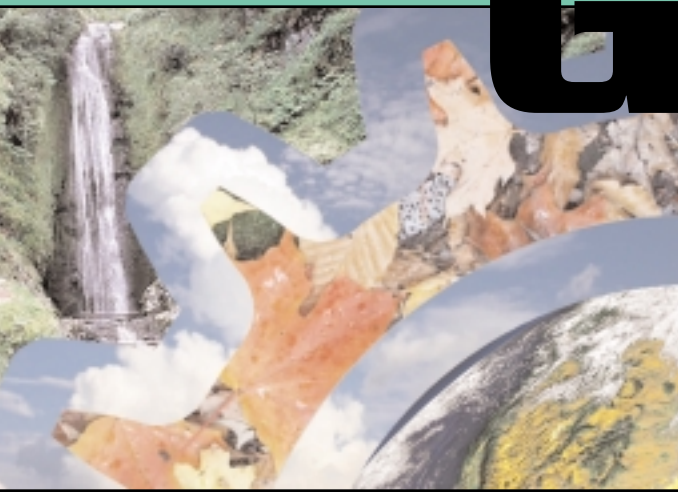
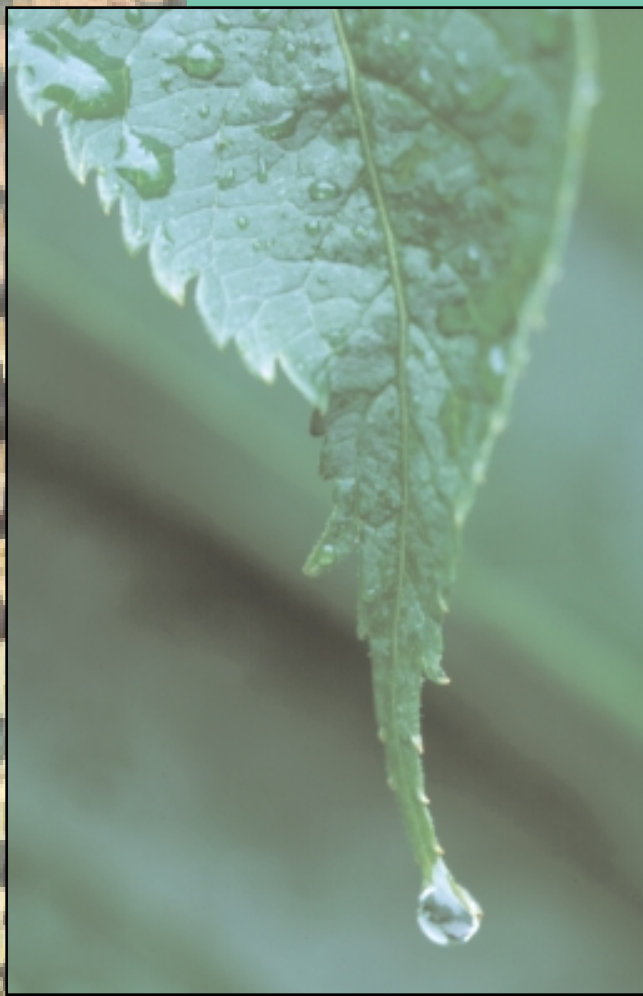


# Greener Gears



Companies around the world are learning to embrace the environment, and the gear industry is no exception. This special section takes a look at how some gear manufacturers are doing their part to conserve resources, preserve and protect the environment, and give back to the land. What we've found is that adopting environmental measures is far more than just good corporate citizenship. For many gear industry companies, good environmental practices also turn out to be good for the bottom line.



# Enviro-Friendly Gear Manufacturing



Our goal is zero discharge," says Bob Morton.

Over the last eight years, Fairfield Manufacturing has made great strides toward that goal—and along the way, the Lafayette, IN-based gear manufacturer has won some prestigious environmental awards.

In recent years, Fairfield has stepped up its commitment to mitigating environmental impacts. "Where we've really made our gains is in the reduction of air pollution and hazardous waste and land-fill disposal," says Morton, who is Fairfield's director of environmental, health and safety affairs.

Recently, Fairfield replaced a copper plating process with a non-toxic, water-based stop-off paint for masking parts before heat treating. The old process generated 25,000 pounds of cyanide-contaminated waste per year, which was hazardous and expensive to properly dispose of.

The new process doesn't generate hazardous waste. "The health hazard is very low," Morton says.

The changes helped Fairfield win the 2002 Indiana Governor's Environmental Excellence Award.

In addition to eliminating hazardous waste, replacing the copper plating process had other benefits. One of those was energy conservation. Copper plating used approximately 25,000 kilowatt hours of energy annually, according to the award application documents filed by Fairfield. Copper plating also required multiple steps and pieces of heavy equipment. The new process, on the other hand, simply involves hand painting the portions of the parts the customer doesn't want heat treated. The result is that all of that energy—and its associated costs—has been saved.

The new process saves money for other reasons as well. "It's actually probably a little cheaper," Morton says, "because of what we save on the expense of the disposal of the hazardous waste."

Finally, from a health and safety standpoint, there isn't a risk of employees being exposed to the toxic copper cyanide. "And that was a big reason to drive this as well," Morton says.

Fairfield is also active in conserving resources, and the company has an extensive recycling program. "We recycle traditional paper, cardboard, glass, scrap steel, wood pallets and aluminum cans," Morton says.

Also, Fairfield buys recycled raw materials whenever possible. Most of Fairfield's gears are made from recycled raw materials, including steel castings, forgings and rolled barstock that are manufactured from scrap steel.

Moreover, Fairfield has internalized its recycling efforts. "Employees are familiar with our recycling efforts. They're all encouraged to recycle," Morton says.

For its recycling efforts, Fairfield won the 1999 Indiana Governor's Recycling Award.

Not all of Fairfield's environmental, health and safety measures have economic benefits. In cases, like recycling, which Morton says doesn't really pay off economically, "It's about being a good corporate citizen."

To bring about these measures, Fairfield evaluates all of the company's processes for their environmental impact. Other measures have included eliminating an alcohol-based cleaning process with a water-based, ultrasonic cleaning process, replacing degreasers that used toxic solvents with washers that use soap and agitation, and eliminating some of the cooling systems on several machines that used fluorocarbons.

"We're always evaluating our processes to try and come up with creative ways we can prevent additional pollution or minimize the generation of waste," he says. ⚙️

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# ITAMCO's Energy Source: The Wind?

“Wind power  
is another  
way we  
can be a  
responsible  
corporate  
citizen”

—David K. Neidig,  
VP Marketing,  
ITAMCO.

**For more information:**  
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Plymouth, IN 46563-0399

Phone: (574) 936-2112

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E-mail: [dkneidig@itamco.com](mailto:dkneidig@itamco.com)

Internet: [www.itamco.com](http://www.itamco.com)

**G**ood corporate citizenship has led ITAMCO to recycle its metal chips and industrial fluids and to restore 350 acres as woodland and wetland. Now that citizenship—with a practical edge—is leading the gear manufacturer toward wind-generated electricity.

The company, 90 percent of which is Indiana Tool-Indiana Gear, studied its bills and realized it could obtain electricity more cheaply from wind turbines than from a conventional power grid.

“Utility cost savings is our main goal,” says David K. Neidig, ITAMCO’s vice president—marketing. But, he adds: “Wind power is another way we can be a responsible corporate citizen.”

So ITAMCO, based in rural Indiana, near Plymouth, applied to the United States’ Federal Aviation Administration to build a temporary tower to test wind force and speed.

ITAMCO must test the winds at its factory for 12 months to determine whether the needed Class 5 winds are consistently present.

If the wind data looks promising, the company can seek wind turbine bids after about six months and can start obtaining permits for installing wind turbines.

ITAMCO doesn’t know yet how many and what size of turbine it would use, but it expects to spend about \$1.5 million to install 1.5 megawatts of capacity.

Neidig estimates the turbines would pay for themselves in about seven years.

After that, how much would ITAMCO save as on its electricity bills?

“Basically 100 percent,” Neidig says.

The company employs about 75 people and operates more than 100 electrically-powered machine tools in a 100,000-square-foot factory for producing metal parts. Half of the machine tools are used to manufacture gears and gear drives.

ITAMCO would locate the turbines on the land it owns next to its factory. The land includes 350 acres that ITAMCO restored in '02 as woodland and wetland.

“We have taken a 750-acre row-crop farm of corn and soybeans and transformed it into a conservation paradise,” Neidig says. “We have reforested 300 acres into a hardwood plantation, 50 acres into wetlands, and still have a patchwork of 350 acres of crops lined with windbreaks and wildlife shrubs to promote soil conservation.”

ITAMCO restored the land by working with Indiana’s Department of Natural Resources and with the Fish and Wildlife Service of the U.S. Interior Department.

“It is all part of our commitment to good stewardship,” Neidig says.

ITAMCO has manufactured wind turbine gears and gear drives for about 10 years, but it hasn’t thought about whether it would manufacture parts for its own wind turbines.

“For us, those two issues are completely separate,” Neidig says.

ITAMCO is still waiting for the FAA’s decision, though. The company is also working with various state agencies on the turbine project.

Neidig says the process takes 2–3 years, from start (applying to the FAA) to finish (having wind turbines operating and supplying electricity). ⚙







**Bacteria can grow in the tramp oil, so it's important to keep the sumps clean and to periodically empty them to remove contaminants and replenish the fluid.**

either pressure or flow be off. Facilities that experience low water pressure can add a booster pump to maintain needed water flow and pressure.

Mixture concentrations should be verified using a refractometer.

Initial selections of proportioner orifice metering may require modification, since water in a solution will evaporate more rapidly than concentrate, which causes the strength of the coolant to increase. Selecting the proper orifice will slow this process. For employees handling the product often, too strong of a mixture can lead to dermatitis. Weak solutions lead to poor machining properties, reduced tool life and corrosion. Maintaining the correct balance is important.

It's also important to inspect each coolant sump daily and to record and correct any deviations from expected norms. Figure 1 shows one method of recording actual refractometer readings and adjustments. Green indicates that the coolant mixture is within functional limits. Red indicates that the coolant mixture is out of tolerance, and that more concentrate or more water is required to rebalance the mixture. Keeping this chart or its equivalent current is critical to the success of the machining process.

Maintaining the coolant will extend its life. It's especially important to keep it oil free. Many manufacturers use coolant sump oil skimmers for tramp oil removal. Tramp oil is often deposited in coolant tanks from way lubrication runoff and hydraulic leaks. Bacteria can grow in the tramp oil, so it's important to keep the sumps clean and to periodically empty them to remove contaminants and replenish the fluid. Should you experience corrosion problems during the machining portion of your operation, contact your coolant manufacturer. Corrosion inhibiting additives are available.

ACR WASHER WEEKLY INSPECTION LOG/CHECKLIST				
UNIT ID: PW01-GRYMLL		DATE:		
ITEM	DESCRIPTION	INSPECTOR	READING	PASS / FAIL
1	WASH FILTERS BEEN SERVICED?			
2	RECORD PRESSURE GAGE READING			
3	ANY MECHANICAL PROBLEMS?			
4	RECORD pH READING			
5	CONDITION OF WASH FLUID			
6	ANY ELECTRICAL PROBLEMS?			
7	RINSE WATER CONDITION			
8	UNIT CLEANNESS			

NOTE 1: pH MUST BE BETWEEN 10.5 AND 11.5  
NOTE 2: RECORD ANY FAILED ITEMS ON NRC FORMSHEET

Figure 2.

### Part Cleaning

Part cleaning using aqueous fluids presents concerns similar to those found during the machining processes. Proportioner-controlled mixing of concentrate and water produces good results, and again, proper orifice selection is required to compensate for evaporation. For commonly used base solutions (a solution in which the pH is greater than 7) the recommended pH level is between 10.5 pH and 11.5 pH. A weak solution (< 10 pH) will cause corrosion. A strong solution (>12 pH) can injure personnel and may not clean the parts any better than a

solution mixed according to recommendations. (It is important to note that our eyes do not have the ability to neutralize base solutions. The base solution will destroy eye tissue. Always wear suitable eye protection when working with cleaning solutions. Also, be sure to rinse eyes for a minimum of 15 minutes with water if exposed to base solutions, then seek medical attention.) An oil skimmer is recommended to remove tramp oil. Changing the fluid as needed and cleaning the sump before replenishing is desirable.

One added feature of parts cleaning that requires attention is heat. For optimum performance, aqueous cleaning solutions require heat. Many recommend a temperature of 145°F. Again, maintain the cleaning solution. Use a checklist to verify conformance to required standards. Cleaning solutions can be checked weekly using the checklist in Figure 2. Your operation may



Figure 3.

require a different inspection frequency.

Should corrosion continue, either introduce a heated aqueous-based corrosion inhibiting rinse cycle, dip the parts in an aqueous-based corrosion inhibitor rinse tank (see Fig. 3) or contact the cleaning concentrate manufacturer regarding corrosion inhibitor additives that can be added to or formulated in the cleaning solution.

### Waste Water

Now that you've taken the environmentally friendly route, what are you going to do with the water-based waste product from machine and parts cleaning sumps?

There are many options available. Machine coolants, depending on the volume used, can be recycled in-house or by the vendor. Recycling is the most cost-effective method, as long as the number of coolant types is kept at a minimum. Coolants can also be processed in a waste treatment system, chemically or through membrane technologies, either in-house or through a vendor.

Spent cleaning solutions can be neutralized in a waste treatment system by adding an acidic compound, such as aluminum sulfate. This additive will adjust the pH to a near-neutral state. Then waste waters can be processed either chemically or through membrane technologies. Treated waters may be re-used to make floor scrubber soap or mop water. Given the appropriate permitting and testing, the treated water can then be placed in sewers—depending on cost benefits. Many options are available for processing waste aqueous fluids, if the fluids are diligently separated from hazardous materials throughout their life cycles.

At ACR, waste water that is produced by temper (nital) etch inspection and vibratory deburring is treated and recycled chemically. The temper etch inspection waste stream is turned into mop water, and the deburring waste stream is re-used following ultraviolet light treatment a maximum of three times. Parts washing waste streams are recycled and used for floor cleaning. A program is currently under way to consolidate coolant types for recycling. Water use has dropped dramatically as a result of these efforts and will fall sharply again as coolant recycling becomes available following product consolidation (see Figs. 4–5). Some waste waters are hauled to off-site treatment centers by licensed waste haulers. Those waters are treated and released at a cost to ACR of 0.12 cents per gallon.

Great—we have processes and procedures in place to prevent corrosion in the manufacturing cycle. Now let's get back to enjoying that summer weather!

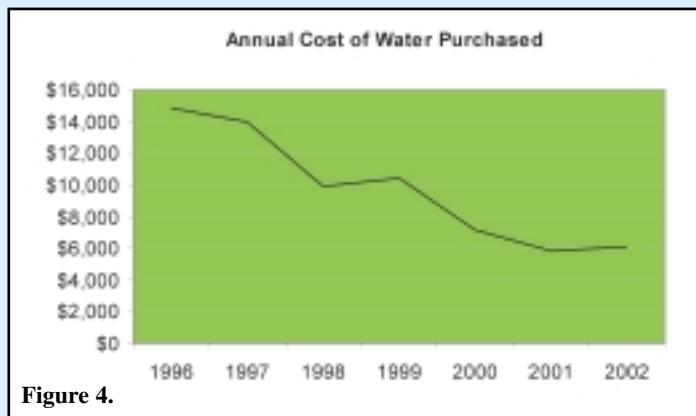


Figure 4.

**ACR Industries Inc.** is a Triumph Group Inc. company. Located in Macomb, Michigan, ACR is a supplier of complex gear assemblies, detail gears, and an array of components servicing the aerospace industry. Triumph Group Inc., headquartered in Wayne, Pennsylvania, designs, engineers, manufactures, repairs and overhauls aircraft components and industrial gas engine components and accessories. The company serves a broad, worldwide spectrum of the aviation industry.

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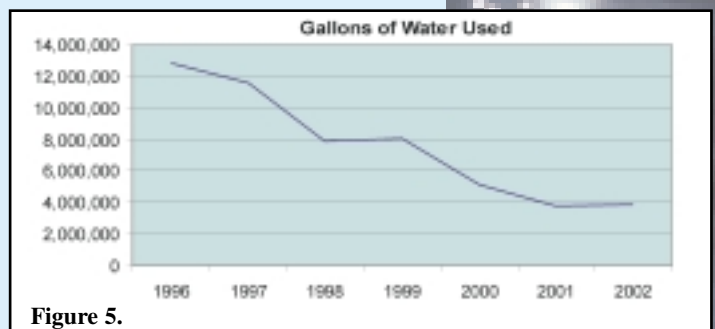


Figure 5.

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## National Lab Looks at New Geared Drivetrain to Aid Wind Energy Industry



The National Renewable Energy Laboratory is testing a prototype wind turbine drivetrain that includes an uncommon part in its planetary gearbox: an internal double helical ring gear with a 60-inch pitch diameter.

"The prototype is based on extensive trade study," says Christopher Walford, a senior engineer at Global Energy Concepts LLC, an American consultancy on renewable energy technology. Located in Kirkland, Washington, Global Energy Concepts is NREL's contracted agent for performing this study.

The consultancy is conducting the study in conjunction with Powertrain Engineers Inc. of Pewaukee, Wisconsin, and DRS Electric Power Technologies Inc. of Hudson, Massachusetts.

According to Walford, the study included eight alternative topologies available for wind turbine drivetrains. The study was created to investigate wind turbines that would be used for utility-scale energy production, to reduce their cost of energy. Given the utility-scale focus, the designs were for 1.5 MW drivetrains. Today, new utility-scale wind farms commonly use wind turbines able to generate at least 1.5 MW.

Walford says the size of wind turbine that can be made with an internal double helical gear depends on the gear form-grinding machine.

The gear industry can form grind internal double helicals with pitch diameters even greater than 60 inches. As an example, Walford mentions Höfler machines able to form grind an internal gear with an 80-inch pitch diameter—"There's a few of those in the world."

However, he adds that double helicals are somewhat new to wind turbines and "definitely a challenge."

But if there's a market for the gears, there are gear manufacturers who would buy the machines to meet the market's demand.

If cost efficiency is a guide, then the market should materialize. "Everybody wants more efficiency," Walford says, "that's the name of the game."

The NREL study compared nine conceptual designs of 1.5 MW drivetrains, eight designs compared against a widely-used baseline design.

Global Energy Concepts estimated cost and operational aspects of the designs and chose for manufacture the drivetrain whose cost of energy (COE) was the lowest of the eight. The designs' COEs took into account annual net energy production, total cost and leveled replacement costs. The chosen design's annual net energy production was the highest, total cost the 3rd lowest, and leveled replacement costs the 3rd lowest.



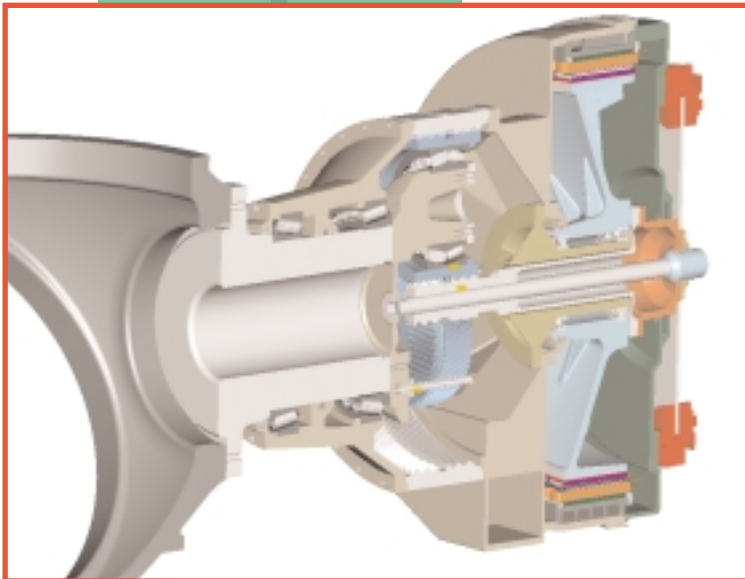
The chosen drivetrain included a single-stage planetary gearbox, a permanent magnet rotor and a permanent magnet generator.

The prototype's COE estimate was 13 percent lower than the baseline COE. Global Energy Concepts also scaled the prototype design to a 3 MW version. The drivetrain's COE estimate hardly changed when scaled to that size.

As for wind turbine demand, America's wind energy industry boomed again in '03. The United States installed a near record 1,687 MW of new capacity. Hundreds of wind turbines, with hundreds of planetary gear drives, were installed in states like California, Illinois, New Mexico, Minnesota, Ohio and Texas.

Global Energy Concepts is scheduled to complete its work in December, depending on whether it can get time in the National Weather Technology Center's dynamometer for load testing. The study will be in the public domain, to ease its entry into the wind turbine manufacturers' world.

The report on the study's first phase, design and comparison, is available at [www.nrel.gov/docs/fy03osti/33196.pdf](http://www.nrel.gov/docs/fy03osti/33196.pdf). There won't be a report on the just-completed second phase, the prototype's manufacture, but there will be a report after the study's final phase, after Global Energy Concepts completes its load and functional testing. ⚙



**Five Feet in Diameter—An internal double helical ring gear lays at the center of a prototype 1.5 MW wind turbine designed by Powertrain Engineers Inc., then manufactured by Brad Foote Gear Works Inc. of Cicero, Illinois.**

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Kirkland, WA 98033-7340  
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Although it's been published for eight years and is very important in the auto industry and outside the United States, ISO 14001 registration is still a project only a few American gear shops have taken on.



# ISO 14001: Coming to a Gear Shop Near You



Although it's been published for eight years and is very important in the auto industry and outside the United States, ISO 14001 registration is still a project only a few American gear shops have taken on.

ISO 14000 is a family of environmental management standards. The group itself encompasses chapters of guidance documents and standards on specific aspects, such as environmental performance evaluation, as well as ISO 14001, which specifies the requirements for an environmental management system. To be registered or certified to ISO 14001, companies must demonstrate to an independent registration body that they are in compliance with all the rules laid out in ISO 14001.

While it can be applicable to any company, ISO 14001 is especially important for manufacturing operations. Factors like electricity usage, cooling fluids and dozen of others are evaluated to maximize environmental safety.

## By Definition

Similar to ISO 9001:2000, the ISO 14001 family of international standards is a voluntary system for management that allows businesses to identify the company's impact on the environment and a framework to improve its environmental performance.

ISO 14001 was originally published in 1996 and is currently undergoing its first revision. While it did grow out of ISO 9000, there is a fundamental difference. Consultant Jim Highlands of Management Systems Analysis of Limerick, PA, explains the growth process between the two standards.

"ISO 14001 is a transition from measuring what's coming out of the organization to having a set of controls to preclude that result," he says.

According to the ISO website, the focus for ISO 14001 is on the process rather than the product. Requirements are centered around assuring that the product will have the least harmful effect on the environment at any stage in its life cycle.

### Hot International Sensation

A European trend that's been implemented in 113 countries worldwide, the adopting of ISO 14001 has not taken off quite as quickly in the United States. Currently, the U.S. ranks 6<sup>th</sup> in the world as far as number of registered companies.

Part of the reason for this is geographical, explains Regina Thompson, Louisville Forge & Gear Works' environmental management representative.

"The U.S. has been slow with ISO 14001. In Europe, there's such a massive population per square foot, but, in the States, there is still a lot of open territory to dump waste, so the motivation isn't the same," she explains.

A number of those American companies that are certified to ISO 14001 took the plunge at the encouragement of their parent companies. That was the case with Louisville Forge of Georgetown, KY, whose parent company is Aichi Steel Corp. of Aichi-ken, Japan. The company, a Tier 2 supplier to Toyota, primarily manufactures forgings, crankshafts and ring gears.

The driving reason behind their ISO 14001 certification was the automotive requirement, but Thompson says it's also a step that more Americans are taking.

"It is growing in this country. More U.S. companies are realizing that it's better to jump on the bandwagon now than to wait for it to become an EPA mandate," she says.

By the end of 2002, a total of 49,462 ISO 14001 certificates had been issued. The data, accessible online at [www.iso.org](http://www.iso.org), suggests that ISO 14001 is growing at a rapid rate. By December 2002, North America accounted for 8.2% of the new certificates granted, while Europe took 47%, and 36% of the new ISO 14001 companies were in the Far East.

### Help from the Outside

Attaining ISO 14001 status is a long process and many companies find it easier to outsource that task. Greg Marchand, president of Great Bay Consulting of Lyndon Center, VT, has worked on ISO with large corporations like Toyota Motor Sales down to a workplace with a single employee. For the average company with 200 employees, he says it usually takes about a year to move through the certification process.

"It's not for the faint of heart," says Marchand. "It can be done in a shorter time, depending on how documented the processes are."

Once hired, the consultant works on-site to ensure that the entire system is in place before an auditor arrives.

However, it is possible to pass the audit without

the presence of a third party. Implementing the environmental management system usually falls under the jurisdiction of a quality control manager.

Whoever prepares the company for the audit, it's an independent third party registrar that conducts it and issues the ISO certificate. Worldwide there are 750 registrars, popular names being DNV, TUV and BVQI. For a more complete list of registrars, visit [www.rabnet.com](http://www.rabnet.com).

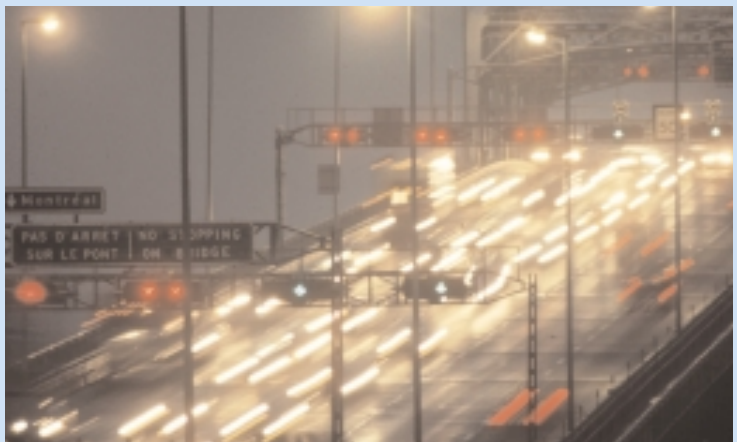
"A lot of companies fail the initial audit," says Marchand. "Then you have to do a lot of fast talking to get the registrars to come back in. Generally, for the company with 200 employees, it can cost upwards of \$20,000 for the initial (certification) and around \$6,000-\$8,000 for annual maintenance."

For Al Descoteaux, director of operational excellence for Nypro Inc., a plastic injection molding company that manufactures plastic gears, getting the ISO 14001 registration in 1999 was worth every penny.

"Customers are becoming increasingly concerned with the environment. It's been an asset in gaining new business and accounts and establishing ourselves as a leader because less than half of our competitors are doing it," he says. "It keeps us out of trouble with the EPA too, which ultimately helps our bottom line."

In the coming years, this may be an investment that gear companies will have no choice but to make. Public demand will force companies to start the registration process.

"Customers think it's a great thing. It forces you to document your current processes and shows environmental responsibility," concludes Marchand. ⚙



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