The fact that Bruce is now tending a natural grass field is a story in itself. Arrowhead and neighboring Kauffman Stadium were built in the early 1970s — when artificial turf had a space-age cachet about it.

Sentiment for natural grass increased in the past few years, however, as both teams faced the expense of replacing their fraying carpets. Sophisticated drainage systems for natural grass made wet fields a non-issue. The acquisition of high-priced veterans Joe Montana and Marcus Allen cinched the Chiefs' decision to move to grass this season. The Royals will follow suit for the 1995 season.

Laying the Groundwork

Work on the new field began late last spring by ripping out the old carpet and installing an intricate network of irrigation, drainage and communications systems. Layered over the subsurface is a 4-inch pea-gravel base, topped by a 12-inch root zone. The root zone is composed of 5,000 tons of 85 percent sand and 15 percent reed sedge peat. Bermudagrass sod, treated with Panacea steroid to promote root strength, was laid immediately after the concert onto the root zone treated with Bovamura.

Coach Marty Schottenheimer lobbied hard for Bermudagrass, even though Kansas City is on the extreme northern edge of the Bermudagrass growing zone. Schottenheimer believes it stands up to game conditions better than other grasses. Keeping it green is Bruce's responsibility.

Despite having an artificial surface in his four seasons as head groundskeeper, Bruce has extensive experience with grass. The adjacent practice facility has two Bermudagrass fields. Add in the stadium grounds and the training camp facilities at the University of Wisconsin, River Falls, and Bruce is responsible for 11 acres of grass. But none of it carries as high a profile as Arrowhead, where the 78,000 seats regularly sell out and additional millions of fans watch on television.

"Having a grass field means a lot to me as a groundskeeper," he says. "But it also means a ton of pressure."

Detailed Routine

Bruce transferred his weekly routine from the practice fields to Arrowhead. He has four full-time and four part-time crew members. The process begins on Monday with mowing the field to exactly 1 inch. Coach Schottenheimer has definite ideas about grass height and player performance.

"I leave the grass higher in training camp because the team is on it for two-a-day workouts," Bruce says. "Coach Schottenheimer had me change from 1.75 inches to 1.5 inches because players were slipping."

Fields are mowed daily and watered in the afternoon.

"I water the turf from 30-40 minutes throughout the week," he says. "I like to flood the plants for 30 minutes one day, then water for just one revolution the next day to give them a drink."

The crew paints the field with Mautz 8-30 on Wednesday and Thursday, then repaints on Saturday. Scott's 19-0-17 fertilizer is applied mid-afternoon on Thursday, supplemented with Step micro-nutrients and Ferromec iron.

A final Saturday mowing wraps up the preparation. For a noon Sunday kickoff, the crew comes out at 6 a.m. to wipe off the dew with two John Deere AMTs. That job is completed by mid-morning when the cheerleaders begin practice.

When the game ends, Bruce checks the field for damage. The crew sweeps the field with Parker sweepers. Mowers follow 10 yards behind them; and rollers follow another 10 yards behind. The entire process is completed in 45 minutes. The field is watered for 20 minutes per station.

Overseeding Strategy

That routine will change soon, because Bermudagrass goes dormant early in Kansas City.

"Bermuda starts to go brown when temperatures drop below 60°," Bruce says. "Cool nights will do it. I take soil temperatures daily. The last two years Bermudagrass began turning brown in early October."

Bruce began his overseeding program after the San Francisco game on September 11. He plans to use 3,000 pounds of Ph.D. perennial ryegrass split into two applications. The seed will be pre-germinated four days before planting. He'll also consider a fungicide application.

"Bermudagrass loves hot weather and doesn't need a fungicide," he says. "But in the overseeded grass, we have to watch out for leaf spot."

Bruce is confident his overseeding program will keep the field attractive and playable well into the January post-season. However, unpredictable Midwest winters could be a wild card. Beginning in December, the field will be thawed by blowing hot air under tarps.

"We'll start thawing on Thursday evening, depending on how cold it is, to have the field thawed by Sunday," Bruce says. "I plan to use four 600,000-BTU blowers — one on each corner — and two tractors to blow 160 mph winds to create a slight bubble."

His worst nightmare? A rainy game day late in the season.

"Our three home games in November may cause damage," he says. "If we get a rainy day in December, I'll have to re-sod. We can't get sod locally that time of year because everything is frozen. It will be a challenge to find it and ship it in."

Next spring, Bruce will assess the damage from the winter and resume irrigation and fertilization. Kansas City is a finalist for a Major League Soccer franchise, so he also has to prepare for a possible summer sports season at Arrowhead. Throw in spring mini-camps, the summer concert season and training camp and there is little downtime.

By painstaking attention to detail, Bruce plans to make sure that if his name becomes known, it will be for all the right reasons. ❑

A Maze of Pipes and Underground Cable

What fans *don't* see when they look at Arrowhead's new field may be just as impressive as what they *do* see.

Professional football has changed dramatically since the stadium was built, and the subsurface was prepared to take advantage of new technology. Consider what was installed after 9,000 tons of dirt were hauled away:

- Five miles of electrical conduit to facilitate everything from video boards to sideline reports to rock concerts.
- Two miles of drainage pipes.
- One mile of irrigation pipe.

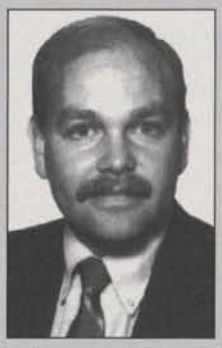
The field was laser-graded to ensure proper irrigation and drainage. To improve sight lines, the field was lowered by 6 inches along the sidelines, and elevated just 12 inches in the center, compared to 18 inches on the old field.

Finally, the layer of gravel and sand was carefully sized and cleaned to prevent clogging the drainage system, and the field was ready for the new turf.

PRESIDENT'S MESSAGE

By Greg Petry

Sports Turf Managers Association



Have you ever wondered why people join an association like STMA? One way to examine the question is to look back at the origin and development of associations.

In the 17th century, common men would surround themselves with the brotherhood of their trade. These men immersed themselves in each other's lives. They worked together, lived together and enveloped each other with their common lives.

Even in the Old Testament, references are made to people of common occupations living and working together to share knowledge, train apprentices and ultimately, to leave a successor behind to carry on their trade.

People join associations for many reasons. Among the most common is a desire to advance common interests, to address political and educational needs and to protect the status of their profession and industry. With the roots and ties to the Old World guilds, associations today have evolved to occupy a unique and important place in society.

We learn early in our careers that by joining associations, we can accomplish what we could not do by ourselves.

So why do people join an association such as STMA? For the same reason we join other associations — to solve problems; to meet educational needs; to obtain information and to better oneself.

I personally feel that the most rewarding aspect of STMA membership is the development of professional relationships. It is so natural for people to share personal experiences (both good and bad) and information. As time goes on, your relationship with the contacts you have begins to form a network.

It's the network of friends and fellow professionals that make STMA membership so valuable!

STMA CHAPTER NEWS

Iowa STMA. The Iowa Sports Turf Managers Association will hold a Football Field Maintenance Practice and Care Workshop at Atlantic High School, Atlantic, IA on November 5 from 8 a.m. to 2:30 p.m.

Registration opens at 8 a.m. in the high school auditorium. Morning sessions include: Welcome and Introduction of Speakers, 8:30 a.m.; "Turf Grass Selection of Sports Fields" presented by Dr. Eldon Everhart; "Setting Up a Fertilizer Program for Your Field" by Mike McCaffrey; "Aerification on Compacted Fields" by Dale Roe; "Pest and Weed Control" by Dr. Everhart; "Mowing Tips" presented by Bill Antons; and "Traffic Control on Fields," also by Antons.

Afternoon sessions include: "Painting and Marking Fields," "Putting Your Field Away for Winter," and "Planning Next Season's Turf Program."

For more information about the workshop, contact McCaffrey at (712) 792-8010 or Dr. Everhart, (712) 755-3104. For information about the Iowa Chapter or other chapter activities, call Gary Peterson at (515) 791-0765.

STMA Florida Chapter #1. The Florida Chapter will hold a meeting at the University of Miami's Mark Light Stadium on November 15, beginning at 10 a.m. The program will focus on the conversion of the field from artificial to natural turf. Kevin Hardy will host the meeting.

For more information about the meeting or other chapter activities, call John Mascaro, (305) 938-7477.

Chesapeake Chapter STMA. Do you plan to attend the National STMA Meeting in Florida? Will you be leaving from the Baltimore area? Would you like to make the trip with other Chesapeake Chapter members? If so, contact Art Downing at (410) 313-7254.

The Chesapeake Chapter postponed its Regional Institute until the spring of 1995. One workshop will revolve around the installation of an irrigation system on a soccer field at Worcester, MD, City Parks Department. Mike Howell of the Worcester Parks Department will help coordinate the program.

A Field Day will be held in Bowie, MD, at the new baseball complex of the Double-A Bowie Bay Sox. Jimmy Juergens, director of field maintenance for the complex will coordinate the program.

Chesapeake Chapter board meetings are held the first Tuesday of each month from 4-6 p.m. For information on the chapter or any upcoming activities, call the Chapter Hotline, (301) 865-0667, or Downing at (410) 313-7254.

Midwest Chapter STMA. The Midwest Chapter of the STMA is one of the 10 allied turfgrass organizations co-sponsoring the North Central Turfgrass Exposition, which is scheduled for November 28-30 at the Pheasant Run Resort & ExpoCenter in St. Charles, IL. The conference will address the needs of seasoned turfgrass professionals as well as offer introductory material, including five sessions of a "Back to Basics" program. Over 100 firms will exhibit at the trade show in the Pheasant Run MegaCenter.

A designated Sports Turf session is set for Tuesday, November 29, beginning at 8:30 a.m. The program includes: "Planning and Constructing Athletic Fields on a Tight Budget," presented by Norm Hummel; "Assessing Athletic Field Quality and Safety," by Mark Altman; "Maintaining Turf Density," by Dr. Ken Diesburg; and "Managing Water for Sports Fields," by Dr. Clark Throssell.

Midwest Chapter board meetings are held the second Wednesday of every month. For information on the chapter, the NCTE or other upcoming events, call the Chapter Hotline, (708) 439-4727 or Marc Van Landuyt, (708) 367-7828.

The Heartland Chapter STMA. Matt Hoops, director of maintenance for the Gladstone, MO City Parks and Recreation Department, is the new acting president of The Heartland

Chapter STMA. Announcements of the chapter's upcoming events will be released soon.

For information on chapter activities, call Hoops at (816) 436-2200 or Jack Schwarz at (816) 792-2808 or (800) 344-8873.

Minnesota STMA. The Minnesota Sports Turf Managers Association is one of eight "green industry" member Associations of the Minnesota Turf and Grounds Foundation that are cooperating in the conference scheduled for December 7-9 at the Minneapolis Convention Center.

The chapter's annual meeting is scheduled for 4:30 p.m. on December 8 at the Convention Center. Meeting highlights include the election of officers and committee assignments for 1995, as well as a "preview" of coming events. Details will be announced soon.

A Sports Turf Seminar, sponsored by Turf Supply Company of Eagan, MN, is scheduled for November 29, 8 a.m. to noon. The meeting location will be announced soon. This seminar will focus on interpreting soil sample results and examination of infield mixes. For more details on this seminar, contact John or Rick at (612) 454-3106.

For information about the conference, call Scott Turtinen of the Minnesota Golf Course Superintendents Association, (612) 473-0557.

For information about the chapter, the annual meeting or future chapter activities, call: Tom Rudberg, (612) 962-6545; Mike McDonald, (612) 625-6097; or Brian Deyak, (612) 255-7223.

New England Chapter STMA. For information about the chapter or its upcoming activities, call Mary Owen, University of Massachusetts, (508) 892-0382.

Southern California Chapter STMA. For information on the Southern California Chapter, or its upcoming activities, call Chris Bunnell, (619) 350-9340.

Colorado Chapter STMA. For more information on the chapter or its future activities, call Joe Adams, (303) 350-9340.

STMA Headquarters
401 N. Michigan Avenue
Chicago, IL 60611
(312) 644-6610

Organic Dust Warning

The National Institute for Occupational Safety and Health (NIOSH) warns of a risk for developing organic dust toxic syndrome (ODTS), a common respiratory illness that may follow exposure to organic dust contaminated with microorganisms. Workers are typically exposed to this dust when shoveling or moving organic materials such as composted leaves.

An estimated 30- to 40 percent of workers exposed to organic dust will develop the disease. The syndrome is characterized by fever occurring four to 12 hours after exposure, and flu-like symptoms such as general weakness, headache, chills, body aches and cough. The disease may also bring on a shortness of breath, impaired pulmonary function, and increased white-blood-cell count.

The symptoms usually disappear within 24 hours to a few days after the worker is removed from the exposure.

Sports Turf Managers Association

Is Your Field the Best in the Country?

Does Your Research Program Deserve Recognition?

If you would like to offer a nomination for the STMA 1994 Awards, *now is the time.*

STMA recognizes that sports turf managers make personal and professional contributions to our industry and the organization they serve. We encourage you to participate in the awards program. **STMA**'s 1994 Awards Program is open to all interested parties.

This year, the following awards will be bestowed at the:

STMA Annual Awards Banquet,
February 6, 1995 in Bradenton, Florida:

- ✔ **STMA/Beam Clay/sportsTURF Baseball Diamond of the Year Awards**
- ✔ **STMA Football Field of the Year Award**
- ✔ **STMA Soccer Field of the Year Award**
- ✔ **STMA Excellence in Research Award**

Municipal, College and Professional categories are offered for each Field of the Year award. All nomination material must be submitted in accordance with the procedures outlined for each award. The awards committee will judge information submitted by the nominator. All nominations must be postmarked no later than Wednesday, November 30, 1994.

For questions or nomination forms contact:

Robert Milano
Grounds Services
U. of California at Davis
Davis, CA 95616
(916) 752-1691

STMA
401 N. Michigan Ave.
Chicago, IL 60611
Attn: Awards
(312) 644-6610

Jim Kelsey
(Baseball Awards)
Partac Peat/Beam Clay
Kelsey Park
Great Meadows, NJ 07838
(800) 247-2326

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Protect Your Irrigation System From Winter's Fury

Northern turf managers must build flexibility into their irrigation systems to avoid serious damage.

By Lawrence Cammarata

Those of us in northern climes who contend with winter soil frost lines down to four feet have a strong appreciation of nature and its power. Pipes, sprinklers, wires, valves, boxes, etc., are continually "heaved" and moved all winter. Install something poorly in the fall and it will have to be redone in the spring.

In most cases, there is little we can do to "beat" our weather conditions. However, there is much that can be done to make a system "give" with the conditions.

Winter protection must begin with design. This is the initial key to providing a system that is reliable year after year, even with repeated winter abuse. For example, any system will usually be installed in the upper 12 to 24 inches of the soil profile. These systems are in the direct line of fire for winter abuse.

Techniques such as "pipe pitching" are intended to direct water flow to an automatic or manual drain for winter water removal. If this pipe were truly pitched during installation, it doesn't necessarily remain that way, due to frost heaving, after the first season. Each fall, less and less water will be released as more of it remains in the piping system. This remaining water then freezes and expands to continually, over time, weaken fittings and pipe through fatigue. Each year system-damage and spring-activation costs increase.

Mainline systems on all projects should be set up in such a way that compressed air can be introduced into the system at key locations and provide for the easy removal of the majority of water from the entire mainline system promptly. An outlet needs to be designed into the water source(s) just downstream of the backflow prevention device so it can be used as the point of connection for the compressor hose. Quick couplers should be included at the end of the mainlines, or at isolation points in looped system design, to allow for water release. Of course, these would be useful for manual watering during the season, but just remember to place them in designated key locations so that high volumes of water can be released from the system easily during winterization. Also, design quick couplers to be placed next to electric valve groupings or in a valve box itself for ease of location during winterization.

Pumping systems can be designed to require very little winterization when well thought out. Study and use of sprinklers, valves, etc. that perform better than others during winterization procedures and during harsh winter months. Poor designs will result in systems that are hard to maintain and winterize.

Installation Precautions

Construction techniques must also strongly support the fundamentals of ease of maintenance. No system should sacrifice those tools needed for a long, durable life for the sake of saving a few dollars during construction.

In these climates of heavy frost, building-in flexibility for heaving is very important. All systems should be installed with some appropriate flexible unit at each sprinkler. Valves should be installed so that valve boxes do not rest on the incoming pipe. Mainlines are to remain completely outside of the electric valve boxes. These comments are based upon providing extra space for wintertime movement.

It is very important for the installer to produce reliable, accurate "as-built" drawings. Keep copies in your file for reference during site changes, winterization, and service.

Accurate as-built drawings provide information that tells the winterization service crew where to begin and where to end. The drawings also warn them of peculiar issues and how to deal with them. As-builts provide a picture to show buried drip lines or isolated quick couplers around the corner that everyone forgot about.

The installing contractor should provide written details about the known needs of the system as part of the as-built

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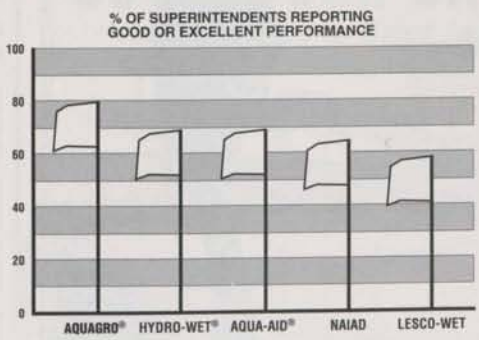
To our delight not only did AquaGro receive the highest satisfaction rating, it also received the lowest "poor" rating. Only 1.5% of the superintendents responded that they were dissatisfied with its performance. Among the leading competitors 8.1% of the Naiad users, 7.6% of the Lesco-Wet users, 6.1% of the Aqua-Aid® users and 3.7% of the Hydro-Wet® users rated the performance of their wetting agent as "poor".



We sincerely thank the nearly 1000 superintendents who participated in this survey, and the thousands of loyal AquaGro users who vote each year with their budgets.

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Winterization

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production process. While these details may not be a problem if the installing contractor remains under contract, they will be important if another firm takes over servicing.

With "as-built" drawings in hand, and a well-designed and installed system, the service contractor begins winterization. This service firm will usually pull up to the curb and extend the air compressor hose to the designated tap provided.

On larger projects with multiple taps and/or looped mainlines, a "game plan" must be thought through and implemented. The overall goal in all cases is to replace the full water volume with equal or greater air volume and push the water out from one point to another. Looped mainlines will need to be isolated to create single independent flow direction. Multiple tap systems will also need to be isolated, one tap from the other, to form independent flow directions.

To begin the winterization process, the service crew must first shut down the water source. If it is a metered system, it may be as simple as shutting a valve. On a pump station designed for non-winter removal, it may be the same (shutting a valve) plus shutting off power. In others, it may require suction line removals, hydraulic valve pumping or microchip removals.

Once the water source is shut down, the compressor can be hooked up to the provided location(s). Find the small drain tap by the water meter. This allows for compressed air to be directed through the meter by the opening the drain tap.

Firms that have been winterizing with compressed air have found air pressures of 70 to 80 psi combined with air volumes of 160 cfm will service most properly laid out systems on large recreational fields.

Larger or some poorly designed sites may require two or more compressor units to provide the air volume needed to purge water from the system. Remember full air volumes are the key to the best system purging. Compressors operating at 70 to 80 psi and providing 160 cfm will winterize most systems in an hour or two. A golf course system, for comparison, usually needs at least two compressor units and requires up to two days to purge water.

Turn the compressor on and let it build up the desired pressure. Once accomplished, go to the end(s) of the mainline and insert a quick-coupler key into the quick coupler provided (or threaded connection — remove cap/open valve). When the key is completely inserted, water will begin to flow. Gradually a combination of water and air, next very moist air and water vapor, and finally just air will be released. Mainline purging is now complete. (Time frame varies with system.)

Designs and construction that provide these provisions (quick couplers and outlets) will be easily and completely purged in shorter time frames, and in a much more thorough manner. Larger volumes of water are released first through the mainline, making circuit-by-circuit procedures less time-consuming.

Next, go to the irrigation controller and activate it, circuit by circuit. Repeat the same process looking for the same results as discussed above. Follow this by locating any manual circuit, drip circuit, fountain system supply taps, lake fill lines, etc. and perform the same process. If additional quick couplers are on site, the same procedure should be followed.

On larger systems with varied topography an additional step is taken. After the initial winterization occurs compressors are shut down. The remaining water is allowed to "pocket." Later, the compressors are reactivated and the remaining water will be purged.

With the system now purged of water for the winter, you can be assured that only a minimal amount of water will reenter the system through sprinklers. Water will not accumulate in volumes large enough to cause damage.

In areas of the country where frost enters the ground but does not reach the piping systems, the use of drain valves may be sufficient as a method of system freeze protection. Our designs usually will work toward system purging with compressed air unless site conditions and topography work very favorably to drain the system. ❑

Lawrence Cammarata, CID, ASIC, is the vice president of Certified Consultants Ltd. in Woodstock, IL. The company is a nationally oriented water-management consulting firm. Cammarata is a member of the Irrigation Association Board of Directors and active in IA education processes.

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RESTORING POWER TO SMALL ENGINES

By Daniel Ingham, Equipment Editor

Is your mower *sounding* winded rather than *running* with the wind? Does the engine bog down if you try to mow more than a quarter inch of *dry* grass or tough weeds?

If you have noticed any of these symptoms you're probably already considering a new engine or mower. Depending on the severity of the problem, a new engine or mower may be in order. However, such drastic measures may not be needed.

If the mower, or any other piece of powered equipment for that matter, is in relatively good shape, replacing or overhauling the engine is usually the most economical thing to do. Deciding to overhaul or replace an engine is not especially difficult if you follow some basic rules and guidelines.

Surprising as it may seem, most engine manufacturers are not that eager to sell you a new engine at the first sign of trouble with the old one. A company's reputation rides on the durability and rebuildability of its engines. So, if there's usable life left in it, they would rather see it remain in service for as long as possible with their name emblazoned across it. What better advertising can there be for an engine manufacturer than a 20-year lawnmower engine humming along like it did the day it was purchased? Engine manufacturers cannot afford to make throw-aways.

Regardless of whether you intend to repair or rebuild, the decision must be made before a crisis occurs. The signs of impending engine failure are usually visible long before the failure occurs. High oil consumption is usually the most reliable sign that internal engine wear has gone beyond the point where simple repairs will solve the problem. That, accompanied by low power, low oil pressure, misfiring or excessive noise are signs that trouble is on the horizon.

Repair or Rebuild?

If an engine is well maintained during its normal operational life it will cost less to rebuild and return it to its original performance. A properly maintained engine can usually be rebuilt twice. A not-so-well-maintained engine, probably once.

The reason has to do with the engine's cylinder, which needs to be refinished and bored out each time (removing some of the metal), and requiring the installation of an oversized piston and rings. The more wear and damage in the cylinder bore, the more metal will need to be removed and the fewer rebuilds that can be accomplished. Theoretically, a properly maintained and repaired engine can keep running forever.

Herein lies the difference between repairing and rebuilding.

With repair we're talking about minor things like gasket replacement, carburetor repair/adjustment, spark plugs, fuel lines, head and valve cleaning to remove carbon build-up and servicing electrical components or connections. These are the types of things that most novice or self-taught mechanics can tackle in the garage on a Saturday afternoon or be quickly repaired by the dealer.

Rebuilding goes deeper. It includes things like replacing valves, valve springs, gaskets, seals, piston rings, crankshaft bearings and more. When you rebuild an engine, you are machining and reusing most of the basic components and bringing it back to new tolerances by replacing the remaining parts. Depending on the condition of the engine before rebuild, the skill of the mechanic and the quality of the replacement parts used, a rebuilt engine can achieve "like-new" performance.

The decision to rebuild or repair is based on how the engine is performing, and what is necessary to bring performance back to an acceptable level. If performance has deteriorated only a little and can be brought back with minor parts replacement, fine. If performance is way down, chances are that minor repairs will only be a waste of money because they will not bring the engine back to previous performance levels and will simply delay the inevitable.

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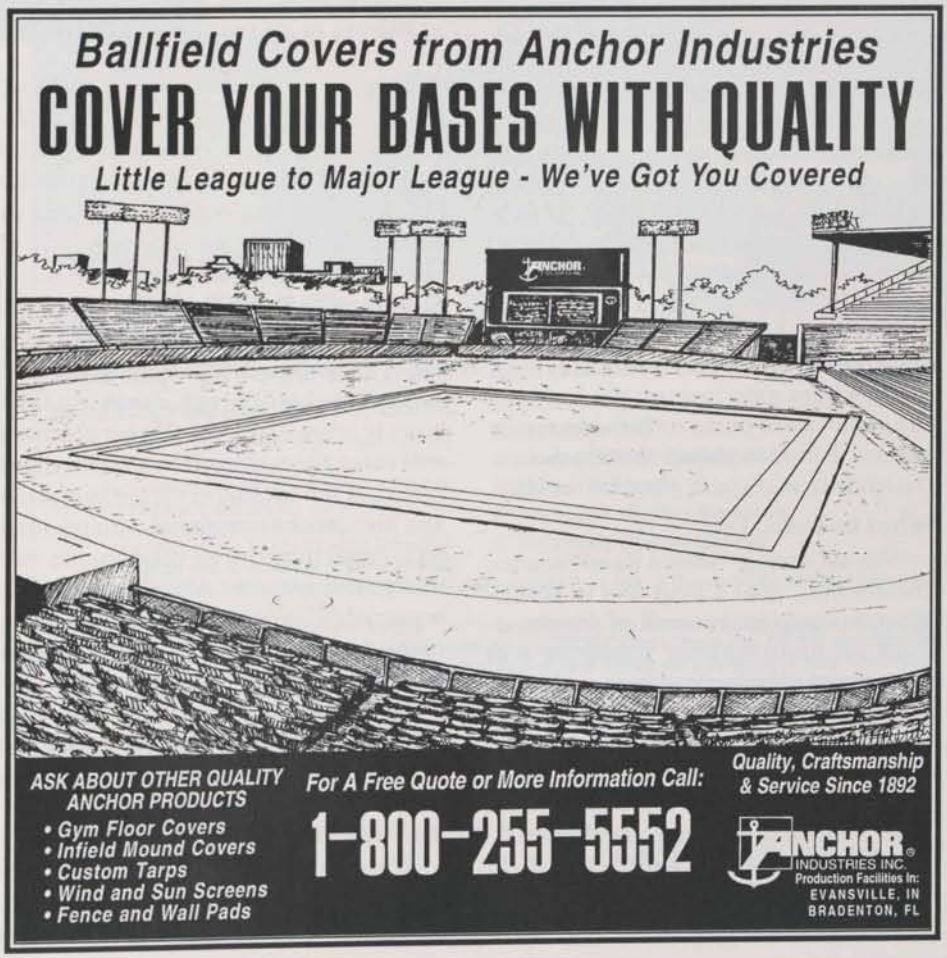

Restoring Power

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The decision to rebuild or replace is based on cost as well as the condition of the engine (the probability that it can be successfully rebuilt). A new engine, depending on the model and horsepower, can cost from $200 to over $1,000. As a rule of thumb, if the cost of rebuilding an engine is going to be 50 percent of the cost of a new engine or less—rebuild it. If the cost is going to be 50 to 70 percent of a new engine there are additional factors to be considered. If the cost will exceed 70 percent of a new engine—buy a new one.

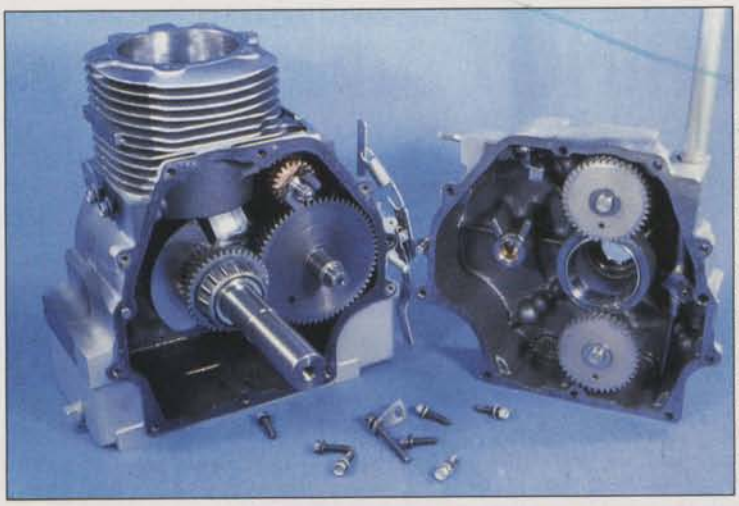
The closer the cost of a rebuild moves toward the cost of a new engine, the more considerations there are. Today, those include things like pending CARB regulations, fuel economy, engine type, power requirements and equipment standardization. Phase one of the new EPA emissions regulations will hit soon, and if you rebuild now, you may be forced into a situation where you are required to buy a new engine after phase-two kicks in, giving you no choice but to buy a significantly more expensive engine sooner than you would like (most current overhead valve engines meet phase-one requirements—it's phase-two that worries manufacturers).

You may have an older engine that, even with a successful rebuild is going to consume more gas than a new one, thus making it uneconomical in the long run. The older "L-Head" engines, for example, use about 25 percent more gas than the new overhead-valve engines and produce about 20 to 30 percent less horsepower for the same engine size (displacement). Also, standardizing equipment types can reduce overall maintenance costs because you can keep the same spare parts on hand to repair several different pieces of equipment—the same type of spark plug, for instance.

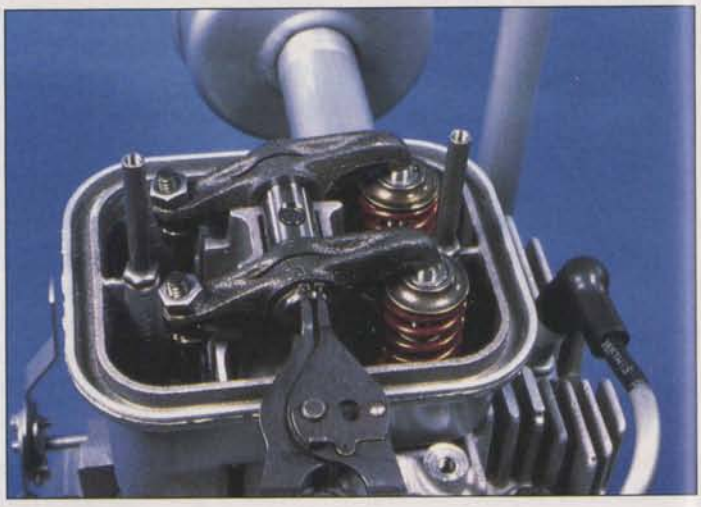
What to Look For

The old saying, "Where there's smoke, there's fire," goes a long way in identifying an engine in need of overhaul. Poor oil maintenance practices will cause most *significant* engine problems, and excessive oil consumption and blue smoke from the exhaust will tell you they have or are occurring.

Engines designed for mowers and other outdoor power equipment are usually air-cooled and operate in very dirty conditions at high temperatures. Their oil requirements are different from liquid-cooled automobile engines. Most people use multi-viscosity oils (like 10W-40) in trucks and autos and usually carry and extra quart or two under the seat. Chances are you've used some in your mower because you were out of the factory recommended oil.



Overhaul generally consists of replacing all those parts that are subject to wear during normal operation, replacing seals and the removal of carbon and sludge deposits in the engine.



Valves can usually be cleaned-up and the valve seats re-ground during overhaul.

Because of the operating temperatures and speeds of these small engines, multi-viscosity automotive oils do not hold up well and will break down. As they begin to break down, the thinner elements will enter the combustion chamber and result in the excessive oil consumption and blue smoke associated with burning oil (smoke may not be produced in visible quantities until actual damage has occurred, so oil consumption should be monitored). If allowed to continue, this will damage the engine.

Drain the oil from the engine and use the oil recommended by the manufacturer. If excessive oil consumption persists, then there is probably significant internal wear or damage.

If excessive oil consumption is accompanied by power loss, there is probably a loss of compression in the cylinder. Loss of compression may just require a new head gasket, but could also be due to badly worn piston rings or valves not closing completely because of carbon build-up. The dealer can do a compression or crankcase vacuum test to check cylinder compression.

Oil analysis is another method of determining engine problems and what to do about them. Companies with large fleets of equipment often send regular oil samples to labs so they can detect potential failures before they happen. The analysis will show what kinds of metals or abrasives are in the oil. Different materials indicate different problems. Copper, for example, will let you know that the bearings are wearing out. The presence of chrome might let you know that the piston rings are wearing since many are chrome plated. How much of the material is present, measured in parts-per-million, will tell you how much wear is occurring and if it indicates a major problem.

Oil Maintenance Practices

Engine oil is a major factor affecting the performance and service life of your

Crankshaft bearings and seals are commoly replaced during overhaul. Excessive vibration that continues after tune-up is often a sign that crankshaft bearings need replacing.

engines. Monitoring the oil levels and frequent oil changes are essential for maintaining and prolonging the life of your commercial equipment.

Engine oil performs the following vital functions:

Lubrication. Oil maintains a film between moving parts to help prevent metal-to-metal contact, which causes friction (heat) and engine wear. The key to an oil's ability to lubricate is its viscosity, or resistance to flow. The higher an oil's number, the higher its viscosity—40-weight is thicker than 20-weight. Unless operating at very low temperatures, multi-viscosity oil is not recommended. During summer months, straight 30-weight oil should be used. Refer to the owner's manual for specific oil recommendations.

Sealing. The same oil film that provides lubrication also assists seals to maintain engine efficiency. Oil provides sealing both in the combustion chamber and with seals and shafts. It helps the piston rings seal pressure in the combustion chamber, maintaining compression and power.

Cooling. Your engine's oil also carries heat away from hot areas, especially the piston and cylinder head.

Cleaning. The term "detergent oil" refers to the cleaning capabilities of engine oil. Many engine oil additives assist in keeping the engine clean. About half the test criteria engine oils must meet have to do with detergent properties. These detergents are necessary because of combustion by-products that find their way into the oil. Detergents keep varnish and deposits from forming in the engine, and to some degree, remove existing deposits. Most small engine manufacturers recommend using oil with an API service class of SF or SG. Using oils that do not meet this certification can result in damage to the engine.

Running an engine with insufficient oil can cause serious damage, resulting in costly repairs or down time.

Adding oil regularly isn't enough. You need periodically to drain the old oil and replace it with clean oil. As crankcase oil lubricates, seals, cools and cleans, it becomes contaminated with acids, dirt and abrasives. These contaminants stay in the oil and will damage the engine if allowed to build-up. Also, prolonged use depletes many oil additives, rendering them ineffective.

Synthetic oils, new to the market, offer some potential benefits to small

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Restoring Power

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engines. According to David Kunkel, vice president of national accounts at Penzoil, "The attributes of synthetic oils are perfect for small engines, especially for air-cooled engines that run at hotter consistent temperatures. Synthetics remain stable at these higher temperatures." However, he says, "The jury is still out whether small engine users will actually realize a cost benefit in the long-term because of the significantly higher cost of the oil. We are still doing testing in this area."

Dirt that gets into the engine oil and the use of the wrong type of oil, says Kunkel, are the two main factors contributing to small-engine damage. One of the things Penzoil is doing is downsizing some of its product line, like oil and engine cleaner containers, to sizes more convenient for small engine users.

Troubleshooting

The following troubleshooting guide will help you diagnose engine problems and what to do about them. When using a trouble shooting chart, finding the common denominator is the best way to find the problem. For example, your engine may have more than one symptom originating from a single cause.

Check under each symptom that your engine exhibits such as *Engine starts hard, Engine runs but misses* and *Engine will not idle.* In each of these categories the common causes are faulty spark plugs, dirt or water in fuel and improperly adjusted carburetor. Using this method will help isolate the problem quicker and reduce your frustration level. Check and correct the easiest problem first and then go to the next until the problem is solved.

Engine cranks but will not start. Empty fuel tank. Fuel shutoff valve closed. Clogged fuel line. Spark plug lead disconnected. Keyswitch or kill switch in "off" position. Faulty spark plug. Faulty ignition module. Dirt or water in fuel system.

Engine starts but does not keep running. Restricted fuel tank vent. Dirt or water in fuel system. Faulty choke or throttle controls/cables. Loose wires or connections which short the kill terminal of the ignition module to ground. Carburetor improperly adjusted. Faulty cylinder head gasket. Faulty fuel pump.

Engine starts hard. Hydrostatic transmission is not in neutral/PTO drive is engaged. Loose wires or connections. Dirt or water in fuel systems. Clogged or restricted fuel lines. Faulty choke or throttle controls/cables. Faulty spark plug. Carburetor improperly adjusted. Incorrect valve-to-tappet clearance. Low compression. Faulty ACR mechanism.

Engine will not crank. Hydrostatic transmission is not in neutral/PTO drive is engaged. Battery is discharged. Safety interlock switch is engaged. Loose or faulty wires or connections. Faulty keyswitch or ignition switch. Faulty electric starter/starter solenoid. Retractable starter not engaging in drive cup. *Seized internal engine components.*

Engine runs but misses. Dirt or water in fuel system. Spark plug lead loose. Loose wires or connections which intermittently short kill terminal of ignition module to ground. Carburetor improperly adjusted. Engine overheating. Incorrect valve-to-tappet clearance. Faulty ignition module.

Engine will not idle. Idle speed adjusting screw improperly set. Dirt or water in fuel system. Idle fuel adjusting screw improperly set. Restricted fuel tank vent. Faulty spark plug. Incorrect valve-to-tappet clearance. Low compression.

Engine overheats. Grass screen, cooling fins, or shrouding clogged. Excessive engine load. Low crankcase oil level. High crankcase oil level (overfilled). Carburetor improperly adjusted.

Engine knocks. Low crankcase oil level. Excessive engine load.

Engine loses power. Low crankcase oil level. High crankcase oil level. Restricted air cleaner element. Dirt or water in fuel system. Excessive engine load. Engine overheating. Faulty spark plug. Carburetor improperly adjusted. Low compression.

Engine uses excessive amount of oil. Incorrect oil viscosity or type. Clogged or improperly assembled breather system. Worn or broken piston rings. Worn cylinder bore. Worn valve stems and/or valve guides.

In addition to these symptoms, there are some external checks that can give clues to what might be found inside the engine once it is disassembled.

- Check for buildup of dirt and debris on the crankcase, cooling fins, grass screen, and other external surfaces. Dirt and debris in these areas are causes of overheating.
- Check for obvious fuel and oil leaks, and damaged components. Excessive oil leakage can indicate a clogged or improperly assembled breather, worn or damaged seals and gaskets, or loose or improperly torqued fasteners.
- Check the air cleaner cover, element cover, and air cleaner base for damage or indication of improper fit and seal.
- Check the air cleaner element. Look for holes, tears, cracked or damaged sealing surfaces, or other damage that could allow dirt to enter the engine. Also note if the element is clogged or restricted. These could indicate that the air cleaner has been underserviced.
- Check the carburetor throat for dirt. Dirt in the throat is further indication that the air cleaner is not functioning properly.
- Check the oil level. Note if the level is within the operating range on the dipstick, or if it's low or overfilled.
- Check the condition of the oil. Drain the oil into a container—it should flow freely. Check for metal chips or other foreign particles (a magnet can be used to detect and remove metal chips in the oil for examination). Sludge is a natural by-product of combustion; a small accumulation is normal. Excessive sludge formation could indicate that the oil has not been changed as recommended, and incorrect type or weight of oil was used, overrich carburetor settings and weak ignition to name a few.

One of the best things you can do for yourself and your equipment is to order the appropriate service manuals for the equipment and the engines on that equipment. These are the manuals that mechanics use when repairing engines and contain useful information you should know. Even if you do not intend to use them for doing your own repairs, it is a good idea to read them and increase your understanding of the equipment. They will help you understand what the service technician tells you when discussing needed repairs and let you know if they are being honest with you (dishonest mechanics are a fact of life). If you don't understand what he is telling you, pull out your manual and ask him to show you the page that explains it. A good, honest mechanic should be happy to show you. ❑

Editor's note: Technical information provided by Kohler Engines and Tecumseh Product Company.