

## Report of Test of Model Torque ATC

Date of Test: 18 December 2002

Tester: Kert Peterson

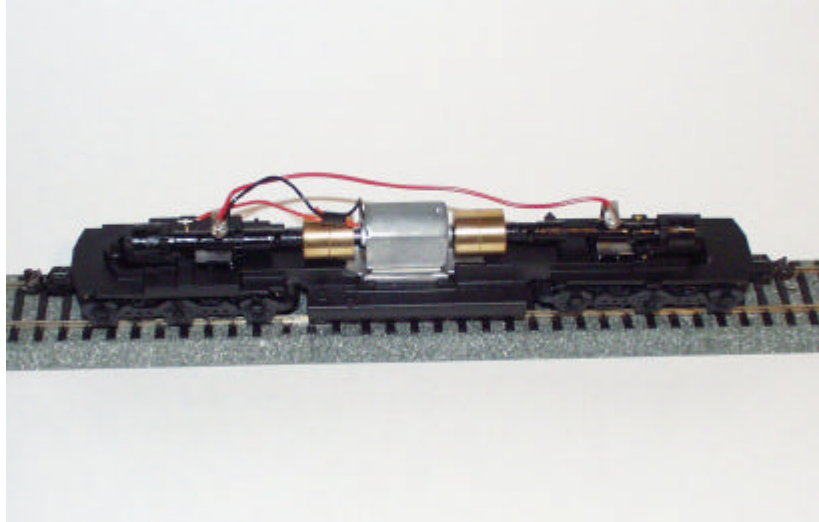
### Summary of Test:

A Model Torque ATC-equipped Athearn locomotive chassis was compared to a stock Athearn chassis and a Kato chassis in a series of tests involving pulling effort on three different track profiles. The three track profiles were level track, 2.2% grade, and 5% grade. Load consisted of hoppers weighted to NMRA standards, and several heavy load cars. Total weight of loads could be varied between 3.5 ounces (.100 kg) and 80 ounces (2.25 kg). Testing consisted of objective evaluation of voltage and amperage levels for the locomotives pulling various loads, and subjective evaluations of locomotive performance. Overall, the Kato locomotive pulled more weight, and was smoother in operation than either the Model Torque ATC-equipped locomotive or the stock Athearn locomotive. Under light to mid-weight loads, the Model Torque ATC-equipped locomotive's pulling effort was as similar to the Kato, but required more voltage and amperage to move the same load (push or pull).

### Test Equipment:

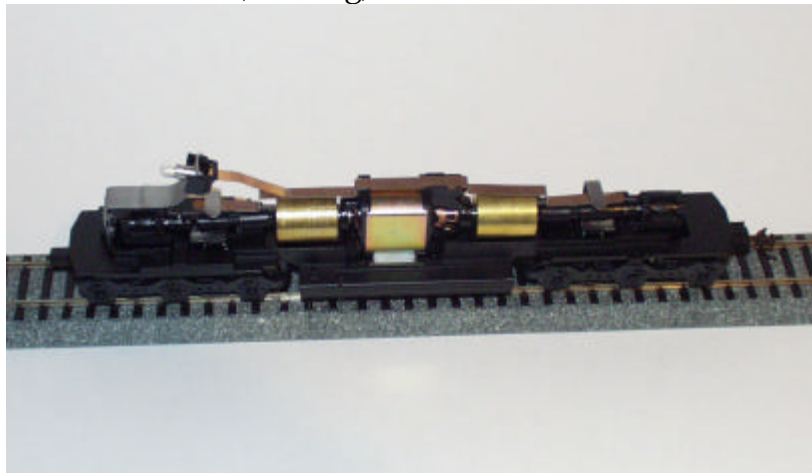
A. Locomotives: Three models of SD40-2 locomotives were used for these tests, two were based on Athearn chassis, and the third was a stock Kato.

1. An Athearn chassis was remotored with the Model Torque ATC and fitted with NorthWest Short Line (NWSL) nickel-silver wheels. An A-Line/ProtoPower West motor mount weight was installed to aid in driveline alignment. I debated using the motor mount supplied with the ATC, but decided that it would be easier to use the A-Line motor mount and double stick mounting tape than to modify the ATC motor mount to fit the chassis. Weight of the modified chassis was 13.5 ounces (.380 kg). The photo at the top of the next page shows the Athearn chassis with the Model Torque ATC and motor installed:



Note the A-Line motor mount under the motor. The mount adds only .25 ounces (7 gm), so should not be classified as a weight. The .25 ounces (7 gm) only allowed the ATC-equipped chassis to retain the same weight as the stock Athearn chassis.

2. A stock Athearn chassis, literally taken straight from the box. This provided a comparison for what will most likely be the primary vehicle used by potential buyers of the ATC. Weight of the Athearn chassis was 13.5 ounces (.380 kg).



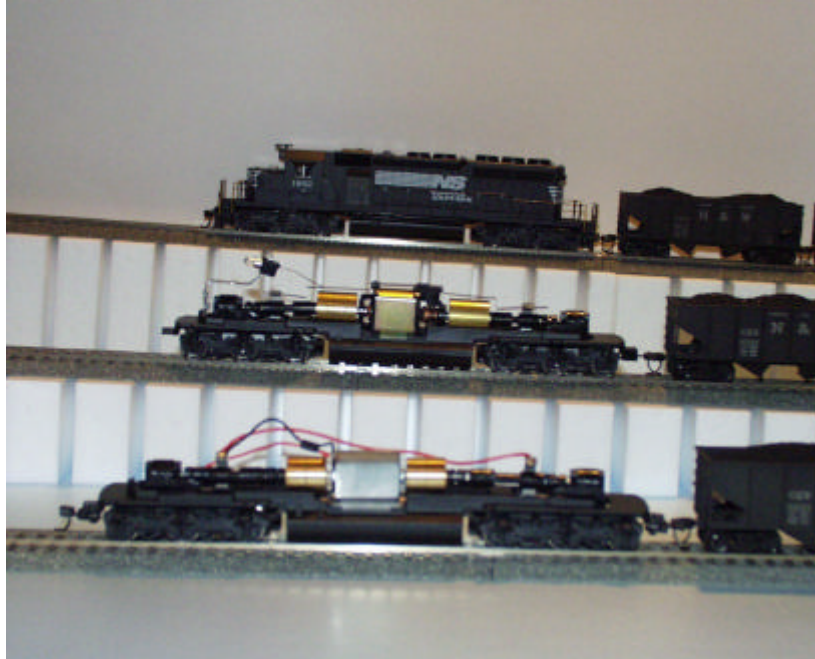
3. A stock Kato SD40-2 model was used for comparison with the model railroad industry "Gold Standard". The Kato locomotive weighed 24 ounces (.680 kg), and this additional weight made a huge difference in pulling power.



B. Load: Load for testing consisted of twelve Coal hoppers weighted to NMRA standards (3.5 ounces or 100 gm), one hopper weighted to 10 ounces (285 gm), one hopper weighted to 12 ounces (340 gm), and one hopper weighted to 16 ounces (454 gm) were used. The heavily weighted hoppers were use to save track length, while the lighter hoppers were used to ensure that wheel friction was included with the load. Test track length limited using entire consists of cars all weighted to NMRA standards to achieve full loads. All cars were equipped with metal wheelsets, and all would stay in place on the 2.2% grade, but roll easily on the 5% grade.

C. Test track: Kato Uni-Track was used for the test track to ensure a uniform track surface. For grades, Woodland Scenics Subterranean Incline Sets for 2% and 4%. When measured with a digital level, the 2% grade actually measured 2.2% and the 4% grade actually measured 5%. While this definitely makes a difference in pulling capability of the locomotives, since the locomotives were all measured on the same grades, the tests are valid for the track profiles. The particular grades were chosen to represent a medium grade and a steep grade. Model railroaders have generally set a standard of 2% for the steepest grade desirable for a mainline. However, since that is not always possible, steeper grades are occasionally used. One track plan considered as a standard by the tester includes one 5% grade on a branchline to a mine tipple. So, the 4% (5%) Woodland Scenics Incline Set was used to represent such grades. Throughout this report the two grades are referred to by their actual gradient rather than the Woodland Scenics designation.

This is a comparison photo of the test grades:



Note that the camera was not perfectly level when the photo was taken, but the level grade was truly level.

D. Power source: A MRC Tech 3 Power Command Model 9500 DC power pack was used. The 9500 is capable of producing 20 volts of electromotive force and 3 amps of current.

E. Weights: All weights were measured using a digital scale, calibrated with known weights in imperial units. SI units of mass were determined by conversion. (I suppose I could have used SI units of weight, but kilograms is better known in the non-scientific world.)

#### Test Methodology:

Each locomotive was tested in three modes on each grade. The first mode was locomotive only, which was to determine the starting voltage and amperage for the locomotive. The second mode was with a light load, which was 21 ounces (.595 kg) for the level and 2.2% tracks, and 10 ounces (.285 kg) for the 5% grade. The third mode was with the heaviest load that the locomotive was capable of pulling on that grade. For the Athearn and Kato locomotives, the heaviest load used less than 12 volts, but for the ATC-equipped locomotive, the heaviest load required 16 volts to pull.

## Test Results:

Empirical Data are compiled in the following table:

Test	ATC- Equipped	Locomotive Results Stock Athearn	Kato	Comments
Locomotive Only				
Level track	3 V @ .1 A	3 V @ .2 A	3 V @ .05 A	ATC-equipped motor began spinning at 2 V @ .1 A
2.2% grade	3 V @ .2 A	3 V @ .2 A	3 V @ .1 A	ATC-equipped motor began spinning at 2 V @ .1 A
5% grade	5.5V @ .25 A	4 V @ .3 A	3 V @ .15 A	ATC-equipped motor began spinning at 2 V @ .1 A
Locomotive with Light Load				
Level track	8 V @ .3 A	8 V @ .5 A	4 V @ .1 A	
2.2% grade	9 V @ .3 A	8 V @ .5 A	5 V @ .1 A	
5% grade	10 V @ .35 A	10 V @ .6 A	6 V @ .1 A	
Locomotive with Heavy Load				
Level track	12 V @ .4A w/ 64 oz (1.8 kg) 16 V @ .5 A w/ 80 oz (2.25 kg)	12 V @ .6A w/ 80 oz (2.25 kg)	4 V @ .2 A w/ 80 oz (2.25 kg)	Loss of traction with heaviest load at maximum voltage - ATC
2.2% grade	12 V @ .4A w/ 42 oz (1.2 kg) 16 V @ .5 A w/ 48 oz (1.36 kg)	8 V @ .6 A w/ 48 oz (1.36 kg)	12 V @ .4 A w/ 64 oz (1.8 kg) 14 V @ .5 A w/ 80 oz (2.25 kg)	Loss of traction with heaviest load at maximum voltage - ATC and Kato
5% grade	12 V @ .4 A w/ 21 oz (.595 kg) 16 V @ .5 A w/ 28 oz (.795 kg)	12 V @ .6A w/ 28 oz (.795 kg)	12 V @ .4 A w/ 45 oz (1.25 kg)	Loss of traction with heaviest load at maximum voltage - ATC

Smoothness, or level of vibration, was a subjective evaluation made during the objective tests. Comments on subjective evaluation criteria are provide in the following paragraphs.

Observations: The Athearn was a distant third in smoothness in any of the tests, but pulled more weight than the ATC-equipped locomotive. Both locomotives with Athearn chassis were limited in tractive force, compared to the Kato, because of the significantly less weight on drivers of the Athearn chassis. As far as harmonics, the Kato is the hands-down winner in smoothness. The Athearn is known for its rather buzzy harmonics. The ATC was in between the Kato and the Athearn, but still exhibits a vibration that would require dampening to keep sound to a minimum when the body shell is installed. Under light to medium loads, the ATC-equipped chassis seemed vibration free. However, when a body shell was attached to the chassis, there was still an undesirable buzz. This buzz was markedly less than the stock Athearn chassis produces, but, I believe, most modelers would still find it undesirable, especially when compared to a Mashima or Kato remotored Athearn chassis. A Mashima or Kato motor with a pair of ATCs installed would most likely be the ultimate remotor for the Athearn chassis. This combination was not tested during this test.

Weight in the chassis had a significant effect on tractive effort of the locomotives. The Kato locomotive weighed almost twice as much as the Athearn chassis of the other two test locomotives. The greater tractive level provided by that level of chassis weight is significant. Some modelers, the tester included, would add as much weight to the remotored Athearn chassis as is possible. These tests were conducted without the additional weight so that a fair evaluation could be rendered

using stock components. Also, many modelers do not add additional weight to their remotored chassis. A combination of the additional weight and the power characteristics of the Kato HM-5 motor resulted in the Kato locomotive being able to pull more weight with less current and less voltage than either of the other two combinations. Weight of the chassis makes a significant difference in pulling power. Adding weight to the chassis will allow the remotored locomotive to perform closer to its potential.

The operating characteristics of the ATC are exceptional, and would be even more so if Digital Command Control (DCC) and sound were to be used. The operational characteristics of the motor, particularly harmonic vibration, make a significant difference in overall performance of the remotor package. The ATC allows the model locomotive to react similar to the prototype in “notching up” power before beginning to pull its load.

The current version of the ATC may allow slightly too little torque transfer. The optimum torque transfer may be somewhere between the original version and the current version.

Conclusions: The Model Torque ATC has the potential to revolutionize model railroad remotoring. Its ability to simulate prototypical performance is exciting, and something that modelers have been striving to achieve for decades by using external means such as momentum controls on power packs. The largest potential market for the ATC may be the DCC modelers, as this will simplify the use of sound synchronization. When combined with a motor like the Kato HM-5 or Mashima or NWSL can motor, the vibration-free operation of the motor combined with the operational characteristics of the ATC, will yield a locomotive that will perform more prototypically than anything currently on the market.

Recommendations:

- A. Construct a Kato HM-5 motor with Model Torque ATC powertrain, and install in the Athearn chassis and test using the same battery of tests that were used in this report.
- B. Add sufficient weight to the chassis with the combination in recommendation A. above, and test using the same test procedures and set-up as used in this report.
- C. Based on results of testing in recommendations A and B, adjust the amount (%) torque transfer of the ATC to optimize performance.
- D. Test the revised combination in a chassis with DCC and sound.