

Title	Demonstrate and apply knowledge of factors impacting performance of wireless systems and methods to mitigate impacts		
Level	4	Credits	30

Purpose	<p>This unit standard is intended for service technicians and servicepersons, who test, diagnose and repair complex faults to a modular level and/or configure systems to restore operation and performance of wireless systems.</p> <p>People credited with this unit standard are able to:</p> <ul style="list-style-type: none"> - explain propagation paths and factors impacting on path performance; - identify potential causes of reduced system performance; - evaluate a faulty wireless system and prepare for service restoration; - prepare for site visit to maintain or restore a wireless system; - complete on-site service tasks and perform maintenance or fault correction; - complete pre departure tasks following maintenance or fault correction; - complete post service tasks following maintenance or fault correction.
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Classification	Electrical Engineering > Electrotechnology
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Available grade	Achieved
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Prerequisites	<p>Unit 27911, <i>Demonstrate knowledge of workplace safety in an electrotechnology or telecommunications environment</i>; Unit 28881, <i>Enhance workplace safety and mitigate environmental impacts in an electrotechnology or telecommunications environment</i>; or demonstrate equivalent knowledge and skills.</p>
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Guidance Information

- 1 This unit standard has been developed for learning and assessment on-job or off-job in a simulated workplace environment or combination, and where electrical work is included under adequate supervision as defined in the Electricity Act 1992, unless the candidate is registered and licenced under the Electricity Act 1992.

- 2 Recommended unit standards for entry:
 Unit 30644, *Demonstrate basic knowledge of diagnostics and fault finding for service and installation technicians*;
 Unit 32984, *Demonstrate knowledge of radio theory and installation practice*;
- 3 References
 AS/NZS 4509.1:2009 *Stand-alone power systems Part 1: Safety and installation*, available from <http://www.standards.govt.nz>;
 AS/NZS 4509.2:2010 *Stand-alone power systems Part 1: System design*, available from <https://www.standards.govt.nz>;
 AS/NZS 5033:2014 *Installation and safety requirements for photovoltaic (PV) arrays*, available from <http://www.standards.govt.nz>;
 AS/NZS 5070.1 *Siting and operation of radiocommunications facilities – Guidelines for fixed, mobile and broadcasting services*;
 Compliance Standards for EMC and Radio, available from <https://www.rsm.govt.nz>;
 Consumer Guarantees Act 1993;
 Contract and Commercial Law Act 2017, Part 3 Sale of Goods;
 Electricity Act 1992;
 Electricity (Safety) Regulations 2010;
 Fair Trading Act 1986;
 Hazardous Substances and New Organisms Act 1996;
 Health and Safety at Work (Hazardous Substances) Regulations 2017;
 Health and Safety at Work Act 2015;
 New Zealand Electrical Codes of Practice, ISSN 0114-0663, available from <https://worksafe.govt.nz>;
 Official Information Notices, available from <https://www.rsm.govt.nz/>;
 Privacy Act 1993;
 Resource Management Act 1991;
 and all subsequent amendments and replacements.
- 4 Definitions
 AF – Audio Frequency.
 AGC – Automatic Gain Control.
 BITE – built in test equipment.
Company practice – those practices and procedures that have been circulated by the company for use by their employees.
 DAQ – Data acquisition system.
 DMR – digital mobile radio.
 EME/EMR – Electromagnetic emissions/ Electromagnetic Radiation, specifically exposure levels permitted for workers and public.
 GPS – Global Positioning Systems.
Industry conventions – a set of agreed, specified, or generally accepted standards.
Industry practice – those practices that competent practitioners within the industry recognise as current industry best practice.
 LCR – least cost routing.
Non-standard – three or more services/network types, hardware or subsystems used or operating together to provide a purpose built mobile or re-locatable installation solution based on customer or installation requirements.
 NTP – network time protocol.
 RF – radio frequency.
Safe and sound practice – relating to the installation of electrical equipment as defined in AS/NZS 3000:2018 *Electrical Installations - Known as the Australian/New*

*Zealand Wiring Rules.**SINAD* – signal to noise and distortion.*S/N Ratio* – signal to noise ratio.

5 Assessment

a Competence may be assessed on:

- i Systems installations may include but is not limited to – radio, low voltage, extra-low voltage, data and voice, TV broadcasting, standalone power systems, solar;
 - ii Locations may include but is not limited to – vehicles, caravans, mobile homes, transmission and reception sites, repeaters, mobile sites;
 - iii Cabling and communications may include but is not limited to – copper, twisted-pair, coaxial copper, fibre optical cable, data cable, waveguides, Wi-Fi, Bluetooth or some combination of these.
- b Evidence of three different mobile or re-locatable installations is required for each outcome of this unit standard, with one being a non-standard solution, except where otherwise indicated. The installations must be relevant to, and in context for the industry sector the candidate works in.

6 Range

a All activities and evidence presented for all outcomes and performance criteria in this unit standard must be in accordance with:

- i legislation;
- ii policies and procedures;
- iii ethical codes;
- iv Standards – may include but are not limited to those listed in Schedule 2 of the Electricity (Safety) Regulations 2010;
- v safe and sound practice;
- vi applicable site, company and industry practice, and industry conventions;
- vii where appropriate or applicable, environmental requirements, manufacturer instructions, specifications, data sheets and manufacturer, supplier and company health and safety procedures.

Outcomes and performance criteria

Outcome 1

Explain propagation paths and factors impacting on path performance.

Performance criteria

1.1 Identify methods of Radio Frequency (RF) propagation.

Range space wave, sky wave, ground wave.

1.2 Identify factors impacting on paths and area coverage for given situations.

Range may include but is not limited to – path loss, nearfield effects, far field effects, fresnel zone, antenna performance, directional effects, rain fade, thermal effects, sporadic e, ionospheric variations, solar weather, water, tidal effects.

1.3 Explain path loss calculations and coverage predictions for given applications using common industry methods.

Range space wave, sky wave, ground wave; techniques may include but are not limited to – prediction software, drive testing.

1.4 Identify potential future impacts on a given site.

Range planning, potential development, natural bush growth, commercial development.

Outcome 2

Identify potential causes of reduced system performance.

Performance criteria

2.1 Explain techniques to identify component factors impacting on system performance.

Range may include but is not limited to – antenna performance, connector performance, moisture ingress, receiver de-sensing, co-channel interference, intermodulation, adjacent channel interference, wide band noise, modulation depth, deviation index, output power, signal to noise ratio, phasing, polarisation, physical location, co-located equipment.

2.2 Identify instrumentation and BITE that can identify reduced system performance.

Range may include but is not limited to – QoS measurement, monitoring, DAQ, S/N Ratio, SINAD, signal levels, carrier levels, DMR test set.

2.3 Identify the hardware and components that are responsible for a given reduced performance situation, using available design tools.

Range may include but is not limited to – frequency/band plans, transmitter power output, antenna selection, cable, modulation mode, receiver specifications, filter effects, system and cable losses, digital features.

2.4 Identify factors that result in reduced performance using standard industry practices.

Range may include but is not limited to – selectivity, sensitivity, filtering, AGC, AFC, tracking, RF gain, frequency drift, timing drift.

- 2.5 Mitigate factors that result in reduced performance using standard industry practices.
- Range may include but is not limited to – NTP or GPS timing systems, frequency references, component selection, LCR filtering, cavity resonator tuning, circulators, isolators, antenna diversity.
- 2.6 Apply performance testing and monitoring to confirm the restored service is operational to customer requirements and licensing conditions, and benchmarks are documented for future reference.

Outcome 3

Evaluate a faulty wireless system and prepare for service restoration.

Performance criteria

- 3.1 Identify the requirements and scope of the service restoration of the wireless system.
- Range may include but is not limited to – system performance information, review user report, user contact, site access including permits and consents, customer requirements, budgetary constraints, company policies and procedures, health and safety, remote log-in, other site checks, service spares, tools.
- 3.2 Evaluate and apply remote restoration methods and procedures and/or workarounds.
- Range may include but is not limited to – other resources, trades and services, work plan, timeline, remote switching options, alternate service arrangements.
- 3.3 Select test instruments, diagnostic tools and/or equipment required for the site visit.

Outcome 4

Prepare for site visit to maintain or restore a wireless system.

Performance criteria

- 4.1 Evaluate and apply potential remote restoration.
- Range may include but is not limited to – remote restoration methods, alternative system use, workarounds, company restoration procedures.

4.2 Prepare for service restoration.

Range may include but is not limited to – additional required resources, other trade services, required materials, site access requirements, work plan, installation plan, specifications and drawings, EME/EMR safety requirements, transmitter isolation or power reduction, supervisor or manager guidance.

4.3 Arrange the required permits and consents.

Range may include but is not limited to – permit to work, site access, security consents, customer consent, notifications of site arrival.

4.4 Develop safety plans in accordance with company practice.

Range may include but is not limited to – lone worker plans, site access.

Outcome 5

Complete on-site service tasks and perform maintenance or fault correction.

Performance criteria

5.1 Owners are advised of arrival on site.

5.2 Perform visual checks of equipment and alarms.

Range may include but is not limited to – site integrity, equipment integrity, corrosion, bonding and earthing, cable and interface management, connections, dust, ventilation, air flow, fault codes, BITE, remote interfacing, mobile app interface.

5.3 Apply logical fault-finding techniques to identify cause of performance loss.

Range may include but is not limited to – test equipment selection, diagnostics, customer feedback, questioning, observation, simulation, measurement, identification of function loss, comparison with previous data, frequency of occurrence, company procedures, alarm priority, ancillary systems, firmware/software.

5.4 Take steps to ensure testing does not impact on other operational systems.

5.5 Repair or replace faulty module subsystem in a wireless system.

Range may include but is not limited to – ESD protection, firmware/software configuration recovery, module configuration, system status evaluation, labelling of faulty component.

5.6 Update plans and customer records to reflect changes made.

Range may include but is not limited to – alterations, photographs, technical documentation, timelines, future reference benchmarks; evidence of three including the use of an electronic recording system is required.

Outcome 6

Complete pre departure tasks following maintenance or fault correction.

Performance criteria

6.1 Site is restored to a clean and tidy condition.

6.2 Customer confirmation of system operation is obtained.

Range may include but is not limited to – operational checks, acceptance of outcome, documentation of remedial actions, user training, potential upgrades, company practices, service level agreements.

6.3 Site departure procedures are completed in accordance with company practice and service level agreements.

Range may include but is not limited to – alarm checks, ventilation settings, power and backup settings, enclosures and covers secured, test results recorded, job close in management system, electrical safety testing and issuing of certification documents.

Outcome 7

Complete post service tasks following maintenance or fault correction.

Performance criteria

7.1 Company databases are updated in accordance with policies and requirements.

Range must include – use of electronic record system; may include but is not limited to – log and file change records, update asset registers, update company databases, close job in task management system, update timelines.

7.2 Arrange repair of faulty modules recovered from site.

Planned review date	31 December 2026
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Status information and last date for assessment for superseded versions

Process	Version	Date	Last Date for Assessment
Registration	1	25 November 2021	N/A

Consent and Moderation Requirements (CMR) reference	0003
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This CMR can be accessed at <http://www.nzqa.govt.nz/framework/search/index.do>.

Comments on this unit standard

Please contact Waihangā Ara Rau – Construction and Infrastructure Workforce Development Council at qualifications@waihanga.nz if you wish to suggest changes to the content of this unit standard.