JM Juett

1 General

The primary purposes of NMRA STANDARDS are to establish the broadest correlated set of limiting dimensions, electrical parameters, and communications parameters within which interchange may be assured.

1.1 Introduction and Intended Use (Informative)

This is intended to set the specifics for inspecting and vetting a model for certification of a Conformance Warrant.

1.2 References

This standard should be interpreted in the context of the following NMRA Standards, Technical Notes, and Technical Information.

1.2.1 Normative

- S-1. General Overview
- S-1.1 General Proto Scales
- S-1.2 General Standard Scales
- S-1.3 General Scales with Deep Flanges
- S-2 Coupler Measurements
- S-3 Track Measurements
- S-4 Wheel Measurements
- S-9 Electrical
- RP-7 Clearance
- RP-20.1 Weight
- RP-23 Bolsters

1.2.2 Informative

- S-2 Couplers
- S-3.1 Track-work-Proto Scales
- S-3.2 Track-work Standard Scales
- S-3.3 Track-work Deep Flanges
- S-4.1 Wheels Proto & Fine Scale
- S-4.2 Wheels Standard Scales
- S-4.3 Wheels with Deep Flanges
- S-9 Electrical Standards
- S-9.1.1 Decoder Interfaces and any applicable daughter Standards
- S-9.2 Communication Protocol by decoder testing procedure
- S-9.2.2 Configuration Variables by decoder testing procedures
- RP-7 Track Centers and Clearance
- RP-20.1 Car Weight
- RP-22 Coupler Pocket

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- RP-23 Bolsters
- RP-24.1 Journals
- RP-24.3 Axles
- RP-25 Wheel Contours

1.3 Terminology

Term	Definition
Inspector	A volunteer within the Conformance & Inspection group that is trained and qualified to conduct an inspection and review.
C&I	Conformance & Inspection is a group within the S&C Department whose primary function is to conduct inspections and write reviews with the goal of awarding a Warrant of Conformance and assisting manufacturers whose product is not within conformance, to get it in conformance.
S&C	Standards & Conformance is a Department within the NMRA that sets and maintains Standards (mechanical & electrical) and assists model manufacturers in adherence to those Standards.
Standards	A set of parameters for products to assure interoperability and interchange irrespective of manufacturer
RP	Recommended Practice is a set of parameters that are suggested to improve performance and interchange. Failure to meet an RP does not disqualify a product from receiving a Warrant of Conformance
Warrant of Conformance	An official document stating that a product meets all applicable NMRA Standards. Sometimes called a Conformance Warrant.
Warrant Seal 	A seal that a manufacturer can display on the product box, advertising and literature if it is awarded a Warrant of Conformance.

2 Obtaining Samples for Review

The NMRA Corporate Policies and Procedures Manual https://www.nmra.org/sites/default/files/nmraorg/secy/2022_cppm-pppm_v_1.0_2022.03.04-master.pdf Section Q5 outlines three ways that sample product may be obtained for Inspection and Review.

3 Existing Warrant of Conformance

Check to verify that the model under consideration has not previously received a Warrant of Conformance. The listing of all previously issued Warrants may be found at https://www.nmra.org/nmra-conformance-warrants. If no warrant has been issued for this product proceed with the inspection.

4 Inspection Forms

The NMRA has official Inspection Forms for recording the results of the inspection. All product submitted for consideration of a Warrant of Conformance shall be on an official Inspection Form,

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current version. These forms are protected MS Word forms with text boxes, check boxes and drop-down list. Forms are to be completed in full.

4.1 Obtaining Current Forms

Current up to date forms can be found at https://www.nmra.org/conformance-and-inspection-main-page. It is important that you download the latest version of the form. Click on the desired form and it will be downloaded to your computer. Click on the downloaded file and it will open the template as an MS Word document. You may need to click the 'Enable Editing' box at the top of the form.

Set up a new folder on your computer for your inspection/review. It is helpful to organize the folders by year and incorporate the name of the product in the folder name. Save the form there with the name NMRA Inspection Form and add to the end of this the product name. E.G. NMRA Inspection Form Athearn PS4750 Covered Hopper.

Complete the information as much as you know for now on the first page. You can return later and add the address of the manufacturer, contact, phone number, etc. As you work to take measurements and complete the Inspection Form, save it often.

4.2 General Information On All Forms

The first page of all Inspection Forms is a place to collect information about the identification of the product, of the Inspector performing the inspection and the manufacturer of the product.

Start adding information to the form in the gray boxes. This is a word document. It is protected. You can add or change information in the boxes. They are formatted for the type of information, text, numerical limited to the desired number of decimal places etc. In some cases drop down pick list or check boxes are used to log the information. Save often.

All sections of the Inspection Form shall be completed in full.

4.3 Car Inspection Form

The Car Inspection Form has sections to record information about couplers (S-2) and wheels (S-4). Measurements should be taken using a good pair of calipers capable of taking measurements to at least 0.001" or better. If the car uses power from the rails section for S-9 should be completed. Some cars come equipped with DC lighting or sound and lighting decoders.

Also to be completed are sections on RP-7 Clearance, RP-20.1 Weight, RP-24.1 Journals, RP-24.3 axels and RP-25 Wheel Contour. Failure to meet a Recommended Practice does not prevent a car or locomotive from receiving a Warrant of Conformance. NMRA members will be interested in the results so they get a complete set of data on the product.

4.4 Locomotive Inspection Form

In addition to the above measurements in the previous section, inspection of Electrical conformance shall be conducted. This includes S-9 Electrical, S-9.1.1 Decoder Interfaces and daughter Standards for the applicable DCC Standard. If DCC equipped, check to verify that the decoder supplied has a Warrant of Conformance. If not, contact the C&I Manager to make arrangements to ship the locomotive or the decoder for DCC Conformance Testing. For locomotives there are no requirements to measure RP-20.1 Weight, RP-24.1 Journals or RP-24.3 axles.

4.5 Turnout Inspection Form

There are three track standards covering several scales and gages, Proto or Fine Scale, Standard and Deep Flange or High Rail. Be sure to use the proper table for the turnout that you are measuring.

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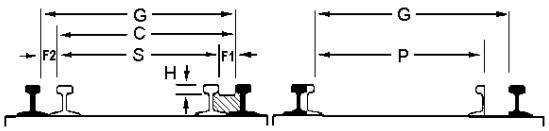
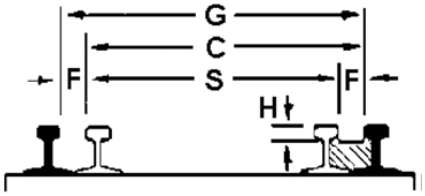
Using a set of calipers, take a gage measurement at the points and record it. Take another gage measurement at the frog for both routes and record them. Measure check gage, span, frog and guard rail flange-way width and depth and record each. Last measure flange-way depths at the frog and guard rail and record the measurements. Compare your measurements to the applicable S-3.x Standard.



4.6 Crossing Inspection Form

There are three track standards covering several scales and gages, Proto or Fine Scale, Standard and Deep Flange or High Rail. Be sure to use the proper table for the crossing that you are measuring.

Using a set of calipers, take a gage measurement at each leg and record it. Take a check-gage measurement at each leg for both routes and record them. Measure span, and guard rail flange-way width and depth and record each. Last measure flange-way depths at the frog and guard rail and record the measurements. Compare your measurements to the applicable S-3.x Standard.



5 Taking Mechanical Measurements

All mechanical measurements should be taken with a set of calipers to 0.001” (0.0025mm) or better. Periodically the calipers should be calibrated. Measurements shall be recorded in the Inspection Form and compared to the applicable Standard or RP on NMRA.ORG.

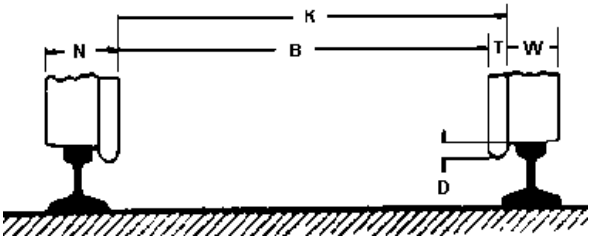
5.1 S-2 Coupler

The coupler height measurements shall be taken from top of rail to the middle of the coupler. Other unofficial checks may be obtained by using the NMRA Standards Gauge or a Kadee coupler height gauge to verify, but the measurements must be taken and recorded. Measuring to the center of a coupler is difficult to achieve accurately. A method to measure this is to measure from top of rail to top of coupler. Then measure the coupler thickness (height) and subtract ½ this value from the previous measurement. Care must be taken to not push down the coupler while taking this measurement. Employment of a re-rail track where the center of the re-rail track is at the same height as the top of rail can aid in taking these measurements. Both front and rear couplers shall be measured, and the values recorded.

Further, the Inspector must check if one or both couplers are metal and insulated from the frame.

5.2 S-4 Wheels

Wheel measurements are the same for cars or locomotives. To take some of these measurements it may be advantageous to remove the wheels and axels from the trucks. To check measurements, the Inspector should take the measurements at multiple locations to verify that they are consistent.



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5.2.1 Back-to-back (B)

This measurement shall be taken as stated on the back side of the wheels near the flange of the wheel. Caution should be taken to not use excessive pressure with the calipers and spread the wheels by pushing them out of gage. Record this measurement for each set of wheels under column B.

5.2.2 Wheel Width (N)

This measurement shall be taken across the thickness of the wheel from outside to outside. This will determine if the wheel is standard, proto or deep flange. Each wheel shall be measured at multiple locations to verify the consistency of the measurements and recorded under column N.

5.2.3 Flange Width (T)

This measurement shall be taken at multiple points to verify consistency. The measurement shall be taken on the flange at the outside of the radius that transitions from the tread to the flange. Measurements shall be recorded under column T.

5.2.4 Flange Depth (D)

This is a more difficult measurement to take. A method to assure better accuracy is to take a measurement across the whole wheel face from outside to outside of the flange. Then take a measurement of the wheel tread across the face at the point where the radius ends in the transition from the flange to the tread. Subtract the former from the latter and divide that by 2 to get the flange depth. Record these measurements under column D.

5.2.5 Wheel Gage (K+T)

This measurement shall be taken from the outside of one flange to the other near the point of the radius where the flange turns to the tread. Record each of these measurements under the column K+T.

5.2.6 Check Gage K

This is a difficult measurement to take accurately. It can be derived by taking the wheel gage and subtracting the flange thickness T. Record each of these numbers under column K.

6 S-9 Electrical

Locomotives will obviously require checking electrical items. However, some cars will be equipped with AC/DC lighting or DCC sound and lighting decoders. For AC and DC equipment a check of maximum voltage is required. A DC locomotive must also run forward when the right rail is positive relative to the left rail. This is also a good time to test a DCC decoder in DC operation.

Where a car or locomotive comes supplied with a decoder factory installed, the DCC Test Team will test any decoder not previously awarded a Warrant of Conformance. Should the installed decoder model and software version have previously been issued a Warrant of Conformance, no further testing of the decoder is required. Make note of any installed decoder on the Inspection Form.

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To verify that the wiring has been performed properly and that the decoder is configured pro[erly a DCC test by running the locomotive in the forward and reverse direction shall be conducted. In addition, one shall test all lighting outputs for proper operation.

Checks for AC/DC/DCC operation are required as well as verification of any decoder interface and the associated wiring. Wire color codes as outlined in S-9.1.1 shall be followed. The exception to this is where there is a factory installed Standard interface (21MTC, PulX22 or Next18 etc.) and the end user is not expected to perform any wire connections.

7 Recommended Practice

As stated in the name, these are practices that are recommended to increase performance and interchange. Failure to meet an RP will not prevent a piece of equipment from obtaining a Warrant of Conformance. However, all RPs shall be checked and recorded. These will be reported in all reviews submitted to the NMRA Magazine.

7.1 RP-7 Clearance

The easiest way to check the clearance is to put the car on the track and put the latest NMRA Gauge at the end of the car or locomotive and sight down the car to see that it is within the profile of the Gauge. For modern era equipment there is a plastic snap-on clearance Gauge which is larger than the early era Gauge. This reflects Association of American Railroads larger modern clearance requirements.

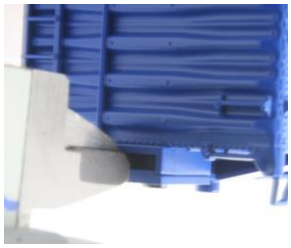
7.2 RP-20.1 Weight

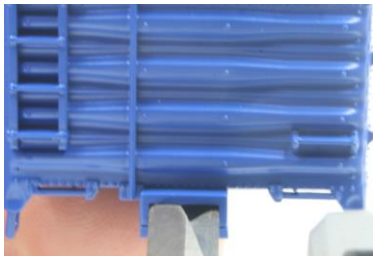
Measure the total length of the car body in inches, excluding couplers and calculate the desired weight by the table on that page of RP-20.1 for the scale of the car being inspected. There is a base weight and an additional weight per inch of length. Go weigh the car on an accurate set of postage scales or food scales and compare. Some cars will be short of the target weight.

Many end users will add weight to reach this minimum or even add more weight to exceed this amount. This was calculated to improve tracking of cars to help them stay on the rails yet not so much as to increase the drag beyond a reasonable level. This formula also takes into account the lengths of cars to improve performance around curves without the string line effect.

With the newer free rolling wheels and trucks today, exceeding the RP-20.1 recommendations is possible without creating excess drag. Many end users exceed this amount with good success. The values of RP-20.1 are the minimum recommended weights.

7.3 RP-22 Coupler Pocket





The interior width and height of the coupler box shall be measured and recorded on the inspection form and compared to the values in RP-22. The coupler (box) pocket should accommodate the greatest possible number of commercially available couplers of all types.

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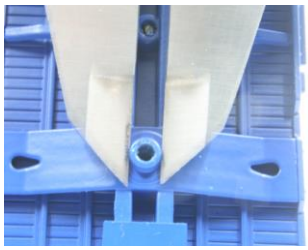
7.4 RP-23 Bolsters

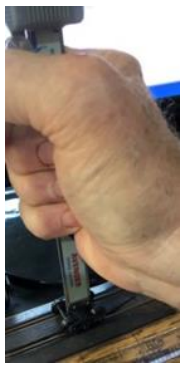
Since the Inspector has the axels out of the trucks it is a good time to remove the trucks from the car and measure RP24.3 axel length and diameter and then come back to bolster and kingpin measurements.

This RP is to make it easier to swap trucks from car to car or replace the trucks with the design of your choice. However, manufacturers seem to excel at making their trucks and bolsters to different dimensions to make an exchange more difficult and require a bit of work to do so.



Measuring the diameter of the kingpin is a simple process, but you will encounter at least two types of kingpins. The older style uses a screw used to attach the truck to the car as the kingpin. A short section near the head of the screw is void of threads and is smooth. This is where the measurement should be taken. The kingpin screw may be a wood screw or a machine screw. In other cases, the kingpin may be plastic or metal with the screw inside the threaded opening in the kingpin. See photo to the right. Run the outside jaws down to the outside of the kingpin and take the measurement.

The inside of the truck bolster hole is easy to measure by using the inside jaws of the caliper. There is an offset that makes this measurement a bit more difficult. So, work the calipers around a bit to see that both jaws are against the inside of the bolster hole. The best performance is when the play between the kingpin and bolster is small without binding. Usually between 0.005”-0.010”



The bolster height requires removing the truck from the car and placing it on that re-rail section again. Then place the tail of the caliper down the bolster hole until it touches the re-railer which is at rail head height and use the thumbscrew to lower the body of the caliper until it just touches the bolster nearing surface. Record that measurement in decimal format and then convert to 16ths of an inch. Being that it is to 1/16” it is a very crude measurement but can be measured more precisely with your calipers and converted to fractional inch measurements.

7.5 RP-24.1 Journals

Identify if it is a type I or II journal. No other measurements are required.

7.6 RP-24.3 Axles

Measure the axle diameter and length. The axle diameter “A” is to be measured outside the wheel face, not between the wheels. The shoulder Y shall be measured on the axle between the wheels near the back of the wheel. The axle length “U” is measured from tip to tip. Record these measurements. Note if the axle is a Type I (pointed) or Type II (blunt axle).

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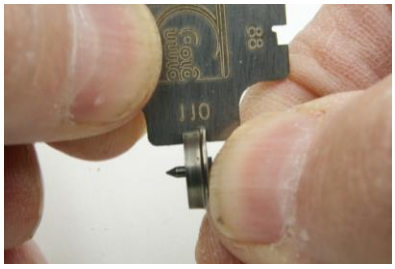
7.7 RP-25 Wheel Contours

Wheel measurements previously taken for N, D and T are automatically populated from the Table for S-4 in section 3) to the Table for RP-25 in section 10). The Inspector shall calculate the tread width W by subtracting the flange thickness T from the tire width N.



If the measurements N, D, T and W pass, the Inspector now must measure the radii of the fillet between the tread and flange as well as the radii at the outside of the flange. Using a set of radius gauges of the appropriate size and holding the wheel and gauge up to a strong light the Inspector can check that the radius gauge is a good fit to the radii of the wheel. The NMRA has an RP-25 gauge for wheel sizes 145, 110, 88 and 72. This gauge will check wheel width, flange depth and width as well as each of the three radii. If the wheel fits within the gauge without excessive light showing in the gaps the wheel is acceptable. These measurements shall also be recorded in the Table for RP-25

8 Minimum Radius

When completing a review of rolling stock, the Inspector shall also verify the minimum radius on which the car or locomotive will operate reliably when coupled to a car or locomotive of the same length. Setup a short section of track of a known radius using sectional track securely fixed to a sheet of plywood or similar material. Move the car around the track while coupled to a car or locomotive of the same length. It is not required that the equipment couple of this minimum radius but simple that it transvers the section of track without derailing. Note this on the Car or Locomotive Inspection Form

9 Free Rolling Characteristics

At what grade will the car overcome friction and begin to roll? On a straight piece of track mounted to a flat board, gently raise one end until the car breaks free of static friction and begins to roll. Measure this grade with a calibrated digital level. Repeat five times and take the average, excluding any outlying measurements. Compare your results to the chart below.

Rolling Resistance Category	Grade Range
☐ Extremely Free Rolling	< 1.0%
☐ Very Free Rolling	1.0% – 1.5%
☐ Free Rolling	1.6% – 1.9%
☐ Moderately Free Rolling	2.0% - 2.5%
☐ Less Than Free Rolling	> 2.5%

The process is described in detail in an article by Chris Thompson in the NMRA Magazine April 2024.

10 Verification

Once all measurements have been taken and logged on the form, forward a copy to the C&I Manager CIManager@NMRA.ORG to review and confirm that all measurements conform to the Standards.

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11 Failure to Meet Standards

From time to time, we will discovery that some part of a product falls short of the Standard. In this case the Inspector should contact the manufacturer with the information and include a copy of the Inspection Form, with an offer to assist. Copy the have the C&I Manager on this email. Most manufacturers are interested in correcting the offending issue and will produce new parts and supply replacements parts that conform to the Inspector to check.

The S&C Manager should be informed and can become involved if needed. It is the policy of the NMRA to assist manufacturers in meeting our Standards. However, if a manufacturer refuses or is reluctant to correct the offending parts after a reasonable period of time (no longer than 6 months), the NMRA has a responsibility to our members to inform them of products that do not meet NMRA Standards. This information will be published in the NMRA Magazine.

12 Issuance of Warrant of Conformance

If all is in order the C&I Manager will forward (via email) with a cc to the Inspector, the Inspection Form to the S&C Manager for issuance of a Warrant of Conformance. The S&C Manager will have the information on the Form to complete the Warrant. Manufacturer, main contact person there (President or CEO), email address for that person. Product Identification including item stock number. The Warrant will be emailed to the Inspector, with cc to the C&I Manager. The Inspector then sends an email containing the Warrant of Conformance to the manufacturer with ”congratulations” on the success inspection.

13 Review for the NMRA Magazine

Once the Warrant has been issued the Inspector can proceed with writing a product review and including the information from the Inspection.

The Inspector is responsible for taking good quality photos of the product and writing the review. Assistance with photography is available. The crux of the review is a table listing all applicable Standards and Recommended Practices and where the model passed or failed. The Conformance Warrant Number issued shall be included. The Inspector can go on to talk about aspects of the model, such as how well it conforms to the prototype, accuracy and quality of the paint and lettering and other aspects that would be of interest to NMRA members. A bit of history on the prototype is also desirable. This part of the review can add a lot of desired information for our readers.

A copy is provided to the C&I Manager to proofread. It is also recommended that a copy be provided to the manufacturer to catch any errors before going to print.

A File Transfer Program (FTP) site is where all NMRA Magazine articles and reviews are uploaded. https://www.wrpftp.com/ is the preferred way to get the review to the Magazine. With high-definition photos the files become very large and exceed email capacity. The FTP does this in a short time. The password for this site is sometimes changed. Therefore, it is not published here but will be provided by the NMRA Magazine Editor.

The NMRA Magazine Editor will send the final proof to the Inspector, copy to the C&I Manager for final review and proof.

14 Document History

Date	Description

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30 Dec-2023	First Issue JM Juett
8 Feb-2025	Added proto and instructions for measuring RP-25, wheel contour. Various spelling and grammar corrections. JM Juett
4-July-2025	Added RP-22 coupler pocket measurements. Added photos and revised instructions for axle measurement RP-24.3. Improved photo of kingpin measurement RP-23. Added more instructions on information to be included on the Inspection Form to issue the Warrant of Conformance. JM Juett

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NMRA's development of NMRA Standards documents involves the review of documents in English only. In the event that an NMRA Standards document is translated, only the English version published by NMRA is the approved NMRA Standards document.

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