# Transit Systems Use Recycling to Reduce Maintenance Costs

Steve Watt and Ralph Malec
Maxwell Industries Inc.
Ventura, California

## Introduction

We all know how difficult it has been for transit systems to keep their operations running smoothly in light of tighter operating budgets. Rail maintenance departments are being asked to cut staff and curtail material usage to reduce their costs. This has raised concerns that reduced maintenance budgets could lead to vehicle reliability issues. Savvy maintenance directors are exploring every avenue to come up with creative ways to reduce their operating costs. A number of these individuals have discovered a new, environmentally friendly strategy to reduce parts costs. These transit systems have learned that the rail car shock absorber, long considered to be a throwaway item, can now be reused indefinitely. Forty years ago rail car shock absorbers were simple, hydraulic devices and very inexpensive. Current rail car designs feature trucks with more advanced suspension systems which utilize European designed shock absorbers that are more sophisticated and often re-buildable.

## Shock Absorber Technology

The shock absorbers currently being used on heavy and light rail vehicles are supplied by companies like ZF-Sachs and Koni. These European damper companies have long built rail car shock absorbers that are rugged in design and completely serviceable. The cost of these units is often three or four times that of the simple hydraulic devices they replaced, but they are designed to last the life of the vehicles. These twin tube designs feature few moving parts and a robust disc valve system that guarantees high dependability and an extremely long life between overhauls. The performance of these dampers deteriorates very slowly and when needed can easily be rebuilt to like new conditions. They also can be readjusted to change the ride quality of the rail car. If a shock absorber begins to leak the shaft seal can easily be changed in a couple of hours. Unfortunately, few North American transit systems are taking advantage of these features and continue to discard their shock absorbers when they leak and as part of planned truck overhauls

## .The CTA Experience

About six years ago the Chicago Transit Authority Rail Car Engineering Department was pursuing a method to evaluate the condition of shock absorbers removed from trucks during its quarter life overhaul program. The CTA like most other systems was changing out all shock absorbers regardless of condition as part of this planned maintenance operation. They were replacing about 1200 shock absorbers annually at a cost near $500,000. They knew that these shock absorbers were designed for a much longer life, but they had no way to accurately test them for reusability. Consequently, the shocks were replaced rather than fail during the time span to the next truck overhaul.

Their goal was to find a simple method to test the damping characteristics of their used shock absorbers. CTA found the answer in professional auto racing. Racing cars and motorcycles use a re-buildable shock absorber with deflective disc technology similar in design to the railway dampers built by Koni and ZF-Sachs. Teams change the damping characteristics of their shock absorbers to meet the requirements of each track where they race. They retain the basic tube assemblies and only change the internal valving. Professional racers measure the damping force of each shock absorber configuration they build. They use dynamometer testing machines to set these parameters. The CTA staff researched manufacturers of racing shock absorber dynamometers to see if they could find a machine to accommodate their rail car shock absorbers. They ended up connecting with a racing equipment manufacturer in Ventura, California called Maxwell Industries Inc.

Maxwell agreed to test a half dozen of the CTA's used shock absorbers and compare damping rates to several new shock absorbers supplied by the CTA. The test data revealed that all six used shocks were still within the damping specs for the new shocks. The CTA placed

the re-certified shocks back into service. These shocks worked flawlessly during several years of service. Reusing those six shock absorbers saved the CTA almost $2,000. As previously stated the CTA was normally replacing over 1200 shock absorbers a year at a cost of nearly $500,000. The potential savings were enough to convince the CTA to purchase their own shock dynamometer machine and begin to test and re-cycle their shock absorbers. The CTA has experienced over a 90% reuse rate on shock absorbers since purchasing their shock dyno. The cost of the machine was recovered in savings from shock absorbers that were found re-useable within the first three months of testing.

## Maxwell Industries

Because of their experience with the CTA, Maxwell started approaching other transit systems about rail car and bus shock absorber testing and re-certification. Maxwell found that smaller systems often did not have the quantities of used shock absorbers to justify a purchase of their own dynamometers. Maxwell began to offer testing and rebuilding services in addition to the sales of complete dynamometers. The first system to utilize Maxwell's testing services was SkyTrain in Vancouver, BC. Their results were better than the CTA's. In the last three years over 95% of the SkyTrain shocks tested by Maxwell passed the dynamometer test and were recertified for re-use. Other systems that have since used the Maxwell shock testing program include: St. Louis Metro, San Diego MTS, Denver RTD, ProTrans BC and Minneapolis Metro Transit. Calgary Transit decided to purchase a dynamometer and do their own shock absorber testing. All these systems have discovered the benefits of shock absorber recycling.

### How the Program Works

The Maxwell shock testing program is not complicated. When a system contracts with Maxwell to do shock testing the first step is to determine the baseline data for each type of shock absorber in use. Most systems do not have copies of the shock manufacturers' damping force graphs, so Maxwell runs tests on three or four new shock absorbers and uses the average as the baseline standard. Maxwell then tests a group of used shocks submitted by the transit system and compares the results to the baseline standard. The system can specify the acceptable deviation from the standard or use Maxwell's recommended deviation of 20%. (Note: Both Koni and ZF-Sachs consider any shock within 25% of the original damping rate as acceptable for reuse.) Prior to testing any used shock absorbers, Maxwell inspects the units for physical damage and leaks. They clean the unit and affix a label containing a unique Maxwell serial number. All shocks that test within the specified deviation are certified for reuse and returned to the transit system. Maxwell supplies complete electronic test data for each shock tested. The cost to test and recertify a shock absorber is a small fraction of the cost of a new shock absorber and Maxwell guarantees the shock for a full year from the date of installation.

Maxwell advises the system of any shocks that failed the test but appear to be satisfactory for rebuilding. Maxwell can rebuild leaking and weak shock absorbers to like-new condition if desired by the transit system. Maxwell does a complete teardown of each shock absorber being rebuilt and inspects and cleans all components. Damaged components are changed and the old oil is replaced with a high performance, synthetic oil. Maxwell installs a new, upgraded Viton shaft seal that is guaranteed for two years. After reassembling the unit it is tested on the dynamometer to make sure it is within the deviation specified by the customer. Maxwell supplies electronic test data for each rebuilt shock absorber displaying curves comparing initial and rebuilt damping performance. Each rebuilt shock absorber is warranted for two years.

## Other Components

While Maxwell's prime business is shock absorbers and suspension testing equipment, they are eager to work with transit systems on other recycling/reverse engineering projects. One such project was a joint venture with San Diego MTS to rebuild the coupler damper struts on their early Siemens cars. San Diego maintenance staff approached Maxwell about major issues they were having with the damper struts on their Dellner couplers. There are two of these struts on each coupler and San Diego found that they needed frequent readjustment after years of use. In some cases the internal components deteriorated so badly that they caused the strut to tear open, totally destroying it. After evaluating several of these damaged struts Maxwell came up with a new design for the unit. They found that the Belleville spring washers began to fail after years of operation. A mechanic could readjust the unit to make up for a few broken washers, but the units required more frequent readjusting when other washers failed. Maxwell replaced the Belleville spring washers in the unit with a special designed coil spring. Maxwell built a couple of improved units, tested them on the dynamometer and gave them to San Diego to install. These units performed flawlessly for over two years. They never required adjusting. San Diego has since contracted with Maxwell to rebuild the struts on all their couplers with the new improved design at less than half the cost of buying replacements from the OEM supplier.

Maxwell is constantly looking for new recycling challenges. Currently they are looking at rebuilding the door links on a San Diego Siemens car. The goal, as always, is to determine a way to recycle an old, worn out component. The transit industry is constantly talking about Green initiatives. Testing and rebuilding shock absorbers truly fits that definition. Recycling shock absorbers and other rail car components keeps them out of municipal landfills and saves maintenance operations the cash they had previously been spending on replacement units. Maxwell Industries is proud to be able to partner with systems to make this happen.