

**WORLDSKILLS SINGAPORE 2025**  
**TECHNICAL DESCRIPTION**  
**WATER TECHNOLOGY**



**Skill Competition**

1. This competition covers a broad range of tasks related to the operation of water and wastewater treatment plants and maintenance of the critical equipment. The specific skills include chemistry, biology, mechanical, electrical, automaton and environmental protection.
2. Conducted as an individual event, competitors are given around 14 hours over 3 days to complete the Test Projects for this competition.

**Scope of Work**

3. Competitors must be able to demonstrate competencies in the following areas:

3.1 **Work Organization and Management**

The individual needs to know and understand:

- Principles and applications of safe working in general and for water and wastewater treatment and operation in the networks and in solid waste management;
- The purposes, uses, care, calibration and maintenance of all equipment and materials, together with their safety implications;
- Environmental, Health and safety principles and their application to good housekeeping in the work environment;
- Principles and methods for work organization, control and management;
- Principles of team working and their applications;
- The personal skills, strengths and needs that relate to the roles, responsibilities and duties of others, individually and collectively;
- The parameters within which activities need to be scheduled.

The individual shall be able to:

- Prepare and maintain a safe, tidy and efficient work area;
- Manage and dispose of the refuses produced in the work area;
- Prepare for the tasks in hand, with full regard to environment, health and safety;
- Schedule work to maximize efficiency and minimize disruption;
- Select and use all equipment and materials safely and in compliance with manufacturers' instructions;
- Apply or exceed health and safety standards applying to the environment, equipment and materials;
- Understand the various impact, e.g., business, EHS, corporate image etc., when non-compliance occurs, and be able to conduct

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RCA so as to restore the work area to an appropriate state and condition in a timely manner;

- Contribute to team performance broadly and specifically;
- Give feedback and support.

**3.2 Communication and interpersonal skills**

The individual needs to know and understand:

- The range and purposes of documentation in both paper and digital form;
- The technical language associated with the occupation and the industry;
- The standards required for routine and abnormal reporting in oral, written and digital form (e.g. values, figures, units, minimal information, recommendations);
- The procedures and ways for communication with clients, team members and others;
- The purposes and techniques for generating, maintaining and presenting records.

The individual shall be able to:

- Read, interpret, and extract technical data and instructions from documentation in any available format;
- Communicate by oral, written and digital means to ensure clarity, effectiveness and efficiency;
- Use a standard range of communication technologies;
- Discuss complex technical principles and applications with others;
- Complete reports and respond to issues and questions arising;
- Respond to clients' needs face-to-face and indirectly;
- Gather information and prepare documentation targeted to and as required by the client or client group.

**3.3 Electrical**

The individual needs to know and understand:

- The basic principles of electricity;
- The basic principles of electrical systems;
- The basics of electrical control of machines and actuators;
- Circuit- and P&ID as well as operating manuals and/or instruction manuals;
- The protection methods of electrical systems;
- The dangers/hazards of electrical systems;
- Technique for safe de-commissioning, fault finding, troubleshooting and commissioning.

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- Knowledge of applicable codes and standards, both industry and in-house.
- Develop strategies for problem solving;
- Methods and procedures for identifying high energy consumers;
- Strategies for energy efficiency.

The individual shall be able to:

- Disengage electrical equipment commonly used in water and wastewater treatment plants;
- Identify and resolve areas of uncertainty within the briefs or specifications;
- Identify different components within a control cabinet and their functionality;
- Exchange defective components within a control cabinet;
- Raising requisition for spares so as to maintain healthy inventory based on equipment life cycle.
- Take electrical measurements and interpret/verify the results;
- Connect wires/cables according to industrial standards;
- Install, set up and adjust/calibrate electrical and sensor systems as required;
- Ensure connection of all wiring according to the circuit diagram;
- Ensure the functionality of the electrical system (i.e., rotation direction).

### 3.4 Mechanical

The individual needs to know and understand:

- The basics of materials (metals, composites, plastics, etc.), and their respective compatibility, operating and design specifications;
- The basics of different material manufacturing methods;
- The basics of material connection technology;
- The basics of mechanical engineering (mechanics, sealing methods, gear technology, etc.), and the common equipment specifications, e.g. ASME, ANSI, JIS, BS etc.
- The basics of fluid dynamics and thermodynamics;
- Criteria and methods for testing equipment and systems;
- Technique for safe de-commissioning, fault finding (e.g. RCA, FMEA), troubleshooting and commissioning.
- Techniques and options for making mechanical repairs, and to conduct timely testing and inspection for SI equipment (e.g. lifting equipment, pressure vessels, heat exchangers etc.) so as to meet regulatory requirement.
- Develop strategies for problem solving;
- Principles and techniques for generating creative and innovative solution;

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- Water loss and leakage, its potential causes and potential solutions for its prevention.

The individual shall be able to:

- Repair components (up to systems) efficiently;
- Monitor and control process relevant equipment;
- Adjust and/or calibrate systems where necessary, according to instruction manuals;
- Use accessories efficiently;
- Ensure the correct function of the system, and that all equipment is operating within the safe design specifications.
- Adjust process relevant parameters;
- Identify cost drivers and define methods for its minimization;
- Work in a professional manner;
- Identify equipment that requires preventive maintenance and develop/take appropriate measures;
- Create quick and reliable temporary solutions in emergencies.

**3.5 Environmental Protection**

The individual needs to know and understand:

- The logical sequence of network flow and purification steps including the individual treatment system design capacity and operating envelope;
- The hazardous aspects/points for the environment (danger/risk analysis/control measures);
- Different mitigation methods;
- The basic calculations required within water and wastewater network and treatment processes;
- New trends in environmental processes and protection;
- Dangers of relevant hazardous substances used in the networks and plants, and procedures and measures for their safe handling and storage.
- The different potential hazardous sources in the vicinity, their potential contents and their possible effects, both individually and their interactions.
- The contingency plans.

The individual shall be able to:

- Operate all processes or steps in a water or wastewater network and treatment plants;
- Individuals shall be aware of basic industrial design tools / software available for the process design of water and waste water treatment systems.

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- Execute proper preventive or correction actions in order to maintain the efficiency of all treatment processes or steps; and also conduct timely testing and inspection for SI equipment to meet statutory requirement.
- Perform calculations based on given facts;
- Identify potential problem zones and propose remedies accordingly;
- Communicate closely with defined target groups (e.g. Operations / Production Department) to ensure plan changes in the operation / production, which can potentially affect the incoming water conditions, are adequately identified and mitigation plans established.
- Communicate with the defined target groups to give correct information about the types of wastewater that can be discharged to the wastewater collection system;
- Communicate with the defined target groups to give the correct information about a water distribution system, its possible flaws, water quality and shortage periods;
- Take measurement and carry out analyses for process and quality control;
- Monitor and document in compliance with the legal requirements;
- Work in a cost-effective, environmental and hygiene-conscious manner;
- Use different energy forms (electricity, oil, gas, air, water and steam);
- Review the possibilities of economical energy use (i.e.: mitigation of leakage or usage of heat);
- Avoid the use of hazardous substances and make proposals for their replacement;
- Create and evaluate contingency plans to enhance emergencies/crisis management program.

**3.6 Chemical and Biological**

The individual needs to know and understand:

- The basics and principles of solvents and solution preparation, mixing and dilution, including basic calculation; and their MSDS (SDS), handling and storage in the lab.
- The proper use of each specific glassware, analytical equipment or instrument;
- How to read and execute standard analytical assay protocols;
- The basics and principles of sample pre-treatment, storage, sample preserving and sampling;

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- The basics and principles of measuring samples using different techniques (classical and instrumental analysis);
- Basic principles of chemical analysis; and the understanding of international testing methods, e.g. Standard Methods for the Examination of Water and Wastewater published jointly by the American Water Works Association and the Water Pollution Control Federation of the United States.
- Basic principles of biological analysis;
- The basics and principles of the statistical analysis that concern the specific sample (e.g. standard calibration curves, quantification limit, standard deviation);
- Basic operation/function of laboratory equipment, and its safe operating procedures

The individual shall be able to:

- Prepare any kind of chemical reactants or solutions;
- Execute analytical measurement using the proper glassware, equipment and instrument, according to the specific assay protocol;
- Clean and calibrate equipment and instruments before starting the assay protocol;
- Take samples, including its preservation and pre-treatment;
- Laboratory equipment according to their function;
- Follow chemical and biological analysis protocols and quality control, and the proper and safe disposal of samples after analysis.
- Clean and store the equipment and instruments used;
- Estimate the concentration of an unknown sample, using the proper analytical method, protocol and statistical analysis;
- Document results and findings;
- Provide information about the water or wastewater quality, in order to identify problems within water or wastewater treatment plants;
- Acquire information about the water or wastewater quality, in order to identify and execute preventative or corrective actions in the treatment plants;
- Provide information about the water or wastewater quality in order to meet laws and regulations, and to keep people safe and healthy.

### 3.7 Automation and Documentation

The individual needs to know and understand:

- The basic principles of sensor technology;
- The basic principles and functionality of closed loop technology;

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- The basic principles of actuators;
- The basic principles of control technology;
- Knowledge of various common industry codes and standards, e.g. ANSI, IEE, SIL, IEC;
- Techniques for safe de-commissioning, fault finding, troubleshooting, calibrating and commissioning.
- Develop strategies for problem solving.

The individual shall be able to:

- Identify cost drivers and define methods for its minimization;
- Interpret and differentiate circuit diagrams, and the various instrument data sheet.
- Regulate and adjust components for efficient use;
- Identify different automation components within a system and make appropriate adjustments;
- Identify elements within process control, together with their functionality;
- Monitor, control and regulate systems manually and by using control and communication systems;
- Document all data in digital and/or paper form.

**3.8 Application of Health and Safety Measures**

The individual needs to know and understand:

- Principles and practices of hygiene;
- Risk assessment for biological, chemical, electrical, thermal and mechanical operations, and safe work permit system;
- Health and work related regulations;
- Meaning of relevant danger and safety symbols/signage;
- Safety and health regulations, and personal protective equipment (PPE).

The individual shall be able to:

- Recognize and analyse risks;
- Create/develop safety instructions;
- Apply and adhere to work related safety and accident mitigation regulations;
- Identify health and safety hazards as well as dangerous situations in workspace environment and generate actions/steps for their mitigation.

**Assessment**

4. Competitors will be assessed based on measurement (objective) and judgement (subjective) marking.

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**Major Tools & Materials**

5. The following tools and materials will be used in the competition:
- 5.1. Tools for electrical and automation works, e.g., stripping pliers, cable jacket removing tool, crimping pliers, set of hex L-shape keys 1.5 to 10mm, cable isolation remover tool, tubing cutter, wire end ferrules crimper, etc.
  - 5.2. Tools for electrical and automation works, e.g., stripping pliers, cable jacket removing tool, crimping pliers, set of hex L-shape keys 1.5 to 10mm, cable isolation remover tool, tubing cutter, wire end ferrules crimper, etc.
  - 5.3. Others, e.g., measuring tape, etc.
6. Personal protective equipment (PPE) for the competition may include:
- Lab gloves (latex or others)
  - Lab coat (cotton and long sleeve)
  - Safety glasses
  - Gloves for mechanical work with full finger coverage
  - Safety shoes
  - Safety trousers (for mechanical work)
  - Safety jacket (for mechanical work)

7. Standards of the Marking Scheme

**WorldSkills Standards Specification**

<b>WSSS Marks</b>	<b>WSSS Marks</b>
Work Organization and Management	10
Communication and interpersonal skills	5
Electrical	10
Mechanical	15
Environmental Protection	10
Chemical and Biological	25
Automation and Documentation	15
Application of Health and Safety Measures	10

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