

Colorado LTAP

September 2004

Serving local transportation agencies throughout Colorado

Fall Issue



By Lydia Abarr

Operating heavy equipment can be a dangerous job for both the operator and the ground-based worker. In an OSHA report spanning 1985-1989, it was reported that approximately 10% of the 3496 fatal construction accidents occurred as a result of workers being struck by heavy equipment. The people that were struck and killed were commonly the 'signalmen', the person that was responsible for the safe movement of the equipment. This is why the operation of heavy equipment should only be done by highly skilled operators and the ground-based workers should be trained in how to work safely around the equipment.

There are some common rules that the operators and the ground-based workers can follow to ensure a safe working environment. It is essential that there is good communication between the operator and the ground-based worker. This can be accomplished by using a standardized set of hand signals and two-way radios. The equipment

should have a back-up warning alarm. It should be noted though, that the operator should not solely rely on the back-up warning alarm to warn the ground workers because they can become accustomed to the sound and not respond when needed. This is a reason that the operator should always know where the ground-based workers are located. The ground-based workers can be made more visible with reflective, brightly colored clothing. It is also suggested that all workers on the job should wear hearing protection as noise levels around equipment could potentially cause hearing loss.

To ensure safe vehicle operation, the following safety procedures should be followed. The heavy equipment must have a rollover protective structure (ROPS). This is designed to protect the operator if the machine tips over. The operator should always use the three-point contact rule when mounting and dismounting the equipment. This means

Strict safety precautions are followed at APWA's Snow & Ice Equipment Roadeo in Gunnison.

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Routing Slip

After reading this issue of Colorado LTAP, please initial below and pass it along to the rest of your staff.

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The Colorado Local Technical Assistance Program is sponsored by the Federal Highway Administration, the Colorado Department of Transportation, and the University of Colorado at Boulder.

The Colorado LTAP Newsletter is published quarterly. Articles, pictures and comments are welcome.

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Program Manager's Corner

We hope you were all productive with summer construction projects. The summer has flown by and we are anxious to start another fall training program. Lindsay has been working hard to schedule a wide range of topics. A list of upcoming courses is included under *Upcoming Events*. Keep an eye on incoming class brochures for up-to-date and location and date change information.

Just a few reminders about our training courses:

* To guarantee a spot in class, please sign up no later than a week prior to the class date.

* Due to course expenses, **we have a cancellation policy**. A full refund will be made if you cancel no later than 36 hours prior to the class; otherwise, you will forfeit the registration fee. Someone may substitute for you. *No shows will be charged the full fee.*

* We suggest that you dress comfortably in layers. Temperatures in the conference rooms can vary so you may wish to bring a sweater or light jacket.

We look forward to seeing you all at an upcoming training event!



Quotes of the Day

Whatever you can dream, begin to do it.
Boldness has the power and magic in it.

~Goethe

If you know where you want to go, you have a better chance of getting there.

~Anonymous

The difference between hindsight and foresight is *planning*.

~Anonymous

If your plan is for one year, plant rice;
If your plan is for ten years, plant trees;
If your plan is for a hundred years,
Educate children.

~Confucious



<http://ltap.colorado.edu>

Visit Colorado LTAP online today for online training, class registration, free lending library, and more.

Ten Reasons to Become a Colorado LTAP Road Scholar

The Colorado Local Technical Assistance Program (CLTAP) Center offers workforce training and development to all state, county, and city municipal employees with an interest in transportation related topics. The Road Scholar program was started in the fall of 1991, and was designed to provide participants with the training to increase their knowledge of transportation safety, local road maintenance procedures and improve their technical skills by attending a wide variety of programs available at reasonable costs.

1. Knowledge for Yourself and Your Employees - We don't know everything about our business. By attending these classes, your knowledge will be taken to another level. This knowledge can help you and your employees keep their jobs.

2. Advice - Technical advice about road problems that you may face while doing your projects. We face so many issues in maintaining roads and we don't know all the answers. Sometimes we need to ask questions.

3. Hands-On Training - Working with equipment and materials that you, your employees and your hired contractors use - knowing the equipment and standards used in this field can help you save money and make your contractors and taxpayers love you.

4. Cost - Cost is minimal. Due to our funding resources, LTAP is able to subsidize a lot of the costs for local gov't agencies, providing quality training for a minimal fee.



5. Friends - Meeting new people, meeting good people, and trading ideas.

6. LTAP Needs Us
- LTAP is funded with FHWA and State money which can be reduced if unused.



7. Looks Good on Your Resumé - You may need one someday. Listing some training and experience will enhance your options.

8. Confidence - Knowing what to tell people when they have a problem or telling your employees how to fix a problem builds their confidence in you and also strengthens your own confidence in yourself. Both of these help you have a better working relationship with your employees and constituents.

9. Not Having to Worry - Having a well-trained work force saves time for you and your supervisors and saves money for your district which makes you look good.

10. Save Dollars for Your District - By completing projects correctly the first time, you are saving tax dollars for the people for whom you work.

How to Participate:

To become a designated "Road Scholar" each participant must take the required four core curriculum courses and five additional electives of their choice, for a total of nine courses. For more information about the Road Scholar Program please contact the CLTAP office. Course schedules and registration forms are also available online through our website at <http://ltap.colorado.edu>.

Email: cltap@colorado.edu
1-888-848-LTAP

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HE Electric Safety

If you make contact with a high voltage line while operating heavy equipment, take the following precautions:

- o Stay on the equipment, if possible, until help arrives.
- o Avoid touching any metal parts.
- o Try to break the contact by moving the vehicle.

IMPORTANT

If it is absolutely necessary to exit the machine, jump as far out as possible and make sure you do not fall back against the machine. Land with both feet together and hop or shuffle your feet a few inches at a time making sure to never break contact with the ground.

When electricity makes contact with the ground, the earth becomes energized for a good distance around the contact point. This is why it is vital not to separate your feet. Don't walk or run!



Heavy Equipment Operation Safety

continued from page 1...

that three points of the body should be touching the equipment at all times while mounting/dismounting, be that two feet and one hand or two hands and one foot. Upon entering the cab, the first thing should be to "click-it", the operator must always wear a seat belt. Heavy equipment operators should investigate the working area and be aware of certain areas and terrain such as; stumps, rocks, hidden debris and low tree limbs. These trouble spots can cause overturn or knock an unsuspecting operator off of the equipment. Extra caution should be taken when working on slopes. Inspect banks or slopes for stability and if possible avoid moving across the face of the slope. Also be aware when operating on wet or icy surfaces because these conditions reduce traction.

The equipment should be inspected and serviced regularly and this should be done in accordance with the manufacturer's recommendations. A qualified person should periodically perform a safety inspection on all components. The steering system and brake systems should be checked carefully and regularly. The operator should always perform a pre-shift walk around inspection.

This is a brief review of some common safety rules that should be followed by both the operator and the ground-based worker. To ensure safety

the ground-based workers need to stay alert at all times and the operator must have appropriate training and/or licenses before operating. The operator should also know how to properly operate the equipment being used as well as the limitations of the machinery.

If you would like more information about heavy equipment safety please check out our library, which can be accessed at <http://ltap.colorado.edu>. In addition to safety guidebooks, the videos listed below are a few recommendations on heavy equipment safety that can be loaned free of charge through our library.



V40 OAOA *On Again, Off Again: A Guide To Mounting And Dismounting Heavy Equipment*

V50 LTUHE *Highway Work Zone Safety: Loading, Transporting, And Unloading Heavy Equipment*

V50 IAHO *It Always Happens To The Other Guy*

V50 SHWD *Shake Hands With Danger*

V40 ITT *In The Trenches: Excavation Safety For Workers*

V50 CSHT 1 *Equipment Operation Maintenance Overview*

V50 ATAS *Always Think About Safety*

V40 RLMC *Rigging & Lifting With Mobile Construction Equipment*

Proper mounting and dismounting techniques include the three point contact rule.



REPAIR or REPLACE?

The Question Regarding Settled Concrete Curb & Gutter, Sidewalks, Pavements

Concrete Stabilization Technologies (CST) of Denver, Colorado offers an economical solution for restoring settled concrete structural facilities to their original position instead of replacing them. Vertical realignment and stabilization of settled structures is accomplished by injecting expanding polymers below the bottom surface of concrete slabs and asphalt pavements, foundations, and spread footings. The pressures exerted by the expansive polymers lift the structures to the desired grade elevation and stabilize the facility within acceptable tolerances.

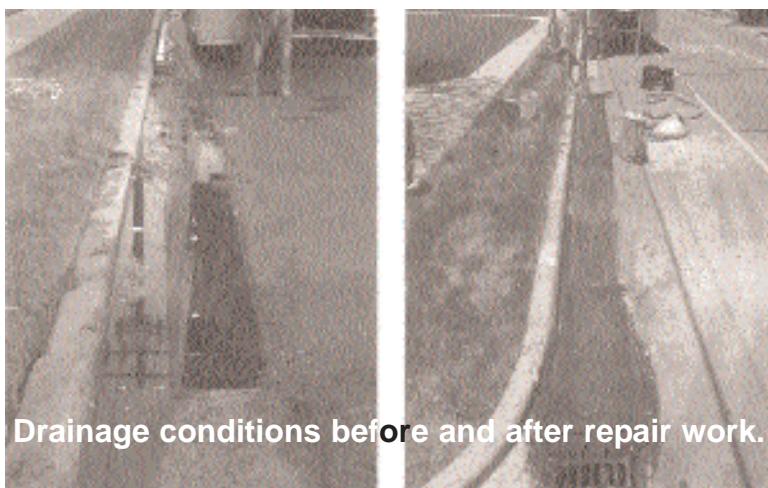
Some DOT's in the country use the injection stabilization technique to raise settled bridge approach slabs and faulted concrete pavement slabs to their original position, thus, avoiding costly and time consuming replacement procedures. Following the lead of their DOT, many municipalities have also started to use this technique to lift and stabilize concrete curb and gutter sections, pavement sections, and sidewalks. The expanding polymer injection technique also can be used to lift and stabilize structure foundations, concrete floor slabs, and other structural elements.

When structures and other facilities settle, the problem is often located in the subsurface layers under the structures. Many times fill materials under the facility have not been properly

compacted during construction, or a subsurface layer is simply too weak to support the loads. When these conditions are suspected, CST utilizes a dynamic cone penetrometer to locate the depth and thickness of weak layers. Steps are then taken to densify the weak layers by injecting the expansive polymers at strategic locations within the weak layers.

The expansive polymers stabilize and strengthen the weak layers, thus providing adequate load carrying capacity. The expansive polymer, when injected, not only lifts the structural element to proper grade but also fills all voids, thus stabilizing the element and providing adequate foundational support. Subsequent settlement is virtually eliminated.

Lifting and aligning faulted and settled curb and gutter sections have proven to be a money saving tool for several municipalities in surrounding states. During the past four years, projects have been successively completed in Brush, Colorado; Douglas, Wyoming; and Holladay, Utah. Early in 2002 Taylorsville, Utah initiated a test project to evaluate the cost benefits of the polymer injection technique. This project showed fifty percent savings over the cost of conventional remove-and-replace procedures. Subsequent projects have been awarded and completed during 2003 as a result.



Drainage conditions before and after repair work.

Further information regarding the expandable polymer injection technique can be obtained by contacting Concrete Stabilization Technologie's Roy Mathis at 888-306-9191 in CST's main office in Denver.

Adapted with permission from an article by Concrete Stabilization Technologies

Why Curb & Gutter?

When a municipality accepts public ownership of the streets in a development, it also accepts public responsibility for the maintenance of those streets.

Streets with curb and gutter can be substantially more economical to maintain than those with ribbon paving.

According to *Why Curb & Gutter?* by APWA, the primary reasons to curb & gutter include:

- o Tends to be more cost-effective over the life of the street.
- o Reduces pavement failure
- o Provides safety
- o Controls drainage
- o Improves the appearance of the neighborhood
- o Reduces weeds and litter
- o Provides driveway & traffic control
- o Aids in cleaning and snow plowing
- o Tends to require less right-of-way than other designs

Skid Steer Safety

The following recommendations were given by NIOSH for safely entering and exiting a skid steer.

- ◆ Enter only when the bucket or other attachment is flat on the ground or when the lift-arm supports are in place.
- ◆ When entering the loader face the seat and keep a three point contact with handholds and steps.
- ◆ Never use foot or hand controls for steps or handholds.
- ◆ Keep all walking and working surfaces clean and clear of debris.
- ◆ Before leaving the operator's seat:

- o Lower the bucket or other attachment flat to the ground
- o Set the parking break
- o Turn off the engine

If you are unable to exit through the front of the machine, use the emergency exit through the roof or across the back.

CLTAP is offering Equipment Maintenance and Inspection classes in November 2004. Check out "Upcoming Events" pg 12 for more info.

Skid Steer Loader Safety

By Lydia Abarr

Between 1980 and 1992, the National Institute for Occupational Safety and Health (NIOSH) National Traumatic Occupational Fatalities Surveillance System identified 54 work-related fatalities involving skid steer loaders. As indicated by the number of fatalities, skid steer loaders can be dangerous machines. Given its size the skid steer loader seems like an easily controllable machine, but size can be deceiving. It is important to keep in mind that the power a skid steer loader can generate can be overwhelming. The accidents that can happen with a skid steer loader include rollovers, runovers, and pinning between the bucket and the frame or between the lift arms and the frame. One of the most common ways an accident occurs is from the operator entering or exiting the machine. Most of the skid steer loaders must be entered or exited through the front, over the bucket or other attachment. Because of this it is very important that safety precautions are followed when entering or exiting the machine.

Beyond safely entering and exiting the machine, it is vitally important to maintain safe operation of the skid steer loader. The operator should always read the operator's manual before operating the machine because it provides specific information about that particular machine. Some of the safety rules to follow include; work with the seat belt fastened and the restraint bar in place, operate the loader from the operator's compartment - never from the outside, stay seated when operating the loader controls, keep your arms, legs, and head inside the cab while operating the loader, when possible, plan to load, unload, and turn on level ground, never exceed the manufacturer's recommended load capacity for the machine, avoid traveling across slopes, travel straight up or down with the heavy end of the machine pointed uphill, always face the direction of travel, keep bystanders away



from the work area, and never modify or bypass safety devices.

The safeguards that most skid steer loaders come equipped with are there to prevent fatal accidents. The first safeguard comes in the form of interlocking. This means that the controls are interlocked so that a nonoperational control or fixture (such as a seat belt or restraint bar) must be secured or activated before operational controls can function. The other safeguards are rollover protective structures (ROPS), falling object protective structures (FOPS), side screens, and seat belts or operator restraint bars.

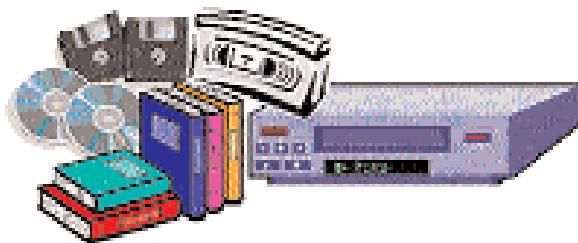
One of the most common ways an accident occurs is from the operator entering or exiting the machine.

It is also important to keep safety in mind when maintaining or inspecting the skid steer loader. Maintenance or service should never be performed under a raised lift arm unless a manufacturer-approved lift arm support is used properly. The equipment should be maintained and inspected according to the manufacturer's instructions.

The skid steer loader should also be supported according to the manufacturer's instructions prior to raising the lift arms and cage.

Skid steer loaders may seem like small, manageable machines, but as has been discussed, they can be powerful and overwhelming, which can lead to injuries or fatalities. It is important to always use and maintain the safety devices provided by the manufacturers, to follow safe operating procedures and safe mounting/dismounting procedures, and to train operators to follow the manufacturer's procedures for operating and servicing skid steer loaders.





What's New in the Library?

All videos, publications and CDs in the LTAP lending library are available for checkout for a two-week period, free of charge. To check out materials or request a library catalogue, contact the Colorado LTAP office at 1-888-848-5827. Library materials can also be ordered online on our website at <http://ltap.colorado.edu>.

Below is a list of the most recent materials added to the library.

New CDs

Location	Title
CD CIRL	<i>Comprehensive Intersection Resource Library</i> A compilation of resources about traditional signalized and unsignalized intersections, roundabouts, highway/rail grade crossings, and other nontraditional intersection designs.
CD RURA Superpave	<i>Recommended Use of Reclaimed Asphalt Pavement in the Superpave Mix Design Method</i> Research developed guidelines for incorporating reclaimed asphalt pavement (RAP) in the system and prepare a manual that can be used by laboratory and field technicians.

New Publications

Location	Title
30 FPTB 18	<i>Field Performance of Timber Bridges: 18. Byron Stress-Laminated Truss Bridge</i> During a field monitoring program, data were collected related to wood moisture content, force level of stressing bars, behavior under static truck loading, and overall structural condition.
80 FSPT2	<i>Funding Strategies for Public Transportation, Volume 2: TCRP Report 31</i> This report addresses the current state of funding for public transportation in the United States, the various circumstances that have contributed to today's funding environment, and specific strategies that transit agencies are pursuing to identify new sources of funding.
50 NMFE	<i>Family Emergency Preparedness Guide</i> This book contains a step-by-step guide to disaster planning along with other essential information you will need in building a comprehensive family emergency preparedness plan.
24 DSSE	<i>Development of Site-Specific Equivalent Single Axle Load</i> One of the key input parameter for designing new and rehabilitated pavements is traffic loading, which is based on equivalent single axle load (ESAL) applications. Inaccurate traffic load data, in conjunction with the use of 3-bin vehicle classification, has caused under-designing and sometimes over-designing of the pavements in Colorado. This report looks at these aspects.
24 PDS	<i>Pavement Design Standards and Construction Specifications</i> The object of this publication is to provide design parameters for local materials and conditions, and to provide guidance on use of AASHTO equations. The AASHTO design equations have been modified to account for Denver Metro typical subgrade soils and pavement materials so that sections have equal design life based upon fatigue.
50 HWT	<i>How Can We Work Together?</i> This guidebook is intended to help local communities coordinate their deployment of powerful new information and communication technologies for improving both emergency response time and the quality of day-to-day services.

What's New in the Library

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New Videos

Location	Title
V40 ACT	<i>Asphalt Crack Treatment</i> Introduction of asphalt crack treatments. It describes how cracks are created, explain the difference between sealing and filling cracks, and equipment and procedures used to treat cracks in asphalt.
V70 BMD	<i>Better Mousetrap Demos</i> This is a video illustrating entries in a competition of innovative items they have made in their own shops using used materials to make something that will make a specific task easier or more cost effective.
V50 CBP	<i>Chemical - Biological Preparedness: The New Threat</i> Useful video to familiarize staff with essential procedures for preventing, identifying & responding to bio/chemical threats: potential chem and bio weapons, including chlorine, phosgene, mustard gas, nerve gas, VX, Sarin, smallpox, anthrax, and botulinum; with signs & symptoms for detection.
V50 FL	<i>Forklift 2000</i> Provides all the academic training requirements for OSHA 1910.178 standard. Includes engineering, technical information, tipovers/turn overs, operating rules, operator maintenance and more.
V20 GDC	<i>Guidelines for Dust Control on Unsurfaced Roads in Alabama</i> This video explains basic treatment options for dust control and examines two treatments in depth: calcium chloride and lignosulfonate, a byproduct of the paper industry.
V50 TC	<i>Traffic Control</i> Protect the public & your employees through safe & effective traffic control procedures. It covers: Common causes of traffic control accidents; Requirements of effective traffic control; Signs; and Flagging traffic control devices: flashers, barricades, cones, delineators, drums and flags.
V50 TCTWZ	<i>Traffic Control Thru Work Zones</i> This video emphasizes worker safety & shows the proper set-up for traffic control on a short-term job. It also details safe work practices as well as covering the following topics: Basic flagging techniques; Safe taper length determination; Proper positioning of channeling devices
V50 WPE	<i>What to do About Work Place Emergencies</i> This video provides information to ensure safety in a workplace emergency. This program focuses on establishing an Emergency Action Plan and written policies and procedures. It covers: earthquakes, fires, tornadoes, hurricanes, bomb threats, chemical spills, biological threats, workplace violence, and Bloodborne pathogens; Hazardous chemicals, MSDS and labeling; Fire- PASS and types of extinguishers; emergency drills, planning and testing.
V50 WZSC	<i>Work Zone Safety for Construction & Utility Employees</i> Based on NIOSH recommendations, this program reviews work zone safety from traffic control to worksite coordination in an effort to reduce fearful accidents. It covers the following topics: - Regulations, standards & warning signs - Equipment inspections & maintenance - Channeling devices; flaggers and PPE.

Preventive Maintenance of Hydraulic Systems

By Jennifer Xi

Most agencies spend significant amounts of money to maintain and troubleshoot hydraulic systems. Management and personnel regard failure as a normal operational symptom of hydraulic systems. However, this does not have to be the case. With proper preventive maintenance procedures and discipline on the part of employees to follow them, most problems associated with hydraulic system failure can be avoided.

Because the components of hydraulic systems are intricately linked, minor damage to one component triggers a series of significant damage to other components. As a result, expensive parts and long man-hours are spent repairing major components. Conversely, in preventive maintenance procedures, a little time and money is spent inspecting and replacing minor parts, saving valuable resources from future malfunctions and downtime.

Contaminants in hydraulic fluid are the primary source of system failure. Nearly all problems can be eliminated through the use of proper hydraulic oil and routine inspection of it.

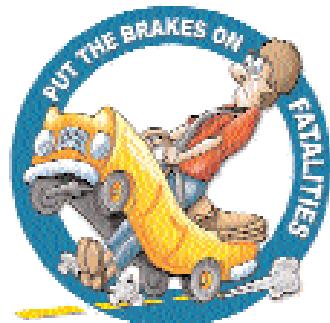
Viscosity is an important factor when choosing proper oil. If the majority of work occurs in extreme temperatures, multigrade oil is a good choice for equipment because it maintains constant viscosity across a wide range of operating conditions. However, while multigrade oil improves the viscosity index, it can negatively affect air separation abilities. Because mobile hydraulic equipment typically already has poor de-aeration qualities, using multigrade oil may further aggravate the problem. Therefore, if the equipment operates in relatively narrow temperatures, it is safer to stay with monograde oil.¹ In all cases, premium oils are preferable to regular; spend more on oil now and save on costly replacement parts later.

Additionally, detergent and anti-wear

oils are available for high performance in hydraulic systems. Detergent oils emulsify water and suspends contaminants, which then can be filtered out. Be sure to closely monitor fluid condition reports, as water levels above 100ppm can turn into steam and reduce lubricity, filterability, and speed the ageing of oil. Anti-wear additives, a common one of which is Zinc Diakyl Dithiophosphate (ZnDTP), may chemically break down and damage some metals, but it is essential to high performance in mobile hydraulic equipment. In all cases, follow manufacturer recommendations.¹

In order to maintain unpolluted oil, clean the area around the filters and fill plugs before removing them to change or check the hydraulic fluid. Check the fluid before each use for adequate levels; too little fluid can cause damage to the pumps. Also inspect the oil for discoloration. If the oil appears milky or foamy, then there is most likely an air leak in the system. Examine the system for a leak and seal immediately if there is one. If there is no leak, the contamination is most likely from moisture in the air of the system that condensed and mixed with the hydraulic fluid. To test for water, heat 1/8 cup of hydraulic fluid from the system in a metal can with a propane torch. If there is popping or crackling, then there is water in the system and the fluid should be changed immediately to avoid further damage.²

Aside from daily inspection, keep oil clean by installing the largest capacity filter available for the system. Fine filtering minimizes the entrance of metal particles into the system that cause wear, damage, and loss of efficiency to cylinders, pumps, valves, hoses, and motors. For easier maintenance, install a filter with a visibly accessible gauge to check when the filter needs changing. Changing the filter when necessary is much more practical and usually less expensive than an hourly or mileage



Put the Brakes on Fatalities Day

Did you know 116 of our fellow citizens, almost all of whom are someone's friend, family and most beloved become a statistic each day? They are dying in tragic, and what are most often preventable accidents on our nation's roadways.

Each year 42,000 Americans are killed on our Nation's Roadways. Imagine... a day with ZERO traffic fatalities.

Put the Brakes on Fatalities Day® was initiated by the National Society of Professional Engineers and has been joined by many partners who are working to lower the statistics. Our efforts to reduce fatalities address the need for improvements to our roadways, our vehicles and basic driver behavior. You too can become involved to promote the reduction of fatalities by utilizing

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Put the Brakes on Fatalities Day

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resources and information available on the website at: <http://brakesonfatalities.org>

The site includes a toolkit, the two previous years' local events list, fact sheets, press information, safety tips, partners and various links. Use this information to initiate and create your own 2004 event or program.

In 2003, a total of 42,643 lost their lives in traffic fatalities.

We hope you will join us in making a special commitment to reducing fatalities and become involved by changing your driving habits and encouraging others to do the same. We must change our driving habits as evidenced by statistics that say in 2003, a total of 42,643 lost their lives in traffic fatalities.

Please mark October 10, 2004 on your calendar "Put the Brakes on Fatalities Day®." Tell your co-workers, family, members and friends to do the same.

<http://brakesonfatalities.org>

Hydraulic System Preventive Maintenance

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schedule. Oil analysis is also recommended for equipment in corrosive or dusty areas, such as road building, to better identify areas of concern in the system before they become serious problems.

Low fluid levels, clogged filters, and contaminants in fluid can cause cavitation, or restricted flows to the pump. When more fluid is demanded than is supplied, the absolute pressure of the pump falls below the vapor pressure of the hydraulic fluid. Vapor bubbles then form in the fluid, which implode when compressed and cause metal erosion. In severe cases, cavitation results in complete mechanical failure of motors and pumps.³

To prevent cavitation, thoroughly inspect the pump every 50 hours. If the pump rattles, then cavitation is occurring and the system should be shut down immediately. Check the fluid for adequate levels, and clean filters to ensure a steady flow. Restricted flow could also be caused by discontinuities and contaminants in inlet lines.

Overheating of oil is another common and serious problem that is easily solved through daily inspection. For every increase of 18° over 130°, oil life is reduced by 50 percent.⁴ More importantly, overheating instigates a chain of failure that leads to costly replacements, labor, and downtime. Overheating reduces oil life by causing it to break down and lose its ability to lubricate properly. Loss of lubrication produces friction and therefore more heat between moving parts. Constant grinding of surfaces causes parts to break away and become contaminants.

The oil is suffering from overheating when the fluid smells burnt or the

reservoir is too hot to touch. In the majority of cases high oil temperature is due to frequent operation at a higher RPM than recommended, which produces pressure-related problems. Another possible cause is debris in or around the cooling system. Debris restricts airflow in the cooling system and consequently decreases its ability to cool. Other reasons for overheating include: incorrect oil viscosity (see above), insufficient oil supply, oil cycling over relief valve caused by dirt or overpressure, flow restrictions from improper hose and fittings, aeration and cavitation (see above), and clogged breather cap.⁴

In the majority of cases, the root of the problem is a contaminant somewhere in the system. Accordingly, the most important aspect of preventive maintenance is maintaining clean fluid and filters. Equally important is vigilance and attention on the part of employees to follow inspection procedures to maintain a clean and healthy system. Hydraulic system failure should no longer be seen as a common problem that simply occurs, but rather as a consequence of poor maintenance.



¹ *Insider Secrets to Hydraulics. Which Hydraulic Oil? 2004*
<http://www.insidersecretstohydraulics.com/which-hydraulic-oil.html>

² *Hydraulic System Maintenance.* 4/1/2002
http://grounds-mag.com/mag/grounds_maintenance_hydraulic_system_maintenance

³ *Hydraulic Valve Failure Caused by Cavitation.*
<http://www.insidersecretstohydraulics.com/hydraulic-valve.html>

⁴ *Simplifying Hydraulic Maintenance.*
Reece, David C.
<http://www.transportandconstruction.co.za/articles/article8.htm>



Website Question

At 1,053 feet above the Arkansas River, the Royal Gorge Bridge in Colorado is the highest bridge above water. Constructed in six months in 1929, the main span of the Royal Gorge Bridge is 880 ft long. At nearly 15 times longer, where is the longest suspension bridge in the world? Please visit the Colorado LTAP website at <http://ltap.colorado.edu> for the answer.

Upcoming Events

Conferences

County Road Advisors Conference
October 20-22, 2004

Rapid City, South Dakota

Call the LTAP center for a brochure.

2004 Roadway Work Zone Safety Conference

November 3-6, 2004

Baltimore, MD

Info and registration available at
<http://www.artba.org>

Transportation Research Board

Annual Meeting

January 9-13, 2004

Washington D.C.

Info and registration available at
<http://www.trb.org/meeting>

Training

Fall 2004

NOTE: Dates and locations are subject to change. Please contact the Colorado LTAP office for an updated schedule.

Road Scholar Core Classes

Drainage

October 6, 2004 - Northglenn

October 7, 2004 - Northglenn

Drainage, con't
October 14, 2004 - Pueblo
October 26, 2004 - Rifle
November 3, 2004 - Durango

Roadway Safety & WZTC
November 1, 2004 - Glenwood Springs
November 3, 2004 - Ft. Collins
November 4, 2004 - Limon
November 5, 2004 - Walsenburg

Road Scholar Elective Classes

Basics of a Gravel Road
October 4, 2004 - Ft. Morgan
October 12, 2004 - Colorado Springs
October 25, 2004 - Glenwood Springs
November 1, 2004 - Durango

Safety Risk Management
November 15, 2004 - Northglenn
November 16, 2004 - Pueblo
November 18, 2004 - Grand Junction

Equipment Maintenance/Inspection
November 22, 2004 - Montrose
November 23, 2004 - Silverthorne
December 2, 2004 - Pueblo
December 3, 2004 - Ft. Morgan

Advance Computer Skills (Word/Excel)
Grand Junction, November 10, 1/2-day
Lakewood, December 8 or 15, full-day

Supervisory Skills and Development Program

Successful Employees Make Successful Supervisors
November 9, 2004 - Castle Rock

Who's Coming through the Door Today
December 7, 2004 - Glenwood Springs



Congratulations to our latest Supervisory Skills Graduates!!

Sean McCormick
Gunnison County

Duane Taramarcz
Gunnison County

Look for these upcoming topics in 2005:

Signing, Pavement Markings, MUTCD

Safety on the Job

Mat'ls: Soils & Gravel
Access Management

Roundabout Design

Work Zone Inspection

Winter Maintenance

Public Relations

....and more



FREE PUBLICATIONS

The following is a list of **FREE publications** available to Colorado local government agencies in the transportation field.

Quantities are limited and available on a first-come, first-serve basis.

Contact the Colorado LTAP office to put in a request for these free publications.

Requests can also be made through the library page of our website, <http://ltap.colorado.edu>.

Portable Changeable Message Sign Handbook

The purpose of this handbook is to present basic guidelines for the use of portable changeable message signs (PCMS). This handbook presents information on the PCMS and is intended to illustrate the principles of proper PCMS use.

Traffic Control for Mobile Operations at Night

This Handbook provides guidance for mobile highway work operations scheduled to take place during darkness. This guidance addresses issues of when and where mobile night operations may be suitable, as well as the traffic control & safety devices that should be used to ensure a high level of safety.

Excavations

This booklet highlights key elements of OSHA's Excavation & Trenching standard, shows ways to protect employees against cave-ins, and describes safe work practices for employees.

Guidelines for Developing Traffic Incident Management Plans for Work Zones

Produced by CDOT, these guidelines cover Best practices, considerations for developing traffic incident mgmt programs, planning process issues, key components of a plan, and program implementation and management.

Colorado LTAP

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