

Technical Description

# Chemical Laboratory Technology

Skill 52



WorldSkills International, by a resolution of the Competitions Committee and in accordance with the Constitution, the Standing Orders, and the Competition Rules, has adopted the following minimum requirements for this skill for the WorldSkills Competition.

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# 1 Introduction

## 1.1 Name and description of the skill competition

### 1.1.1 The name of the skill competition is

Chemical Laboratory Technology

### 1.1.2 Description of the associated work role(s) or occupation(s)

The work of laboratory chemical analysts is the basis of product quality in many industries. Chemical analysis is necessary to control the compliance of properties of raw materials, intermediate stages of the technological process, and finished products with current standards.

The laboratory chemical analyst performs laboratory analyses, tests, measurements aimed at determining the following:

- The qualitative chemical composition of a substance;
- The quantitative ratio of chemical elements and compounds within them;
- Processing of the obtained data;
- Reporting results of analyses and;
- Other types of laboratory work.

In accordance with the requirements of standards and specifications. The scope and complexity of the tests performed depend on the type of tasks set by the employer.

The role includes knowledge of the following objects of professional activity:

- Natural and industrial materials;
- Synthetic materials;
- Equipment and instruments;
- Regulatory and technical documents.

Laboratory chemical analysts should be able to determine the optimal tools and methods for the analysis of various natural and synthetic materials, to perform qualitative and quantitative tests using modern chemical, bioanalytical and physicochemical analytical methods. They should be able to act logically and systematically, complying with sanitary and hygienic requirements and occupational safety and health standards.

Usually, laboratory chemical analysts work in the chemical laboratories of quality control departments, research and development departments, or in environmental departments in plants in various industries: chemical, petrochemical, pharmaceutical, food, bioproducts, and the supply of construction materials, paint and varnish, polymers, defense and many others.

### 1.1.3 Number of Competitors per team

Chemical Laboratory Technology is a single Competitor skill competition.

### 1.1.4 Age limit of Competitors

The Competitors must not be older than 22 years in the year of the Competition.

## 1.2 The relevance and significance of this document

This document contains information about the standards required to compete in this skill competition, and the assessment principles, methods, and procedures that govern the competition.

Every Expert and Competitor must know and understand this Technical Description.

In the event of any conflict within the different languages of the Technical Descriptions, the English version takes precedence.

## 1.3 Associated documents

Since this Technical Description contains only skill-specific information it must be used in association with the following:

- WSI – Code of Ethics and Conduct
- WSI – Competition Rules
- WSI – WorldSkills Occupational Standards framework
- WSI – WorldSkills Assessment Strategy
- WSI online resources as indicated in this document
- WorldSkills Health, Safety, and Environment Policy and Regulations
- WorldSkills Standards and Assessment Guide (skill-specific)

## 2 The WorldSkills Occupational Standards (WSOS)

### 2.1 General notes on the WSOS

The WSOS specifies the knowledge, understanding, skills, and capabilities that underpin international best practice in technical and vocational performance. These are both specific to an occupational role and also transversal. Together they should reflect a shared global understanding of what the associated work role(s) or occupation(s) represent for industry and business ([www.worldskills.org/WSOS](http://www.worldskills.org/WSOS)).

The skill competition is intended to reflect international best practice as described by the WSOS, to the extent that it can. The Standard is therefore a guide to the required training and preparation for the skill competition.

In the skill competition the assessment of knowledge and understanding will take place through the assessment of performance. There will only be separate tests of knowledge and understanding where there is an overwhelming reason for these.

The Standard is divided into distinct sections with headings and reference numbers added.

Each section is assigned a percentage of the total marks to indicate its relative importance within the Standards. This is often referred to as the “weighting”. The sum of all the percentage marks is 100. The weightings determine the distribution of marks within the Marking Scheme.

Through the Test Project, the Marking Scheme will assess only those skills and capabilities that are set out in the WorldSkills Occupational Standards. They will reflect the Standards as comprehensively as possible within the constraints of the skill competition.

The Marking Scheme will follow the allocation of marks within the Standards to the extent practically possible. A variation of up to five percent is allowed, if this does not distort the weightings assigned by the Standards.

### 2.2 WorldSkills Occupational Standards

| Section |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Relative importance (%) |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| 1       | <b>Work organization and management</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 10                      |
|         | <p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> <li>• The internal and external regulatory environment for the sector</li> <li>• The internal business environment including one's personal role, ethical practice, and codes of conduct</li> <li>• Health and safety legislation, regulations, and best practice</li> <li>• Scientific principles for laboratory-based activities</li> <li>• Principles for work planning, scheduling, organization, and completion</li> <li>• The theoretical basis for applied chemistry including how to apply physical, organic, and inorganic chemistry to laboratory work</li> </ul> |                         |

| Section  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Relative importance (%) |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
|          | <ul style="list-style-type: none"> <li>Principles and methods for the safe disposal or recycling of chemicals and chemically related substances.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                         |
|          | <p>The individual shall be able to:</p> <ul style="list-style-type: none"> <li>Maintain personal health and safety at all times including through personal protective clothing and equipment</li> <li>Take into account relevant regulations, norms, quality, safety and environmental standards</li> <li>Implement safety data sheets and the measures and procedures derived from them for <ul style="list-style-type: none"> <li>Handling, maintaining, and repairing laboratory devices, apparatus, and equipment</li> <li>Handling, maintaining, and disposing of/recycling chemicals used in laboratories</li> </ul> </li> <li>Follow risk management systems, proactively</li> <li>Maintain good housekeeping</li> <li>Order and inventory materials to maintain supplies, within budget and budgetary procedures</li> <li>Ensure electronic equipment is fit for purpose</li> <li>Inspect structures and materials for their condition and usability</li> <li>Work independently, taking responsibility for initiating and completing tasks within the parameters of the work role</li> <li>Estimate the requirements of a piece of work in terms of time, costs, resources, and materials needed for completion.</li> <li>Develop specific goals and plans to prioritize, organize, and accomplish work, relative to set objectives and targets</li> <li>Investigate alternative means of resolving delays</li> <li>Adjust activities as required, keeping relevant others informed.</li> </ul> |                         |
| <b>2</b> | <b>Communication and interpersonal skills</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>10</b>               |
|          | <p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> <li>Principles of communication</li> <li>Principles for human interactivity</li> <li>The impact of one's own work on others, especially where related to diversity and equality</li> <li>The specialist terminology associated with the work role and sector</li> <li>The intention and purpose of statistical methods for data presentation</li> <li>The limitations in reporting results</li> <li>The uses of ICT, management information systems, and databases in chemical environments.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                         |
|          | <p>The individual shall be able to:</p> <ul style="list-style-type: none"> <li>Establish and maintain interpersonal relations</li> <li>Work and interact with others including within teams</li> <li>Provide technical support to chemists or other specialists</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                         |

| Section  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Relative importance (%) |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
|          | <ul style="list-style-type: none"> <li>• Communicate using a full range of techniques for speaking, writing, body language, and active listening, for formal and informal purposes</li> <li>• Use specialist terminology including where these are in another language</li> <li>• Obtain information from all relevant sources, citing sources as required</li> <li>• Read and apply the content of technical documents relating to <ul style="list-style-type: none"> <li>◦ Analyses</li> <li>◦ Formulations</li> <li>◦ Procedural instructions</li> <li>◦ Specifications</li> <li>◦ Diagrams</li> </ul> </li> <li>• Listen actively, asking questions appropriately for full understanding</li> <li>• Use laboratory information and laboratory management systems, both digital and paper based</li> <li>• Order information and actions according to logic or given rules</li> <li>• Apply statistical techniques for data presentation</li> <li>• Use a range of textual and graphical methods to inform others</li> <li>• Communicate scientific information appropriately for the audience or recipient</li> <li>• Prepare and give formal and informal presentations</li> <li>• Seek, accept and, as appropriate, build on feedback and constructive criticism.</li> </ul> |                         |
| <b>3</b> | <b>Techniques, procedures, and methods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>35</b>               |
|          | <p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> <li>• The foundations of inorganic chemistry relative to structure and bonding</li> <li>• The chemistry of important elements and compounds</li> <li>• The principles and practical techniques of organic chemistry</li> <li>• Reaction mechanisms and functional group conversions</li> <li>• Concepts and practical techniques in physical chemistry, including thermodynamics, reaction kinetics, conductivity, electrochemical cells, and electrolysis</li> <li>• Principles of laboratory techniques and scientific experimentation</li> <li>• Principles of project management, and how these apply to laboratory work</li> <li>• The requirements for the development and validation of analytical methods and instrumentation, including understanding suitable sampling methods</li> <li>• Trends in support for experiments, including the use of kits.</li> </ul>                                                                                                                                                                                                                                                                                                                |                         |
|          | <p>The individual shall be able to:</p> <ul style="list-style-type: none"> <li>• Prepare for laboratory tasks using the appropriate scientific techniques, procedures, and methods</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                         |

| Section                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Relative importance (%) |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| <ul style="list-style-type: none"> <li>• Use specified instrumentation and laboratory equipment, including calibration as required</li> <li>• Evaluate the quality of materials or products to be used</li> <li>• Design or fabricate experimental apparatus to develop new products or processes</li> <li>• Perform laboratory tasks using specified methodologies, including standard operating procedures</li> <li>• Perform specific sampling duties including preparation and processing of samples as well as separation processes for mixtures of liquids and solids</li> <li>• Perform purification and concentration processes such as <ul style="list-style-type: none"> <li>◦ Distilling</li> <li>◦ Extracting</li> <li>◦ Evaporating</li> <li>◦ Chromatography</li> <li>◦ Potentiometry</li> <li>◦ Conductometry</li> </ul> </li> <li>• Use titrimetric, volumetric, and gravimetric methods</li> <li>• Use instrumental and electroanalytical methods such as <ul style="list-style-type: none"> <li>◦ Photometry</li> <li>◦ Chromatography</li> <li>◦ Potentiometry</li> <li>◦ Conductometry</li> <li>◦ Electrophoresis</li> </ul> </li> <li>• Set up and conduct experiments, extractions, tests, and analyses, using techniques such as <ul style="list-style-type: none"> <li>◦ Chromatography</li> <li>◦ Spectroscopy</li> <li>◦ Physical or chemical separation techniques</li> <li>◦ Microscopy</li> <li>◦ Electrophoresis</li> </ul> </li> <li>• Determine the structures of organic and inorganic compounds</li> <li>• Use synthesis techniques for organic, inorganic and polymer synthesis</li> <li>• Prepare chemical solutions for products or processes, following standardized formulae, or create experimental formulae</li> <li>• Validate analytical procedures, methods, and instrumentation.</li> </ul> |                         |

| Section |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Relative importance (%) |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| 4       | <b>Data processing and record keeping</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 10                      |
|         | <p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> <li>• The rules relating to record keeping, traceability and confidentiality</li> <li>• Procedures for maintaining the security of records, in all forms used</li> <li>• The capabilities of software for recording and displaying data</li> <li>• Processes for ensuring the accuracy of information</li> <li>• The implications of error and inaccuracy.</li> </ul>                                                                                                                                                                                                                                                                                                                                                       |                         |
|         | <p>The individual shall be able to:</p> <ul style="list-style-type: none"> <li>• Log and document laboratory work, including by using given house style, IT and statistical methods</li> <li>• Process and collate digital information from automated digital machines</li> <li>• Produce reliable, accurate data</li> <li>• Present the results of laboratory work and problem solving clearly and concisely in written and oral form</li> <li>• Write technical reports, using graphs and charts as appropriate</li> <li>• Check own work for codification, categorization, calculations, tabulations, and completeness</li> <li>• Acknowledge errors, inaccuracies, and shortcomings promptly</li> <li>• Arrange for information or data to be verified or audited</li> <li>• Archive documentation.</li> </ul> |                         |
| 5       | <b>Analysis, interpretation, and evaluation</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 15                      |
|         | <p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> <li>• Principles of quality management</li> <li>• Applications of quality management to production processes</li> <li>• Mathematical and statistical techniques used in analysis of scientific data</li> <li>• The nature, probabilities, sources, and types of errors</li> <li>• Principles and methods for quality control</li> <li>• Principles and applications for continuous improvement</li> <li>• The physiological implications of the work role.</li> </ul>                                                                                                                                                                                                                                                       |                         |
|         | <p>The individual shall be able to:</p> <ul style="list-style-type: none"> <li>• Maintain efficient kinaesthetic and fine motor skills</li> <li>• Apply personal techniques for sustained attentiveness and focus</li> <li>• Follow procedures to meet the workplace's quality standards</li> <li>• Analyse, interpret, and evaluate data and identify results requiring further investigation</li> <li>• Evaluate information to determine compliance with standards</li> <li>• Work autonomously within the parameters of the work role</li> </ul>                                                                                                                                                                                                                                                               |                         |

| Section  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Relative importance (%) |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
|          | <ul style="list-style-type: none"> <li>• Identify the meaning of outputs from the analytical techniques used and assess their importance</li> <li>• Use correct computational, statistical, and mathematical methods or formulae to solve problems</li> <li>• Identify by analysis the underlying principles, reasons, or facts determining results.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                         |
| <b>6</b> | <b>Problem solving through the application of scientific methods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>10</b>               |
|          | <p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> <li>• Principles and applications of scientific rules and methods to solve problems</li> <li>• Principles for critical thinking and complex problem solving</li> <li>• The scope and limits of their role and one's understanding and expertise in relation to problem solving.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                         |
|          | <p>The individual shall be able to:</p> <ul style="list-style-type: none"> <li>• Recognize when there is either a problem or the likelihood of a problem</li> <li>• Identify or detect patterns within larger and distracting material</li> <li>• Apply suitable scientific methods to identify causes and achieve solutions</li> <li>• Use logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems by, for example: <ul style="list-style-type: none"> <li>◦ Applying general rules to specific issues to produce reasonable conclusions</li> <li>◦ Combining pieces of information to form reasonable conclusions or rules</li> </ul> </li> <li>• Use creative thinking and problem solving to challenge assumptions, innovate, make new proposals, and build on existing ideas</li> <li>• Seek advice from senior colleagues as appropriate</li> <li>• Make recommendations for improved workflows or scientific solutions</li> <li>• Support new investigations and follow-up experiments for routine and non-routine analytical tasks</li> <li>• Take responsibility for personal development, demonstrating commitment to learning and self-improvement.</li> </ul> |                         |

| Section |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Relative importance (%) |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| 7       | <b>Trends in applied Chemistry</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>10</b>               |
|         | <p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> <li>• The interdisciplinary nature of science</li> <li>• The role of applied chemistry in scientific developments</li> <li>• The growing impact of digitization</li> <li>• The growing importance of sustainability</li> <li>• New ethical concerns derived from new possibilities.</li> </ul>                                                                                                                                                                                                                                                                                       |                         |
|         | <p>The individual shall be able to:</p> <ul style="list-style-type: none"> <li>• Install, commission and test automated laboratory systems</li> <li>• Install and configure programs</li> <li>• Develop simple programs</li> <li>• Switch on, switch off and operate automated laboratory systems</li> <li>• Optimize and implement adjustments and changes to automated laboratory systems</li> <li>• Maintain and service automated laboratory systems</li> <li>• Systematically search, localize, and eliminate faults, defects, and malfunctions on automated laboratory systems</li> <li>• Respond appropriately to change and change management processes.</li> </ul> |                         |
|         | <b>Total</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>100</b>              |

## 3 The Assessment Strategy and Specification

### 3.1 General guidance

Assessment is governed by the WorldSkills Assessment Strategy. The Strategy establishes the principles and techniques to which WorldSkills assessment and marking must conform.

Expert assessment practice lies at the heart of the WorldSkills Competition. For this reason, it is the subject of continuing professional development and scrutiny. The growth of expertise in assessment will inform the future use and direction of the main assessment instruments used by the WorldSkills Competition: the Marking Scheme, Test Project, and Competition Information System (CIS).

Assessment at the WorldSkills Competition falls into two broad types: Measurement and Judgement. For both types of assessment, the use of explicit benchmarks against which to assess each Aspect is essential to guarantee quality.

The Marking Scheme must follow the weightings within the Standards. The Test Project is the assessment vehicle for the skill competition, and therefore also follows the Standards. The CIS enables the timely and accurate recording of marks; its capacity for scrutiny, support, and feedback is continuously expanding.

The Marking Scheme, in outline, will lead the process of Test Project design. After this, the Marking Scheme and Test Project will be designed, developed, and verified through an iterative process, to ensure that both together optimize their relationship with the Standards and the Assessment Strategy. They will be agreed by the Experts and submitted to WSI for approval together, to demonstrate their quality and conformity with the Standards.

Prior to submission for approval to WSI, the Marking Scheme and Test Project will liaise with the WSI Skill Advisors for quality assurance and to benefit from the capabilities of the CIS.

## 4 Assessment Design and Practice

### 4.1 General guidance

This section describes the role and place of the Marking Scheme, how the Experts will assess Competitors' work as demonstrated through the Test Project, and the procedures and requirements for marking.

The Marking Scheme is the pivotal instrument of the WorldSkills Competition, in that it ties assessment to the standard that represents each skill competition, which itself represents a global occupation. It is designed to allocate marks for each assessed aspect of performance in accordance with the weightings in the Standards.

By reflecting the weightings in the Standards, the Marking Scheme establishes the parameters for the design of the Test Project. Depending on the nature of the skill competition and its assessment needs, it may initially be appropriate to develop the Marking Scheme in more detail as a guide for Test Project design. Alternatively, initial Test Project design can be based on the outline Marking Scheme. From this point onwards the Marking Scheme and Test Project should be developed together.

Section 2.1 above indicates the extent to which the Marking Scheme and Test Project may diverge from the weightings given in the Standards, if there is no practicable alternative.

For integrity and fairness, the Marking Scheme and Test Project are increasingly designed and developed by one or more Independent Test Project Designer(s) with relevant expertise. In these instances, the Marking Scheme and Test Project are unseen by Experts until immediately before the start of the skill competition, or competition module. Where the detailed and final Marking Scheme and Test Project are designed by Experts, they must be approved by the whole Expert group prior to submission for independent validation and quality assurance. Please see the Competition Rules for further details.

Experts and Independent Test Project Designers are required to submit their Marking Schemes and Test Projects for review, verification, and validation well in advance of completion. They are also expected to work with their Skill Advisor, reviewers, and verifiers, throughout the design and development process, for quality assurance and in order to take full advantage of the CIS's features.

In all cases a draft Marking Scheme must be entered into the CIS at least eight weeks prior to the Competition. Skill Advisors actively facilitate this process.

### 4.2 Assessment Criteria

The main headings of the Marking Scheme are the Assessment Criteria. These headings are derived before, or in conjunction with, the Test Project. In some skill competitions the Assessment Criteria may be similar to the section headings in the Standards; in others they may be different. There will normally be between five and nine Assessment Criteria. Whether or not the headings match, the Marking Scheme as a whole must reflect the weightings in the Standards.

Assessment Criteria are created by the person or people developing the Marking Scheme, who are free to define the Criteria that they consider most suited to the assessment and marking of the Test Project. Each Assessment Criterion is defined by a letter (A-I). **The Assessment Criteria, the allocation of marks, and the assessment methods, should not be set out within this Technical Description. This is because the Criteria, allocation of marks, and assessment**

methods all depend on the nature of the Marking Scheme and Test Project, which is decided after this Technical Description is published.

The Mark Summary Form generated by the CIS will comprise a list of the Assessment Criteria and Sub Criteria.

The marks allocated to each Criterion will be calculated by the CIS. These will be the cumulative sum of marks given to each Aspect within that Assessment Criterion.

## 4.3 Sub Criteria

Each Assessment Criterion is divided into one or more Sub Criteria. Each Sub Criterion becomes the heading for a WorldSkills marking form. Each marking form (Sub Criterion) contains Aspects to be assessed and marked by Measurement or Judgement, or both Measurement and Judgement.

Each marking form (Sub Criterion) specifies both the day on which it will be marked, and the identity of the marking team.

## 4.4 Aspects

Each Aspect defines, in detail, a single item to be assessed and marked, together with the marks, and detailed descriptors or instructions as a guide to marking. Each Aspect is assessed either by Measurement or by Judgement.

The marking form lists, in detail, every Aspect to be marked together with the mark allocated to it. The sum of the marks allocated to each Aspect must fall within the range of marks specified for that section of the Standards. This will be displayed in the Mark Allocation Table of the CIS, in the following format, when the Marking Scheme is reviewed from C-8 weeks. (Section 4.1 refers.)

| TOTAL<br>MARKS | STANDARDS<br>SPECIFICATION SECTION | CRITERIA |      |       |       |       |       |       |       | TOTAL MARKS PER<br>SECTION | WSSS MARKS PER<br>SECTION | VARIANCE |      |
|----------------|------------------------------------|----------|------|-------|-------|-------|-------|-------|-------|----------------------------|---------------------------|----------|------|
|                |                                    |          | A    | B     | C     | D     | E     | F     | G     | H                          |                           |          |      |
|                |                                    | 1        | 5.00 |       |       |       |       |       |       |                            | 5.00                      | 5.00     | 0.00 |
|                |                                    | 2        |      | 2.00  |       |       |       |       | 7.50  |                            | 9.50                      | 10.00    | 0.50 |
|                |                                    | 3        |      |       |       |       |       |       |       | 11.00                      | 11.00                     | 10.00    | 1.00 |
|                |                                    | 4        |      |       | 5.00  |       |       |       |       |                            | 5.00                      | 5.00     | 0.00 |
|                |                                    | 5        |      |       |       | 10.00 | 10.00 | 10.00 |       |                            | 30.00                     | 30.00    | 0.00 |
|                |                                    | 6        |      | 8.00  | 5.00  |       |       |       | 2.50  | 9.00                       | 24.50                     | 25.00    | 0.50 |
|                |                                    | 7        |      |       | 10.00 |       |       |       | 5.00  |                            | 15.00                     | 15.00    | 0.00 |
|                |                                    |          | 5.00 | 10.00 | 20.00 | 10.00 | 10.00 | 10.00 | 15.00 | 20.00                      | 100.00                    | 100.00   | 2.00 |

## 4.5 Assessment and marking

There is to be one marking team for each Sub Criterion, whether it is assessed and marked by Judgement, Measurement, or both. The same marking team must assess and mark all Competitors. Where this is impracticable (for example where an action must be done by every Competitor simultaneously, and must be observed doing so), a second tier of assessment and marking will be put in place, with the approval of the Competitions Committee Management Team. The marking teams must be organized to ensure that there is no compatriot marking in any circumstances. (Section 4.6 refers.)

## 4.6 Assessment and marking using Judgement

Judgement uses a scale of 0-3. To apply the scale with rigour and consistency, Judgement must be conducted using:

- benchmarks (criteria) for detailed guidance for each Aspect (in words, images, artefacts, or separate guidance notes). This is documented in the Standards and Assessment Guide.
- the 0-3 scale to indicate:
  - 0: performance below industry standard
  - 1: performance meets industry standard
  - 2: performance meets and, in specific respects, exceeds industry standard
  - 3: performance wholly exceeds industry standard and is judged as excellent

Three Experts will judge each Aspect, normally simultaneously, and record their scores. A fourth Expert coordinates and supervises the scoring, and checks their validity. They also act as a judge when required to prevent compatriot marking.

## 4.7 Assessment and marking using Measurement

Normally three Experts will be used to assess each Aspect, with a fourth Expert supervising. In some circumstances the team may organize itself as two pairs, for dual marking. Unless otherwise stated, only the maximum mark or zero will be awarded. Where they are used, the benchmarks for awarding partial marks will be clearly defined within the Aspect. To avoid errors in calculation or transmission, the CIS provides a large number of automated calculation options, the use of which is mandated.

## 4.8 The use of Measurement and Judgement

Decisions regarding the choice of criteria and assessment methods will be made during the design of the competition through the Marking Scheme and Test Project.

## 4.9 Skill assessment strategy and procedures

WorldSkills is committed to continuous improvement including reviewing past limitations and building on good practice. The following skill assessment strategy and procedures for this skill competition take this into account and explain how the marking process will be managed.

Marking Scheme design will begin with the broad allocation of marks referenced to WSOS weightings, according to the scope of each module and the requirement to match those weightings. The Marking Scheme and modules will then be designed in detail and completed together. This will ensure that:

- There is a full match between the Marking Scheme and the WSOS;
- There is consistency of approach and standards across the modules;
- The results of assessment will authentically reflect the quality of the Competitor relative to their work role in detail and overall.

The nature of the WSOS indicates that, for validity, the ratio of Measurement to Judgement is in the range of 5:1 to 10:1,

The Test Project is organized in two (2) to six (6) modules to be completed in four days. The modules may be of different durations, and have different values in marks, according to the WorldSkills Occupational Standards.

The modular structure will limit the numbers of assessing Experts available to assess and mark work processes in each module. One leading Expert is identified for each module, based on their particular expertise. They will assess and mark work processes as they are carried out. The Experts who mark will also be paired in order to change places to avoid compatriot marking.

When each module has been completed by the Competitor, Experts will form Marking Teams of three, or four for supervision, to assess and mark outcomes. This will support compliance with assessment procedures and enable cross-module parity of assessment and marking.

One or more Independent Assessors may be available to support standardization and increase openness.

## 5 The Test Project

### 5.1 General notes

Sections 3 and 4 govern the development of the Test Project. These notes are supplementary.

Whether it is a single entity, or a series of stand-alone or connected modules, the Test Project will enable the assessment of the applied knowledge, skills, and behaviours set out in each section of the WSOS.

The purpose of the Test Project is to provide full, balanced, and authentic opportunities for assessment and marking across the Standards, in conjunction with the Marking Scheme. The relationship between the Test Project, Marking Scheme, and Standards will be a key indicator of quality, as will be its relationship with actual work performance.

The Test Project will not cover areas outside the Standards or affect the balance of marks within the Standards other than in the circumstances indicated by Section 2. This Technical Description will note any issues that affect the Test Project's capacity to support the full range of assessment relative to the Standards. Section 2.1 refers.

The Test Project will enable knowledge and understanding to be assessed solely through their applications within practical work. The Test Project will not assess knowledge of WorldSkills rules and regulations.

Most Test Projects and Marking Schemes are now designed and developed independently of the Experts. They are designed and developed either by the Skill Competition Manager, or an Independent Test Project Designer, normally from C-12 months. They are subject to independent review, verification, and validation. (Section 4.1 refers.)

The information provided below will be subject to what is known at the time of completing this Technical Description, and the requirement for confidentiality.

Please refer to the current version of the Competition Rules for further details.

### 5.2 Format/structure of the Test Project

The Test Project is a series of two (2) to six (6) standalone modules.

### 5.3 Test Project design requirements

Test Projects should reflect the purposes, structures, processes, and outcomes of the occupational role they are based on. They should aim to be a small-scale version of that role. Before focusing on practicalities, SMTs should show how the Test Project design will provide full, balanced, and authentic opportunities for assessment and marking across the Standards, as set out in Section 5.1.

The Test Project will cover all features of the role: both specific functions and overall role execution. It will sample both traditional and modern digitalized methods, and the purposes for which they are carried out. In common with all WorldSkills skill competitions the competition focuses on the occupation and not jobs. That is a challenge because Chemical Laboratory Technicians often specialize in certain techniques. The Test Project may consist of:

- Sampling;
- Sample preparation;
- Identification of material constants and chemical parameters;

- Qualitative analysis;
- Quantitative analysis;
- Gravimetry;
- Elementary analysis;
- Photometry;
- Gas chromatography;
- High pressure liquid chromatography;
- Mass spectrometry;
- Spectroscopy;
- Titrimetric analysis;
- Electrochemical analysis;
- Inorganic and organic synthesis;
- Data documentation and interpretation;
- Quality management;
- Work management and health and safety;
- Waste disposal.

The competition will assess Competitors' ability to solve problems, be accurate, meticulous, creative, and innovative, through the modules set, which are practical.

The competition is set up with stations (one for each module instead of setting up a workstation for each Competitor). Each workstation will cover a different analysing method and additionally different tasks covering sectors 1, 2, 4, 5, 6 and 7 so that the whole range of the WorldSkills Occupational Standards are covered. For all tasks where we use equipment for instrumented analytics (which can be from a lot of different suppliers) just the preparation of the sample and the interpretation of the results are done by the Competitor; the operating of the equipment is done by a technician.

## 5.4 Test Project coordination and development

The Test Project MUST be submitted using the templates provided by WorldSkills International ([www.worldskills.org/expertcentre](http://www.worldskills.org/expertcentre)). Use the Word template for text documents and DWG template for drawings.

### 5.4.1 Test Project coordination (preparation for Competition)

Coordination of the Test Project/modules will be undertaken by the Skill Competition Manager.

### 5.4.2 Who develops the Test Project/modules

The Test Project/modules are developed by an Independent Test Project Designer (ITPD) in collaboration with the Skill Competition Manager.

### 5.4.3 When is the Test Project developed

The Test Project/modules are developed according to the following timeline:

| Time                                         | Action                                                                                                           |
|----------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| Fifteen (15) months prior to the Competition | The ITPD is identified and a Confidentiality Agreement between WSI and the ITPD is organized.                    |
| Two (2) months prior to the Competition      | The Test Project documents are sent to the WorldSkills International Skills Competitions Administration Manager. |
| At the Competition on C-2                    | The Test Project/documents are presented to Experts.                                                             |

| Time                                               | Action                                                 |
|----------------------------------------------------|--------------------------------------------------------|
| At the Competition at the beginning of each module | The Test Project/modules are presented to Competitors. |

## 5.5 Test Project initial review and verification

The purpose of a Test Project is to create a challenge for Competitors which authentically represents working life for an outstanding practitioner in an identified occupation. By doing this, the Test Project will apply the Marking Scheme and fully represent the WSOS. In this way it is unique in its context, purpose, activities, and expectations.

To support Test Project design and development, a rigorous quality assurance and design process is in place (Competition Rules sections 10.6-10.7 refer.) Once approved by WorldSkills, the Independent Test Project Designer (ITPD) is expected to identify one or more independent expert(s), and trusted individuals initially to review the Independent Test Project Designer's ideas and plans, and subsequently to verify the Test Project, prior to validation.

A Skill Advisor will ensure and coordinate this arrangement, to guarantee the timeliness and thoroughness of both initial review, and verification, based on the risk analysis that underpins Section 10.7 of the Competition Rules.

## 5.6 Test Project validation

The Skill Competition Manager coordinates the validation of the Test Project/modules and will ensure that it can be completed within the material, equipment, knowledge, and time constraints of Competitors.

## 5.7 Test Project circulation

The Test Project/modules are not circulated prior to the Competition. The Test Project/modules are presented to Experts on C-2 and to Competitors at the beginning of each module.

## 5.8 Test Project change

Due to the Test Project being developed by an Independent Test Project Designer (ITPD), there is no change required to be made to the Test Project/modules at the Competition. Exceptions are amendments to technical errors in the Test Project documents and according to infrastructure limitations.

## 5.9 Test Project translation and use of Interpreters

The Test Project documentation and the Mark Summary Form may be translated into the language of the Competitors' choice, however, it is the Member's responsibility to translate the Test Project documents, either by a compatriot Interpreter or by the Expert. Refer to the Skill Management Plan for time allocation for translation.

For more information refer to **Competition Rule 10.12**.

## 6 Skill management and communication

### 6.1 Discussion Forum

Prior to the Competition, all discussion, communication, collaboration, and decision making regarding the skill competition must take place on the WorldSkills skill-specific Discussion Forum. (<http://forums.worldskills.org>). Skill related decisions and communication are only valid if they take place on the WorldSkills Discussion Forum. The Chief Expert (or an Expert Lead appointed by the Skill Management Team) will be the moderator for this Discussion Forum. Refer to the Competition Rules for the timeline of communication and competition development requirements.

### 6.2 Competitor information

All information for registered Competitors is available from the Competitor Centre ([www.worldskills.org/competitorcentre](http://www.worldskills.org/competitorcentre)).

This information includes:

- Competition Rules
- Technical Descriptions
- Mark Summary Form (where applicable)
- Test Projects (where applicable)
- Infrastructure List
- WorldSkills Health, Safety, and Environment Policy and Regulations
- Other Competition-related information

### 6.3 Test Projects and Marking Schemes

Circulated Test Projects will be available from [www.worldskills.org/testprojects](http://www.worldskills.org/testprojects) and the Competitor Centre ([www.worldskills.org/competitorcentre](http://www.worldskills.org/competitorcentre)).

### 6.4 Day-to-day management

The day-to-day management of the skill competition during the Competition is defined in the Skill Management Plan that is created by the Skill Management Team. The Skill Management Team comprises the Skill Competition Manager, Chief Expert, and the Expert Leads. The Skill Management Plan is progressively developed in the six (6) months prior to the Competition and finalized at the Competition. The Skill Management Plan can be viewed in the Expert Centre ([www.worldskills.org/expertcentre](http://www.worldskills.org/expertcentre)).

### 6.5 General best practice procedures

General best practice procedures clearly delineate the difference between what is a best practice procedure and skill-specific rules (section 9). General best practice procedures are those where Experts and Competitors CANNOT be held accountable as a breach to the Competition Rules or skill-specific rules which would have a penalty applied as part of the Issue and Dispute Resolution procedure including the Code of Ethics and Conduct Penalty System. In some cases, general best practice procedures for Competitors may be reflected in the Marking Scheme.

| Topic/task                              | Best practice procedure                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Release of an uncirculated Test Project | <ul style="list-style-type: none"> <li>The uncirculated Test Project and corresponding Marking Scheme are to be released to the Experts on C-2. No parts of the Test Project or the Marking Scheme are to be taken outside the workshop at any time of the Competition.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Translation of the Test Project         | <ul style="list-style-type: none"> <li>The Skill Management Team (SMT) provides a draft translation of the Test Project on the actual date of the module execution. Official Interpreters are given 30 minutes time immediately before the familiarization time to verify that translation is correct and correct all potential mistakes. Although the Skill Competition Manager will do their best to make sure that translation has been performed in a highly professional way the final responsibility lies on the official Interpreter of the corresponding National Team. In case of any discrepancies between the English version and national version hereof, the English version shall prevail.</li> </ul> |
| Use of tools                            | <ul style="list-style-type: none"> <li>Interpreters have rights to use their own dictionaries or translation devices approved by the Skill Competition Manager and the Chief Expert or Internet access to the corresponding translation tools or online dictionaries provided by the Competition Organizer.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                              |
| Communication with the Competitor       | <ul style="list-style-type: none"> <li>An Interpreter can attend to the Competitor any time during the Competition accompanied by two Expert other than the compatriot. The Skill Competition Manager or the Chief Expert should be notified. The nature of the question shall be described to the Experts who shall witness communication. An Expert shall not permit or witness communication for their compatriot Competitor.</li> </ul>                                                                                                                                                                                                                                                                         |
| Equipment failure                       | <ul style="list-style-type: none"> <li>If equipment or tools which are brought by the Competitor fail, no extra time is allowed.</li> <li>If equipment or tools supplied by the Competition Organizer fail extra time is allowed only if the Technician of the sponsor or supplying company specifies and proves it is not a "user error".</li> </ul>                                                                                                                                                                                                                                                                                                                                                               |

## 7 Skill-specific safety requirements

### 7.1 Personal Protective Equipment

Refer to WorldSkills Safety Policy and Regulations for Host country or region regulations.

| Task                                               | Safety glasses with side protection | Laboratory gloves (nitrile or latex) | Laboratory coat (knee-length) | Safety shoes (chemically resistant, ant-static) | Long Trousers (no open ankles) | Hear protection |
|----------------------------------------------------|-------------------------------------|--------------------------------------|-------------------------------|-------------------------------------------------|--------------------------------|-----------------|
| General PPE for safe areas                         |                                     |                                      |                               | √                                               | √                              |                 |
| During working/ commissioning time in the workshop | √                                   |                                      | √                             | √                                               | √                              |                 |
| During working/ commissioning in the workstation   | √                                   | √                                    | √                             | √                                               | √                              |                 |
| Working with machines and tool over 85 dB          | √                                   | √                                    | √                             | √                                               | √                              | √               |

## 8 Materials and equipment

### 8.1 Infrastructure List

The Infrastructure List details all equipment, materials, and facilities provided by the Competition Organizer.

The Infrastructure List is available at [www.worldskills.org/infrastructure](http://www.worldskills.org/infrastructure).

The Infrastructure List specifies the items and quantities requested by the Skill Management Team for the next Competition. The Competition Organizer will progressively update the Infrastructure List specifying the actual quantity, type, brand, and model of the items. Note that in some cases details of specific materials and/or manufacturer specifications may remain secret and will not be released prior to the Competition. These items may include those for fault finding modules or modules not circulated.

At each Competition, the Skill Management Team must review and update the Infrastructure List in preparation for the next Competition. The Skill Competition Manager must advise the Director of Skills Competitions of any increases in space and/or equipment.

At each Competition, the Technical Observer must audit the Infrastructure List that was used at that Competition for the upcoming WorldSkills Competition.

The Infrastructure List does not include items that Competitors and/or Experts are required to bring and items that Competitors are not allowed to bring – they are specified below.

### 8.2 Material or manufacturer specifications

Specific material and/or manufacturer specifications required to allow the Competitor to complete the Test Project will be supplied by the Competition Organizer and are available from [www.worldskills.org/infrastructure](http://www.worldskills.org/infrastructure) located in the Expert Centre. However, note that in some cases details of specific materials and/or manufacturer specifications may remain secret and will not be released prior to the Competition. These items may include those for fault finding modules or modules not circulated.

The Competition Organizer will upload specifications of the used equipment in the Infrastructure List.

Six (6) months prior to the competition Competitors are notified of any Competition Organizer requirements with regard to safety and/or equipment.

### 8.3 Competitors toolbox

Competitors are not allowed to send a toolbox to the Competition. All tools are provided by the Competition Organizer.

### 8.4 Materials, equipment, and tools supplied by Competitors

It is not applicable for Competitors to bring materials, equipment, and tools to the Competition.

However, Competitors are required to supply their own Personal Protective Equipment as specified in section 7 skill-specific safety requirements.

## 8.5 Materials, equipment, and tools supplied by Experts

Experts are required to supply their own Personal Protective Equipment as specified in section 7 skill-specific safety requirements.

Experts are responsible that Interpreters bring their own PPE.

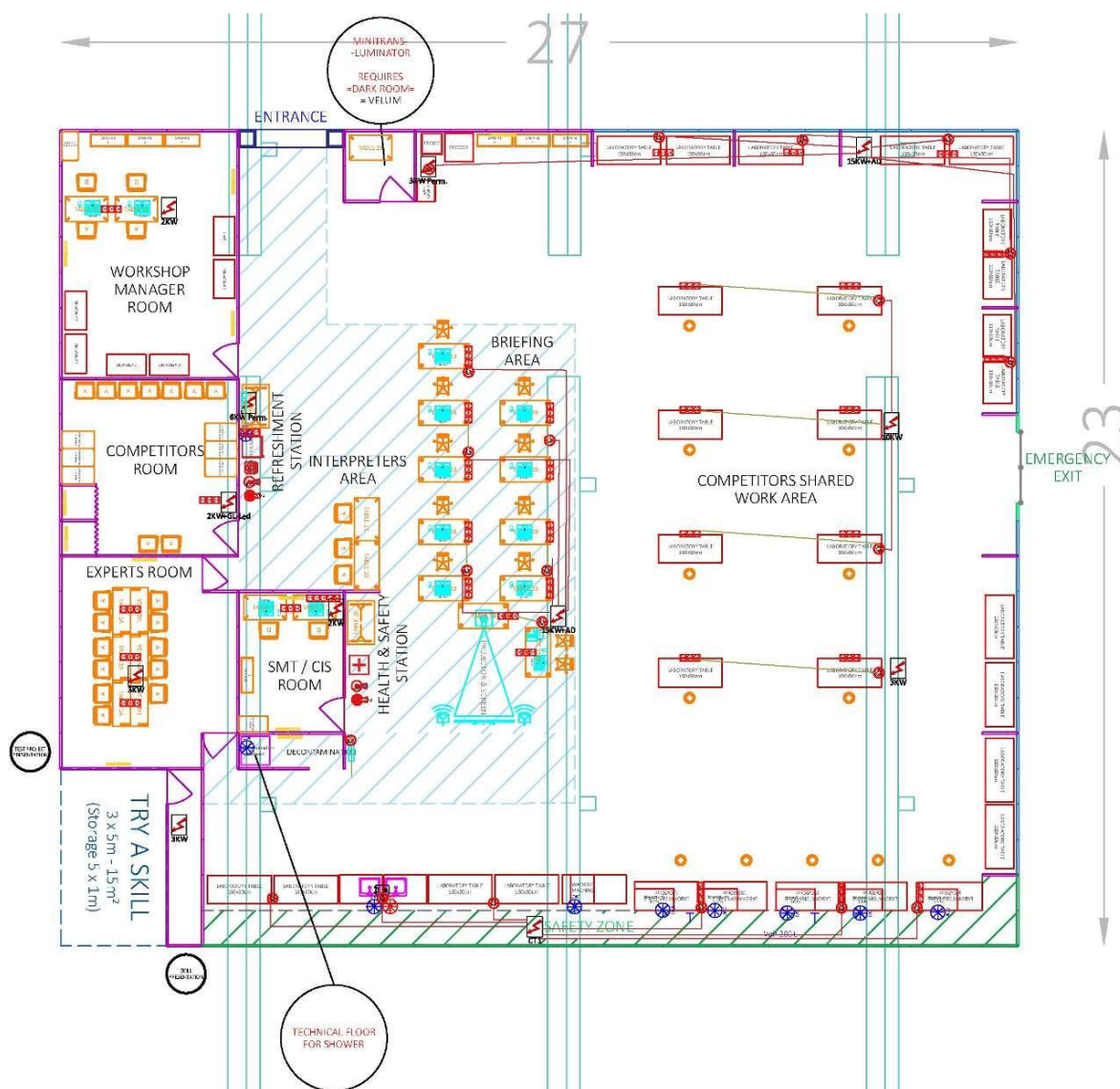
## 8.6 Materials and equipment prohibited in the skill area

Competitors and Experts are prohibited to bring any materials or equipment not listed in section 8.3 and section 8.4.

## 8.7 Proposed workshop and workstation layouts

Workshop layouts from previous competitions are available at [www.worldskills.org/sitelayout](http://www.worldskills.org/sitelayout).

### Example workshop layout



## 9 Skill-specific rules

### 9.1 General notes

Skill-specific rules cannot contradict or take priority over the Competition Rules. They do provide specific details and clarity in areas that may vary from skill competition to skill competition. This includes but is not limited to personal IT equipment, data storage devices, Internet access, procedures and workflow, and documentation management and distribution. Breaches of these rules will be solved according to the Issue and Dispute Resolution procedure including the Code of Ethics and Conduct Penalty System.

### 9.2 Skill-specific rules

| Topic/task                                                       | Skill-specific rule                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Use of technology – USB, memory sticks                           | <ul style="list-style-type: none"> <li>Competitors and Experts are not allowed to bring memory sticks into the workshop. In situations where memory sticks are brought into the workshop these shall be collected by a member of the SMT who shall lock them away until end of the Competition.</li> <li>The Skill Competition Manager, Chief Expert, and Interpreters are allowed to bring memory sticks into the workshop.</li> </ul>                                                             |
| Use of technology – personal laptops, tablets, and mobile phones | <ul style="list-style-type: none"> <li>Competitors are not allowed to bring personal laptops, tablets, or mobile phones into the workshop. In situations where personal devices brought into the workshop these shall be stored in the personal lockers and released at the end of the day or during lunch time.</li> <li>Skill Competition Manager, Chief Expert, Experts, and Interpreters are allowed to bring and use personal laptops, tablets, or mobile phones into the workshop.</li> </ul> |
| Use of technology – personal photo and video taking devices      | <ul style="list-style-type: none"> <li>Skill Competition Manager, Chief Expert, Competitors, Experts and Interpreters are allowed to use personal photo and video taking devices in the workshop at the conclusion of the competition on C4 only.</li> </ul>                                                                                                                                                                                                                                        |
| Assessment                                                       | <ul style="list-style-type: none"> <li>Skill Competition Manager, Chief Expert, Competitors, Experts, and Interpreters are not permitted to take paper or digital copies of the Marking Scheme and Competitors reports out of the workshop until the competition has finished on C4.</li> </ul>                                                                                                                                                                                                     |
| Drawings, recording information                                  | <ul style="list-style-type: none"> <li>Competitors and Interpreters are not allowed to bring any prepared drawings or documented information into the workshop.</li> <li>Skill Competition Manager, Chief Expert, and Experts are allowed to bring prepared drawings or documented information into the workshop only if the corresponding task was assigned by the Skill Competition Manager or the Chief Expert (for example, homework for Mandatory Assessment Training).</li> </ul>             |

| Topic/task | Skill-specific rule                                                                                                                              |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
|            | <ul style="list-style-type: none"> <li>• All Test Project documents must be stored in the Expert room in lockers by the Chief Expert.</li> </ul> |

## 10 Expert knowledge and experience

### 10.1 Requirements

Experts appointed for this skill competition must have the following knowledge and experience for the appropriate occupation or work role as documented in **section 1.1.2**.

**The minimum and the desirable qualification:**

- Technical Degree in Chemistry or Chemical Analysis.
- Desirable bachelor's and master's degrees in Chemistry, Chemical Engineering, or related field.

**Industry experience or TVET experience:**

- With minimum 5 years of experience in chemical analysis, methods development and validation or quality control at **industrial laboratories**.

OR

- With minimum 5 years of experience teaching chemistry at Technical Institutes or Universities, with a focus on Analytical Chemistry, Instrumental Chemistry, and Organic Chemistry Laboratory.

**Areas of specialism:**

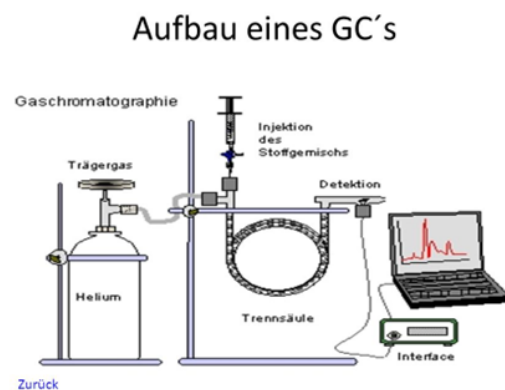
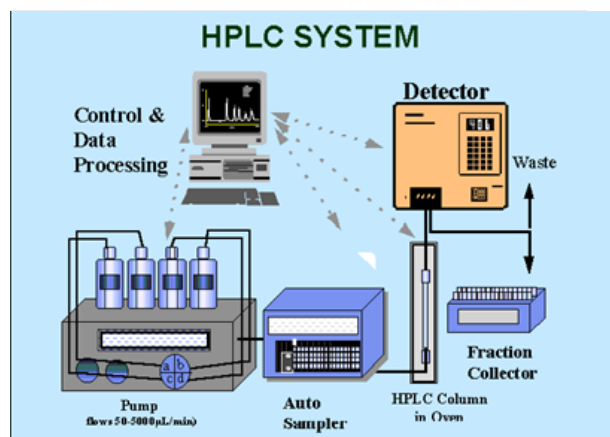
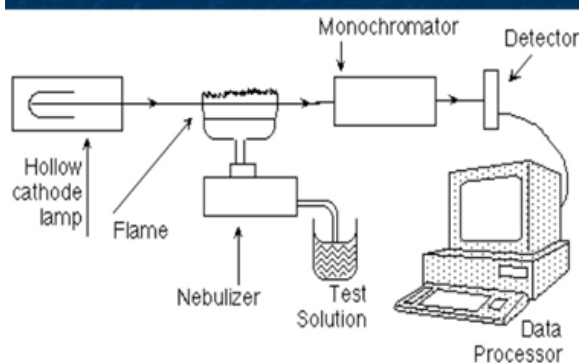
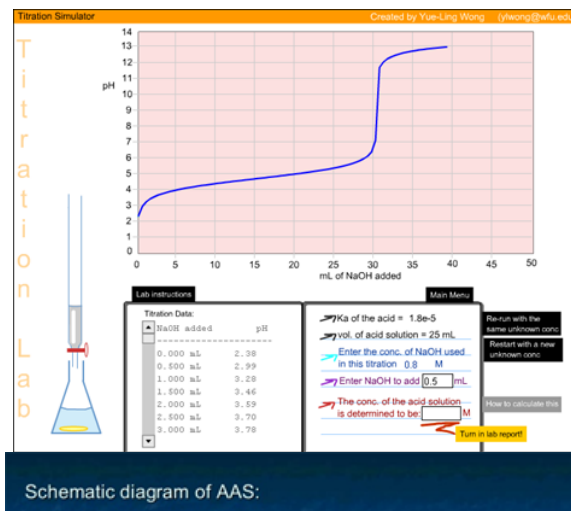
- Laboratory equipment handling, configuration, inspection, installation, commissioning and troubleshooting.
- Sample treatment.
- Classical and instrumental titration – fundamentals and techniques.
- UV - Vis Spectrophotometry – fundamentals and techniques.
- FTIR Spectroscopy – fundamentals and techniques.
- Organic Synthesis and purification – fundamentals and techniques.

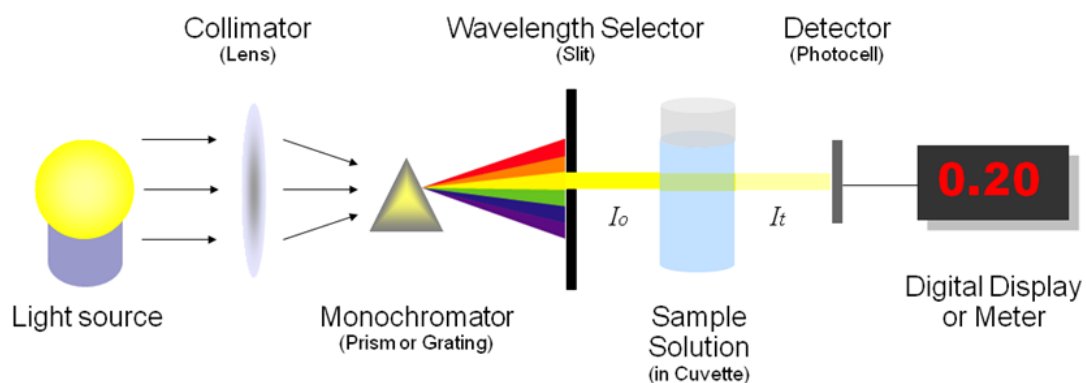
# 11 Visitor and media engagement

## 11.1 Engagement methods

Following is a list of possible ways to maximize visitor and media engagement:

All can be explained to the audience in a very simple way using simulation software and education material exists (see below some examples):





- To invite visitors to try themselves in the profession: an interactive site where visitors and members of the press can try themselves as a chemist (a simple titrimetric analysis can be done by the spectators themselves. Visitors could bring a sample of water for analysis of which parts can be done by visitors themselves too).
- To use demonstration screens showing the work progress and information about the Competitor, advertising career prospects.

# 12 Sustainability

## 12.1 Sustainable practices

This skill competition will focus on the sustainable practices below:

With the format of using stations we can ensure another main goal of WorldSkills, besides the quality and excellence of a competition, the sustainability of it. That means we can reduce the needed infrastructure (devices, equipment, tools, and so on) to a minimum.

Working with a station approach means also to reduce needed glassware (max. two sets per station plus some spare parts) and number of instruments (max. one per station plus one spare instrument).

All equipment and glassware can be reused again. The amount of chemicals required is almost zero and some of them can be recycled too.

Competition Organizer (IL minimized by using stations as competition format):

- Glassware for different task;
- Analytical equipment (including technicians);
- Chemicals;
- Laboratory benches and chairs;
- Exhausts;
- Energy supply like electricity, water, gas, and so on.

## 13 References for industry consultation

### 13.1 General notes

WorldSkills is committed to ensuring that the WorldSkills Occupational Standards fully reflect the dynamism of internationally recognized best practice in industry and business. To do this WorldSkills approaches a number of organizations across the world that can offer feedback on the draft Description of the Associated Role and WorldSkills Occupational Standards on a two-yearly cycle.

In parallel to this, WSI consults three international occupational classifications and databases:

- ISCO-08: (<http://www.ilo.org/public/english/bureau/stat/isco/isco08/>)
- ESCO: (<https://ec.europa.eu/esco/portal/home> )
- O\*NET OnLine ([www.onetonline.org/](http://www.onetonline.org/))

### 13.2 References

This WSOS (Section 2) most closely resembles Chemical Technicians:

<https://www.onetonline.org/link/summary/19-4031.00>

and Chemistry Technician:

<http://data.europa.eu/esco/occupation/87775d69-ae88-449e-ad71-6f9875711816>

These links can also be used to explore adjacent occupations.

ILO 3111

The following table indicates which organizations were approached and provided valuable feedback for the Description of the Associated Role and WorldSkills Occupational Standards in place for WorldSkills Shanghai 2026.

| Organization                               | Contact name                              |
|--------------------------------------------|-------------------------------------------|
| AXILS GmbH                                 | Siegfried Ingruber, Training & Consulting |
| Bildungszentrum Lenzing                    | Michaela Pusch, Chemistry Trainer         |
| CCV de Colombia                            | Jesús Acedo, Service Manager              |
| Novartis Pharmaceutical Manufacturing GmbH | Lisa Voggenberger, Senior QC Specialist   |

## 14 Appendix

### 14.1 Appendix information

Not applicable.