Welcome to the first ModelTorque Information Bulletin.

The purpose of the Bulletin is to provide information on all aspects of ModelTorque's Automatic Torque-control Coupling (ATC).

This method of sharing the product information has been prompted by the enthusiastic response to the product and the need to fully explain its operation and how it may fit with individual Modellers' railroad operating requirements.

Please ask any questions. They will be answered either directly or in a future 'Bulletin'.

In this Bulletin ...

Best regards on behalf of the ModelTorque Team,
Graham Rooke

1 The beginning !

ATC Concepts.

The concept of the ModelTorque Automatic Torque-control Coupling (ATC) was borne out of the belief that truly prototypical operation of models of diesel-engined prototypes could not be achieved using the present 50 year old "direct-coupled motor-to-wheel" drive systems ... even utilising the latest sophisticated motor designs.

We felt that an alternative should be possible to provide modellers with a drive system which truly replicated the operation of diesel prototypes ... so we set out to try to design such a device.

All diesel-engined railroad stock (from rail cars to main-line locos, and everything in between) operate in a manner almost identical to the private motor car equipped with auto transmission ... irrespective of the different transmission elements used in different prototype locos.

An analysis of motor car operation therefore set the basic parameters for the ModelTorque ATC.

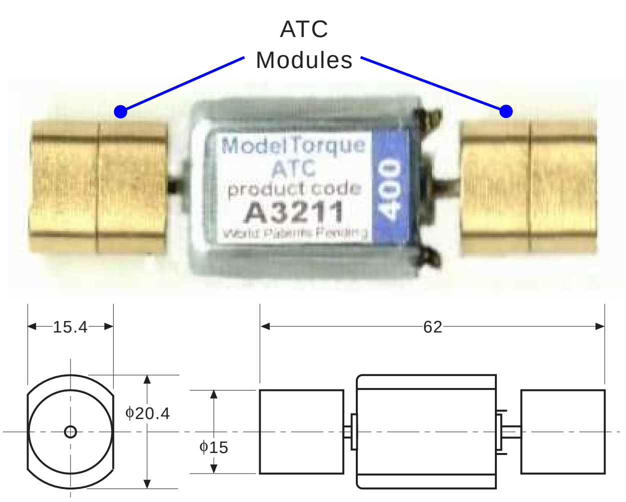

Figure 1
ATC Assembly
Product Code A3211

ATC Design Parameters.

Using the motor car as being analogous to diesel loco operation, we identified the following operational features as the cornerstones for the ATC design :

1. To start a car, the accelerator (throttle) must be opened to rev the engine sufficiently to overcome the vehicle weight and friction. Until sufficient torque has been generated the vehicle remains stationary.
2. The torque to maintain a set speed on a level road is less that the starting torque, and so the accelerator is eased back once the car starts.
3. If the car travels up a grade, the torque required to maintain the same speed increases.
4. If the same vehicle has (say) a caravan attached, all the above torque levels will be increased in proportion to the load.
5. If a limited-slip differential is fitted to the vehicle, power (torque) will favour the wheel(s) with the greatest adhesion.

Based on the above considerations, we detailed the ATC design parameters as follows :

1. The ATC should be designed to fit between the drive motor and the driven wheels, eliminating the present "fixed-ratio" configuration,
2. The ATC must contain no liquid,
3. The ATC design should allow for different primary sizes to suit different scales, and within each size should be able to provide different torque transfer efficiencies to suit different prototype 'power plant' capacities and weights,
4. The design should incorporate "limited-slip differential" functionality to enable (a) diesels of B-B & C-C configurations, and (b) multiple unit loco consists, to operate with automatic driven-wheel load sharing.

Three years on, and after many tries, patent searches and applications, and help from modellers to test prototype units in 'real life' model railroad environments, we believe that the ATC does provide a new alternate drive-train product and philosophy.

2 Principles of Operation ... Overview

Module.

An ATC Module is shown diagrammatically in *Figure 2*. The RHS (red) is the module input (drive motor shaft), the LHS (green) is the module output. There is no mechanical connection between input and output, except for the bearings supporting the module that allow it to rotate freely around the drive motor shaft.

The connection between input and output is an inductive field generated at the module input by the rotation of the drive motor. This field induces a rotational force at the module output. This output torque is connected to the driving wheels through the usual cardan shaft arrangement.

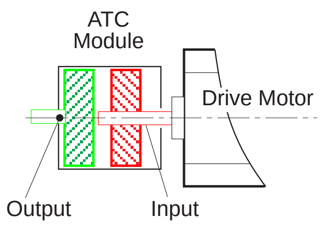

Figure 2
ATC Module Operation

The ATC module is designed in such a manner that a selected torque transfer function may be built into the module during manufacture. This allows the final ATC assembly to be matched to loco weights etc. This issue is explored in the following section.

ATC modules are usually supplied as an assembly with either 1 or 2 modules integrated with a drive motor. The drive motors are high-torque high-rpm units designed specifically for this application. A typical 2 module ATC assembly is shown in *Figure 1* (page 1.1).

ATC Assembly

The ATC assemblies are designed to provide specific torque output ranges for a throttle movement from 0% to 100% (0-12Vdc). These torque ranges have been selected to match bands of loco weights. For example the ATC Product Code A3211 provides a total output torque between 3 and 16.5gm.cm which by experimentation is considered best for loco weights of approximately 400 gm. The aim of 'pairing' the ATC torque range to loco weights is again in pursuit of prototypical operation.

The recommended torque ranges vs loco weights will be discussed in detail in the next Bulletin.

The following example of model operation with ATC drives explains the principles of operation that this form of drive will provide.

Figure 3a shows the operation of a loco running light. The loco requires a starting torque of 9gm.cm and a running torque (depending upon the speed requirement) of (say) 4.5gm.cm. Note that the throttle must be opened to about 40% before the model will begin to move; at which time the drive motor is running at about 2,000rpm. At this speed it is developing hightorque that is reduced by the ATC module torque transfer function, but at the point of starting to move, the ATC is providing a reserve of power to keep the loco moving slowly and smoothly.

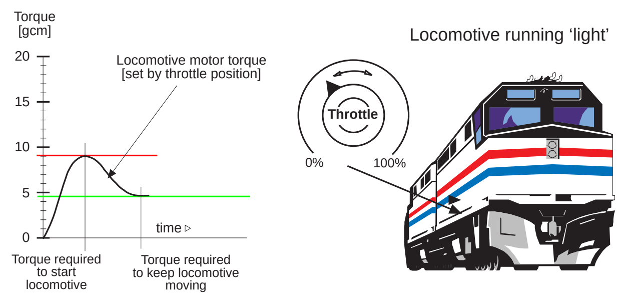

Figure 3a
ATC-fitted loco operation

When movement has commenced, the throttle is adjusted to settle the loco to the required speed.

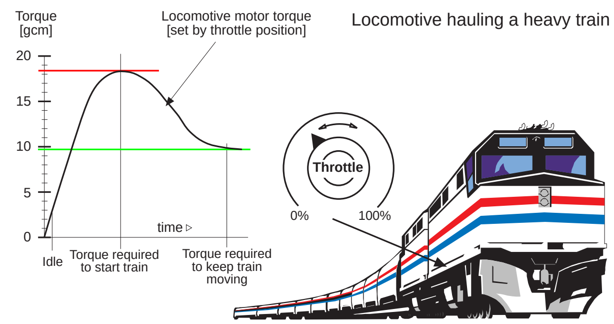

Figure 3b
ATC-fitted loco operation

Figure 3b shows the same loco now coupled to a heavy train. The operation is similar to that described above, but to lift the train requires (a) a significantly higher loco starting torque, and (b) a higher ongoing torque.

The operating torque differences highlighted between Figures 3a & 3b apply also as the train moves up or down grades etc.

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