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The Official Publication of the Association of Equipment Management Professionals

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Our Online Future

By Daryl Crear, 2010-2011 AEMP National President

At the AEMP 2010 summer board meeting, our Board of Directors looked carefully at the past and future of the association. We looked back with pride at the recent launch of the telematics standard, the new EMS credential, and the major success of our annual meeting.

As we looked to the future, we were greeted with grand opportunities and new challenges. AEMP was not immune to the vulnerability that the economic downturn brought our industry. But we have optimism and confidence that our association has the courage and creativity to triumph in the face of these challenges and never to lose sight of our vision.

We concluded that we need to focus our energies in order to have a greater impact on our membership. In everything we do we want to foster leadership, continually build on the knowledge we offer and gain, and prioritize projects that will make significant educational contributions to our members.

It is now clear that AEMP must not merely “weather the storm.” What AEMP is experiencing is not simply an economy-driven passing storm; it is a climate change. We are experiencing more than just a market-driven recession. We are experiencing a shift in the entire way people go about business.

We cannot simply attempt to cling to what we have; we must take account of new realities and technologies and adjust accordingly. A 2007 study by the U.S. Department of Education shows that more than two-thirds of all postsecondary institutions in the nation offered popular online distance education courses. Furthermore, more than 97 percent of all public two-year institutions offered online education courses.

Keeping these staggering statistics in mind, AEMP will be seeking funding to create a website that will be a dynamic educational resource to our membership. The website will not only be the 24-7 home base for articles, videos and other types of education, but it will also host the future online AEMP University. A stronger online presence will help AEMP present a professional and credible image. Contemporary web users expect to be able to find information and communicate online.

Organizations that still do not have a Web presence are inadvertently making a statement about their ability to embrace technology and adapt to change in today’s dynamic environment.

Our boosted online presence will also offer greater accessibility and convenience to members looking for information or education. Furthermore, our members will be able to enjoy travel and time savings, as education will be delivered directly to their screen.

Building a website that will grow with AEMP is a big goal. It’s challenging. And we know we can’t do it alone. The AEMP Education Foundation has agreed to assist AEMP with tax deductible fund collection. We will look for partners and individuals who can help us in any way. We plan to pursue an active, strategic approach for the use of our resources.

Although we have not set a new direction, we have decided to narrow our focus to a project that can be the foundation for many future successes. As we build on our achievements, lessons and innovation of those who came before us, we ask all of our members to help achieve these goals. We invite you to help us with this process—be it a tax deductible donation to the AEMP Foundation or by sharing web development resources. Most of all, we thank you—for your past and future support as we embark on this exciting new project.
AEMP Foundation Announces 20 Scholarship Recipients

The AEMP Foundation is pleased to award scholarships to 20 students planning to enter the diesel technician profession. The scholarship competition is open to students all over the United States who are interested in pursuing a career as a heavy-equipment technician.

The AEMP Foundation is committed to addressing the critical technician shortage by assisting those who wish to make a career in the heavy equipment industry. This year the Foundation saw a record amount of interest in the scholarship program and awarded a record number of scholarships.

This year, scholarships were awarded to:

**Jacob Novotny, Hot Springs, SD.** Jacob kept busy through high school with 4H, varsity track, cross country, and swimming. Diesel has always been one of his top interests, starting from when he had the opportunity to help a local rancher fix tractors or combines. Jacob plans on studying diesel mechanics at Laclede Area Technical Institute.

**Caleb Freidrich, Henry, IL.** Caleb is an Eagle Scout who is involved in Premier Boys State of Illinois as a delegate. Caleb is interested in the challenge of the ever-changing field of diesel technology. He will be studying Diesel Technology at Illinois Central College.

**Corey Fuhrman, Holtwood, PA.** Corey has worked nearly full time with diesel for two and a half years and is attending the Lancaster County Career & Technology Center program for diesel technology. Corey will be attending the UTI campus located in Exton, PA.

**Jeremy Raney, Kearney, MO.** Jeremy kept busy in high school with his participation in Skills USA as an executive council member. He has wanted to be a diesel technician for a long time and is especially interested in medium/heavy trucks. Jeremy is excited to start his diesel studies at Linn State Technical College.

**Courtney Krueger, Grand Forks, ND.** Courtney was busy in high school, serving as team captain for Red River Soccer and being chosen to play on Team North Dakota. He also was involved in National Honors Society, National Society of High School Scholars, traveling hockey, and his church youth group. He is also the recipient of two academic awards: Breakfast of Champions award and the Personal Best Award. Courtney will be attending North Dakota State College of Science to study diesel technology.

**Dylan Pieper, Norfolk, NE.** Dylan was involved with football, basketball and track in high school. Dylan currently works at a lawn care company where he has had the opportunity to service skid-steer loaders, tractors, wheel loaders and snowplows. Dylan wants to specialize in demolition and will be studying at South Dakota State University.

**Bryan Eaton, Amesbury, MA.** Bryan is an honor student who won an academic excellence award as well as a scholarship awarded to Massachusetts students based on state exam scores. Bryan will be attending Wyotech in Laramie, WY, to study in the diesel program as well as pursue studies in chassis fabrication.

**Timothy Chartrand, Rindge, NH.** Timothy has always been interested in diesel engines. Timothy studied at his high school’s ASE-certified automotive career center, but is excited to learn even more about...
diesel engine design and hydraulics systems. Timothy will be studying at White Mountains Community College in Berlin, NH.

**Thomas Finley, Bridgeport, IL.** Thomas is a four-year participant in FFA, serving throughout his time as President, Vice President and Treasurer. Thomas was also his class President as a senior and Vice President as a sophomore and junior. Thomas plans on pursuing an associate’s degree in Diesel Equipment Technology at Wabash Valley College.

**Jacob Parnaby, Middlefield, OH.** Jacob was busy in high school, serving as team captain on his high school’s basketball team and working more than 30 hours a week as a farmhand. Jacob wishes to become a diesel technician to “keep America running.” Jacob will be studying at the University of Northwestern Ohio for hands on training and certification as a diesel technician.

**Zachariah Parnaby, Middlefield, OH.** Zachariah was the recipient of numerous awards, including the National Technical Honor Society, Auburn Career Center Award of Excellence, Auburn Exemplary Student Award, and the Student of the Month award. Zachariah will be studying agriculture and Diesel at the University of Northwestern Ohio.

**William “Alan” Kennedy, Skowegan, ME.** Alan participated in the Order of the Elks, Varsity Golf and Varsity Bowling throughout high school. He also works as a mechanic apprentice at R. F. Automotive. Alan is looking forward to gaining new skills and advancing his knowledge at Universal Technical Institute in Norwood, MA.

**Tyson Mayhall, Grant, AL.** Tyson was an active participant in the FFA, serving as Vice President and receiving Star and Chapter Green Hand awards. Tyson currently works on a farm and wishes to expand his knowledge in diesel repair and maintenance. Tyson is looking forward to studying diesel technology at Wallace State Community College.

**Brian Appleman, Amboy, IL.** Brian was involved with FFA, Key Club, National Honors Society, baseball, wrestling, and football. Additionally, Brian spent time as a firefighter at the Amboy fire department. Brian is excited to start his studies in diesel power technology at Kishwaukee College.

**Logan Nelson, Rigby, ID.** Logan participated in baseball for 15 years as a pitcher and first baseman. In addition, he participated in Marion County Search and Rescue, getting certified in CPR/first aid, life support. Logan currently works at an auto parts store but will be looking forward to studying diesel technology at Idaho State University.

**Zane Osgood, Ischua, NY.** Zane is a second-year scholarship recipient who is busy studying at Alfred State College. Among some of the skills he has gained, Zane has learned to repair and describe brake functions, perform wheel alignments, and repair suspension parts. Zane’s professors applaud his work and people skills.

**Sam Boyle, Polson, MT.** Sam is a second-year scholarship recipient. Sam is attending Montana State University-Northern. Sam’s professors are pleased that he is challenging himself in the Diesel Technology Program and applaud his decision to pursue a bachelor’s degree.

**Kevin McKinley, Fairlee, VT.** A second-year scholarship recipient, Kevin is gaining hands-on experience at Washington County Community College. Kevin attended the 2010 AEMP annual meeting in Dallas and gained an abundance of industry knowledge and made valuable industry contacts.

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**The AEMP Foundation was able to provide additional scholarships with the generous support of the Foundation’s annual scholarship donors: Terex, Bechtel, Delta Rigging & Tools and ACEM. For more information on the AEMP Foundation’s scholarship program, visit AEMP.org.**
The Certified Equipment Manager (CEM) Certification program was developed by AEMP and is the recognized certification in the industry. The CEM program is designed to evaluate professional standards, enhance individual performance, and recognize those who demonstrate knowledge essential to the successful practice of equipment maintenance and fleet management. The Equipment Manager Specialist (EMS) designation recognizes the achievement of equipment managers in the first five years of their careers when they are developing the knowledge and skills to become a CEM.

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2010
Carter Dicken, CEM
David Dicken, CEM
David Heredia, CEM
Joseph E. Martin, CEM

2009
Richard Miller, CEM
Jason Marmann, CEM
Donald Lubinsky, CEM
Lowell Burgett, CEM
Tim Boland, CEM
Rich Hahn, CEM
Mike Blankenship, CEM
Ron Kennedy, CEM
Ronald Sharp, CEM
Jim Sulkaran, CEM
Robert Fitchett, CEM
Larry LeClair, CEM

2008
Bradley Ament, CEM
Brent Bailuff, CEM
Mark Bellamy, CEM
Robert Bogardus, CEM
Myron Brubacher, CEM
Tom Burbank, CEM
Donald Carson, CEM
Keith Cox, CEM
Mike Demelo, CEM
Ted Dexheimer, CEM
Kevin Edwards, CEM
Mike Fink, CEM
Will Ford, CEM
Cliff Francois, CEM
Mark Gannon, CEM
Robert Genter, CEM
Ed Gestido, CEM
Charles Hall, CEM
Mac Hardaway, CEM
James Hardesty, CEM
Gene Huffman, CEM
George Hrichak, CEM
Brent Johnson, CEM
Jarot Karcher, CEM
James Kulesa, CEM
Ron Lallo, CEM
Robert Lawson, CEM
Dave Leicester, CEM
Richard Lutz, CEM
Bob Merritt, CEM
Verlon Moore, CEM
Richard Mullins, CEM
Dan Pitt, CEM
Bill Prussman, CEM
Harold Reich, CEM
Marvin Rivera, CEM
John Rothweiler, CEM
James Smith, CEM
Gregory Stashuk, CEM
Robert Torin, CEM
Nathan Watts, CEM
Roy Winidley, CEM
Craig Worrell, CEM

2007
James Amspaugh, CEM
Richard Behrens, CEM
Danny Brashear, CEM
John Brewington, CEM
Robert Bucklew, CEM
Jeff Buckmaster, CEM
Randall Carter, CEM
Tommas Cochran, CEM
Daniel Connelly, CEM
Jeremy Cowing, CEM
Robert Dix, CEM
Mason Ford, CEM
Dominic Galati, CEM
Lawrence Gray, CEM
Steven L. Hагel, CEM
Myron Kuebler, CEM
Jason Mauney, CEM
Gary Merrifield, CEM
Sandra Mesquita, CEM
James Miller, CEM
William Mueller, CEM
Bruce Prentice, CEM
Kar Quackenbush, CEM
Warren Schmidt, CEM
Earl Swingham, CEM
Stacy Smith, CEM
Angel Sosa, CEM
Phillip Strain, CEM
Dwayne B. Thomas, CEM
Philip Wolfley, CEM
Mike Young, CEM

2006
Dan Beaver, CEM
Ryan Scott Bentley, CEM
Dan Bernosky, CEM
Terry Fox, CEM
Rodney George, CEM
Gil Gilbert, CEM
Harold Huddleston, CEM
Larry Maready, CEM
Gregory E. Morris, CEM
Andrew Murad, CEM
Steve Nester, CEM
Joe O’Leary, CEM
Phil Picone, CEM
Michael Pierce, CEM
Juan Ramirez, CEM
John Root, CEM
John Summerfield, CEM
Bradley S. Wright, CEM
Robert Weeks III, CEM

2005
Dale Abbott, CEM
Michael J. Brennan, CEM
Steve Burleyson, CEM
Robert Collett, CEM
Matthew S. Endsley, CEM
Lorne Fleming, CEM
Steve Frazier, CEM
John Gray, CEM
David Greenlee, CEM
Chuck Hoffner, CEM
Jeremy Holt, CEM
Peter Huisenga, CEM
Carter LaFoy, CEM
Michael Lax, CEM
Randall Lykins, CEM
Mark R. Malnack, CEM
John McCorkhill Jr., CEM
Tim Morgan, CEM
Tracy Ochsner, CEM
Troy Peterson, CEM
Marilyn Rawlings, CEM
Barry Schlouch, CEM
Paul Schmidt, CEM
Walt Shaw, CEM
Tom Stoner, CEM
Don Swasing, CEM
Richard VonVolkenburg, CEM
Richard Weston, CEM

2004
Christopher B. Anderson, CEM
Michael A. Bates, CEM
Steve Bell, CEM
Richard J. Brannigan, CEM
Matt Bush, CEM
Bradley J. Bylsma, CEM
Richard Byrd, CEM
Deborah S. Clark, CEM
Patrick T. Crail, CEM
Rex Davis, CEM
Richard S. Deeds Jr., CEM
David Dingey, CEM
David Doss, CEM
Robert Ermer, CEM
Todd Fulsom, CEM
Darrell Gregory, CEM
Grant Harrod, CEM
Kelly Hogan, CEM
Thomas Kelpe, CEM
Larry Kader, CEM
Robert Lang, CEM
Mark E. Lynes, CEM
Lewis Martin, CEM
Robbie Martin, CEM
Gregory Moore, CEM
Michael O’Brien, CEM
Michael Reischman, CEM
Randy Rendom, CEM
Brian Richards, CEM
David R. Schulhofer, CEM
John Sharp, CEM
Marcus Skaggs, CEM
C. Bryan Soilceau, CEM
William Stanley, CEM
Michael Tenski, CEM
Ben Tucker, CEM
Carl Uninick, CEM
Ervin W. Yahr Jr., CEM
Mike Zobel, CEM

2003
Robert Andrade, CEM
James Brohamer, CEM
Stephen Burton, CEM
Jonathon Chupp, CEM
Dan Delk, CEM
B.E. Denton III, CEM
Kent Field, CEM
Kevin Fritzenger, CEM
Paul Hays, CEM
Stephen B. Howard, CEM
Charlie Johnson, CEM
Terry Kader, CEM
Greg Kittle, CEM
James L. Landolt, CEM
Michael E. Lockhart, CEM
Richard Lower, CEM
Bradley Melcher, CEM
Karen Palencar, CEM
Robert Patterson, CEM
Tom Paulin, CEM
Leon M. Prillaman, CEM
Gary P. Rakes, CEM
M. Lee Shaffer, CEM
L.T. Williams, CEM
William Don Wright, CEM
The Certified Equipment Manager Institute (CEMI) takes place twice annually in conjunction with the AEMP Annual Conference in March and the AEMP Fall Symposium in October. It consists of sixteen, one-hour sessions relating to the sixteen equipment manager competencies covered extensively in the Career Equipment Fleet Manager (CEFM) manual.

Candidates for the Equipment Manager Specialist, Certified Equipment Manager, or the Certified Equipment Support Professional exams will find that the course is an excellent opportunity to study the content, ask questions of the professionals, and network with study groups prior to any of the three exams.

The Institute is open to all Conference registrants to attend any of the individual sessions but the Institute materials are only available to those that register specifically for the CEM Institute. Register for the October 26-27 CEMI and/or Certification Exams at the equipment manager learning source, aemp.org
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As hybrid technology emerges in earthmoving machines, at least three of the industry’s major OEMs—Komatsu, John Deere and Caterpillar—have turned to electrical power to “green up” and clean up the environment. Volvo Construction Equipment is “advancing its hybrid technology,” says a spokesperson, but chose not to comment for this article because it does not yet have a hybrid machine on the market.

If OEMs are right, hybrid technology issues facing fleet managers should be few and far between. They suggest hybrid technology will outlive the machine itself. Related components shouldn’t fail as often, owning and operating costs should go down (Caterpillar estimates a 10-percent decrease), and maintaining the machines will require normal servicing. In fact, since hybrid equipment has fewer moving parts, there are fewer components to fail, say OEMs.

“Hybrid technology does affect component life, but not negatively,” says Erik Wilde, vice president of product marketing at Komatsu. “Basically, our machine (the PC200 excavator) runs off what we call an ultra-capacitor. The life of that capacitor is astronomical. In theory it shouldn’t need to be replaced during the life of the machine.”

Wilde says capacitors will degrade over time, “but when you are looking at 100,000 hours on a capacitor the odds are, for a machine that size, the equipment won’t run that long.”

Fewer mechanical parts will boost reliability, suggests Joe Mastanduno, product marketing manager for engines and drivelines at John Deere Construction and Forestry. “When you electrify the driveline, it allows you to remove a lot of mechanical parts, like torque converters, transmission and differential,” he says. “When you eliminate the mechanical driveline, you have fewer components and your reliability should go up.”

Todd Lohnes, D7E service engineer with Caterpillar, concurs. “Compared to today’s nonhybrid D7R machines, we have a generator replacing the torque converter and a propulsion module with electric motors that replaces the planetary power shift transmission. As far as
component life goes, we expect the motors and generator to last the life of the tractor when maintained properly.”

Lohnes says that on the Cat generator, the rotor uses permanent magnet technology, a technology commonly used today. The rotors, he says, have the magnets. The stator—the fixed portion of the generator—has basically coils and windings. “As the rotor rotates, you generate an electric field and, from there, you can develop your electrical energy, depending on the magnets and the poles.”

The propulsion module has stators and rotors as well, Lohnes says. “Within the electric drive system we have a lot less rotating components.”

Energy storage

One of the major challenges in adapting hybrid technology to off-road applications has been how best to store the energy that is generated. One method that Komatsu, John Deere and Caterpillar say they are not using is batteries—other than the usual battery to crank the engine.

Although battery technology is the most familiar energy storage method and has made outstanding progress in the electronic world of PCs and laptops, for instance, batteries are not yet practical in off-highway applications, according to OEMs.

“We decided not to use batteries because in off-highway equipment you need quick bursts of energy,” says Wilde. “By their nature, batteries are slow to provide that energy release. You can’t get that quick function.”

Batteries take up additional space and weight, too. “The downside of using batteries on construction equipment is that they tend to be bulky,” Mastanduno says. “The battery technology just isn’t there now to have the payback for these construction machines. If there is no payback for contractors until five or 10 years out, they won’t buy the machine.”

Caterpillar rejected batteries because of the machine type, Lohnes says. “Battery storage technology does not lend itself to track machine applications. To our knowledge, we are the only company right now doing what we’re doing (with hybrid technology) on track-type tractors. Many of our competitors, on the other hand, are looking at hybrid technology for use on excavators and wheel loaders.”

Another energy storage method is fluid storage. That method, for on-highway vehicles, involves a reservoir, Mastanduno says. “They store pressurized fluid in the reservoir, and then when they need it, they release it. They can control or help assist the movement of the machine. Storage of hydraulics calls for a big reservoir, which might be hard to use on construction equipment.”

Caterpillar’s system will look different to equipment managers, Lohnes says. “We are unique in how we use generators and motors in our system,” he asserts.

Cat still uses a diesel engine in its D7E dozer to drive a generator, he says. The generator, mounted on the back end of the engine, replaces
the torque converter to produce electrical power that runs motors. The motors replace planetary shift transmissions that traditionally have been controlled by hydraulics.

“In the hybrid technology that we utilize, we take our mechanical energy that is developed from the diesel engine and convert it to electrical energy,” Lohnes says. “That electrical energy converts back to rotational energy out through our driveline and eventually to our final drive.”

The motors, which work together as opposed to one motor powering the left final drive and the other powering the right final drive, are used strictly to provide forward and reverse direction, nothing else. Steering is handled through a hydraulic differential steering system. “We have a pump that rotates a steering motor that changes speed and direction to handle the steering left to right,” Lohnes says.

Mastanduno says Deere’s approach focuses on hybrid electrification. “That has many features,” he says. “One is electrifying some of the auxiliaries. We call that auxiliary electrification. That’s one piece. Another is electric traction that converts the energy from the engine into electricity, which, in turn, controls the traction of the machine to go forward. The third part is energy storage, or energy management.”

Energy storage can be achieved in several ways. “You need to have one in some cases to get to the other,” Mastanduno says. “All are involved with moving things from mechanical energy to electrical.”

Hybrid electrification in construction equipment simply means two sources of energy, such as diesel and electricity—with energy being created, transferred or stored. Although electric traction (the engine drives a generator to create electricity) is in the construction market today, says Mastanduno, “electric drive is a future just waiting to happen.”

Deere already has developed hybrid electrification technology for use on mowers that cut golf greens and fairways, he says, and it is this technology that “sets the stage for electric traction on construction equipment.”

“As energy storage technology reuse capabilities and costs improve over time, this technology will provide contractors viable paybacks on equipment that does a lot of repetitive motion, or equipment with short cycle times such as loaders and excavators,” Mastanduno says.

Maintenance concerns

With all this complex generation of electrical power, many equipment managers are concerned about safety issues for technicians who work on the equipment.

Mastanduno says training addresses those concerns. “Traditionally, when people looked at construction equipment they saw a big mechanical bunch of metal with a bunch of mechanical parts,” he says. “When you switch over to electrical, there is training involved. But when you start talking with fleet managers, you hear, ‘Hey, isn’t that the same system that’s on the big loaders,’ or they say, ‘Isn’t that...
the same system used on railroads?" Well, yes, that’s exactly what’s being used. It’s not a big jump.

Rather than being trained on torque converters and drivelines, now technicians have to be taught about voltage converters and switching electronics.

“Technicians—especially the younger ones who play video games—won’t have any trouble adapting to that,” Mastanduno says. “It’s just a matter of education and training on a new system.”

Lohnes says technicians are protected. “We operate in an industry-spec’d low-voltage application, which is less than 1,000 volts DC,” he says. “We operate below that. Also, we have designed within our system a proprietary ground fault detection system, and a troubleshooting system within that allows technicians never to be exposed to hazardous voltage during any kind of system repair or troubleshooting.”

In addition to the engine that is not running during repair, Cat has a safe shut-down procedure in its manual for technicians to follow. “It’s as simple as turning off the ignition key and within five or six seconds the energy in the system is bled down,” Lohnes says. “Also, we have a hazardous indication lamp next to our battery disconnect switch. Once that lamp is out it means there is less than 40 volts in the system.”

Preventative maintenance on hybrid equipment will be no different than PM on nonhybrid equipment, according to Komatsu’s Wilde. “We do have coolant to make sure the capacitor is cool, but there are no reduced drain intervals or increased service time on the machine from the general PM activity.”

Caterpillar does not require additional PM requirements for its hybrid equipment, either. “What we’ve done for PM as far as fluids go is extend the intervals on our powertrain oil and filter life compared to a nonhybrid D7R,” Lohnes says. “We’ve extended the filter. In the hybrid there are electrical cables, which are expected to last the life of the machine as well. There are some tests to be done but only, for instance, at times when we need to check the integrity of the cable for current leakage.”

Hybrids are being shipped from Caterpillar factories with nonsynthetic multiseasonal oil, Lohnes says. “We ship machines all over the world,” he says. “This allows some areas of the country not to have to change oil simply because of climate changes, whether it’s hot or very cold.”

In addition Cat uses a powertrain oil to cool the motors and propulsion module. Engine coolant is used to cool the generator and
power electronics. “These are standard fluids, nothing special,” Lohnes says.
Cat did develop service tools to help disassemble and assemble the new drivetrain components. Other than that, standard service trucks can be used in keeping hybrids healthy, OEMs say.

Technician training on hybrids promises not to pose a problem either. “For most areas, technicians don’t have to be certified on mobile equipment at the levels we operate at,” Lohnes says. “We have created a service training class for the D7E that we recommend for technicians, but it is not required and isn’t mandatory.”

Komatsu also recommends training on its machine, but the training isn’t required, Wilde says. “We’re not talking intensive training on the system. We rely on our distributors for this training, but before we make delivery of a machine they have to be trained on the products that we ship into their territory.”

It’s the same at Deere, Mastanduno says. “A lot of OEMs have new model qualification for technicians. A certain number of technicians or parts managers have to be certified, but in this case it’s just another new piece of equipment that happens to be more electrical-based that it is mechanical-based.”

Hybrid technology won’t immediately have an impact on today’s warranties, say OEMs. “I think the market may go toward increasing warranties over time because of the reliability of electronics,” says Mastanduno. “That’s one of the things you could do, but at the end of the day the most critical parts are the engine and emission. That all remains the same. The government requires a certain warranty on the duration of the engine and the emissions system. Those key things will stay in place. But,” he adds, “you might see some people upping the ante on electrical parts versus mechanical parts.”

Komatsu’s standard machine has a one-year limited warranty, Wilde says. “For the hybrid system, it is five years, 7,000 hours. With the PC200 generally, you are going to operate between 800 and 1,500 hours a year.”

Caterpillar developed its hybrid “to be just like other tractors we have in production today relative to liability and durability,” says Lohnes. “Warranties that we offer for nonhybrid machines today are the same for the D7E. There’s nothing special that we do differently for the hybrid machine in regards to warranty.”

Among these particular OEMs, and perhaps others, achieving hybrid technology for earthmoving equipment is best done through electrification.

“We really like the idea of electrical components,” says Mastanduno. “You can do a lot more, such as traction control,” he says, “operate the machine if you have only two motors rather than four, or if you have two or three motors and one of them stops working you can still operate the machine. By comparison, with a mechanical drive-line, if one of the parts fails along the way, you’re out of luck.”

Wilde offers the final reassurance for equipment managers: “The key thing is not to be afraid of the technology,” he says. “We have more than 700 units working out in the field, and we know it is a proven technology.”
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Make grooming a replacement part of your job function, whether it’s a formal plan or informal

By G. C. Skipper, Contributing Editor

Replacing yourself on the corporate career ladder or, more appropriately, choosing a successor, can be done in two ways: formally or informally. Yet many of today’s equipment managers remember all too well a third way to do it, politely referred to as the “old school” approach.

“With that approach, you learn more from your failures than your successes,” says Dick Brannigan, CEM, equipment operations manager, John R. Jurgensen Company.

Brannigan doesn’t necessarily subscribe to “old school” ways, but he did have one thing to say about it. “You certainly learned way quicker what not to do.”

Selecting a successor has changed dramatically. Brannigan and others have learned that the best way to successfully pass the baton requires insight into talented employees who may not recognize their own potential, identifying a “self starter” who is serious about his job and his future, and recognizing the value of continuing education in the overall mix of things.

“AEMP’s Certified Equipment Manager program is a good example of continued education,” Brannigan says. Also, he points out, individuals who go back to school to earn degrees or sharpen technical skills on their own are worth keeping an eye on. Brannigan has identified Pat Crail as a possible successor to his position.

“When I came here nine years ago, Pat was a technician who, you might say, tapped himself for the shop foreman’s position, and from there he decided he wanted to do more,” Brannigan says. “He went back to school and earned his Bachelor’s degree and now is within a few days of receiving his Master’s degree.”

Lining up someone to take the helm when you retire doesn’t have to mean rankling feathers of other employees, Brannigan says. “I try to get everybody on the continuing education program,” he says, noting that there are other success stories within his operation.

“We have a talented group of employees and are always on the lookout, trying to identify strengths that will be a good fit for advancement.”

In Jurgensen’s environment, successor planning is done informally. The company offers tuition assistance, but it is up to the individual to work with his supervisor to obtain the additional education he needs. “Everything is informally stated,” Brannigan says.

In a session on mentoring held at AEMP’s annual conference last spring, Brannigan and Crail discussed the formal approach that calls for an analysis of the demographics and talent within the organization. In addition to formally identifying talent from within, consideration is given to return on investment and the necessity of mentoring. Procedures are established for not only setting up a formalized program, but also for recruiting mentors.
Both formal and informal approaches include the necessity of continuing education.

Another fleet manager who developed under the “old school” philosophy is Marilyn Rawlings, CEM, fleet director for Lee County (Fla.) Fleet Management. Initially, she says, she was a finance person for the county, but in 1994 she was given an opportunity to move over to the fleet side.

“I was told, ‘Fleet is in a mess. Go out there and get it ready so we can privatize it,’” Rawlings says. When she arrived, she wasn’t too well received.

“They threw me in the pool and I had to sink or swim,” she says. “One of the first things I did when I came in the door was to tell the people I didn’t know how to do their jobs, but what I did know was business and financing. I told them that as of that minute the county was looking at privatizing fleet management and if that happened, they would all lose their jobs. I also told them that I needed their help, and if they would work with me everybody’s job could be saved. If they worked against me, I said, fleet management will be privatized within a year.”

Fifteen years later the fleet is not privatized, the jobs are still there, and so is Rawlings. What do her employees think now?

“There are people here who would jump in front of a truck for me. There are others who would like to push me in front of the truck,” she jokes.

“Having people know that you believe enough in them to invest in them is critical. We don’t have a lot of turnover.”

Kinder Morgan Energy Partners has a different spin on the formal approach to successor planning.

“We have an executive search firm that recruits retired military officers to fill our Terminal Manager positions,” says Don Pleu, CEM, and heavy equipment manager.

“We’ve found that the regimentation, training, life style and the military culture in general work very well with our bulk and liquid terminal operations.”

The recruit comes in as a Manager-in-Training and is given a choice of functions, such as maintenance operations, administration or procurement, all within the terminal operation. “This gives these Managers-in-Training a sense of the terminal aspects,” Pleu says. At the end of the training period, the recruit is promoted into a Terminal Manager’s position, depending on openings that come up.

This program came about when the company, like many other fleet operations, realized it had an aging management and had better start considering successors. The second consideration was that terminal managers, due to operating such a lean staff, seldom had time to take vacations that they had “earned and deserved,” says Pleu. “They had no

“Prepare Successors For Others?”

Sometimes fleet managers do such a good job at successor planning they wind up grooming a person for somebody else’s company.

That scares off some fleet professionals who say, “Why should I spend all that time and effort on somebody who is going to leave the company?”

That’s a valid question, however if the successor plan has been done correctly in the first place, the fleet manager has already determined if the potential candidate is, and wants to be, loyal to the organization.

Nevertheless, says Marilyn Rawlings, CEM, Lee County Fleet Management, during her career she “has developed some people who are really good and someone comes along and hires them away. That’s happened to me twice,” she says.

In one case, the person is now a fleet manager in a neighboring municipality; in the second situation, the person she spent a lot of time training now works for a software company.

Rawlings’ philosophy is simple: “When that happens, you feel you have successfully launched a person’s career. That’s what it’s all about.”
one to fall back on, so the Manager-in-Training program accomplished two things. It gave us additional resources to terminal management, and two, it functions as succession planning.

At this time, Pleu has identified two individuals who have the potential to replace him when he retires. “They are completely different,” he says, “but the core interest and skills and knowledge are there, and either of them could transition into a replacement for me.”

Presently, neither candidate knows he is being considered, although one individual did tell Pleu he’d like to have his job one day. “Both of them need to grow educationally and, to a certain degree, in job maturity by taking on additional responsibilities that allow them to grow,” he says.

Once a person becomes a Terminal Manager, the career path typically runs from there to an area manager’s position in charge of several terminals, to a director, a regional general manager and then to vice president.

The day is coming

Although fleet operations differ in many respects, depending on the corporate culture and what kind of fleet it is, all fleets have one thing in common; the stark realization that today’s work force is aging and the younger supply pool is beginning to dry up.

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One advantage to growing internal talent, Brannigan says, is the ability to development relationships. “In addition to the normal comfort factor, you already have an ongoing dialog with the person and that person is a known quantity,” he says. “Therefore, you reduce your risk factor. There are a lot of talented people outside, but whether or not they see eye-to-eye with your philosophy is something else. You have a better success rate from developing from within.”

If you’re looking across the shop floor or out the window for a successor there are certain basic guidelines fleet operators should keep in mind.

Pleu says the first thing is to make sure the individual wants the career. “Make sure they are in the right industry,” he says. “You don’t want someone who is in a maintenance position today, but has aspirations to become an accountant. The key to the whole process is to identify that this is the right career path for the individual.”
Rawlings looks for cooperation and leadership. “I look for water throwers rather than gasoline throwers,” she says. “If I have a fire in my organization I want people who will help me throw water to help put it out, not gasoline to keep it spreading. I look for influencers. There can be bad influencers and good influencers, so it’s the good influencers I look for. I look for people who share the basic core values—honesty, integrity and so forth—and I look for true leaders in my organization.”

If she sits down with a group, Rawlings says, she tries to find out who the leaders in that group are. Once she knows who that individual is, she meets with the person privately and explains the situation. “Those are the ones I want,” she says.

In addition to observation, Rawlings also does an annual survey of supervisors to find out who the influencers are, not necessarily limited to the worker base. “Those leaders have more impact on the organization.”

Of course her color organization chart plays into the picture as well, but just because somebody is “green,” she says, doesn’t necessarily mean you want to bring them along. “We have a couple of people who are really sharp,” she says, “and those are the people I need to spend time with, to cultivate them.”

Rawlings not only focuses on her employees at large, but she also concentrates on the staff who reports directly to her. She encourages them to identify the person who could replace them.

“It can’t be predetermined,” she says, “but you can still identify who are the natural leaders.”

Those “natural leaders” are evident, for example, every time someone goes on vacation. “They just naturally step up and assume the role,” she says. “People will follow some individuals, simply by virtue of who the individual is. If no one follows you, that’s not leadership. That’s just being out for a stroll.”

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“Growing from Within

Knowing when to tap into an employee’s potential and how to do it requires a certain degree of skill. As with most things, timing is everything.

Marilyn Rawlings, CEM, who is fleet director for Lee County Fleet Management in Fort Myers, Fla., had been keeping an eye on a particular technician in her shop who was “very sharp and willing to learn,” she says. The technician over a period of time had shown, perhaps without realizing it, the potential for taking on more responsibilities, learning them quickly, and displaying an honest interest in his job.

When Rawlings recognized the employee’s talent, she waited until the appropriate time to make her move. It came, she says, when she was shopping around to find a welder that was needed in the shop.

“I went to this technician and told him I was going to hire a welder and I wanted him on the interviewing panel that would screen candidates for the job,” Rawlings says.

The technician’s first reaction was total surprise, she says. He looked at her and said, “Me?” as if she had made some kind of mistake. She assured him that he could prove useful on the review committee because he might be able to recognize certain abilities in the candidates that she and the other committee members might miss.

She explained that everyone would be there during the telephone sessions and all he had to do was watch two or three interviews to see how it was done. When he felt comfortable with the situation, she told the employee, he should go ahead and ask a question. When he was ready, the technician could do an interview by himself, she says.

“During the first couple of interviews, he didn’t say one word,” Rawlings recalls. “I let him pick out one part of the interview he would like to do, and when it got to that point, I turned it over to him.”

He jumped into the interview with quivering voice, Rawlings says, “but by the time we finished he was getting much more comfortable and was asking good questions.”

Now, she points out, when she has a supervisor’s position that opens up—and interviewing is part of that position—the technician is already trained to take over the job.
Talk to Marilyn Rawlings, CEM, about training and you’ll hear things you’ve never heard before, terms like “fleet barrel” and “the cutest knees.” She’s also the first to say, “Around here we do some weird things.”

Of course, as a fleet professional, there’s method to her madness. Rawlings, director of Lee County Fleet Management, Fort Myers, Fla., is dead serious about training and team building, both of which are only intertwining threads of the same tapestry.

“Many times,” she says, “if we can’t hire it, we have to create it.” The “it” is providing technicians and administrative employees alike with the knowledge they need to do their work, to advance their skills, and to gently push them out of their “comfort zone.”

The same rules apply to Rawlings as well as to the staff. “If I go to a conference and make a speech, that’s just part of my job,” she says. “However, I’ve been able to move out of my comfort zone by doing several things over the years, things that people don’t expect me to do. I have a motorcycle license. I’ve written a business book. I’ve written a novel. I also made up my mind to do a complete brake job. When I told that to the staff, they said, ‘Not on my vehicle.’”

Rawlings eventually did her complete brake job. One thing she keeps putting off, however: jumping out of an airplane. The more she thinks about it, the more it slides toward the back burner, she says.

At a more practical level, Rawlings guarantees 40 hours of training per employee per year. “It’s easier to train people to do what they need to do,” she says. “We try to create an environment where everyone has an opportunity to learn something every day for the entire 2,080-hour year.”

This intense focus on training is based on something familiar to most fleet managers: keeping up with the lightning-speed changes in technology.

“A technician today has to be a plumber, an electrician, a computer programmer and quite a few other things that make that person different from the 1950 and 1980 mechanic,” says Rawlings. Because of this almost-metamorphic change, training has become an essential ingredient in the development of her entire fleet staff.

The training comes from a number of sources: calling in the experts, tapping the resources of the Equipment Triangle, and making use of internal expertise, to name a few.
necessarily make you a good trainer, Rawlings is quick to point out. To avoid wasting employees’ time and to keep presenters from “winging it,” she requires the trainer to draw up a lesson plan that she reviews and approves in advance.

“The importance of teamwork is not always measurable, but it is critical to the overall operation of the division. This is not to say we always have to agree. It does, however, speak of the respect that all employees must have for one another.” —Marilyn Rawlings, CEM

Other sources for training are equipment OEMs and vendors who come to Rawlings’ facility. “My only stipulation is that they don’t make it a sales pitch,” she says. “I tell them the audience they are addressing does not make buying decisions on purchasing products. I do.”

Such sessions are often inexpensive or free, and they help the OEMs and vendors, as well, she says. “They want technicians to know how to install the parts correctly.”

Of course, there is an initial cost in training personnel. “If I can bill out a technician for, say, $50 an hour and send him to an all-day training session, then it cost me $400 in lost revenue,” she says. “But if that person learns how to do the repair in three hours, rather than four, I’ve just saved that much money. To me it’s a good investment.”

Training is not always formal, Rawlings says. “It’s not always in a classroom or sitting with an instructor. It’s every moment of every day.” This approach, in fact, was one of the aspects of the Lee County operations that judges noted when awarding the organization the AEMP 2010 Fleet Masters Award.

For example, someone may be having trouble with an air conditioning repair. Since most shops have technicians who can do a lot of everything, Rawlings works at creating an environment where the person having problems repairing the air conditioning can call to a tech in the next bay and ask for help.

Sometimes she carries this one step further. If she has someone who is particularly good, for instance in hydraulics, she has that person conduct an hydraulics training session for the others. Of course, she follows the process of a required lesson plan for review and approval.

Then comes the weird

Rawlings finds that training is even more effective when it’s implemented within a strong team environment. Hence, she invests time in creating fun team-building activities.

“The importance of teamwork is not always measurable,” she says, “but it is critical to the overall operation of the division. This is not to say we always have to agree. It does, however, speak of the respect that all employees must have for one another.”

Although not used frequently (to avoid wearing out the novelty), Rawlings will stage an off-the-wall session, such as taking photos of employees’ knees and having staff members vote on “the cutest knees” with a $1 donation that goes to charity.

Then there was “Where’s Waldo?” where Rawlings took photos of all sizes of all 31 participants, cut their faces into the different sizes and placed each person’s face in an unlikely spot—on the helmet of a race car driver in the conference room, on the face of a safety poster character with a broken arm or—and she says this one was almost never found—at the end of a four inch pipe hanging from the shop ceiling. The only reason that photo was located, she says, was by accident. “A guy looked up to see if a ladder was going to clear and saw the picture. He burst out laughing,” Rawlings says.

Perhaps the strangest idea, however, is the fleet barrel—an incredibly brightly colored, super-ugly thing, rocket-shaped and made out of the body of a fire extinguisher, and filled with ball bearings. The fleet barrel has a silver painted broom handle sticking through it. The contraption was first presented to an Employee of the Month who then had 48 hours to hide it in the shop. Whoever found it had to move it and find a new hiding place. The only catch, says Rawlings, was that the fleet barrel had to be in plain sight with part of it showing. At the end of the month whoever brought the fleet barrel to the meeting won a prize.

The only misadventure came, Rawlings says, when an ashen-faced facilities worker came hurrying into her office and told her to vacant the building immediately. He had just found something that looked like a bomb. Rawlings followed him out into the shop. Near the exit sign she spotted the silver-painted end of the fleet barrel broom stick protruding from the ceiling. She told the facilities worker what it was—and then told him he had exactly 48 hours to hide it somewhere else.

In addition to individual and professional advancement and reinforcing working relationships, a light and preferably humorous touch goes a long way.

“This is particularly true during today’s economic times,” Rawlings says. “Sometimes you simply need to have fun, even in the work place.” EM
How to Seasonalize a Fleet

Follow these guidelines to ensure proper operation in cold-weather conditions

By Dean Mock

Is your equipment fleet ready for the cold winter ahead? Although the amount of work required to seasonalize your fleet varies by location, number of units, age, and other factors, almost every equipment manager needs to do something to prepare for winter. Preparation varies from minor maintenance work to significant additional components and relocation of lines or controls for severe weather preparation. Let’s start with the easiest.

Engine oil viscosity is extremely important. OEMs recommend that when you start a cold-soaked engine or when you operate an engine in ambient temperatures that are below 0F, use base oils that can flow in low temperatures. These multi-grade oils have lubricant viscosity grade of SAE 0W or SAE 5W (SAE 5W-40). For temperatures below 22F, use a synthetic basestock multigrade oil with similar viscosity grade of SAE 0W or SAE 5W (SAE 0W-30, etc.).

Hydraulic, transmission and final drive oils have similar requirements. For example, synthetic hydraulic oil is recommended for ambient temperatures below -22F. In extreme cases, an oil pan or hydraulic tank heater may be required.

Cooling systems must be charged and validated for freeze protection. Some coolants such as extended life coolant do not need supplemental coolant additives (SCA). Coolants with SCA must also be charged and validated. Antifreeze and SCA consistency is paramount as both will have tendencies, under sustained heat and time, to chemically break down and minimize protection. Simply adding antifreeze isn’t always adequate and refractometers must be used to determine the acceptable levels of the proper antifreeze in addition to OEM- or aftermarket-supplied test procedures and devices to check SCA levels. Jacket water heaters should be considered for faster, easier starting in ambient air temperatures below 70F. Another rule of thumb is when a 15-mph wind is present, heater requirements double.

Fuel purchases and availability should be reviewed and high attention given to the consistency, gel points, and respective flow restriction attributes. Fuel tanks, especially aluminum tanks, will actually make water with ambient temperature changes, thus permitting the growth of algae in the tanks and sometimes catastrophic fuel system failure. All bulk storage tanks should be tested regularly for water content and drums placed in covered storage to prevent water entry through external ice or water buildup on barrels/tanks themselves. Fuel water separators are most important in these situations and should be checked daily and brought up to OEM specifications. There are many products on the market that, for the most part, provide good results. Many fleets run mixtures of No. 1 (winter grade) and No. 2 (summer grade) diesel, and these decisions are dependent upon operational demographics.

The cab heater cores in many units have not been active during the summer months and therefore must be inspected to ensure that no detrimental corrosion has occurred while they were inactive. Drain lines must also be cleared of debris. Tires are also more susceptible to damage in cold weather conditions. Extremely cold temperatures...
can cause sidewalls to become brittle and subject to impact damage. It’s also important to remember that during the heat of the summer air pressure tends to elevate; as cooler weather approaches the acceptable PSI gauged in your tires will be much different than on a cooler day. Your air pressure program is equally as important during winter months as it is during summer months. Use dry nitrogen gas to inflate the tires in order to eliminate ice crystals. Ice crystals could hold the valve stem open in the tire. In severe cold, ice or muddy conditions, isolate the tires from ground conditions if possible. Park on straw, wood planking or other dry insulating materials in the area.

Severe-weather preparation

In addition to the basic cold-weather maintenance actions above, fleet managers in severe-weather situations will need much more drastic actions. Bob Merritt, CEM, from URS Corporation, will tell you that if the temperature in Kapuskasing, Ontario, changes for the worst before their machines are ready, they could have big problems.

Merritt has seen mud frozen so hard on equipment that a jackhammer had to be used to remove it from the machine. “Frozen mud has broken off lines and fittings as the machines operate normally,” he says. “Backs of buckets and shovels have extra guarding to protect grease and hydraulic lines.” URS has changed from air auto-lube to electric systems, too.

His company installs very effective “winter fronts” on all trucks to keep engines from overcooling. These fronts can be described as complete covers of the radiator with cutouts for lights. There are also four small rectangular “flaps” that can be opened during warmer weather.

URS installs alcohol (Tanner) gas injectors to prevent freeze up of the air system. They have installed guarding around 777D hoist control valves to protect exposed valves and lines that are under the chassis of the vehicle. They also install gas systems for the safety brake after the air dryer for all units that have air systems. Heaters are installed on some water tanks and drill rock oil tanks to maintain operating temperatures. URS also puts covers around big hydraulic tanks to maintain heat in the systems for their large hydraulic shovels.

URS has worked in this extreme cold territory for a long time and has learned how to protect and manage their equipment in order to obtain the longest life and lowest lifecycle cost.

Cold-weather Checklist

- Check and replace batteries.
- Change engine oil and filters. Use OEM recommended filters and fluids.
- Check hydraulic oil and filters.
- Verify through testing and sampling proper coolant condition.
- Special grease may be required.
- Verify all grease fittings are not plugged or damaged and accepting grease.
- Reduce idle time.
- Check all sheet metal for rust or damage that would permit entry of ice or water into critical areas or components including glass fixtures.
- Check all radiators to ensure cleanliness and proper operating condition for the coming winter season.
- Do not store starting fluid or store alcohol in the operator’s compartment.
- De-icers lower the freezing point of the moisture in the fuel. De-icers are not generally needed when fuel heaters are used. If you experience trouble, consult your fuel supplier for recommendations of a compatible commercial de-icer.
- Inject alcohol into air compressors in order to prevent moisture from freezing in the air system.

Not in Ontario?

Not every manager deals with such extreme weather conditions as Merritt. Consult with local dealers or OEM representatives for equipment protection recommendations or best practices in your territory. Also reference OEM guidelines depending on your average ambient winter temperature and conditions.

The cooling system and the lubrication system for the engine do not lose heat immediately upon
shutdown. The transmission and the hydraulic system lose heat more rapidly because of more exposed areas. Gear cases cool rapidly, since the gear cases do not operate as warm as other compartments. This means that an engine can maintain the ability to start readily after being shut down for a few hours. The other systems will lose heat more rapidly. The equipment will require exercising upon starting. If the engine is shut down for at least 16 hours, the engine will cool down to the outside temperature.

Running the engine at idle will keep the engine compartment warm. The compartment for the transmission will also be kept warm. However, running the engine will not keep hydraulic systems warm. The outer wrapper on hydraulic hoses can crack when flexing occurs in cold temperatures. This does not mean that the hoses have failed. The hoses will still carry oil under pressure. Consult with your OEM on how to condition the hydraulic hoses on the equipment before the temperatures decrease below -40°F. One final recommendation is to exercise patience when starting a machine. Extreme cold can considerably shorten component life and drive up maintenance and repair costs. Allow extra time to start the machine and make sure equipment is up to operating temperature (180°F) before putting it under load. This will prevent carbon deposit build up on exhaust valves. Carbon deposits can cause the following problems: burned valves, bent pushrods, and other damage to valve mechanism components. Some companies even make a makeshift tent at night to keep the engine compartment warm.

Whether you are just doing some preventative maintenance for the coming cold or preparing for severe winter weather, the key is to do some planning and executing to ready the equipment fleet prior to significant weather changes. EM —Dean Mock is a market professional at Caterpillar, Inc.

**Cold-weather Components**

Many OEMs provide “arctic packages” on their machines, including:
- Jump-start receptacle
- Ether aid
- Extra heavy duty 2400-amp starter
- 1000-watt hydraulic reservoir heater
- 500-watt engine oil pan heater
- Two additional maintenance-free, high-CCA gel cell batteries
- 160-watt battery heating blanket
- 1000-watt engine block heater
- 60/40 blend -62°F antifreeze
- Arctic-ready lubrication oils
- Diesel fuel anti-gel supplement added to fuel tank
- Pre-operation boom hose circulation kit
- Diesel fuel heater
- Cold weather lines for ripper, cylinders, pin puller, and other tools
- Engine enclosures
- Dual pane glass with fan defroster
- Reversible fan
- Precleaner under the hood to avoid snow particles
- Flexxaire fan system that adjusts the pitch and air flow based on engine coolant temperature. In extremely cold weather, the fan will remain at zero pitch and act as a dam, providing a cost effective alternative to shutters.

**Beating the Common Cold**

- Proper oil viscosity is most important.
- If unit is in a heated shop all night or for any length of time, start the unit and then park it outside (while running) and allow the exterior components to cool to ambient temperature before going to work. This will keep the snow from melting on surface of the machine and sticking.
- When working in snow, regularly clean out areas where snow can accumulate and damage components.
- Reduce the load on the machine in -20°F or colder conditions to prevent metal cracking.
- When leaving machines running unattended in extreme cold, -15°C or less, or for extended periods of time, leave running at an elevated idle in the 1200 RPM range.
- Ensure machine has winter tarps or guarding.
- Fill the fuel tank at the end of each shift.
- Regularly inspect engine crank case breather for icing.
- Before returning the machine to working conditions, the hydraulics should be cycled to warm up the oil in the cylinders and exposed hydraulic components.
- Do not return machine to full working conditions until all systems are warmed to operating temperatures.
- Keep all starting fluid at room temperature. Inject starting fluid only when the engine is cranking.
- To prevent final drive seal failures in the case that ice has formed due to cooling down condensation on the seals, move the machine from forward to reverse a few times in very small movements.
- Cyclone precleaners help prevent snow build up in air filters.
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