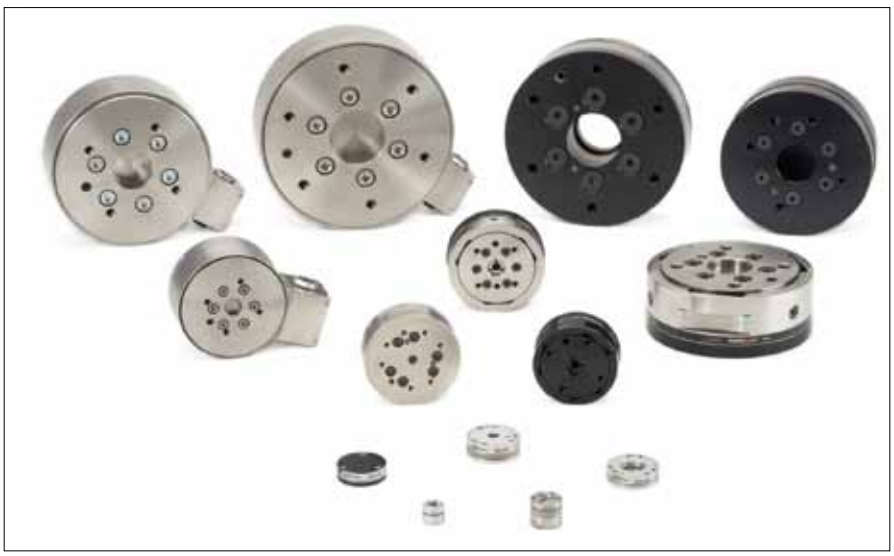
Cut and Print

PAPER CONVERTER INCREASES ROLL CONVERTING PROCESS BY 300%

Courtesy of ABB Robotics

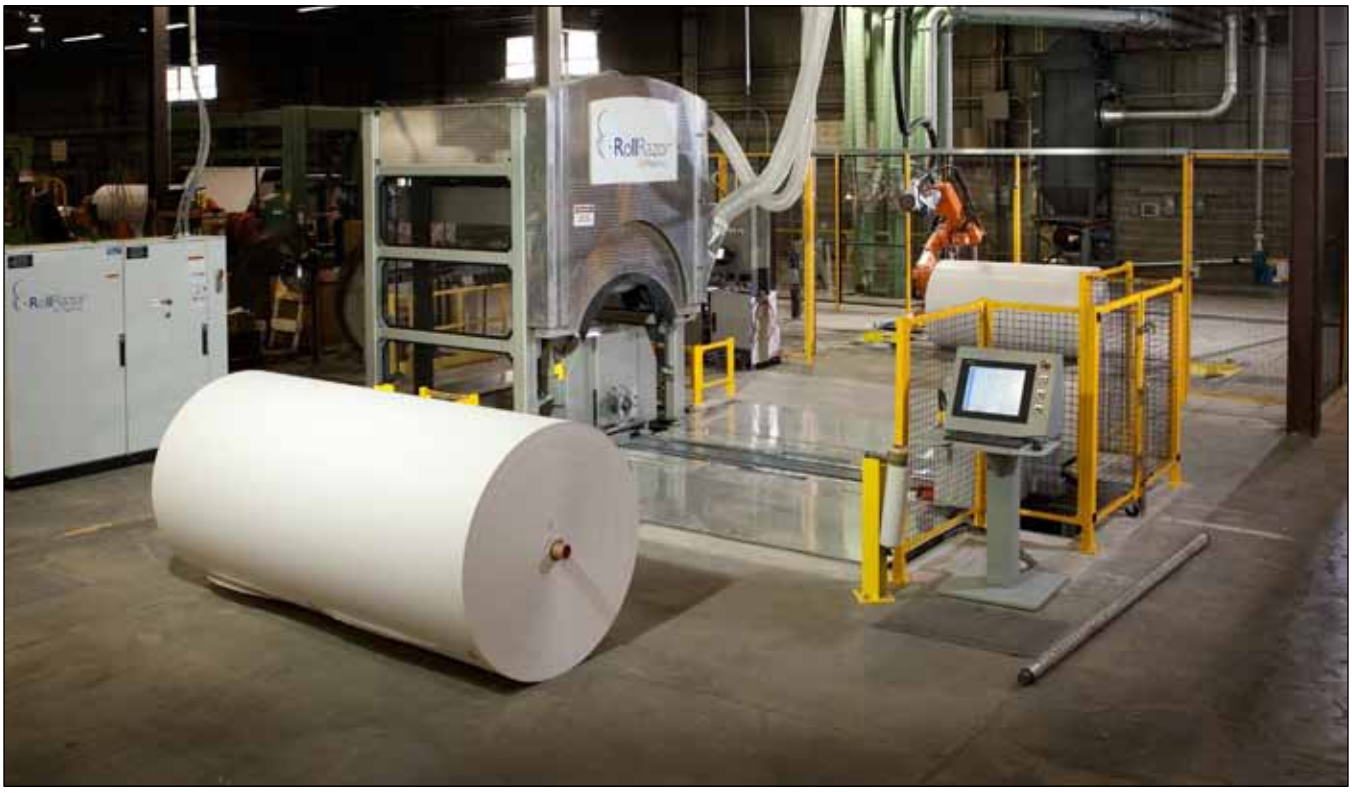
Norkol Converting Corporation is one of the nation's leading independently owned converters and distributors of commercial printing papers. Founded in 1968, the company's corporate location in Northlake, Illinois has full production capabilities and state-of-the-art machinery for winding, trimming and sheeting. The company utilizes traditional slitter re-wind equipment that unwinds, slits and then re-winds paper to new dimensions. These conventional re-winders, while typically producing new widths of paper with clean cuts, work at an inefficient, slow pace.



ATI Industrial Automation offers a line of sensor products for assembly, machining and finishing tasks (All photos courtesy of ABB).

"Re-winders have been used for years in the paper converting industry and although they do the job, we are constantly researching and adopting the newest technologies to help us remain competitive," says Mike Maloy, president of Norkol Converting Corporation. "Our original re-winders take between 30 to 40 minutes to process one roll, so we were very excited when we were introduced to new technology that processes four to six rolls per hour without the need to unwind and rewind."

The company turned to system integrator Mapleroc Industries of Portland, Maine and their automation partners—ABB Robotics and ATI Industrial Automation—to implement a new cutting and finishing system to speed up their process. Together the partners developed and implemented a new fully automated cutting and finishing system using Mapleroc's RollRazor cutting technology, which features a highly engineered cut-



Mapleroc's RollRazor utilized ABB and ATI Industrial Automation to increase productivity.

ting blade capable of cutting as much as 300 percent more paper in one hour than traditional re-winders. As part of the new application, the system features a new Robotic Roll Finishing System utilizing an ABB IRB 6620 class robot equipped with a force-controlled machining package with ATI Force/Torque Sensors.

"ATI Force/Torque Sensors integrated into the robot wrist measure the forces and torques, giving the robot a sense of touch," says Dwayne Perry, PE chief sensor technologist for ATI Industrial Automation. "Robots integrated with these sensors make it possible to automate (a variety of) difficult assembly, machining and finishing tasks that previously required skilled personnel or complex assembly machines, allowing manufacturers to cut costs and improve employee safety."

The RollRazor. Developed by Mapleroc, the RollRazor utilizes a finely honed and engineered blade to cut parent rolls of paper in their rolled state in one pass, cutting them to press-ready roll sizes in three minutes, all without the need to un-wind and re-wind the paper. It is the fastest paper roll converting machine currently available. The system is capable of handling all grades of paper including tissue, napkin, cigarette, Bible, coated, uncoated, cardboard and kraft papers.

"In addition to vastly increasing cutting speed, the RollRazor's circular blade generates virtually no heat, cutting seamlessly in one pass through the roll and thereby maintaining the paper quality of the mill wound roll," says Todd Morrison, president of Mapleroc Industries. "This

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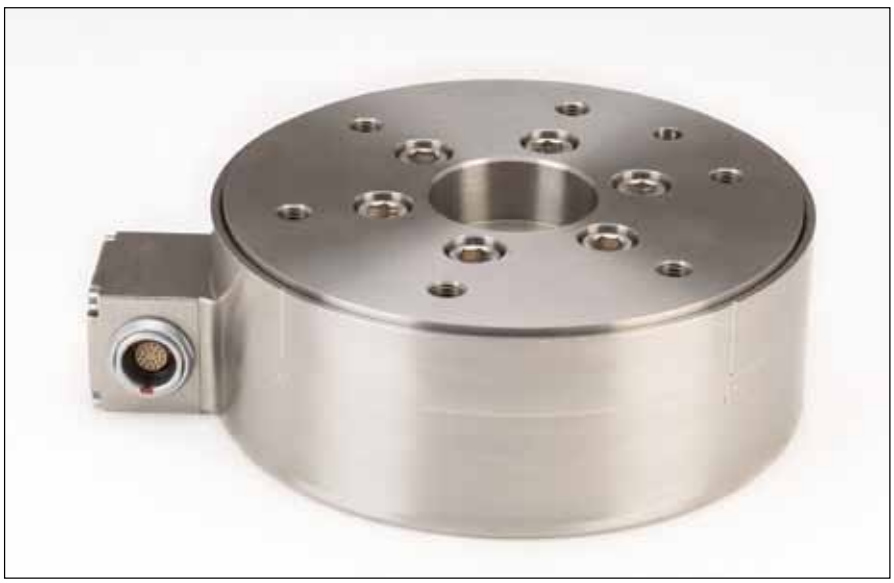
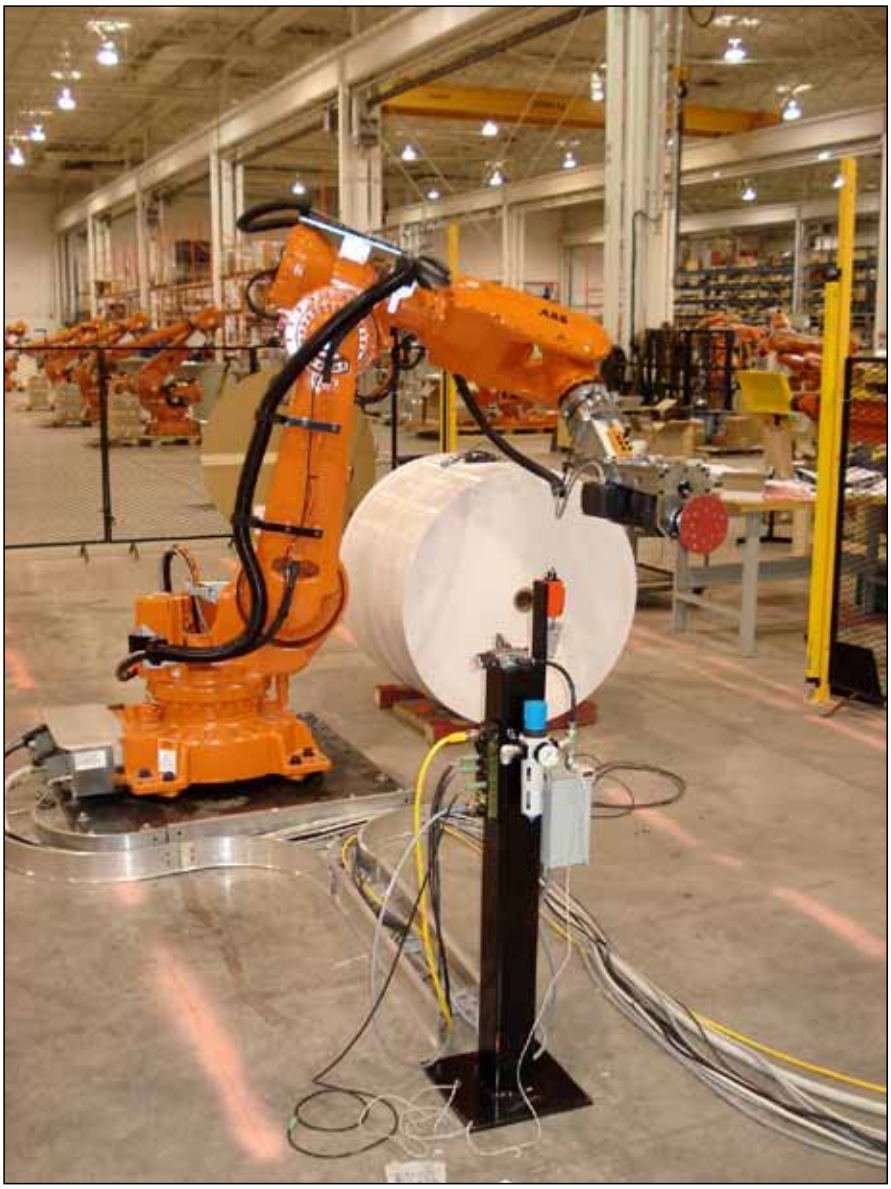


ATI Force/Torque Sensors gave the ABB robot a sense of touch.



The ABB IRB 6620 is a flexible six-axis robot with a compact design.

avoids possible errors inherent in the un-winding and re-winding process such as wrinkling and tension problems." Pressrooms today cannot afford upsets on press due to inconsistent roll quality. RollRazor ensures consistent mill wound rolls with all the "original" manufactured specs still built-in to the press-ready rolls."

Mapleroc estimates that mills or paper convertors can triple production output, improve efficiency by 2.7 times and reduce operating costs by as much as 72 percent using this new system.

Robotic Roll Finishing System. Traditional slitter rewinding equipment makes a clean cut and the new rolls do not require any additional finishing. The RollRazor blade cuts through the entire roll with a circular saw blade. Because not all rolls are wound the same, not all cuts come out the same. In an effort to remove the "witness lines" that are left over from the cutting process and producing a consistent looking roll, these edges then require sanding to meet the customer's requirements. To complete the robotic cutting application, Mapleroc, ABB and ATI partnered to develop a roll finishing solution to automatically sand and smooth these edges. The newly developed Robotic Roll Finishing System creates a fully automated, high precision force-controlled roll finishing station.

"We worked with Mapleroc and ATI jointly to turn the Mapleroc finishing center into a workable concept of an unmanned, fully robotized system," says Slawomir Smolec, business unit manager for robot automation at ABB Robotics. "The resulting Robotic Roll Finishing System utilizes an ABB IRB 6620 class robot equipped with a force-controlled machining package from ABB."

"The IRB 6620 robot is equipped with an end-of-arm roll finishing tool and an integrated dust collection system," added Adrian Kiss, engineering manager of ABB Robotics. "As the robot sands the rolls, an integrated dust collection system removes the excess paper using a vacuum system."

The IRB 6620 is a flexible and agile six-axis robot with a large working envelope. It features an extremely compact design, has a reach of 2.2 m and can handle payloads of up to 150 kg.

With the cut roll moved into place, the robot equipped with the sanding head smoothes the edges utilizing the ATI Force/Torque sensor technology to provide force feedback. This enables the robot to feel and have a sense of touch just as a human would. This sense of touch allows the robot to make quick adjustments in real-time to maintain a constant contact force—all while mantaining an average finishing temperature of 85 degrees. Together, the robot and sensor make this finishing task possible.

The system uses ABB's force control package featuring the force/torque sensors integrated on to the robot wrist and where the signals from the force/torque sensor are interpreted directly into the motion control of the robot. The package includes ABB's *RobotWare Force Control Machining* software with a user-friendly machining GUI. The hardware includes an axis computer, data acquisition board for the sensor, cabling between the sensor and controller and ATI's force-and-torque sensor.

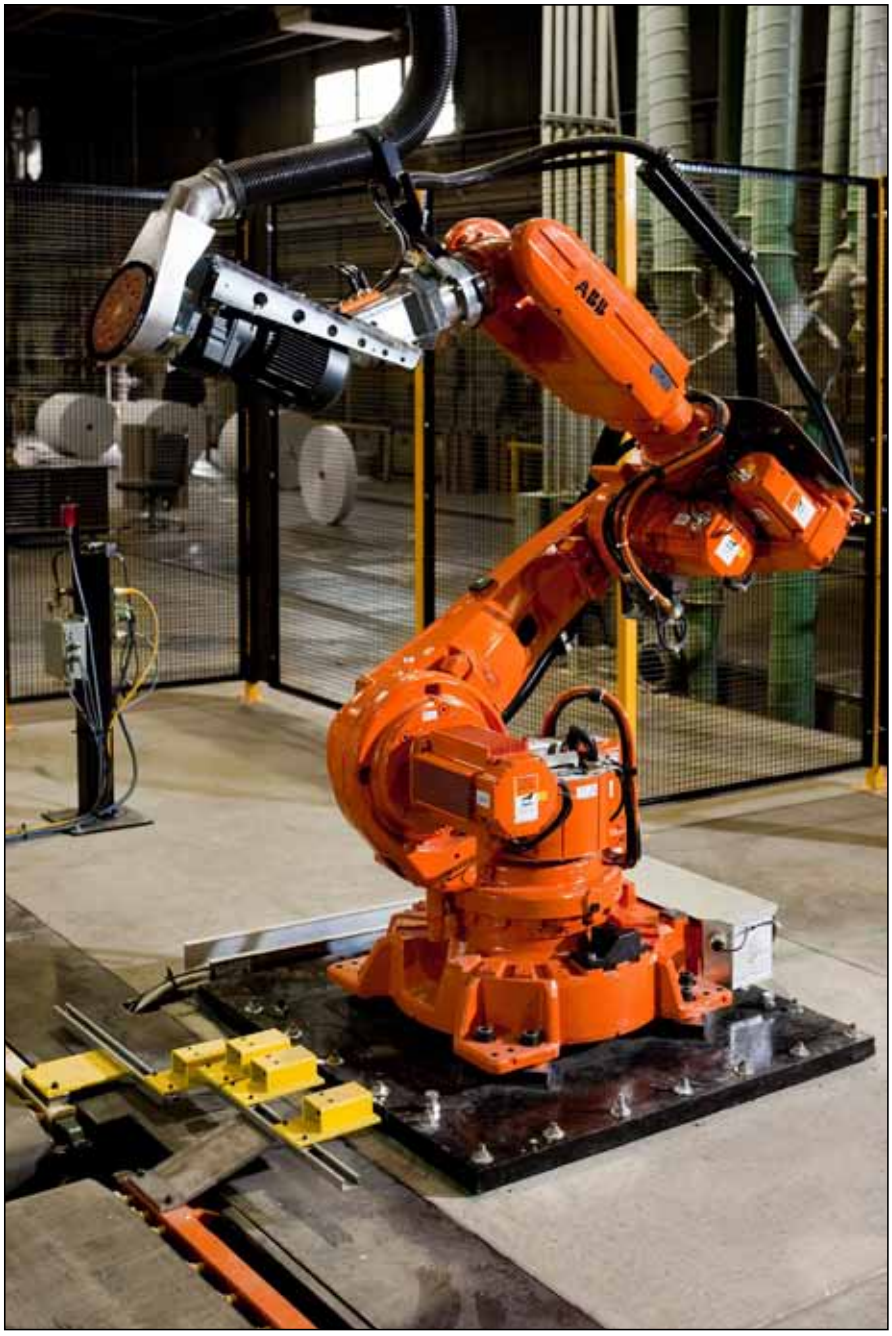
Multi-Axis Force/Torque Sensors. The key to smoothly sanding the paper rolls to meet the high standards Norkol's customers require is the system's sensor technology. The multi-axis force/torque sensors measure all six components of force and torque. Each consists of a transducer, shielded high-flex cable, and an interface card specially designed to work in the ABB robot.

So how does it work? When you

apply a load to the transducer, microscopic strains develop on its internal beams. Silicon strain gages placed on these beams react to the strains, and electronics measure this reaction. Software analyzes the measurements and is able to report and transmit the information about the amount of load that is being applied. Simply put, the transducer bends microscopically; it measures that bending and the software determines and transmits that information to the robot. The sensors give the robot force feedback when the unit is pushing too hard or moving to the left or right.

Force/Torque Sensor Technology versus a Load Cell. "A common question we hear when customers are considering various force sensing solutions is how our sensors differ from load cell force sensing," says ATI's Perry. "The three important differences include the elimination of crosstalk with our product, a wide range of interfacing options making connections simple, and our product's ability to withstand overloads of greater than 20 times its capacity."

Perry elaborates that ATI's Force/Torque Sensors are largely immune to crosstalk. Load cells typically measure just one or two axes of loading, which can unintentionally react to loads on other axes, resulting in undesirable crosstalk. Six-degree-of-freedom transducers don't have this type of crosstalk problem. Another advantage with the ATI sensors is the availability of connecting to a wide range of industrial interfacing options including Ethernet, EtherNet/IP, USB, PCI bus, PCMCIA, RS-232, analog voltage and more. The sensors come as a complete system, making it simple for customers to connect to their equipment, whereas load cells usually have only one or two ways of connecting, require external electronics bought separately and usually only use analog voltages. Finally, and perhaps most importantly, Perry adds that load cells can only withstand 150 to 200 percent of an axis's rated range, thus increasing the chances of it failing. On the other hand, force/torque sensors' overload capacities generally run from five times to greater than 20 times, depending on the selected calibration.



The ABB IRB 6620 provides force feedback thanks to ATI's Force/Torque technology.

Additional Applications. In addition to the robotic roll finishing application, force control is suitable for many other applications including difficult assembly, machining and finishing tasks that previously required skilled personnel or complex assembly machines. Force/torque sensors are used throughout the industry for product testing, robotic assembly, grinding and polishing. Force control provides excellent robotic contour following, such as in grinding or deburring, to ensure the correct force is being applied. It is also used for robotic material handling to verify product weight and collision-free placement. In research, ATI's sensors are currently being used in robotic surgery, haptics, rehabilitation, neurology and many other applications.

Cutting and Finishing Benefits. Utilzing the new RollRazor cutting technology has significantly sped up Norkol's converting process and reduced their costs. The company estimates that with the new equipment they can produce one press-ready roll in six minutes where it originally would take approximately 30

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minutes to process. For the company this increased production lowers their cost per ton and cost of labor. The new equipment increases plant flexibility, maintains original mill roll quality, guarantees original sheet orientation and web tension and can also convert wet or damaged rolls.

The Robotic Roll Finishing System with its force/torque sensing capability eliminates safety risks for employees and offers manufacturers a quick and efficient method of finishing the roll to the standards required by the customer. The system allows the robots to address all roll sizes and unfinished surfaces automatically, eliminating the need for manual set-up. With this new system everything is embedded in the robot control, thereby eliminating the need for an expensive programmable logic controller (PLC) which typically would be used to regulate pressure and prevent the paper from burning or melting.

"Our goal at Mapleroc is to manufacture roll converting equipment with the best available technologies that improves our customers' runability and printability of their paper. We are doing this while dramatically lowering the cost of roll converting" commented Mapleroc's Morrison.

"We have been very pleased with the new cutting and finishing system as it is faster and eliminates problems for most applications. We are currently evaluating and considering replacing additional rewinders with this more efficient system," adds Maloy of Norkol.

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