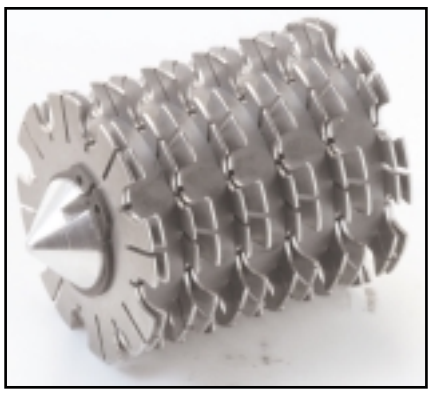
Magnetic Filtration

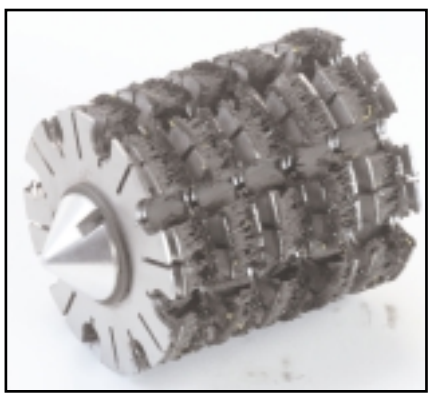
Fluid Conditioning Systems, of Warwick, U.K., has developed a simple device to remove ferrous contaminants from oil or transmission fluid with minimal reduction in fluid pressure.

The patented device, called the Magnom™, uses a magnetic field effect to remove particles as small as 0.07 microns from a variety of fluid types and viscosities. It was developed by a former Royal Air Force engineer who was working in the field of performance transmissions, according to Tom Hulme, CEO of FCS.

The engineer had been trying to solve the problem of scoring on pistons and gear teeth. He needed a better way to remove ferrous wear debris from the oil and transmission fluid. Conventional barrier filtration methods created too big a pressure drop, Hulme says. Another alternative, magnetic sump plugs, showed some promise, but they couldn't catch all the debris. In addition, Hulme says, large lumps of debris can sometimes wash off magnetic sump plugs and be reintroduced into the system, causing damage.



A Magnom core before use.



Debris is captured without reducing fluid flow.

The Magnom, however, is composed of simple annular steel plates, with flow channels sized so that fluid flow remains at or near 100%, no matter how much debris has been removed. In addition, Hulme says, contaminants are pulled laterally, and fluid flow causes refraction forces that compact the debris, preventing pieces from washing back into the flow.

Today, the Magnom is used by Lola Cars International for engine oil filtration. In a written statement, senior design engineer Duncan McRobbie said, "After four seasons of accumulating positive experience with a combination of fine mesh and Magnom filtration, we now have the confidence to use the Magnom unit, on selected projects, as the sole fine filtration media."

The Magnom was originally developed for performance motorsports, but Hulme says it has a wide variety of applications. Magnom filters have been manufactured in lengths ranging from 35 millimeters to 1 meter, and they've been used in gear transmissions, machine tools, and hydraulic equipment.

For example, Magnom filters have been used at electrical power generation plants to replace edge filtration for the removal of contaminants from the lubrication systems of coal mill gearboxes. They've also been used in the lubrication systems of print roller drive transmissions by a major American newspaper.

"We've never installed into a transmission environment and failed," Hulme says. "The majority of customers who've built up experience with the Magnom are now using it as their only fine filtration."

Another application of the Magnom filters is in machine tool cutting fluids. Magnom filters have been fitted on a variety of machine tools, including metal cutting, injection molding and EDM machines. According to FCS literature, a major British automobile transmission manufacturer has replaced its conventional filters on machine coolant systems, resulting in savings of £80,000 (approximately $140,000) per year due to reduced disposal and maintenance costs.

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The Magnom can be sized depending on requirements. In many cases, it's designed as a "fit to forget" solution, where the filter never has to be replaced. "It never blocks," Hulme says. But in other cases, the Magnom can be designed for regular maintenance because it's easily cleaned.

Although the Magnom is used mainly to remove submicron debris from fluid systems, it is also capable of catching much larger debris. For example, the company has seen chunks of gear teeth as big as 4 or 5 centimeters removed from larger Magnom filters, Hulme says.

The Magnom is designed not to reduce fluid pressure, no matter how much debris has been captured, so it is most often placed before the pump in a system—a place where conventional fine mesh filtration can't go. Because there's minimal loss in pressure with the Magnom, Hulme says, the filter can be placed where it will be most effective in protecting the pump without risk of cavitation.

In addition to capturing ferrous materials through magnetic attraction, the Magnom captures some nonferrous particulate material.

The Magnom also has environmental benefits, Hulme says. It reduces or eliminates the need to dispose of conventional filters, and it reduces the amount of lubricant normally discarded. Contaminants can be disposed of separately instead of with used filters and excess oil.

Despite the benefits, the cost of the Magnom is relatively small. The unit has no moving parts, and the magnets and plates which make up the core are relatively inexpensive. Most of the cost of the unit is in the housing, Hulme says. Prices might range from $80 up to $7,000 for larger industrial systems.

"Like all good ideas, the cleverness is a function of the simplicity," Hulme says.

Better Blanking from Bar Stock

If you manufacture your own gear blanks from barstock or outsource your requirements, Watkins Manufacturing of Cincinnati, OH, wants to talk to you.

The company's SAW-Lutions™ rotary saw cutting attachment can be added to single- and multi-spindle automatic screw machines and CNC turning machines to replace the traditional cutoff method using single-point tooling. The result is a much faster, more efficient process that produces less waste and requires less secondary work, says sales manager Dirk Greulich.

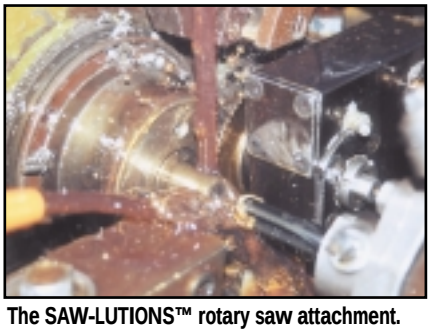
"Almost any job that runs through a screw machine, you're going to experience at least a 5–8% cost reduction on the total cost of manufacturing," Greulich says. "On parts such as gear blanks, or any part where the predominant operation is cutting off, the savings can be in excess of 30–50%."

The attachment was first developed in the 1960s. Known also as the Kerf Cutter™ system, it has been used extensively in the screw machine industry, according to Greulich. But recently, the company has begun exploring how the process can help the gear industry.

The attachment mounts to a host machine and replaces conventional tooling with a rotating saw. As the stock turns, so does the saw.

Watkins Manufacturing believes in the process so much that they have set up their own gear blanking operation to attract contract manufacturing work. If a gear manufacturer wants to install rotary sawing systems on his machines, Watkins will supply them. The company provides ongoing service and support, as well as on-site startup assistance with each system. But if you normally buy your gear blanks, Watkins believes it can manufacture the blanks more efficiently than companies that use other methods.

One of the benefits of the rotary saw cutoff method is that the cut is much thinner than methods that use single-point tooling, Greulich says. Because of the thinner cut, manufacturers can real-



The SAW-LUTIONS™ rotary saw attachment.

ize significant savings because less bar stock is wasted. At least 8–10% material savings is experienced and, in some cases, bar stock usage can be cut by 25–50% or more, Greulich says. Also, longer tool life and fewer tool changes contribute to long-term savings, he says.

Greulich adds that instead of long strings of sharp metal, the rotary saw produces very small, dustlike chips, that are much more disposable.

The process can become even more productive when multiple saws are run on the same arbor. With gear blanking, it's common to cut two or three blanks at a time, Greulich says. But the company has run as many as 10 saws on a single arbor.

Another advantage of the rotary saw process is that it can typically cut faster than conventional tooling. "This initial impact can drive cycle time down and productivity up substantially," Greulich says.

Also, irregular shapes, such as extruded bar stock or pinion stock, pose no special problems for rotary saw cutting, whereas traditional single-point tooling has a more difficult time with start-and-stop edges.

In many cases, secondary machining processes, such as double disk grinding, can be reduced or eliminated, because the rotary saw attachment produces parts with better squareness, flatness and surface finish than parts cut off with single-point tooling, Greulich says. The cut-off surface flatness and squareness, he adds, can be held to tolerances within 0.0003–0.002", depending on job characteristics.

The rotary saw attachment can be used on a multi-spindle machine, so additional machining operations can be performed at the same time. Those operations might include cutting blanks for shoulder gears, providing chamfers on the gear blank, drilling, reaming holes or OD work.

The process is ideal for volumes of more than 1,000 pieces, Greulich says. "But there really is no ramp-up. Eighty to ninety percent of the savings are from gear one." According to Greulich, there are even greater efficiency gains when a machine is producing the same part continuously over a period of a week or a month.

The Watkins rotary saw cutoff process has been used on bar stock up to 4" in diameter and up to 30 Rc in hardness, but the company is willing to "push the envelope," Greulich says, "especially when it's with materials we want to do R&D on."

Saws for the attachment can be made of high speed steel, tool steel or solid carbide, and a variety of coatings, including TiN, TiAlN and TiCN, are available to enhance performance.

In addition to gear blanks, the process can be used to make other high volume, precision turned parts, such as bearing races, spacers, rollers or bushings.

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