

TECHNICAL DESCRIPTION

Recommended Entry Requirements

1. Possess technical skills and knowledge in electrical, mechanical and pneumatic installation at National ITE Certificate (*Nitec*) level and above.
2. Must undergo and complete training which comprises both theory and practical sessions as follows:
 - 1 day training for tasks in the area of Traction Power Supply
 - 1.5 day training for tasks in the area of Signalling
 - 3 days training for tasks in the area of Rolling Stock
 - 3 days training for tasks in the area of Permanent Way
 - 1 day training refresher for each tasks area

Note: For considerations of resource availability and safety precautions, the above training programme will be conducted at SBST Sengkang Depot, Gali Batu Depot and SMRT Bishan Depot. Participants must register in advance for security clearance.

3. Participate in a team of two persons.
4. Physically fit and able to handle and work under pressure.
5. For safety requirements, all competition participants MUST put on safety boots throughout the training and competition periods.
6. Non-compliance to the above requirements will automatically disqualify participants from the training and competition.

Skill Explained

7. In Singapore, the Rapid Transit Systems (RTS) include the Mass Rapid Transit (MRT) and the Light Rail Transit (LRT) systems. Forming the backbone of the public transportation, the RTS is currently operated by two operators; SMRT and SBS Transit. SMRT operates the East West Line (EWL), North South Line (NSL), Bukit Panjang LRT, Circle Line (CCL) and Thomson East Coast Line (TEL). SBS Transit operated the North East Line (NEL), Sengkang-Punggol LRT, and Downtown Line (DTL).

Skill Competition

8. This competition will be a team event comprising 2 competitors per team which focuses on 4 key domain areas of maintenance works carried out by Rapid Transit technicians and engineers, namely, (i) **Rolling Stock**, (ii) **Traction Power Supply**, (iii) **Signalling** and (iv) **Permanent Way**.

i) Rolling Stock

Rolling Stock refers to the trains of the MRT system. In operation, trains tap power from the electric traction system through either the Current Collector Device

WORLDSKILLS SINGAPORE 2025

RAPID TRANSIT SYSTEMS (RTS)

(CCD) or the Pantograph system.

Participants will learn the functionality of the CCD and Pantograph system, and also be taught the basic Preventive Maintenance (PM) and Corrective Maintenance (CM) that are carried out on them by the industry operators. PM are periodic maintenance that usually involves:

- Disassembling of parts for inspection
- Cleaning and replacement of parts that are due and assembling it back
- Carrying out functional test before declaring system/sub-system as serviceable

On the other hand, CM involves:

- Identifying faulty or out of specification components
- Carrying out the necessary replacement
- Functional checks before declaring system/sub-system serviceable

The competition will involve undertaking PM and CM tasks on the two types of sub- systems: a) CCD, and b) Pantograph system.

ii) Traction Power Supply

The scope in the area of traction power supply covers elements from operation and troubleshooting of a traction DC switchgear (model: Hawker Siddeley NDC Circuit Breaker) used in a railway power supply system. A wide range of technical skills are required from the participants, including

- Measurements using testing instrument
- Identifying faults in the 750V Direct Current (DC) switchgear
- Replacing electrical / mechanical parts and wiring connections

Participants will be trained by experts from the RTS Power Supply System industry in the area of operating and servicing the DC switchgear. Participants will take away key skills in troubleshooting the 750V DC switchgear to its initial workable condition, and acquiring an overview that the switchgear serves in a railway traction power supply system.

Participants needs to be aware of the implications leading to train service disruption due to failure of the 750V DC switchgear, as well as complying with safety, health and housekeeping requirements and understanding potential hazards and risks management.

iii) Signalling

Signalling system directs railway traffic and ensures a safe distance between trains. The competition will involve two distinct tasks: a) Maintaining a Spot Transmission Function (STF) sub-system and setting up Base Communication Unit (BCU), and b) Modification of Signalling circuits.

a) Signalling Task 1 – Maintaining a Spot Transmission Function (STF) sub-system and BCU setting
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WORLDSKILLS SINGAPORE 2025

RAPID TRANSIT SYSTEMS (RTS)

Participants will attend training to understand the functionalities of the Alstom Urbalis 300 Spot Transmission Function (STF) sub-system, which is used in the NEL and CCL. This system enables trains to be localised along the line by providing data to the train-borne Automatic Train Control (ATC) System. These data are then used by the ATC to perform the following functions: initialization of train at standstill position; initialization of moving train; relocalisation of train; train alignment management with the platform screen doors; and odometric management. As for critical data transmission CBTC system needs continuous communication between train and trackside and this communication is being executed through BCU. Therefore, participants will be tasked to set the BCU in accordance to its intended location, transmitting power and frequency.

Participants will be tested on the following:

- Troubleshooting skills on the STF sub-system
- Load test of the programmed beacon
- Setting up the BCU configuration
- Functional test of the BCU

Hence, participants will require basic skills such as mechanical skills for replacement of equipment, electrical and digital skills for failure diagnostic, digital and software skills for beacon Parametering (programming).

b) Signalling Task 2 – Modification of Signalling circuits

Signalling systems will from time to time require modifications either to accommodate a line extension, replace obsolete systems and/or to improve performance. Such modifications must be done using controlled procedures to ensure that the safety of the installation is maintained. Participants will attend training to understand the presentation of signalling circuits and the modification process, which has been used on the North South and East West Lines.

Participants will be tested on their:

- Correct use of the modification procedure.
- Understanding of circuit operation.
- Modification of a circuit against tight timescales which mimic the short engineering hours available during a typical night shift.

Hence, participants will require basic skills such as circuit symbol understanding, as well as how to using circuit modification tools such as wire strippers, crimpers and labelling systems.

iv) Permanent Way

Trains are supported and guided by the track and energized by the third rail. In the maintenance regime of the track and third rail, it is important to maintain the geometry and alignment of the track and the third rail to ensure that they are safe and reliable for the passage of trains.

Participants are required to inspect and where necessary perform corrective

WORLDSKILLS SINGAPORE 2025

RAPID TRANSIT SYSTEMS (RTS)

maintenance on the track and third rail assembly.

Participants will be tested on the following aspects when performing maintenance on the track and third rail:

- Safety consciousness
- Ability to detect abnormalities and carry out effective corrective measures
- Completeness of tasks
- Quality in carrying out the task
- Teamwork

Competition Format

9. The total duration of competition is 20 hours that is spread across 3 days. The competition will be conducted in a round robin format where the focus is on one / two specialization per day.

Assessment

10. The marking scheme for the competition is detailed as follows:

i) Rolling Stock

For the PM and CM tasks, competitors will be assessed based on the following criteria, where the PM and CM tasks will constitute 60% and 40% of the overall score respectively.

10.1. Work Organisation and Management (10%)

- Organisation before task
- Tidiness after task

10.2. Team Work (10%)

- Participation of all members on the tasks
- Effective communications and interpersonal skills

10.3. Safety Awareness (20%)

- Any unsafe act caught when carrying out the tasks
- Any injury inflicted on competitors when carrying out the tasks

10.4. Measurement using Test Equipment (10%)

- Using the correct tools for the correct tasks
- Demerits will be given for parts or tools that are damaged after the tasks

10.5. Speed of completing the tasks (25%)

- Time taken to complete the tasks
- Completeness of tasks

10.6. Quality of work (25%)

- Accuracy of measurement, alignment and placement
- Workmanship of the end product

WORLDSKILLS SINGAPORE 2025

RAPID TRANSIT SYSTEMS (RTS)

ii) Traction Power Supply

Test project for power will be organised into sections and tasks with the weightings as indicated:

- 10.7. Work Organisation and Management (1/33 = 3%)
- Effective communications and interpersonal skills
 - Effective tasks planning and team works
 - Leadership and tasks distribution
 - Complete the allocated tasks in timely manner
- 10.8. Safety, Health and Housekeeping (6/33 = 18%)
- Safety and health regulations and best practices
 - Safety requirements relating to the tasks performed
 - Safety awareness to protect self and others
 - Types of hazards that may be encountered and risk management
 - Correct methods to handle tools and test equipment
 - Proper housekeeping of tools, test equipment and parts
- 10.9. Measurement using Test Equipment (10/33 = 30%)
- Understanding on technical specifications and drawings of 750VDC switchgear
 - Use of instrument to measure the insulation resistance, contact resistance and coil resistance reading etc.
 - Verify the measured reading against the criteria and determine whether the reading is Pass or Fail
 - Proper recording of measured data
- 10.10. Troubleshooting on Switchgear Fault (8/33 = 24%)
- Clear understanding on operation of 750VDC switchgear
 - Use the correct fault finding methodology
 - Identify possible faults causing malfunction of the 750V DC switchgear
 - Rectify the fault and restore the switchgear to working condition by performing the T & C
- 10.11. Replacing Electrical and Mechanical Parts (6/33 = 18%)
- Apply all safety precautions
 - Use of the correct tools and methods to dismantle trip coil unit, catch box and carrier assembly, lock mechanism and electrical relay
 - Use of correct tools and methods to install a new trip coil unit, catch box and carrier assembly, lock mechanism and electrical relay
 - Check and confirm the functionality and operation of the 750V DC switchgear after the replacement of parts
- 10.12. Speed of Completing Task (2/33 =7%)
- Time taken to identify the fault and restore the switchgear to working condition

WORLDSKILLS SINGAPORE 2025

RAPID TRANSIT SYSTEMS (RTS)

iii) Signalling

The two test projects for Signalling will be organised into sections and tasks with the weightings (as applicable) as indicated.

a) *Maintaining a Spot Transmission Function (STF) sub-system (35% of signalling score):*

10.13. Work organization and Management (10%)

- Effective communication and interpersonal skills
- Effective tasks planning and distribution
- Timely completion of tasks

10.14. Health and Safety (15%)

- Safety awareness to protect self and team mates
- Safety requirements relating to the tasks being performed
- Performance of tasks safely
- Correct methods to handle tools/test equipment safely

10.15. Troubleshooting and Fault Finding (35%)

- Ability to demonstrate the understanding of the STF sub-system
- Systematic approach to fault investigation
- Fault rectification

10.16. Usage of Tools and Test Equipment (20%)

- Usage of correct tools for the task
- Wearing of protective gear

10.17. Quality of Work (10%)

- Accuracy of measurement
- Workmanship of CM works

10.18. Speed of Completing Task and Team Work (10%)

- Time taken to identify the fault
- Time taken to complete the corrective maintenance
- Team effectiveness

b) *Modification of Signalling circuits (65% of signalling score)*

10.19. Safety, Health and Housekeeping (16%)

- Conduct of toolbox briefing (6%)
- Correct use of PPE during the modification and work carried out safely (6%)
- Proper housekeeping and tidiness of tools, equipment and parts; before, during and after the test. (4%)

WORLDSKILLS SINGAPORE 2025

RAPID TRANSIT SYSTEMS (RTS)

- 10.20. Verification of Circuit Drawing (6%)
- Wire count the existing circuit (2%)
 - Identify wiring errors (2%)
 - Correctly report wiring errors to the supervisor (2%)
- 10.21. Understanding of circuit drawing (6%)
- Explain how the modified circuit operates and the purpose of the modification
- 10.22. Preparation of Works (12%)
- Record serial number of crimping tool (3%)
 - Perform a test crimp (3%)
 - Torque test (6%)
- 10.23. Modification Works (42%)
- Bell testing of old wire before removal (6%)
 - Redundant cables removed carefully (without damage to other cables) (6%)
 - Wire running (neatness and without damage) (6%)
 - Crimping (no bare wires, crimps secure sheath correct length) (6%)
 - Labelling (6%)
 - Bell testing of new and re-terminated wires (6%)
 - Circuit testing (6%)
- 10.24. Post-modification Works (12%)
- Wire count (6%)
 - New wires dressed neatly (4%)
 - Paperwork completed (2%)
- 10.25. Work Organisation and Management (6%)
- Demonstration of teamwork and good communication and task distribution (3%)
 - Speed of completing task - able to complete within 2 hours and 15 minutes (3%)

iv) Permanent Way

- 10.26. Safety, Health and Housekeeping (30%)
- Conduct of toolbox briefing
 - Check that correct PPE are worn properly, and equipment and tools are brought and fit for use
 - Proper housekeeping and tidiness of tools, equipment and parts; before, during and after the maintenance
 - Installation of electrical protection at worksite
 - Normalization of electrical protection at worksite
 - Perform line clear

WORLDSKILLS SINGAPORE 2025

RAPID TRANSIT SYSTEMS (RTS)

- Awareness of safety hazards and any unsafe acts observed during task
- 10.27. Inspection and Maintenance of Track (25%)
- Inspect track for abnormalities and rectify accordingly
 - 'Broken' rail - Clamp rail defect
 - 'Missing/Broken' clip - Replace rail clip
 - 'Loose (broken torque seal)' fastening bolt – Re-tighten bolt and apply torque seal
 - 'Missing/Cracked' sidepost insulator – Replace sidepost insulator
 - Measure track geometry (cant and gauge)
 - Adjust track gauge
 - Verify track is reinstated within maintenance tolerance and fit for operations
- 10.28. Inspection and Maintenance of Third Rail (25%)
- Inspect 3rd rail assembly for abnormalities and rectify accordingly
 - 'Broken/Dislodged' claw and insulator assembly - Replace 3rd rail claw and insulator assembly and apply torque seal
 - Measure 3rd rail gauge
 - Adjust 3rd rail gauge
 - Verify 3rd rail is reinstated within maintenance tolerance and fit for operations
- 10.29. Teamwork and Management (20%)
- Demonstration of teamwork and good communication and task distribution
 - Speed of completing tasks

WORLDSKILLS SINGAPORE 2025

RAPID TRANSIT SYSTEMS (RTS)

Relative Weighting of Marks

11. The relative weighting of marks for tasks in the areas of Rolling Stock, Power, Signalling and Permanent Way are:

Test Project		Weighting
i	Rolling Stock	25%
ii	Power	25%
iii	Signalling	25%
iv	Permanent Way	25%
	Total	100%

Major Tools & Materials

12. The major tools and materials used for the competition will be communicated to the competitors during training and reflected on the project papers.