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FOREWORD

(Supplementation is prohibited.)

DPSC Manual 4155.18 is published by the Defense Personnel Support Center for use by Government personnel assigned to inspection of items procured on DPSC subsistence contracts. Instructions are applicable to contractor personnel.

This Manual will be maintained in a current status and reviewed annually.

Users of this publication are encouraged to submit recommended changes and comments to improve the publication, through channels, to Directorate of Subsistence, ATTN: DPSC-STQP.

BY ORDER OF THE COMMANDER

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This Manual supersedes DPSC Manual 4155.18, 1 Jul 78, and Change No. 1.

*Denotes Changes.

I. REFERENCES.

- A. \$(SK) MILSTD105, Sampling Procedures and Tables for Inspection by Attributes.
- B. MILSTD109, Quality Assurance Terms and Definitions.
- C. MILHDBK53, Guide for Sampling Inspection.
- D. DPSC Manual 4155.5, Subsistence Contractor Inspection Procedures Manual.
- E. DPSC Manual 4155.6, Subsistence Inspection Manual.

II. PURPOSE AND SCOPE. The purpose of this Manual is to provide information regarding statistical sampling plans. This Manual is applicable to Government personnel performing inspection on DPSC subsistence contracts and may be used in briefing contractor's personnel on contractor inspection procedures.

III. DEFINITIONS.

A. Major Total Defects Concept. This calls for assignment of separate Acceptable Quality Levels (AQLs) for each major class of defects and an AQL for the combined major and minor classes of defects. An AQL is not assigned to the minor class of defects, but the sampling plan for total defects pertains to the total of major defects plus minor defects found in the sample. To standardize procedures and minimize confusion in using MILSTD105 to obtain a sampling plan (i.e. sample size, acceptance and rejection numbers) when a Table of Examination has more than one class of defects (e.g. major, minor, total) and a combination of AQLs, the inspector should follow the instructions in the applicable table of MILSTD105 to arrive at one sample size, with corresponding acceptance and rejection numbers, to be used for all classes of defects in the examination. When there are compelling reasons to use separate sample sizes for the different classes of defects, approval will be obtained from the quality assurance element of the contracting activity.

B. Major-Minor Defects Concept. Such plans require separate AQLs for each class of defects, i.e., major and minor. This makes it possible for the sample size to vary for each class of defects. However, to minimize confusion and to facilitate application, it is preferable that the sample size be the same for all classes of defects in an examination, as for the major-total defects concept. This concept is currently being stressed in Military and Federal specifications more than the major total defects concept.

IV. SAMPLING PLAN EXPRESSION OF NONCONFORMANCE.

A. All sampling plans used by DPSC refer to MILSTD105 unless otherwise specified in the contract documents. They contain criteria for determining product acceptability or nonconformance as follows:

1. "Defects per Hundred Units" (DHU or DPHU) expresses nonconformance based on the number of defects in the sample.

2. "Percent Defective" (PD) expresses nonconformance based on the number of units in the sample that contain one or more defects.

B. The elements of inspection, i.e., examination and testing, may use either term of expression of nonconformance in the sampling plans applied.

V. TYPES OF SAMPLING PLANS.

A. MILSTD105 is based on inspection by attributes, i.e., based on a characteristic either meeting or not meeting a requirement. Single, Double, Multiple, Reduced, Normal and Tightened Sampling Plans are provided. Tables XA thru XR of MILSTD105 depict approximate operating characteristic curves for the single sampling plans. Matching of the single sampling plan used to the corresponding operating characteristic curve provides an understanding of the producer and consumer risks associated with the particular single sampling plan. Producer risks are those associated with the rejection of lots of good quality, whereas consumer risks are those associated with the acceptance of lots of poor quality.

1. "Single" sampling is ordinarily used because it provides the most information at least cost when quality is at or near the Acceptable Quality Level.

2. Double or multiple sampling may be feasible when history records or observation of production at a plant show that quality is markedly worse or markedly better than the AQL.

3. The type of sampling plan is omitted from Quality Assurance Provisions of contractual documents to permit flexibility in field inspection quality assurance operations.

B. Attribute sampling plans are identified as to severity of inspection, i.e., normal, tightened or reduced. The degree of inspection and the procedures for switching from one degree to another are explained in paragraph 8 of MILSTD105. In accordance with these procedures, MILSTD105, Tables I, IIA, IIIA, and IVA are used for normal inspection. Tables I, IIB, IIIB, and IVB are used for tightened inspection. Tables I, IIC, IIIC, and IVC are used for reduced inspection. This manual illustrates the extraction of sampling plans using normal inspection. The extraction of tightened or reduced sampling plans is performed in the same manner using the appropriate "B" or "C" series tables.

C. Under the major total defects concept, the entire examination (all classes) will be subjected to tightened inspection when any one class in the examination qualifies for such inspection. Under the major minor defects concept only the affected class need be subjected to tightened inspection. Reduced inspection is discouraged due to the high risks associated with the reduced sampling plans.

D. Lot Average and Composite Sampling Plans, based on a continuous scale of measurement of lot characteristic requirements, are also used by DPSC.

1. Examples are net weight, net volume and milk fat content.
2. These sampling plans may be effected in two ways:
 - a. Lot Average Inspect each sample unit, record the individual results and compute the average. Compare this value with the average specification requirement to determine lot conformance.
 - b. Composite Form a composite sample by intermingling and blending the individual units. (Equal portions from each unit may be used.) Inspect the composite sample and compare the results with the specification requirement.
3. The contractual documents will indicate whether the lot average or composite sampling plan is to be used.

VI. APPLICATION OF SAMPLING PLANS.

A. General.

1. The contract, or documents referenced in it, will specify the Inspection Levels and AQLs designating the sampling plans applicable to each element of inspection to be performed. For example, the contract may call for examination of primary containers, of net weight, and of product organoleptic qualities, and testing of physical and chemical properties of the product and component items.

2. The factors for determining the sample sizes to be used for each examination or test are:

a. The concept indicated, i.e., whether major total defects concept or major minor defects concept.

b. The Inspection Level.

c. The AQL.

d. The type of sampling plan utilized, i.e., single, double, or multiple.

e. The severity of inspection required, i.e., normal, tightened or reduced.

B. Example of Uses of Single Sampling Plans for Major Total Defects Concept under Normal Inspection.

This example involves single sampling of a lot of 3,250 primary containers.

The specified inspection is Level II and AQLs are 0.15 DHU for Major A defects,

1.0 DHU for Major B defects, and 4.0 DHU for Total defects.

a. Referring to MILSTD105, Table I, with the lot size of 3,250 containers and Inspection Level II, we derive sample size code letter "L".

b. Referring code letter "L" to Table IIA of MILSTD105, we find that the corresponding sample size is 200 units (primary containers). Following this row horizontally to the right to determine the acceptance and rejection numbers associated with this sample size for the AQLs stipulated, we find an arrow pointing downward in the 0.15 AQL column, 5 and 6 respectively in the 1.0 AQL column, and 14 and 15 respectively in the 4.0 AQL column. Since these sampling plans use the major total defects concept, it is preferred that the sample size be increased to 315 for all of the AQLs stipulated and not for just the Major A defects plan with an AQL of 0.15. Therefore, the proper sampling plans are:

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Major B		Total		Sample Size	Major A		
					AC	RE	AC
RE	AC	RE		315	1	2	7
8	21	22					

c. Under the major total defects concept, the number of minor defects permitted is reduced by the number of major defects found. Therefore, if one defect of Major A class is found, only 20 minor defects will be tolerated, provided no defects of Major B class are found without the lot being considered nonconforming. Similarly, the finding of any defects of Major B class reduces, still further, the number of minor defects permitted.

C. Example of Use of Multiple Sampling Plans for Major Total Defects Concept under Normal Inspection.

This example involves sampling of a lot of 1,250 primary containers. The specified Inspection Level is II and AQLs are 0.065 DHU for Major A defects, 1.0 DHU for Major B defects and 4.0 for Total defects. (Sampling examinations of prior lots indicated that the quality was consistently better than the specified AQL and administrative decision permitted use of multiple sampling.)

a. Referring to MILSTD105, Table I, with lot size of 1,250 units (containers) and Inspection Level II, we derive sample size code letter "K".

b. Referring code letter "K" to Table IVA of MILSTD105, we find a cumulative sample size of 224 units for seven increment sample sizes of 32 units each. Following these rows horizontally to the right, instead of criteria we find an arrow directing us downward in the 0.065 AQL column. Note, however, that the block below the arrow also lacks criteria for this next code letter "L". The asterisk in the block for code letter "L" and AQL of 0.065 indicates use of the corresponding single sampling plan rather than the multiple sampling plan.

c. Referring code letter "L" to Table IIA, we find the proper sampling plans are:

Major B		Total		Sample Size	Major A	
AC	RE	AC	RE		AC	RE
5	6	14	15	200	0	1

d. When different sample sizes are indicated for the same examination or test in a lot, the entire amount of samples drawn for that inspection element ordinarily should not exceed the larger of the sample sizes. To facilitate the physical job of sampling, the larger sample should be drawn. As it is drawn, the lesser sample should be differentiated by marking and, if convenient, by physical separation from the units that bring the sample amount up to the size of the larger quantity. Differentiation should take place at the time the sample units are drawn, i.e., before any examination or testing is performed, to preclude bias in sampling. If examination or testing preceded differentiation, bias may be introduced intentionally or inadvertently by redistributing defective units from the sequence of drawing. Such redistribution of defective units could result in a decision about conformance of the lot differing from what would properly have been indicated. When multiple sampling is to be used, consideration should be given to such factors as repeated availability of forklift equipment, repeated tearing down and rebuilding stacks of boxes, etc., as successive increment sample sizes may be required. Should these factors appear prohibitive as to time and effort, the entire cumulative sample size should be drawn from sufficient shipping containers in accordance with instruction as to number of units to be extracted per shipping container or case (e.g., not more than two units). The cases could then be opened as the need arose for successive increment sample sizes. Expansion of this general topic and examples follow.

e. In double or multiple sampling, differentiation of the increment sample size will be necessary for inspection in the proper sequence, if the indicated entire cumulative sample size is drawn; for example, the multiple sampling plans in Table IVA for code letter "G" and AQLs of 2.5 DHU for major defects and 10.0 DHU for total defects are:

Major Sample		Total AQL 10.0		Sample Size	Cumulative Sample Size
AQL 2.5		AC	RE		
AC	RE	AC	RE		
First				8	8
# 2		0	4		
Second				8	16
0 3		1	6		
Third				8	24
0 3		3	8		
Fourth				8	32
1 4		5	10		
Fifth				8	40
2 4		7	11		
Sixth				8	48
3 5		10	12		
Seventh				8	56
4 5		13	14		

It should be noted that upon examination of the first sample size of eight units, a decision of nonconformance can be reached if two or more major defects, or four or more major and minor defects combined, or if both events occur. However, a decision of conformance cannot be reached before the second increment sample size has been inspected under this plan as the "#" means acceptance is not permitted at this sample size.

D. Single Sampling Plans: Major-Minor Defects Concept.

1. Under the major-minor defects concept, more than one sample size per examination or testing may occur in both single sampling and double or multiple sampling. It is preferable to arrive at one sample size for all classes of defects in the examination (see paragraph VI.B.). Should compelling reasons exist for using a different sample size for each class of defects in the examination, the following means will be used to differentiate the various sample sizes.

2. Single sampling for major minor concept entails drawing the large sample indicated by MILSTD105 and separating the smaller sample size either by marking or physical separation, or both, at the time the sample units are drawn. For example, Inspection Level S2 and AQLs of 1.5 DHU for major defects and 4.0 DHU for minor defects applied against a lot of 6,500 units indicates sample size code letter "D" in Table I. Referring to Table IIA with code letter "D", we find acceptance criteria associated with the corresponding sample size 8 for the AQL of 1.5 DHU and an arrow directing us downward to a larger sample size for the AQL of 4.0 DHU. Therefore, the proper sampling plans are:

Class of Defects	Sample Size	Acceptance No.	Rejection No.
Major	8	0	1
Minor	13	1	2

Therefore, a maximum sample of 13 units should be drawn from the lot. The first randomly drawn units comprising the lesser sample size are differentiated by marking or tagging from the rest of the units that bring the total number up to the larger sample size. In this example, the lesser sample size (the first eight units drawn) shall be examined and the units scored for all classes of defects, i.e., majors and minors. The remaining units that complete the larger sample size (five in this example) shall be examined and the units scored for the applicable class of defects (minor defects in this example) only.

E. Multiple Sampling Plans: Major-Minor Defects Concept.

1. This circumstance requires more attention to the sequence in which the sample units are inspected for each class in order to comply with the randomness of selection. For example, Inspection Level I and AQLs of 1.0 DHU for major defects and 6.5 DHU for minor defects applied against a lot of 790 units indicates sample size code letter "G" in Table I. Referring to Table IVA with code letter "G", we find an arrow directing us downward to a larger sample size for the AQL of 1.0 DHU than for the sample sizes corresponding to code letter "G" for the AQL of 6.5 DHU.

Therefore, the proper sampling plans are:

Sample Size		MAJOR DEFECTS				MINOR DEFECTS	
		Cumulative		AQL 1.0		Cumulative	
Sample	Size	Sample	Size	AC	RE	Sample	Size
Sample	AQL 6.5						
AC	RE						
First	13	13		#	2	8	8
#	4						
Second	13	26		#	2	8	16
1	5						
Third	13	39		0	2	8	24
2	6						
Fourth	13	52		0	3	8	32
3	7						
Fifth	13	65		1	3	8	40
5	8						
Sixth	13	78		1	3	8	48
7	9						
Seventh	13	91		2	3	8	56
9	10						

2. To best illustrate the need for differentiation of the sample sizes for each class of defects and the sequence of inspection, the larger entire cumulative sample size will be drawn as indicated.

Entire Cumulative Sample Size for Major Defects

1st	2nd	3rd	4th	5th	6th	7th							
18	913	1416	1724	2526	2732	3339	40	4148	4952	5356	5765	6678	7991

1st	2nd	3rd	4th	5th	6th	7th
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Entire Cumulative Sample Size for Minor Defects

3. Inspection should proceed as follows:

a. Examine units 1 through 8 for minor defects. If four or more minor defects are found, the lot is nonconforming and no further examination need be made for minor defects. If 0, 1, 2, or 3 minor defects are found, units 9 through 16 must be examined from the cumulative sample for minor defects.

b. Examine units 1 through 13 for major defects. If two or more major defects are found, the lot is nonconforming and no further examination need be made for major defects. If 0 or 1 major defect is found, units 14 through 26 must be examined from the cumulative sample size for major defects.

c. If examination of units 1 through 16 revealed 0 or 1 minor defect, the lot is conforming for minor defects and no further examination for that class of defects need be made. Similarly, if not more than three minor defects were found in the first eight units and the cumulative sample of 16 units revealed five or more minor defects, the lot is nonconforming and no further examination for that class of defects need be made. If 2, 3, or 4 minor defects were found in the cumulative sample of 16 units, examination of units 17 through 24 must be made for minor defects.

d. If examination of units 1 through 26 revealed two or more major defects, the lot is nonconforming for major defects and no further examination for that class of defects need be made. If 0 or 1 major defect is found in the 26 units examined thus far, units 27 through 39 must be examined for major defects. It should be noted that while a decision that the lot conforms for the minor defect class requires examining 16 units as a minimum; to reach the same decision for the major defects class requires examining 39 units as a minimum.

4. The procedure for inspecting successive increment sample sizes is continued for any class until the number of defects for that class indicates nonconformance by equaling or exceeding the rejection number, or indicates conformance by being less than or equal to the acceptance number. Note that if 0 or 1 minor defect had been found in units 1 through 16, examination for major defects would continue through 39 units, at least, if less than 2 major defects were found. Any minor defects found starting with unit 17 would not be scored or recorded since the lot had been found conforming to the criteria for the cumulative sample size for the second increment for minor defects. Similarly, if 0 major defects had been found in units 1 through 39 and examination for minor defects had to continue through unit 40, any major defects found starting with unit 40 would not be scored or recorded. The lot had been found conforming to the criteria for the cumulative sample size for the third increment for major defects. Scoring or recording defects of any particular class found after reaching a valid decision of conformance for that particular class on a previous sample size violates the doctrine of statistical sampling.

5. Generally speaking, for each examination or test the entire single sample or first increment sample size of double or multiple sampling must be examined or tested. This is necessary in order to obtain a sufficiently accurate picture as to quality of the lot. Under certain conditions, however, it may not be desirable after the rejection number has been reached to complete inspection of the entire sample. When either of the conditions below apply, the inspection record will be annotated "Inspection stopped after...units because...". The blanks will be filled in, respectively, with the number of units and the reason for stopping, e.g., "moving lot inspection" or "improper nomenclature printed on cases." Conditions for halting inspection upon reaching the rejection number are:

a. When moving lot inspection is specified, the inspector will discontinue examination once the rejection number has been reached.

b. When the defect is an overall or general defect, e.g., wrong markings printed on the shipping cases, wrong colored ink used for markings, cans not coated when coating is required, or vice versa, etc., that will appear in each unit in the lot, the inspector will discontinue each examination once the rejection number has been reached.

F. Example of Double Sampling Plans: Major-Minor Defects Concept. This example involves sampling of a lot of 2,000 items. The specified Inspection Level is I and the AQLs are 1.0 DHU for major defects and 6.5 DHU for minor defects. A normal sampling plan is authorized.

a. Referring to MILSTD105, Table I, with lot size of 2,000 items and Inspection Level I, sample size code letter "H" is derived.

b. From Table IIIA, sample size code letter "H" and AQLs of 1.0 and 6.5, the following sampling plans are obtained.

Cumulative Sample Size		AQL		AQL	
		Sample Size		1.0	6.5
		AC	RE	AC	RE
First		32		32	
0	2	3	7		
Second		32		64	
1	2	8	9		

c. From the first sample of 32 units, the lot is accepted if no major defects and if 3 or fewer minor defects are found. The lot is rejected if 2 or more major defects and/or if 7 or more minor defects are found. However, no decision can be made from the results of the first sample if 1 major defect and/or 4, 5 or 6 minor defects are found. A second sample of 32 items must be taken. If the combined sample size of 64 items contains 1 or fewer major defects and 8 or fewer minor defects, the lot is accepted. If the combined sample size of 64 items contains 2 or more major defects and/or 9 or more minor defects the lot is nonconforming.

d. The decision whether to draw the first sample, perform examination, and then draw the second sample if required, or whether to draw two samples before examination would depend on the particular circumstances involved (see paragraph VI.C.d.).

G. Lot Average or Composite Sampling Plans. Lot average or composite sampling plans make use of MILSTD105 only for determining the sample size. These sampling plans call for other considerations before a decision is made on the lot acceptability when an apparent nonconformance is indicated by the results of the samples. Detailed information on lot average sampling plans is contained in DPSC Manual 4155.6. An example of determining the sample size from MILSTD105 for a lot average sampling plan would be where the instructions read: "The sample size shall be the number of primary containers indicated by Inspection Level S1. Test requirements shall be lot average requirements." If the lot consisted of 24,000 primary containers of product, reference to Table I, MILSTD105, indicates code letter "C". Referring to Table IIA with code letter "C", we find the sample size to be 5 units. The MILSTD105 acceptance criteria, i.e., AQLs and Acceptance and Rejection Numbers, are not employed for lot average determinations.

H. Lot Acceptance-Rejection Criteria. A lot shall be considered acceptable or conforming to requirements only if it passes every sampling plan applied. If the lot fails one or more sampling plans, it shall be considered unacceptable or nonconforming to requirements.

VII. INSTRUCTIONS FOR THE USE OF LIMITING QUALITY (LQ) VALUES.

A. General.

1. These values are applicable in those instances when it is desirable to control quality at particular consumer's risk (P_a) for isolated lots. When using MILSTD105 this is accomplished by the selection of a sampling plan that provides not less than a specified LQ protection and is associated with a designated AQL value. When the contractual documents stipulate an LQ value for a table of defects, the sampling plan shall be selected in accordance with the instructions of Section 11 of MILSTD105. This sampling plan shall be compared to the plan indicated by the Inspection Level and AQL without application of LQ information. The plan requiring the larger sample size will be used.

2. When LQs with the associated consumer's risk expressed as percent are used, they will be placed in contractual documents and will be identified as to Inspection Level and AQL to which they apply in any examination. An LQ value may be specified for one or more AQLs and for any examination or test.

B. Sampling Plan - Limiting Quality Protection.

This example involves examination of a single lot (20,000 units) of ration component produced on contract. The following inspection data applies:

Insp. Level	Sample Unit	Lot Size Expressed as	AQLsLQs	
			Major A	Major B
S2 10.00	Contents of Primary Container	Primary Container	0.65 LQ = 8 DHU Pa = 10%	2.5

a. Refer to Table I, MILSTD105. For lot size of 20,000 with Inspection Level of S2, the sample size code letter indicated is "D".

b. Refer to Table IIA, MILSTD105, for code letter "D". In AQL column, headed 0.65, an arrow points downward resulting in the following sampling plan:

Sample Size		DEFECTS				Total
		Major A		Major B		
AC	RE	AC	RE	AC	RE	
0	1	1	2	5	6	20

c. Refer to Table VIB, MILSTD105. Contract specifies an LQ of 8 DHU. In AQL column, headed 0.65, locate the value, equal to or less than 8, which is "4.9". The sample size indicated is "80" and the code letter is "J".

d. Refer to Table IIA, MILSTD105, for sampling plan for sample size code letter "J". Since the LQ sample size of 80 is greater than the sample size 20 indicated for code letter "D" (paragraph VII.B.b.), the following plan will apply:

Sample Size		DEFECTS				Total
		Major A		Major B		
AC	RE	AC	RE	AC	RE	
1	2	5	6	14	15	80

e. In the above example, if the stipulated Inspection Level were "II" instead of "S2", Table I, MILSTD105, would have indicated the sample size code letter to be "M". Refer to Table IIA, MILSTD105, for code letter "M". An upward pointing arrow is encountered in the AQL column headed 10.0, which results in the following sampling plan:

Sample Size		DEFECTS				Total
		Major A		Major B		
AC	RE	AC	RE	AC	RE	
2	3	7	8	21	22	125

f. The plan indicated by the LQ value would be the same as in paragraph VII.B.d. Since the sampling plan resulting from application of the LQ value has a smaller sample size and offers less protection than the sampling plan resulting from application of the Inspection Level and the AQL, the latter plan with the larger sample size is applied.

VIII. INSTRUCTIONS FOR COUNTING DEFECTIVES.

A. This Manual has thus far discussed defects and methods of scoring defects. Some Quality Assurance Provisions are concerned with defective units rather than defects. Basically, a "defective" is a unit which contains one or more defects. A major defective is a unit containing one or more major defects; a minor defective is a unit containing one or more minor defects. Depending upon classification of defects, a unit may be scored simultaneously as a major defective and a minor defective, or simply as a defective.

E. Counting: Procedure B.

1. Major and minor defects are scored and counted separately when classified separately. The first major defect found on a unit is tallied "1"; the first minor defect found on a unit is tallied "1". If a major and a minor defect are found on the same unit, a "1" is tallied for major and a "1" is tallied for minor. Subsequent defects for either class of defects after the first defect is tallied as "0". Upon completion of inspection of his sample size, he determines the quality of the lot by counting the tallied "1s". For example:

	Major	Minor
Defect	103	10111
Defect	211	10
Defect	106	01
Defect	214	001
Defect	221	1

2. The total number of major defects is 7; the total number of major defectives is 5.

3. The total number of minor defects is 6; the total number of minor defectives is 3.