



# Checking the Checks for Zero Defects

**Well-defined inspection procedures and innovative ideas keep bad parts contained — and customers happy.**

**By John Iwanski with Rich Applebee, Wayne Ford and Nick Bowen**

*Photos by Charles Celandor*

When it comes to ensuring the strict, zero-defect demands of automotive customers are met, plant engineer Wayne Ford of Grandville, MI-based BMC Bil-Mac Corp. has a simple explanation to what is a very complex problem. “Here the focus is on predictive machining. We have to anticipate all the problems that might come into a job — even those the customer can’t imagine, because if a bad part gets to a customer it’s bad for everyone.”

This precision-parts supplier has seen the tolerances of its largest market — automotive — tighten to the point of perfection. The company’s answer: Meet those tolerances with improved inspection techniques and technology, and utilize the talents of its engineers to eliminate as much opportunity for human error as possible.

## **A TIGHTENING NOOSE**

BMC — nestled just outside Grand Rapids, MI — started out as a garage-sized job shop along a dirt road. As business grew under owner Mike Bowen, the 45,000 sq.-ft., 70-employee shop full of Brown & Sharps and New Britains added CNC and broaching equipment to keep things moving out the door. Furniture manufacturing, a huge driver in Western Michigan, came calling, asking the company to craft components and subassemblies. Then, notes operations manager Rich Applebee, the quality demands started coming — and kept right on going.

“We were doing all the things that we needed to,” notes Applebee. “About seven years ago we had our defect external PPMs at around 100. We thought that was pretty good. We got it down to 75, then down to 50. But the automotive manufacturers kept dropping that number. When

they started telling us that 35 PPM was unacceptable for bad parts, we knew things were going to have to start changing. We had no choice.”

What made things even tougher was that, according to Applebee, customers not only were demanding that no defective parts get to their plants — they were insisting that those parts not even get to the sorter. “They weren’t expecting us to catch bad parts at the sort stage,” he says. “They expected that bad parts would never GET to the sort stage.”

The acceptable defect numbers kept dropping, and eventually, about two years ago, a customer informed Applebee, Ford and vice-president Nick Bowen that a 3-PPM defect rate was too poor. “It was amazing,” adds Ford. “But we had to figure it out. We won’t just throw money at a problem if there isn’t a return there, but for that part of our customer base (ed. note: Approximately 70% of the company’s work is automotive-related), we had to keep improving our processes, which we already felt were well-defined and adhered to.”

It wasn’t as though BMC was in the dark when it came to tracking its quality and inspecting parts. “We’re QS-9000 certified, so we keep track of how parts were running through our operation,” notes Applebee. “We had SPC in place and have seven networked computer stations that monitor the process variation of critical characteristics. We placed optical comparators throughout the shop so that operators can go right there and check a part; inspection plans of all the parts are placed next to each comparator so the operator doesn’t need to bring paperwork with them, and they can see what



**Engineer/plant manager Wayne Ford uses a modified eddy current machine to inspect for defects on a part's threads that other inspection units would be unable to locate.**

"It's simple really," Hiller explains as she picks up a setup package in the inspection office that contains prints and gages for a job. "We give the operator everything they need. The prints; critical dimensions; gages to measure — it's all right here. We put it in a bin, they come and pick it up, and there is no misunderstanding. A lot of quality is just that; having a plan in place and staying with it."

That plan is an integral part of how the company conducts daily operations. Once the setter/operator gets the specifications and the job from the Q.C. office, the setup is completed and given to BMC's quality technician Tom Langland. He verifies the setup meets all quality requirements before any operator starts producing parts. An operator such as Steve Green will run a job on one of the company's New Britain or Brown & Sharpe units. As the parts are running, he'll use the gages and measuring tools supplied with the prints to inspect the parts, and enter the information into one of the aforementioned computer monitoring stations. If there is a problem, he can find it right away and contain it before it moves further down the supply chain.

Meanwhile, Hiller makes her rounds and double-checks to make sure that the critical dimensions on each part are met. She meets with operators on the floor, conducts spot checks and helps them out with any concerns they might have. If a machine is running rough, or an operator notices something, a simple correction is made to eliminate a bigger problem down the road. Once that's done, she works her way back to the Q.C. office and makes note of any problems.

To Applebee, who's been with BMC for nine years, and Ford, who is approaching 20 years of service with the company, the plan is a beautiful thing

critical dimensions have to be met. It's just that the demand for quality has been elevated so much in recent years."

### **A WORK IN PROGRESS**

Quality and inspection has always been a priority. Walk into the shop and you'll find Karen Hiller, BMC's quality

control supervisor, constantly prowling around on the floor. It's rare if her seat in the Q.C. office is warm — not because there is a problem with a part, but because she is constantly going from operator to operator auditing their inspection process as part of the company's inspection protocol.



**Operator Glenna Kindle checks the status of parts running (see inset) through BMC's Mectron inspection unit. The machine's high-speed capacity allows for faster sorting and defect identification on large volumes of parts, helping meet ever-increasing quality demands from customers.**

to behold. "You have to 'full-proof' the system," notes Ford, who says that interaction between operators, management and sorters is really the recipe for success. Applebee adds that, "To a visitor, it seems almost like we have checks on top of checks. We do. But there is a method to our madness. That process is critical to our success, because if we have a part run bad for an hour, not only do we run the risk of the customer receiving a bad piece, but we have to spend that time inspecting all those parts with a fine-tooth comb."

### **MECHANICAL "COMBS"**

What the company didn't have, however, was the same thing that nobody did, or does, for that matter — a full-proof way to make sure that no bad parts walk out the door. "We have great people in our sorting department here," says BMC's quality assurance manager Mike Pierce as he holds up two parts that have been tapped on the ends. "But if you are eyeballing these parts for eight hours a day, are you going to be able to tell if this tap is nine-hundredths of an inch deeper than this one? The answer is no. It's no fault of the sorter; you have to be realistic. They get tired. Their eyes get strained. But to the customer, this is a defect that they can't accept. So it's our job to solve that problem."

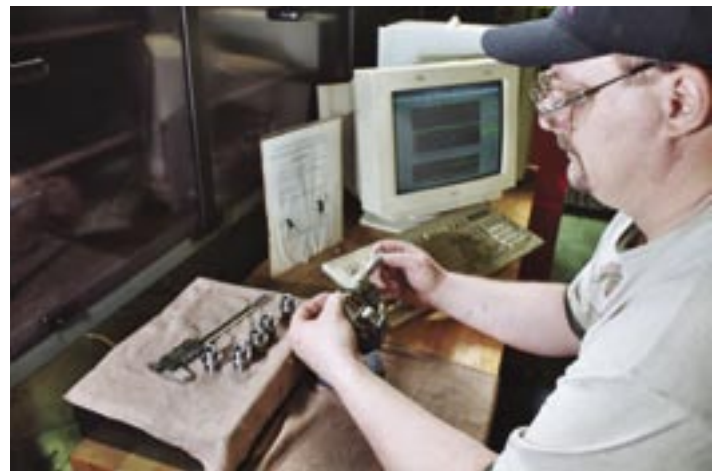
That problem-solving mentality can be seen throughout the shop and is driven by Mike Bowen — a degreed engineer from Britain who at one time ran a post-WWII ordnance plant in Pakistan. He and Ford have designed a variety of custom-built inspection units, which utilize out-of-production switches that use pressure to detect change, and integrated those directly into machining operations. On one unit, if the unit detects a bad or broken tool, the unit automatically shuts down and a counter records that. The setter has to change the tooling out and manually restart the unit. Another counter actually notes the number of bad parts the unit makes. The setter simply checks the defect bin and makes sure the number of parts in that bin match the number on the counter.

This engineering innovation has led to the development of a new patent pending measurement device repeatable to 0.0001 in. that adjusts easily with a micrometer barrel. BMC plans to incorporate this (as yet unnamed) device into existing machines for 100% in-process inspection and then introduce it into the market for sale.

Another problem BMC deals with is volume. The reality is the company puts out large numbers of parts every day, and those parts require in-process inspection and sorting. Enter

technology, married to a human component.

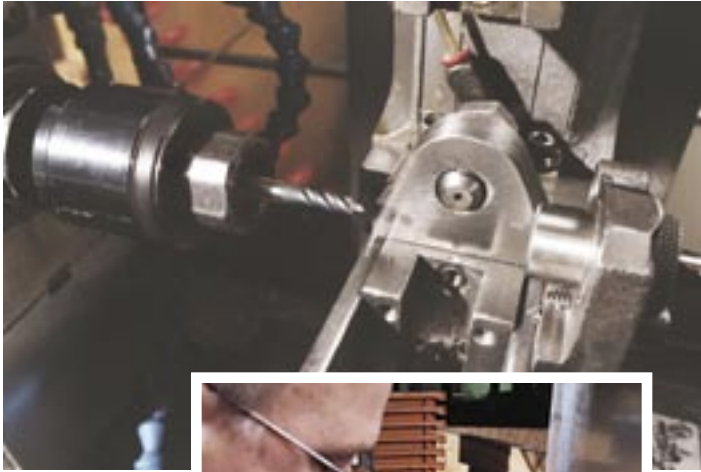
Mike Bowen, Ford, Pierce and others in the company merge their collective understanding of the business and machining to figure out how to eliminate defects without inflating costs. "We'll get a bad part, go through the inspection paperwork and talk with the operator," says Ford. "We'll explain to them that we're not mad at them, but we just need to figure out how this defect got made. Nine times out of 10, they'll tell us something that we never in a million years would have thought an operator would do. So we'll develop something to prevent that from happening. I'll figure out how to put a peg in place that will prevent them from putting a part in a machine backwards or upside down. You just remove that possibility from the process."



***Operator Steve Green checks dimensions on a part at one of seven inspection stations on the shop floor. Next he'll enter the information into the computer, which is linked to the other units as well as a computer in the inspection office, supplying up-to-the-minute data on where the part is in-process.***



***Quality control supervisor Karen Hiller inspects a part with operator Steve Green on the shop floor. Hiller not only will check dimensions and specs on parts in the office, but constantly walks throughout the shop performing spot inspections to make sure defects are caught.***



Pierce adds that, “You’re never going to be able to completely eliminate the human element from manufacturing.” Applebee agrees, and notes that, in fact, humans are the best resource in the shop. “People give you flexibility, can adapt to situations and produce on a high level,” states Applebee. “But you have to give them a backup with the demands today’s customers place on us.”

The company incorporates laser inspection and machine vision inspection with many of its secondary and value-added equipment. Walk into the primary sorting area and you find

a Mectron Qualifier Q-4000 inspection and sorting device next to a bin of finished parts. Sorters go through smaller lots on a table standing next to the machine, but for large runs, this unit has been invaluable. “You just can’t underestimate the help it gives us,” says Applebee on the addition of the inspection unit, which the company integrated into its operations in 1997. The Mectron Laser Sorter has limitations — that’s why you need good people. But for the applications that we have it

*An in-house-designed detection unit finds a broken drill bit (top), automatically shutting the machine down.*

*Lead man Ernie Culver will remove the broken bit and replace it with new tooling. Only then can he reset the machine and get production moving again.*

*Back in the inspection office, quality supervisor Karen Hiller fills out inspection and documentation reports. BMC conducts audits every six months to ensure that process and quality goals are met.*

performing — checking critical dimensions on a part that the naked eye might miss while running a high volume of parts at high speed — it just is superb. It gives us another check, a great way to document to customers what we are doing to make sure we meet their quality standards.”

### EASY EDDY

BMC and Ford’s latest sorting project is actually a result of the company’s improvements in defect reduction. A part they were running through a C.J. Winter thread-rolling attachment would occasionally end up with a warped or drunken thread. BMC worked with Winter to figure out exactly why the threads would end up that way, and corrections to the machining process were made.

The problem, Applebee notes, is that they could never completely eliminate the warped, or “drunken,” threads from showing up. “We were able to reduce the size of the warp considerably. But if the part moves, or the thread roll moves, or there is a chip or change in pressure — there are 16 parameters altogether — then the machine will produce a drunken thread,” he says. “We worked with Winter, asked them how we could correct it, and we were able to reduce the occurrence well below the 3 PPM level we started with. We also made the defect smaller and smaller, but we could never completely eliminate it from happening.”

Ford and Pierce said the plan was to use the Mectron Laser Sorter to catch this defect, but they had reduced the size of the defect so much that the Mectron could no longer detect the warped thread 100% of the time. That’s where Mike Bowen, Ford and eddy current technology came in to play. This engineering team has worked to craft an eddy current inspection unit that will locate defects too small for other checking equipment. Now all a sorter has to do is load parts into the unit and the machine does the rest. “It’s just another way to fix a problem. We solved one group of problems, but the smaller warps presented new ones,” notes Pierce. “Our engineers were able to look at it from an overhead perspective and create a solution that keeps us moving forward.”

It’s the forward thinking that has Applebee, Ford, the Bowens and the rest of BMC excited. The company plans on completely integrating inspection and sorting with its shipping department when it decides to build an addition to the back of the building, and will consolidate all of the operations so that parts flow seamlessly from the time they come out of production to their dispersion to customers.

“It makes sense for us to do this,” says Applebee. “We want to handle the part as little as possible from start to finish. Once that part is sorted and we know its ready to go, it should be in our customer’s hands.” **TMW**



*Wayne Ford stands next to “The Jigger,” an ice-fishing unit that he designed and BMC Bil-*

*Mac has patented. The original design (shown on the inset) and its catch prove it does more than just sit on the ice.*

## GETTING JIGGY WITH IT

BMC Bil-Mac Corp. has witnessed a lot of changes over its 50-plus years of operation. Founded in 1954, and purchased by Mike and Jean Bowen in 1979, the company turns mostly cold drawn steels from 1018 through leaded, lead-free, and stress-proof draws. It also turns various alloys ranging from various grades of aluminums, copper/bronze, brass and plastics. While the company makes most of its parts for the automotive industry, a healthy furniture-component business (the company is located in West Michigan, office furniture capital of the world) and pieces for other industries also contribute to the bottom line.

Vice-president Nick Bowen is quick to note that the reason the company has seen continuous growth, even during the recent rough-and-tumble recession, is the versatility and skills of its employees. “We have people here who just like to create,” he says. “Whether that is a guy on the shop floor making a part, or Wayne (Ford) getting a patent on a mechanical ice-fishing unit. The strength of our company comes from our employees.”

Yes, from automotive parts to catching fish on the ice, BMC is always looking at new ideas. True to form, BMC worked with Ford and got a patent for the company on the “Jigger.” All the ice fisherman has to do is set the pole in the unit with the lure on the line, set the tension on the unit for the size of fish they’re looking to get, and the rest is, well not exactly rocket science.

“The machine jigs the bait for you,” notes Ford, who built several prototypes before coming up with the current version. “When the fish strikes, it sets the hook, an alarm goes off and a change in color can be seen through the plexiglass on the machine. You still have to reel it in — which is where the fun is. And it lets you have a free hand to fish at another hole too.”