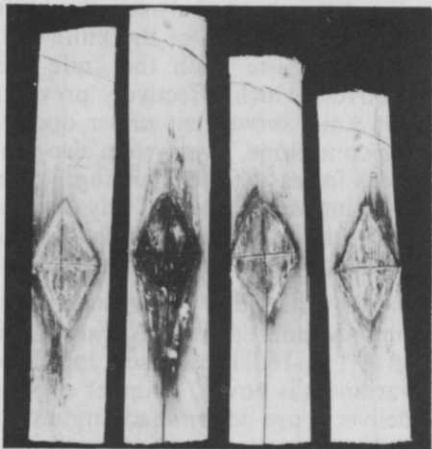
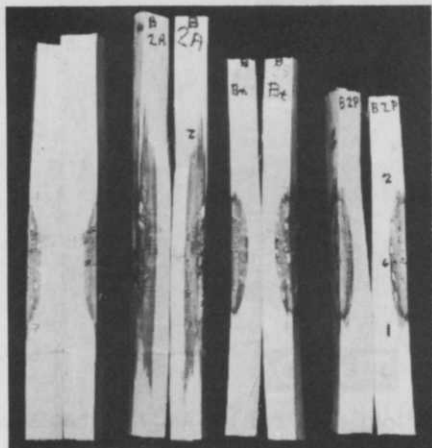


that healthy bark is in contact with sound wood at the margins of the wound. Usually this means enlarging the wound, in the shape of a lens.

Then do everything possible to increase the vigor of the tree. Properly prune dead and dying branches; fertilize and water the tree; and thin out less valuable competing trees. After all these steps



ABOVE: Four 1-year wounds on a red maple tree after treatment with wound dressings. Left to right: untreated; asphalt-base dressing; orange shellac; and polyurethane varnish. BELOW: Dissection of wounds shown above reveals discolored wood. Studies of 160 wounds on 40 red maple trees after 4 years indicated that none of the wound treatments reduced the amount of discolored and decayed wood.



A wound on the base of a red maple tree. Trees do not repair or replace wood injured by wounds. The injured wood is walled off or compartmentalized. After a tree is wounded, help it to help itself by doing everything possible to increase its vigor. This will bring about faster compartmentalization of the injured wood.



have been taken, you can apply some wound dressing — only to indicate that someone has treated the tree.

Too often people think that trees are so big and strong that they can withstand anything. Not so. The wounding of city trees is a serious problem now, and it will get no better unless something is done. One thing we can do is to develop sound tree-maintenance programs, using new information and new tools that have come from recent research on wounds and decay.

### Selected References

The processes that lead to discoloration and decay within living trees are complex. Research is still being carried on to better our understanding of these processes. For more technical details, we suggest the following publications:

- Shigo, A. L. 1967. Successions of organisms in discoloration and decay of wood. *Int. Rev. For. Res.* 2: 237-299. Academic Press, New York.
- Shigo, A. L., and W. E. Hillis. 1973. Heartwood, discolored wood, and microorganisms in living trees. *Annu. Rev. Phytopathol.* 11: 197-222.

Shigo, A. L., and E. vH. Larson. 1969. A photo guide to the patterns of discoloration and decay in living northern hardwood trees. *USDA For. Serv. Res. Pap. NE-127.* 100 p., illus. Northeast. For. Exp. Stn., Upper Darby, Pa.

Shigo, A. L., and A. Shigo. 1974. Detection of discoloration and decay in living trees and utility poles. *USDA For. Serv. Res. Pap. NE-294.* 11 p., illus. Northeast. For. Exp. Stn., Upper Darby, Pa.

Shigo, A. L., and C. L. Wilson. 1971. Are wound dressings beneficial? *Arborist's News* 36: 85-88.

### CHIPPER (from page 14)

and a wedge which matches the taper of the knife. As the wedge is drawn down by its bolts, the flat side of the knife is pushed against the cutting cylinder, and the tapered side is locked against the wedge with no means of escape. Most of the above systems are resharpenable, adjustable and easily changed. Adjustments after sharpening are usually made by increasing the height of two setscrews beneath each knife, until proper clearance from the cutting bar is obtained.

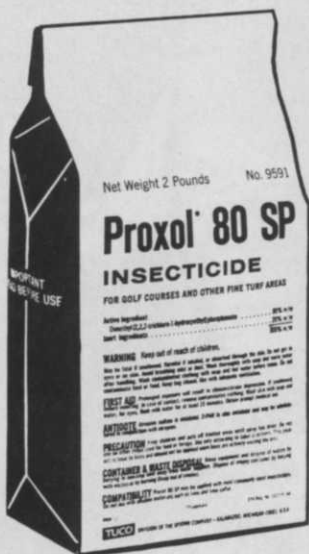
Several other knife systems are also offered. One uses 12 or 16 individual knives, firmly secured with wedges. This system places its knives in a staggered pattern around the cutting cylinder; the knives are sharpened on both ends and are easily changed. Another straight-knife design has V-grooves cut in the back of the knife which match grooves cut into the cutting cylinder. Gib screws, between the knife and opposite side of the knife slot, exert pressure upon the knife and grooves, which effectively prevents any knife movement under operating conditions. This system also provides for easy knife changing. When working with knives of any system, it should be understood that they be handled with a cautious attitude.

As previously mentioned, cutting cylinder diameters vary from 11 1/2" to 16." The reason for these variances is power. Chipper engines deliver a pre-determined amount of power to the cutting cylinder through a V-belt drive, with very little difference among competing ma-

# Take the guesswork out of turf insect control

## Diagnostic Aid from TUCO

Many turf insect larvae are night feeders, so the first evidence of their activity frequently is damaged turf. Diagnostic Aid, applied to turf as directed, causes insects to emerge to the surface within 10 minutes. They can be identified and counted to determine the level of infestation and whether an insecticide should be applied. It also can be used after insecticide application to measure the control obtained.



## Proxol\* 80 SP Insecticide from TUCO

Proxol is the one insecticide developed especially for use on fine turf and ornamentals. Sod webworms and cutworms are two major groups of turf insects controlled by Proxol. It is estimated that each sod webworm larva can chew up 20 square inches of turf in its average life span of 20 to 40 days; the cutworm larva can devour up to 36 square inches. With 300 to 500 larvae generated from each adult in a period of 10 to 21 days, it becomes apparent why early detection and control are desirable. Using Diagnostic Aid and Proxol together lets you program insect control.

\*Trademark

One bottle of Diagnostic Aid FREE in each case of Proxol 80 SP.



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chines, since the same engine sizes are used by most chipper manufacturers.

Several machines on the market utilize a small diameter (11 1/2") cutting cylinder, which does not, of itself, have enough weight to maintain the power required when chipping medium or large-size limbs. To increase this cutting cylinder's power, a large weight, called a flywheel, is attached to one end of the cutting cylinder's shaft. As the unit reaches its optimum operating speed, the flywheel acts as additional mass added to the cutting cylinder and supplies extra power to complete the chipping process.

An alternative approach to the above method of construction is found on a number of chippers. Instead of having a small-diameter cutting cylinder and a flywheel, a larger diameter (14-16 inches) is used. The torque required to successfully complete the cutting process is within the cutting cylinder itself, thus accomplishing an objective — all of the weight needed for cutting is safely placed directly behind each knife, allowing maximum power from the engine with less recovery time, and maximum power usage because the full amount of weight required is behind each cut.

Wood, once it is chipped, must be removed from the chipper as quickly as possible to accommodate more wood being fed in. This phase of the operation is usually done in one of two ways — with a separate fan-type blower attachment, or by the integral blower action of the cutting cylinder itself. Most small-diameter cutting cylinders can discharge chips from medium diameter branches through their own integral speed, at a restricted distance, but require extra assistance with heavy foliage, small branches and large limbs due to a low peripheral speed. This extra assistance is usually supplied by a fan-type blower attached to the chipper shaft after the flywheel is mounted. The blower provides a considerable amount of air movement which aids the chip movement initiated by the cutting cylinder's rotation, and will, in most situations, eliminate chip build-up in the discharge chute.

Most large-diameter cutting cylinders have a high peripheral



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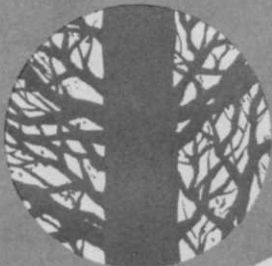
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speed, which imparts the actual mass, or weight, and speed of the cutting cylinder to the chip itself. Thus, for a few seconds, the chip has the same weight and speed of the cutting cylinder which creates an integral blower action. This power carries the chip out the discharge chute in most situations, whether large, medium or small material is fed into the chipper. A satisfactory discharge distance is obtained with the large-diameter cutting cylinder, while chip build-up in the discharge chute is held to a minimum. The most efficient means of discharge with a large cylinder is made with the use of a seal bar to provide maximum removal of chipped material.

Material to be reduced is introduced to the cutting cylinder by means of a feed chute located at the rear of the machine. Feed chutes are also referred to as feed tables, feed platforms or feed aprons, and are available in two configurations — straight and folding. The straight feed chute design is best suited for applications not requiring a great deal of maneuverability, such as



*A chipper can, conservatively, reduce five to eight truckloads of brush and branches to one truckload of chips; free as many as four men for other work assignments; provide a good bio-degradable substance for soil structuring, weed control, ground cover and mulch. But purchasing an over-or-under-powered unit or one not heavy duty enough for your type of work can result in just as many negative aspects.*



## TOUGH RUGGED HARDWARE for TOUGH RUGGED HARDWOOD

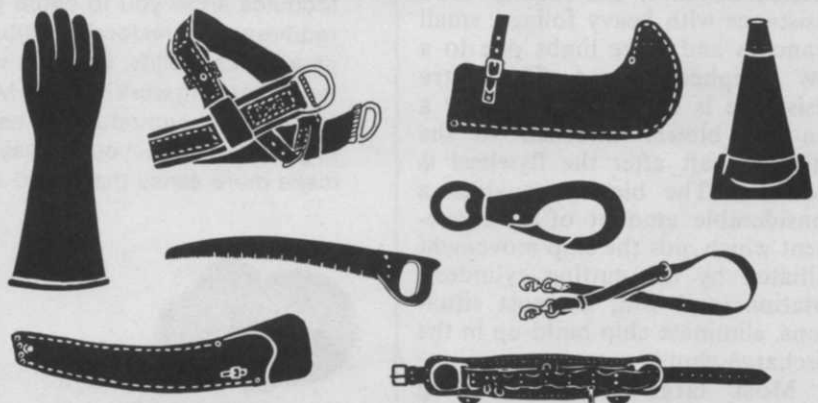
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right-of-way maintenance, street trimming, or street pickup. The folding feed chute design has gained in popularity because it can be folded in half, creating an effective barrier against vandalism and urban trash accumulation in the feed area of a parked chipper. The folding feed chute, when closed, reduces the overall towing length of the chipper by about 30 inches, allowing for more maneuverability in tight areas.

Feed chute bottom, top and sides are required by OSHA to be designed to prevent operator contact with the cutting cylinder, knives, or blower blades under normal operating conditions. It is the equipment owner's responsibility to insure that his equipment is in good condition and compliance with these standards. It is the operator's responsibility to use the machine in accordance with national, state, and local safety standards, as well as the manufacturer's recommended operating methods.

Once the wood is past the feed chute, and through the cutting cylinder, it is exhausted by means of a discharge chute, which is available in two designs — straight or round. The straight discharge chute will place chips in one direction — straight ahead, but usually incorporates a deflector, or bonnet, at its far end to direct the chip flow up or down. Some straight chutes are available with an attachment for directing chip flow to the right or left as well.

Round discharge chutes are designed to allow the chip direction to be quickly and easily changed from straight ahead to any position within 360°. They also include an adjustable bonnet and the added feature of being adjustable for height, to allow for varying chip box heights when one chipper is used with several trucks.

All chippers' discharge chutes will plug up with material at one time or another, for a variety of reasons. The most common reasons are incorrect engine RPM (running too slow), worn throttle controls, improper engine governor and linkage maintenance, incorrect angle used when knives are sharpened, dull knives or worn cutting bar. Nevertheless, a plugged chute is an inconvenience, and most chipper manufacturers have made provisions for cleaning out their dis-

charge chutes. Some chutes have hinges in the middle and can be folded back for cleanout. Others have an access door in the side which is simply opened to remove whatever has caused a problem. Access doors can also be used to inspect knife condition without having to use wrenches or other tools. In the interest of safety, it is strongly recommended that no maintenance work be performed on any chipper until the engine is shut off, key removed, and the cutting cylinder has come to a complete stop.

In the final analysis, it should be pointed out that all brush chippers will chip wood. It is, however, to the buyer's advantage that he be aware of the chipper which is best suited for his needs. There are high-production and low-production chippers; long-life and short-life chippers; and, of course, expensive chippers and less expensive chippers. Of the wide selection of brush chippers on the market today, the potential buyer can be assured of finding several makes which will prove to be inexpensive, low maintenance, long-life and high-production machines.

## PROFILE (from page 16)

travel around the United States attending meetings, visiting member companies and collecting ideas for redistribution to the rest of the membership. I also stay on top of the Washington scene and represent our membership there.

Therefore our role is to see to it that our members are the most well informed, up-to-date individuals in the tree care industry. As a group we have impact. The more numbers we have the more weight we will carry. We want to up-grade our profession as an industry and we can better do this as a group than we can individually.

There are many facets to today's successful commercial arborist. It is our intent to provide as much input to each facet of that commercial arborist as we can!

**WTT. What do you feel would be the single most important step that the industry could take at this time?**

A. Sadly enough, as technically proficient as we are and as astute as we are becoming as businessmen, there is one ingredient that is lacking; a professional image. We are as

unprofessional a group of pseudo professionals as one would find anywhere. In the last sixteen months I have traveled close to 50,000 miles visiting tree companies in all parts of the country from Maine to Florida and West to California. I have seen good tree work coupled with poor business practices and good business practices coupled with poor tree work. I have seen abominable customer relations and amateur equipment. If I was an OSHA compliance officer I would have writers cramp. Our professional image either doesn't exist or has been so maligned by unprofessional practices that it is beyond recognition.

With only a few exceptions, I have yet to see a commercial tree care company that has really put it all together. Considering the volume of information that management receives from trade association affiliations, trade publications and other sources it really is shocking to witness some of the things that I have seen.

It is imperative, if we have any hope of creating and maintaining a professional image, that we upgrade our standards and meet those standards with suitable management and production practices. Good practices mean more sales and more profit. Professionalism is a void in our image that must be filled.



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# Greenbelt Buys Moody, Nees

Greenbelt Industries Inc. has announced the purchase of Moody Sprinkler Company and Nees Turf Supply. A group of private investors from within the irrigation industry comprise the nucleus of the Greenbelt venture.

Jim Head, spokesman for the Greenbelt group, has been named President of Moody Sprinkler Company, Inc. Other Moody officers will be A. C. "Ade" Klinkenberg, Vice President of Marketing, Rick Green, Vice President of Production and Leo Feuer, Secretary/Treasurer.

"The goal of this group is very simple," says Head. "We plan to use

the well established Moody organization and its fine reputation for quality equipment as the foundation to build a strong, highly competitive irrigation manufacturer."

In addition to expanding the existing turf market, Moody plans rapid development of products in the lawn and garden, agriculture, hardware and international markets.

Head, former owner of South Orange Supply, a Southern California irrigation distributor, plans to direct Moody Sprinkler toward a program closely tied to its distributors.



*"As president of the National Arborist Association, it is my privilege, with this bronze plaque to dedicate this live National Christmas Tree presented to the American people by the National Arborist Association." With these words NAA president, Thomas A. Morrison, Wilmette, Ill., (left) opened the ceremonies at which a commemorative plaque was installed at the National Christmas Tree in Washington, D.C. The occasion was appropriately Arbor Day 1975. Pictured at right is Bill Ruback of the National Capitol Park Service who will be responsible for the care of the tree.*

## Carbide's Sevin 4 Oil Insecticide Registered for Spruce Budworm

Sevin 4 Oil carbaryl insecticide has received federal registration for protection of spruce and fir foliage against spruce budworm. The material will be used operationally on one-half million acres of Maine forests this summer. Spraying began in early June and will take two to three weeks to complete.

Some 20,000 acres of budworm infested spruce-fir forests in Aroostook County, Maine were sprayed with the material in June of 1974 as a test. "Results showed good protection of foliage and that's what we were after," said Dr. John Dimond, professor of entomology, University of Maine.

Dimond explained that an important criteria of the test program was to determine the economics of various chemicals used. "Because pulpwood is a low value crop," Dimond said, "we were trying to determine the best material to use so that we don't apply any more chemical than the minimum amount necessary to keep those trees alive. We've demonstrated that Sevin 4 Oil works, and now we have to find the most economical application rates."

J. P. Cartier, Union Carbide field development representative for the Northeastern U.S., said Sevin 4 Oil will be used operation-

ally at a rate of 1 pound per acre. Tests also will be conducted at lower rates.

Sevin 4 Oil is a unique liquid formulation of Sevin carbaryl insecticide in a low volatile, nonaromatic oil. This oil base formulation may be applied as an ultra-low volume or low volume aerial spray. The material is particularly well suited to large scale programs for control of forest and rangeland insects, due to its resistance to weathering and wash-off by rain. This results in longer residual activity on plant surfaces than Sevin wettable powder formulations. Another advantage is that the material needs to be applied only once per season for budworm control.

Dimond said the spruce budworm is a very mobile insect that now has established itself in most forest lands in Maine, Quebec and New Brunswick.

An estimated 185,000 cords of the spruce-fir timber in the Maine spray project area have already been lost to budworm attack. This infestation has been increasing steadily in eastern North America from five million acres in 1963 to an estimated 100 million acres now according to Dimond.

## OSHA Training Institute Gets Improvement Award

Presidential Management Improvement Certificates for 1974 were awarded to the instructional staff of OSHA Training Institute in an award ceremony recently at the facility in Rosemont, Ill.

The award, the only one presented to an element of the U.S. Department of Labor for 1974, is based on criteria requiring "achievements having an outstanding impact on increased effectiveness in a vital function of government, including improved service to the public."

Citing accomplishments of the Institute faculty that made the award possible, Assistant Secretary of Labor John H. Stender, head of OSHA, who presided at the award ceremony, presented certificates to eight faculty members.

Stender conveyed to those pres-

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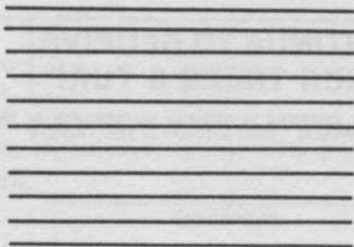
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 (18)  Industrial Parks (Factory Lawns)  
 (19)  Golf Course Greens Chairmen, Owners, Managers and other Supervisory personnel  
 (20)  Consultants  
 (21)  Industrial Research  
 (22)  Institutional Research and Teaching  
 (23)  Formulators of Herbicides, Insecticides, and Related Compounds for Vegetation Maintenance and Control  
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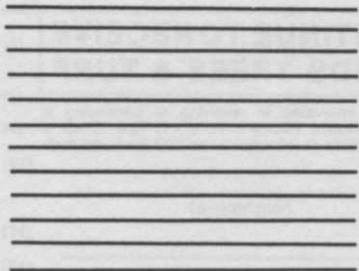
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ent at the ceremony the congratulations of James T. Lynn, Director, Office of Management and Budget, Executive Office of the President, who, in forwarding the certificates for presentation, had noted that "the significant achievements of these individuals in improving organizational effectiveness set an outstanding example for others in the Federal Government and reflect favorably upon (the Labor) Department."

### EPA Sets Use Agreement For Noise Testing Lab

EPA announced recently that a use agreement has been negotiated with the National Aeronautics and Space Administration whereby EPA will use approximately 260 acres of land and buildings located within NASA's Plum Brook Research Center near Sandusky, Ohio, to conduct noise emission tests in connection with enforcement of new noise control regulations.

The 1972 Noise Control Act requires that EPA identify and set standards for new products that are major sources of noise pollution. In order to provide a national reference test site and to avoid relying completely on manufacturers' tests to determine compliance with the regulations, EPA determined that it would need a site of its own to conduct standardized tests for product noise emissions.

In choosing the Sandusky site, the Agency took into account such things as weather conditions, ambient noise levels at the site, and the proximity of the facility to places where products to be tested are manufactured.

To date, EPA has identified new medium and heavy duty trucks and new portable air compressors as major sources for which noise emission standards are feasible. As proposed, the EPA standards for these products will go into effect in late 1976.

EPA is currently considering noise regulations for tires, motorcycles, school buses, specialty and light trucks, lawnmowers, automobiles, snowmobiles, bulldozers, truck refrigeration units, garbage compactors, and other products. Limited simultaneous testing of different products is foreseen in the immediate future, but as more prod-

ucts come under regulation, EPA will expand the test facility.

EPA's noise regulations are expected to affect many small manufacturers who do not have

noise testing facilities or the finances to construct them. Such manufacturers may wish to conduct their product verification tests at the Sandusky site.



Charles H. Cissel, vice president of Guardian Tree Experts and president of the Maryland Arborist Assoc., presents a plaque to Al Shigo, chief plant pathologist for the Northeastern Forest Experiment Station, Durham, N.H. The plaque reads "Dr. Alex L. Shigo, for dedication and superior service to the Maryland Arborist Association in the field of tree preservation, 1975."

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Watch for Our ASPA Special

## Landscaping, Horticulture In Need of Trained People

Arborists, florists, golf superintendents, landscape contractors, landscape designers, landscape maintenance firms, nursery businessmen and related horticultural enterprises are looking for young people with training in horticulture relating to production and landscaping.

With the current emphasis on ecology and maintaining or improving the environment, many firms specializing in these areas of horticulture are limited either in the scope of services they are able to provide or the quality of the service by the lack of personnel with adequate scientific horticultural training.

Thus, a number of horticultural associations cooperated in a national survey aimed at determining the expanding training opportunities available in these fields. The survey was planned as a follow-up to a similar one conducted in 1969. Participating in the current survey were the American Association of Nurserymen, American Sod Producers Association, Associated Landscape Contractors of

America, National Arborist Association, National Landscape Association, Sprinkler Irrigation Association and the Professional Grounds Management Society.

Owners and managers of florist, nursery and landscape horticultural businesses, explained representatives of the cooperating associations, are becoming increasingly aware of the improved training programs at the technical level leading to certification or an associate degree. At the college and university level, some training institutions are emphasizing more applied work experience for those students planning to enter industry in contrast to a curriculum for someone planning a career in teaching or research.

In contrast to the earlier survey which only attempted to reach these training institutions offering a technical certificate or associate degree, this survey also attempted to reach those offering baccalaureate degrees in similar horticultural specialties. The survey was sent to 225 institutions in the U.S. and Canada. Of these, 202 responded.

The survey lists the name and address of the institution, the type of certificate or degree offered, the length of the training program, whether or not a work/study or co-op program is offered on an optional or mandatory basis, and whether or not instruction in sprinkler irrigation is included in the training program. In addition, the survey requested the number of students majoring in the specialty areas and in general environmental (ornamental) horticulture. The specialty areas included were nursery, landscape architecture, landscape contracting, landscape maintenance, general landscape, turf grass, arboriculture, and floriculture.

Copies of this survey, entitled National Survey of Post High School Vocational Horticulture Training, are available for \$1 from the participating associations.

## Guide to Turfgrass Pests, New Publication from NPCA

A new technical guide on identification and control of lawn pests is now available from the National Pest Control Association.

**NPCA's Guide to Turfgrass Pests**

is oriented towards the increasing number of commercial applicators in outdoor pest control. The 50-page manual provides descriptions and accompanying color photographs of every major insect and disease pest that attacks the American lawn. Descriptions detail:

- Scientific and common pest name
- Local or regional pest name
- Geographic locations where pests occur
- Host grasses
- Time of year when pest is active
- Conditions of lawns which favor pest development
- Description of pest and life cycle
- Symptoms of pest damage which aid in identification

A special lift-out page for continuing updates on chemical controls for pests described is also included.

The new guide costs \$10 for NPCA members and \$15 for non-members. Order the manual from National Pest Control Assn., Dept. OPS, Suite 1100, 8150 Leesburg Pike, Vienna, VA 22180.

## Growing Bark Industry Plans Florida Meeting

The bark industry has burgeoned into big business during the past decade. Many mills which previously ignored the production possibilities for bark have been made aware that bark is a highly diversified product whose market is great and still expanding. Bark producers, those who are thinking of opening bark plants, nurserymen, grounds managers, landscape contractors and educators should plan now to attend the 1975 Annual Meeting of the National Bark Producers Association (NBPA).

This meeting, to be held October 2-5, in the Key Biscayne Hotel, Key Biscayne, Florida, will feature leaders of the bark industry discussing their specialties under three general outlines — merchandising and packaging, marketing of bark products and bark packaging techniques.

For further information, write: National Bark Producers Association, 1750 Old Meadow Road, McLean, Virginia 22101.



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## TOUGH ONES (from page 18)

arrives with a load, so a worker is directed to use a forklift to unload. To get what he needs he looks for a forklift. Under such an arrangement, who's responsible for getting best service from the forklift at best possible cost, or even keeping it running?

A careful preventive maintenance (PM) program for rough terrain forklifts can pay off with a surprising improvement in equipment reliability, a significant extension of useful and economical service life, a means of forecasting replacement, a reduction in service costs and a marked gain in productivity. Here's why.

Today's rough terrain forklift is designed as an all-purpose machine with use objectives keyed to creating a high productivity machine which is economical, serviceable, safe and easy to operate. Forklifts are now being designed with power trains, hydraulics systems and increased load stability which are unique to this equipment. These are designed as integral units and not as add-on attachments to existing tractors. This means they are, first of all, more expensive. Yet, because they are unit-designed for specific applications, they are also more suited to the required jobs. If maintained properly, these machines will surely give maximum return on investment, through reduced downtime and increased service life.

### Start with Discipline

There's no magic formula to preventive maintenance programs. You simply must follow procedures outlined in the operator's manual at the intervals designated by the manufacturer. These recommendations are based on years of experience — both good and bad. Localized or special conditions may sometimes require a reduction of service intervals from factory recommendations, however, it is poor economy to extend service intervals beyond the manufacturers recommendations.

There are 11 major areas where forklift PM is often times neglected. Yet, all have specific means of contributing to lower operating costs.

1. **Engine lubrication neglect is disastrous.** Although today's oils are marvels of efficiency compared with

those in the past, they are still affected by heat, cold, dust, fuel contamination and oxidation due to extended service intervals.

Recommended lubricant levels must be maintained and the lubricant changed at designated intervals. There's an old cliché that lubricating oils don't wear out, but very few people in the service business believe it. High temperatures cause oxidation, piston ring blow by causes fuel contamination, and dirt, which escapes the filters, adds to the lubricant contamination. All this means engine oil and the filter must be changed regularly.

In many situations, lubricant, fuel and air inlets also need protection from foreign material introduction due to vandalism. This last item is especially true around the big city job sites.

2. **Oil must be chosen with care.** Manufacturers of machinery specify both the API service grade of oil and SAE oil viscosities for various temperature ranges. Their recommendations are based on experience with the products. Depart from these recommendations and you have a cost stimulant. You can't choose lubricants by hunch. A low viscosity engine oil used during high ambient temperatures, or a viscous hydraulic fluid used during cold weather is a misapplication and can create major breakdowns.

3. **Electric starter motors, especially on diesel engines can be a source of high costs.** Many starters are ruined in this way: an operator will attempt to start a machine which is out of fuel. A machine, which has run out of diesel fuel, is refueled without having the entrained air bled out of its injection system. Of course, the engine won't start. Engine starters may draw in excess of 100 amps of battery current. The heat resulting from extended efforts to start can be extremely destructive to internal connections and wire insulation. This is why many operating manuals specify: "Do not crank an electric starter more than 30 seconds without allowing a two-minute cool down period."

Starting problems are often created by improper fuels. For example, a No. 2 diesel fuel in sub-zero temperatures can clog the injection pump and filters.

4. **Hydraulic systems can be**

**harmed with costly results.** A. Probably the worst enemy of hydraulic systems is dirt in areas of close tolerance. In modern valves, clearances of 0.0005 inch between valve spool and valve body are not uncommon. While modern filters are capable of removing some contaminants of this particle size range, they can't remove them all. When hydraulic filters are not changed as recommended, the filters may load up. Then the filter bypass permits contaminants to go through the hydraulic system and the resulting action increases critical clearances.

A sticking valve spool is often an indication of severe oil contamination. A service mechanic can recognize this problem, because if he cleans or changes a valve without changing the contaminated oil, the valve spools will stick again.

In hydraulic pumps, contamination tends to increase the clearances, allowing oil to slip by the internal parts, thus creating heat.

B. Heat is probably the second

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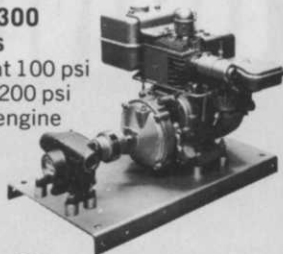
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most destructive thing in the hydraulic system because high temperatures tend to oxidize hydraulic oils, thus breaking down lubricity. Hot oil becomes thinner, thus increasing "slippage" through pumps which heats the oil even more, at high working pressures.

Hydraulic preventive maintenance, however, is simple, consisting of regular filter changes at specified intervals, the use of the proper hydraulic oil, keeping oil coolers and the outer surfaces of reservoirs clean. In all cases, oil must be stable throughout the recommended temperature range and have a high resistance to oxidation and foaming. Since hydraulic oils also deteriorate they should be replaced at recommended intervals.

C. Water or air in a modern hydraulic system is easily recognized as the oil will generally have a "milky" appearance. To determine whether the culprit is water or air, drop a couple of drops on a red hot metal surface; if it spatters then it's water, if it just smokes then it's air. Water may clog the filter, causing some unique problems which vary depending on the system. Most hydraulic filters have a low pressure bypass valve. When the filter becomes clogged, this valve opens and the oil goes around the filter, thus causing loss of filtration.

5. **Tampering with hydraulic relief valves can cause problems.** Hydraulic system relief valves have several functions. Primary of these is to limit the pressures in the circuit to a nondestructive level. Raising the relief valve pressures above the manufacturer's designated level may temporarily give increased lift capacity, but this often proves to be false economy in terms of increased maintenance and major breakdowns. A broken pump center ring is a sure indication of excessive operating pressures. This may be due to a readjusted or stuck relief valve, or it may be due to the wrong viscosity oil used in cold temperatures.

6. **Tires don't just run and run;** planned tire care helps conserve equipment costs and get better equipment use. Modern tires are excellent in terms of puncture-proofing and resistance to abrasion and cuts, but they can be damaged on cluttered worksites. The best preventive tire maintenance in-

volves an operator who looks where he's going before he gets there. Replacement tires of lower ply rating are often times costly due to increased downtime from flats or failures.

7. **Electrical maintenance — a field of its own — starts with batteries.** Today's batteries have excellent service life if properly installed and serviced at regular intervals thereafter. A new dry charge battery should be slow charged until the specific gravity doesn't change over an hour period, after adding electrolyte. It is false economy to use a new dry charged battery without this procedure, because at installation the battery is probably not fully charged. It possibly never will be fully charged, considering that intermittent use of a forklift will not provide the additional charge needed.

Fast charging a new battery is risky, because resulting high temperatures can easily damage the cell structure.

Batteries need regular maintenance. The electrolyte level must be kept above the top of the cells to prevent sulfating of cells, which reduces the output capacity. Water, too, must be chosen with care. Many factory service people believe distilled water is still the best additive to put in a battery.

Excessive need to add water to batteries indicates overcharging, suggesting a voltage regulator problem. A charge voltage in excess of approximately 15 volts will cause water loss, however, this varies with ambient temperature. While you can't adjust many of the new solid state regulators, there may be a loose or corroded connection causing a voltage drop between the alternator or battery and the regulator.

An often neglected electrical maintenance item is keeping the alternator drive belt tensioned properly. If this belt is loose, the alternator may not be delivering enough output to a partially discharged battery to recharge it.

8. **General cleanliness pays off** by preventing hydraulic, fuel, or transmission contamination. By wiping off the filler cap and the filler neck before lubricants or fuel are added, you avoid adding external dirt.

Hydraulic reservoirs are also heat exchangers. An oil-coated reservoir attracts dirt, creating an insulated coating and so loses its

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