

Optimism in Wind Abounds

DESPITE ECONOMIC CHALLENGES

Lindsey Snyder, Assistant Editor



A wind turbine gearbox being moved at Hansen Transmission's Lommel, Belgium facility. Courtesy Hansen Transmissions.

Big gears and wind turbines go together like bees and honey, peas and carrots, bread and butter and—well, you get the idea. Wind isn't just big right now, it's huge. The wind industry means tremendous things for the energy-dependent world we live in and especially big things for gear manufacturers and other beleaguered American industries. Turbines represent progress, innovation, investment, capital and job opportunities—an integral part of the “green” revolution.

“In the last few years, we've seen nothing but increased growth and increased demand for more and more gears for the wind industry,” says Louis Ertel, president and CEO of

Overton Chicago Gear.

In 2007, 20,000 MW of new wind energy capacity was installed on a global level, which is 31 percent more than was installed in 2006, according to the *Global Wind Energy Outlook 2008*, published by the Global Wind Energy Council (GWEC). One megawatt of wind power, on average, can power 250 to 300 homes, according to the U.S. Department of Energy. The GWEC report also states that for the first time in decades, over half of the annual wind market was outside of Europe. Between 2006 and 2007 the Chinese wind market grew by 145 percent, and this is just the beginning for China.

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The United States reported 5,244 MW were installed in 2007 which is more than twice the amount installed in 2006, and overall generating capacity increased by 45 percent in 2007, according to the GWEC. The American Wind Energy Association (AWEA) says 1,389 MW were installed in the third quarter, according to the market report published for that financial period. This brings the total capacity installed in 2008 to 4,204 MW at the time of the report. AWEA expects the installed capacity to reach 7,500 MW in 2008, which is enough electricity for approximately 2.2 million homes.

Clearly the U.S. wind industry has progressed significantly over the past few years, but there is even more development being planned and executed as you read this. AWEA reports that in the United States eight wind turbine component manufacturing facilities have been opened in 2008, nine have been expanded and 19 new facilities have been announced, which translates to an estimated 9,000 new green jobs.

Brevini is one such manufacturer, announcing in October construction of a 150,000-square-foot plant to produce planetary gearboxes for wind turbines. Moventas announced plans in September for a new assembly plant in Faribault, Minnesota. "Expansion of production in North America is a significant step closer to our customers and it strengthens our ability to meet the after-sales service demands in the market," says Ilkka Hakala, CEO and president of Finland-based Moventas.

Winergy Drive Systems, one of a small handful of U.S. turbine gearbox assemblers, is in the midst of expanding with a 175,000-square-foot plant scheduled to open in March 2009. There are already plans to double the size of the new facility in the next two years. The current plant will mostly be reserved for service and parts, according to Parthiv Amin, president of Winergy. It will eventually begin producing a small portion of gears and other parts, which are currently imported from their German facilities.

Hansen Transmissions is another wind gearbox manufacturer with ambitious expansion in the works. The company recently completed a major addition to its Belgian

plant in Lommel. The facility is now capable of producing gearboxes for turbines up to 6 MW. Turbines with that size capacity are currently used for offshore projects, which are the largest wind ventures existing today. "Further expansion is in progress in India and China, where we are building respective 5 and 3 MW plants," says Ivan Brems, CEO of Hansen Transmissions.

Brems views Hansen's expansion as "a testimony of the strength and growth potential of the wind energy sector."

Brems expects these new projects to be the biggest challenges Hansen will face in the next year. Supply chain woes and a volatile economy don't top the list of concerns for Hansen, where business continues to grow. "We have a full order book till the end of 2009, and already a lot of orders till 2011," Brems says.

Overton Chicago Gear has also expanded recently. "We've added a 20,000-square-foot facility here in Addison (IL). We've added 10,000 square feet to our heat treat facility, and we've purchased Chicago Gear, so we've had tremendous expansion," Ertel says.

"The heat treat expansion was specifically aimed at gaining more heat treat capacity for wind," he says. "In order to make room for some larger tooth grinders, we moved all our small tooth grinders offsite to a new facility. That was all pretty much looking at the wind industry requirements."

Another indication that the wind energy market is thriving is the investment by oil companies, such as BP, which anticipated generating over 1,000 MW of zero-carbon electricity from its wind projects by the end of 2008, according to a press release. The company already has wind operations in Colorado, California and two in Texas that started commercial production in October. Currently under construction by BP is a wind farm near Wichita, Kansas and one near Indianapolis.

Many other non-energy related corporations are jumping on the wind wagon, including retailers like Wal-Mart, which announced in November that it is purchasing wind power capable of supplying 15 percent of the total energy used by 360 Texas stores and other Wal-Mart facilities. JCPenney recently announced a pilot program to install wind turbines at a distribution center in Reno, Nevada.

"While there was a market for wind turbines a decade ago, there is no comparison to the market we have today," says Lyle Nuhring, vice president of sales and marketing for Columbia Gear Corp, which supplies gears to the wind industry.

The Economic Specter Looms Large

The general consensus in regards to the economy is that the wind industry, while not immune, is uniquely poised to ride the recession out more successfully than other industries, due largely to the current social and political climate.

"Despite adverse economic conditions nationwide, investors view wind as a sound strategic investment, and prospects for long-term growth in the wind energy industry continue to be bright," says Randall Swisher, executive director of AWEA.

"The convenient truth here is that wind power provides



An assembled wind turbine gearbox. Courtesy Winergy Drive Systems.

a stimulus for our economy, as well as a climate change and energy security solution," Swisher says. "The market, in spite of all its turmoil, clearly points to wind power as one of the most attractive energy options available today."

According to Brent Reardon, chair of AGMA's wind turbine gear committee and manager of the turbine group at wind energy consulting firm Garrad Hassan, the wind industry is "a little more insulated from the downturn in the market.

"The financial markets as a whole are a concern, but there is a lot of interest in green and alternative energies," he says.

"We've seen slowdown in the general market, but not significantly."

Reardon projects tremendous growth for the future.

"This is a very strong market," affirms Winergy's Amin.

He expects the current economic conditions to impact business at Winergy starting the second quarter of 2009. He believes the rate of growth will remain high for the long term; although, for now he foresees slower growth. For 2011 and beyond, he predicts a 30-40 percent growth per year.

Regardless of the success many in the wind industry are experiencing, the global financial crisis remains a threat to business in the near future. "The credit crunch has affected the timing of certain programs. There is a certain softness in the demand side of the gear business that hasn't been there for awhile," says Chuck Schultz, gear industry veteran, founder of consulting firm Beyta Gear Service and technical editor for *Gear Technology*.



Hoisting a drivetrain up to its nacelle home. Courtesy Paul Anderson.

Ertel considers financial turmoil as the biggest challenge facing the wind industry as a whole because there are many projects in various stages of development.

For Columbia Gear Corp., the biggest challenge to overcome in the next year will be "reacting quickly to how current economic issues and the new administration's programs will affect the market," Nuhring says.

Schultz believes there is a cautious optimism coming from gear manufacturers involved in the wind industry. "We were just starting to get some of the supply issues worked out, and now this uncertainty comes in, so we kind of have to hope that

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the momentum will stay there towards solving the problems," he says. "Everyone involved in the industry I think believes that this is only a temporary speed bump."

"I think by May or June we'll have the credit crunch fairly under control, and it will start building up again," he predicts.

Supply Chain

The supply chain and a new element of doubt is at hand due to the economy. In particular, a shortage in steel supply and significant demand has been an obstacle; however, the ongoing economic and automotive crises have caused a considerable drop in steel demand just in the past few months. According to the American Iron and Steel Institute (AISI), U.S. steel shipments dropped 6.8 percent from the correlating 2007 figure.

Reardon believes steel costs may continue coming down in the near future, which will serve to free up the supply chain.

"Material was an issue in the past," Ertel says. "But I think that situation has improved dramatically, and I don't see material as being an issue anymore."

When asked why, he says, "Because they've qualified some domestic suppliers, and steel is being purchased domestically as opposed to all of it coming from overseas."

Nuhring notes, "Raw material deliveries for gears have improved. However, the availability of other components has indirectly affected the rate at which our customers' gearboxes can be assembled and therefore have affected our schedules."

Nuhring believes it's too early to tell if current economic conditions will change this in the near future.

For Winergy, Amin says, "An overall challenge is the growing supply chain at the quality we need."

"Demand with steel is huge, but also the quality and type of steel."

Quality is the biggest concern at Winergy because most steel mills don't require the degree of chemistry and purity in material that is necessary for wind projects, according to Amin. He also says Winergy, like most companies, deals with bearing limitations. Winergy started an initiative about two years ago to grow their supply chain by pursuing potential suppliers and educating them about the wind market's growth and viability. "It took awhile to get to the right management people," he says, but "now they're enjoying [the benefits of] the market."

A regional wind power supply chain workshop sharing a similar purpose was recently cosponsored by the Jane Addams Resource Corporation (JARC), a not-for-profit Illinois community development organization that provides technical training to metalworking trades.

"We are optimistic about the potential wind power has to add to the customer base of the companies we serve and to create manufacturing jobs here in Illinois. We believe that supply chain development is the most effective response," according to the JARC website. "Through identification of original equipment manufacturers (OEMs), first-tier suppliers, and the regional suppliers able to meet their needs, we intend

to match supply to demand and bring business to the region."

Schultz attended the October seminar and says, "A lot of states are trying to do some really interesting things with this."

Iowa and Colorado are just two states actively recruiting wind-related businesses to set up shop within their borders. For those with supply chain issues, "People would be well advised to contact their local economic development officials and see what kind of help they can get," Schultz says.

Ushering in the Next Generation of Turbine Technology

New trends in turbine technology seem focused on bigger and lighter. In part, this caters to the offshore wind market, which is predominantly a European market so far. Offshore turbines require more size because they are fixed to the seabed and must optimize foundations. Technology for offshore wind turbines is currently being deployed with 6 MW capacities, and manufacturers will continue to cater to these larger-size needs.

Most turbines on land average a 1.5 to 3 MW capacity, and many designers don't expect this to change greatly in the near future, primarily because of transportation challenges that are already a significant issue when dealing with such large infrastructure, according to the U.S. Department of Energy in its "20 Percent Wind Energy by 2030" report. The new report evaluates and asserts that the United States can viably generate 20 percent of its energy from wind resources by 2030.

There are different predictions for what technological innovations will impact the industry. Gearbox failure is one of the biggest concerns with drivetrain development due in part to steep repair costs. There are various methods being used to minimize gearbox failure.

"One technology some people are using has to do with some sort of device to decouple, like slip-clutch. From an electrical standpoint, people are using different means to vary the speed and power going through the generator," says Andy Milburn, president of Milburn Engineering. "One of the big problems with the failures of gearboxes in wind turbines is that the load is so variable. They get a lot of turbulence in wind gusts. The blade tries to speed up and the generator is basically connected to the grid, and it wants to stay one speed, and so the gearbox takes all the abuse between the blade and generator."

One way to do away with gear losses resides in the direct drive solution. Although gearless, this is a trend gear makers may want to keep their eyes on. "Improved direct drive wind turbines are in the design/test stages," according to Nuhring.

Ertel believes direct drive technology is more of a trend in Europe and not a big concern for American manufacturers at the moment.

Amin expects to see changes in gear configurations, manufacturing methods, tolerance and heat treating. As a trend, he says, "[there is] a lot of drive to reduce weight in all components."



Courtesy of Hansen Transmissions.

Schultz says, "I think you're going to see more use of the superfinishing technologies, and it may move into larger components than it has before. [Superfinishing] helps with lubrication problems. As the parts get bigger the process is more complicated."

Setting the Standards

In the world of wind turbine gearing, standards play an important role, as industry players indicate.

"[Gear standards] create a uniform reference point and contribute to making products more reliable," Hansen's Brems explains.

"Standards provide guidance for gear manufacturers, other manufacturers and consumers on expectations of wind turbine gearboxes," Reardon says. "They help provide a level playing field."

According to Schultz, "Standards have made a tremendous difference. AGMA/AWEA 6006 is probably the best gearbox standard ever written on any subject, but it is specifically about wind energy. And the feeling is that in the five years since it was originally adopted, machines designed using that standard have been much better performers than those that were designed before that. Anybody that wants to do anything in wind gearing probably needs to memorize that standard."

AGMA 6006 was the first original gear standard developed specifically for wind energy. The Wind Turbine Gear Committee, a joint effort between AGMA and AWEA, meets two to three times a year in different locations.

The standard was adopted by ISO—known as ISO 81400-4—about three or four years ago, according to Charlie Fisher, AGMA technical division vice president and staff liaison to the committee. "The standards on the street now, AGMA 6006 or the ISO equivalent, are the documents being cited in customer specifications and, just as importantly, by the certification bodies," he says.

As an international standard now, representatives from all the different countries involved meet as a joint working group to write comments on what is primarily a working draft. "We met in Tokyo this summer to try to resolve all

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those comments," says Milburn, a member of the committee. "We only got about a third of the comments resolved. This next meeting we'll continue trying to resolve more of these comments."

For the upcoming meeting, Reardon says, "We're hoping to get through the rest of the comments submitted. We expect to have another working draft to go to the committee."

Some hot topics of discussion for the joint working group include updates on manufacturing technology, gear rating practices, bearing selection, calculations of bearings life and the criteria for them as well as the practices people use to rate or size the bearings used in drives.

"All these major topics are talked about at nearly every one of these meetings, with specific concentration on the bearing issues—bearing selection and bearing life calculations," Fischer says. "But they continue to develop the other sections of the standard, dealing with lubrication and rating and operation and maintenance and structural design and the like. They're touching on all the different aspects of the standard."

There are also some new parts to the working draft that weren't part of the current standard. "There's a lot more information on loads, and there's a lot of information on housings and other components," Milburn says.

Bearings seem to be the main area of disagreement. "They have historically been a source of failure in the wind industry," Reardon explains. "The biggest challenge is reconciling expectations for bearings."



Workers constructing a wind turbine in Didima, Greece. Courtesy Vestas.

Reardon cites a wide variety of opinions concerning this issue.

"The main area that is causing most of the disagreement at this point is bearings ratings," Milburn reinforces. "There's no agreement on how people should be calculating bearing life. One of the reasons is because bearings have been such a big problem. Certain groups want to keep doing what has been done in the past. Then there are others that say 'If we're having problems, why would we want to keep doing the same as we did before?'"

Milburn explains the U.S. position on the issue. "What we've been trying to do in the United States is reduce the life from L10 to, say, L3, which means we're going to run these same hundred bearings, and we want only three of them to fail, not ten. But to do that, you have to either reduce the loads or increase the bearing size. So far, the U.S. position has been shot down. Right now we're in the minority."

The committee members seem optimistic and focused on future plans, which include "moving the standard along and coming to compromise agreements between all the international delegations on all the technical issues that they continue to address," Fischer says.

Legislation

According to "Wind Energy for a New Era: an Agenda for the New President and Congress," a report published by AWEA, "With the right policies in place, wind power can make a major contribution to the effort to protect the

planet's climate, while spurring tens of billions of dollars in economic investment, supporting hundreds of thousands of new American jobs, making America more independent and secure, and saving consumers more than \$100 billion."

AWEA's report, which can be found at www.awea.org, details several areas where the federal government can help promote wind energy. The report reflects other views in the industry that the federal government should be doing its part to promote the wind industry.

"Federal policies have an important effect on the wind industry at large," Hansen's Brems says. "Driven by the growing need for energy, the concern for the environment and the need for security of energy supplies, we expect increased support from governments all over the world for wind energy."

Amin believes that many in the industry are "waiting for clarity," in legislative form.

He believes federal legislation will provide end-users incentive and a long-term sustainable vision for the industry. He and others seem to have high hopes for this with the new administration and Congress. Amin is "looking forward to a lot that is going to affect business positively," and he hopes the new administration "will set the record straight."

There are several ways the U.S. government could foster wind industry growth through legislation. The wind production tax credit, which was eventually extended for the usual one-year allotment, could be made long term; AWEA

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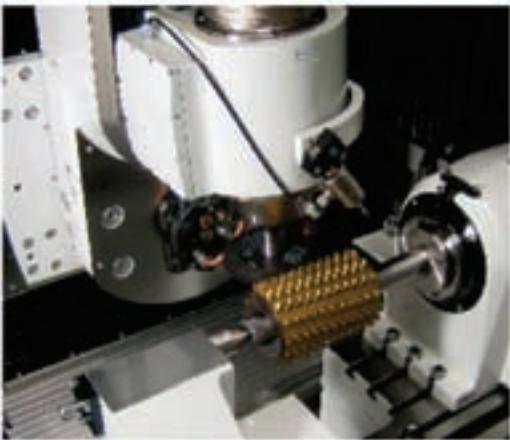
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recommends a minimum five-year extension. Known as the PTC, the tax incentive has been criticized for its year-to-year uncertainty as causing the industry to stagnate. In years that the PTC was not extended, a significant drop in additional installed capacity occurred—a 93 percent drop in 2000, 73 percent in 2002 and 77 percent in 2004, according to AWEA. “When they’re dragging their feet passing the PTC, what happens is the industry drops off dramatically,” Ertel says. “The last three or four years, when they’ve been able to pass the PTC, even though it’s been on a year-to-year basis, we’ve seen dramatic growth in the industry.”

“I think federal policy has a dramatic effect on what’s going on in the wind industry.”

Wind farms require long-term investment, and with only a yearlong tax credit that is applicable to completed projects, there is not much left for planning beyond a year’s time. “It gives a long-term view to investors,” Amin says of federal policy.

A national renewable electricity standard (RES) or renewable portfolio standard is another legislative action that would foster growth in wind development. Each state would be mandated to acquire a minimum percentage of power from renewable sources. So far, 28 states have enacted such a law, but enacting an RES at the federal level would broaden its effects to span the country.

Another measure stemming from the federal government includes stricter climate change legislation, which should involve a cap-and-trade system. This policy sets a limit on greenhouse gas emissions by companies, or, in the case of companies that are not successful in doing so, requires them to buy “carbon permits” from those that earn them by reducing emissions below the required limit. Revenue generated would go to financing renewable projects and providing further incentives to manufacturers.

Other policies include increasing federal R&D for renewable energies and funding individual projects, including a large-scale expansion of transmission lines. The state of the current transmission system remains a major impediment to developing wind as a viable alternative energy source.

“The industry is transmission constrained,” says John Dunlop, senior technical services engineer for AWEA. “And we (AWEA) have had some very aggressive, but very doable and responsible, suggestions for establishing an electron superhighway across America. It’s basically a transmission system that would overlay the existing transmission system. That would allow for a long distance transport of electricity that we can’t currently do.”

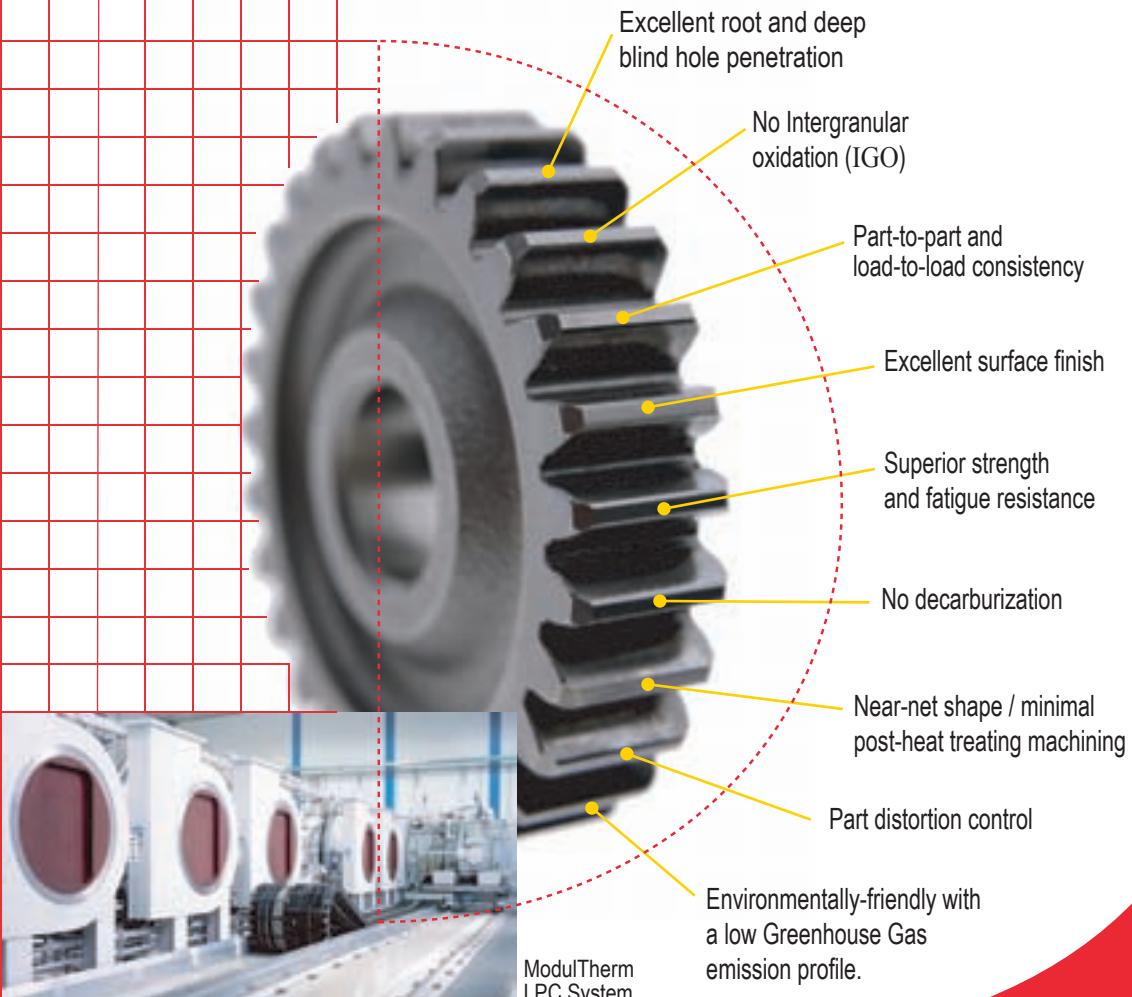
The U.S. Department of Energy estimates the cost of this proposed network to stand at \$60 or 70 billion, Dunlop says, but “Relative to the trillion dollars that frees up, it is a relatively insignificant number.”

The European Union recently endorsed an ambitious climate and energy package with emphasis on wind, and there is every indication that the United States will follow

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suit. So far, every energy and environmental measure taken by the president-elect indicates a much stronger support for alternative energies than ever before in the United States.

"Federal programs promoting renewable energy will increase the demand for wind turbines and therefore have a positive effect on our business," Nuhring says. "At this time, it appears the new administration will promote renewables."

Is it too late to reap the benefits?

While Amin and others encourage suppliers to take advantage of the opportunity the wind industry has to offer, it begs the question: Is it too late in the game for gear manufacturers to get involved in the wind industry?

"Those companies that do not have the ability to manufacture the type/size of gears used in wind turbines will need to make significant investments to enter the market—it's something they need to evaluate," Nuhring says.

Challenges seem to be more of a subject for non-wind gear companies than those involved in the wind industry.

"I think the machinery required to get into it, either from a heat treating standpoint or a gear manufacturing standpoint, that equipment is probably a year and a half to two years away if you tried to order it today," Ertel says. "And for people who aren't involved in high-accuracy, high-quality gearing, I think that is the other challenge. The wind business is all serial production, so it's not easy gearing to manufacture."

Brems echoes this view. "The entry barriers are enormous; for any new entrant it will be a very time- and cost-consuming experience to get a place amongst the established and experienced wind turbine gearbox suppliers."

But gear manufacturers interested in testing the wind waters at this point need not be completely dispelled by long machinery lead times. It's hardly a universal opinion that the challenges render entrance into the wind market impossible. "I don't think it's too late to be involved," Schultz says. Although, "it maybe be too late to be involved in the main drive components."

Amin says, "It's not too late yet."

But he does anticipate the window of opportunity narrowing, and it may be too late in a few more years.

One thing is for sure. With all elements combined, the wind industry is here to stay—in a big way. ☀

For more information:

American Wind Energy Association
1501 M Street, NW, Suite 1000
Washington, DC 20005
Phone: (202) 383-2500
Fax: (202) 383-2505
windmail@awea.org
www.awea.org

Beyta Gear Service
ON230 County Farm Road
Winfield, IL 60190
Phone: (630) 209-1652
chuck@beytagear.com
www.beytagear.com

Columbia Gear Corp.
530 County Road 50
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Belgium
Tel :+ 32 (0) 3 450 58 11
Fax : + 32 (0) 3 450 58 10
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www.hansentransmissions.com

Milburn Engineering, Inc.
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N.W. Seattle, WA 98177
Phone: (206) 365-2818
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A worker prepares the drivetrain for installation. Courtesy Paul Anderson.