(0.736)	0.221	(0.715)	0.223	(0.692)	0.224	(0.670)	0.224	(0.647)
4	0.141	(0.877)	0.149	(0.864)	0.156	(0.848)	0.162	(0.832)	0.168	(0.815)
5	0.074	(0.951)	0.080	(0.944)	0.087	(0.935)	0.094	(0.926)	0.101	(0.916)
6	0.032	(0.983)	0.036	(0.980)	0.041	(0.976)	0.045	(0.971)	0.050	(0.966)
7	0.012	(0.995)	0.014	(0.994)	0.016	(0.992)	0.019	(0.990)	0.022	(0.988)
8	0.004	(0.999)	0.005	(0.999)	0.006	(0.998)	0.007	(0.997)	0.008	(0.996)
9	0.001	(1.000)	0.001	(1.000)	0.002	(1.000)	0.002	(0.999)	0.003	(0.999)
10							0.001	(1.000)	0.001	(1.000)

c \ np_o	3.1		3.2		3.3		3.4		3.5	
0	0.045	(0.045)	0.041	(0.041)	0.037	(0.037)	0.033	(0.033)	0.030	(0.030)
1	0.140	(0.185)	0.130	(0.171)	0.122	(0.159)	0.113	(0.146)	0.106	(0.136)
2	0.216	(0.401)	0.209	(0.380)	0.201	(0.360)	0.193	(0.339)	0.185	(0.321)
3	0.224	(0.625)	0.223	(0.603)	0.222	(0.582)	0.219	(0.558)	0.216	(0.537)
4	0.173	(0.798)	0.178	(0.781)	0.182	(0.764)	0.186	(0.744)	0.189	(0.726)
5	0.107	(0.905)	0.114	(0.895)	0.120	(0.884)	0.126	(0.870)	0.132	(0.858)
6	0.056	(0.961)	0.061	(0.956)	0.066	(0.950)	0.071	(0.941)	0.077	(0.935)
7	0.025	(0.986)	0.028	(0.984)	0.031	(0.981)	0.035	(0.976)	0.038	(0.973)
8	0.010	(0.996)	0.011	(0.995)	0.012	(0.993)	0.015	(0.991)	0.017	(0.990)
9	0.003	(0.999)	0.004	(0.999)	0.005	(0.998)	0.006	(0.997)	0.007	(0.997)
10	0.001	(1.000)	0.001	(1.000)	0.002	(1.000)	0.002	(0.999)	0.002	(0.999)
11							0.001	(1.000)	0.001	(1.000)

c \ np_o	3.6		3.7		3.8		3.9		4.0	
0	0.027	(0.027)	0.025	(0.025)	0.022	(0.022)	0.020	(0.020)	0.018	(0.018)
1	0.098	(0.125)	0.091	(0.116)	0.085	(0.107)	0.079	(0.099)	0.073	(0.091)
2	0.177	(0.302)	0.169	(0.285)	0.161	(0.268)	0.154	(0.253)	0.147	(0.238)
3	0.213	(0.515)	0.209	(0.494)	0.205	(0.473)	0.200	(0.453)	0.195	(0.433)
4	0.191	(0.706)	0.193	(0.687)	0.194	(0.667)	0.195	(0.648)	0.195	(0.628)
5	0.138	(0.844)	0.143	(0.830)	0.148	(0.815)	0.152	(0.800)	0.157	(0.785)
6	0.083	(0.927)	0.088	(0.918)	0.094	(0.909)	0.099	(0.899)	0.104	(0.889)
7	0.042	(0.969)	0.047	(0.965)	0.051	(0.960)	0.055	(0.954)	0.060	(0.949)
8	0.019	(0.988)	0.022	(0.987)	0.024	(0.984)	0.027	(0.981)	0.030	(0.979)
9	0.008	(0.996)	0.009	(0.996)	0.010	(0.994)	0.012	(0.993)	0.013	(0.992)
10	0.003	(0.999)	0.003	(0.999)	0.004	(0.998)	0.004	(0.997)	0.005	(0.997)
11	0.001	(1.000)	0.001	(1.000)	0.001	(0.999)	0.002	(0.999)	0.002	(0.999)
12					0.001	(1.000)	0.001	(1.000)	0.001	(1.000)

Factors for Computing Central Lines and 3σ Control Limits for $\bar{X}$, s, and R Charts

OBSERVATIONS IN SAMPLE, n	CHART FOR AVERAGES: FACTORS FOR CONTROL LIMITS			CHART FOR STANDARD DEVIATIONS: FACTOR FOR CENTRAL LINE	CHART FOR STANDARD DEVIATIONS: FACTORS FOR CONTROL LIMITS				CHART FOR RANGES: FACTOR FOR CENTRAL LINE	CHART FOR RANGES: FACTORS FOR CONTROL LIMITS				
	A	A_2	A_3	c_4	B_3	B_4	B_5	B_6	d_2	d_1	D_1	D_2	D_3	D_4
2	2.121	1.880	2.659	0.7979	0	3.267	0	2.606	1.128	0.853	0	3.686	0	3.267
3	1.732	1.023	1.954	0.8862	0	2.568	0	2.276	1.693	0.888	0	4.358	0	2.574
4	1.500	0.729	1.628	0.9213	0	2.266	0	2.088	2.059	0.880	0	4.698	0	2.282
5	1.342	0.577	1.427	0.9400	0	2.089	0	1.964	2.326	0.864	0	4.918	0	2.114
6	1.225	0.483	1.287	0.9515	0.030	1.970	0.029	1.874	2.534	0.848	0	5.078	0	2.004
7	1.134	0.419	1.182	0.9594	0.118	1.882	0.113	1.806	2.704	0.833	0.204	5.204	0.076	1.924
8	1.061	0.373	1.099	0.9650	0.185	1.815	0.179	1.751	2.847	0.820	0.388	5.306	0.136	1.864
9	1.000	0.337	1.032	0.9693	0.239	1.761	0.232	1.707	2.970	0.808	0.547	5.393	0.184	1.816
10	0.949	0.308	0.975	0.9727	0.284	1.716	0.276	1.669	3.078	0.797	0.687	5.469	0.223	1.777
11	0.905	0.285	0.927	0.9754	0.321	1.679	0.313	1.637	3.173	0.787	0.811	5.535	0.256	1.744
12	0.866	0.266	0.886	0.9776	0.354	1.646	0.346	1.610	3.258	0.778	0.922	5.594	0.283	1.717
13	0.832	0.249	0.850	0.9794	0.382	1.618	0.374	1.585	3.336	0.770	1.025	5.647	0.307	1.693
14	0.802	0.235	0.817	0.9810	0.406	1.594	0.399	1.563	3.407	0.763	1.118	5.696	0.328	1.672
15	0.775	0.223	0.789	0.9823	0.428	1.572	0.421	1.544	3.472	0.756	1.203	5.741	0.347	1.653
16	0.750	0.212	0.763	0.9835	0.448	1.552	0.440	1.526	3.532	0.750	1.282	5.782	0.363	1.637
17	0.728	0.203	0.739	0.9845	0.466	1.534	0.458	1.511	3.588	0.744	1.356	5.820	0.378	1.622
18	0.707	0.194	0.718	0.9854	0.482	1.518	0.475	1.496	3.640	0.739	1.424	5.856	0.391	1.608
19	0.688	0.187	0.698	0.9862	0.497	1.503	0.490	1.483	3.689	0.734	1.487	5.891	0.403	1.597
20	0.671	0.180	0.680	0.9869	0.510	1.490	0.504	1.470	3.735	0.729	1.549	5.921	0.415	1.585