

Biol/Chem 4900/4912

Forensic Internship

Lecture 6

Quality Assurance/Quality Control Sampling

Sampling is defined as

“A defined procedure where a part of a substance, material, or product is taken to provide for testing or calibration to give a representative sample of the whole” ISO/IEC 17025.

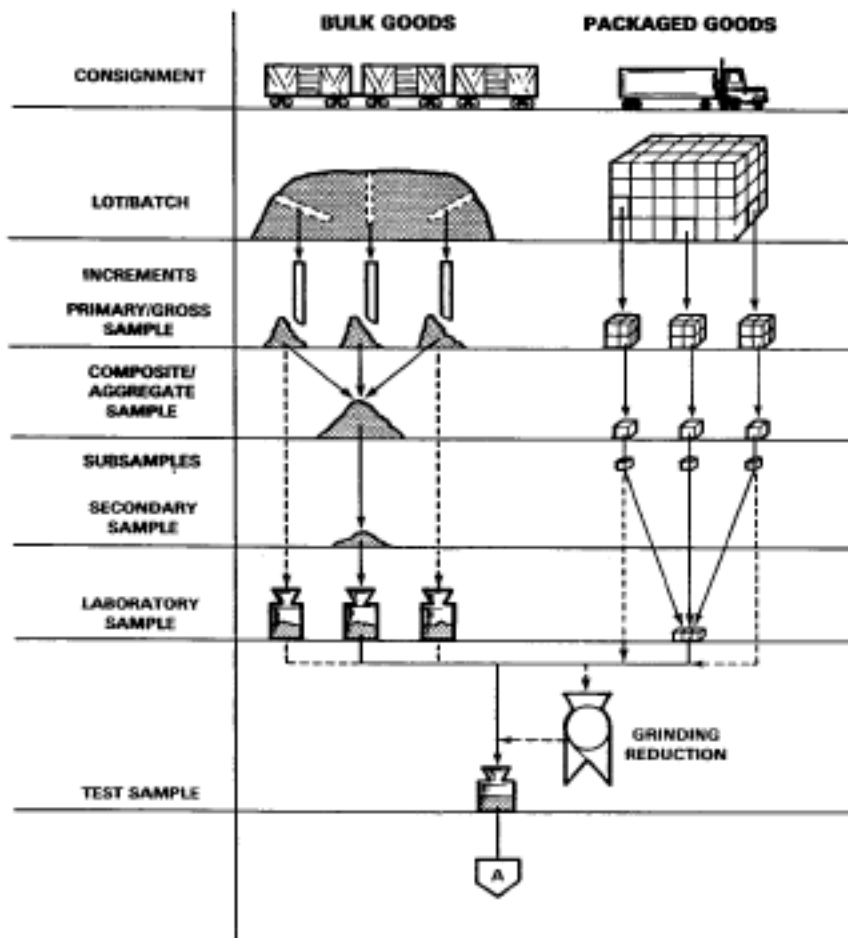
Why do we care about sampling?

QA/QC Sampling

Why do we care about sampling?

- ▶ While analytical results *sometimes* depend on the method used for analysis, they *always* depend on the type of *sampling plan*.
- ▶ Sampling uncertainty is greater than two thirds of the total uncertainty. (part of user error)
- ▶ Sampling uncertainty cannot be evaluated or controlled using standard or reference materials.
- ▶ The sample may not represent the whole.

SAMPLING OPERATIONS



ANALYTICAL OPERATIONS (NO SAMPLING ERRORS)

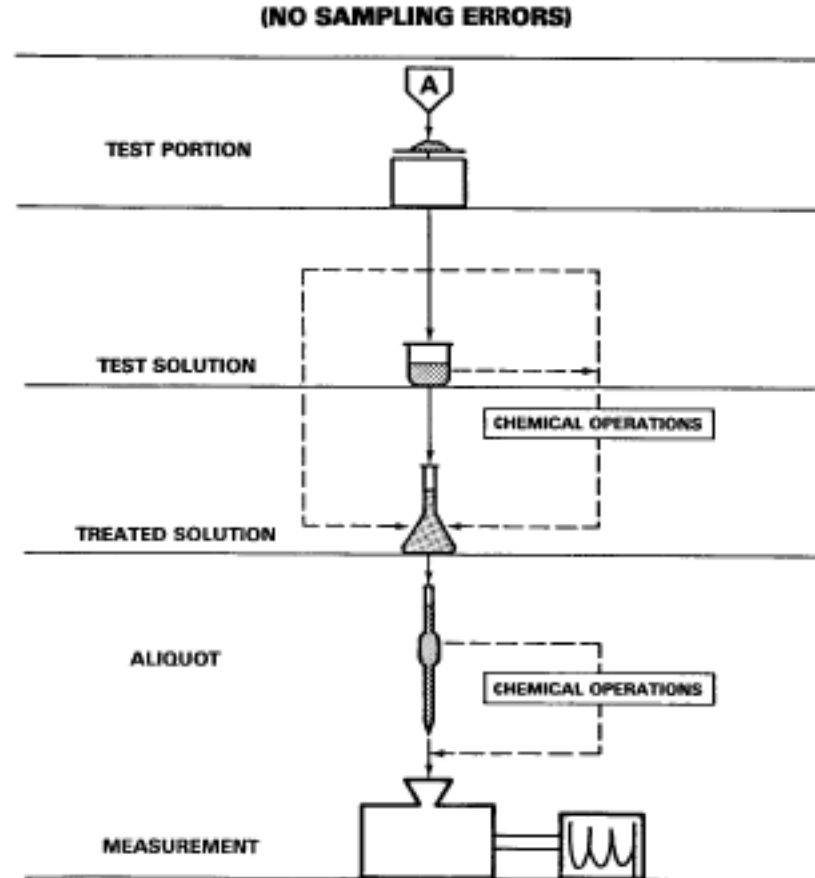


Figure 1. The relationships of the operations involved in sampling and analysis. The lower "A" of the sampling operations continues with the upper "A" of the analytical operations.

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Types of Samples

There are four types of samples:

- ▶ **Representative**
- ▶ **Selective**
- ▶ **Random**
- ▶ **Composite**

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Representative Samples

Sample that is typical of the parent material under inspection. The parent material can be one of four types:

- ▶ Homogeneous - i.e. a stirred aqueous solution
- ▶ Heterogeneous - i.e. mine tailings
- ▶ Static (contained) system - composition of parent material is permanent - i.e. oil in a drum
- ▶ Dynamic system - parent material is changing with time - i.e. wetlands

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Selective Samples

A sample from a sampling plan that deliberately screens out materials or selects certain characteristics.

Give an example of a selective sample?

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Selective Samples

A sample from a sampling plan that deliberately screens out materials or selects certain characteristics.

Give an example of a selective sample?

- i.e. sampling air (gases) above a heated pool

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Random Samples

Sample selected at random to minimize bias, three different types of random sampling:

- ▶ Simple - any sample has an equal chance of selection
- ▶ Stratified - the lot is subdivided and sample selected
- ▶ Systematic - first sample is selected at random and then next samples are sampled at intervals - i.e. 5th, 10th, etc... or 5 min, 10 min, etc...

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Composite Samples

Two or more portions of materials collected at the same time and combined into some ratio.

- i.e. take a sample off a flow line every hour and batch 6 hours together and then take a sample from that to analyze.

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Choose the most appropriate type of sample (representative, selective, random, or composite) for the following parent materials.

1. River water after a recent thaw. An estimate of the average concentration of compounds dissolved in the water is required.
2. Cans of baked beans in a warehouse.
3. Bars of chocolate suspected of being tampered with.
4. Sacks of flour stored near a hydrocarbon source in a ship's hold.
5. Bags of flour in a storeroom, % moisture required.

QA/QC Sampling

Choose the most appropriate type of sample (representative, selective, random, or composite) for the following parent materials.

- 1. River water after a recent thaw. An estimate of the average concentration of compounds dissolved in the water is required.**

Representative - water could be homogeneous or heterogeneous mixture depending on purity.

QA/QC Sampling

Choose the most appropriate type of sample (representative, selective, random, or composite) for the following parent materials.

2. Cans of baked beans in a warehouse.

Random sample - choose a random sampling plan so each can has an equal chance of being selected.

QA/QC Sampling

Choose the most appropriate type of sample (representative, selective, random, or composite) for the following parent materials.

3. Bars of chocolate suspected of being tampered with.

Selective sample - need to identify the contaminate, so need to sample as close to point of contamination as possible with little dilution.

QA/QC Sampling

Choose the most appropriate type of sample (representative, selective, random, or composite) for the following parent materials.

4. Sacks of flour stored near a hydrocarbon source in a ship's hold.

Selective sample - sacks closest to hydrocarbon source should be sampled first.

QA/QC Sampling

Choose the most appropriate type of sample (representative, selective, random, or composite) for the following parent materials.

5. Bags of flour in a storeroom, % moisture required.

Representative sample - any bag selected at random should be representative of the parent material if humidity is evenly distributed.

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Sampling plan

A predetermined procedure for the selection, withdrawal, preservation, transportation, and preparation of the portions to be removed from a population as samples.

Sampling plan includes:

- ▶ Number, location, and size of the samples
- ▶ Instructions for altering, processing or reducing samples
- ▶ How many samples must be run
- ▶ Which method or instrumentation to use
- ▶ How to report results

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Sampling tables may be published by accrediting agencies or developed in house by companies.

- ▶ For example, ISO (International Organization for Standardization) is an independent, non-governmental international organization with a membership of 162 national standards bodies and develops procedures and tables for companies and organizations around the world.

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- ▶ **Inspection level - determined by the responsible party. Levels I, II, and III are possible levels, with level III the highest inspection level.**
- ▶ **AQL - Acceptable Quality Limit**

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Table I — Sample size code letters (see 10.1 and 10.2)

Lot or batch size	Special inspection levels				General inspection levels		
	S-1	S-2	S-3	S-4	I	II	III
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

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Table II-A – Single sampling plans for normal inspection (Master table) (see 10.3 and 10.4)

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	1 000
		Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re
A	2	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
B	3	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
C	5	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
D	8	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
E	13	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
F	20	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
G	32	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
H	50	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
J	80	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
K	125	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
L	200	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
M	315	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
N	500	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
P	800	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
Q	1 250	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
R	2 000	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑

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

↑ = Use first sampling plan above arrow.

Ac = Acceptance number

Re = Rejection number

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Example:

A sampling plan is required for the purpose of inspecting the quality of bags of frozen peas. A bag of peas is considered unsatisfactory if it contains more than 10 wt% defective peas. The bags of peas are produced in lots consisting of 3000 bags of peas. Level II inspection is required, the inspection type is normal and the AQL has been set at 6.5%. Use the tables to determine:

1. The number of samples required (# of bags of peas selected for testing)
2. The maximum number of sampled bags that can be nonconforming if the lot is to be accepted

QA/QC Sampling

Example:

1. The number of samples required (# of bags of peas selected for testing)

For a lot size of 3000 and level II inspection, the sample size code letter is K. K equals a sample size of 125. Need to choose 125 bags of peas at random.

2. The maximum number of sampled bags that can be nonconforming if the lot is to be accepted

For an AQL of 6.5, the acceptance number is 14. So as long as no more than 14 bags of peas from the 125 are >10 wt% defective, then the lot is accepted.

Assignment

- ▶ Review Statistics
- ▶ Homework 6
- ▶ Homework 7: Take the 5 examples of sampling from the lecture and pick 2 of them to develop a full 1-2 page sampling plan for each.
- ▶ Read: QA/QC topic Ch. 3, 4, & 6 of Prichard