TECHNOLOGY MANAGEMENT

TRACTION TECHNOLOGY

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Specification			
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Compiled by:	Tebogo Hlungwani Technician (Technology Management)	**Signature:** 16-09-2025	**Document Rev no: 1.0**
Reviewed by:	Ndzalama Ngobeni Engineer (Technology Management)	**Signature:** 2025-07-17	
Approved by:	Seloke Tladi Principal Engineer (Technology Management)	**Signature:** 2025-09-17	**Issue date:** **2025-09-15**

EXECUTIVE SUMMARY

This specification defines the standard tool requirements for the maintenance of on-board electronic systems on locomotives. It specifies insulated hand tools, electrical test instruments, lithium coin-cell chargers, intelligent soldering solutions, and personal protective equipment, all compliant with international safety and performance standards. By standardising these requirements, the document ensures maintenance teams are equipped with reliable, safe, and durable tools, supporting consistent quality of work, reduced risks, and effective lifecycle support of locomotive electronic systems.

NOTES:






1 Introduction and Background

This specification establishes the minimum tool and equipment requirements necessary to support the maintenance of on-board electronic systems on locomotives. As locomotives become increasingly reliant on integrated electronic subsystems for safety, reliability, and operational efficiency, it is essential that maintenance teams are equipped with the correct, standardised tools to perform installation, verification, troubleshooting, and repair activities.

The document provides detailed requirements for general hand tools, electrical and continuity testing instruments, rechargeable coin-cell charging and verification devices, intelligent soldering solutions, and prescribed safety gear. Each requirement is aligned with recognised international standards (IEC, SANS, CE, or equivalent) to ensure safe, consistent, and repeatable maintenance practices across diverse operating environments.

By defining these requirements upfront, the specification ensures uniformity across maintenance depots, reduces the risk of equipment damage or personal injury, and supports the long-term serviceability of locomotive electronic systems. This standa7rdisation further contributes to reduced downtime, improved reliability, and more efficient lifecycle management of locomotive assets.

2 Scope

This specification covers the mandatory tools, test instruments, and safety equipment required for the maintenance of on-board electronic systems in locomotives. It applies to all maintenance activities involving installation, verification, repair, and lifecycle servicing of locomotive electronic subsystems.

The scope includes:

- **General hand tools** – insulated and compliant with international safety standards for use in high-voltage environments.
- **Electrical and continuity test instruments** – calibrated, high-accuracy devices for diagnostics and verification.
- **Rechargeable coin-cell charging and testing equipment** – ensuring reliable backup power for electronic modules.
- **Intelligent soldering equipment** – portable, digitally controlled solutions for precision field work.
- **Personal protective equipment (PPE)** – minimum safety requirements for all maintenance tasks.

This specification applies to all depots, workshops, and field maintenance environments where locomotive electronic systems are supported. It ensures consistency across maintenance operations, alignment with safety standards, and compatibility with modern locomotive technologies.

3 Applicable Documents

Document Number	Title
IEC 61010-1	Safety requirements for electrical equipment for measurement, control, and laboratory use
SANS/IEC 60900	Live working – Insulated hand tools
IEC 61340-5-1	Protection of electronic devices from electrostatic phenomena – General requirements
IEC 62133	Safety requirements for portable sealed secondary lithium cells and for batteries made from them
IEC 60903	Live working – Electrical insulating gloves
IEC 62485-2	Safety requirements for secondary batteries and installations – Part 2: Stationary batteries
SANS 434	Protective clothing – Flame-retardant workwear

4 Tool Specification

4.1 Hand Tools

Tool	Requirement
Insulated 7-Piece screwdriver set	Flat and Phillips types, IEC 60900 compliant, rated up to 1000 V, dielectric withstand ≥ 10 kV, ergonomic grips.
Ratchet and socket set	Metric sizes 6–22 mm, chrome-vanadium or equivalent high-strength alloy steel, corrosion-resistant, torque rating suitable for electronic system fastening.
Insulated pliers	Long-nose and side-cutter types, IEC 60900 compliant, rated up to 1000 V, dielectric withstand tested to 10 kV AC for 3 minutes, with induction-hardened cutting edges.
Allen key set	Metric, sizes 2–10 mm, hardened steel, corrosion-resistant, ball-end type preferred for angled access.
Cable ties	UV-resistant, minimum tensile strength 80 N, flame-retardant (UL 94 V-2 rated), suitable for locomotive environments.

4.2 Electrical Test Instruments

Instrument	Requirement
Digital Multimeter	True RMS, CAT III 1000 V / CAT IV 600 V rated; accuracy ±0.5% or better; minimum 10 MΩ input impedance; continuity, resistance, capacitance, frequency, and diode test functions; backlit display for depot and field use; IEC 61010-1 compliant.

4.3 Lithium Coin-Cell Charger

Parameter	Requirement
Input Voltage	5 V DC / 1 A minimum, via USB-C input (preferred) or equivalent industry-standard connector.
Output Voltage	3.1 V ± 0.05 V, regulated and ripple ≤ 50 mV.
Charging Current	Adjustable or fixed in the range of 0.3 – 1.0 mA, suitable for rechargeable lithium coin cells
Charging Time	Approximately 2–3 hours per cell, depending on capacity, with automatic cut-off when full charge is reached
Charging Port	USB-C charging port with supplied Type-C to DC adapter cable
Product Certification	CE, UL, or equivalent international certification.
Protection Features	Over-voltage, over-current, reverse-polarity, and thermal protection; compliance with IEC 62133 for lithium battery safety.
Operating Conditions	Ambient temperature 0 °C to 40 °C; relative humidity ≤ 80% non-condensing.
Operating Conditions	Ambient temperature 0 °C to 40 °C; relative humidity ≤ 80% non-condensing.
Portability	Compact, lightweight (<200 g), rugged housing suitable for field maintenance environments.

4.4 Smart Soldering Iron

Parameter	Requirement
Power Input	Dual input: USB-C PD up to 65 W (9–20 V) and DC barrel jack up to 96 W (9–24 V).
Temperature Control	Adjustable 80–420 °C; closed-loop PID control; accuracy ±2%; recovery time ≤ 2 seconds for repeated use.
Heat-Up Time	< 8 seconds to reach 350 °C when powered by ≥ 45 W source.

Display & Interface	OLED display (minimum 0.85"); intuitive multi-button or rotary control; menu access for calibration, sleep timer, and mode settings.
Tips & Accessories	Minimum 6 interchangeable tip types (e.g., BC2, BC3, KR, K65, B2, ILS); ESD-safe; quick-change capability; supplied with stand, protective cap, and cables.
Safety Features	Automatic sleep and auto-shutoff; child lock; over-temperature, short-circuit, and ESD protection; tip-to-ground resistance ≤ 2 Ω.
Certifications	CE, RoHS, WEEE, or equivalent international compliance.
Physical Build	Rugged anodized aluminium or equivalent housing; compact dimensions (approx. 180–190 mm × 20 mm); lightweight (<500 g full kit) for field portability.
Portability & Use	Designed for depot and field environments; supplied with carrying pouch or protective case.
Operating Environment	0 °C to 40 °C ambient; relative humidity ≤ 80% non-condensing.

4.5 Portable ESD Mat with Ground Cord

Parameter	Requirement
Dimensions	Minimum 600 mm × 900 mm (suitable for depot bench and field maintenance use)
Surface Resistance	1×10^6 to 1×10^9 Ω, IEC 61340-5-1 compliant
Material	Two-layer dissipative rubber or equivalent, durable and chemical-resistant
Grounding	Supplied with 1 × 10 mm press stud and detachable ground cord (≥1.8 m, with 1 MΩ resistor)
ESD Compliance	Meets IEC 61340 requirements for ESD protective workstations
Portability	Roll-up, lightweight (<1.5 kg), with carrying strap or case for field use
Certification	CE or equivalent international compliance

5 Personal Protective Equipment (PPE) – Recommended

To ensure safe and effective maintenance of on-board locomotive electronic systems, the following recommended PPE shall be issued to each electronic technician. These items are mandatory for safe execution of maintenance tasks and must be available at all times to support compliance with occupational health, safety, and technical standards.

PPE Item	Requirement / Standard	Application
Safety Goggles / Face Shield	ANSI Z87.1 / EN 166 compliant	Eye protection during soldering, cutting, and battery handling
Anti-static Wrist Strap	IEC 61340-5-1 compliant; 1 MΩ resistor	ESD protection during soldering and electronic module handling
Anti-static Gloves	Conductive-fibre gloves, IEC 61340 compliant	Prevents electrostatic discharge when handling sensitive electronics
Anti-static Footwear or Heel Straps	IEC 61340 compliant	Ensures full-body grounding when working on ESD floors or mats
Safety Boots	EN ISO 20345 or SANS equivalent	Protection in depot and trackside environments
High-visibility Reflective Vest	EN ISO 20471 compliant	Visibility in depots, yards, and trackside environments
Electrical Insulating Gloves	IEC 60903 rated, with leather protectors	Safe handling of live electrical systems during testing
Flame-retardant Overalls	SANS 434 compliant, arc-rated (per risk assessment)	Protection against heat, sparks, and arc flash
Hearing Protection	SANS/EN 352 compliant (ear plugs or ear muffs)	For use in environments exceeding 85 dB

Respiratory Protection	FFP2 or equivalent respirator	Protection against soldering fumes in confined spaces