	STANDARD OPERATING PROCEDURES	SOP
	QUALITY ASSURANCE AND QUALITY CONTROL	04
	SAMPLING – Sampling for inspection and control of demined and searched area	04.03
DOMAIN: HUMANITARIAN DEMINING		TO 523
<p>QUALITY ASSURANCE</p> <ul style="list-style-type: none"> • TERMS AND DEFINITIONS • GENERAL REQUIREMENTS AND ACCEPTABLE QUALITY LEVEL (AQL) • SAMPLING PLAN • LOT ACCEPTABILITY • NON-CONFORMING ITEMS - ENTITIES • QUALITY LEVEL ACCEPTANCE CRITERIA • INSPECTION LEVEL • ANALYSIS OF SOIL TREATMENT DEPTH MEASUREMENT RESULTS AND QUALITY • EXAMPLES OF SAMPLINGS • DOCUMENTING <p>QUALITY CONTROL</p> <ul style="list-style-type: none"> • DEMINING • MINE SEARCH 		
	CROMAC DIRECTOR: Oto Jungwirth	September, 2007

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INTRODUCTION

The aim of this standard is the quality assurance and quality control over the area inspected by metal detectors or mine detection dogs. In order to avoid subjective judgements and estimates of QA Officers and Monitors relating to the quality of inspected area (by metal detectors or mine detection dogs), scientific methods of quality control were applied.

Tasks to be performed by QA Officers and monitors are:

1. Apply the methods of quality control of inspected area based on this SOP,
2. Keep records of the results,
3. Evaluate the controlled area,
4. Pass the decision on acceptance or (nonacceptance) of inspected area.

Final beneficiaries of the humanitarian demining program have to be sure that searched and demined area is completely safe for use. This requires high management level and detailed operating procedures that provide the highest level of quality control over searched and demined MSA.

General principles and procedures for inspection and sampling were developed by the International Organization for Standardization (ISO), and those principles and procedures accepted are published in ISO 2859-1. ISO procedures applied to Quality Assurance (QA) and sampling (based on statistic analysis) provide the rules by which it is easier to decide on product quality. When humanitarian demining is about, "product" means searched and/or demined area.

The way the soil sample is selected influences a great deal the sampling results of searched and/or demined area. Strict procedures for representative sample selection are also required. If the procedures are not regulated and abided, the Quality Assurance can be influenced by a subjective opinion of the QA Monitor and QA Officer.

The results of sampling searched and/or demined area affect a great deal the method of selecting the soil sample. Very strict procedures for the selection of samples are also required. If the procedures are not stipulated and abided, quality assurance can be affected by subjective opinion of the QA Officer and Monitor. Subjective confidence that includes human factors such as perception, estimates and opinions is not specially elaborated in this SOP.

This SOP regulates one of the methods of monitoring the treatment depth of mechanically treated MSA (MSA treatment is carried out using demining machines as an independent method) and that is the inspection of treated soil by attributes (right-wrong). Sampling is performed using the random sampling method based on ISO 2859-1, i.e. **HRN ISO 2859-1: «Sampling procedures for the inspection by attributes»**.

Sampling plans are indexed according to acceptable quality level (AQL) for the lot-by-lot inspection.

I QUALITY ASSURANCE DURING THE EXECUTION OF MINE SEARCH AND DEMINING OPERATIONS

Sampling – sampling for surface area inspection and control using metal detector

1 The Implementation Sphere

This SOP provides the guidelines for the implementation of Quality Assurance (QA) over searched area applying the sampling plans indexed according to acceptable quality level (AQL) for lot-by-lot inspection of treated area. It defines the terms, establishes the management system and procedures based on ISO 2859 and HRN ISO 2859-1 documents and gives instructions on implementation of those procedures.

SOP can be applied in the procedures of demined area Quality Assurance and Quality Control according to the IMAS 09.10 and IMAS 09.20.

2 Referring to Other Standards

List of normative references is given in the Appendix A. Normative references are important documents this standard pleads to and they make a part of this standard's regulations. All standards are being modified so it is required to follow the list of international standards currently in force. Members of IEC and ISO have the lists of international standards registered.

3 Terms and Definitions

Terms and definitions used in this SOP are in accordance with ISO 3534, IMAS 09.20 and HRN ISO 2859-1. Complete dictionary of all terms and definitions used in the series of IMAS are stated in IMAS 04.10.

3.1 incorrectness: Deviation from the characteristic of quality (detection of mines and UXO and their fragments with explosive substances) that results in a fact that searched mine suspected areas do not meet the requirements set by the pilot project or the contract.

3.2 non-conformity: deviation from the characteristic of quality that results in the fact that mechanically searched mine suspected areas do not meet certain requirements. Example: If the required clearance of soil from mines, UXOs and their fragments is to the depth defined by the project (Book of Amendments to the Rules and Regulations on the Method of Conducting Humanitarian Demining, NG 53/07) non-conformities are classified into three classes:

non-conformity of the class A – single measured soil treatment depth is smaller than 12 cm in the I soil category and smaller than 6 cm in II and III category. AQL value is very small. Measurement whose value is smaller than the stated ones is not allowed in the selected sample. Critical defect – the sample is rejected.

non-conformity of the class B – single measured soil treatment depth is smaller than 17 cm and bigger than 12 cm in the first soil category. In the II and III soil category it is smaller than 8 cm and bigger than 6 cm. AQL value is bigger than the one at the class A and smaller than the one at the class B. Two measurements maximum are allowed in the sample. Bigger defect (deficiency) – more than 4 measurements are present in the sample within the stated limits.

non-conformity of the class C - single measured soil treatment depth is smaller than 20 cm and bigger than 17 cm in the I soil category. In the II and III soil category it is smaller than 10 cm and bigger than 8 cm. AQL value is bigger than the one at the class B. Four measurements maximum are allowed within stated limits. Bigger defect – more than 5 measurements are present in the sample within stated limits.

3.3 non-conforming item: searched area item that consists of one non-conformity at least. Non-conforming items are classified into two classes:

Item of the class A – the item that consists of one or more non-conformities of the class A but can also consist of non-conformities of the class B and/or class C.

Item of the class B – the item that consists of one or more non-conformities of the class B, it can also consist of non-conformities of the class C but it does not consist of the non-conformity of the class A.

3.4 Acceptable Quality Level (AQL): when continuous weekly (daily) mechanically treated mine suspected area is concerned, the quality level (average soil treatment depth) that, in terms of weekly (daily) inspection of quality by sampling, makes the border value of acceptable average of the process (see Point 5).

3.5 Percentage of non-conforming items: the percentage of non-conforming items (soil treatment depth smaller than the required one) in any quantity of product items given (for example: 15 measurements in searched area of the size 5 m × 10 m) is equal to the ratio of the number of non-conforming items and total number of product items (measurements of depth) multiplied by 100.

3.6 Sampling plan: special plan that shows how many items (selected entities) from every daily or weekly treated area should be inspected (sample size or a line of sample sizes) and joined criteria for defining the acceptability of daily or weekly treated (searched) area (numbers of acceptances and rejections).

- 3.7 Sampling scheme:** the combination of sampling plans and transition procedures.
- 3.8 Sampling system:** the collection of plans or sampling schemes. This part of ISO 2859 sampling system is indexed by lot size ranges (daily or weekly treated area), levels of survey and AQL values. Sampling system for LQ plans is given in ISO 2859-2 standard.
- 3.9 Inspection:** the measurement process of the soil treatment depth, checking, examination, measurement or different comparison of product items (searched area) with applicable requirements.
- 3.10 Original inspection:** the first inspection of the area of special quality, previously searched, unlike the inspection of treated area that is submitted for inspection all over again upon original non-acceptance.
- 3.11 Inspection by attributes:** the inspection during which the product item (treated entity) is evaluated simply as conformed or non-conformed, or the non-conformities per product item are being counted regarding the requirement or group of requirements given.
- 3.12 Treated MSA (product) item:** the item (the depth of mechanically treated weekly or daily area) that is inspected in order to be classified into the class of conforming or non-conforming items or in order to count the number of non-conformities on the selected area.
- 3.13 Treated MSA lot:** the collection of treated MSA (m²) items – daily or weekly mechanically treated area from which the sample should be taken and inspected in order to define the conformity with acceptance criteria.
- 3.14 Lot size:** number of product items in the lot (number of selected treated-searched entities in weekly or daily treated area using a demining machine).
- 3.15 Sample:** the sample consists of one or more entities of treated MSA taken from weekly or daily treated area (lot); the sample items are chosen at random regardless their quality. Sample size is equal to the number of product items in the sample.
- 3.16 Critical incorrectness:** medium value of soil treatment depth in selected sample is smaller than the one required by the project.

4 General Requirements and Acceptable Quality Level (AQL)

Monitoring and quality control are an important part of the humanitarian demining management process whose goal is to verify the quality of mine search on the mine search projects and establish required quality level according to the Rules and Regulations on Methods of Demining and contractual responsibilities.

Non-conformity on mine search projects is presented as the number of non-conformed soil treatment depths during the mechanical MSA treatment as an

independent method regarding the soil type and present vegetation. In the tables (see Table 3-A, 3-B and 3-C) that will be applied at one-time sampling it is assumed that the non-conformities appear by accident and statistically independently.

The term “acceptable quality level – AQL” that is used in ISO 2859-1, HRN ISO 2859-1 and this SOP refers to the objective mathematical possibility of reaching the required level of average soil treatment depth during the mine search. Subjective confidence that includes human factors such as perception, assessment and opinion is not specially elaborated in this SOP.

For indexing the sampling plans and schemes given in HRN ISO 2859-1 together with the code letters (see Table 2) the acceptable quality level (AQL) is used. AQL is the mark for non-conforming items percentage value (or number of non-conformities on 100 items – can be 50; 100 or 200 m² of searched mine suspected area, see Table 1) that will, by sampling scheme which should be used, be accepted the largest number of times. When it comes to mine search projects the AQL represents reaching the required level of soil treatment depth – depth determined by the project that makes the border value of acceptable mine search average. Sampling plans given are prepared in a way that the acceptance probability for denoted AQL value for AQL given depends on the sample size.

Efficiency and value of expert monitoring by sampling for the purpose of checking the soil treatment depth requires mine search to be “complete and controlled”. “Complete” process implies that every entity to be surveyed includes the land treated/searched using demining machine under the same conditions (daily treated area), in the same way, using the same tools. In order to avoid excessive rejection of daily searched area it is expected that the average of soil treatment depth will be less than AQL or equal to that value.

Acceptable Quality Level (AQL) to be used is defined by the contract or mine search project.

5 Sampling Plan

There is a number of sampling methodologies possible to be applied. Statistically valid sampling system is described in this paper for the needs of this Standard Operating Procedure.

Minimal overall area to be surveyed upon MSA treatment will be calculated using the numbers arising from HRN ISO 2859-1 (see Appendix A: Table 1). Certain parts of treated soil to be surveyed will be selected by QC Monitor using the random selection method.

The positions of soil treatment depth measurement in the sample are selected in a way to cover the entire sample surface (see Appendix D).

5.1 Lot Formation Mode

Daily or weekly MSA treatment (search) using demining machine as an independent method is formed into recognizable lot, sub-lot or in some other adequate form. Every lot should be treated approximately under the same conditions as much as possible (similar soil and climate conditions, the same machine type and working tools).

5.2 Lot Acceptability

Lot acceptability is determined by using sampling plan or sampling plans joined to the denoted AQL or denoted AQLs (see Tables 3-A, 3-B and 3-C).

The term “non – acceptance” is used instead of “rejection” when it relates to the result that ensues from the procedure.

QC Monitor decides how to treat non-accepted lots. Such lots can be searched once again using demining machines by treating the soil up to the depth determined by the project or by manual mine detection as a second method or perform the evaluation according to specific usability criteria once again.

5.3 Non-conforming Items – Entities

QC Monitor has the right to reject every daily entity for which it is determined during the inspection to be non-conformed, no matter whether the entity is a part of weekly sample or not, even when the lot as an entity is accepted (total weekly mechanically searched area has the average soil treatment depth equal or bigger than the one determined by the project.) Rejected entities can be remedied and inspected all over again with the approval and in a way specified by QC Monitor.

5.4 Sampling

When it is appropriate, the number of entities in a sample is selected in proportion to the size of daily or weekly treated MSA established according to the Table 1.

Samples can be determined upon weekly or daily work (treating/searching) or during daily/weekly search when the works interruption is in progress for whatever reasons. In any case, the samples are selected in a random way.

The sample is selected according to the method of demining i.e. mine search, especially for every single contractor i.e. the sample is selected for each method of inspection and each contractor individually (e.g. the sample no.1 for the working path of the company «a», sample no.2 for the area searched by the dogs of the company «a»; samples no. 3, 4 for the area of the working paths of the company «b»., sample no.5 for the area searched by the dogs of the company «b»; sample no.6 for the area searched by manual detection of the company «b»)

5.4.1 Types of Inspection

There are three types of inspection: normal, tightened or reduced (see Appendix D: Table 1 and Appendix C: Tables 3-A, 3-B, 3-C and Figure 1, Appendix C4).

At the beginning of inspection, if not decided differently, the QC Monitor conducts the normal inspection. Normal, tightened or reduced inspection is executed on the following lots without any change except in cases where transfer procedures (see HRN ISO 2859-1, Point 9 and see Appendix C4) require change of inspection type. Transfer procedures are applied independently for each class of conforming or non-conforming items. Rules and procedures of transfer are given in HRN ISO 2859-1.

5.5 Methods of Monitoring and Quality Control

CROMAC approves the procedures and the equipment used by the QA Officer/QC Monitor for checking the samples of searched soil and they will be co-ordinated with authorized demining companies. Any bigger change in the sampling process, monitoring or quality control should be verified in CROMAC and authorized demining companies should be informed on these changes in time, prior to the commencement of monitoring and quality control.

5.5.1 Quality Level Acceptability Criteria

“The entity” will be considered as “quality-searched” only if the class AQL criteria are met.

If any sample of the entity comprises one or more detections of mines, UXO and their fragments, this will make the “critical non-conformity” (non-acceptance/unallowed defect), the entity that comprises this sample will not pass the final inspection/quality control.

Searched soil can comprise single detections of metal fragments of mines and 7or UXO without explosive substance of a certain length L or diameter D i.e. non-conformities classified into classes A, B and C. Such cases would indicate the possible defect and create the critical defect once again. Terms for acceptance or non-acceptance of all non-conformity categories are given in the Table 3.

5.5.2 Inspection Level

QC Monitor can define required quality level for each special application when taking into account the possibility of work with metal detector i.e. mine detection dog according to the Book of Rules and Regulations on the Method of Conducting Humanitarian Demining (NG 53/2007). This enables the QA Officer/QC Monitor to require bigger differentiation for some purposes and smaller for another.

Three levels of inspection (I, II and III) for general use are given in the Table 1. If not defined differently, the level II is used. When the smaller sample differentiation is required the level I can be used and when the bigger differentiation is allowed, the inspection level III is used.

For the selection of sample size code letters (APPENDIX A: Table 1)

5.5.3 Sample Size Code Letters

Sample sizes are marked with code letters. In order to find the applicable code letter for the special lot size and regulated inspection level the Table 1 is used (APPENDIX A).

5.5.4 Treated Entity Acceptability Determination

In order to determine the lot (entity) acceptability according to the number of non-conforming items, the one-time sampling plan is used (see Appendix C: The scheme of one-time sampling and the Tables 3-A, 3-B and 3-C). At single sampling plan the

number of items inspected is equal to the sample size defined by plan. If the number of non-conforming items found in the sample is equal or smaller than the number of acceptances, entity (lot) is considered to be acceptable. If the number of non-conforming items is equal or bigger than the number of rejections, the entity (lot) is considered to be unacceptable.

5.5.5. Determination of Acceptability of the Area Searched by Mine Detection Dogs

During quality assurance and quality control over the area searched by mine detection dogs, detected metal fragments of mines and/or UXO have to contain at least 3 grams of explosive substance to be considered as non-conforming. That relates to metal fragments (pieces of shrapnel): warheads, hand bombs, grenade launchers, artillery projectiles, cartridge cases, antipersonnel mines, detonators etc.

Such metal fragments of mines and/or UXO with traces of explosive substance (3 grams minimum) will be considered as non-conformities of a certain class. Other criteria are consistent with point 5.5.4.

Example 1

Detection of shrapnel of a mortar shell with over 3 grams of TNT and 12 cm long will be treated as non-conformity of the class A.

Example 2

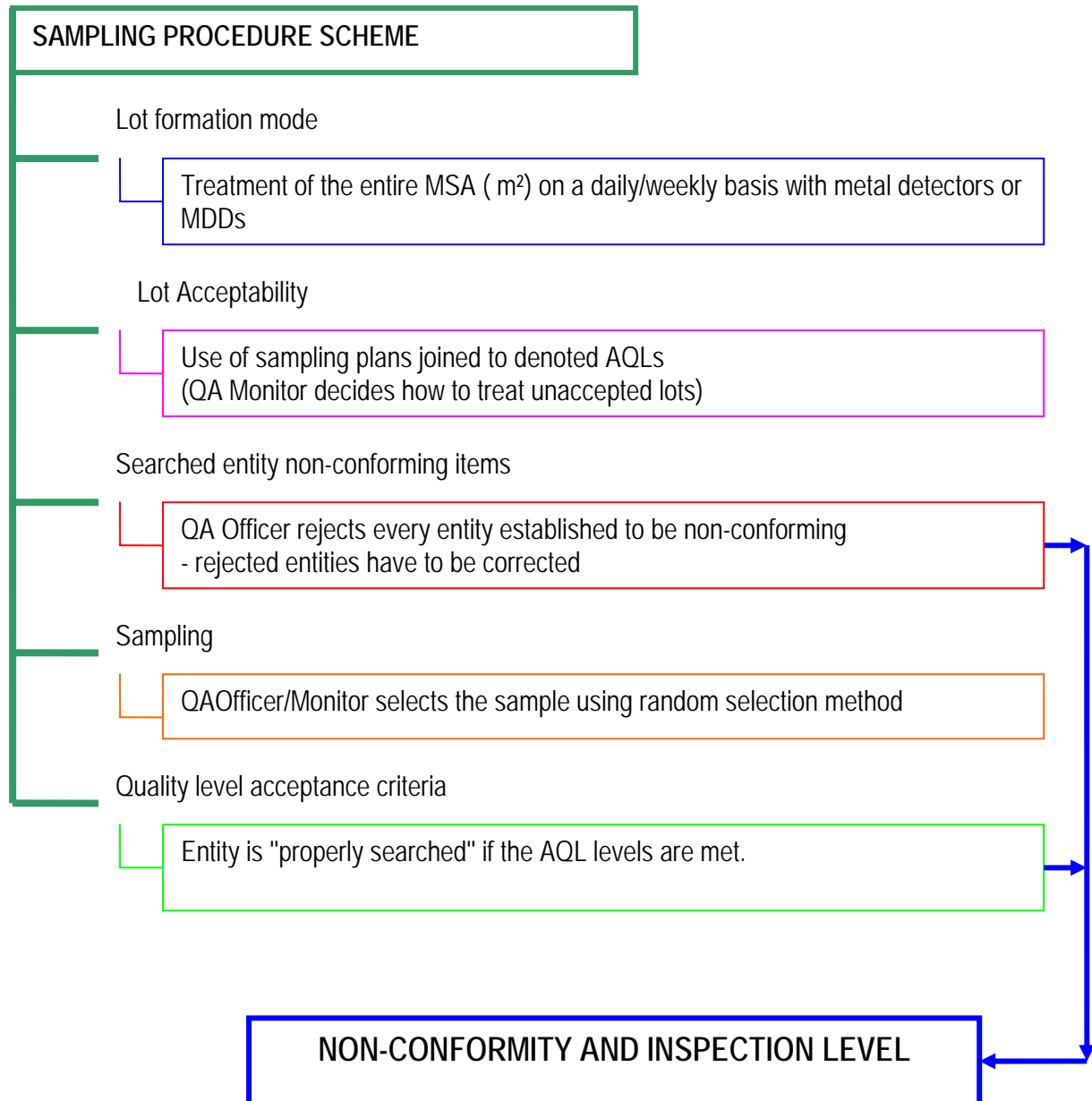
Detection of a stabiliser of a mortar shell with no traces of explosive substance will not be taken into consideration.

Example 3

Detection of DK-8 is incorrectness because this is the part of a mine and not a metal fragment with traces of explosive substance.

6 Proposed Sampling Procedure Scheme

The special sampling plan defining the number of treated MSA entities to be inspected (sample size) is prepared with joined criteria for acceptability determination of daily/weekly treated (searched) area.



NON-CONFORMITY AND INSPECTION LEVEL

Critical non-conformity - incorrectness

If the entire lot (entity) sample contains one mine, UXO or their fragments

Single non-conformity indicator classes

Non-conformity of the class A

Non-conformity of the class B

Non-conformity of the class C

Searched entity non-conforming items– contain at least one non-conformity

Class A unit

Class B unit

Unit that contains one or more non-conformities of the class A, but can also contain non-conformities of the class B and/or C

Unit that contains one or more non-conformities of the class B, and can also contain non-conformities of the class C, but does not contain non-conformities of the class A

Inspection level based on the estimate of soil contamination with metal

General inspection levels

I

II

III

Tables adjusted for the conditions of mechanical MSA search based on ISO 2859-1

Table 1 – Sample size code letters

Table 3 – One-time sampling plans

7 Quality Control and Measurement Results Analysis

7.1 Quality Control of the Area Treated by Metal Detector or MDDs and Length Measurement of Metal Mine and UXO Fragments With No Explosive Substance Detected

Quality control of the MSA treated by a metal detector or MDDs during mine search and/or demining operations depends a great deal on soil conditions.

The representative of a contractor is always present during sampling. He provides the execution of deminer inspection of selected sample combination (Supplement A, in the example – Supplement E). For the areas demined by manual detection, the sample is inspected according to combinations presented in the Supplement F.

In the scheme of selected combination, each square meter represents 1 (one) m² of inspected area. Instead of a meter, a normal footstep of a QA Officer/Monitor can be used. While performing quality control of the areas searched by manual detection i.e. MDDs, control units are grouped in a line so that the control can start from the safe lane.

At the selected measurement spot where metal detection has been indicated, QA Officer/Monitor digs out the inspected soil in a way to carefully remove it with hands, prodder or knife, in layers, with maximum measures of caution.

If it is established that mines, UXO or any of their fragments is detected, QA Officer/Monitor informs the QA Officer-worksite leader about it and drafts the documentation stating the following:

- a) name and type of mines, UXO and their fragments found,
- b) co-ordinates and depth at which mines, UXO and their fragments are found,
- c) status of detected mines, UXO and their fragments (existence/non-existence of detonator, compactness and completeness of ordinance etc.)
- d) photo documentation with clearly presented photographs – of ordinance found, worksite and surrounding landmarks.

Detected/discovered mines, UXO or their fragments must not be moved!

In case of a detection of mine/UXO metal fragment without explosive substance (hereinafter: e.s.) QA Officer/Monitor measures its length L with a ruler (if such fragments are prism-shaped) or diameter D (when fragments are cylindrical or ball-shaped).

In case of a detection of cylindrical fragment, bigger dimension measured is relevant. For example, in case of a cartridge case, diameter D is smaller than the length L, so the length is measured.

Measured values of the length L or diameter D of a metal fragment for separate sample is entered into the form (see point 8. Documenting).

7.2. Example of Sampling the Area Inspected by Metal Detector or Mine Detection Dogs

During the inspection of soil by metal detector, it is required to indicate each detection of metal in the ground since it represents a potential possibility of finding a mine, UXO or their fragment on that spot in the ground.

During quality assurance by sampling of an inspected area, each detection of mine, UXO or their fragments will be considered as incorrectness (demined entirety-lot will not be accepted).

All metal fragments of a mine and/or UXO that stayed in the ground to the projected depth, and are equal or bigger than 3 cm will be considered as non-conformity in the process of mine search or demining of the area.

Code Letter Determination

Example no.1:

Daily demined area (manual demining) is approximately 3 120 m².

Sample size code letter is defined using the Table 1 (Appendix A) in the following way:

- the size of daily lot is under the ordinal number 3 (1 201 – 3 200 m²)
- sample size is 50 m² and the number of depth measurements in the sample is 10, positioned in line with selected combination, for example D1-1
- general inspection level (II) is always selected for the commencement of supervision over the area inspected by metal detector

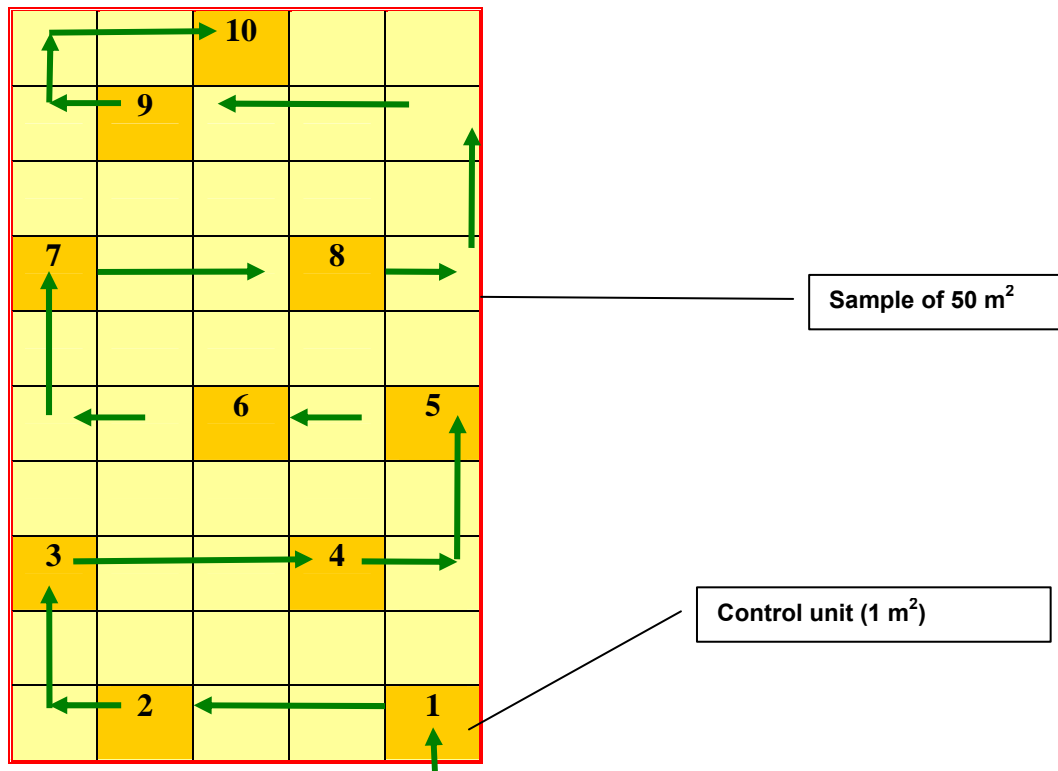
Determination of Sample Number (Sample Size) and Acceptable Quality Level (AQL)

Upon defining the code letters in the Table 1, one-time sampling plan is selected. At the beginning of work one always proceeds from the one-time sampling plans for the normal inspection, Table 3-A (Appendix C1).

For the letter code «D» from the table 3-A for the normal inspection (see Appendix C) sample size is 5. That means, the QA Officer/Monitor chooses (3120 m²) 5 samples of 50 m² in the lot using the random sampling method.

In each of 5 samples (of 50 m²), QA Officer/Monitor has to inspect 10 control units i.e. 10 m² (one control unit totals 1 m²)

COMBINATION D1-1: Sample size: 5x10 m; number of control units 10



If mines, UXO or their fragments with e.g. are found in the sample, the lot is incorrect and rejected.

The presence of non-conformities in the class A with number of acceptances $A_c=0$ represent the non-conformity and the lot is rejected.

The Officer/Monitor informs the QA Officer about the rejection on any basis stated in this SOP.

Non-conformities in the example are defined as follows:

Non-conformity of the class A is:

If the metal fragment of mines and/or UXO without explosive substance detected in the sample with length or diameter bigger than 10 cm, number of lot acceptances is $A_c=0$, number of lot rejections is $Re=1$.

It means, acceptable length or diameter of the fragment detected in the sample is bigger than 10 cm. For this sample, $AQL=0,1$ (from the table 3-A).

Non-conformity of the class B is:

If the metal fragment of mines and/or UXO without explosive substance detected in the sample is of length or diameter between 5 and 10 cm, number of lot acceptances is $A_c=1$, number of lot rejections is $Re=2$.

It means, detection of one metal fragment of length or diameter between 5 and 10 cm is acceptable. Detection of two or more metal fragments of length or diameter between 5 and 10 cm is not acceptable! For this sample, the $AQL=1,5$ (from the table 3-A).

Non-conformity of the class C is:

If the metal fragment of mines and/or UXO detected in the sample is of length or diameter between 3 and 5 cm, number of lot acceptances is $A_c=2$, number of lot rejections is $R_e=3$.

It means, detection of two metal fragments of length or diameter between 3 and 5 cm is acceptable and detection of three or more metal fragments of length or diameter between 3 and 5 cm is not acceptable! For this sample, the AQL is 2,5 (from the table 3-A) (See other examples in the enclosure).

CONCLUSION

1. The lot is rejected if mines, UXO or their fragments are found in the sample. In that case, this is the incorrectness. The QA Officer has to be informed about lot rejection.
2. Detection of metal fragment of measured length or diameter bigger than 10 cm is not allowed. It is the non-conformity of the class A. The lot is rejected if such fragment is found.
3. Detection of two metal fragments of length or diameter between 5 and 10 cm in the sample is not allowed. One is acceptable. Non-conformity of the class B. Lot is rejected if two of such fragments are found.
4. Detection of three metal fragments in the sample of the length or diameter from 3 to 5 cm is not allowed. Two are acceptable. Non-conformity of the class C. The lot is rejected if three of such fragments are found.
5. Officer/Monitor is obliged to inform the QA Officer about lot rejection on any basis stated in this SOP as soon as possible. QA Officer further proceeds in line with the Book of Rules and Regulations on the Method of Conducting Humanitarian Demining Operations.

Example no.2 – Example of sampling the area of walking paths during mine search using manual detection

Daily searched area of walking paths by manual detection (10x10 m grid) is, for example, 3120 m².

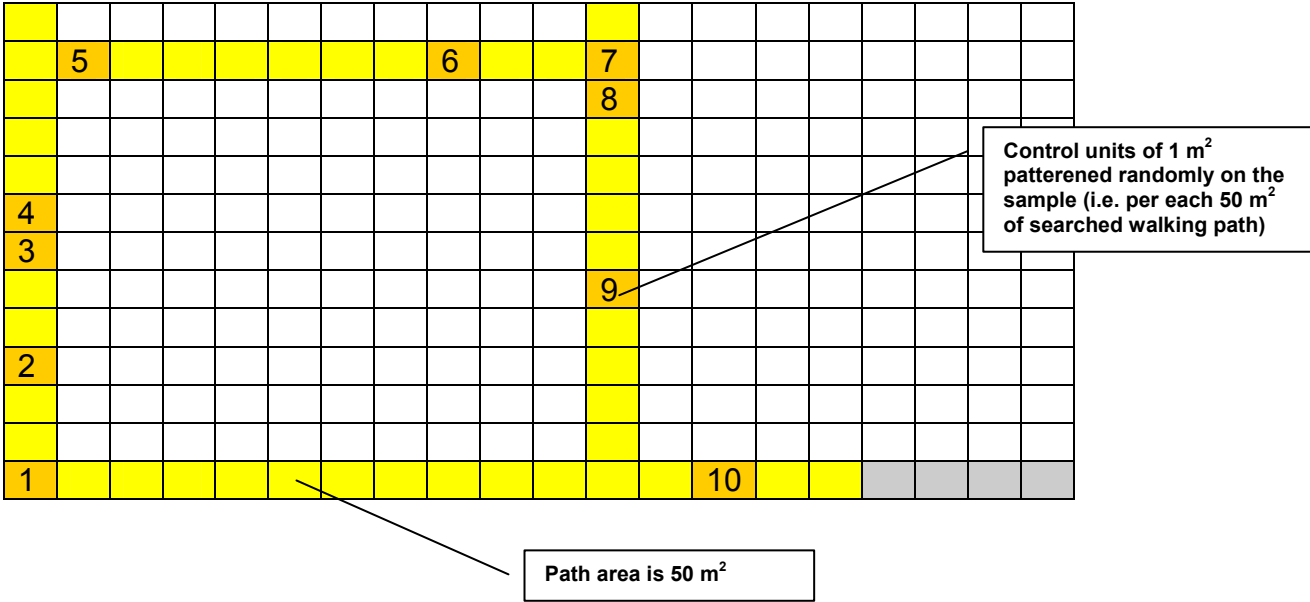
Daily searched area of walking paths is defined using Table 1 (Appendix A) in the following manner:

- daily lot size is under the ordinal number 3 (1201 to 3200 m²)
- sample size is 50 m² and number of control units i.e. m² in the sample is 10
- control units are patterned on the walking paths randomly
- general level (II) is always selected for the commencement of inspection of the area searched by metal detector

Determination of Sample Number (Sample Size) and Acceptable Quality Level (AQL)

Upon defining the code letters in the Table 1, one-time sampling plan is selected. At the beginning of work one always proceeds from the one-time sampling plans for the normal inspection, Table 3-A (Appendix C1).

For the letter code «D» from the table 3-A for the normal inspection (see Appendix C) sample size is 5. That means, the QA Officer/Monitor chooses 5 samples of 50 m² in the lot (3120 m²) using the random sampling method. In each of 5 samples (of 50 m²), QA Officer/Monitor has to inspect 10 control units i.e. 10 m² (one control unit totals 1 m²)



Example no.3 – Example of sampling the area of walking paths during mine search with mine detection dogs

Daily MDD-searched area (boxes 10x10 m) is, for example, 3100 m².

Sample size code letters are determined by Table 1 (Appendix A) in the following manner:

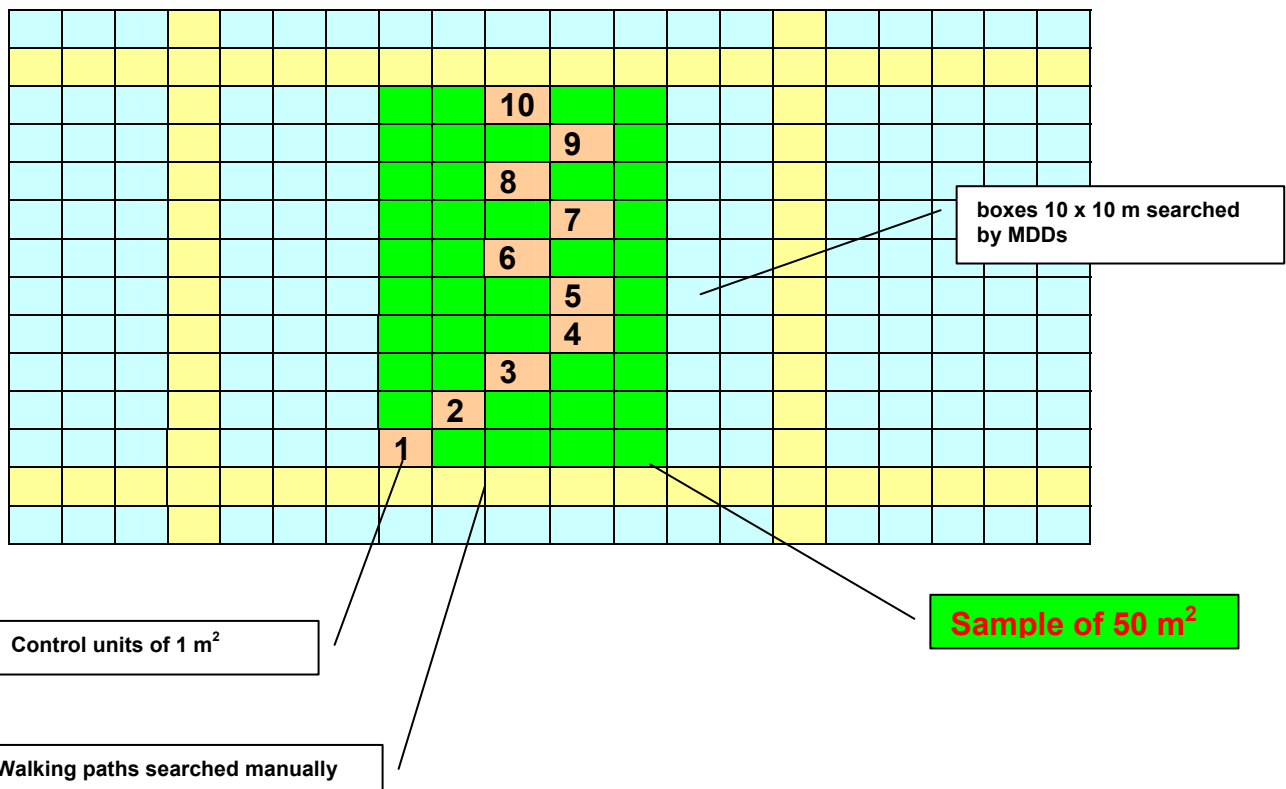
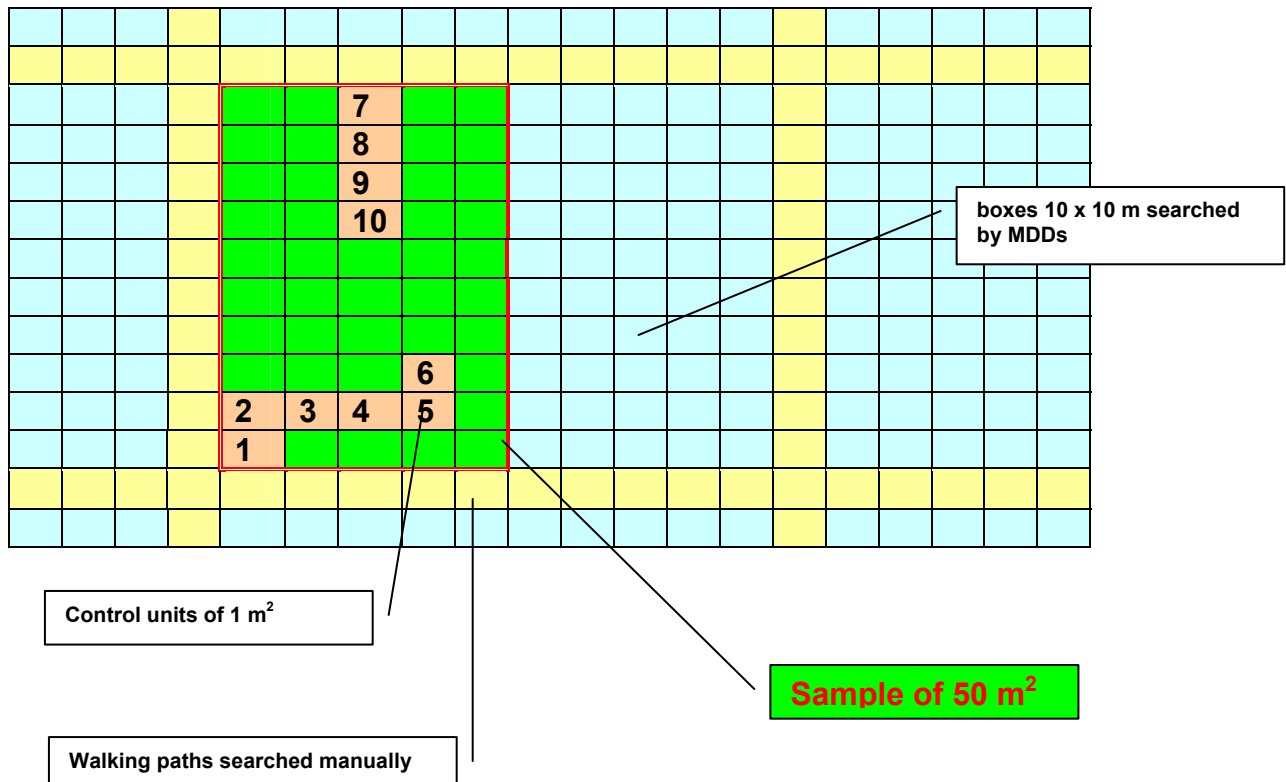
- daily lot size is under the ordinal number 3 (1201 to 3200 m²)
- sample size is 50 m² and number of control units i.e. m² in the sample is 10
- control units are patterned in a line over the area of boxes, in groups, so that a deminer starts his inspection from inspected walking path
- general level (II) is always selected for the commencement of inspection of the area searched by metal detector

Determination of Sample Number (Sample Size) and Acceptable Quality Level (AQL)

Upon defining the code letters in the Table 1, one-time sampling plan is selected. At the beginning of work one always proceeds from the one-time sampling plans for the normal inspection, Table 3-A (Appendix C1).

For the letter code «D» from the table 3-A for the normal inspection (see Appendix C) sample size is 5. That means, the QA Officer/Monitor chooses 5 samples of 50 m² in the lot (3120 m²) using the random sampling method.

In each of 5 samples (of 50 m²), QA Officer/Monitor has to inspect 10 control units i.e. 10 m² (one control unit totals 1 m²)



OEIVDPMD-1: Manual entry form

FORM FOR THE REGISTRATION OF MEASURED VALUES OF THE LENGTH L OR DIAMETER D OF DETECTED METAL FRAGMENTS OF MINES AND/OR UXO IN THE GROUND FOR EACH SINGLE SAMPLE

Date: _____ ; No. of samples according to plan: _____ ; No. of samples: _____

COMPANY	
PROJECT CODE	
PLACE	
COUNTY	
TIME OF SUPERVISION	FROM: _____ TO: _____
NAME AND TYPE OF DETECTOR	
DETECTOR NUMBER	
SIZE OF LOT TO BE CONTROLLED (m ²)	

MEASURED VALUES (L or D) OF DETECTED MINE AND/OR UXO METAL FRAGMENTS

No. of control unit	Metal mine and/or UXO fragments			Mines, UXO and their fragments
	Bigger than 10 cm	From 5 to 10 cm	From 3 to 5 cm	
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
Total:				

Supervision performed by: _____

Worksite leader: _____

APPENDIX A

Table 1- Sample Size Code Letters

No.	Lot size (m ²)	Sample area (m ²)	No. of depth measurements	General levels of inspection		
				I	II	III
1	200-500	50	10	A	B	C
2	501-1-200	50	10	B	C	D
3	1-201-3200	50	10	C	D	E
4	3 201-5 000	100	15	D	D	E
5	5 001-8 000	100	15	D	E	F
6	8 001-15 000	100	15	E	F	F
7	15 001-35 001	200	20	E	F	G
8	35 001-150 000	200	20	F	G	H
9	150 001 and over	200	20	G	H	J

APPENDIX B

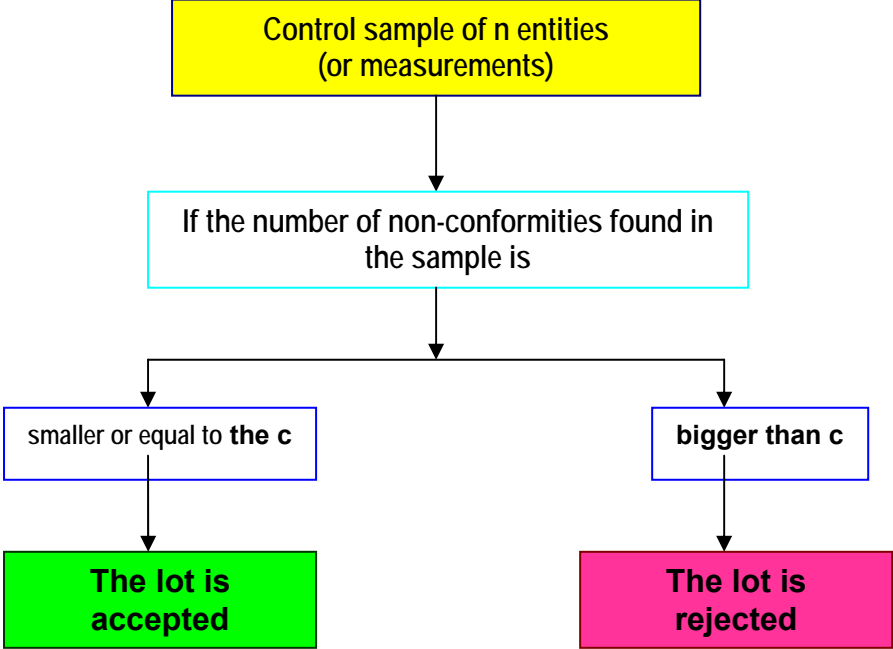


Figure 1: One-time sampling scheme

SUPPLEMENT C1 : Table 3-A - One-time sampling plans for normal inspection

Lot size code letters	Sample size	Acceptable Quality Level, AQL (normal inspection)																											
		0,01	0,015	0,025	0,04	0,065	0,1	0,15	0,25	0,4	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	Ac Re	
A	1	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	1 2	2 3	3 4	5 6	7 8	10 11	14 15							
B	2	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 1	↓	↓	↓	1 2	2 3	3 4	5 6	7 8	10 11	14 15	↑							
C	3	↓	↓	↓	↓	↓	↓	↓	↓	0 1	0 1	↑	↓	1 2	2 3	3 4	5 6	7 8	10 11	14 15	↑	↑							
D	5	↓	↓	↓	↓	↓	↓	0 1	0 1	↑	↓	1 2	2 3	3 4	5 6	7 8	10 11	14 15	↑	↑	↑	↑							
E	8	↓	↓	↓	↓	↓	0 1	↑	↑	↓	1 2	2 3	3 4	5 6	7 8	10 11	14 15	↑	↑	↑	↑	↑							
F	13	↓	↓	↓	↓	0 1	0 1	↑	↓	1 2	2 3	3 4	5 6	7 8	10 11	14 15	↑	↑	↑	↑	↑	↑	↑						
G	36	↓	↓	↓	↓	0 1	0 1	↑	↓	1 2	2 3	3 4	5 6	7 8	10 11	14 15	↑	↑	↑	↑	↑	↑	↑						
H	85	↓	↓	↓	0 1	↑	↑	↓	1 2	2 3	3 4	5 6	7 8	10 11	14 15	↑	↑	↑	↑	↑	↑	↑	↑	↑					
J	135	0 1	0 1	0 1	↑	↑	↑	1 2	2 3	3 4	5 6	7 8	10 11	14 15	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	

↓ = use the first sampling plan below the arrow



↑ = use the first sampling plan above the arrow

Ac = acceptance number

Re = rejection number

SUPPLEMENT C2: Table 3-C - One-time sampling plans for tightened inspection

Lot size code letters	Sample size	Acceptable Quality Level, AQL (tightened inspection)																											
		0,01	0,015	0,025	0,04	0,065	0,1	0,15	0,25	0,4	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	Ac Re	
A	1	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	1 2	2 3	3 4	5 6	8 9	12 13							
B	2	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	1 2	2 3	3 4	5 6	8 9	12 13							
C	3	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	1 2	2 3	3 4	5 6	8 9	12 13							
D	5	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	1 2	2 3	3 4	5 6	8 9	12 13							
E	8	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	1 2	2 3	3 4	5 6	8 9	12 13							
F	13	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	1 2	2 3	3 4	5 6	8 9	12 13							
G	36	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	1 2	2 3	3 4	5 6	8 9	12 13							
H	85	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	1 2	2 3	3 4	5 6	8 9	12 13							
J	135	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	1 2	2 3	3 4	5 6	8 9	12 13							

 = use the first sampling plan below the arrow
 = use the first sampling plan above the arrow
 Ac = acceptance number
 Re = rejection number

SUPPLEMENT C3: Table 3-C - One-time sampling plan for reduced inspection

Lot size code letters	Sample size	Acceptable Quality Level, AQL (reduced inspection)																											
		0,01	0,015	0,025	0,04	0,065	0,1	0,15	0,25	0,4	0,65	1,0	1,5	2,5	4,0	6,5	10	15	25	40	65	100	150	250	400	650	A		
		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	1	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	1 2	2 3	3 4	5 6	7 8	10 11	14 15							
B	1	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 2	1 3	2 4	3 5	5 6	7 8	10 11	14 15						
C	1	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 2	1 3	1 4	2 5	3 6	5 8	7 10	10 13	14 17					
D	3	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 2	1 3	1 4	2 5	3 6	5 8	7 10	10 13	14 17	↑				
E	5	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 2	1 3	1 4	2 5	3 6	5 8	7 10	10 13	14 17	↑	↑			
F	8	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 2	1 3	1 4	2 5	3 6	5 8	7 10	10 13	↑	↑	↑	↑		
G	13	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 2	1 3	1 4	2 5	3 6	5 8	7 10	10 13	↑	↑	↑	↑		
H	50	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 2	1 3	1 4	2 5	3 6	5 8	7 10	10 13	↑	↑	↑	↑		
J	80	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	0 2	1 3	1 4	2 5	3 6	5 8	7 10	10 13	↑	↑	↑	↑		

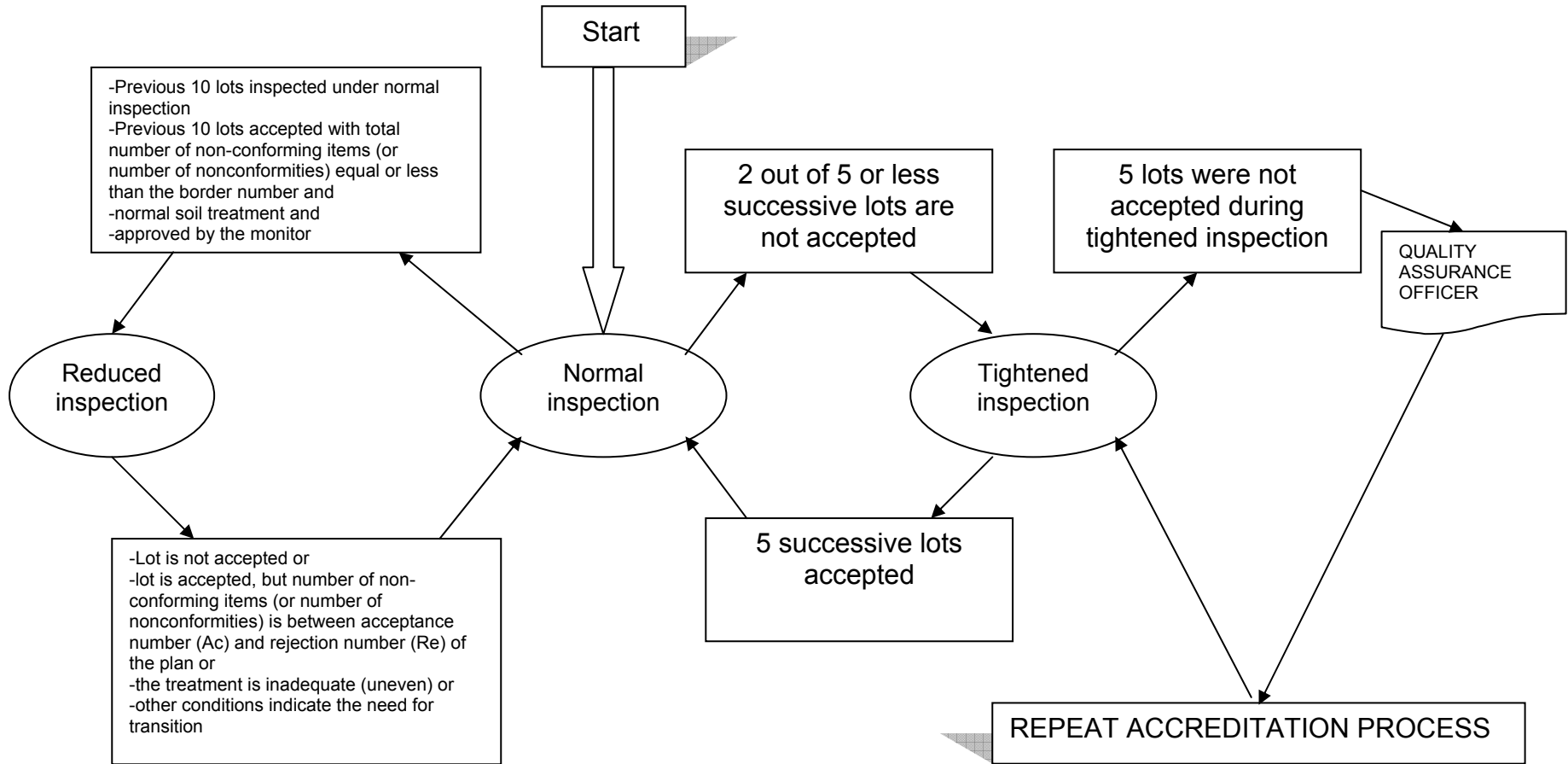
↓ = use the first sampling plan bellow the arrow

↑ = use the first sampling plan above the arrow

Ac = acceptance number

Re = rejection number

APPENDIX C4: Figure 1 - General outline of transition rule (Point 5.4.1)



APPENDIX D

Accessories and equipment used by the QA Officer/Monitor:

1. Metal detector
2. Measurement lath with slide rule –grade level
(for measurement of depth of detected mines, UXO and their fragments)
3. Ruler or measuring instrument
4. Standard tape measure (3 m)
5. Tape measure (up to 50m)
6. GPS
7. Maps

APPENDIX E: Examples

Example no. 1:

Specified:

Weekly manually demined surface area is 10 000 m².

Level of inspection – tightened (General inspection level III)

Solution:

- 1 It should be read off from the table 1 (Appendix A) that the code letter for the sample from 8001 to 15 000 m² and tightened level of inspection is E. It means, surface area size of one sample is 100 m² and a number of control items in the sample is 15.
- 2 It should be established from the table 3-B (Appendix C1) that the number of samples for the code letter F is 13. Monitor determines the positions of these 13 samples per 100 m² by random sampling method.
- 3 It means: sample size is 100 m², number of samples 13 and number of control items 15.
- 4 Control item size is 1 m². A total of 13x15 m² is controlled in the sample. 15 control items are selected in each of 13 samples according to combination in the Appendix F.

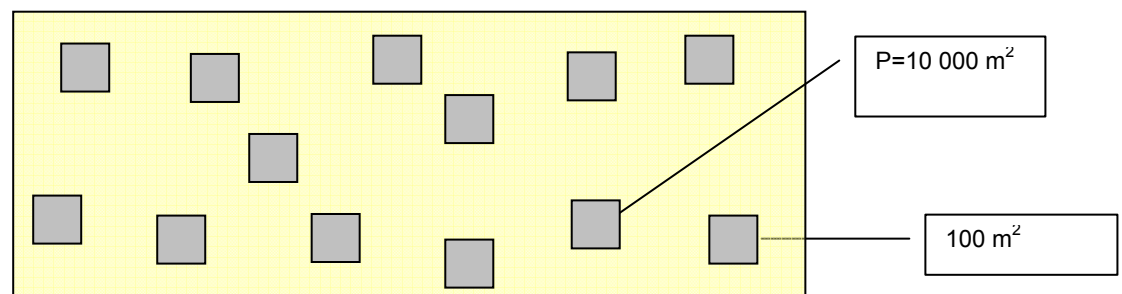


Figure 1 Scheme of surface area of 10 000 m² worked off and positions of 13 samples per 100 m²

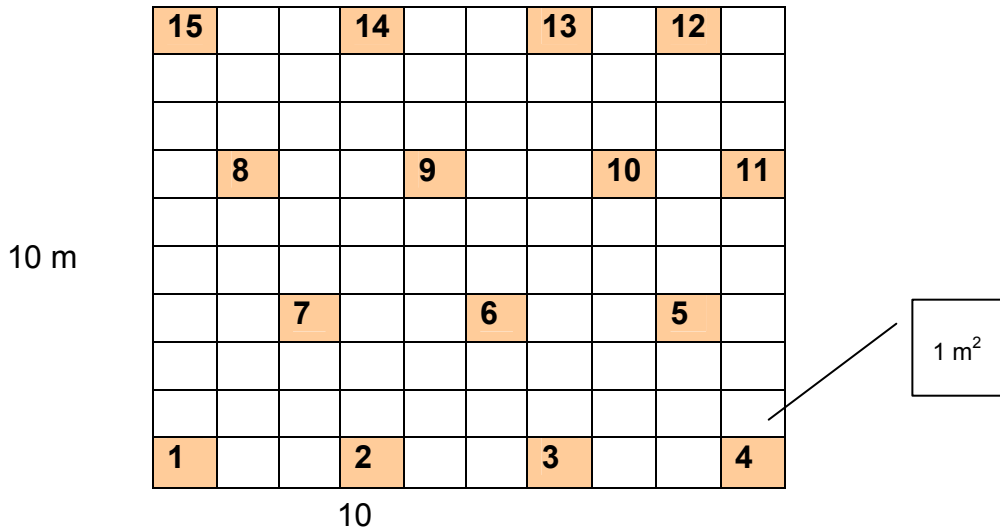


Figure 2 Combination scheme of D2 sample (of 100 m² size) with positions of 15 control items

Sample dimensions do not have to be 10x10 m. The ration between length and with could be different (for example, 20x5 m, 2x50 m etc.)

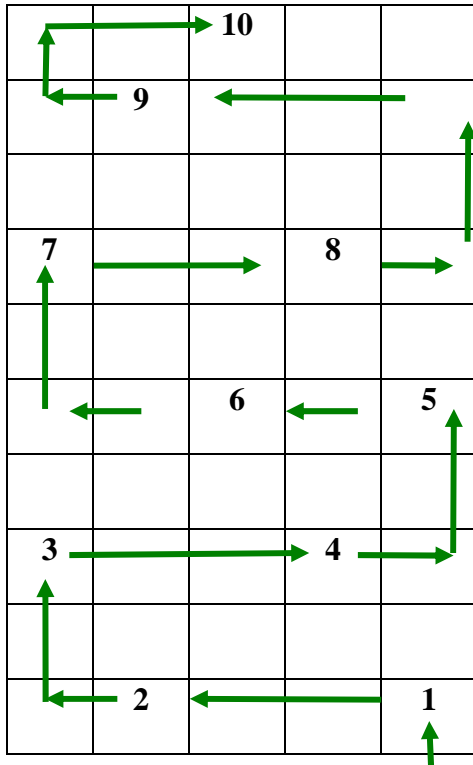
Detection measurement results:

- 1 Detection of mines, UXO and their fragments with explosive substance in any sample is considered to be **incorrectness**. The entirety (all 10 000 m²) is rejected and control suspended.
- 2 Detection of mine/UXO metal fragment of the length or diameter bigger than 10 cm in any sample is considered as **non-conformity** of the **class A** (Ac=0 Re=1). The entirety (all 10 000 m²) is rejected and control suspended. AQL is 0,4 (Table 3-B).
- 3 Detection of mine/UXO metal fragment of the length or diameter from 5 to 10 cm in any sample is considered to be **non-conformity** of the **class B** (AQL=1,5; Table 3-B, Ac=2, Re=3).Two metal fragments of the length or diameter from 5 to 10 cm is accepted but in case of detection of three (3) such fragments the entirety should be rejected (all 10 000 m²).
- 4 Detection of mine/UXO metal fragment of the length or diameter bigger than 3 to 5 cm in any sample is considered to be **non-conformity** of the **class C** (AQL=2,5; Table 3-B, Ac=3 Re=4). Three metal fragments of the length or diameter from 3 to 5 cm are accepted but in case of four the entirety is rejected (all 10 000 m²).

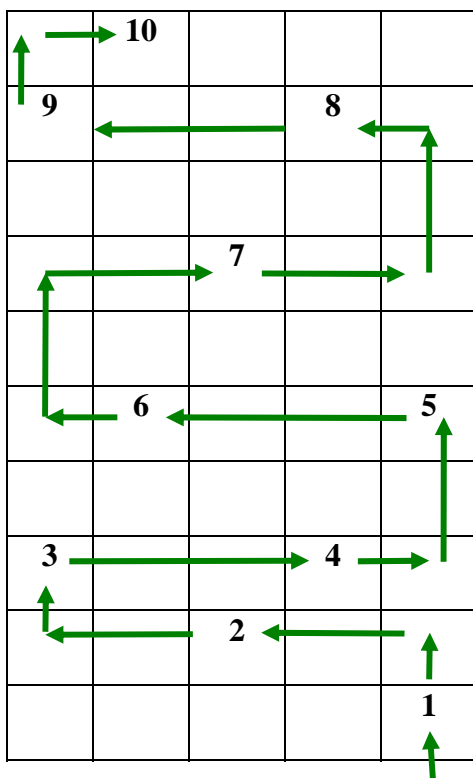
APPENDIX F

COMBINATIONS OF SAMPLES AND CONTROL ITEMS DURING QUALITY CONTROL ON SURFACE AREAS DEMINED BY MANUAL DETECTION

COMBINATION D1-1: Sample size 5x10 m; number of control items 10

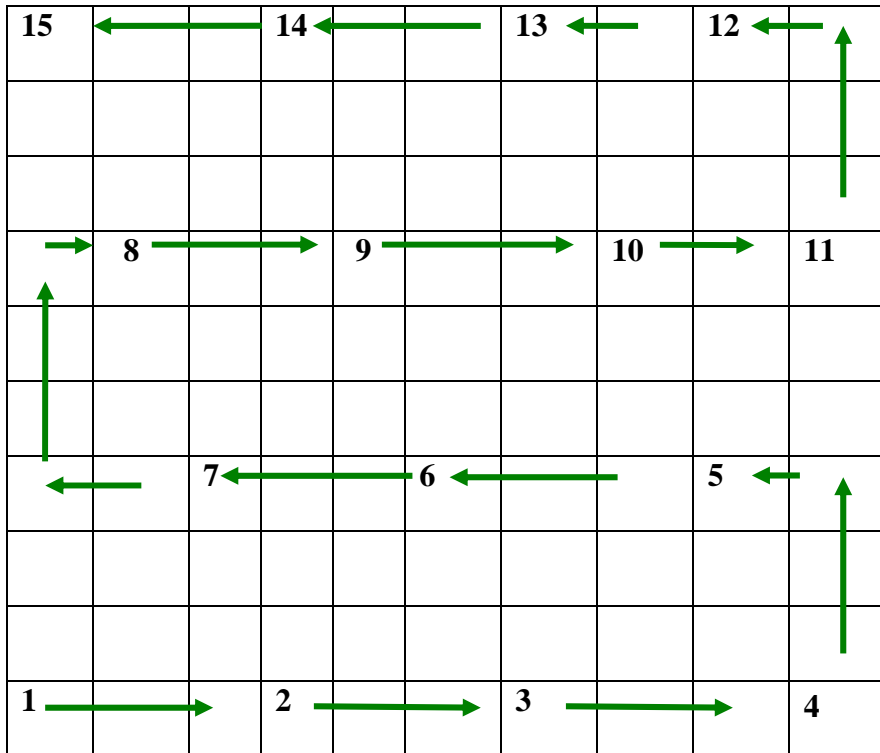


COMBINATION D1-2: Sample size 5x10 m; number of control items 10



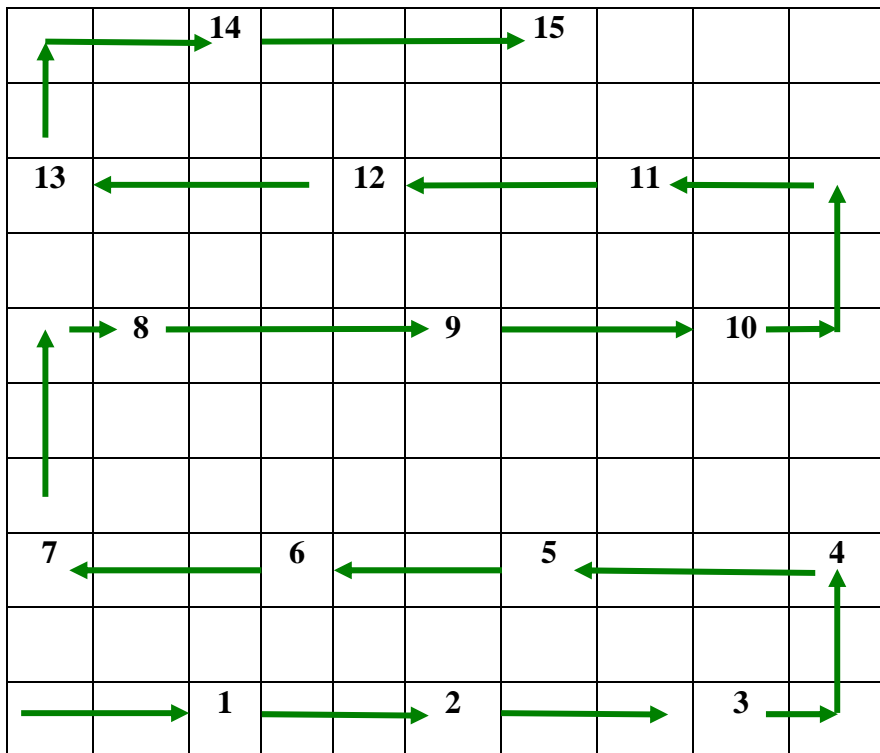
COMBINATION D2

Sample size: 10x10 m; number of control items 15



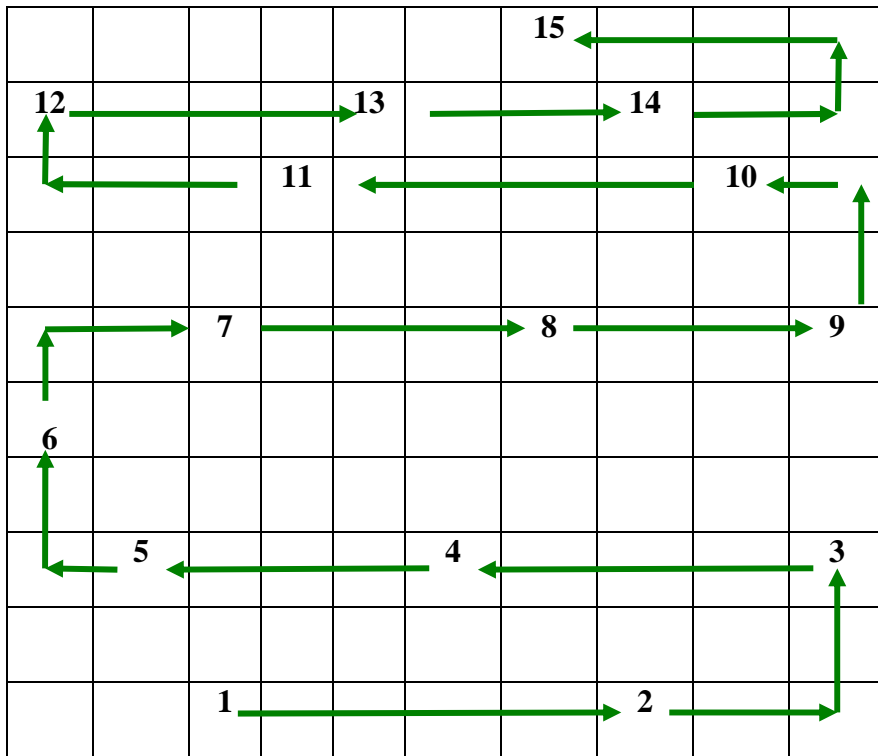
COMBINATION D2-1

Sample size: 10x10 m; number of control items 15



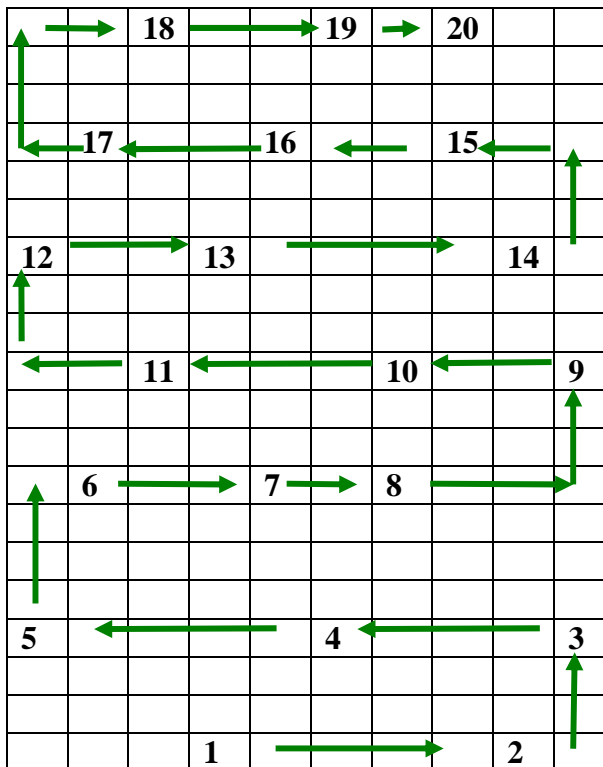
COMBINATION D2-2

Sample size: 10x10 m; number of control items 15



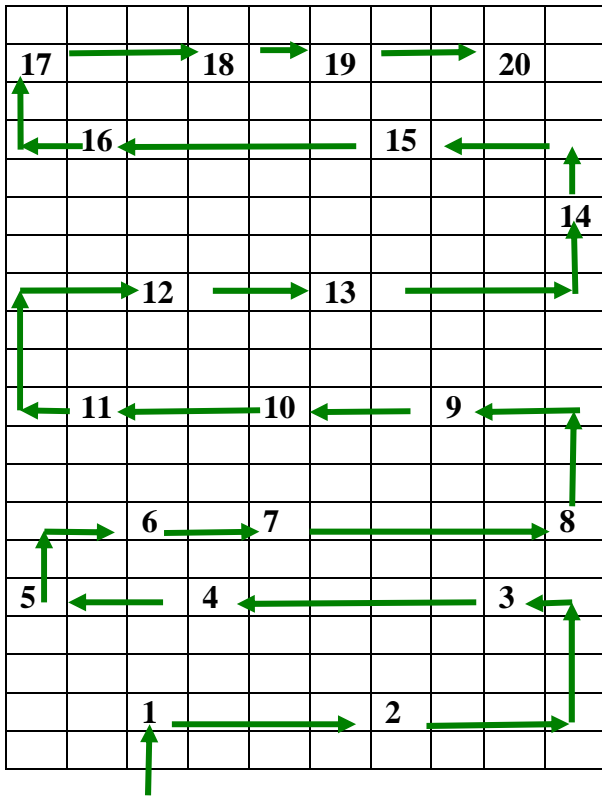
COMBINATION D3

Sample size: 10x20 m; number of control items 20



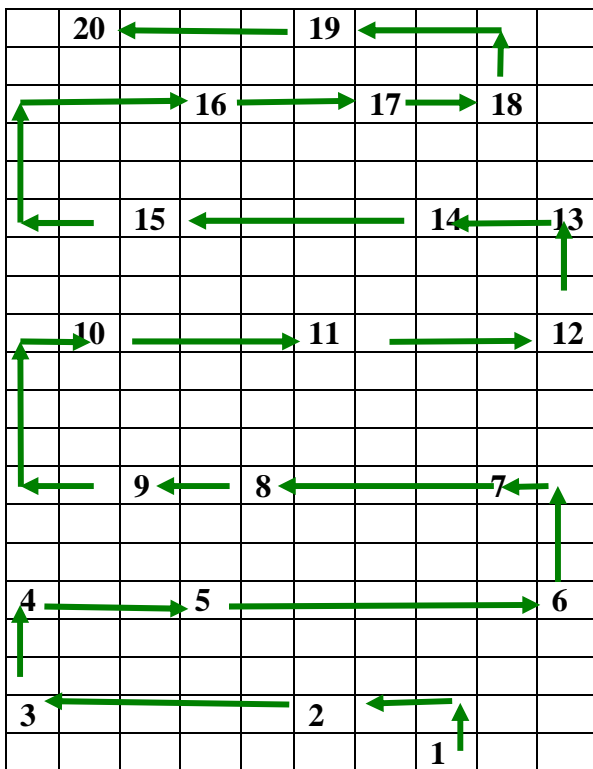
COMBINATION D3-1

Sample size: 10x20 m; number of control items 20

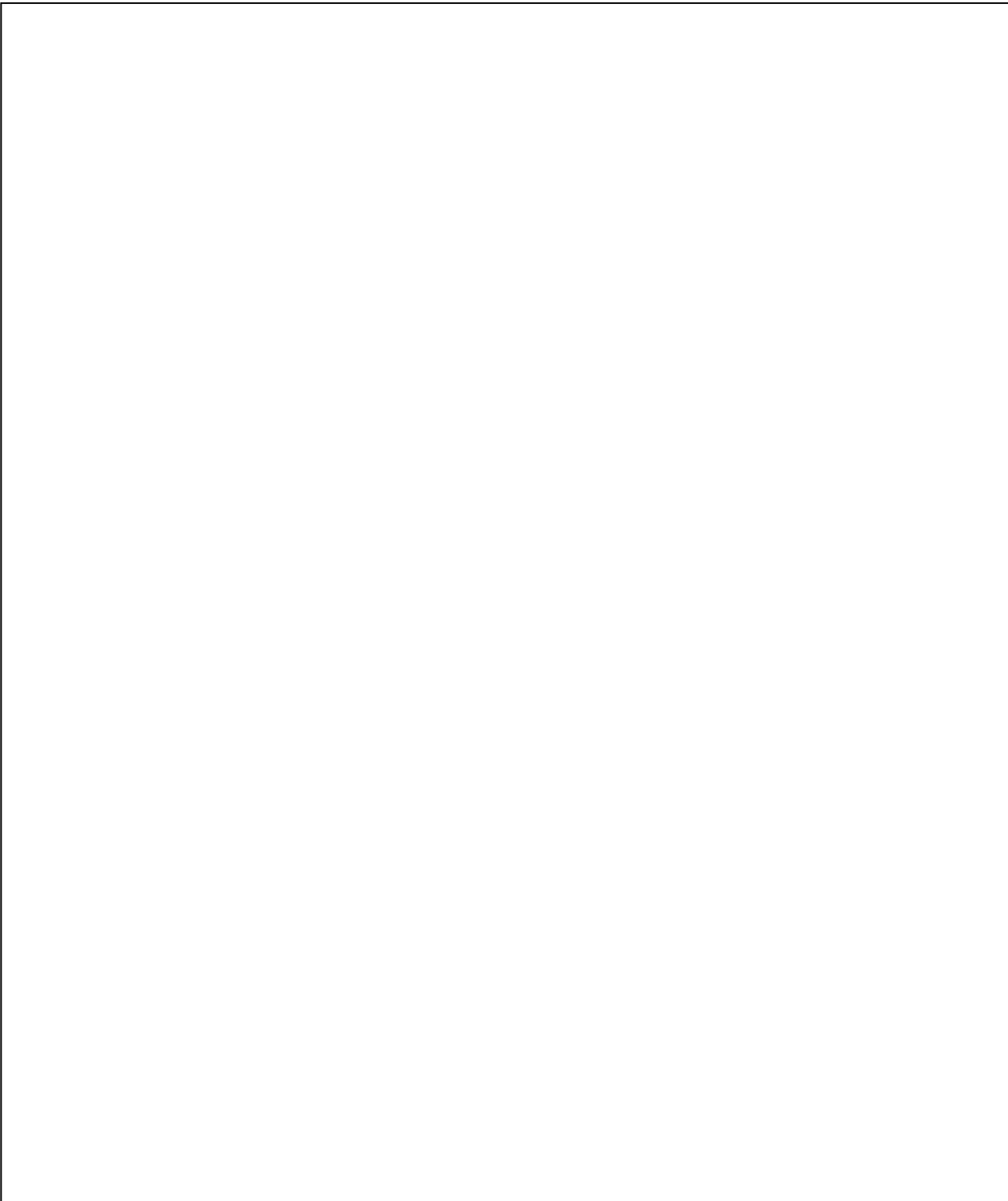


COMBINATION D3-2

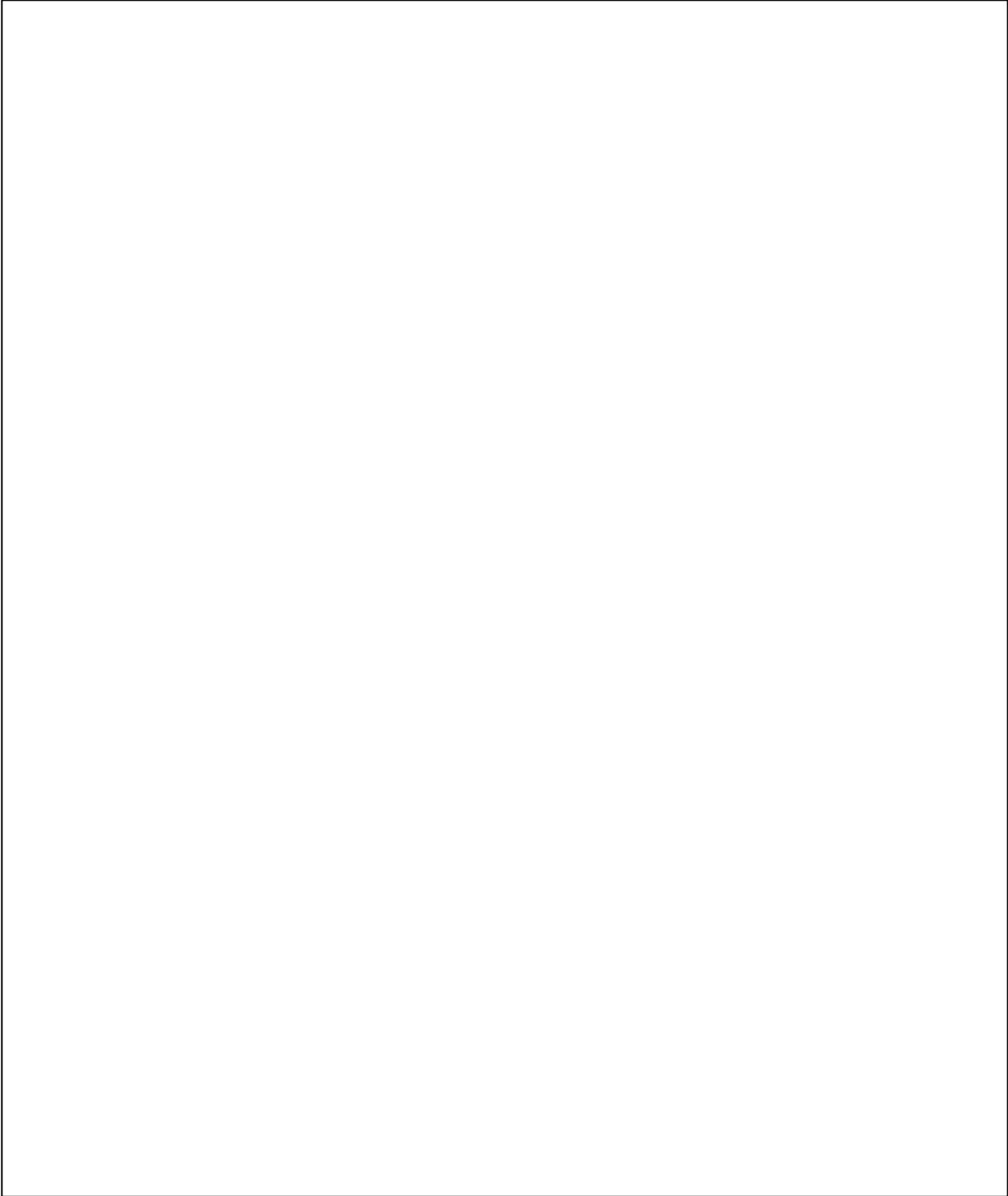
Sample size: 10x20 m; number of control items 20



Work site scheme with marked sample positions:



Work site scheme with marked sample positions:



II. QUALITY CONTROL OVER EXECUTED MINE SEARCH AND DEMINING OPERATIONS

II.a Quality Control over Executed Demining Operations

1 Total sample area:

Total control sample area makes at least 1% of totally demined area.

2 Repeated inspection of demined area:

Established:

2.1. Detection of mines and UXO

3 Defining the control samples of demined or searched area (P)

3.1 Minimum sample area (p_{min}) is 50 m²

3.2 Minimum number of samples (N) is calculated as per following formula:

$$N = (P \times 0,01) / p \quad p - \text{control sample area}$$

Example no.1:

$$P=120.000 \text{ m}^2$$

$$p=50 \text{ m}^2$$

$$N=(120.000 \times 0,01)/50$$

$$N=24$$

Example no.2:

$$P=240.000 \text{ m}^2$$

$$p=100 \text{ m}^2$$

$$N=(240.000 \times 0,01)/100$$

$$N=24$$

If the number of samples is a decimal number (for example: 2,9; 7,8; 10,1; 10,5) it is rounded off to a bigger (whole) number (2; 8; 10; 11 i.e. for decimals from 1 to 5 (5 not included) the number should be rounded off to the stated bigger (whole) number, and for the decimals from 5 to 9 (including all of them) should be rounded off to a bigger (whole) number).

4 Defining maximum control sample area according to the intended use of the land upon demining

$p_{max}=50 \text{ m}^2$ For kindergartens, schools, hospitals, houses, yards, paths, roads

$p_{max}=100 \text{ m}^2$ For agricultural and forest surface areas and industrial zones

$p_{max}=150 \text{ m}^2$ For gas pipelines, oil pipelines, water supply systems, power transmission lines etc.

5 Control sample locations

They are selected according to following criteria:

- a) Over 70% of control sample area needs to cover locations of minefields and minefield records, places where mines and UXO were detected and other suspected areas (border minefield areas, road crossings, etc.)
- b) 30% of control sample area can be selected using random sampling method.

6 The smallest number of control samples

The smallest number of control samples is 2.

At least one of the samples should be selected by CROMAC deminer who will perform the sample inspection. Other samples are selected by CROMAC QA Officer.

II.b Quality Control over Executed Mine Search Operations

1 Total sample area:

Total control sample area makes at least 1% of totally searched area.

2 Repeated inspection of searched area:

2.1 Detection of mines and UXO:

- a) Detected mines and UXO on the paths searched by manual method
 - the company has to demine the entire projected area
- b) Detected mines and UXO on the area searched by manual method is observable on the area:
 - QA Officer will order demining of projected area

3 Defining the control samples of demined or searched area (P)

3.1 Minimum sample surface area (p_{min}) is 100 m²

3.2 Minimum sample number is calculated as per following formula:

$$N = (P \times 0,01) / p \quad \text{p-control sample area}$$

Example no.1:

$$P = 120.000 \text{ m}^2$$

$$p = 100 \text{ m}^2$$

$$N = (120.000 \times 0,01) / 100$$

$$N = 12$$

Example no.2:

$P = 240.000 \text{ m}^2$

$p = 300 \text{ m}^2$

$N = (240.000 \times 0,01) / 300$

$N = 8$

If the number of samples is a decimal number (for example: 2,9; 7,8; 10,1; 10,5) it is rounded off to a bigger (whole) number (2; 8; 10; 11 i.e. for decimals from 1 to 5 (5 not included) the number should be rounded off to the stated bigger (whole) number, and for the decimals from 5 to 9 (including all of them) should be rounded off to a bigger (whole) number).

4 Defining the maximum control sample area according to the intended use of the land area

$p_{\max} = 100 \text{ m}^2$	For kindergartens, schools, hospitals, houses, yards, lanes, roads
$p_{\max} = 200 \text{ m}^2$	For agricultural and forest surface areas and industrial zones
$p_{\max} = 300 \text{ m}^2$	For gas pipelines, oil pipelines, water supply systems, power transmission lines etc.

6 Control sample locations

Samples are located by random sampling method.

7 The smallest number of control samples

The smallest number of control samples is 2.

At least one of the samples should be selected by CROMAC deminer who will perform the sample inspection. Other samples are selected by CROMAC QA Officer.

The company will be submitted the Report on Handover of Cleared Area upon removal of all the means used for marking the worksite (except the final marking).