1 General

1.1 Introduction and Intended Use (Informative)

These RECOMMENDED PRACTICES address electrical matters that are not mandatory for achievement of NMRA Conformance Warrants as required by NMRA STANDARDS for products electrical characteristics but provide details for various topics that have been found to be the best for interchangeability of operational products.

1.2 References

These NMRA RECOMMENDED PRACTICES should be interpreted in the context of the following NMRA STANDARDS:

1.2.1 Normative

- S-1.1 General – Proto Scales
- S-1.2 General – Standard Scales
- S-1.3 General – Scales with Deep Flanges
- S-9 Electrical
- S-9.1 DCC Electrical Standard

1.3 Terminology

Term	Definition
Line Operated Device	Any device operating on local common electrical power, for instance in Canada and the United States, in most instances, 110–120-volt 50-60 Hertz (Hz) Alternating Current (AC)
Power Pack	A power source to reduce voltages of common electrical power from the mains to suitable levels as stated in S-9.1 to operate model trains. This includes power to the track that can be varied for speed control with voltages from zero to the maximum voltage specified. Some power packs may also provide a low voltage fixed DC and or AC current for operating lighting and other accessories. Not to be confused with DCC products using the name Power Pack to refer to what is actually an Energy Storage Capacitor (ESC).
Rheostat	Electrical component that varies electrical resistance by turning a knob or moving a slider.

2 Recommended Practice

2.1 Line Operated Devices (See Notes 1, 2, and 4 below)

A. Devices shall be certified by an international testing laboratory for the market in which it is sold (for example Underwriters Laboratory (UL), Canadian Standards Association (CSA),

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Electronics Technicians Association (ETA), etc., in North America or the “CE” mark shall appear on products traded in the extended Single Market in the European Economic Area (EEA). The “CE” mark signifies that products sold in the EEA are tested by well recognized organizations such as the German Electrotechnical Commission (Deutsche Kommission Elektrotechnik Elektronik Informationstechnik im DIN und VDE), Technical Inspection Association (TÜV), in Australia and New Zealand, the Regulatory Compliance Mark (RCM) certification signifies that products meet safety, telecom, electromagnetic compatibility (ECM), and wireless requirements set by the Australian Communications and Media Authority (ACMA)) etc., and have been assessed to meet high safety, health, and environmental protection requirements including both line and low voltage electrical safety mandates. Note that the examples provided above do not constitute the entire worldwide universe of certification organizations appropriate to all market localities. Responsibility and cost incurred for having the product tested lies with the manufacturer.

B. Devices provided with a National Electrical Manufacturers Association (NEMA) "U" ground plug, or equal, shall have a ground terminal capable of carrying 30 amperes continuously.

C. Speed controllers in power packs shall have a minimum operating range of 180 degrees if rotary, or 3 inches if linear.

D. Direct current (DC) power supplies and packs for propulsion use shall produce between 7 and 18 volts while delivering rated current.

E. Alternating current (AC) power supplies and packs for propulsion use shall produce between 18 and 27 volts while delivering rated current.

F. The maximum resistance of rheostats (if any) shall be marked on the case of power packs or listed in the instruction manual.

2.2 Motors for Propulsion Service

A. Nominal torque or power. and speed data shall be supplied with motors.

B. The manufacturer's recommended maximum continuous current rating under conditions of poor ventilation shall be supplied with motors.

2.3 Powered Equipment (See Note 3 below)

A. Powered equipment shall operate at a speed within 20 percent of their nominal maximum prototype speed up to 125 miles per hour (MPH) (See Note 5). Scale Speed may be determined across distance over time when distance is multiplied by the appropriate scale factor, the proportion found in NMRA STANDARDS S-1.1, S-1.2, and S-1.3 (see Note 6) under the following conditions:

   a. The input voltage shall be the maximum voltage stated in Table 2.3 of STANDARD S-9.1 appropriate to the scale being used.

   b. The unit shall be running "light" after a run in and lubrication according to the manufacturer's instructions, on level, tangent track of sufficient length to measure speed laid at minimum gauge.

B. A low resistance connection shall be provided from motor terminals to the wheels without relying on axle to side frame contact, or truck bolster to body bolster to body contact, or drawbar to pin contact.

C. Couplers (including metal replacement couplers) of a model locomotive shall be insulated.

2.4 General

A. Tenders used with model steam type locomotives shall have their body insulated from both rails.

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Notes

1. Line operated devices shall be tested with "resistive" loads and an input of 115 volts, 60 Hz, or the commercial line voltage and frequency for the country in which they are initially to be sold. Power packs shall be tested with the speed controls set at maximum.

2. Throughout this RECOMMENDED PRACTICE, alternating current quantities are expressed as Root Mean Square (RMS) values and direct current quantities are expressed as Average Values. These are the values measured by conventional meters.

3. The term "insulation" shall mean that not less than 100K ohms resistance shall exist between the points specified as measured with a conventional ohmmeter.

4. Hertz, or Hz., has replaced "cycles per second" as the name of the basic unit of frequency.

5. High Speed Trains (HSTs) such as the French Tres Grandes Vitesse's (TGVs) or Japanese Shinkansens may be excepted from recommended maximum speed parameters as it may be unlikely to perform scale speed tests accurately or practically.

6. To calculate scale speed in miles per hour or kilometers per hour the formulas are shown below.

Scale miles per hour = $\frac{Distance\ in\ feet\ x\ \frac{scale\ factor}{5280}}{time\ in\ seconds/3600}$

Scale Kilometers per hour = $\frac{Distance\ in\ meters\ x\ \frac{scale\ factor}{1000}}{time\ in\ seconds/3600}$

3 Document History

Date	Description
May 1973	RECOMMENDED PRACTICE 9 (RP-9) Approved by the NMRA Board of Directors
Dec 2024	RP-9 changed to current format. Editorial changes made throughout to reflect international characteristic of NMRA community.

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