Canadian Food Inspection Agency
Agence canadienne d'inspection des aliments

CANDIDATE'S GUIDE

TO

SEED ANALYST ACCREDITATION

Saskatoon Laboratory, Seed Science and Technology Section
Canadian Food Inspection Agency

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Canada

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Canadian Seed Institute;
Commercial Seed Analyst Association of Canada;
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CANDIDATES GUIDE TO SEED ANALYST ACCREDITATION

Introduction

The Canadian Food Inspection Agency (CFIA) accredits seed analysts as a part of the CFIA accreditation program for seed testing. The accreditation programs of seed analyst and seed laboratory together ensure the seed test is conducted as an accredited test on behalf of the CFIA. The accredited testing results are used for grading seed lots to be sold in Canada, and for releasing imported seed lots. The primary purpose of the Seed Analyst Accreditation Program is to verify that an accredited analyst has the technical knowledge, practical experience, and ability to conduct purity, germination, and true loose smut disease tests according to the *Canadian Methods and Procedures for Testing Seed*.

Having an accredited seed analyst on staff is a requirement for an accredited seed testing laboratory under the CFIA Seed Laboratory Audit and Accreditation Protocol (Seed LAAP). In addition, an accredited seed analyst is eligible to apply for the membership and the use of the seal of the Commercial Seed Analysts Association of Canada (CSAAC).

1. Purpose of this guide

The purpose of this guide is to inform prospective candidates of:

1) Scope of accreditation for Accredited Seed Analysts.
2) The core skills and knowledge requirements for Accredited Seed Analysts.
3) Requirements for eligibility of candidate to apply to write the accreditation examinations.
4) The general structure of the seed analyst accreditation exams.

Although the guide is <u>not</u> intended as a study guide, the core skills and required knowledge, the relative weights and an overview of the exam structure should aid the candidate to fulfill the requirements and to prepare for the accreditation exam.

2. Scope of seed analyst accreditation

Analysts can be accredited fully or partially in germination and/or purity and/or true loose smut (see 2.7) and write examinations for purity and/or germination of the crop kinds in one or more of the following groups or for true loose smut. The groups have been given general headings, even though some of the kinds within the group do not technically fit the name of that group (e.g. flax is not a cereal). The exams and analyst accreditation cover all the kinds listed in the group.

2.1 CEREALS*

Wheat, common and durum (Grade Table I)
Barley, buckwheat, emmer, oats, rye, spelt, triticale (Grade Table II)
Canarygrass, flax, hemp, sorghum, sorghum Sudan grass hybrids, Sudan grass (Grade Table IV)
Corn, sunflower, safflower (Grade Table V and VI)

2.2 PULSES*

Bean, (mung), lentil, lupine, lupin (grain and forage) (Grade Table II)
Sainfoin, vetch (hairy, Hungarian, common), (Grade Table II.1)
Bean (*Phaseolus vulgaris, Vicia faba*), chickpea, cowpea, pea, soybean (Grade Table V)

*Note: CEREAL MIXTURES (Grade Table III)
Prerequisite accreditation for Cereals and Pulses

2.3 CANOLA AND MUSTARDS

Brassicas, *Sinapis alba*, and Radish (oilseed and forage) (Grade Table VII)

2.4 FORAGE LEGUMES, MILLETS AND TIMOTHY**

Alfalfa, clovers, sweet clover, crown vetch, kidney vetch, cicer milkvetch, birds-foot's trefoil, black medick, timothy, millets (Grade Tables VIII to X)

2.5 GRASSES **

Bromegrass, reed canarygrass, fescues, tall oatgrass, orchardgrass, foxtails, wild-rye, ryegrass, wheatgrasses, Grade Table (XI)
Alkaligrass, bentgrasses, bluegrasses, crested dogtail (Grade Table XII)

** Note: MIXTURES
Forage mixtures, lawn mixtures, and ground cover mixtures (Grade Tables XIII to XV), prerequisite accreditation for forage legumes, millets and timothy and grasses

2.6 VEGETABLES

Beet, mangel, Swiss chard (Grade Table XVI);
Cucurbits (Grade Table XVII);
Corn, bean, pea, chickpea, soybean, sunflower, safflower (Grade Table XVIII);
Brassicas, radish (Grade Table XIX);
Other vegetables and herbs (Grade Table XX).

2.7 TRUE LOOSE SMUT

Barley

3. Core skills and knowledge for accredited seed analysts

3.1 Background Information:

In February 1991, a task force was established by Agriculture Canada (now CFIA), to conduct a review of the Seed Testing Program. The terms of reference were to review the Training and Accreditation of Analysts and Graders. This was carried out by a committee made up of representatives from Commercial Seed Analysts Association of Canada (CSAAC), Canadian Seed Trade Association (CSTA), Canadian Seed Growers' Association (CSGA), SeCan Association and Agriculture Canada.

The committee's objective was to clarify the training, skill achievement and evaluation standards required and to develop a consensus amongst all the stake holders. These standards were intended to be used as the basis for a uniform approach in the training and accreditation of Seed Analyst and Graders.

These specific issues were addressed;

a. Identification of the Core (basic) skills required by the seed analyst
b. Define clearly the accreditation requirements of the analysts
c. Identify the criteria to evaluate the competence of analysts
d. Recommend how training can be delivered
e. Recommend appropriate monitoring and skills maintenance to follow
f. Recommend basic elements for a training curriculum

After a series of consultations with Industry, the CSAAC and Agriculture Canada, a report was presented to a review steering committee made up of representative of Agriculture Canada, CSTA, CSGA and SeCan, who accepted and then recommended that all the recommendations be implemented.

The skills and knowledge inventory (Section 3.2) is one of the recommendations implemented as the guideline to be followed in training seed analysts and preparation for accreditation. This is now included as part of the *Candidate's Guide to Seed Analyst Accreditation*. The skills and knowledge inventory (Section 3.2) was updated in the revision of 2012.

3.2 Core skills and knowledge for accredited seed analysts

The Accredited Seed Analyst must be able to demonstrate knowledge and competence in the following:

A - SEEDS ACT AND REGULATIONS, METHODS AND PROCEDURES

a 1 Purpose and Application of Seed Regulations
State purpose and apply the Seeds Act and Regulations which includes all schedules and orders with respect to testing, inspection, quality and sale of seed.

a 2 Canadian Methods and Procedures for Testing Seed (M&P)

a. Define the purpose of the Canadian Methods and Procedures for Testing Seed.

b. Good working knowledge of the methods and procedures.

a 3 Verify Submitted Samples
Check the sample submitted for the accuracy of the submitted sample information, e.g. crop certificate number, lot number, variety names. In addition, sample size, labelling, packaging and sealing may also be a factor. (Including treated seed).

a 4 Use Grade Tables for Test Determination
Determine the pedigreed status; locate Grade Table and standards for all grading factors.

a 5 Apply *Weed Seeds Order* and *Seeds Regulations*, *Schedule I*
Classify seeds according to the *Weed Seeds Order* and *Schedule I* and report accordingly.

a 6 Seed Industry Agencies
Must have a general knowledge and understanding regarding roles and responsibilities of Agencies involved with the Seed Industry.

e.g. CSGA, CFIA, CSI
CSTA, CSAAC, ISTA
AOSA, ASTA, OECD
Registered Seed Establishments (RSE), Seed Graders
AOSCA Standards

B - TESTING PROCEDURES AND METHODS

b 1 Determine Test Type
Decide, by using the information accompanying the submitted seed sample which type of test(s) is required in order to provide analytical data for the assignment of a grade name and/or to comply with the sender's request.

b 2 Recognize (Verify) Seed Under Analysis

Demonstrate the ability to verify the identity of bulk sample as stated on sample documents.

b 3 Determine Appropriate Sample Mixing and Dividing Method

Decide which of the mixing/dividing methods is suitable for mixing and dividing the submitted sample (mechanical mixer/divider or the hand mixing method) to ensure that all sub-samples obtained are representative of the submitted sample.

b 4 Mix and Divide Submitted Sample

Mix and divide the submitted sample to obtain the required working sample portions for purity and/or germination tests and/or True Loose Smut following the prescribed procedure for the devices.

b 5 Knowledge and Application of Sequential and Full Analysis For Purity

a. Application of the sequential analysis of the working sample portions as prescribed under the M&P.

b. Application of the principles of full analysis as described under the M&P.

b 6 Conduct Pure Seed Determination

a. Determine the percentage pure seed by visual inspection (with or without visual aids) and/or by using the uniform blowing procedure by applying the pure seed definitions.

b. Calculate the percentage of each component in the sample (e.g. % PS, OW, OC, Inert).

b 7 Seed Mixtures Component/Ingredient Separation

Separate each ingredient from the appropriate working sample and quantify the individual components.

b 8 Identify and Classify Contaminants

a. Recognize by common and scientific name, crop and weed seeds, using appropriate reference material and herbarium specimens; classify crop seeds as per *Seeds Regulations*, Schedule I and the weed seeds according to the *Weeds Seeds Order*.

b. For exam purposes, the analyst must be able to identify the following:
   - All species and disease bodies included in the *Minimum List of Species for Seed Identification by Canadian Accredited Seed Analysts and Laboratories*. It is required to know the common name, and/or the scientific name to the species level, e.g. "wild mustard – *Sinapis arvensis*" except as defined in the Note below.
   - Structures which are not seeds but which may be found in seed samples and mistaken for seeds, e.g. ergot, stone cells.

Note:
The requirement for the identification of Crop Seeds depends on the scope of accreditation being sought, as follows:

1) Identify seeds in the crop group(s) covered by the accreditation, to the species level. For example, if accreditation is to include the forage legume group, the analyst must be able to identify white clover as "white clover – *Trifolium repens*"; and

2) Identify seeds in the crop group(s) not covered by the accreditation to the major kind and genus level. For example, if accreditation is not to include the forage legumes, the analyst must be able to identify white clover as "clover – *Trifolium sp.*"

It is not necessary to be able to identify, to any level, kinds included in Grade Tables XVI through XX for vegetables, unless accreditation is to cover vegetables. If accreditation is to cover vegetables, requirement 1) applies.

b 9 Determine % by Weight and/or Number per Unit Weight of Contaminants

Determine the rate of incidence of contaminants in the sample as a percentage by weight and/or number per unit weight.

b 10 Seed Blower

a. Demonstrate knowledge of the procedures for calibrating seed blowers.

b. Application of the Uniform Blowing Method for those kinds requiring blowing.

b 11 Schedule Germination Test

Establish appropriate methodology and scheduling for kind of seed under test.

b 12 Selection and Preparation of Germination Test Media

a. Select the appropriate test media for the species under analysis.

b. Plant seeds to meet the requirements of the appropriate methods and procedure for testing.

b 13 Select Pure Seed for Planting

a. Demonstrate the ability to apply pure seed definitions and to select pure seed for planting.

b. Plant seeds to meet the requirements of the appropriate rules for testing.

b 14 Evaluate Germination Tests

Evaluate seeds and seedlings as normal, abnormal, hard, fresh seeds and dead by following appropriate seedling descriptions, and related memorandum and/or references (e.g. AOSA Rules for Testing Seeds, Volume 4: Seedling Evaluation).

b 15 True Loose Smut

a. Select appropriate seeds for evaluation.

b. Prepare chemicals required meeting the requirements of the methods and procedure for testing.

c. Extract and clear the embryos.

d. Evaluate the embryos identifying those that contain the mycelium of *Ustilago nuda* meeting the requirements of the appropriate methods and procedure for testing.

b 16 Calculation and Recording/Reporting Purity Analysis Results

Report all impurities, the determination of percentage test(s) as required and any other observation(s) made during the sample analysis (tests) in the appropriate space on the worksheet/report of analysis by following the appropriate purity reporting procedures stated in the M&P.

b 17 Calculation and Recording/Reporting Germination Results

Calculate and record/report germination results as required by M&P and any other observation(s) made during the germination evaluation in the appropriate spaces on the worksheet/report of analysis by following the appropriate germination reporting procedures stated in the M&P.

b 18 Calculation and Recording/Reporting True Loose Smut Results

Calculate and record/report true loose smut results as required by M&P and any other observation(s) made during the test in the appropriate spaces on the worksheet/report of analysis by following the appropriate true loose smut reporting procedures stated in the M&P.

b 19 Apply Tolerances

Consulting the appropriate Grade Table:

a. Using the keys in M&P, apply the appropriate purity checking limits and tolerances.

b. Apply the appropriate germination tolerance tables.

c. Apply the appropriate true loose smut tolerance tables.

b 20 Application of Grading Factors for a test

- Decide what are the grading factors for crop kinds under analysis, by using specified Grade Tables and their standards set out in the Seeds Regulations for purity and/or germination and/or true loose smut.
- Application for reporting

b 21 Contrast Canadian, AOSA and ISTA Rules

Know fundamental differences between the current Canadian, AOSA and ISTA Rules

C – BOTANY

c 1 Describe Process of Seed Formation

a. Give a description of the process of seed formation in angiosperms including the process of pollination, fertilization through to the development of an ovule into a seed.

b. Give the botanical definition of seed.

c 2 Factors Influencing Seed Germination

a. Describe factors which affect seed viability.

b. Describe the essential environmental factors required for germination.

c 3 Seed Germination and Seedling Formation

a. Give a description of the sequence of events during the germination process from imbibition to radicle emergence.

b. Describe the physical sequence of events from radicle emergence through the seedling stage of monocotyledon/dicotyledon and epigeal/hypogeal plant types.

c. Describe the function of the essential seedling structures.

d. Define the causes for abnormal seedlings.

c 4 Describe Seed Morphology

Describe the key internal and external characteristics of seeds within families of the various genera commonly found in Canada and frequently occurring during purity seed testing.

c 5 Explain Plant Taxonomy

a. Describe the division of angiosperms from kingdom to species.

b. Describe and demonstrate how plants are named using appropriate nomenclature (scientific name).

c 6 Describe Plant Physiology

Outline the process of the photosynthesis and respiration.

c 7 Describe Plant Pathology (re: Seed Testing)

a. Describe the differences between a seed-borne pathogen and a saprophyte as seen during germination testing.

b. Name the principle seed-borne diseases that are of regulatory concern in Canada and describe how they affect their host.

c. What procedures are used to maintain sanitary germination conditions?

c 8 Describe Plant Anatomy

a. Give a description of plant structures including, roots, stem, leaves, flowers, Inflorescence types and fruits.

b. State the major functions of the plant structures.

c 9 Dormancy

a. Define dormancy.

b. Describe the types of dormancy.

c. Describe the types of dormancy breaking techniques and the appropriate applications.

c 10 Use Seed Identification Keys

Demonstrate the use of keys in identifying seeds.

D - Computation and Statistics (Quantitative Methods)

d 1 Calculate and Report Seed Testing Data

Demonstrate the ability to solve basic mathematic problems of addition, subtraction, multiplication and division; and to solve simple problems in fractions, equations, percentages and rounding of figures.

d 2 Understand the Concepts of Probability

a. Explain the concept of random and non-random sampling as it relates to obtaining submitted samples.

b. Explain the concept of probability as it relates to obtaining a representative working sample.

d 3 Concepts of Precision and Accuracy

Explain the concepts of precision and accuracy for weighing and obtaining the working sample (e.g. number of decimal places).

d 4 Use of the Checking Limits and Tolerance Tables

Explain the application of checking limits and tolerance tables.

E – CHEMICALS AND THEIR USES IN SEED TESTING LABORATORIES

e 1 Potassium nitrate (KNO_3)
e 2 Calcium nitrate $Ca(NO_3)_2$
e 3 Tetrazolium chloride (TZ)
e 4 Gibberellic acid (GA_3)

Note:

See the current version of the *Canadian Methods and Procedures for Testing Seed* for details of germination promotion agents or methods using these chemicals.

4. Accreditation exam

4.1 Purpose of the examinations

The use of a standardized exam provides national uniformity for the accreditation of seed analysts in Canada. The general purpose of the examinations is to objectively verify that the seed analyst has achieved the level of skill and knowledge required to conduct seed analyses according to the *Canadian Methods and Procedures for Testing Seed*. The Commercial Seed Analysts Association of Canada uses the exam to verify that an applicant meets the knowledge and ability components of their membership categories.

4.2 Eligibility to write the examinations

4.2.1 Education:

The minimum education requirement is high school graduation. Background knowledge for seed testing can be obtained by taking plant sciences or biology courses at technical school, college or university levels. Example courses: botany, plant biology, plant physiology, seed technology, plant genetics, plant taxonomy, agronomy, statistics, and plant pathology.

4.2.2 Training:

a. Candidates must have been trained in a fully operational seed testing laboratory, under the supervision of an accredited seed analyst. The training must have followed a documented training program that could be judged to provide sufficient instructions and practice in the skills and knowledge required for seed testing as stated in Section 3.2.

   The accredited seed analyst could be:
   - Fully accredited seed analyst by CFIA
   - Senior member of CSAAC
   - Registered member of the Society of Commercial Seed Technologists
   - Certified member of the Association of Official Seed Analysts
   - Associated member of CSAAC, or partially accredited analyst, provided the trainer is accredited for the crop groups for which the candidate is applying

b. Lab manager, trainer or supervisor must provide a written recommendation that the applicant has the technical knowledge and demonstrated ability to conduct purity and/or germination and /or true loose smut analyses according to the *Canadian Methods and Procedures for Testing* using Appendix F: Seed analyst training sign-off sheet. The trainers must use Section 3.2: Core Skills and Knowledge for Accredited Seed Analysts to evaluate the candidate and to provide a recommendation.

   - All factors must be covered at least to a level where the analyst can perform the tasks satisfactorily.
   - The sign-off form or recommendation letter must be signed by the lab manager, trainer or supervisor who provides the recommendation.

4.2.3 Practical Experience:

Actively engaged in hands-on seed testing as follows:

a. Germination only, minimum 1 year/or approximately 1500 hours (by date of exam)
b. Purity only, minimum 1 year /or approximately 1500 hours (by date of exam)
c. Purity and Germination, minimum of 2 years/or approximately 3000 hours (by date of exam)
d. Candidate must demonstrate the ability to perform the analysis for which accreditation is sought. This might include a statement from the qualified trainer, successful completion of a pre-exam, and/or performance assessment at an accredited laboratory or a Canadian Food Inspection Agency (CFIA) laboratory.
e. Analysts wishing to become accredited for True Loose Smut must have their laboratory manager provide a record of training that must include;
    1. Detailed (signed and dated) training log for a minimum of 100 samples containing True Loose Smut
    2. Or proof of participation of the CFIA True Loose Smut Training with a copy of detailed (signed and dated) training log for a minimum of 50 samples containing True Loose Smut

Note: It is strongly recommended that analysts consider membership in the CSAAC. The Association has membership requirements additional to passing grades on the accreditation exams, and provides continued education opportunities for accreditation maintenance.

4.2.4 Application

The application deadline for purity and germination examinations is April 1 of each year. The application must be in writing, and addressed to the Head, Seed Science and Technology Section, Saskatoon Laboratory; see Appendix G: Application for Seed Analyst Examination. The application must clearly state the scope of accreditation (see Section 2) sought and a statement responding to the above eligibility requirements (see Section 4.2).

The exam fee must be submitted with the application, post-dated to July 1st. See section 4.3.3.

Incomplete forms are returned to the applicant with a request to complete.

4.3 Exam administration and general information

- The actual exam encountered will vary depending on the crop kind(s) for which accreditation is sought.
- Emphasis on the different parts of the exam may shift from year to year, and new elements may be added.
- The four parts of the exam (purity and germination, written and practical) are conducted as separate examinations.
- Time limits are given for each part of the exam. Candidates should finish within the allotted time period, but additional time may be given.

- Candidates are provided with a "Candidate's Number". This is used on all papers so that the marker does not know who the candidate is.
- Previous exams are not distributed because of the difficulty of developing exam questions.
- All parts of the exam are prepared by designated staff of the CFIA Saskatoon Laboratory, Seed Science and Technology Section (SSTS), Saskatoon.
- CFIA Saskatoon Laboratory, Seed Science and Technology Section (SSTS), consults with CSAAC on the general principle and outline of the examinations.
- The evaluation and proficiency samples for true loose smut accreditation are prepared by designated staff of the CFIA Ottawa Plant Laboratory (Fallowfield) – Pathology.

4.3.1 Exam schedule

The exam will usually be the last Thursday and Friday of September. The following table outlines the general time of the exams. This may vary from year to year.

Exam	Day	Duration	References
Germination practical	Thursday: 8:30 am	3 hours	open book
Germination written	Thursday: 1:00 pm	3 hours	open book
Purity practical	Friday: 8:30 am	3 hours	Limited open book
Purity written	Friday: 1:00 pm	3 hours	open book

All exams, except the purity practical are "open book". Reference materials will be provided by CFIA, e. g. M & P; Seeds Act and Regulations including Schedule I, II and III. For the purity practical exam, candidates are provided with the M&P, Seeds Act and Regulations including Schedule I, II and III. Seed specimens or identification reference materials are NOT provided for exams. **Candidates can not use their own reference materials**.

Candidates may provide their own visual aids (e.g. microscopes, magnifiers), calculators, tweezers, and spike, if desired. CFIA will ensure all the required testing equipment and tools are available for each candidate. Candidates may also bring and use blank copies of their laboratory's worksheets for the examinations.

4.3.2 Exam Location

The exam takes place at:

Canadian Food Inspection Agency
Saskatoon Laboratory, Seed Science and
Technology Section (SSTS)
301-421 Downey Rd.
Saskatoon, SK
S7N 4L8

Contact:
Section Head
Phone: 306-385-4858
Fax: 306-385-4944
ssts@inspection.gc.ca

4.3.3 Exam fees

The exam fees are set in the CFIA Fees Notice - Seeds Fees as follows:

Seed Analyst Examination: $385.00 (GST does not apply)

This fee covers both Purity and Germination as follows:

Purity Written:	$50.00
Germination Written:	$50.00
Purity Practical:	$142.50
Germination Practical:	$142.50

The fee is payable to the Receiver General for Canada and post-dated to July 1st. The exam fee must be submitted with the application. The fee is refundable except for $50 until July 1st. After July 1st the fee is non-refundable.

4.3.4 Exam grades

a. Exam pass marks

The exam is made up of four parts: purity practical, purity written, germination practical, germination written with 100 points each. Passing marks for overall and components are specified in the Table below. If the candidate does not achieve a pass on the specific component then they are required to rewrite the entire exam at the next scheduled date.

Exam	Components	Component Passing Mark	Overall Passing Mark
Germination practical	Sample evaluation	80%	80%
	Seedling, TZ evaluation, Crop kind identification, Selection of seed for planting, Germination methodology: mixing and dividing, planting or other applicable hand-on demonstrations		
Germination written	Botany Procedures General		70%
Purity practical	Impurity Retrieval	80%	80%
	Seed Identification, Similar Species separations and ID Pure seed Procedure: mixing and dividing, blower calibration, other applicable hand-on demonstrations		
Purity written	Botany Procedures Reporting General		70%

b. Candidates who do not pass all parts but do pass one or more (e.g. germination written exam), usually are not required to re-write the part which was passed. There are cases where the candidate may be required to re-write a part which the candidate passed (e.g. poor demonstration of knowledge in a key area). The candidate will not have to rewrite the passed part(s) if they re-write the unsuccessful part(s) within two years.

c. If an examination is failed, the candidate may apply to re-write at the next scheduled examination date (See Section 4.3.1). Only under extenuating circumstances will an exam be prepared for writing outside the established schedule.

d. A summary of performance for the practical exam(s) is prepared for each candidate and sent with the results letter. Exam marks and the performance summary are only given to

the candidate. CFIA will inform the laboratory that the candidate has passed or failed. The final marks will be not issued until all examinations have been marked and summarized.

e. A copy of the exam results, performance summary and accreditation certificate are kept in a confidential file at Saskatoon Laboratory, Seed Science and Technology Section.

f. Enquiries regarding results must be made within 30 days to the Head, Seed Science and Technology Section.

4.4 Exam format

The exam has four parts: Germination practical, Germination Written, Purity Practical and Purity written, which are outlined below:

4.4.1 Germination Practical

A. Sample evaluation **Value of Mark: 40%** **Pass Mark 80%**

e.g. *You are given the following sample :*
Barley, 2 x 50, between paper
Soybean, 2 x 25, sand
Bromegrass, 2 x 50, top of paper
Onion, 2 x 25, rolled paper

For each sample, evaluate the seedlings and report number of normal, abnormal and non-germinated seeds on the form provided. Lay out the normal seedlings in groups of ten. Briefly describe the major abnormalities observed.

- The objective is to assess the candidate's ability to accurately conduct a seedling evaluation and report the results.
- The question usually consists of four samples drawn from the crop groupings for which accreditation is sought (e.g. cereals, pulses, canola and mustards, forage legumes, millets and timothy, grasses, and vegetables).
- The candidate:
  - carefully separates the seeds/seedlings into the applicable evaluation categories, Normal, Abnormal, Dead, Hard, Fresh.
  - lays out the seeds and seedlings on moist blotters in groups of 10 to allow easy review by the markers, keeping the categories and replicates clearly separated.
  - records the results on a form provided for this purpose (see Appendix C: Example of a seedling evaluation reporting form). A brief description of the major abnormalities is required (such as in soybean with missing epicotyl, less than one primary leaf, deep open cracks, terminal bud damaged). Designated SSTS exam markers, re-evaluate the seedlings and seeds and indicate any errors on the evaluation forms.
- In the event of truly borderline judgements, the exam candidate's assessment is accepted as correct. It is advisable to place borderline seedlings in a group separate from the others.
- The following marking scheme is used:
  - Each sample has a value of 10 points.
  - Points are deducted for each incorrect classification and for any lost seeds.

4.4.1 Germination Practical

B. Seedling and Tetrazolium evaluations **Value of Mark: 26%**

B. 1 Seedling evaluation

e.g. *On the following pages are ten photographs of seedlings. On each page, Indicate whether you consider the seedling to be normal or abnormal, with the reason why it is abnormal.*

Lettuce

Normal or abnormal, with reason: Abnormal - Seedlings showing any degree of physiological necrosis should be classified as abnormal. In "Remarks" indicate the percentage of necrotic seedlings. (see M&P Seedling Descriptions)

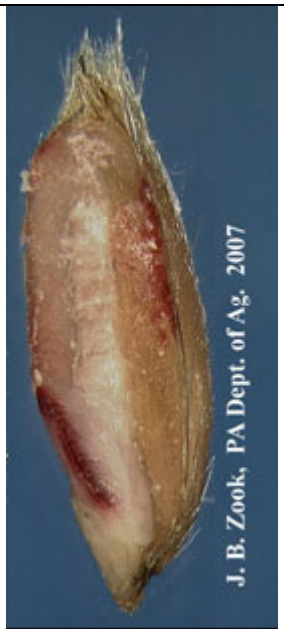
- The objective is to assess the candidate's ability to apply the seedling evaluation rules and describe their observations.
- The name of the crop kind is provided. You don't have to identify the seedlings.
- Give a concise description of the major seedling defect that you observe, e.g. deep hypocotyl lesion.

4.4.1 Germination Practical

B. 2 Tetrazolium evaluation

When accreditation is sought for those crop kinds requiring a tetrazolium test, as stated in the *Canadian Methods and Procedures for Testing Seed*, the candidate will be assessed on their ability to read the results of a tetrazolium test in addition to seedlings from a germination test.

e.g. *On the following pages are photographs of seeds. On each page, indicate whether you consider the seed to be viable or non viable, with the reason why it is abnormal.*

Oats

From Association of Official Seed Analysts (AOSA) website http://www.aosaseed.com/TZwebsite/TZResources/TZphotogallery/AvenaTZimagesZookpdf.pdf
Viable or Non viable, with reason: Non viable – more than ¾ of the radicle is unstained

- The objective is to assess the candidate's ability to apply the tetrazolium evaluation descriptions and to describe their observations.
- The name of the crop kind is provided. You don't have to identify the seed.
- Give a concise description of the major defect that you observe, e.g. radicle not stained

Resources for practice can be found on the AOSA or SCST websites. See Appendix E: Reference Documents.

4.4.1 Germination Practical

C. Crop kind identification **Value of Mark: 14%**

e.g. In the envelope marked "Question 3", there are 10 small plastic bag containing crop seeds. In the space below, indicate the common or scientific name of each crop kind.

Envelope	*Crop Name*
1	

- The objective is to assess the candidate's ability to verify that the sample received for germination testing is the kind named on the label.
- Each seed(s) is located in an individual zip-lock plastic envelope. You can see the seed through the envelope and remove it for closer examination, if necessary.
- The crop kinds which may be included are those which are covered by the scope of accreditation.

4.4.1 Germination Practical

D. Selection of seed for planting **Value of Mark: 10%**

e.g. The envelope marked "Question 4" contains seeds of wheat and some impurities. From this group of seeds:

- *Select 200 seeds suitable for planting in a germination test.*
- *Place the 200 seeds in the envelope marked "200 seeds for planting", and the remainder in the envelope marked "remaining seeds".*

- The objective is to assess the candidate's ability to select pure seed for planting.
- Candidates must know the pure seed definitions.
- Marks are deducted for incorrect counting, non-random selection or selection of non pure seed.

4.4.1 Germination Practical

E. Germination methodology **Value of Mark: 10%**

e.g. Using the equipment provided, demonstrate how you would plant a sample of wheat.

- The objective is to assess the candidate's ability to perform or describe a task in a germination laboratory. The question might involve actual performance of a task (e.g. mixing a sample), or it could require a written answer.
- The question could involve any aspect of germination testing, e.g. germinator maintenance and verification, record keeping, planting and evaluation of samples, etc.

4.4.2 Germination written exam

The objective of the germination written exam is to assess the candidate's knowledge in the three subject areas outlined below. The questions are not necessarily grouped together according to these subjects, i.e. the exam appears as a random mixture of questions. Questions usually require short answers.

For examples of questions see Appendix D: Example of the germination/purity written exam questions.

A. Botany **Value of Mark: 50%**

Basic botany applicable to seeds, including seed and seedling structures, the process of germination, and certain phenomena observed in germination testing such as dormancy. Also includes knowledge of some of the principles behind germination testing.

B. Procedures **Value of Mark: 45%**

Thorough working knowledge of the relevant sections of the Methods and Procedures for Testing Seed and grade standards; includes the use of the methods table, use of special procedures, use of tolerances, application of the seedling descriptions and reporting.

C. General **Value of Mark: 5%**

Questions assess knowledge of topics not directly related to germination testing but which assess the candidate's scope of general knowledge, e.g. knowledge of Seeds Act and Regulations, role of related organizations (e.g. CSGA), basic knowledge of disease testing, quality assurance.

4.4.3 Purity Practical

A. Retrieval **Value of Mark: 30%** **Pass Mark: 80%**

e.g. *Envelope "Question 1 contains 3 mini-samples as listed below:*

a. Crop kind A, 1.5g
b. Crop kind B, 3g
c. Crop kind C, 125g

For each of these:
- *analyse to retrieve all contaminants*
- *place the contaminants in the envelopes provided*

Note:
- *No identification of the impurities is required.*
- *Retrieve <u>contaminants</u> only – marks will be lost for retrieval of seeds of the kind under analysis.*

- The objective is to determine if the candidate can see an impurity and remove it from the crop kind under analysis.
- This question consists of small samples (usually three, but could be more or less) which act as the crop under analysis.
- Samples could be of any species included in the scope of the accreditation.
- Impurities may be other crop, weed or non-seed material (e.g. sclerotia).
- It is not necessary to identify or classify the impurities, only to remove them from the sample.
- Samples are just large enough to act as a background for the impurities. For example, tall fescue samples may be 2g, common wheat may be 100g.
- In general the impurities chosen present some challenge for retrieval. It is assumed that the candidate can see the obvious (e.g. a soybean seed would probably not be added as an impurity in canola).
- Usually 20 to 30 different contaminants are spread over the three samples.
- There may be more than one seed of a contaminant species.
- Marks are given for each contaminant retrieved.
- Marks will be deducted for each seed of the crop under analysis which is retrieved.

4.4.3 Purity Practical

B. Seed identification **Value of Mark: 25%**

e.g. Envelope "Question 2" contains 25 packets, each containing a seed structure. Using the accompanying answer sheet:

Identify each structure by giving either its common or scientific name.

Packet No.	Common name or scientific name
Example	*Bromus inermis*
Example	Wild violet
1	
2	
.	
25	

- The objective is to assess the candidate's ability to identify crop and weed seeds listed in *Minimum list of Species for Seed Identification by Canadian Accredited Seed Analysts and Laboratories* see Section 3.2**.**
- The question consists of 25 individual seeds for identification.
- Each seed(s) is located in an individual zip-lock plastic envelope. You can see the seed through the envelope and remove it for closer examination, if necessary.
- Dehulled seeds may be included if it is possible to find the seeds in this form in regular seed samples.
- In some cases it is not possible to distinguish two or more species with only single seeds as specimens (e.g. *Agropyron cristatum* and *A. desertorum*). In this case full marks are given for reporting one or the other.
- Note: There are a few noxious weeds that have no reference specimens in the Reference Collection of Weed Seeds because of limited availability of seeds. Exam candidates ask whether these will be included on the exam. Pictures of these seeds are available and may be included as such in the exam.

4.4.3 Purity Practical

C. Species separation and identification **Value of Mark: 25%**

e.g. *Envelope "Question 7" contains 10 seeds. Separate the seeds into species and identify them.*
Place your separations in the envelopes labelled for this purpose. Print the name of the species (common or scientific name) and the quantity in the space provided at the bottom of the envelope.

- The objective is to assess the candidate's ability to distinguish between groups of species of similar appearance.
- Any combination of crop and weed seeds may be used.
- There will be 2 or 3 groups of seeds that need to be separated and identified.
- Usually there will be 3 – 6 different species present in each group.
- An example would be 3 seeds of each of 3 species of Wheatgrass.
- Marks will be deducted if the separation and/or the identifications are incorrect.

4.4.3 Purity Practical

D. Pure seed classification **Value of Mark: 10%**

e.g. *On the following pages are ten photographs of a particle extracted from a pure seed test on a sample of Bromegrass. Classify the particles according to the M&P definitions for pure seed, other crop seed, weed seed, inert material. Record your answer beside each photograph.*

***Note**: No identifications are required.*

e.g. *Envelope "Question 8" contains 2 grams of Meadow bromegrass. Conduct a pure seed test according to the M&P.*

The objective is to test the candidate's ability to apply the pure seed definitions.

4.4.3 Purity Practical

E. Purity procedure **Value of Mark: 10%**

e.g. *You are provided with the following:*
A completed worksheet for a Certified Red clover analysis;
Grade Table VIII;
Checking for limits tables;
Key to column headings for M&P Table I.

Following the principles of the sequential analysis method to describe, step-by-step, how the checking limits and the key to column headings were used during this analysis.

***Note**: It is not necessary to grade this sample.*

- The objective is to assess the candidate's working knowledge of purity testing procedures.
- This question could cover any purity analysis procedure. The example for sequential analysis, above, is just one possibility. Candidate may be asked to demonstrate a technical procedure of purity testing e.g. using the seed blower or how to mix and divide a sample.

4.4.4 Purity written exam

The objective of the purity written exam is to assess the candidate's knowledge in the three subject areas outlined below. The questions are not necessarily grouped together according to these subjects, i.e. the exam appears as a random mixture of questions. Questions usually require short answers.

For examples of questions see Appendix D: Example of the germination/purity written exam questions.

A. Botany **Value of Mark: 45%**

Questions cover any aspect of botany which relates to seeds, e.g. seed morphology (internal and external), taxonomy (species/genus/family relationships, use of scientific names), terminology, flower structure, process of seed development, scientific naming and classification.

B. Procedures **Value of Mark: 45%**

Questions may cover any purity testing procedure, e.g. blowing procedures, 400-seed test, sequential analysis, use of checking limits, use of Grade Tables, reporting procedures, pure seed definitions, sub-sampling mixtures, equipment operation, understanding the grading standards, etc.

C. General **Value of Mark: 10%**

Questions assess knowledge of topics not directly related to purity testing but which assess the candidates scope of general knowledge, e.g. knowledge of Seeds Act and Regulations, role of related organizations (e.g. CSGA), basic knowledge of disease testing and cultivar purity testing, basic knowledge of ISTA and AOSA rules, knowledge of the Canadian seed testing system, quality assurance, etc.

4.4.5 Hints for writing the exams

- A long answer is rarely required. Be concise.
- Wherever possible, use point form.
- Drawings are often easier than a written response and are always acceptable if they accurately convey the required information. They should be neat and well-labelled. Correct use of terminology and relative location of structures are important; artistic talent is not important.
- Scan all the questions before starting the exam.
- Read the question thoroughly. For example, a common error on a germination exam is to draw and label a seed rather than a seedling as requested.
- There is an unlimited amount of paper to write on. It is not necessary to crowd your answers into a small space. Be as neat as possible.
- There are no "trick" questions intended, so do not look for hidden interpretations. If the meaning of the question is not clear, do not hesitate to ask the supervisor for clarification.
- Consider the value of the question when preparing an answer. A one point question would not require a whole page to answer.

Appendix A. Example of a purity worksheet

Question No. / No de question _____

Worksheet / Feuille de travail

Kind of Seed / Espèce de semence:

Variety / Variété:

Prohibited Noxious / Mauvaises herbes nuisibles interdites	**In/Dans g**	**In/Dans g**	**In/Dans g**	**Per/Par kg**	**Other Weed Seeds / Graines d'autre mauvaise herbe**	**In/Dans g**	**In/Dans g**	**In/Dans g**	**Per/Par kg**
Primary Noxious / Mauvaises herbes nuisibles principales									
Total Primary / Total - Principales									
Secondary Noxious / Mauvaises herbes nuisibles secondaires					**Total Other Weeds / Total - Autres mauvaises herbes**				
					Total Weed Seeds / Total - Graines de mauvaises herbes				
					Sweet Clover / Mélilot				
					Brassica Crops / Espèces de Brassica cultivées				
Total Secondary / Total - Secondaires					**Other Crop Seeds / Semences d'autres plantes cultivées**				
Total Primary plus Secondary Noxious / Total - Principales et secondaires									
Pure Seed / Semence pure			**%**						
Other Crop Seeds / Semences d'autres plantes cultivées			**%**						
Weed Seeds / Graines de mauvaises herbes			**%**		**Total Other Crops / Total - Autres plantes cultivées**				
Inert Matter / Matière inerte			**%**		**Disease / Maladie**				

Remarks / Remarques

Appendix B. Example of a Germination Worksheet

Germination Worksheet / Feuille de travail pour les essais de germination						
Kind / Espèce					Sample No. / N° d'échantillon	
Variety / Variété					Received date / Date de réception	
Lot:						
Client:						
Method / Méthode						
BP/EP	TP/SP	RT/SPR	S	Other / Autre : ____ ____		
5 ºC	10 ºC	15 ºC	20 ºC	25 ºC	15-25 ºC	20-30 ºC
Planted date / Date d'ensemencement :						
			Number of Seeds / Nombre de semences			
Count dates / Dates de numération	Days / Jours					
Normal / Plantules normales						
Abnormal / Plantules anormales						
Dead / Semences mortes						
Hard seeds / Semences dures						
Fresh ungerminated / Semences fraîches non germées						
% Pure seed / % de semences pures						
% Germination / % de germination						
% Hard seeds / % de semences dures						
% Germination and hard seeds / % total de semences germées ou dures						
% Pure living seed / % de semences pures vivantes						
Comments / Commentaires						
Analyst/Analyste :						

Appendix C. Example of a seedling evaluation reporting form

Crop Kind/ Espèce _____ Sample No./ N^{o} d'échantillon _____

Evaluate the sample provided and enter your results in the appropriate spaces. Do not write in the shaded spaces./ Évaluez l'échantillon fourni et inscrivez les résultats dans les cases voulues. N'écrivez pas dans les cases ombrées
Note: For some samples there may be only one replicate / Pour certains échantillons, il n'y a qu'une seule répétition

Rep No. / Rép. n^{o}	Normal (No.) / Normales (N^{bre})	Abnormal (No.) / Anormales (N^{bre})	Hard (No.) / Dures (N^{bre})	Fresh (No.) / Fraîches (N^{bre})	Dead (No.) / Mortes (N^{bre})	Remarks (Description of seedlings classified as abnormal) / Remarques (description des plantules anormales)	
						Abnormal seedling type / Type d'anomalie	No. / Nombre
1							
2							

Checked by/ Vérifié par :

Appendix D. Example of the germination/purity written exam questions

Question			Value
1	Give the function of each of the following structures: Scutellum, cotyledon, micropyle.		3
2	Define the following terms: Hypogeal germination, phytotoxicity.		2
3	Draw and label a bean seedling (0.5 marks per structure)		3.5
4	Indicate whether the following statements are True (T) or False (F):		
	a.	It is not necessary to separate multiple florets of oats for a germination test.	1
	b.	The cotyledons are often the first photosynthetic organs in plants with epigeal germination.	1
	c.	If a sample has been prechilled, it is permissible to extend the test by an equivalent number of days.	1
5	Describe the development of an endosperm-containing seed starting with the pollination of an ovule.		6
6	Name two crop kinds considered to be chaffy.		2
7	Explain how to distinguish seeds of White cockle and Bladder campion. You may use diagrams.		4
8	Briefly describe how you report the results of a numbers per unit weight test on the worksheet.		4
9	What criteria do you use to decide if a contaminant species is to be classified as 'other crop' or 'other weed'?		2
10	While dividing down a submitted sample of wheat to obtain a working sample, you observe a wild oat seed in the sample. No wild oat is found in your analysis. What should you do?		1
11	An analysis for a pure seed percentage determination on a sample gave the following component weights: Pure seed _____g Other crop _____g Weeds _____g Inert _____g Calculate the percentages for the components you would report on the certificate of analysis.		4
12	Describe how you would distinguish between the following species (you may use labelled drawings): 1. seeds of species a and species b 2. seeds of species c and species d 3. seeds of species e, species f and species g		6
13	Define the term dormancy and indicate why it would be advantageous to the plant to produce dormant seeds.		3
14	A germination test of four 50-seed replicates gave the following replicate results: 44, 37, 42, and 46. Is a retest necessary for this sample? Outline the steps followed to arrive at this conclusion.		3

Appendix E. Reference Documents

Required References:

Canadian Methods and Procedures for Testing Seed (current version)

Canada Seeds Act and Seeds Regulations Schedules I, II and III (current version)

Weed Seeds Order

Minimum List of Species for Seed Identification by Canadian Accredited Seed Analysts and Laboratories (current version)

Recommended Germination References:

Specific Work Instructions for Seed Sampling (SWI 132.1.1) (current version)

CSGA Circular 6 (current version)

AOSA Rules for Testing Seeds (current version)

- Volume 1 – Principals and Procedures
- Volume 4 – Seedling Evaluation

AOSA Tetrazolium Testing Handbook or ISTA Tetrazolium Handbook (current versions)

ISTA International Rules for Seed Testing (current version)

AOSA website – Virtual Germination Practice Exam material
http://www.aosaseed.com/Training.htm

AOSA website – Tetrazolium
http://www.aosaseed.com/TZwebsite/TZcommitteemain.html

Seed Technologist Training Manual, SCST (2001)

Recommended Purity References:

Specific Work Instructions for Seed Sampling (SWI 132.1.1) (current version)

CSGA Circular 6 (current version)

Identification of crop and weed seeds - Agriculture Handbook 219, 1978.

AOSA Rules for Testing Seeds (current version)

- Volume 1 – Principals and Procedures
- Volume 2 – Uniform Blowing Procedure
- Volume 3 – Uniform Classification of Weed and Crop Seeds

AOSA Cultivar Purity Testing Handbook – (current version)

ISTA International Rules for Seed Testing (current version)

Recommended True Loose Smut References:

ISTA International Rules for Seed Testing (17-03 current version) for 400 seeds/lot

Specific Work Instructions for Seed Sampling (SWI 132.1.1) (current version)

Other References:

CFIA *Seed Laboratory Accreditation and Audit Protocol*

CFIA Accredited Seed Testing Laboratory Proficiency Monitoring Program

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- Seed Testing: Principles and Practices, Sabry G. Elias, Lawrence O. Copeland, Miller B. McDonald, Riad Z. Baalbaki, Michigan State University Press (June 1, 2012)
- Seed Science and Technology Laboratory Manual, Iowa State University Press, M. B. McDonald and L. O. Copeland, (1989)
- Principals of Seed Science and Technology, 4th Edition, M. B. McDonald and L. O. Copeland, (2001)
- Seedborne Diseases and Their Control - Principles and Practice - University Press, Cambridge, R. B. Maude (1966).
- Principles of Seed Pathology, 2nd Edition - Lewis Publishers V. K. Agarwal, James B. Sinclair (1996).

Appendix F. Seed analyst training sign-off sheet

This verifies that: _____

(name of trainee)

has received the required number of hours* of training as required in Section 4.2.3 during the period:

_____ to _____

(dates)

and that the trainer and trainee agree that training was provided covering the skills as required in Section *3.2. Core skills and knowledge* for Accredited Seed Analysts.

TRAINEE	**TRAINER**	**SUPERVISOR** **LAB MANAGER** **(where applicable)**
Signature	Signature	Signature
Date	Date	Date

Name of Laboratory: _____

***** See Section 4.2, Eligibility to write the examination

This form must be submitted with the Application For Seed Analyst Examination (Appendix G)

Appendix G. Application for Seed Analyst Examination

APPLICATION FOR SEED ANALYST EXAMINATION

CANADIAN FOOD INSPECTION AGENCY (CFIA)

Please read this application carefully and fill in completely. Applications which are improperly filled in or incomplete will be returned. Application must be received by April 1st.

Name of Applicant		
Employed by		
Mailing Address		
Telephone		Fax
Email		

Please indicate scope of accreditation for which you are applying.

( ) Full Accreditation in all Grade Tables and Crop Kinds for Purity and Germination.
( ) Partial Accreditation - Please describe the Grade Table(s) or Crop Kind(s) for Purity and/or Germination Accreditation

Purity:	
Germination:	

Do you want CFIA to forward your name to the Commercial Seed Analysts Association of Canada (CSAAC)?

Yes	
No	

Signature of Applicant _____ Date _____

Forward completed form to: Section Head, Seed Science and Technology Section
Saskatoon Laboratory
301 - 421 Downey Rd.
Saskatoon, SK S7N 4L8
Telephone: (306) 385-4858 Fax: (306) 385-4944
Email: ssts@inspection.gc.ca

Appendix H. Revision Table

Previous version	Previous version revision date	Paragraph revised, deleted, added	Reason for update	Revision Author
January 2013	2013/01	Revision table	Added a revision table	L. Duncan
		4.2.4	Changed application date from May 1 to April 1 and clarified the types of exams	J. Maruschak
		4.3.1	Removed the text "modified: scientific names may not be included" in relation to Schedule I.	J. Maruschak
		4.3.2	Changed the phone and fax numbers	J. Maruschak
		Appendix G	Changed application date from May 1 to April 1 and the phone and fax numbers	J. Maruschak